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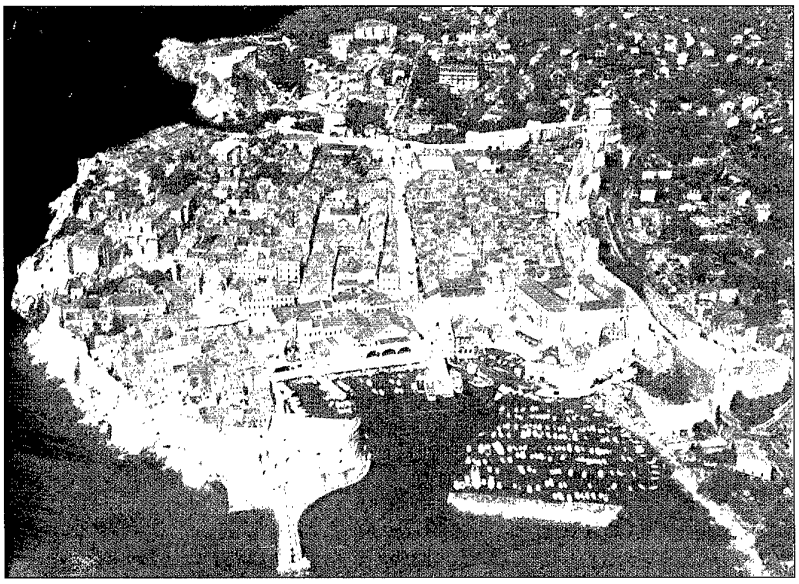

The First World Congress on Chemical and Biological Terrorism

Dubrovnik, Croatia, 21-27 April, 2001

Croatian Organizing Committee

ASA

Applied Science and Analysis Inc.

Battelle | Irvin Aerospace | NBC Team Limited Canada | PETROKEMIJA KUTINA

a dedication

These Proceedings of the CBMTS-Industry II "The First World Congress on Chemical and Biological Terrorism", Dubrovnik, Croatia, 20 - 28, April 2001, are dedicated to the victims of 9/11.

9/11

We now know that the information exchanged during this First World Congress was directly and immediately applied within the first hours of 9/11. With this knowledge we must now further rededicate our efforts at ensuring we again surface, explore and exchange that vital information from across the spectrum of science and medicine that would most help mitigate the effects of future 9/11 type catastrophic events.

The Proceedings of the Chemical and Biological Medical Treatment Symposium CB MTS- Industry II

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Abstract: This book contains the Proceeding of the seventh meeting in the Chemical and Biological Medical Treatment Symposium series, CB MTS-Industry II that was held in Dubrovnik, Croatia from 21-27 April 2001. The papers contained herein were presented in five sectors and seventeen sessions.

The papers covered: the CBMTS-Industry II Opening; Exercise, Demonstrations; Congress Workshop; General and Overview; Problem Definition; Preparation and Response; General Aspects and Assistance; Threat Assessment; Medical Treatment of OP Intoxication; Biological Sources and Prevention; Chemical and Situational Analysis; General Chemical and Biological Aspects; Dissemination, Detection of Biological Agents and Management; National Approach to Terrorism; Countermeasures and Effects of CB Agents; Response to Terrorist Events; Chemical Sources and Prevention; Provisioning and Communication Problems; Protection, Information of Responders; Summaries and Conclusions.

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Dear Participants of CBMTS-Industry II,

Allow me to extend to each of you my warmest best wishes, as well as my personal as well and official thank you on behalf of the Government of the Republic of Croatia. We were very pleased that we were once again able to bring together this group of well known and highly respected professionals for this seventh international meeting of the Chemical and Biological Medical Treatment Symposium, the **CBMTS-Industry II "The First World Congress on Chemical and Biological Terrorism"**. At the beginning of this extremely important meeting, we stated that we believed "the current world situation in regards to terrorism in general and chemical and biological terrorism in particular, demands that we provide our best knowledge and resources to the problems that confront us across this arena". At that time we could not foresee that in exactly four and half months the information that you surfaced, explored and exchanged would be directly and immediately applied within the first hours of the 9/11 tragedy. This gathering was made possible by your direct interest, as well as the interest, and sometimes-substantial financial support, of all Ministries within the Government of Croatia and numerous national and international organizations, industries and institutions. Prime examples of this support include that of Petrokemija Kutina, Croatia, Battelle Memorial Institute, USA and NBC Team Ltd, Canada. Of special importance is the interest and support of the Organization for the Prohibition of Chemical Weapons (OPCW) and the U.S. Army Medical Research and Materiel Command, the Agency for International Development (AID) and Agency for Toxic Substances and Disease Registry (ATSDR) as well as State of Georgia's WMD Civil Support Team. We were very pleased and grateful for this extended support.

Building on the base of the very successful CBMTS-Industry I in 1998, which was the first international science and medicine symposium on the role of toxic industrial chemicals (TICs) and releases of these TICs via acts of war and terrorism, we now sought a more comprehensive understanding of the problems associated with chemical and biological terrorism and for CBMTS a very important new area, that of radiological terrorism. Our excellent Pre-Congress Workshop included discussion and exchange of security information across the CB terrorism arena; discussions on the issues involved in pharmaceutical stockpiling for local, national, regional and international emergencies; discussions and exchange of information on industrial chemicals being used as Weapons of Mass Destruction; and, emergency management during chemical and oil spills, etc. The Congress exercise demonstrated the terrorist use of chemical agents, rapid response, identification and detection of the used agent, handling great numbers of poisoned people, medical treatment and therapy, protection, decontamination of the contaminated area.

This CBMTS platform provided a meeting place to unify specialists from all over the world. Our participants were provided a unique opportunity to freely exchange their views on science and medicine. We believe that this well be used as a very meaningful contribution to peace.

Sincerely yours,
President of Organizing Committee
Zlatko Gareljic
Deputy Minister of Defense of
the Republic of Croatia

An Introduction to the CBMTS-Industry II

During the Spring and Summer of 1993, Applied Science and Analysis (ASA) of Portland, Maine USA and Battelle Memorial Institute of Columbus, Ohio USA attempted to develop a baseline of information on antidotes and planned medical treatment for military and civilian medical casualties, in both peace and war. What we found, unfortunately, was an almost complete lack of communications across the full spectrum of chemical and biological medical treatment. To remedy this situation and to develop the format that would ensure communications across this most important arena, ASA, with the complete cooperation and support of Battelle and the AC Laboratory Spiez, Switzerland, developed the process and initiated the international meetings we today call the "Chemical and Biological Medical Treatment Symposia (CBMTS)" series.

This symposium, CBMTS Industry II, is the seventh meeting in the CBMTS series. CBMTS I, December 1994, II, July 1996, and III in May 2000 were held at the AC Laboratory Spiez; CBMTS PMMA I, May 1997, was held in Hradec Kralove, Czech Republic; and, CBMTS Middle East I was held in Cairo, December 1997. This meeting CBMTS-Industry II is the second CBMTS to be held in Croatia; CBMTS-Industry I was held in Croatia in 1998. Croatia was selected as the venue for the CBMTS-Industry series for many reasons and one reason actually goes back to the second meeting in the CBMTS series.

At CBMTS II in Spiez in July 1996, Lt. Col. Zvonko Orehovec and Dr. Slavko Bokan of MOD Croatia presented their paper "Eco-Terrorism and Chemical Warfare without Chemical Weapons". This paper was of immediate interest to the assembled group of 95 professionals from 28 countries. Based on actual incidents that affected their chemical, petrochemical and pharmaceutical industries during the recent war, they had very ably highlighted a danger that every country could face in the event of military actions, sabotage and especially terrorist actions, as well as major incidents or accidents involving these industries.

The fact that you were here is proof of the intense interest the CBMTS-Industry II "The First World Congress on Chemical and Biological Terrorism" topics generated. Also the fact that these as well as previous CBMTS topics have been copied directly from the CBMTS series by other organizations, such as NATO for their meetings, also demonstrates that the CBMTS topic areas are of very high interest to all. With this meeting we will now had over 1,050 professionals from over 70 different countries attend the CBMTS. The next CBMTS meeting, CBMTS IV, will be held at the AC-Laboratory Spiez, Switzerland from 28 April-3 May 2002.

An added note. The very tragic events of 9/11 have graphically demonstrated the importance of our CBMTS approach at bringing together the world's very best professionals in science and medicine to explore at the outer edges of science and technology, the most important issue facing the international community. Although the success in this approach has been continually documented for many years, we, as the CBMTS, will rededicate our total efforts towards defining the issues, surfacing the problems across the NBC science and medical spectrum and applying our best efforts at developing solutions that would most benefit our world community.

Colonel Richard Price

Lt. Colonel Zvonko Orehovec

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IN MEMORIAM – JOSIP FRIŠČIĆ

After a long and serious illness, Mr. Josip Friščić, a leading expert for technical support in the factory for mineral fertilizer production "Petrokemija" Kutina passed away on 25 August 2001. Josip's relationship with both ASA and CBMTS-Industry series goes back many years. On the basis of attacks on the factory for mineral fertilizer production "Petrokemija" Kutina a very important CBMTS first a series of very professional meetings on chemical and biological warfare without chemical and biological weapons, the CBMTS-Industry series. This series began as a result of a joint paper presented at CBMTS II at the Spiez Laboratory in July 1996. The authors, Josip Friščić, Zvonko Orehovec, Slavko Bokan and Ivan Jukić, highlighted the exceptional dangers inherent in petrochemical, pharmaceutical and other large industries when they are either under attack in war, by terrorist action or by naturally occurring accidents or incidents. In 1998 and for the CBMTS-Industry I symposium, Josip helped to recreate the combat conditions Petrokemija had been in the early 1990's. His contribution in the organization of the "Kutina 98" exercise as a very important part of CBMTS-Industry I, was exceptional. "Petrokemija" Kutina was a general sponsor of "CBMTS-Industry II, The World Congress on Chemical and Biological Terrorism" that was held from 21-27 April 2001, in Dubrovnik. Mr. Josip Friščić was a member of The Organizing Committee of CBMTS Industry II. His contribution in organization of exercise held during the "Kutina 98" symposium CBMTS Industry I was exceptional. The exercise "Kutina 98" showed simulated air attack on plant for production of mineral fertilizers Petrokemija Kutina in sight of 200 participants from 32 countries and military attaches from 15 countries. With the passing of Mr. Friščić, Petrokemija has lost an recorganized expert and the CBMTS family has lost a friend and much deserving collaborator. Bon voyage Josip Friščić, we will miss you.

Organizing Committee
CBMTS – Industry II

CBMTS-Industry II "The First World Congress on Chemical and Biological Terrorism" Dubrovnik, Croatia, 21 – 27 April 2001.

Congress Chair: Dr. Slavko Bokan M.D. (Croatia)
Congress Co-Chair: Dr. Barbara Price (USA)

Congress Overview and Summary

Sector: Pre-Congress Workshop
Sector Chair: Dr. David Moore (USA)
Sector Co-Chair: Dr. Leo Laughlin (USA)
Sector Co-Chair: Dr. Brian Davey (OPCW/The Netherlands)

The following report by Dr. David Moore covers the Pre-Congress Workshop, 21/22 April, which was, very much appreciated by the CBMTS members. This Workshop archetype will be incorporated into future CBMTS meetings. The CBMTS-Industry II World Congress on Chemical and Biological Terrorism Pre-Congress Workshop presented by Dr. David Moore. Sector information compiled and edited by Dr. David Moore, Battelle Memorial Institute, Sector Chair and Dr. Brian Davy, OPCW, Sector Co-Chair.

Session 1: A workshop on pharmaceutical stockpiles which was chaired by Mr. Steve Bice, Director of the U.S. Pharmaceutical Stockpile Program at the U.S. Centers for Disease Control and Prevention in Atlanta, Georgia. The Co-chair for the session was Dr. Slavko Antolic, Belupo Pharmaceuticals of Croatia. Mr. Bice provided an overview of the U.S. pharmaceutical stockpile program that includes drugs, antidotes and equipment.

It was emphasized throughout the session that knowing what to buy and actually buying it is actually the easy part of the process. What is much more difficult and equally important is to see that the supplies are delivered to the right location in the right configuration at the right time. Additionally, there are many details that are required to maintain the stockpiles including the proper rotation of stocks, QA and QC inspections and database management. Counties that are considering establishing a national stockpile of medications and equipment for WMD preparedness should consider the many important details and establish a strong management system before the first supplies are procured.

Session 2: Industrial Chemical Terrorism Workshop. This was a three-hour pre-conference workshop on industrial chemical terrorism. The session chair was Mr. Joe Hughart of the Agency for Toxic substances and Disease Registry at the U.S. Centers for Disease Control and Prevention in Atlanta, Georgia. The session Co-chair was Captain Boris Ilijaš of Croatia.

The workshop covered recent incidents of industrial chemical terrorism, assessment factors, appropriate forms of assistance, and sources of information on industrial chemicals. Groups of chemicals most frequently involved in recent incidents include hydrocarbons; industrial chemicals used to fabricate explosives; corrosive gases, liquids, and mists; and poisonous industrial chemicals such as arsenic, cyanide, heavy metals, and phosgene.

State of the art survey methods were presented by the 4th Weapons of Mass Destruction Civil Support Team of the Georgia (USA) National Guard. The U.S. Agency also discussed U.S. foreign disaster assistance for chemical and biological terrorism for International Development Office of Foreign Disaster Assistance.

Session 3: The third preference workshop on equipment and procedures was held on Sunday afternoon. The session Chair was Dr. Thomas H. Snitch and the Co-chair was Major Ivan Jukic. Four presentations were delivered and the paper session was followed by an hour of hands on demonstrations with the equipment.

Gary Eifried of the EAI Corporation and Peter Stopa of the US Army's Edgewood Chemical and Biological Center at Aberdeen Proving Grounds discussed the recent progress made in developing a screen for identifying the presence of biological material in a suspected sample. They demonstrated the use of a variety of sampling and processing tests that are used to prepare a sample of material for processing. The samples are analyzed to determine the presence of DNA, ATP and proteins. A positive result in their testing procedures identifies the presence of biological materials.

Thomas Sizemore of Global Technology Applications demonstrated the 'Visual Purple' project. This is an interactive, computer-based program that is currently being used for training the next generation of crisis managers. The format is to employ an interactive game in which the participants are faced with making a series of choices in a crisis situation. This involves multiple feedbacks assessments and allows the player to work on decision-making skills.

Thor Thompson of RMP and Paul Kahl from the Battelle Memorial Institute demonstrated the configuration of the RMP meteorological tower. They discussed the recent work in developing a package, for installation on the tower that would identify CW, BW, and RW agents. The package would be remotely deployed, with the tower, and feed information on local conditions back to a command center in a safe location. The information is then used to create a graphic of the actual plume in real time and assist in tracking the toxic plume.

Vaso Taleski of the Military Health Institute Center in Skopje, Macedonia explained the further refinements and use of alight cycler called RAPID developed by Idaho Technologies for the U.S. Air Force for the identification of specific biological agents. He showed how the portable system, known as 'Suzanne', could be used in the event of an actual toxic release.

Sector: Congress Exercise and related Exhibitions
Sector Chair: Lt. Col. Zvonko Orehovec (Croatia)
Sector Co-Chair: Mr. Douglas Eaton (Canada)

Session 1: **Congress Exercise**
Chair: Major Tomica Sabolić (Croatia), Co-Chair: Captain Warwick Penrose (Australia)

The main topic of this Congress was chemical and biological terrorism as one of the primary threats for world peace and safety. The Congress Exercise was held during this Congress. This exercise demonstrated the terrorist use of chemical agents, rapid response, identification and detection of the used agent, handling great numbers of poisoned people, medical treatment and therapy, protection, decontamination of the contaminated area.

Somewheria and Anywheria are neighboring countries in transition with border disputes. Both countries are not State Parties of OPCW. Somewheria has a warehouse with old chemical weapons in the mountains 70km from the border with Anywheria. In the wider area of the warehouse complex, rapid settlement began because of the development of new production technology of electronic equipment. Anywheria decided to execute a terrorist attack on the warehouse and cause panic and suffering with the population in order to stop further settlement in that area and slow down the economic development of the neighboring country. A terrorist group executed an attack on a warehouse complex containing old chemical weapons. The attack was executed using armor-piercing system RPG-7. Following

the attack the special antiterrorist unit from Ministry of Interior entered the area and neutralized the terrorist units. After the attack, a line of secondary explosions occurred, as rocket projectiles, which dispersed to the distance of few kilometers from the place of attack and cause the contamination of a wider area. After that alert and evacuation of civilian population followed, as well as the organization for a rapid response and medical help. Neutralization of the released toxic substances and decontamination of the attacked space (decontamination system by IRVIN AEROSPACE, NBC Team Limited Canada) were conducted. Neutralization of the primary source of contamination was performed by decontamination platoon with special equipment for fire extinguishing and decontamination (CASCAD System). CASCAD, an aqueous foam, is designed to contain and eliminate chemical and biological warfare agents, and for removing radioactive particle contamination. Decontamination platoon used special protective equipment and system for protection of the respiratory tract (Dräger, Germany). Effective detection of a presence of toxic agents in the area around the warehouse before and during this action was performed using very sophisticated and effective detection equipment purchased by Tradeways Ltd. (Annapolis, Maryland, USA).

Session 2: Exhibition of Important Equipment and Procedures
Chair: Mr. Per Ake Kristensson (Sweden), Co-chair: Mr. Neil Pitts (Canada)

IRVIN AEROSPACE Limited Canada (NBC Team Limited Canada) (Exhibition of Equipment)

Explosive devices filled with chemical and biological agents was neutralized and decontaminated using the equipment by Canadian company Irvin Aerospace, NBC Team Ltd. Canada. These devices may be found as objects of terrorist acts or they may be results of terrorist attacks on warehouses that store chemical and biological warfare agents.

As a result of primary explosions, it is possible to come to the activation of rocket fuel which causes uncontrollable flying out of projectiles that drop at a distance of few kilometers from the primary source. That is an additional secondary source of contamination with chemical and biological agents that makes rapid response more difficult. If it does not come to activation of projectiles because of the rearming of detonators and fuses such projectiles are sensitive to self-activation and therefore need to be destroyed on the spot. BLAST GUARD equipment, which makes possible the destruction of such projectiles, is manufactured by Irvin Aerospace, NBC Team Limited Canada. BLAST GUARD offers unique capabilities and provides a cost effective means of increasing the safety of both EOD personnel and general public. When dealing with chemical or biological devices, Irvin ICD/IBD kit is the only one that can be placed over the suspect device and will mitigate any chemical or biological agent present.

Irvin Aerospace, NBC Team Ltd. Canada is the exclusive supplier of a world leading line of Foam technology based products including the CASCAD Decontamination System, capable of neutralizing and removing chemical, biological and radiological contamination from vehicles, ships or aircrafts, using fresh, gray or salt water. CASCAD can also be used to fight fires. Other such products include the BLAST GUARD System for mitigation of chemical or biological terrorist weapons, and the suppression of conventional munitions and explosive devices in excess of 1kg of plastic, while capturing shrapnel. NBC protective products from Irvin Canada also include NBC protective clothing, ballistic protection, gas masks and casualty bags. Irvin supplies these systems, and the requisite training and documentation, to the military, police and first responder agencies worldwide.

Sector A: General Overview to Chemical and Biological Terrorism
Sector Chair: Dr. Keith Vesely (USA)
Sector Co-Chair: Dr. Cornelis Erasmus (South Africa)

This World Congress on Chemical and Biological Terrorism, the CBMTS-Industry II, held in Dubrovnik, Croatia was exceptional in that it brought together over 200 professionals from 43 countries to discuss the primary issues that confront the international community in this most critical area. Included in the meeting's six sectors were 20 sessions. One sector, devoted to the Pre-Congress Workshop on 21/22 April. was discussed in ASA Newsletter 01-3, and a sector was devoted to the Congress Exercise, which was carried out with utmost precision by several Croatian government organizations with a direct interest in preparations for CB Terrorism. The first Symposium sector, Sector A. was Chaired by Dr. Keith Vesely (US) and Co-Chaired by Dr. Cornelis Erasmus (South Africa). Other Sectors will be covered in future ASA issues.

In the first session, which was chaired by Dr. Bernhard Brunner (Switzerland) and Co-Chaired by Dr. Robert DeBell (US), Dr. Brian Davey (OPCW) provided us a baseline of data from which to start these proceedings. Dr. Davey gave a brief history of the CBMTS and reviewed the six preceding meetings. He outlined the changes in direction the CBMTS has taken over the years to stay well forward of current thinking across the arena of CBW defense. The CBMTS is noted for its special emphasis on all aspects of the CB medical problem as well as terrorism and its impact on the military and civil infrastructure and industry. He gave the current status of the CWC and OPCW to include an update on the number of signatories and ratifies as well as a review of existing CW agent and munitions stockpiles.

What are the industrial chemicals most attractive to terrorists? Cmdr. Joseph Hughart of the Agency for Toxic Substances and Disease Registry, said the chemicals would be corrosive, ignitable, toxic or chemically reactive. and include hydrocarbons, explosive chemicals, ammonia and chlorine as corrosive gases, and pesticides as toxic organic chemicals. He said those chemicals most involved in accidents are also the ones most likely to be used by terrorists.

Jack McGeorge, US, said that in an analysis of non-military incidents involving chem or bio agents, motives for use ranged from philosophical to religious to extortion, and no sophisticated engineering skills were required or employed for dissemination. More than 50% of the bio incidents were only threats and did not involve any agents.

Bernard Anet of the AC-Laboratorium Spiez, Switzerland provided a first for the CBMTS series and that was a very important look at nuclear and radiological terrorism. The spread of radiological materials is most likely as a terrorist weapon, while stolen fissible material is unlikely.

Thor Thomsen and Tom Snitch (US) then presented a video, which described a computer model to predict the movement and impact of a major chemical explosion.

In the second session which was Chaired by Dr. Elena Ryabchikova (Russia) and Co-Chaired by Dr. Gui Santana (Brazil), Florin Paul (Romania) of the Army Center for Medical Research in Bucharest reported on the treatment approaches in the event of a biological crisis. He addressed the signs of natural events and the criminal application of infectious agents and, the problems on epidemiological and ethical aspects of the response to biological weapons were summarized.

Thor Thomsen (US) talked on the use of the Risk Management Planning modeling system to model terrorist actions and industrial accidents. The importance of using meteorological, demographic, and geographic information to accurately assess a chemical disaster was discussed.

The paper presented by Zvonko Orehovec (Croatia) provided good evidence that the CWC is not a memorial paper, but is a working document, which causes questions and

discussions. Dr. Orehovec pointed out the need for clear designation of all aspects of the international assistance in the case of chemical attack. Per-Ake Kristensson (Sweden) presented information about the Swedish Rescue Service Agency, which is responsible for the coordination of all rescue activities. He displayed the assignments, assumptions, organization, personnel and tasks, preparedness, equipment, safety, transport, training, exercise and planning. The report provided a comprehensive vision of Swedish chemical support team.

The last reporter of the session, Michelle Jennings (US), presented a scheme of the response of US Agency for International Development to disasters in other countries. Her report was devoted to the program developed by the Agency, which is destined to provide a broad range of support, including funding, supplies, equipment and technical services. She gave examples of the work of this program implemented in several countries.

In the third session which was Chaired by Mr. Thomas Sizemore (US) and Co-Chaired by Prof. Gurayten Ozyurt (Turkey), Corneel Bellanger's paper, CB Terrorism Defense in Belgium: How and Why?, discussed key points heard many times in this Congress. Countries have to assess the main terrorist threat for their own situation. Belgium has many international companies and organizations (i.e. NATO) and sees them as the most likely targets. Belgium took the option to use one single disaster plan and to prepare its first responders to exceptional situations like terrorist attacks. The final key issue identified is the difference in risk perception between the expert in the field and the political leaders. Technical experts tend to focus on a certain kind of crisis, independent of time, while politicians focus on a larger spectrum but a shorter time frame.

Much more narrow in scope, both Mika Otakar (Czech Republic), The New Integrated System in the Czech Republic, and Laszlo Kozari (Hungary), System of Hungarian System Management, emphasized the recently enacted laws within their respective countries. The two countries have independently created a unified code for better response to the possible threat from chemical and biological terrorism.

The paper, Chemical and Biological Terrorism: A Brazilian Perspective, presented by Gui Santana (Brazil) outlined the unique terrorist problems faced by Brazil. The biggest problem has been the move of more drug dealers from Columbia into the Amazon (cont. pg 14 - CBMTS Ind II) (CBMTS Ind II - from pg 12) basin. This has brought a rise of violence as the various groups compete for the illegal trade. One group recently used poison as a means to attack another group. Even though there has been no terrorist activity directed at Brazil, they are aware of terrorist groups who want to use Brazil to aid in drug and arms smuggling and laundry money.

Gianfranco Tracci's (Italy) paper, A New Threat Chemical and Biological Terrorism, An Italian Perspective, provided a historical view of terrorism in Italian history since the Roman times. The conclusion was that international organizations are the key vehicle to combating the possible new type of terrorism.

Two papers, Meeting the Chemical Biological and Radiological (CBR) Threat: Sydney Olympic Games - 2000, and The New Global Standard: WMD Community Preparedness, from Australia and the United States respectfully, showed the large amount of funds being spent on chemical and biological terrorism. Warwick Penrose (Australia) described their two-year effort to get ready for the Olympics. Preparation required the best equipment and training available. Later in the session, Richard Vigus (US) described the program developed by the U.S. Army to assist local officials to prepare to protect the civilian population from the consequences of a possible terrorist use of chemical or biological agent. The Military Improved Response Program was developed with input from local leaders and technical experts.

Dario Matika's (Croatia) paper, Undersea Detection of Chemical Weapons and Mines, expressed the Croatian concern that munitions dumped in the sea since World War II may pose a threat to shipping and commercial fishing. The paper described a possible method to

find, localize, and destroy such underwater hazards. However, the only known dumps are not in Croatian territorial waters. The fourth and final session in this sector was Chaired by Dr. Corneel Bellanger (Belgium) and Co-Chaired by Mr. Jack McGeorge (US). Evelyn LeChene's (UK) presentation examined the terrorist threat. In analyzing the threat, the goalpost has changed from military targets to civilian populations. This is facilitated by improved communications, enhanced access to data and the ease of cross border travel. "New Terrorism" targets include industry, food chains., and individual groups that are targeted on the basis of political, religious or ethnic considerations. The weaponization and delivery of CB agents involves a fundamental and sequential relationship between the agent, its dissemination, and its delivery as a CB weapon was presented by Jack Mc George (US). From an analysis of 233 non-military incidents of the actual or apparent intended use of chemical or biological agents, a typology of weaponization and delivery means was developed. This analysis indicates a significant difference between terrorist and conventional military thinking regarding agent dissemination and delivery to intended targets.

Joseph Hughart (US) proposed the assessment of the threat from industrial chemicals as WMD can be conducted using a simple model. The model is constructed by arranging a number of critical factors in such a way that their first letters spell the word ASSESSMENT. i.e. Amount of chemicals, Sources of WMD, Signs of incidents, Environmental contamination/delivery, Syndromes, Sensitive populations, Morbidity/mortality, Equipment available, Needs, and Training. Industrial chemicals can be arranged in descending order of frequency and hazard as follows, viz: flammable liquids (gasoline), > industrial gases (ammonia and chlorine) > solid and liquid pesticides > radiation chemicals.

Douglas Eaton (Canada) presented an overview of the current NBC mitigation technologies and equipment from Irvin Aerospace in Canada, which was also demonstrated during a field exercise. Colin Harwood (Canada) presented a generic protocol for decisions regarding packages possibly containing a chemical or biological agent. Two scenarios viz. opened or unopened packages need to be considered, and guidelines were given, both for immediate action as well as for CBRN response teams, according to a decision algorithm.

Following complaints of unknown ailments by Canadian soldiers who were stationed in Croatia during 1993 - 1995, Ladislav Palinkas (Croatia) presented details of an investigation launched by Croatia regarding the possible cause of such ailments. Sandbags used to build shelters for these soldiers during the war were filled with bauxitic material, red mud, terra rosa red soil and brown soil. Analysis of samples by both Croatian and Canadian expert teams were inconclusive as to the cause of the ailments.

Sector B: Problem Definition
Sector Chair: Prof. Sergey Netesov, Russia
Sector Co-chair: Mr. Richard Vigus, USA

"The seventh meeting in the Chemical and Biological Medical Treatment Symposia (CBMTS) series, which was held in Dubrovnik, Croatia from 21 through 27 April 2001, attracted over 200 of the world's most noted professionals in science and medicine from 43 countries. Considering the tragic events which have unfolded within the past several weeks, this Congress "The first World Congress on Chemical and Biological Terrorism" was very prophetic in the issues surfaced and solutions recommended within the broad range of approximately 100 papers presented in Dubrovnik. The below Sector Summary with all of its Session Summaries was compiled and edited by Professor, Dr. Sergey Netesov, Deputy Director Vector in Novosibirsk.

Session B1: Chemical Sources and Prevention.

Chair: Dr. Vera Simeon-Rudolf, Croatia and Co-Chair: Dr. Otakar Mika, Czech Republic

Jiri Matousek, Czech Republic, (Possibilities of Detection and Early Warning in Case of Terrorist Chemical Attacks in Subways) presented a lecture on the detection system in the underground in Prague. He informed the Congress that responsible authorities of the city of Prague decided to equip the Prague underground with a detection system for toxic gases using the ion mobility spectrometer RAID-I. Underground transportation systems and station tunnels, crowded with people within relatively narrow and closed spaces, are vulnerable to attack with toxic chemicals.

Mario Morales, US, (Development and Implementation of Civil Support Teams for Weapons of Mass Destruction) presented in his contribution, the need of a special service for the first order responders such as police, local firefighters and emergency medical services. He provided information on the Civil Support Teams for weapons of mass destruction and their support to first order responders.

Constantin Mircioiu, Romania, (Sources of Chemical Toxics and their Precursors in the Pharmaceutical Industry) presented some examples of the pharmaceutical industry and drug laboratories as possible targets or sources of terrorist attacks. Franjo Plavsic, Croatia, (Liquefied toxic and corrosive gases in heavily populated areas) described the possible problems of liquefied toxic and corrosive gases such as chlorine, when used as a water disinfectant and ammonia in refrigerating plants located close to or in populated areas, which include possible accidents due to damage, gas leakage or terrorist attack.

Galina Makhaeva, Russia, presented a highly sensitive biosensor for the analysis of neuropathic target esterase in human and hen blood (Blood Neuropathy Target Esterase as Biochemical Markers for Neuropathic Organophosphate Exposure) and in addition the author described in vitro and in vivo studies of a series of organophosphorus compounds concerning their effect on target enzymes acetylcholinesterase and neuropathy target esterase (O-alkyl-O-methylchloroformiminophenyl phosphonates delayed neurotoxicity risk assessment). Some organophosphorus compounds, due to their acute cholinergic toxicity and in addition possible organophosphate-induced delayed neurotoxicity, might be of interest for terrorist groups.

Session B2: Biological Sources and Prevention.

Chair: Prof. Christophor Dishovsky, Bulgaria and Co-Chair: Dr. Joe Brumfield, USA.

Problems of emerging and re-emerging infections are closely related to possible bioterrorism actions because the former could mask the latter. Due to the increase of national fanaticism and national conflicts in multinational states, the probability of bioterrorism actions is increasing and therefore civilized countries should be prepared to suppress these actions by having a special emergency management system, emergency stocks of fast and sensitive diagnostic kits, emergency prophylactic and treatment means and a decontamination team with appropriate equipment and disinfection means. One of the key things, which should be pre-determined, is the list of possible bioterrorism agents, which, obviously, does not coincide with the list of possible BW agents. Two reports of this session, given by Prof. Lotfali Haghighi, Iran, (Emerging Infections and Bioterrorism) and by Dr. Slavo Bokan, Croatia, (Evaluation of Nipah Virus as a Human and Animal Biological Terrorism and Warfare Agent) were devoted to this problem. A case was presented for the inclusion of Nipah virus as an animal biological agent. The effectiveness of this virus was detailed. Several outbreaks of the virus have resulted in human deaths. It remains uncertain how the virus is transmitted although direct contact appears most likely. Instances of the virus transmission from contact with swine sick from >barking pig> disease has been identified. Researchers believe that fox/fruit bats may be the original reservoir of Nipah virus. The virus is not included in the list of animal biological agents because it did not fulfill all the criteria of a bioweapon; it has not

been identified as having been weaponized. Dr. Bokan suggested that the Nipah paramyxovirus should be added to this list. It also became clear that many factors should be taken into account for determination of this list, and special experiments should be done in some cases to clarify the suitability of infectious agents for this purpose.

Prof. Lotfali Haghighi drew attention to several infectious materials that may have future use as bioterrorism weapons. It was detailed that several outbreaks of infection had the potential to be bioterrorism (Sector B - from p. 7) acts. The case was presented that these events, had they been a deliberate act of terrorism, could not have been identified as such since the infectious material would not have been suspect. Materials that have not been used as biological agents (Chlamydia pneumonia, Legionella multophilla, etc.) could find their way into terrorist hands and be used as bioterrorist agents. Older materials should also be considered.

Dr. Mirko Hadzija (Managing Chemical and Biological Agents) reported that some unusual substance - similar to a cobweb - had been found in Croatia during the '90s war. He discussed some characteristics of this material and explored the possibility of its use for carrying infectious agents for bioterrorism or BW purposes. The biological effects of this material (eye/cell damage) were detailed. The discussion that followed showed that the methodology of identification of the microorganisms in some countries should be improved. The chemical analysis and final evaluation was the topic of a paper in Session C.2.

A new paper on the Ebola virus was substituted for the paper on Orthopoxvirus. Dr. Elena Ryabchikova, Russia, (The Ebola Virus Replication in Macrophages and its Relation to the Virus Pathogenicity) reported the data from the experimental investigation of pathogenesis of Ebola virus infection to determine the correct choice of an animal model suitable for potential drug evaluation. Studies of the Ebola virus biological properties are very important for the development of antiviral treatment and prophylaxis. Initial (wild) population of Ebola virus is not homogeneous. It contains virus particles having different biological and genetic properties. This study showed that the virus particles have different pathogenic potential for guinea pigs and may be different for other animals. The interaction of the virus with macrophages plays a critical role for the disease development and outcome. This study showed the importance of host systems for development of abilities of Ebola virus to kill the host. Simple procedures of transmission of Ebola from one animal to another may result in unpredictable changes of the virus properties. Viruses are poorly understood pathogens. This is a reason for paying particular attention to these pathogens and for the development of treatment and prophylaxis.

A position was established for consideration of VECTOR (State Research Center of Virology and Biotechnology at Koltsovo, Russia) as an international center for responding to bioterrorism in Asia. Details on the facility available at VECTOR as well as the current and future projects were presented by Dr. Sergey Netesov, Russia, (The Need for Creation of the International Center in Novosibirsk, Russia for Combatting Infectious Diseases and Bioterrorism Threat in Asia). This center could be both a research and educational institution for emergency team specialists. The need for the center also is justified by the unique opportunities which Vector already has as the WHO Collaborating Center for Orthopoxvirus Research, as a long-term acting BSL-4 lab and being located near the geographical center of Former Soviet Union (FSU) and Asia. It was interesting to note that international research on several aspects of smallpox virus (genome sequence and search for antiviral drugs) is planned at a cost of over $4.5M (US). The proposed Center could also conduct experimental research to investigate unusual outbreaks for their possible artificial nature by molecular epidemiology methods. Details on the facility available at VECTOR as well as the current and future projects were discussed.

After the presentations there was also a small discussion about the World Health Assembly (WHA) recommendation to destroy in December 2002, the remaining smallpox

virus strains being preserved now at CDC in the US and at Vector in Russia. A concern was voiced from the floor during the Q&A session about the wisdom of maintaining the smallpox virus since it may pose a target for bioterrorists. It was mentioned that the physical security of these labs should be upgraded to the best possible level, and, at the same time, the strains should not be destroyed until modern diagnostics, prophylactic and treatment means are developed based on the comprehensive knowledge of the strains sequences which is still in the initial stage.

Session B3: Dissemination, Detection of Biological Agents and Management.
Chair: Dr. Colin Harwood, Canada Co-Chair: Prof. Lotfali Haghighi, Iran.

Dr. Robert DeBell, US, (Particle Size and Organism Number: Impact on Bio-aerosols) presented a new approach to the evaluation of aerosol infectious dose of microorganisms. The effects of particle size on retention within the respiratory system and its relationships between infectivity and particle size are important concepts with respect to bio-aerosols. Exposure to a bio-aerosol is usually dependent on arbitrary units of mass alone that does not define particle size and, subsequently, distribution in the respiratory system. It was shown that aerosol particles containing much smaller amount of infectious agents than it had been suggested earlier might cause the disease. Models used to develop technologies to protect from a BW event should use microbial infectivity with an understanding of the real particle size and infectivity. These considerations should be valuable to produce samplers and detection and protection devices needed to predict and limit the effects of a BW attack.

Dr. Vaso Taleski, Macedonia, (Rapid - PCR (Light Cycler) in Diagnosis of Biological Agents) made a presentation of the new portable device for PCR-analysis of biosamples. The R.A.P.I.D. - PCR (Ruggedized Advanced Pathogen Identification Device) is a 32 sample capacity, automated instrument integrating Idaho Technology's Light Cycler technology into a portable, impact resistant package. Protocols for isolation of bacterial and viral DNA or RNA have been developed for clinical specimens, air samples and water samples. Protocols for food samples are being developed now. Assays are in use for: B anthracis, Y. pestis, Clostridium botulinum, Staphylococcus, F. tularensis, Salmonella, Shigella, V. cholerae, E. coli, Campylobacter, Venezuelan equine encephalitis (VEE) virus, West Nile encephalitis virus, Yellow fever virus, Brucella spp. and many others. This device is quite portable, simple in use and is a prospective candidate for field investigations of biosamples for the presence of different DNA- and RNA-containing biological agents.

Dr. Gary Eifried, US, (Psychological Effects of CB Terrorism: Lessons from the Past) reported about the real experience of psychological stress effect on different population groups after a terrorist attack. The psychological implications of a terrorist attack using CB weapons were discussed. The methodology used was a review of the literature and published interviews with those affected, especially those involved in the Tokyo subway and the Oklahoma terrorist attacks. Mr. Eifried described the symptoms of Acute Stress Disorder (ASD) and Post-traumatic Stress Disorder (PTSD), and discussed the results of further follow-up of these affected populations. The psychological stress is described as a very important complication among the victims, population and emergency response teams after terrorist action. Mr. Eifried is a retired US Army Chemical Officer who has been involved in providing terrorism response training to emergency responders in more than 105 cities in the US and internationally.

Dr. Rassie Erasmus, South Africa, (South African Military Health Service Involvement during an Outbreak of Cholera in Kwazulu - Natal) made a presentation describing the management of a recent cholera outbreak in South Africa. Insight is provided into the first SA experience of large-scale cooperation between public and military health services during the current cholera epidemic in the KwaZulu- Natal province of South Africa. Unfavorable socio-economic and environmental features of affected areas and the influence

thereof on planning and execution of support and response operations are highlighted, with emphasis on the establishment of oral rehydration centers, treatment regimes and adverse working conditions. Lessons learned from a Military Health Service perspective may have significance for international initiatives such as the CBMTS regarding preparedness and response towards the possible effects of biological agents on civilian populations, particularly in remote and underdeveloped areas. This experience is especially valuable because it describes the real events and real measures taken for response to the outbreak of enterically transmitted infectious disease in a rural remote district with poor infrastructure. It is emphasized that failure by international authorities to install timely precautionary measures against the spread of disease across international borders through increasing globalization may result in global catastrophe.

Dr. Peter Stopa, US, (Strategies for the Detection of Unknown Biological Materials) reported about the strategy development for detection of biological hazards. The potential use of biological materials as weapons of terror dictates that rapid methods are needed to screen for the presence of these materials in environmental samples. There are a variety of signatures that could be present in weaponized materials that could be used. These include particle size and shape or the determination of whether the material is either biological or toxin in nature. Additives or encapsulant materials could also be used for screening. Once such a material has been used, it may be useful to provide rapid medical intervention. These signatures could be exploited to provide protection to high value, fixed site assets, or can be used by first responders.

The presentation with title Biohaz: a Concept for First Responders: (Rapid on-site Biological Detection) was been given by Dr. Peter Stopa for Randall Bright of EAI in the US. The increase in hoax events by terrorists shows that a means is needed to rapidly screen for the presence of biological materials in suspect samples. The BioHaz system provides a means for first responders to sample and detect biological materials on surfaces or in liquids, envelopes, etc. The system uses conventional laboratory tests for DNA, protein and adenosine triphosphate (ATP), as components of live microorganisms. These three approaches are compared and discussed. The results of these tests could then be further analysed either on site or in the laboratory with confirmatory techniques. This system thus provides the first responder with a simple, cost effective means to minimize responses to events that may be hoaxes.

It would be useful in the future to organize round-table discussions about the most controversial and actual problems: a real and timely example during the meeting would be to organize the discussions about the need of smallpox strains destruction and the list of possible bioterrorism agents.

Sector C: Preparation and Response
Sector Chair: Dr. Rudolf Portmann (Switzerland)
Sector Co-Chair: Ph.G. Steven Bice (USA)

Sector C chaired by Rudolf Portmann and co-chaired by Steven Bice dealt with the preparation and response. Sector was divisoned in six sessions.

Session C1: Protection, Information of Responders
Chair: Dr. Rajka Turk (Croatia), Co-Chair: Dr. Alan Hall (USA)

The paper with title (CB-Protection: Modeling to Evaluation Filtration Characteristics) presented by dr. Ankica Čižmek, Croatia, showed simulation modeling and techniques, which allow to investigate the use of different substances as filters. The paper with title (Protecting first Responders to Acts of Terrorism) of Scott Deitchman, USA presented protection

methods and equipment for first responders including police, firefighters, emergency medical servis workers and others. Dr. Slavica Vučinić, Yugoslavia (The Role of National Poison Control Centre in Organization and Management of Mass Ammonia Accident) and Dr. Gurayten Ozyurt, Turkey (Cooperation between Poison Control Center and Organized Industrial District for Chemical Disaster Prevention) presented very important role of national poison centers in management of Mass-casualties accidents. Robert Gum, USA (Chemical Warfare Agent Disposal: Public Health Oversight) presented also the role and activities of the Department of Health and Human Services in transportation of deadly chemical warfare agents. Dr. Vladivoj Valković, Croatia (Detection Systems for Illicit Trafficking in Weapons and Terrorist Agents) showed a detection system of terrorism agents such as explosives, nuclear materials. The inspection systems are using penetrating radiation in the scanning geometry, with the detection of transmitted or radiation produced in investigated sample.

Session C2: Chemical and Situational Analysis

Chair: Prof. Esad Prohić (Croatia), Co-Chair: Dr. Robert Gum (USA)

Very interesting paper with title (Artificial Cobweb: Chemical and Physical Analysis) which was been presented by prof. Krešimir Furić, Croatia, reported about chemical and physical analysis of artificial cobweb, which was used during the war in Croatia. Chris Knowlton, Canada (Environmental Site Investigation in Croatia and the Conception of the Environmental and Industrial Health Hazard Risk Framework for Deployed Canadian Forces) reported about modern battle space, which encompasses many hazards to life and health. Virginia Mathenge, Kenya (Proposed Measures to Reduce Human Suffering after Terrorist's Attack. A Lesson from the 1998 Bomb Blast of the American Embassy Building in Nairobi, Kenya) showed measures to reduce human suffering after terrorist's attack. This paper outlined proposed measures and response that could be taken prior to and after a disaster to reduce further injury to humans and damage to property.

Session C3: Medical Treatment of OP Intoxication

Chair: Dr. Peter Stopa (USA), Co-Chairs: Dr. Mostafa Ghaeni (Iran)

Dr. Vera Simeon-Rudolf, Croatia (Biochemical Studies on Oximes Synthesized in Croatia over the Past Decades) reported about biochemical studies on oximes synthesized in Croatia over the past decades. Biochemical studies of the compounds comprised interactions with cholinesterases, organophosphats, and cholinesterase substrates. Dr. Biljana Antonijević, Yugoslavia (Antidotal Efficacy and Pharmacokinetics of Pyridinium Oximes in Mice Poisoned with Soman and Paraoxon) presented antidotal efficacy and pharmacokinetics of pyridinium oximes. The aim of this work was to examine reactivating moiety and pharmatokinetic properties of HI-6 and trimedoxime in mice poisoned with soman or paraoxon. Christofer Dishovski, Bulgaria (Analysis of the HI-6 Influence on the Liver Metabolizing Enzime Systems) presented also influence of HI-6 on the liver metabolizing enzime systems. This previous research showed that toxogonin changes the liver drug metabolizing enzyme system. Alan Hall, USA (In Vitro Decontamination of Cobalt-60 Exposed Pigs Eyes with Diphoterine(R) vs. Water) showed efficacy of Diphoterine(R) vs. water in vitro decontamination of Cobalt-60 exposed pigs eyes. Diphoterine(R) is widely used in Europe to decontaminate occupational eye/skin chemical splashes. Khateri Shahriar, Iran (Statistical Views on Late Complication of Chemical Weapons in Iranian C.W. Victims of Iran - Iraq War) reported about late complication of chemical weapons in Iranian C.W. victims. He showed three categories of patients with mild, moderate and severe complications.

Session C4: Other Medical Aspects

Chair: Dr. Brennie Hackley (USA), Co-Chair: Dr. Biljana Antonijević (Yugoslavia), Co-Chair: Krešimir Furić (Croatia)

Mostafa Ghanei, Iran (Late Pulmonary Complications of Mustard Gas Inhalation) reported about patients with late pulmonary complications of mustard gas inhalation. Thousands of Iranian people were injured by mustard gas in the Iran-Iraq war. This injury results in chronic disabilities of eyes, lung and skin organs. Dalia Simona Miron, Romania (Pyridostigmine as Preventive Antidote in Pesticides Research and Production Units) reported about efficacy of pyridostigmine as preventive antidote in pesticides research and production. Valeriy Chernyak, Ukraine (New Advanced Oxidation Technologies for Destruction of Toxic Chemicals and Biological Agents in Water) showed new technologies for destruction of chemical and biological agents in water. The possibility of evaluating these methods for use in the complete plasma-bio-photochemical technologies explored.

Session C5: Provisioning and Communication Problems

Chair: Dr. Scott Deitchman (USA), Co-Chair: Dr. Constantin Mircioiu (Romania)

Stephen Bice, USA (Description of the U.S. National Pharmaceutical Stockpile Program), (The U.S. National Pharmaceutical Stockpile Program "Buying is the Easy Part") and Michael Robbins, USA (The U.S. National Pharmaceutical Stockpile: Contents and Applications) provided an overview of the U.S. pharmaceutical stockpile program that includes drugs, antidotes and equipment. Damir Subašić, Croatia (Pharmaceutical Waste Disposal in Croatia) reported about method of the pharmaceutical waste disposal in Croatia. Gui Santana, Brazil (Towards Effective Crisis Communication: An Analysis of Management Inhibitors and Facilitators) showed effective crisis communication. Effective communication is key for the successful management of chemical and biological accidents or threats (terrorism). Zdravka Tečić, Croatia (Terrorism and Communication with the Public) reported about communication with the public during the terrorist's attack. On time, regular, considerate and objective informing about terrorism through the mass media can lessen the fear, and thus increase the effect of protection activities. Tom Sizemore, USA (Visual Purple, The Next Generation Crisis Management Decision Training Tool) presented that the CB terrorism training challenges facing national and local governments are formidable.

Session C6: Response to Terrorist Events

Chair: Dr. Kiam Wee Ang (Singapore), Co-Chair: Dr. Ankica Čižmek (Croatia)

Valburga Kanazir, Croatia (Implementation of the Convention on Transboundary Effects of Industrial Accidents in the Republic of Croatia) reported about of experience in implementation of the Convention on transboundary effects of industrial accidents in the Republic of Croatia. Vadim Petrov, Russia (Antiterrorism Training Course in Udmurtia to Provide Safety During the Works with Chemical Weapons) reported about antiterrorism training course. These training courses have shown the importance and the necessity of conducting such events to provide safety for chemical weapon storage. Zvonko Brigljević, Croatia (Counterterrorism, Security and Stability Improvement - Croatian Experience for the new Beginning) showed Croatian experience in Counterterrorism. Richard Vigus, USA (The Improved Response Program), (Improving Local and State Agency Response to Terrorist Incidents Involving Biological Weapons: Interim Planning Guide) presented improved response Program on local and state level.

Sector D: Posters
Sector Chair: Prof. Ladislav Palinkaš (Croatia)
Sector Co-Chair: Mr. Gary Eifried (USA)

Poster Sector, chaired by Prof. Ladislav Palinkas and the co-chair Mr. Gary Eifried was diverse, covering countermeasures and effects of CB agents and general chemical and biological aspects. There were 25 posters.

Session D1: General Chemical and Biological Aspects (Posters)
Chair: Prof. Esad Prohić (Croatia), Co-Chair: Dr. Robert Gum (USA)

Dr. Vadim Petrov, Russia (Technical Aspects of Realization of the New Chemical Disarmament Concept in Russia) reported about technical aspect of chemical disarmament concept in Russia. The new concept increases the risk of terrorism. Mr. Otokar Mika, Czech Republic (Czech Chemical Units for Fast and Reliable Intervention) presented Czech chemical units for fast and reliable intervention. A short historical overview of Czech participation at the Gulf war ten years ago presented.

Dr. Slavko Bokan, Croatia (Evaluation ff Animal and Plant Pathogens as Terrorism and Warfare Agents, Vectors and Pests) presented an evaluation of animal and plant pathogens, vectors and pests as biological warfare and terrorism agents according to different criteria. Dr. Branislav Lako, Yugoslavia (The first Epidemic of Tularemia in FR Yugoslavia) reported about the first epidemic of tularemia in FR Yugoslavia. Dr. Ankica Čižmek, Croatia (Simulation Modeling of Ecological Appearance) showed simulation modeling of ecological appearance. The aim of this work was modeling of ecological systems with special emphasis on water purification.

Dr. Jiri Matousek, Czech Republic (Personal Protection of Decontamination and Rescue Teams Engaged Following to Terrorist Chemical and Biological Strikes) presented method for personal protection and decontamination. He presented new generations of protective means suitable for rescue missions after such terrorist CB strikes. Mr. Otokar Mika, Czech Republic (Overview of the Czech NBC Equipment) reported about the Czech NBC protective equipment. Mr. Paul Joe, USA (CDC Public Health Oversight of Chemical Weapons Disposal) presented CDC oversight of public health of chemical weapons disposal. Kiam Wee Ang, Singapore (Protection Factors of first Responder's Garment) presented method for protection of first responders against the percutaneous toxic effects of the chemical agents.

Session D2: Countermeasures and Effects of CB Agents (Posters)
Chair: Dr. Brennie Hackley (USA), Co-Chair: Krešimir Furić (Croatia), Co-Chair: Dr. Biljana Antonijević (Yugoslavia)

A very interesting paper presented by dr. Rajka Turk, Croatia, (Role of Poison Information Center in the Prevention and Management of Chemical Accidents) showed the very important role of poison center in prevention and management of Mass-casualties accidents. Dr. Tonči Vuinac, Croatia (Aggressive Atropinization and Prolonged Administration of Oximes In the Treatment of Severe Poisoning with Organophosphorous Compounds) presented his experience in aggressive atropinization and prolonged administration of oximes during the treatment of severe poisoning with organophosphorous compounds.

Dr. Mostafa Ghanei, Iran (Late Haematologic Complications of Mustard Gas) reported Iranian's experience in the treatment of patients with late hematological complications of mustard gas. This research compares hematological parameters of war gas victims to a cohort control. June Webber, USA (Rehabilitation after a Chem/Bio Incident) showed method of rehabilitation after C/B incidents. After a C/B incident, triage and initial treatment would need

to be followed by extensive periods of rehabilitation, in respiratory, cardiac, wound care, pain and psychiatry. Dr. Maja Blanuša, Croatia (*Meso*- and *Racemic*-DMSA as Antidotes in Heavy Metal Poisoning) reported her experience with *meso*- and *racemic*-DMSA as antidotes in heavy metal poisoning. The results showed that *rac*-DMSA is more efficient in reducing body burden of metals and target organ retention than *meso*-DMSA. Mr. Ivan Jukić, Croatia (The Zeolites as Skin Decontaminants Against Nerve Agent Sarin in vivo) reported about possibilities of zeolites as skin decontaminants against nerve agent sarin *in vivo*.

Dr. Dario Matika, Croatia (Undersea Detection of Chemical Weapons and Mines) presented very interesting method of undersea detection of chemical weapons and mines. Dr. Jiri Matousek, Czech Republic (Role of International Organizations in Combating Terrorism) presented a very important role of international organizations in combating terrorism. Renata Sinovčević, Croatia (Hazardous Waste Management Technical Systems as the Environmental Emergency Responding Systems of Croatia) showed the Croatian's experience in hazardous waste management. Dr. Davorka Perić, Croatia (Blood Borne Pathogen Microbes and Bioterrorism) reported about experiance in blood borne pathogen microbes in terrorist's attacks. Dr. Petar Gotovac, Croatia (Emerging Infections, Transition and Bioterrorism) reported about emerging infections and bioterrorism in transition countries. Mr. Josip Talapko, Croatia (Prion - new answer or the Old Riddle) presented possibilities of using prions in terrorism. Prion diseases may be the plague of the 21st century. Dr. Đorđe Jovanović, Yugoslavia (Biochemical Effects of Topical Application and Decontamination of T-2 Toxin in Rats) showed a very interesting method of decontamination of T-2 toxin.

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Technical Agenda

Saturday 21 April 2001

The Pre-Congress Workshop
21-22 April 2001

Sector:Pre-Congress Workshop
Chair: Dr. David Moore (USA)
Co-Chair: Dr. Leo Laughlin (USA)
Co-Chair: Dr. Brian Davey (OPWC/The Netherlands)

Session 1: **A Workshop on Pharmaceutical Stockpiles**
Chair: Ph.G. Steven Bice (USA)
Co-Chair: Dr. Slavko Antolić (Croatia)

- **08:30 -** **A. Purchasing**
  1. Working with private pharmaceutical manufacturers: What can they produce? What are the costs? Incentives and partnerships between government agencies and private corporations.
  2. How much does one buy? Estimating the requirements, the numbers of potentially exposed, the numbers requiring treatment.
  3. Special populations considerations: pediatric dosing, immune compromised patients, frail elderly and institutionalized persons, etc.

  B. Oversight and maintenance
  1. Storage, quality assurance, quality control, inspections, inventory management: who does what and when?
  2. When product reaches its shelf-life end-date, what do you do with it?
  3. Who is responsible for oversight and management of the stockpile?

  C. Delivery
  1. How is the stockpile to be delivered?
  2. What will it look like when it is delivered and who knows what products are located where...what comes off the plane or truck first? Why are things packaged the way they are: what is the loading plan?
  3. Timeframes for delivery.

  D. Distribution
  1. How are points of distribution established? What are the criteria used to establish a point of distribution?
  2. Bulk product breakdown: why not unit or single patient dosing.
  3. Information management: What do you tell the victims? How do you inform and educate the patients to ensure or enhance compliance in taking medications and overall understanding? What providers need to know: how can private corporations help?

Session 2: **A Workshop on Industrial Chemical Terrorism**
Sponsored by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR); U.S. Agency for International Development (US AID), and the 4th Weapons of Mass Destruction Civil Support Team, Georgia (USA) Army National Guard.
Chair: Captain Joseph Hugart, USPHS (USA)
Co-Chair: Captain Boris Ilijaš (Croatia)

▪ **13:00 -**	Threat Assessments	Directory of World Chemical Producers Database
▪ **13:30 -**	Petrochemicals	Colorimetric water analysis kits for hydrocarbons
▪ **14:00 -**	Explosives	Cripkit explosives detection kit
▪ **14:30 -**	Industrial Gases	Multi-RAE photo-ionization detector

- **15:30** - Acids and Bases — Detector tubes
- **16:00** - Pesticides — Pur Test colorimetric water analyses kits
- **16:30** - Radiation — ADM 300 survey meter
- **17:00** - Metals/Cyanides — Pur Test water test kits and other detection devices
- **17:30** - **Adjourn**

Sunday 22 April 2001

Pre-Congress Workshop (Continued)

Session 3: **A Workshop on Equipment and Procedures**
Chair: Dr. Tom Snitch (USA)
Co-Chair: Major Ivan Jukić (Croatia)

- **13:00** -
  - a. **Advance in Biodetection for WMD Response:**
    Randall Bright, Gary Eifried
  - b. **Visual Purple, Reality-Based Interactive Training Demonstration:**
    Tom Sizemore
  - c. **RMP SAFER Meteorological Tower Demonstration:**
    Thor Thomsen, Paul Kahl
  - d. **The Rapid-PCR (Light Cycler) in Diagnosis of Biological Agents**
    Vaso Taleski
  - e. **And others such as the 4th Weapons of Mass Destruction Civil Support Team will be available for discussions on procedures and methodologies for Civil Support Teams**

- **18:30** - Meeting of Sector/Session Chairs/Co-Chairs – Main Auditorium
- **18:45** - Session Chairs/Co-Chairs meet with Session presenters
- **19:00** - **Welcome Party CBMTS Industry II (Excelsior Hotel)**

Monday 23 April 2001

The Chemical and Biological Medical Treatment Symposium - Industry II

Honorary Director: Mr. Zlatko Gareljić, Deputy Minister of Defense, Croatia
Co-Director: Mr. Richard Price (USA)
Co-Director: Mr. Zvonko Orehovec (Croatia)

The First World Congress on Chemical and Biological Terrorism
22-27 April 2001

Congress Chair: Dr. Slavko Bokan M.D. (Croatia)
Congress Co-Chair: Dr. Barbara Price (USA)
Sectors:

A. **General and Overview**
   Chair: Dr. Keith Vesely (USA)
   Co-Chair: Dr. Cornelis Erasmus (South Africa)
B. **Problem Definition**
   Chair: Dr. Sergey Netesov (Russia)
   Co-Chair: Mr. Richard Vigus (USA)
C. **Preparation and Response**
   Chair: Dr. Rudolf Portmann (Switzerland)
   Co-Chair: Ph.G. Steven Bice (USA)
D. **Posters**
   Chair: Prof. Ladislav Palinkaš (Croatia)
   Co-Chair: Mr. Gary Eifried (USA)

- **08:45** - **World Congress Opens with Official Welcome and Introductions**
  - Introduction – Lt. Col. Zvonko Orehovec and Mr. Richard Price
  - Dr. Bernard Brunner – Official Representative of CBMTS series
  - Official Representative of Government of the Republic of Croatia
  - Official World Congress Open - Mr. Zlatko Gareljić, Deputy Minister of the Republic of Croatia

Session A1: Scope of Meeting and Introduction
Chair: Dr. Bernhard Brunner (Switzerland)
Co-Chair: Dr. Robert DeBell (USA)

- **10:00** - **Introductions**
  - The CBMTS and the Congress on Chemical and Biological Terrorism: **Dr. Brian Davey**, Head Health and Safety, OPCW, The Netherlands
  - International Trends in Industrial Terrorism: **Joseph Hughart**, Agency for Toxic Substances and Disease Registry,USA
  - An Analysis of 404 Non-military Incidents Involving either Chemical or Biological Agents [96]: **Jack McGeorge,** Public Safety Group, USA
  - And What About Nuclear And Radiological Terrorism? [74]: **Bernard Anet**, AC-Laboratorium, Spiez, Switzerland
  - Predicting the Movements and Impacts of a Major Chemical Explosion in an Urban Environment – A Video Presentation. **Thor Tomsen**, **Tom Snitch**, USA

The Congress Exercise and Related Exibitions
23 April 2001

Sector: **Chair: Lt. Col. Zvonko Orehovec (Croatia)**
Co-Chair: Mr. Douglas Eaton (Canada)

Session 1: **The Congress at Exercise Exercise Area "GOLUBINAC"**

Chair: Major Tomica Sabolić (Croatia)
Co-Chair: Captain Warwick Penrose (Australia)

- **14:15** **The Congress Exercise**

Session 2: **Exhibition of Important Equipment and Procedures**
Chair: Mr. Per Åke Kristensson (Sweden)
Co-Chair: Mr. Neil Pitts (Canada)

- **15:25** - NBC Team Ltd., Canada (Exhibition of Equipment)
- **15:50** - Other Exhibitions including RAID and the Met Tower
- **17:00** - Dinner at Kupari

Tuesday 24 April 2001

Session A2: General Aspects and Assistance
Chair: Dr. Elena Ryabchikova (Russia)
Co-Chair: Dr. Gui Santana (Brazil)

- **08:00** - Changing Face of Global Terrorism [48]: **Liaquat Ali Khan**
  - Treatment Approach in Biological Crisis: An Epidemiological and Ethical Point of View [53]: **Florin Paul**
  - Responding to a Terrorist Initiated Toxic Chemical Release: Protecting High Value Facilities and Very Vulnerable Populations [91]: **Thomas Snitch**

- Assistance and Protection under Article X of the CWC [17]: **Zvonko Orehovec**
- Swedish Chemical Support Team for the OPCW: A Survey of the Offer According to Article X in the CWC [70]: **Per-Åke Kristensson**
- U.S. Government Assistance for Foreign Chemical and Biological Disasters [89]: **Michelle Jennings**

Session A4: Threat Assessment
Chair: Dr. Corneel Bellanger (Belgium)
Co-Chairs: Mr. Jack McGeorge (USA)

- **10:00** - Analysing the Terrorist Threat [78]: **Evelyn LeChene**
  - Weaponization and Delivery of Chem and Bio Agents: from a terrorism perspective [97]: **Jack McGeorge**
  - How to Achieve Better Protection from Chemical Terrorism Using Preventive Activities [80]: **Josip Friščić**
  - Industrial Chemicals as Weapons of Mass Destruction [92]: **Joseph Hughart**
  - Chem/Bio Terrorism Preparedness: Current Technologies and Application [8]: **Douglas Eaton**
  - Generic Protocol for Decisions Regarding Packages Possibly Containing a Chemical or Biological Agent [9]: **Colin Harwood**
  - Contamination of an Environment as Possible CB Terrorism [15]: **Ladislav Palinkaš**

Session C3: Medical Treatment of OP Intoxication
Chair: Dr. Peter Stopa (USA)
Co-Chairs: Dr. Mostafa Ghaeni (Iran)

- **13:00** - Biochemical Studies on Oximes Synthesized in Croatia over the Past Decades [19]: **Vera Simeon - Rudolf**
  - The Treatment of Intoxication with Selected Organophosphates and a Carbamate: Comparison of Different Therapeutic Approaches [28]: **Jiri Bajgar**
  - Antidotal Efficacy and Pharmacokinetics of Pyridinium Oximes in Mice Poisoned with Soman and Paraoxon [40]: **Biljana Antonijević**
  - Analysis of the HI-6 Influence on the Liver Metabolizing Enzime Systems [6]: **Christofer Dishovski**
  - In Vitro Decontamination of Cobalt-60 Exposed Pigs Eyes with Diphoterine(R) vs. Water [33]: **Alan Hall**
  - Statistical Views on Late Complication of Chemical Weapons in Iranian C.W. Victims of Iran - Iraq War [98]: **Khateri Shahriar**

Session B2: Biological Sources and Prevention
Chair: Dr. Christopher Dishovsky (Bulgaria)

- **15:00** - Managing Chemical and Biological Agents [71]: **Mirko Hadžija**
  - Evaluation of Nipah Virus as a Human and Animal Biological Terrorism and Warfare Agent [14]: **Slavko Bokan**
  - Emerging Infections and Bioterrorism [39]: **Loti Haghighi**
  - Pathogenesis of Orthopox Viral Diseases: A Review [57]: **Elena Ryabtchikova**
  - The Need for Creation of the International Center in Novosibirsk, Russia for Combatting Infectious Diseases and Bioterrorism Threat in Asia [62]: **Sergey Netesov**
  -
- **17:00** - **Adjourn**

Wednesday 25 April 2001

Session C2: Chemical and Situational Analysis & Introduction of Poster D1
Chair: Prof. Esad Prohić (Croatia)
Co-Chair: Dr. Robert Gum (USA)

- **08:00** - Artificial Cobweb: Chemical and Physical Analysis [21]: **Krešimir Furić**
  - Environmental Site Investigation in Croatia and the Conception of the Environmental and Industrial Health Hazard Risk Framework for Deployed Canadian Forces [1]: **Chris Knowlton**
  - Analysis of CWC-related Compounds in a Rubber Sample [47]: **Abdouraman Barry**
  - Proposed Measures to Reduce Human Suffering after Terrorist's Attack. A Lesson from the 1998 Bomb Blast of the American Embassy Building in Nairobi, Kenya. [45]: **Virginia Mathenge**
  - Introduction of Poster D1

Session D1: General Chemical and Biological Aspects (Posters)
Chair: Prof. Esad Prohić (Croatia)
Co-Chair: Dr. Robert Gum (USA)

- **10:00** - Technical Aspects of Realization of the New Chemical Disarmament Concept in Russia [56]: **Vadim Petrov**
  - Czech Chemical Units for Fast and Reliable Intervention [36]: **Mika Otakar**
  - Hazard Materials Emergency Experience in Croatia [23]: **Branimir Molak**
  - Globalization of the Infectious Diseases and Croatian Civil Defense [61]: **Tomo Sugnetić**
  - Evaluation of Animal and Plant Pathogens as Terrorism and Warfare Agents, Vectors and Pests [49]: **Slavko Bokan**
  - The first Epidemic of Tularemia in FR Yugoslavia [54]: **Branislav Lako**
  - Simulation Modeling of Ecological Appearance [18]: **Ankica Čižmek**
  - Personal Protection of Decontamination and Rescue Teams Engaged Following to Terrorist Chemical and Biological Strikes [25]: **Jiri Matousek**
  - Overview of the Czech NBC Equipment [34]: **Mika Otakar**
  - CDC Public Health Oversight of Chemical Weapons Disposal [93]: **Paul Joe**
  - Protection Factors of first Responder's Garment [63]: **Kiam Wee Ang**

Session B3: Dissemination, Detection of Biological Agents and Management
Chair: Dr. Colin Harwood (Canada)
Co-Chair: Prof. Loti Haghighi (Iran)

- **13:00** - Particle Size and Organism Number: Impact on Bioaerosols [86]: **Robert Debell**
  - Rapid - PCR (LightCycler) in Diagnosis of Biological Agents [46]: **Vaso Taleski**
  - Rapid on-site Biological Detection for First Responders [84]: **Randall Bright**
  - Strategies for the Detection of Biological Materials [85]: **Peter Stopa**
  - South African Military Health Service Involvement during Outbreak of Cholera in Kwazulu-Natal [68]: **Cornelis Erasmus**
  - Psychological Effects of CB Terrorism: Lessons from the Past [88]: **Gary Eifried**

Session A3: National Approach to Terrorism
Chair: Mr. Tom Sizemore (USA)
Co-Chair: Prof. Gurayten Ozyurt (Turkey)

- **15:00** - Meeting The Chemical Biological and Radiological (CBR) Threat: Sydney Olympic Games - 2000 [2]: **Warwick Penrose**

- CB Terrorism Defence in Belgium : How and Why [3]: **Dirk Pauwels**
- Chemical and Biological Terrorism: A Brazilian Perspective [7]: **Gui Santana**
- Emergency Management Experience in Croatia [22]: **Branimir Molak**
- The New Integrated System in the Czech Republic [27]: **Mika Otakar**
- System of Hungarian System Management [67]: **Laszlo Kozari**
- The New Global Standard: WMD Community Preparedness [76]: **Richard Vigus**

▪ **17:00** - **Adjourn**

▪ **18:30** - Dinner (Restaurant Jadran) National folklore ensemble LINDZO

Thursday 26 April 2001

Session C4: Other Medical Aspects & Introduction of Poster D2
Chair: Dr. Brennie Hackley (USA)
Co-Chair: Dr. Biljana Antonijević (Yugoslavia)
Co-Chair: Krešimir Furić (Croatia)

▪ **08:00** - Late Pulmonary Complications of Mustard Gas Inhalation [38]: **Mostafa Ghanei**
- Pyridostigmine as Preventive Antidote in Pesticides Research and Production Units [51]: **Dalia Simona Miron**
- High Dose Pralidoxime (PRX) Treatment Prolongs Time to Extubation (TTE) and Increases Mortality in Paraoxon (POX) Exposed Minipigs [32]: **Georg Petroianu**
- New Advanced Oxidation Technologies for Destruction of Toxic Chemicals and Biological Agents in Water [79]: **Valeriy Chernyak**
- Introduction of Poster D2

Session D2: Countermeasures and Effects of CB Agents (Posters)
Chair: Dr. Brennie Hackley (USA)
Co-Chair: Krešimir Furić (Croatia)
Co-Chair: Dr. Biljana Antonijević (Yugoslavia)

▪ **10:00** - Role of Poison Information Centre in the Prevention and Management of Chemical Accidents [30]: **Rajka Turk**
- Aggressive Atropinization and Prolonged Administration of Oximes in the Treatment of Severe Poisoning with Organophosphorous Compounds [31]: **Tonči Vuinac**
- Late Haematologic Complications of Mustard Gas [37]: **Mostafa Ghanei**
- Rehabilitation After a Chem/Bio Incident [73]: **June Webber**
- *Meso* - and *Racemic*-DMSA as Antidotes in Heavy Metal Poisoning [13]: **Maja Blanuša**
- The Zeolites as Skin Decontaminants against Nerve Agent Sarin in Vivo [43]: **Ante Vučemilović**
- Undersea Detection of Chemical Weapons and Mines [35]: **Dario Matika**
- Role of International Organizations in Combating Terrorism [26]: **Jiri Matousek**
- Hazardous Waste Management Technical Systems as the Environmental Emergency Responding Systems of Croatia [4]: **Renata Sinovčević**
- Blood Borne Pathogen Microbes and Bioterrorism [10]: **Davorka Perić**
- An Integrated Approach to Sound Management of Certain ("Multipurpose") Chemicals and Dual-Use Materials in Croatia [44]: **Ivana Halle**
- Emerging Infections, Transition and Bioterrorism [55]: **Petar Gotovac**
- Prion - new answer or the Old Riddle [29]: **Josip Talapko**
- Biochemical Effects of Topical Application and Decontamination of T-2 toxin in Rats [52]: **Đorđe Jovanović**

Session C6: Response to Terrorist Events
Chair: Dr. Kiam Wee Ang (Singapore)
Co-Chair: Dr. Ankica Čižmek (Croatia)

- **13:00** - Implementation of The Convention on Transboundary Effects of Industrial Accidents in the Republic of Croatia [20]: **Valburga Kanazir**
  - Antiterrorism Training Course in Udmurtia to Provide Safety During the Works with Chemical Weapons [41]: **Vadim Petrov**
  - The Croatian Population and Responsibilities for Medical Protection [58]: **Tomo Sugnetić**
  - Counterterrorism, Security and Stability Improvement - Croatian Experience for the New Beginning [64]: **Zvonko Brigljević**
  - The Improved Response Program [83]: **Richard Vigus**
  - Improving Local and State Agency Response to Terrorist Incidents Involving Biological Weapons: Interim Planning Guide [77]: **Richard Vigus**

Session B1: Chemical Sources and Prevention
Chair: Dr. Vera Simeon-Rudolf (Croatia)
Co-Chair: Dr. Otokar Mika (Czech Republic)

- **15:00** - Development and Implementation of Civil Support Teams for Weapons of Mass Destruction [95]: **Mario Morales**
  - Sources of Chemical Toxics and their Precursors in the Pharmaceutical Industry [50]: **Constantine Mircioiu**
  - Possibilities of Detection and Early Warning in Case of Terrorist Chemical Attacks in Subways [24]: **Jiri Matousek**
  - Liquified, Toxic and Corrosive Gases in Haevily Populated Areas [42]: **Franjo Plavšić**
  - Blood Neuropathy Target Esterase (NTE) as Biochemical Marker for Neuropathic Organophosphates (OP) Exposure [59]: **Galina Makhaeva**
  - O-alkyl-O-methylchlorformiminophenyl Phosphonates Delayed Neurotoxicity Risk Assessment: in vitro and in vivo Studies. [60]: **Vladimir Malygi**
- **16:30** - **Available for demonstrations of equipment/procedures**
- **17:00** - **Adjourn**
- **20:00** - Congress Dinner (Excelsior Hotel)

Friday 27 April 2001

Session C5: Provisioning and Communication Problems
Chair: Dr. Scott Deitchman (USA)
Co-Chair: Dr. Constantin Mircioiu (Romania)

- **08:00** - Description of the U.S. National Pharmaceutical Stockpile Program [81]: **Stephen Bice**
  - The U.S. National Pharmaceutical Stockpile: Contents and Applications [94]: **Michael Robbins**
  - The U.S. National Pharmaceutical Stockpile Program "Buying is the Easy Part" [82]: **Stephen Bice**
  - Pharmaceutical Waste Disposal in Croatia [69]: **Damir Subašić**
  - Towards Effective Crisis Communication: An Analysis of Management Inhibitors and Facilitators [5]: **Gui Santana**
  - Terrorism and Communication with the Public [65]: **Zdravka Tečić**
  - Visual Purple, The Next Generation Crisis Management Decision Training Tool [72]: **Tom Sizemore**

Session C1: Protection, Information of Responders
Chair: Dr. Rajka Turk (Croatia)
Co-Chair: Dr. Alan Hall (USA)

- **10:00** - CB-Protection: Modeling to Evaluation Filtration Characteristics [11]: **Ankica Čižmek**
  - Protecting first Responders to Acts of Terrorism [87]: **Scott Deitchman**
  - The Role of National Poison Control Centre in Organisation and Management of Mass Ammonia Accident [12]: **Slavica Vučinić**
  - Cooperation between Poison Control Center and Organized Industrial District for Chemical Disaster Prevention [75]: **Gurayten Ozyurt**
  - Chemical Warfare Agent Disposal: Public Health Oversight [90]: **Robert Gum**
  - Detection Systems for Illicit Trafficking in Weapons and Terrorist Agents [66]: **Vladivoj Valković**

- **13:00** - **Review of Sector Chairs/Co-Chairs, Congress Summaries and Conclusions and Short Discussion on Future Efforts, Congress Adjourns**

- **15:00** - Tour of Dubrovnik

CONGRESS EXERCISE AND RELATED EXHIBITIONS

Sector Chair: Lt. Col. Zvonko Orehovec (Croatia)
Sector Co-chair: Mr. Douglas Eaton (Canada)

SCONGRESS EXERCISE

Chair: Major Tomica Sabolić (Croatia)
Co-chair: Captain Warwick Penrose (Australia)

INTRODUCTION

Somewheria and Anywheria are neighboring countries in transition with border disputes. Both countries are not State Parties of OPCW. Somewheria has a warehouse with old chemical weapons in the mountains 70km from the border with Anywheria. In the wider area of the warehouse complex, rapid settlement began because of the development of new production technology of electronic equipment. Anywheria decided to execute a terrorist attack on the warehouse and cause panic and suffering with the population in order to stop further settlement in that area and slow down the economic development of the neighboring country.

A DESCRIPTION OF THE TERRORIST ACT

A terrorist group executed an attack on a warehouse complex containing old chemical weapons. The attack was executed using armor-piercing system RPG-7. Following the attack the special antiterrorist unit from Ministry of Interior entered the area and neutralized the terrorist units. After the attack, a line of secondary explosions occurred, as rocket projectiles, which dispersed to the distance of few kilometers from the place of attack and cause the contamination of a wider area.

Next, alert and evacuation of civilian population followed, as well as the organization for a rapid response and medical help.

Neutralization of the released toxic substances and decontamination of the attacked space (decontamination system by Irvin Aerospace, NBC Team Limited Canada) were conducted.

Neutralization of the primary source of contamination was performed by decontamination platoon with special equipment for fire extinguishing and decontamination (CASCAD System). CASCAD, an aqueous foam, was designed to contain and eliminate chemical and biological warfare agents, and for removing radioactive particle contamination. Decontamination platoon used special protective equipment and system for protection of the respiratory tract (Dräger, Germany).

Effective detection of a presence of toxic agents in the area around the warehouse before and during this action was performed using very sophisticated and effective detection equipment purchased by Tradeways Ltd. (Annapolis, Maryland, USA).

A DESCRIPTION OF THE INCIDENT

A warehouse complex containing old chemical weapons was situated in the southern part of Somewheria,

The complex, inside of which those weapons were stored, was secured by classic and sophisticated technical security (fence, cameras, sensors, automatic chemical detectors and monitors, meteorological system). Aside from that, the warehouse was located under patrolled surveillance by the NBC defense unit, which is responsible for its security.

There was a barrack around 70 km from the area where the warehouse was located, containing the atomic-biologic-chemical defense unit. In case of an accident in the

warehouse, considering the distance and readiness factor, the unit could intervene within 2 hours after receiving the alert signal. The unit had an operational headquarters through which it received information in real time from all devices and instruments founded in the technical security system of the warehouse.

Terrorist groups from Anywheria attacked the warehouse wanting to cause a chemical accident. The attack was carried out using hand held rocket launchers. The attack caused serious damage to the warehouse, which resulted in explosions of chemical projectiles and release of chemical agents (chemical warfare agents) contained in stored old chemical weapons.

Explosions caused by direct hits create secondary explosions of chemical projectiles, which spread to all three buildings in a warehouse complex. Secondary explosions caused a fire by ignition of a transport vehicle parked in the area of the warehouse.

The NBC defense unit received a "chemical alert" signal, 3 minutes after releasing of the chemical agent ("response time" of the automatic chemical detector).

Decontamination platoon (with the NBC reconnaissance and surveillance equipment), trained and equipped for accidents of this kind was directed to the area of the warehouse complex with a task of chemical decontamination of the accident area. Upon entering the area of contamination, the platoon located visible damage on the warehouse complex, the release of the chemical agent and forming of a smaller cloud of chemical contamination, as well as a smaller fire on the transport vehicle near one of the warehouses. The unit split into three groups and began with the operation.

NBC reconnaissance group approached the warehouse in a vehicle, and determined places of greatest damage to the warehouses, or the strongest "emission" of chemical agents.

After determining the locations of damage and "emissions" of chemical agents, four decontamination platoons approached the warehouse complex with mobile cisterns for decontamination. Water supply crew (with 2 mobile water cisterns) and the support crew remained on the border of the outer area of contamination.

Decontamination platoons approached the warehouse and split up for operation. They began extinguishing the fire on the transport vehicle. Next, the decontamination began on the building that has been most severely damaged, with the strongest chemical agent "emission". The other two warehouse buildings experienced short-term intensification of the release of chemical agents, during the operation of the water for decontamination.

Decontamination of the remaining two warehouse buildings began.

After the completion of decontamination of buildings, the decontamination platoons moved on to decontamination of surrounding area.

Decontamination platoons finished the operation and exited the inner area of the warehouse complex. After their departure, the NBC reconnaissance unit performed the control of the decontamination on the warehouse buildings and the inner area of the warehouse complex.

Upon the completion of decontamination control the NBC reconnaissance unit exited the inner area of the warehouse complex.

Primary and secondary explosions started fires in the surrounding area, but because of the inaccessible terrain airplanes and helicopters were not used. Instead, special fire units were used, equipped with special equipment for fire extinguishing and protection. They secure the approach of special NBC units whose members continued to work on fires and prevention of further emission of toxic substances that expands in form of a toxic cloud. After that an action of combined units for medical care and civilian protection followed. It provided rapid response and took care of hurt and poisoned members of special fire and NBC units in the area of primary release of toxic agents.

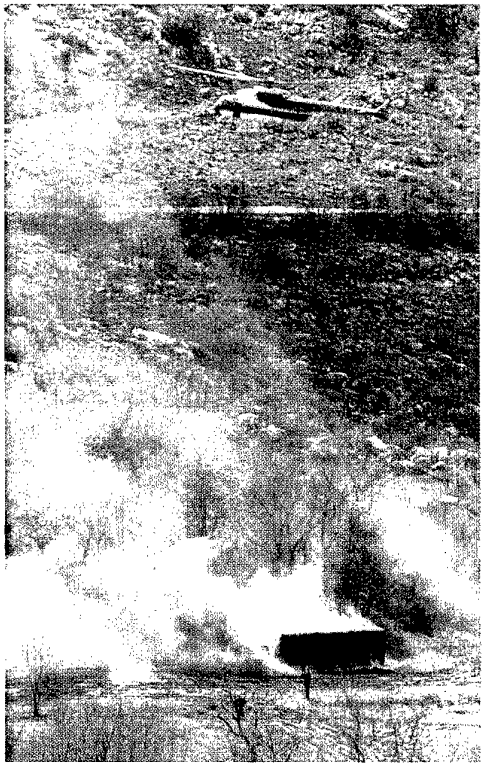

Fig.1: Terrorist attack on warehouse with old chemical weapons. A special antiterrorist unit from Ministry of Interior entered the area and neutralized the terrorist units.

1. ENVIRONMENTAL SITE INVESTIGATION IN CROATIA AND THE CONCEPTION OF THE ENVIRONMENTAL AND INDUSTRIAL HEALTH HAZARD RISK FRAMEWORK FOR DEPLOYED CANADIAN FORCES

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INTRODUCTION

The modern battlespace encompasses many hazards to life and health. In addition to the obvious risks from the action of belligerents and naturally occurring hazards such as those caused by climate and endemic disease, current patterns of deployment carry the additional risk of potentially harmful exposure to chemical, biological and radiological hazards within the man-made environment. Acute or chronic exposure to these hazards may result in adverse health effects to military personnel and could have an impact on Canadian Forces operational capability. "Eco-terrorism" or the intentional dispersing of chemical, biological or radiological material can further increase these risk to exposure and represent a definite area of concern that must be predicted and properly evaluated in a timely manner.

Canadian Forces personnel serving with the United Nations Protection Force (UNPROFOR – OP Harmony) in Croatia initially raised the possibility that troops had been exposed to contaminants in 1993-1994. The concerns at the time focused on the potential exposure to polychlorinated biphenyls (PCBs) and bauxite - used to fill sandbags for defensive works. Unfortunately, these concerns were never confirmed or fully investigated with proper closure, as they were not well understood by the operational planners at that time. Subsequently, the need to characterize environmental hazards was emphasized in 1998 when allegations were made that unexplainable illnesses being reported by Canadian Forces Personnel were as a result of being unknowingly exposed to environmental contaminants while in Croatia. These allegations prompted a review of all available documentation dating back from 1993. It was at this point that it became clear that no scientifically defendable information could be found. As a result, an environmental investigation team was sent to Croatia in July 1999 in an effort to determine the presence of environmental contamination that could explain the reported illnesses.

METHODS

In the four years or more timeframe between the investigation and the last presence of Canadian troops in the area of concern, many site conditions had changed, making it difficult to obtain truly representative samples. Most of the Canadian sites were observation posts positioned on mountain summits or along ridges removed from built up areas and industry (Map 1). In many cases, access to the sites was limited; some locations could not be reached due to the existing mine threat or impassable roads. Another limitation to the environmental study was that non-persistent contaminants would have undergone natural attenuation and volatilization, and contaminants in the air and water would have migrated away. Therefore, a forensic sampling approach was taken to screen for persistent contamination and degradation products at the locations occupied by Canadians. Environmental forensics is an evolving discipline virtually unheard of five years ago. The practice is used increasingly frequently to help investigators gain a better understanding of the nature, extent, ownership, and allocation of site contamination. Environmental forensics was applied in Croatia to discover whether any contaminants were present at sites where Canadians were serving during Operation Harmony, and if so, to determine whether persistent contaminants were present at

concentrations that could result in adverse health effects. Background samples were also collected in areas free from any localized contamination to provide a reference for determining whether targeted samples had significantly different levels of contaminants.

Although the concerns were centered on PCBs and bauxite, analyses were also performed for a wide range of persistent chemicals, by-products, and radioisotopes. The analytical program was developed which included both screening and specific analytical approaches. A strict quality assurance/quality control program was established to ensure that the data would be accurate and representative of actual conditions. Details of the analytical program can be found at Table 1.

RESULTS AND DISCUSSION

Despite the exhaustive analytical program, only a few selected metals (arsenic, cadmium, zinc, vanadium, and chromium) were found in concentrations exceeding Canadian soil quality guidelines for the protection of human health and there was very little evidence of organic chemical contamination (Table 2). It was later determined through a qualitative risk assessment that these levels were deemed not to be a risk to human health. Despite the lack of persistent environmental contaminants, the links between service in Croatia and health problems were observed. Furthermore, the possibility of exposure to other more volatile soil contamination and other form of water-borne, air-borne or transient contamination could not be ruled out. In the end, the results of the environmental forensic study were presented to a formal Board of Inquiry (BOI).

Over a 6-month period, the Board interviewed Op Harmony veterans and discovered that many had a variety of unexplained medical conditions, many of which had not been reported for fear of jeopardizing their military careers. The Board also observed that one of the major differences between OP Harmony and other Canadian UN and NATO missions between 1960 and 1993 was the intensity of the conflict area. It became clear to the Board that during the early events of OP Harmony, many of the Canadian soldiers lived under constant combat conditions and were frequently caught in the crossfire between the warring sides; at times even becoming targets themselves. Coincidentally, the Board observed that others who fought in previous high intensity conflicts over the ages reported many of the same symptoms as reported by OP Harmony veterans. This testimony led to identify stress as a probable major cause of the illnesses reported among soldiers who served in Croatia. Experts have described combat stress reaction, not as a new phenomenon, but as a very old one. Combat stress reaction has been documented among veterans of conflict in other military forces of other generations. For example, records show that for more than 300 years soldiers have reported a mysterious range of physical symptoms. In the end, the Board concluded that the health problems reported by OP Harmony veterans were from what appears to be stress-related ailments. However due to the forensic nature of the environmental study, only persistent contaminants could be were ruled out. It is doubtful that the cause will ever be identified for certain.

RISK FRAMEWORK

In the interests of preventing exposure to harmful contamination during future missions, it was recommended by the BOI that the Canadian Forces take measures to identify, characterize and predict risks from environmental and industrial health hazards (EIHH) and public health concerns (PHC) on deployed operations. This may include such hazards as: toxic industrial chemicals, pathogenic organisms, and radiation hazards from Release Other Than Attack (ROTA); public health threats such as disease vectors; and, physical hazards such as dust, smoke, noise, altitude and temperature extremes. As a result,

since 1999, when the planning for any operation is initiated, strategic intelligence resources are dedicated to allow information gathering aimed at identifying potential EIHH and PHC. Identification of potential activities and an assessment of facilities or devices that may be hazardous or may cause contamination are made to determine if they could pose a threat to CF personnel. The assessment takes into account different exposure scenarios ranging from health hazards created during the peacetime operation of industrial sites to those created as a result of conflict. By assessing the suspected potential threats, commanders are able to determine what areas should be further examined and characterized. To accomplish this task, multidisciplinary teams of preventative medicine, environmental engineer, NBC (nuclear, biological, chemical) and intelligence personnel are grouped together to provide deployed commanders with competent specialist expertise. Since the creation of the EIHH/PHC Risk Framework, several successful environmental studies have been conducted, which has identified and mitigated potential health risks to Canadian Forces. This risk framework will not eliminate all risks to CF personnel involved in contingency operations but will help in identifying and reducing the risks posed to soldiers by protecting them from exposure to hazards that may be detrimental to human health, both over the short and long term.

ACKNOWLEDGEMENTS

Authors would like to especially acknowledge the contributions of the Croatian liaison team during the environmental investigation in 1999: Captain (Frigate) Ivica Lukovic, Lieutenant-Colonel Zvonko Orehovec, and Captain Drazen Paradinovic. The excellent support provided by the Croatian Ministry of Defence personnel was essential in gaining access to locations that would otherwise have been out of bounds, due to the unknown mine threat beyond hardstand paved surfaces. The success of the environmental forensic study would not have been possible without their professional assistance. Hvala.

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KEYWORDS

Forensic Investigation, Croatia, Deployed Operations, Environmental, Contaminants, Risk Assessment

Table 1a: Screening analysis

Inorganic Analyses	Analytes	Organic Analyses	Analytes
ICP	Aluminum, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, strontium, sulphur, titanium, vanadium, and zinc	ABN	polycyclic aromatic hydrocarbons, phenols, chlorinated hydrocarbons, and phthalates
NAA		GC/MS	polychlorinated biphenyls (PCBs), chlorinated pesticides. organic compounds
AAS	lead, chromium and cadmium	Energetics	RDX, HMX, and TNT
		Pesticides	organophosphates triazine-like herbicides phenoxyacid herbicides
		Chemical Warfare Agents	common chemical warfare agents including: methylphosphonofluorid ates, tabun, VX, and mustard

Table 1b: Specific analysis

Inorganic Analyses	Method	Organic Analyses	Method
Arsenic (As)	hydride generation AAS	PCBs	GC-ECD
Mercury (Hg)	cold vapour atomic absorption	Dioxin/ Furans	High resolution GC-MS
Hexavalent chromium (Cr^{+6})	colorimetric and reagent	PAHs	GC-MS

Table 2: Analytical results

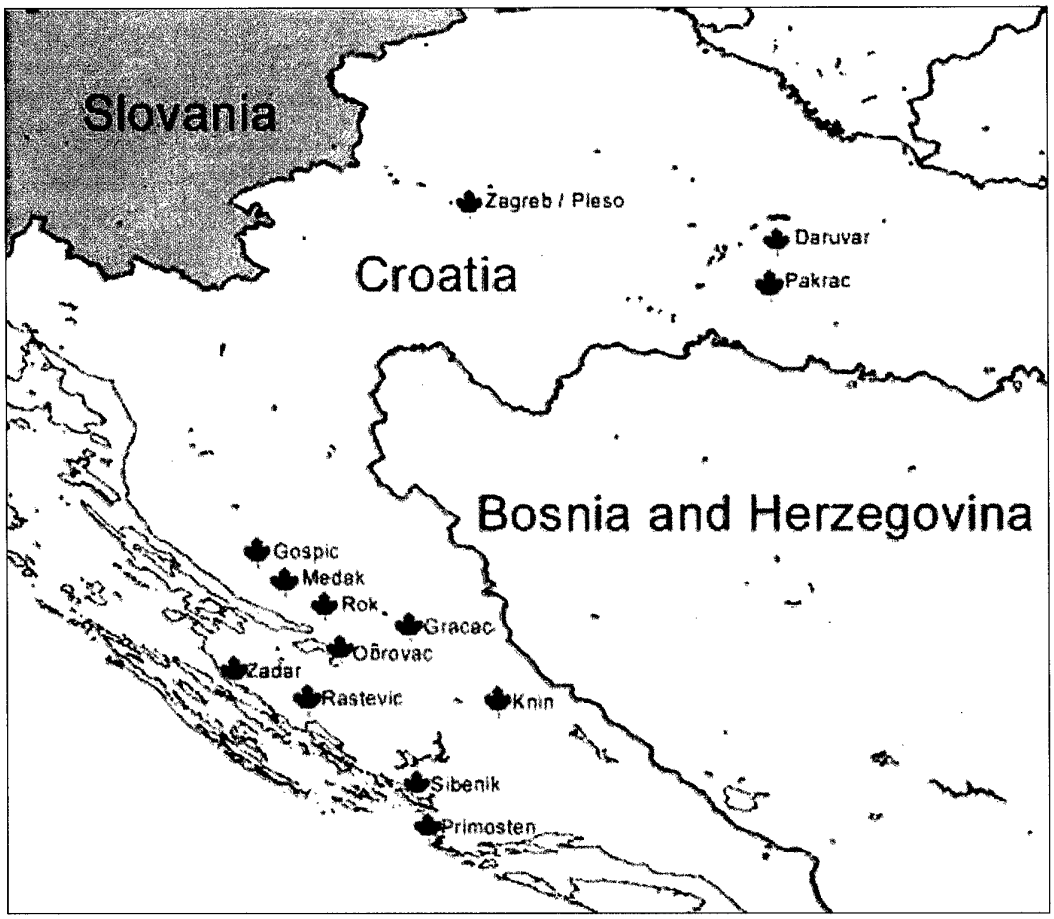
Element	Analytical Results (mg/kg)	Human Health-Based Soil Quality Guidelines (mg/kg) [a]
Aluminum, Al	1370 - 260350	-
Antimony, Sb	0.3 - 16.5	20 [b]
Arsenic, As	0.7 - 149	12
Barium, Ba	<5 - 137	500
Cadmium, Cd	<1 - 23.9	14
Calcium, Ca	1300 - 475000	-
Chromium, Cr	<5 - 2269	220
Cobalt, Co	<10 - 14.3	50 [b]
Copper, Cu	<5 - 106	1100
Iron, Fe	1200 - 248000	-
Lanthanum, La	4.4 - 178	-
Lead, Pb	<10 - 142	140
Magnesium, Mg	900 - 61500	-
Manganese, Mn	<15 - 3674	-
Mercury, Hg	<0.1 - 0.3	6.6
Nickel, Ni	<5 - 460	100 [b]
Potassium, K	<500 - 6400	-
Sodium, Na	500 - 15600	-
Strontium, Sr	8.4 - 276	-
Uranium, U	1.9 - 12	-
Vanadium, V	<5 - 1068	200 [b]
Zinc, Zn	<5 - 254	500 [b]
Dioxins/Furans (TEQs) [c]	1.6×10^{-9} - 1.0×10^{-6}	1.0×10^{-3} [b]

a - Canadian Environmental Quality Guidelines (CCME, 1999), except where noted;

b - Interim Soil Quality Guidelines (CCME, 1991);

c - Concentrations of dioxins/furans reported as toxic equivalents (TEQs) to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin; data on typical concentrations in soil from OMEE (1994).

Map 1: Canadian locations during OP harmony



2. MEETING THE CHEMICAL BIOLOGICAL AND RADIOLOGICAL (CBR) THREAT: SYDNEY OLYMPIC GAMES - 2000

Captain Warwick D.G. Penrose
CBR Response Disposal Troop Commander

ABSTRACT

The Joint Incident Response Unit (JIRU) was given the specialist mission of reducing the hazard of Chemical, Biological, Radiological (CBR) and Explosive threats to the Sydney 2000 Olympic Games. The primary responsibility of reducing the CBR terrorist threat rested with the CBR Response Squadron (CBRR Sqn). The CBRR Sqn was primarily focused on supporting the New South Wales Police, however this support also included coverage of all other Australian cities that hosted Olympic events as well as supporting a hostage recovery incident should a CBR threat develop.

Two separate CBR Response teams were on standby during the Olympic Security Period. The CBRR Sqn developed a two tiered crisis response system. A small CBRR Diagnostic team, with their own organic decontamination, triage and communication assets, would be reacted to confirm the presence of a CBR threat. An extensive scientific reachback capability supplied from the Technical and Scientific Support Group (TSSG) (which consisted of personnel from US Department of Energy, UK Department of Defence and the Defence Scientific and Technology Organisation of the Australian Defence Force (ADF)) was in direct support of this team.

If a CBR threat was confirmed, CBRR Disposal elements with dedicated decontamination stations and resus bays, would be called forward to support the CBRR operation. Concurrently, the CBRR Diagnostic team once it had confirmed the threat would focus on containing and rendering safe the device in the crisis management phase, before taking samples and assisting in site remediation during the consequence management phase. The significant lessons learnt from the Sydney 2000 Olympic Games, from the CBRR crisis management perspective will be described.

KEYWORDS

CBRR, chemical threat, biological threat, radiological threat

3. CB TERRORISM DEFENCE IN BELGIUM, HOW & WHY

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1. GENERAL CONSIDERATIONS

a. Introduction

Talking about the way a country deals with the threat of CB terrorism is like taking the plunge : you may fall on the left side or on the right side of the rope, but nobody expects you to make it. Going to much in details will give problems with the authorities at home, talking about generalities exposes you to catcalls from the audience. To guarantee our health and safety in the short and long term, we want to state that all information used in this paper is openly available and that the answer to the question "why", is much more interesting for this audience than the facts, enumerated in the chapter "How?". Indeed, the way we deal (or don't) with this particular problem is dictated by history, culture and actual emergency system. In another time, in another country, this system just wouldn't work. So let's first consider some basics to help us understand the actual situation in Belgium.

b. Belgium

Belgium is a very densely populated and industrialised country in the hart of Europe: ten million people live on thirty thousand square kilometres between highly developed private enterprises, capitalized on their central geographic location, highly developed transport network, and diversified industrial and commercial base. Industry is concentrated mainly in the populous Flemish area in the north and consists of engineering and metal products, motor vehicle assembly, processed food and beverages, chemicals, basic metals, textiles, glass and petroleum. Between those industrial complexes, administrative and dormitory towns, some rare people try to make their living from agriculture and produce fresh vegetables, fruits, grain, beef, veal, pork and milk. We export most of what we produce and so Antwerp is one of the world's busiest ports. To facilitate transport of fuel we developed a pipeline network: 1,167 km for petroleum products and 3.300 km for natural gas (3). On the surface we have the most dense highway and railway network in Europe.
Reasons enough to develop detailed contingency plans for Normal Accidents.(1,2)

c. Contingency planning

Disaster planning in Belgium is based on the Seveso directive (82/501/EEG) from the European Community and was implemented on July 11, 1990 by a Directive from the Minister of Internal Affairs.
We distinguish two levels of management: the on-scene tactical level and the strategic level by a political authority.

The on-scene commander (or tactical commander) coordinates five distinctive disciplines:

1. Relief Operations
2. Medical and Sanitary Aid
3. Police
4. Logistic Support
5. Information of the Population

The on-scene commander is responsible for the safety and the coordination during the incident management. Normally this very demanding job is done by the officer highest in rank from the fire brigade present at the scene. He reports to the authority in charge of the whole disaster response.

The person who has the responsibility for the whole operation (disaster area and the areas at risk) is the Mayor, the Governor of a province or the Minister of internal affaires, depending on the level of response needed or on the extent of the disaster area.(4). On this strategic level, the authorities can rely on a coordination committee composed of senior representatives of the corpses involved in the action and every other expert whose presence can be useful. A representative of the army is present from the provincial level on. The General Disaster Plan is omnivalent enough to cover most incidents and disasters a man can imagine. For specific risks, specific plans are conceived, however without going against the principles of the general plan. The most drastic change we ever witnessed, was during a prison revolt where the function of on-scene commander was hold by the officer in charge for Discipline 3, the police. This happened in consultation with the chief of the fire brigade and with the approval of the Mayor.

The persons in charge during the incident are also responsible for the preparation during the silent phase as well as for the debriefings and the updates of the intervention plans in the post-disaster phase.

2. HOW ?

a. Hazard

Can Belgium be defined as a country at risk for a CB terrorist attack? The answer depends largely on the definition given to the expressions "terrorist" and "CB":

Personally we consider three kinds of terrorists: the politically oriented groups with very idealistic members, the criminal oriented groups interested in extortion and last, but not least, the a- or antisocial loner. Depending on the part of this spectrum you are interested in, the threat will be different.

When talking about "CB", the question "What do you *exactly* mean? "is even more appropriate: some people only consider those chemicals known as warfare agents while a lot of industrial products are as toxic and even more available for illegal actions. Those same people link this term to "mass casualty incidents" while it is much easier and less eye-catching to obtain enough agents to harm individuals or small groups.

An objective analysis confirms that this country is an ideal target for CB terrorism: a dense population, a highly industrialised and a dense road network without controlled borders with neighboring countries compile to almost the ideal situation for terrorists.

And in practice since the 1980's Belgium has had no experience anymore with terrorist groups acting on its territory. This group, called CCC, didn't use unconventional weapons. The groups on the covers of our newspapers in the 1990's were either folkloristic or logistic bases for international acting groups (e.g. GIA). Besides this the police had to deal with different incidents where individuals tried to make money pretending they were in possession of N, B or C material and willing to use it.

b. Risk

Considering the previous paragraphs, what are our conclusions concerning the risks we have to prepare for?

First of all, a person who wants to use CB agents for his terrorist action will find in Belgium all sort of opportunities together.

Belgium is not a mega world power and has no intention to become one. The risk that some ethnic groups, driven to a desperate act, will try to kill half the population is almost inexistent. However, we host a lot of international institutions and commercial headquarters that may be subject to terrorist activities.

Beside the almost negligible risk of organised terrorism, we have to consider the same risk as all nations when facing the loner or criminal with a preference for CB weapons.
If CB weapons are used, the choice will depend on local opportunities. If the terrorist wants to use a considerable amount of CWA, the only possibility he has, is to steel it in our stockpile of chemical munitions from World War I. It is far more convenient for him to use industrial chemicals by steeling them from production plants or during transport.

c. Answer

If we agree that the threat comes from loners, mostly with criminal intentions, and foreign organisations aiming at embassies or other international representations, then how can we prepare ourselves for such incidents? We will focus ourselves on the medical discipline, mentioning the other partners only when they influence our way of dealing with the problem.

While preparing our medical first responders, we consider that our worst case is the one where there is no previous warning from the terrorist. To help our people to survive such an incident (as well as a toxic traffic accident for instance), ambulance personnel is trained to make an assessment of the situation from the moment they arrive at the scene: "does this incident looks familiar to me? " is the first question they have to pose themselves when overseeing the incident. If they are not sure about the safety, they must seek advise from the fire-fighters, who are trained for such an assessments.

Leading functions in the medical discipline receive their education and training during the post-graduate course on disaster medicine. In the different modules of this course, intentionally man made disasters – including war and terrorism - are discussed by experts from the police, the fire brigades and the military medical service.

When first responders unexpectedly face a terrorist attack they should have enough knowledge and judgment to limit the damage and to assure the safety of the victims and all those involved. As soon as possible they will be coached by experts who will join the scene if necessary.

The Civil Protection, with permanent mobile units all over the country, has nuclear and chemical detection, decontamination equipment and trained personnel. Every province has a hygiene cell for evaluation of the risk for human health.

The national poison centre is responsible for providing information on the health effects and therapeutic measures to be taken in case of industrial agents.

If CWA are involved, and when civil resources are at an end or not available, the military representative in the co-ordination committee at provincial level is competent to send military decontamination teams or technical experts. The problem is that we have no permanence for this role. However a 24 hoursday service exists for explosives: a team of EOD specialists is always ready to intervene when necessary. On federal level the Governmental Crisis and Co-ordination Centre assures a 24/24 hours duty.

If a certain threat is detected on beforehand those specialists could be assigned to the first responders for a limited time.

This brings us to the delicate point of information and intelligence: our national police has a cell specialised in terrorist threat. It is a division of the Central Board of Tracing in the central headquarter. It is delicate problem because of the international character of our terrorist threat: as mentioned earlier most terrorists encountered in Belgium are imported

ones, as are their problems. Our police experts depend on international cooperation to obtain relevant information on them.

If things really go bad, national coordination of material and intellectual resources will be necessary. In 1950 Belgium created a Commission for National Defence Matters on Governmental level. In different Mixed Committees (COMIX-) civilian representatives of the key ministries and the private sector meet with military experts to find the most appropriate solutions for the crises.

Overlooking our preparation the reader may have the impression that most efforts apply to the tactical level. This is so because of the highly unexpected and hidden character of the terrorist actions we fear. However, another reason is the difference in risk perception that exists between the top and the bottom of the disaster response pyramid. The top level is not at all convinced of the importance of the threat and thus the necessity of an adequate technical and tactical preparedness plan or policy is questioned. This leads to a lack of budget for equipment and training. The question is: why?

3. WHY?

As mentioned earlier the main problem in Belgium is the difference in priority assigned to this problem between the people in the field and the higher authorities. This results in a lack of funding for specific equipment and specialists although these could facilitate the tasks of our first responders and protect them.

We see two main reasons for this misunderstanding:

First there is a technical reason: the idea politicians or laymen have of the scope of NBC: most of them imagine scenes like first World War attacks with chlorine and thousands of casualties or a nuclear bomb explosion on Hiroshima. On the other hand we have the technician who sees the parallelism with the daily accidents or near-misses in industry. A better communication supported by realistic case studies could help us clarify this situation.

A second reason and a more fundamental one is the difference in risk assessment made by the managers and by the technicians or experts.

To explain the fundamentals of this difference would take too long, but it is very well developed in a marvelous book written by Peter Bernstein "Against the Gods" (6). After reading this best seller it becomes clear why people with a different background and different objectives will come to different assessments after analysing (correctly) the same objective facts.

Two major factors assessing the risk of a future incident are its frequency with which it occurs and the importance of the consequences if that incident really happens. In our situation the frequency is very low but the consequences may be very serious.

A fire brigade commander will focus on the consequences because he fears losing control of the situation and having to live with a feeling of guild for all the lives he couldn't safe. The politician, on the other hand, will focus on the frequency because he doesn't want to spent resources on events that will probably never occur during the period he is in charge.

A mathematician could bring the solution because the importance of a risk can be calculated by multiplying the frequency and the importance of the consequences (exemption made for all other minor factors). That is the way insurance companies deal with such incertitude. Unfortunately here we face a situation where the frequency is extremely low and the consequences may be extremely heavy. In such a case no statistical program will be able to come up with a meaningful estimation on the screen of our computer. (5)

Because we didn't want to complicate the situation too much, we didn't include the fact that risk assessment is always based on references from the past, supposing that the environment in the future will be identical to the one in the past. In the case of CB terrorism we only have to refer to the world politics before and after the fall of the iron curtain to prove that this stability is a false assumption.

We hope that this few examples prove to you the complexity of the problem and explains the reason why we don't know where to place CB terrorism on our priority list.
Because we want to end with a positive note, we like to announce that the Belgian chemical industry started a so-called "Product Steward Plan". Aware of the possible misuse one can make of their products the industry will try to trace the possible effects on health and environment of their products, not only during their production but also during their lifetime and after their disposal. Is this a start to a safer world?

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5. KEYWORDS

Terrorism, Belgium, disaster, contingency plan, risk assessment

4. HAZARDOUS WASTE MANAGEMENT TECHNICAL SYSTEMS AS THE ENVIRONMENTAL EMERGENCY RESPONDING SUBSYSTEMS OF CROATIA

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INTRODUCTION

For purposes of this paper, terrorist activity that generates hazardous waste causing changes in the environment is considered an environmental emergency. Certain legislative, institutional, scientific, technological, information and other preconditions exist in the Republic of Croatia that are needed for the functioning of preparedness, response, mitigation and environmental restoration systems for environmental emergencies caused by hazardous wastes. The existing system currently covers the hazardous waste management needs, interests and international obligations of the Republic of Croatia for cases of environmental emergencies only partially. Aiming to improve the situation, a preliminary survey of the current legislative framework has been conducted, relevant data processed, observations recorded, and hazardous waste management technical capacity assessment for cases of environmental emergency made.

SHORT OVERVIEW

Certain technical capacities for hazardous waste collection, storage, treatment and disposal exist in Croatia. The said activities are developing according to economic and environmental principles. To that effect, hazardous waste is considered dangerous goods, and hazardous waste handling activities are considered services in the free market of goods and services. Further, the above activities should be conducted in an environmentally sound and healthy manner. In line with the Environmental Emergency Plan of the Republic of Croatia, legal and natural persons certified for hazardous waste handling are the response units for removal and handling of hazardous waste generated by an environmental emergency. These units are equipped and trained for collection, storage and treatment of only specific hazardous waste types. Only some response units are equipped and trained for *in-situ* environmental clean-up in cases of oil spills, and discharges of some oil derivatives, acids and alkalis. At present, these units do not perform a 24-hour service, but voluntarily respond to phone calls in cases of environmental accidents. A short overview of legislative framework governing this area follows:

- hazardous waste is defined in Appendices I, II, and III of the Law on Ratification of the Basel Convention and contains the substances exhibiting one of the following properties: explosiveness, reactivity, flammability, corrosiveness, irritability, harmfulness, toxicity, infectivity, carcinogenicity, mutagenicity, teratogenicity, ecotoxicity, and the property of releasing toxic gases in chemical reactions or biological decomposition processes,
- hazardous waste is classified according to hazardous features exhibited by the substance which appears in highest quantities and in concentrations above threshold values,
- hazardous waste, apart from originating from a production activity or a service or household, may also be generated by uncontrolled introduction, discharge or disposal of solid or liquid hazardous substances or oil and oil derivatives into the environment,

- legal or natural persons whose actions or processes generate hazardous waste are considered hazardous waste generators,
- hazardous waste generated by uncontrolled discharge, introduction, or disposal of hazardous substances or oil and oil derivatives may cause changes in the environment or environmental emergencies,
- legal and natural persons that have caused changes in the environment by uncontrolled introduction, discharge or disposal of solid or liquid hazardous substances or oil and oil derivatives into the environment are considered environmental polluters,
- terrorist activity generating hazardous waste is considered environmental emergency,
- types, quantities and features of hazardous waste that might be generated as a result of a terrorist activity should be defined by competent experts in the environmental risk assessment procedure,
- in case of an environmental emergency caused by unknown hazardous substances, types, quantities and features of generated hazardous waste should be determined by physical and chemical analyses in certified laboratories, prior to its management.

The Republic of Croatia has prescribed certain environmental damage reduction and mitigation measures. This paper focuses only on the measures important for understanding the functioning of the hazardous waste management systems as terrorist attack responding subsystems. According to the regulations in force:

- hazardous waste shall be handled in such a manner as to avoid human health hazards, hazards for flora and fauna, environmental pollution, uncontrolled disposal and incineration, or possible explosions or fires,
- collection, storage, treatment and disposal of hazardous waste may be conducted exclusively by the legal and natural persons certified for such activities by the decision of the Ministry of Environmental Protection and Physical Planning (MEPPP),
- transport of hazardous waste should be carried out in compliance with the regulations on packaging, labeling and transport of hazardous substances,
- legal and natural persons engaged in collection, storage, treatment, transport or other activities related to hazardous substances or oil and oil derivatives above threshold values, must develop environmental emergency response plans,
- waste generators must determine types, quantities, hazardous features and the related risk-labels for hazardous waste that they generate and for hazardous waste that could be generated in an environmental emergency,
- when there is a risk of accidental soil pollution, pollution of flora and fauna, and of cultural and natural heritage as parts of the man-made environment, hazardous waste management measures should be defined within environmental emergency response plans, in accordance with the Environmental Emergency Plan of the Republic of Croatia,
- in case of an environmental emergency, only legal and natural persons certified for hazardous waste handling may perform environmental clean-up, which consists of the removal and management of hazardous waste generated by discharge, introduction or disposal of a hazardous substance or of oil and oil derivatives,
- environmental polluter that is responsible for the resulting damage should without delay undertake all measures defined in the environmental emergency response plan and cover all costs of environmental clean-up,

- when the polluter is unknown, the competent administrative authority should immediately undertake all measures defined in the environmental emergency response plan and cover all costs of environmental clean-up,
- hazardous waste must be handled in the territory of the Republic of Croatia, if there are adequate facilities for it,
- hazardous waste can be handled in other countries, parties of the Basel Convention, if there are no facilities for it in the Republic of Croatia.

RESULTS AND DISCUSSION

Analysis of the data in the National Register of Legal and Natural Persons Certified by MEPPP for Hazardous Waste Management Activities has been conducted. The analysis has shown that the Register does not contain sufficient data for an evaluation of capacities of the existing hazardous waste management system for responding to environmental emergencies.

The questionnaire has managed to collect additional data. Fundamental databases now contain the following information and data: company title and location of certified activity; name, phone, fax and e-mail of the authorised officer; names and codes of all hazardous waste types handled; available capacities for collection and transportation, available capacities for storage and daily treatment or disposal, according to the operation categories referred to in Annex IV to the Basel Convention. Table 1 is an overview of data gathered from the databases. Tree maps show the dispersion of the existing capacities building for waste management.

Table 1 specifically contains data on built capacities for collection, storage, and recycling/recovery/incineration, according to hazardous waste types generated by different activities. Circles within the maps mark the areas with existing capacities for waste management, with the numbers in circles denoting the number of certified companies.

Analysis of the presented data yield the following results:

- out of 313 hazardous waste types in the Croatian Waste Catalogue and the European List of Hazardous Wastes, collection of 69 hazardous waste types falling in 12 industry groups, storage of 84 hazardous waste types in 15 industry groups, and treatment and disposal of 73 hazardous waste types falling in 15 industry groups are possible in Croatia,
- hazardous waste types that are not listed in this paper can not be handled in the Republic of Croatia,
- maps display an unbalanced distribution of existing facilities around the Croatian territory, being predominantly concentrated in the north part,
- capacities of the hazardous waste management technical system are limited by the hazardous waste types that can be handled, the technical possibilities and their distribution in the Croatian territory.

CONCLUSIONS

In case of an environmental emergency caused by terrorist activity, which could generate hazardous wastes that can be handled in the Republic of Croatia, the wastes in question must be handled within Croatia.

In case of an environmental emergency caused by terrorist activity, which could generate hazardous wastes that cannot be handled in the Republic of Croatia, its collection and temporary storage, and export for treatment in other countries, parties of the Basel Convention must be ensured.

As the capacities of existing facilities are limited by the hazardous waste types that can be handled, the technical possibilities and their distribution in the Croatian territory, the emergency response plans based on the data presented and the potential demand should consider their rational use.

As hazardous waste management emergency response teams are self-sustaining economic entities, their 24-hour service and hazardous waste management service fees should be ensured in accordance with the market principles.

The data presented, combined with the data at the disposal of the Waste Management Department of the Ministry of Environmental Protection and Physical Planning and the data to be obtained from the environmental accident risk assessment, can be used in improving and strengthening the preparedness, response, mitigation and environmental restoration systems for environmental emergencies caused by terrorist activities.

In co-operation with all interested stakeholders, and based on an integrated assessment of environmental emergency preparedness, response, mitigation and environmental restoration systems, one of future priority tasks is improvement of legislative, institutional, technological, safety, information and financial frameworks for capacity building in the management of waste that might be generated during such emergencies.

SUMMARY

The main objective of this paper is the assessment of the possibilities as well as the vulnerabilities of the current hazardous waste management technical system as the environmental emergency responding subsystem. In this paper, terrorist activities as possible sources of hazardous waste are considered an environmental emergency. This paper provides a short review of the relevant legal framework and current national capacities for collection, storage, preparation and disposal of hazardous waste. Certain possibilities as well as vulnerabilities of current capacities in case of a terrorist activity are considered. Further activities for improvement of the current hazardous waste management technical systems as the environmental emergency responding subsystem are proposed.

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2. Law on Waste (*Narodne novine* #34/95)
3. Rule Book on Waste Types (*Narodne novine* #27/96)
4. Environmental Emergency Plan (*Narodne novine* #82/99)
5. Law on Ratification of the Basel Convention (*Narodne novine* - International treaties #3/94)

KEYWORDS

Hazardous waste management, terrorist activities response

Table 1.: Capacities building for hazardous waste management

COLLECTION			STORE-HOUSE			CAPACITIES FOR R/D OPERATIONS		
HR Ident. No EWC No	Capacity m3	%	HR Ident. No EWC No	Capacity t	%	HR Ident. No EWC No	Capacity t/day	%
						02 01 05	3,6	0,10%
05 00 00	13	0,55%						0,00%
05 01 03	30	0,70%	05 01 03	200	1,50%	05 01 03	25	0,72%
05 01 05	38	0,00%	05 01 05	200	1,50%	05 01 05	25	0,72%
		0,73%	05 06 03	200	1,50%	05 06 03	25	0,72%
06 01 01	40	0,73%	06 01 01	60	0,45%	06 01 01	4	0,12%
06 01 02	40	0,73%	06 01 02	60	0,45%	06 01 02	4	0,12%
06 01 03	40	0,73%	06 01 03	60	0,45%	06 01 03	4	0,12%
06 01 04	40	0,73%	06 01 04	60	0,45%	06 01 04	4	0,12%
06 01 05	40	0,73%	06 01 05	60	0,45%	06 01 05	4	0,12%
06 01 99	40	0,73%	06 01 99	40	0,30%			0,00%
06 02 03	40	0,02%	06 02 03	60	0,45%	06 02 03	25	0,72%
07 01 03	1	0,02%			0,00%			0,00%
07 01 04	1	0,00%	07 01 04	200	1,50%	07 01 04	25	0,72%
		0,00%	07 01 08	200	1,50%	07 01 08	25	0,72%
		0,00%	07 02 08	200	1,50%	07 02 08	25	0,72%
		0,00%	07 02 10	200	1,50%	07 02 10	25	0,72%
		0,00%	07 04 04	200	1,50%	07 04 04	25	0,72%
		0,00%	07 04 08	200	1,50%	07 04 08	25	0,72%
		0,00%	07 05 08	200	1,50%	07 05 08	25	0,72%
		0,00%	07 05 10	200	1,50%	07 05 10	25	0,72%
		0,00%	07 06 03	200	1,50%	07 06 03	25	0,72%
		0,00%	07 06 04	200	1,50%	07 06 04	25	0,72%
		0,00%	07 06 08	200	1,50%	07 06 08	25	0,72%
		0,00%	07 07 04	200	1,50%	07 07 04	25	0,72%
		0,18%	08 01 00	200	1,50%	08 01 00	25	0,72%
08 01 01	10	0,18%	08 01 01	10	0,08%			0,00%
08 01 02	10	0,03%	08 01 02	210	1,58%	08 01 02	25	0,72%
08 01 07	1,5	0,40%	08 01 07	200	1,50%	08 01 07	25	0,72%
08 01 10	22	0,00%			0,00%	08 01 10	9	0,26%
		0,00%	08 03 01	200	1,50%	08 03 01	25	0,72%
		0,00%	08 03 02	200	1,50%	08 03 02	25	0,72%
		0,00%	08 03 05	200	1,50%	08 03 05	25	0,72%
		0,51%	08 03 06	200	1,50%	08 03 06	25	0,72%
08 03 08	28	0,00%	08 03 08	200	1,50%	08 03 08	9	0,26%
		0,00%	08 04 02	200	1,50%	08 04 02	25	0,72%
		0,00%	09 01 01	200	1,50%	09 01 01	25	0,72%
		0,27%	09 01 02	200	1,50%	09 01 02	25	0,72%
10 01 04	15	0,16%	10 01 04	200	1,50%	10 01 04	25	0,72%
11 01 00	9	0,73%			0,00%	11 01 00	9	0,26%
11 01 05	40	0,73%	11 01 05	60	0,45%	11 01 05	4	0,12%
11 01 06	40	0,73%	11 01 06	60	0,45%	11 01 06	4	0,12%
11 01 07	40	0,00%	11 01 07	60	0,45%	11 01 07	4	0,12%
		0,09%			0,00%	11 04 00	6,5	0,19%
11 01 08	5	0,24%	11 01 08	5	0,04%			0,00%
12 00 00	13	0,04%			0,00%			0,00%
12 01 09	2	0,73%	12 01 09	200	1,50%	12 01 09	27	0,78%
12 01 06	40	0,73%	12 01 06	40	0,30%			0,00%
12 01 07	40	0,73%	12 01 07	40	0,30%			0,00%
12 01 10	40	0,09%	12 01 10	40	0,30%			0,00%
12 01 12	5	0,73%	12 01 12	205	1,54%	12 01 12	25	0,72%
12 03 01	40	0,73%			0,00%	12 03 01	10	0,29%
12 03 02	40	0,27%			0,00%	12 03 02	10	0,29%
13 00 00	15	0,73%	13 00 00	138	1,04%	13 00 00	709	20,47%
13 01 01	40	0,00%	13 01 01	40	0,30%			0,00%
		0,04%	13 01 02	40	0,30%			0,00%
13 01 03	2	0,73%	13 01 03	240	1,80%	13 01 03	25	0,72%
13 01 04	40	0,00%	13 01 04	240	1,80%	13 01 05	25	0,72%
		0,73%	13 01 07	200	1,50%	13 01 07	25	0,72%
13 01 08	40	2,02%	13 01 08	40	0,30%			0,00%
13 02 00	110	0,73%	13 02 00	50	0,38%	13 02 00	1084,5	31,32%
13 02 01	40	4,20%	13 02 01	40	0,30%			0,00%
13 02 02	229,4	1,12%	13 02 02	638,2	4,80%	13 02 02	56,7	1,64%

COLLECTION			STORE-HOUSE			CAPACITIES FOR R/D OPERATIONS		
13 02 03	61	0,73%	13 02 03	69,7	0,52%	13 02 03	25,25	0,73%
13 03 01	40	0,73%	13 03 01	200	1,50%	13 03 01	25	0,72%
13 03 02	40	0,73%	13 03 02	40	0,30%			0,00%
13 03 03	40	0,90%	13 03 03	360	2,71%	13 03 03	27	0,78%
13 03 04	49	0,73%	13 03 04	60	0,45%			0,00%
13 03 05	40	1,10%	13 03 05	40	0,30%			0,00%
13 04 00	60	0,64%			0,00%			0,00%
13 05 00	35	0,18%	13 05 00	35	0,26%	13 05 00	10	0,29%
13 05 01	10	9,71%			0,00%			0,00%
13 05 02	530	0,73%	13 05 02	200	1,50%	13 05 02	95	2,74%
13 05 05	40	1,93%	13 05 05	240	1,80%	13 05 05	25	0,72%
13 06 01	105,6	0,00%	13 06 01	240,64	1,81%	13 06 01	35,002	1,01%
		0,73%	14 01 02	200	1,50%	14 01 02	25	0,72%
14 01 03	40	0,73%	14 01 03	200	1,50%	14 01 03	25	0,72%
14 01 04	40	0,73%			0,00%			0,00%
14 01 05	40	0,00%			0,00%			0,00%
		0,03%	15 02 99	11	0,08%			0,00%
16 02 01	1,5	0,00%	14 02 03		0,00%	14 02 01	0,6	0,02%
		0,35%	14 02 03	200	1,50%	14 02 03	25	0,72%
16 06 00	19	4,27%	16 06 00	2	0,02%			0,00%
16 06 01	232,8	0,03%	16 06 01	0,8	0,01%			0,00%
16 06 02	1,5	0,08%			0,00%			0,00%
16 06 06	4,16	11,91%			0,00%			0,00%
16 07 02	650	0,73%	16 07 02	450	3,38%			0,00%
16 07 03	40	0,73%	16 07 03	240	1,80%	16 07 03	35	1,01%
16 07 04	40	0,73%			0,00%			0,00%
16 07 05	40	34,12%			0,00%			0,00%
16 07 06	1862	0,00%	16 07 06	280	2,10%	16 07 06	155	4,48%
		0,00%	18 01 03	200	1,50%	18 01 03	25	0,72%
		0,00%	18 02 02	200	1,50%	18 02 02	25	0,72%
		0,00%	18 02 04	200	1,50%	18 02 04	25	0,72%
		0,21%	19 01 00	200	1,50%	19 01 00	25	0,72%
19 02 01	11,5	0,82%			0,00%			0,00%
19 08 03	45	0,00%			0,00%			0,00%
19 08 06		0,00%			0,00%			0,00%
		0,09%	19 02 01	10	0,08%			0,00%
20 01 12	5	0,27%			0,00%			0,00%
20 01 13	15	0,00%			0,00%			0,00%
		0,00%	19 08 06	210	1,58%	19 08 03	25	0,72%
		0,00%	20 01 00	200	1,50%	20 01 00	25	0,72%
		0,00%	20 01 09	200	1,50%	20 01 09	25	0,72%
		0,00%	20 01 12	205	1,54%	20 01 12	25	0,72%
		0,00%	20 01 13	215	1,62%	20 01 13	25	0,72%
		100,00%	20 01 19	200	1,50%	20 01 19	25	0,72%
	5457,96			13305,34			3499,152	

5. TOWARDS EFFECTIVE CRISIS COMMUNICATION: AN ANALYSIS OF MANAGEMENT INHIBITORS AND FACILITATORS

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ABSTRACT

Effective communication is key for the successful management of chemical or biological accidents or threats (terrorism). Given the devastating destructive potential of chemical and biological warfare agents to both mankind and the environment, they are always a concern that requires immediate attention, coordination and response from a number of different stakeholders. In a time constraining situation, however, there are several inhibitors that may block or disrupt the flow of communication, and which potentially increase the likelihood of disaster of large scale. This paper, using a crisis communication model, looks at some effects of crises on organizations and how they, in turn, affect the critical issue of communication during a crisis.

INTRODUCTION

Studies on organizational behavior in critical times currently under way at the Centre for Marine and Earth Sciences and Technologies, SC, Brazil, suggest that organizational effectiveness in crisis prevention and management is often compromised due to a combination of factors. Apart from factors already identified and well documented in the literature, such as the culture of the organization and their core believes (1) (2) (3) (4) (5), the approach to both internal and external communication (6) (7), it has been identified that more fundamental and some how elementary issues are driving organizations into creating further aggravation to their operations. One critical issue revealed by the studies is that organizations are often unable to define and state problems. Although most of the organizations studied seem to be efficient in identifying organizational, operational and structural problems, stating and communicating efficiently these problems to both internal and external interest publics have been quite another matter.

The way organizations define a problem has a direct correlation to how it is going to approach it in both formal and informal ways. Moreover, a definition of a problem tells as much about the phenomenon being defined as about the definer itself. Thus, it is an important management issue that has been largely overlooked. The net result of this neglected management issue is that organizations have developed a disturbing pattern: the ability of generating further crises by responding to critical events, even though in many cases the solutions are practically correct. Where these patterns were observed, two situations were predominant: (1) the application of the right solution to the wrong problem, and (2) the application of the wrong solution to the right problem.

Research conducted by Wieck in the 1980s (8) (9) may partially explain this organizational dysfunction. Weick argues that when the variety that exits in the system to be managed exceeds the variety in the people whom must control it we have a problem of "Requisite Variety". That is, when people have less variety than is requisite to cope with the system, they miss important information, their diagnoses are incomplete, and their remedies are shortsighted and can magnify rater than reduce or eliminate a problem.

The potential destructive effect of chemical and biological terrorism attacks provides an enormous challenge to the central core of management. Organizations, therefore, should

provide answers to three essential questions: (a) what role management plays in the incubation of crisis potential?; (b) what role management plays in the prevention and management of crisis events?; (c) why do many organizations and managers still deal with the issue of crisis in a superficial manner? Inherent to all these questions there are the critical issues of problem identification, definition, and organizational communication. This paper argues that the definition of a problem plays a key role in crisis management and resolution. Moreover, it addresses several organizational and situational inhibitors that may block or disrupt the flow of communication, which may potentially increase the likelihood of further disasters. The paper also identifies some facilitating organizational issues that enhance management abilities to function effectively in critical times.

PROBLEM DEFINITION

Crises occur as a consequence of the dysfunctional nature of organization's culture, core beliefs, values and basic assumptions of decision markers and the approach taken to both external and internal communication (10) (11). A crisis evolves through a pattern of different phases, each with its own distinct features and dynamics, that demands specific management approaches (12) (13). Since the status of a crisis (intensity, scope, effects on stakeholders, etc.) changes as it develops within each phase, the various stakeholders involved in managing the crisis need to be constantly informed of crisis status so that they could act (decision making) in a concerted and effective way. Communications, then, play one of the most important roles in the process of administering and resolving crises. The effectiveness of strategy implementation, however, depends on basic organizational procedures, such as problem identification and definition. While several mechanisms, both organizational and technological, have been developed and used successfully by organizations worldwide, it seems that stating and defining a problem is far more difficult for organizations.

Defining an issue is an extremely important, tough complex, task. The way one defines a particular problem necessarily implies in the way the problem will be approached by the organization and all the management issues that would be involved in trying to resolve it. Considering the potential destructive effect of chemical and biological terrorism attacks, defining a particular event (threat or attack) poses an enormous challenge to organizations since it will dictate the way the organization will deal with the problem. That is, manage all the prevention, preparation, and management issues of a possible attack.

How do we define Bio/Chem Terrorism?

- By its causes?
- By its consequences?
- By its degree of unpredictability?
- By the means of attack?
- By the speed of onset?
- By the type of substance used?
- By its intrinsic characteristics?
- By its degree of severity?
- By its political implications?
- By typology?
- Etc.

Individually or in combination, there are several significant management implications.

DECISION-MAKING DURING CRISES AND ORGANIZATIONAL COMMUNICATION – INHIBITORS AND FACILITATORS

Decision making is an integral part of crisis management process (14). The quality of decision depends greatly upon the quality of information available to the decision process which in turn depends on how and when (timing) it is communicated to the decision making person or team. That is, if communication is not effective and timely, quality information is of no use or value. Communication is regarded as the "essence" of crisis management. Without a well conceived and implemented communication system chaos reign. There are, however, many factors that may constrain communications in times of crises.

A typical feature of crisis is information overload. The quality of information input into the decision process depends on the ability of the system to effectively absorb information flow, thus preventing overloads. Information overload results in dysfunctional selective attention, retention of information, and delays and subversion of communication flows. Information overload and the need to act quickly cause decision makers to use fewer communication channels for the collection and dissemination of information. Limiting the search for information can be disastrous. Divergent searching increases the variety and quantity of alternative solutions, and is essential in poorly structured circumstances in which fluency and flexibility of thought are vital.

When communication is not effective, the information content of the messages is frequently distorted because intermediate message-handling units omit, delay, filter, and most often process incorrect information. As a result, the decision group not only has fewer creative solutions available to it, but it is also more likely to fashion flawed solutions from the information they have.

CB crises invariably exert a great amount of emotional and psychological pressure on decision makers. During a CB crisis stress is of such magnitude that it promotes dysfunctional behavior. An increasingly severe crisis tends to make creative policy both more important and less likely. Decision makers find it harder to reason abstractly and are also less able to predict the consequences of various alternative courses of action. All this contributes to a restricted and distorted understanding of the decision situation. As a result, unaided crisis decision makers tend to make and implement inferior decisions.

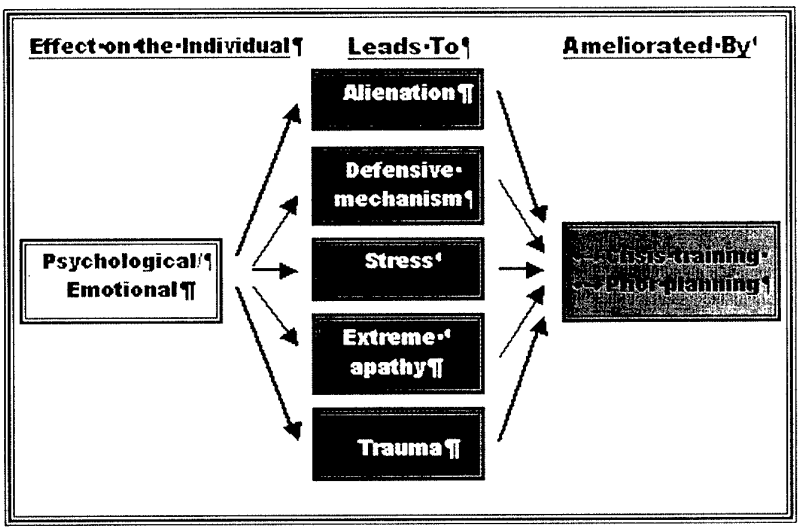

Figure 1

In this scenario, open communications channels and quality information are the only hope for a positive outcome. Effective internal communication enables management to make sound decisions and be in control of the situation whilst effective external communications allows management to tell their history avoiding rumors and pseudo experts accounts. The net results are often a faster resolution of crisis, less internal anxiety and higher commitment to crisis management, less speculation and scrutiny from various external publics, among others.

Communications during crisis differ substantially from communications in "normal times". Those involved or responsible for dealing with CB threats and crisis need to have in place specially designed communication strategies and structure for managing adverse situations. It is virtually impossible to learn about crisis communications or to invent things in the heat of a crisis. As crisis evolves, each phase requires different management treatment and approaches. The amount of attention given to each particular issue is clearly an strategic decision of the organization and each decision taken will inevitably reflect on the status of crisis and on its resolution potential.

Effective crisis management starts well before an issue erupts into a full blown crisis. Indeed, it is much safer to manage the symptoms than the chain of complications resulted from a crisis. Communications, then, plays a vital role in crisis prevention. Most major crises to date (including some well-publicized CB crises) could have been prevented if the organizations involved had in place effective communication systems. Communication system in this sense means both formal and informal communications. As mentioned previously, organizations, depending on the nature of their culture and core beliefs, have a high potential for crisis incubation. Therefore, understanding and de-codifying the unwritten organizational rules and norms seems to be of crucial value for crisis prevention and management. If an organization has a crisis-prone culture, the incubation of crisis will occur as a function of the strategic decision-making that takes place within the organization and the failure of management to identify and acknowledge the limitation of its control mechanisms. A crisis-prone culture inhibits communications that, in turn, severely weakens management's ability to develop resilience within the system. In another words, it deprives an organization from the essential abilities and mechanisms needed for developing preventive measures and strongly influence the psychological, emotional, and technical abilities of its member to manage the crises that occur.

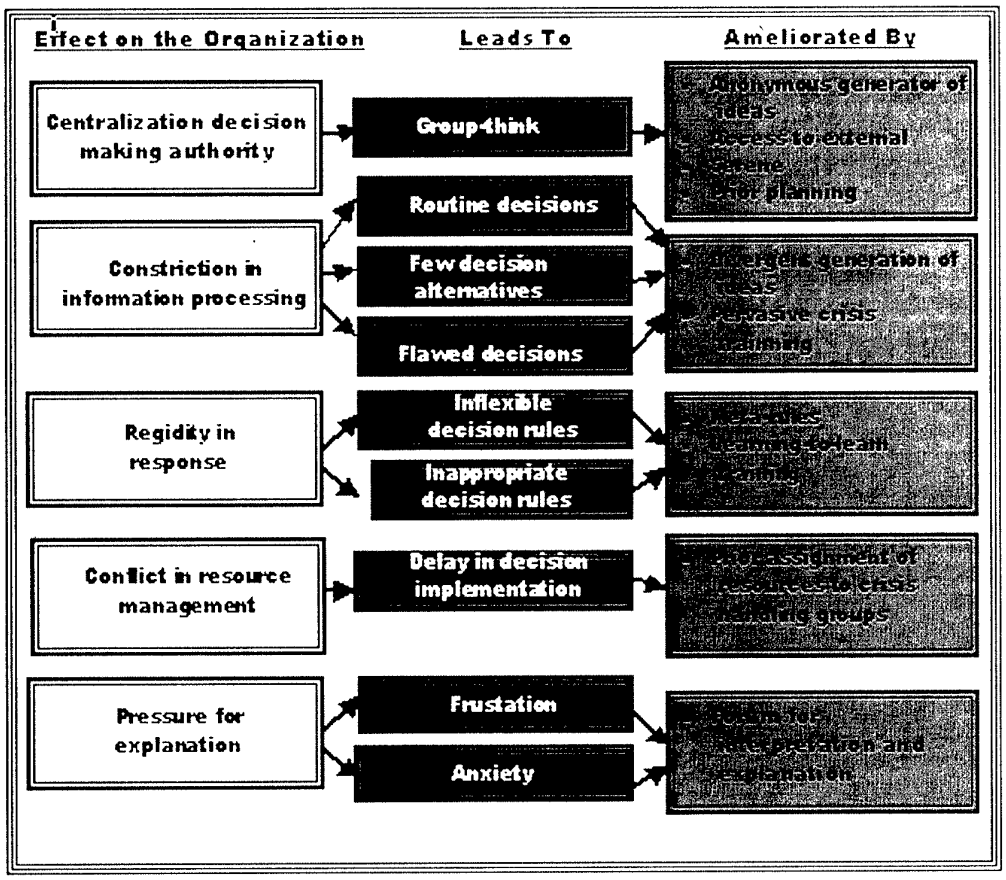

Figure 2

Considering the evolutionary nature of a crisis, a communication model that contemplates all phases of a crisis has been developed. The model proposes that open lines of communications should be established to and from the environment. The effectiveness of crisis management depends not only on the efficiency of the formal and informal communication structures but also on the organization's ability and capacity to absorb, filter, process, manage, and implement strategies based on the information received.

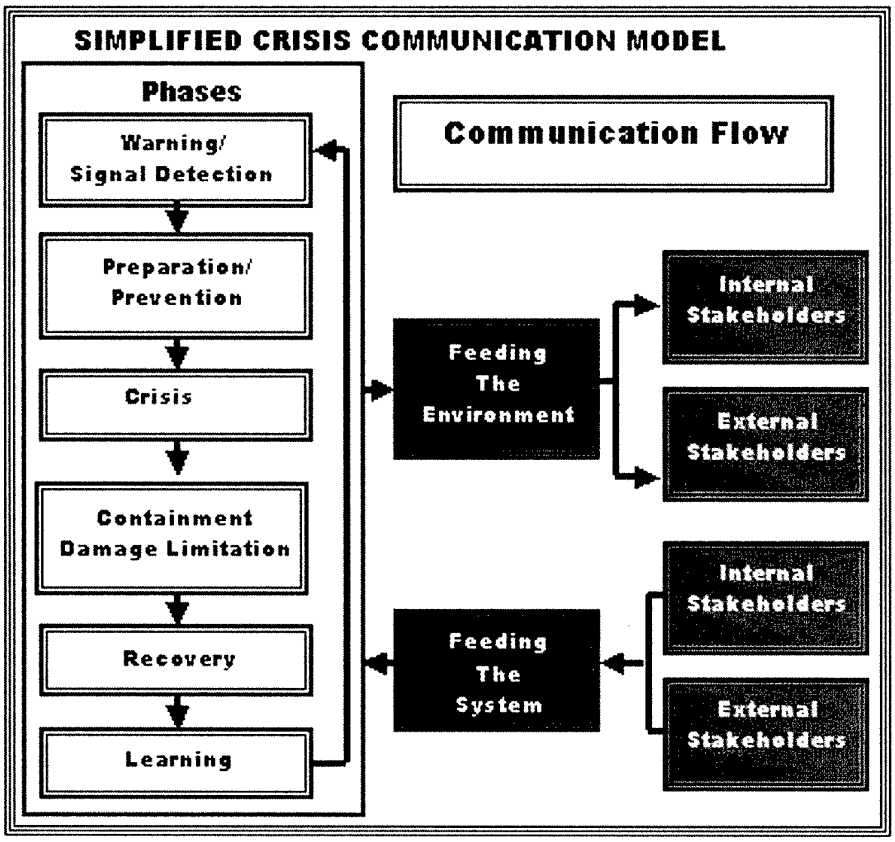

Figure 3

Crisis communication training is essential. CB crises invariably arouse a great deal of emotions and scrutiny from all sectors of society is unavoidable. Different stakeholders require a different set of information to satisfy their particular interests or concerns. The establishment of a crisis management communication center is imperative.

CONCLUSION

Effective crisis management starts with problem identification and definition. Organizational studies in Brazil revealed that despite the fact that organizations are becoming increasingly efficient in identifying problems in both their operating environment and systems, they have difficulties in defining, stating and communicating them. This has resulted in the implementation of inappropriate strategic decisions, which in turn generated further crises.

Prevention and management of crises depends on the effectiveness of communications. Communications and management inhibitors emanate from the characteristics of crises themselves (information overload, etc.), from the limited complexity of system operators (requisite variety), from the consequences of crises on both the organization and on the individuals (psychological and emotional toll). In order to enhance management's abilities to deal with crises it is necessary to understand how crises behave in each phase of its life cycle and what role communications plays in each individual phase. This paper examined the role communications (formal and informal) play in times of crisis,

emphasizing its importance for effective decision making for crisis prevention and in averting further chaos. Facilitating factors have also been identified and explored.

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KEYWORDS

Problem definition, crisis management, crisis communication, stakeholder, crisis communication model

FIGURES

Figure 1 – The Consequences of Crisis at a Psychological and Emotional Levels
Figure 2 – The Consequences of Crisis at an Organizational Level
Figure 3 – A Simplified Crisis Communication Model

6. ANALYSIS OF THE HI-6, HS-3 and HS-6, INFLUENCE ON THE LIVER METHABOLIZING ENZIME SYSTEMS

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INTRODUCTION

At the present stage of the therapy and prophylactics of the poisonings with organophosphorous compounds (OPC), the reactivators of the cholinesterase take an important place. However, the application of these compounds is always combined with some other drugs. Therefore, it is necessary to know the possibilities for influence of the drug metabolism by the reactivators, as well their own metabolism and pharmacokinetics. This type of research is very necessary, when the newly synthesized compounds are concerned. Our research has shown that the classical reactivator of the cholinesterase Toxogonin, causes decrease of microsomal ethylmorphin N-demethylation activity, which probably was connected to the coincident loss of cytochrome P450 (Dishovsky, et al, 1989). The reactivators TMB-4 (Trimedoxime) and Diethyxime, have a similar effect (Dishovsky, et al, 1990). In this relation, the aim of the present work was to follow changes in liver drug metabolism after in vivo treatment with some H-Oximes – HS-3, HS-6 and HI-6, which are reactivators of the cholinesterase. This is necessary, in order to optimize the conditions for the application of these antidote compounds during the therapy and prophylactics of the OPC intoxications.

MATERIALS AND METODS

The experiments were performed on male albino Wister rats weighting 160-180 g. The animals were divided in groups of five. They were treated with the following cholinesterase reactivators: HS-6, HS-3 and HI-6. Each reactivator was injected i.m. in two different doses – 20 mg./kg. b. weight and 0,25mmol/kg b. weight for three different time intervals – 2nd, 24th hour after the injection and with the same dosages, injected daily, after three days. For hexobarbital sleeping time studies, animals were injected i.p. With 100 mg. b. weight hexobarbital, 30 min, after the injection of the reactivators.

For the biochemical studies rats were sacrificed and the livers were perfused with iced physiological solution, homogenized in isotonic solution of KCl (0,05M Tris-HCl, pH=7,4) and microsomic fraction was separated. The following parameters were measured:

- ethylmorphin N-demethylation activity (EMD) by the method of Nash (1953);
- aniline hydroxylation activity (AH) – by the method, modified by Mazel (1971);
- amaunts of cytochrome b5 and P-450 (Omura and Sato, 1964);

The protein content in microsomes was determined after Lowry et al. (1951) procedure. Results were statistically processed by Student's T-test.

RESULTS AND DISCUSSIONS

On Table 1 are presented the results from the effect of the researched cholinesterase reactivators on the length of the hexobarbital sleep of rats treated with 2 doses of the compounds and during various time intervals.

It was found that HS-3 shows tendency toward shortening of the sleeping time of the rats, when the observed interval was 2 hours. HI-6 - 0.25 mmol/kg dose also cause shortening of the hexobarbital sleep, while on the 72nd hour the two doses had a tendency toward a sleep time, longer than the control group. It was also found that the two applied HS-6 doses on the

2nd and 24th hour after the i.m. application did not show any statistically reliable influence on the length of the hexobarbital sleep in comparison with the respective control group.

The results of the research of the in-vivo injected cholinesterase reactivators effect on some parameters of the liver is shown on the following tables. On table 2 is shown the effect of the reactivators of the cholinesterase on the activity of the microsomal mixed function monooxygenases. The observation times were 2 hours after the application of a dose of 0.25 mmol/kg, b. weight. The experiment showed that neither of the researched reactivators of the cholinesterase had an effect on the liver drug metabolism on the 2nd hour after the application of the reactivator.

On the Table 3 is shown the effect of HS-6 and HS-3 on the monooxigenase activities enzyme on the 24th hour after the application of the compounds in a does of 0.25 mmol/kg b. weight. The experiment showed that 24 hours after its application HS-3 caused decrease of the activity of AH compared to the control group. Neither of the two observed cholinesterase reactivators had a major influence on the rest of the researched parameters.

On Table 4 is shown the effect of the researched compounds on the liver drug metabolism after a daily application of the reactivators for a three-day period in a dose of 0,25 mmol/kg. b. weight. The conclusion was that the HI-6 decreases to a large extent the activity of the AH.

In an enzyme-dependent metabolic transformation of the oximes (primarily in the liver) took part various enzyme systems. Our experiment data showed that even indirectly, the cytochrome P-450 system in the liver (of the experimental animals) was taking part in the metabolism of the oximes, or at least it was changing under the influence of the oximes and their metabolites.

Our results showed that the effect of the researched reactivators of the cholinesterase on the length of the hexobarbital sleep, microsomal mixed function monooxygenases and the quantity of the cytochrom P-450 and cytochrom b5, is a complex/multilevel process, and depends on the type and dose of the reactivator of the cholinesterase and the time of application. In general, the observed compounds showed tendency toward shortening of the hexobarbital sleep on the 2nd hour after their application. They do not change or lengthen it on the 24th hour, and they lengthen it after a 3-day treatment. The researched oximes – HS-6, HS-3 and HI-6, after application of various doses during later time intervals - 24 hours and mostly after the 3rd day of treatment, lead to suppression of the metabolism of some test-substrates of the cytochrome system, such as aniline. The conclusion is that most probably this is due to the effect of some of the metabolites of the above mentioned oximes, since it is well known also from the literature that the oximes are eliminated very quickly by the organism and this is done through metabolism.

SUMMARY

The reactivators of the ChE activity are almost always used with other drugs. Our previous research showed that toxogonine changes the liver drug metabolizing enzyme systems. We conducted investigations on Wister white male rats with b. weight 160-180g. (n=150) We made the analysis on the 2nd and 24th hour with HS-3, HS-6 and HI-6 with dosage 0,25 mmol/kg and 20 mg/kg b. weight i.m., as well as after three-day application of the same dosages.

Our results showed that the effect of the researched reactivators of the cholinesterase on the length of the hexobarbital sleep, microsomal mixed function monooxygenases and the quantity of the cytochrom P-450 and cytochrom b5, is a complex/multilevel process, and depends on the type and dose of the reactivator of the cholinesterase and the time of application. In general, the observed compounds showed tendency toward shortening of the

hexobarbital sleep on the 2nd hour after their application (HS-3 and HI-6). They do not change or lengthen it on the 24th hour, and they lengthen it after a 3-day treatment (HI-6). The researched oximes – HS-3 and HI-6, after application of various doses during later time intervals - 24 hours and mostly after the 3rd day of treatment (HI-6), lead to suppression of the metabolism of some test-substrates of the cytochrome system.

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KEY WORDES

H-oximes, HI-6, reactivators of ChE, liver, methabolizing enzime systems

FIGURES AND TABLES

Table 1. Effect of reactivators of ChE HS-3, HS-6, HI-6 on the hexobarbital sleeping time in male Wistar albino rats

	Sleeping time (min)		
	2 hours	**24 hours**	**72 hours**
Controls	24,00±6,70	20,00±4,90	
HS-6 (20 mg/kg)	25,20±8,00	24,20±5,21	
HS-6 (0,25 mmol/kg)	30,50±7,70	27,30±8,50	
Controls	26,50±3,70	22,00±0,63	
HS-3 (20 mg/kg)	18,30±1,33	23,00±1,79	
HS-3 (0,25 mmol/kg)	16,30±1,26*	25,60±1,69±	
Controls	23,80±1,32	23,00±0,41	17,70±2,00
HI-6 (20 mg/kg)	25,00±1,71	23,80±2,81	24,40±1,61*
HI-6 (0,25 mmol/kg)	18,00±1,30*	23,00±3,10	25,00±2,20*

* P<0,05

Table 2. The effect of 0,25 mM/kg b. weight HS-3, HS-6 and HI-6 on some rat liver microsomal parameters (2 hours after treatment)

	EMD nmol/mg.min	**AH nmol/mg.min**	**P450 nmol/mg**	**b5 nmol/mg**
Controls	2.24±0.11	0.235±0.015	0.44±0.05	0.21±0.05
HS-6	2.05±0.35	0.179±0.025	0.38±0.09	0.15±0.09
Controls	4.40±0.45	0.605±0.018	0.78±0.05	0.57±0.06
HS-3	3.93±0.35	0.723±0.019	0.66±0.08	0.38±0.06
Controls	2.45±0.19	0.149±0.01	0.43±0.01	0.17±0.02
HI-6	2.77±0.13	0.158±0.01	0.47±0.03	0.15±0.02

Table 3. The effect of 0,25 mM/kg b. weight HS-3 and HS-6 on some rat liver microsomal parameters (24 hours after treatment)

	EMD nmol/mg.min	**AH nmol/mg.min**	**P450 nmol/mg**	**b5 nmol/mg**
Controls	1.66±0.52	0.223±0.030	0.31±0.08	0.25±0.05
HS-6	1.90±0.31	0.230±0.032	0.38±0.09	0.33±0.06
Controls	3.96±0.41	0.545±0.024	0.84±0.07	0.42±0.03
HS-3	4.50±0.21	0.428±0.019*	0.99±0.05	0.52±0.01

Table 4. The effect of 0,25 mM/kg b. weight HS-3 and HI-6 on some rat liver microsomal parameters (3 days treatment)

	EMD nmol/mg.min	**AH nmol/mg.min**	**P450 nmol/mg**	**b5 nmol/mg**
Controls	4.97±0.66	0.508±0.009	0.54±0.04	0.30±0.03
HS-3	5.15±0.29	0.493±0.034	0.56±0.03	0.35±0.04
Controls	4.25±0.47	0.185±0.010	0.47±0.04	0.19±0.04
HI-6	3.33±0.21	0.064±0.070*	0.43±0.03	0.26±0.02

* $P<0.05$

7. CHEMICAL AND BIOLOGICAL TERRORISM: A BRAZILIAN PERSPECTIVE

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ABSTRACT

While several regions in the world suffer the increase of terrorism threat of both "conventional" or chemical and biological nature, Brazil has been largely immune to such situation. This paper analyses the Federal Government's position in relation to chemical and biological terrorism and assesses the current prevention and response capability to such an event.

INTRODUCTION

While the process of globalisation has promoted constructive global and political alliances, it has concurrently advanced the activities of, and alliances among, transnational terrorists, organised crime enterprises, and extremist groups of every conceivable type. These "threat alliances" have formed transnational cooperatives with immense global financial and human resources. Moreover, national, regional, and international security issues are of quite a different nature from those that the world has been dealing with for decades. The post Cold War era presents a different, diversified and more threatening range of security issues that places large civilian populations in direct danger. Today, new security issues have supplanted traditional ones (e.g., force balances, deterrence, etc.) and one of the main threats comes from the spread of conventional and non-conventional weapons and terrorism. South American countries present the right conditions for the organization of terrorism groups and action. In fact, most countries in region have a history of terrorism. Despite the fact that several of these conditions, such as high unemployment and lack of opportunity, chronic economic problems, political instability, civil unrest, famine and disease, environmental problem, and others, were present in Brazil for decades, the country has no history of terrorism. This paper examines the Brazilian perspective on Bio/Chem terrorism.

GLOBALISATION AND NATIONAL SECURITY - A BRIEF OVERVIEW

Globalisation can be broadly defined as the process of softening geopolitical boundaries, favouring relatively unrestricted travel, commerce and communication of all types. The process of globalisation has, directly or indirectly, involved all sectors of the global economy and no country can avoid it. While transnational companies and a few countries benefit enormously from the gains of "playing" on a global scale, some nations experience just the opposite. A study conducted by Boxberg and Klimenta (1999) (1) reveals a sinister side of globalisation, with endemic unemployment in a growing number of countries, criminal exploitation of the finite natural resources of emerging and underdeveloped countries, a concentration of financial resources, and weakening of national state.

This irreversible process has also favoured the activities of groups that promote terror and has permitted others the access to destructive technologies that are today threatening national and regional security. Moreover, in the aftermath of the Cold War, states and other groups began to have unlimited access to conventional weapons, weapons of mass destruction, and communications technologies.

TERRORISM: DEFINITIONS, PATTERNS AND CAUSES

Definitions of terrorism have not gained universal acceptance. The US Department of State has provided some definitions of terms that are generally used and applied when terrorism is discussed. For the US Department of State the term "terrorism" means "premeditated, politically motivated violence perpetrated against noncombatant targets by sub national groups or clandestine agents, usually intended to influence an audience." The term "international terrorism" has been defined as "terrorism involving citizens or the territory of more than one country" and the term "terrorism group" as "any group practicing, or that has significant subgroups that practice, international terrorism" (1999).

Although the amount of international terrorism has been falling consistently since the mid 1980's, the threat of terrorist acts is increasing. The reduction in the number of attacks can be largely attributed to progress in law enforcement measures and diplomatic efforts around the world. The total number of terrorist attacks in 1998 was 273, a reduction from the 304 attacks registered in 1997, and the lowest annual total figure since 1971. However, the number of fatal victims in 1998 was 741, a record high, and the number of injured reached 5,952 (2). The most prominent attacks in 1998 were the bombings in August of the US Embassies in Nairobi, Kenya and Dar as Salaam, Tanzania. The attack in Kenya helped to increase significantly the number of fatal victims and injuries. The US Embassy in Nairobi was located in a highly congested area and as a result of the explosion 291 people died and about 5,000 were wounded.

Terrorism is not a new phenomenon and has been used as a political weapon in virtually all parts of the globe. Sendero Luminoso (Peru), the IRA (Northern Ireland), the ETA (Basque Separatist Group - Spain), the Red Brigade (Italy), the Fundi (Algeris), the Abu Nidal Organization (Iraq), the Hizballah (Lebanon), and the Khmer Rouge (Cambodia), are just a few examples of some well established groups. The causes of terrorism, or what leads to the organisation of terrorism groups, are many and diversified. Terrorism root causes have been attributed to religion fanaticism, political instability, chronic economic problems, famine and disease, environmental problems, demography (over population), lack of opportunities, civil unrest, wars and guerrillas, among others. All these issues can contribute or trigger the organisation of terrorist groups and action. The globalisation process, as discussed previously, provides the right conditions and environment for terrorism to flourish and become more deadly.

TERRORISM: A BRAZILIAN PERSPECTIVE

It is interesting to observe that Brazil, a country that presents several of the above "conditions", has been largely immune to terrorism. The largest country in South America has a near clean sheet in respect to terrorism. The dictatorial military regime that ruled the country between 1964 and 1985 registered a few cases of terrorism. As it turned out, most attacks were attributed to the regime itself. Apart from a few episodes during this dark period, the country has no history of terrorism.

The fact that terrorism has been largely regarded as a non-priority security issue does not mean that the country is completely immune to terrorism activities. There are a number of South American neighboring countries that suffer from terrorism activities such as Colombia (FRAC - Revolutionary Armed Forces of Colombia), Peru SL (Sendero Luminoso) and the MRTA (Tupac Amaru Revolutionary Movement), Chile (the Manuel Rodriguez Patriotic Front) just to name a few. The main governmental concern has been with the use of the Brazilian territory by those groups to carry out several illicit activists such drug and arms smuggling to support their causes. The recent United States presence in Colombia has driven both drug lords and terrorists into the Brazilian Amazon forest. This region is virtually

uninhabited and almost impossible to control due to its continental dimensions and inhospitable conditions. There are thousands of kilometers of jungle that borders with other countries.

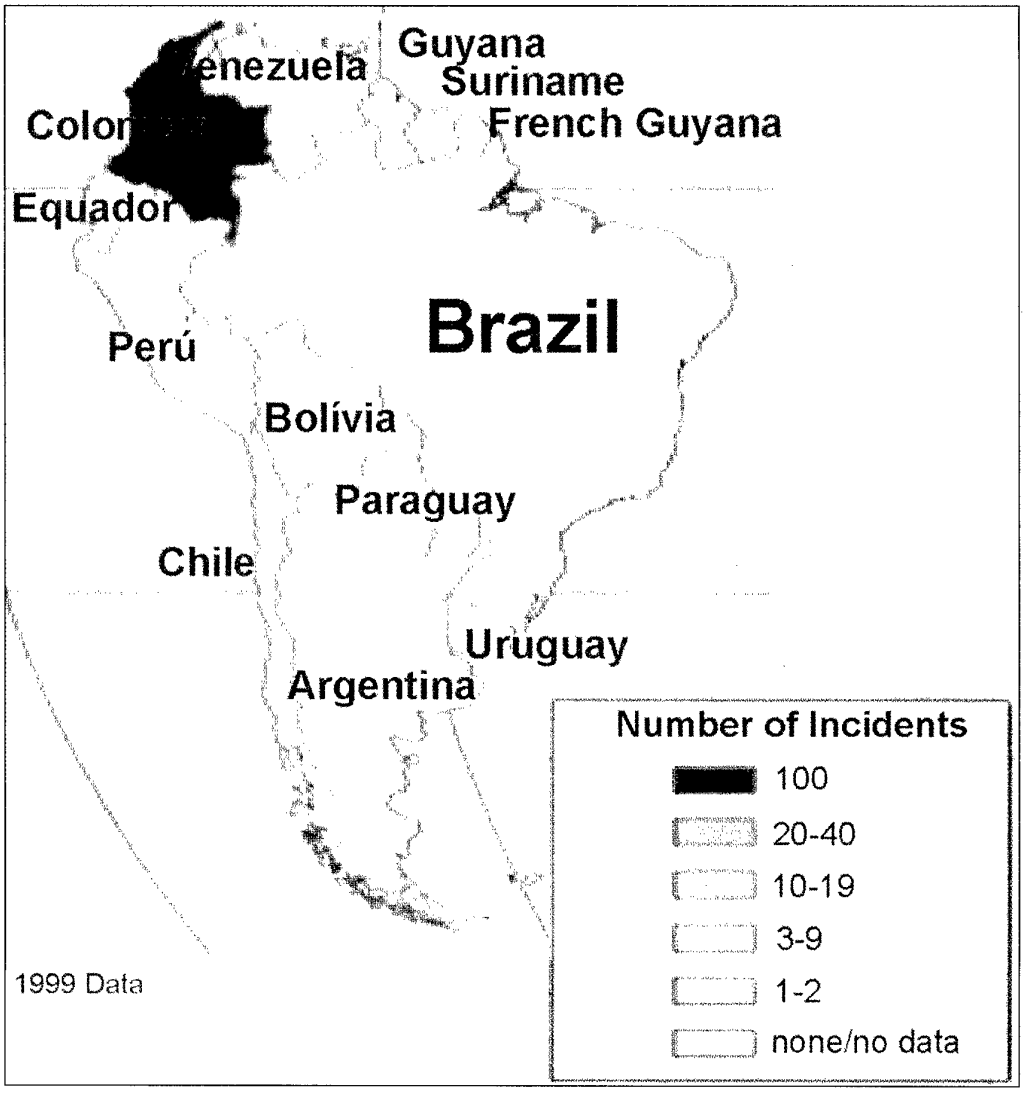

Figure 1 - South American Map

The opening of the borders with other Mercosul (Southern Common Market) member states (Paraguay, Uruguay and Argentina) has also contributed to the free flow of both goods and people. It is now known that both the Chinese and Russian mafias are well established in the country and has been involved in several cases of arms smuggling to and from regions that host terrorism groups in neighbouring countries. Hate groups has emerged in the last decades in some parts of the country and their activities involve attacks to both properties and individuals. The Brazilian land reform movement (MST) has carried out hostile manifestation against governmental and private properties, including cutting power towers, which have caused blackouts in large industrial and residential areas for several days. Considering that the Brazilian Government has been unable to inhibit objectively any of the above recent

trends in violence and illicit activities, it is not impossible to envisage any of the groups above applying terrorism tactics. Indeed, the escalation of violence in large cities such as Rio de Janeiro, São Paulo, Recife and others, has reached a guerilla status. Criminals are better equipped than the police forces and have been using grenades and explosives in their activities. These incidents would be characterized in other countries as terrorism, but the term has not yet been used in Brazil.

The responsibility for overseeing terrorism issues in Brazil lies under several bodies. At the Federal level it involves the Ministry of Defense (Army), the Ministry of Foreign Affairs, the Ministry of Science and Technology, the Civil Defense and the Federal Police. Brazilian capability to deal with a Bio/Chem attack is limited. The main reason for that is the lack of precedent. Another reason is the fact that there are clearly other security priority issues topping governmental agenda. The country does not count with any formal special force or unit to deal with a CB terrorism threat or attack. In late 1990s, Brazil engaged in international counterterrorism efforts specially with Argentina and Paraguay.

CONCLUSION

The organization of terrorist groups and action is said to occur where conditions such as political instability, chronic economic problems, religion fanaticism, famine and disease, over population, environmental problems, lack of opportunities, civil unrest, wars and guerrillas, among others, prevail. Despite the fact that many of these conditions were for decades, and some still are, present in Brazil, the country has no history of terrorism.

However, recent events, such as the US presence in Colombia, have driven terrorist groups into the Brazilian territory. There is evidence to suggest that terrorist groups are using the country for money laundering, drug and arms smuggling and training. The lack of terrorism precedent has not prompted the government to proactive action and the country does not count with any special or formal counterterrorism unity or force. Having said that, if a Bio/Chem terrorism attack occurs, the consequences can be catastrophic.

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KEYWORDS:
Brazil, Terrorism, National Preparedness

FIGURE

Figure 1 – South America

8. CHEM/BIO TERRORISM PREPAREDNESS: CURRENT TECHNOLOGIES AND APPLICATIONS

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The current status of NBC counter-terrorism response and preparedness does not meet the new and projected terrorist threat for most countries. Although many nations have specific dedicated counter-terrorist forces and organizations, the focus on NBC counter-terrorism is relatively new. Combating this type of threat is resource intensive, very expensive and cannot be done with conventional methods.

New programs for developing and procuring equipment and scientific R&D are underway to meet this challenge in many countries. The Australian Olympic Response model and effort perhaps best exemplify these programs. International coordination is necessary and exists through some current alliances but more is needed. New advances must keep pace with the threat, as well as equipment and scientific and medical efforts must reflect this focus.

CBMTS is a leader in this field and as outlined in this abstract, provides a model for government and industry to use as a guide for communication and international coordination. Meetings and communications of this type, guide the Scientific, Medical and Response communities in the development of an economical and successful NBC counter-terrorism model.

KEYWORDS
Counterterrorism, NBC threat, CBMTS

9. GENERIC PROTOCOL FOR DECISIONS REGARDING PACKAGES POSSIBLY CONTAINING A CHEMICAL, BIOLOGICAL OR RADIOLOGICAL (CBRN) AGENT *(A 'PACKAGE OF CONCERN')*

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DEFINITION:

A **'Package of Concern'** is a letter, bag, canister or box that may contain a maliciously placed biological, chemical or radiological hazard. The suspicion may be raised in a number of ways, e.g. a threatening letter or phone call, odd markings or shape, leakage, unusual odour, immediate adverse health effects in package handlers, suspicious placement of the package (e.g. adjacent to the ventilation system).

SOME POSSIBLE SCENARIOS:

Unopened, contents not visible (e.g. a shipping box labelled 'Anthrax');
Opened, contents not visible (e.g. partially opened envelope with suspicious contents);
Opened, leaking, contents visible (e.g. a box with white powder inside, or an envelope leaking a red/brown substance);
Threat note plus package/s in a different location or in multiple locations in the same building, town or in different cities;
A combination of two or more types of contents: explosive, biological, radiological and/or chemical;
Location: mail room *vs* airport terminal *vs* cargo warehouse.
Exposed versus non-exposed persons;

GUIDING PRINCIPLES

- Assume the 'worst case scenario' until it can be ruled out, then gradually scale back as the information/evidence allows;
- The critical initial decision-making/response actions and the incident commander must be local/on site (with advice from experts in other locations if warranted);
- Use all available evidence/information to decide on the course of action;
- Stop further exposure, e.g. of initial handlers, emergency responders, transporters, laboratory personnel, others;
- Determine the nature of the contents expeditiously, but safely;
- Preserve the forensic 'chain of evidence' (evidence tape, signatures, photographs, etc).

The sequence of investigation is usually: *Explosives ˜ ILTC* chemical agent ˜ radiological agent ˜ biological agent*, but this may be changed according to individual circumstances. Local responders should take into consideration all information when deciding what aspects of the decision algorithm will be applied and how they will be applied. Information could include the existence and nature of a threatening note, recent history of similar threats or packages, the credibility of a specific threat, whether significant exposure has occurred, the likelihood of biological or chemical contents, the resources available, and the advice of experts.
ILTC* = *Immediately Life Threatening Chemical Agent.*

IMMEDIATE ACTION ADVICE to package handlers: reduce further contact with the package, e.g. do not handle it further and do not open it. Leave it where it lies, evacuate the immediate area, secure the area. Wash your hands and report to security. Stay available for possible decontamination, information gathering or treatment.

THE LOCAL CBRN RESPONSE TEAM

This is the appointed local public safety group assigned to respond to a CBRN release or incident. It could include fire, police, hazardous material (HAZMAT) and/or ambulance groups who have additional training to deal with these specific incidents.

They should be prepared:

to determine whether an explosive hazard exists,
to safely contain and secure the package to prevent further exposure,
to provide appropriate personnel decontamination,
to collect samples/trace back information on package/sender,
to make an initial determination of whether a hazard exists and if possible, the approximate nature of that hazard (a triage function only),
to assess the dangers to the initial package handlers & building occupants,
to decontaminate the environment/area if needed, and
to preserve forensic evidence (to assist the investigation of a terrorist act).

MEDICAL NOTIFICATION (each country may have different priorities):

The local medical authorities should be informed of a possible CBRN event immediately, so that they can contact exposed people.

The provincial public health authority should be notified when the immediate life-threatening situation has subsided. What health actions are being taken? Is a standard operational procedure (SOP) being followed?

The federal health authorities should be notified - they can provide technical advice and maintain a database. [The Centre for Emergency Preparedness and Response in Ottawa is the federal centre for Health Canada].

RISK ASSESSMENT

This is based on the package,/letter/phone call. Using intelligence sources and advice from experts, make an assessment and rank the level of your response (low, medium or high). Is the threat credible? The police or other law enforcement people have the primary responsibility to make the initial risk assessment.

THE PROTOCOL

Note: The protocol cited below may be varied. It is the prerogative of each nation and province/region to decide what will work best in each situation.
Appropriate training is imperative for all named situations.

1. Rule out an *explosive device* (police/military unit: ticking, detonator, putty-like feel?).
2. Test for an *Immediately Life Threatening Chemical Agent* (ILTC, the obvious ones being the nerve gasses such as Sarin or Tabun, and blister agents such as Mustard. Even a sealed envelope may leak a deadly gas. If ILTC triage is positive, transfer a sample to a chemical laboratory that is equipped to provide definitive analysis.
3. Rule out a *radiological hazard* with a radiation survey meter that can detect alpha, beta and gamma radiation:

a. before opening the package, check for a high penetration radiological hazard, such as gamma rays (e.g. Cesium^{137} or Cobalt^{60}) and some beta particles. If detection is negative then there is no high penetration hazard present or it is well contained.
b. after opening it, check for a low penetration hazard, such as some beta particles (e.g. strontium^{90}) or alpha particles e.g. (plutonium^{138}; americium^{241} - used in smoke detectors). Precautions taken to prevent exposure to chemical or biological agents in the laboratory should be sufficient to protect against inhalation and skin absorption from these low penetration radiologic hazards.

4. If there is concern that a *biological hazard* may exist, the samples may be split, one portion being irradiated and sent for chemical analysis, the other being sent to a CL3 laboratory.

Note: If the package has not been opened, or has been opened, but then re-closed by the first responders, it should not be opened/re-opened at the scene; it would be wise to remove it to a secure location (eg a CL# laboratory) before opening. When opening the package, sufficient precautions should be taken to protect the handlers against an inhalation hazard and skin contamination, and to prevent spread of the contents. Recent practical experiments using a fluorescent powder in a letter resulted in widespread dissemination of the contents when it was opened. [An alternative is to destroy the package without opening it].

A table for chemical / biological differentiation and a procedural decision algorithm have been placed at the end of this paper.

EMERGENCY RESPONSE ASSISTANCE PLAN (ERAP) TEAMS

These teams are specially trained to respond to a spill that may contain biological agents. There are 15 teams in Canada (at least one in every province and territory); they are on call 24 hours a day and 7 days a week to go anywhere in Canada for a package emergency.

Functions of an ERAP team:

initial triage to rule out a bio-hazard,
package biological samples for transportation according to the IATA regulations*,
alert the relevant authorities,
determine the need for site decontamination,
assist in the determination of post-exposure prophylaxis of those people who came into contact with the agent,
do regular preparedness training and exercises,
are experts at containment, neutralization, clean-up of spills and preservation of evidence.

TRANSFER OF A BIOLOGICAL PACKAGE:

Deliver the package to a level 3 containment facility and initiate triage; then if needed, package it for onward transport (e.g. to a CL 4 lab) as per the International Air Transport Association (IATA) Dangerous Goods Regulations* or federal/provincial ground transportation regulations that determine the packaging, labeling and documentation of specimens. Specimens need to be prepared for transfer, and transferred to meet:

public safety regulations,
timeliness, and
forensic evidence ('chain of custody').

Life Forms: the first laboratory triage determines if there are likely to be biologic agents in the specimen. Gram staining and electron microscopy will provide important initial information to guide further examination of the sample and the prophylaxis of those people exposed to the agent. The minimum microbiological containment level recommended for first line examination of an unknown biological threat agent is level 3 (CL3 lab).

LABORATORIES

There are four levels of containment appropriate to the 4 risk groups of infectious agents. Here follows an abbreviated description of a level 3 lab:

CL3 (for high individual risk, low community risk agents such as anthrax, plague, tularemia, brucellosis, glanders, Q-fever, typhus and VEE): In addition to level 1 and 2 requirements (eg a Class 2 type B2 biological safety cabinet, preferably with a charcoal filter), some of the requirements of this level include specialized design and construction, break-resistant glass, controlled access through change/shower rooms with self-closing doors, negative air pressure with a dedicated, sealed exhaust system; specialized, solid-front, dedicated lab clothing with a combination HEPA and chemical filter for the breathing device, plus chemical resistant gloves eg nitrile, if initial chemical triage is to be performed, and specific training regarding the handling of organisms for lab staff, as well as medical surveillance. The lab must undergo annual performance testing and verification.

UNKNOWN AND COMBINATION HAZARDS (e.g. level 3 and/or 4 organisms, or biological and chemical agents). Where do you send them?

As mentioned previously, samples can be split, one part being sent for biological evaluation and the other being irradiated and then sent for chemical analysis. In Canada we have a facility that can test for both CL3 and CL4 biological agents and another that can test for both CL3 biological agents and chemical warfare agents. We also have a specialized military mobile team that can deal with chemical agents, contain biological agents and test for radiation.

For possible chemical analysis, consider:

a forensic laboratory,
an environmental lab,
an occupational health lab,
a toxicology lab.

If you still cannot decide:

destroy the package, or
send it to a CL3 lab, where the staff can open it with chemical precautions.

KEY WORDS

Package, chemical/biological agent, protocols

ERAP team = Emergency Response Assistance Plan Team
CBRN = Chemical, biological, radiological and nuclear.

TABLES & FIGURES:

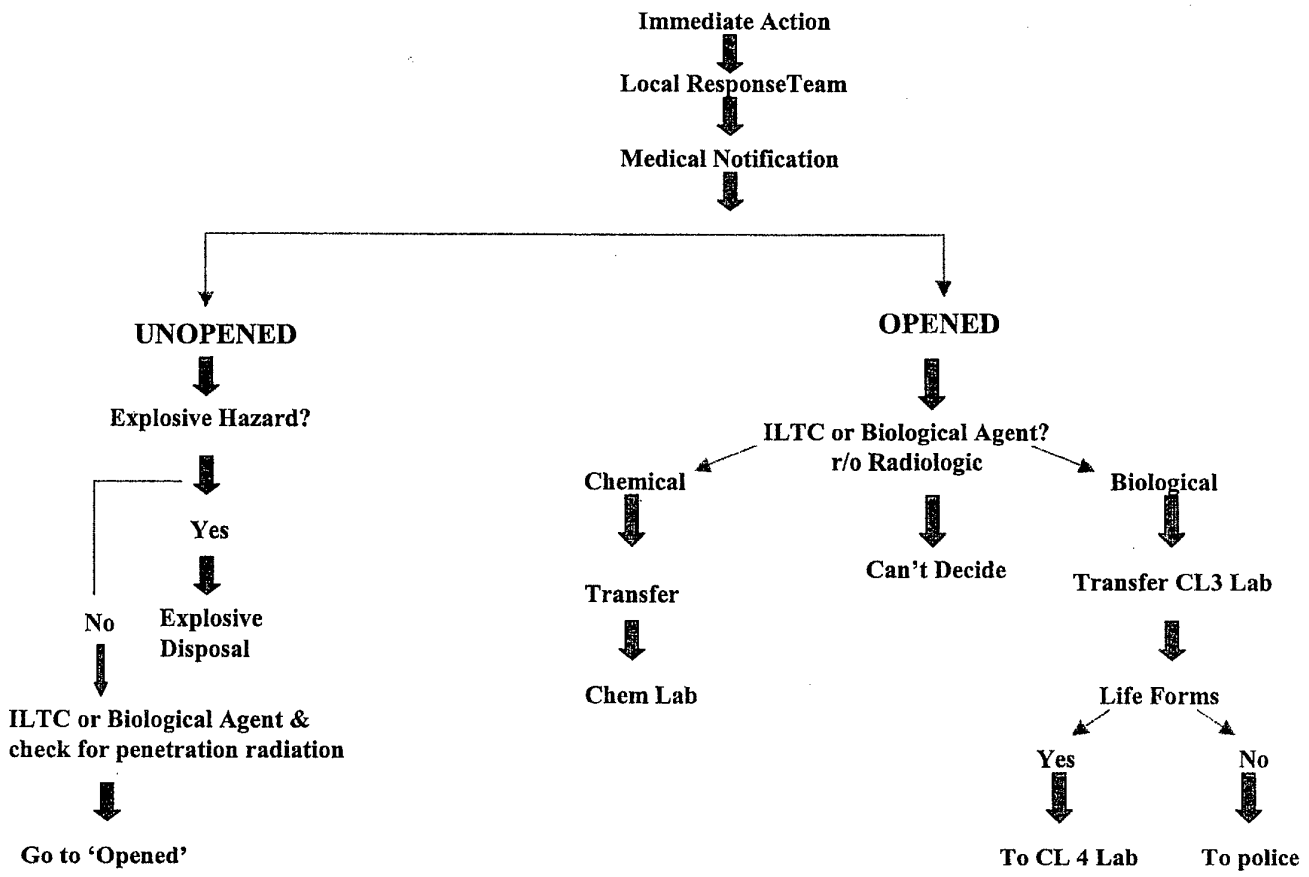
Figure 1: Decision Algorithm for a package of concern.
Table 1: Chemical / Biological Differentiation.

Chemical / Biological Differentiation:

Criteria	Chemical	Biological
Deaths or immediate illness	+	-
Powder	-	+
Liquid	+	+/-
Explicit threat	+	+
On-scene detection	+	NA

+ = more likely; - = less likely; NA = not available

Figure 1 Package of Concern – Decision Algorithm



10. BLOOD BORNE PATHOGEN MICROBES AND BIOTERRORISM

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ABSTRACT

Blood may be considered both a medicine and strategic material. In Croatia blood is collected on voluntary basis and undergoes an obligatory screening for blood borne pathogen microbes, including human immunodeficiency virus (HIV), Hepatitis B and C viruses. As a result of this screening, the risk of infection through exposure to blood and blood products has been markedly reduced, but not eliminated. There are possibilities, although very small, that an infected person (undetected as agent's carrier) could be a blood donor, or a blackmailer. In either case, this could create fear and be real threat to public health.

We studied two separate registers, the data concerning positive isolates of blood borne pathogens in the Croatian Institute for Transfusion Medicine and in confirmed cases reported to the National Infective Diseases Register. Over time, the incidence of blood borne infective diseases decreased. But since new pathogen microbes are emerging, this changing public health problem could be of particular interest to bioterrorism. Laboratory diagnostic procedures for prevention of blood borne pathogen microbes' transmission are discussed.

KEYWORDS
Blood, bioterrorism and preventive measures

11. CB - PROTECTION: DIFFERENT MATERIALS AS ECOLOGICAL FILTERS

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Changes in nature that are the consequences of men's work, are bigger and bigger every day, and they start to be a threat to the whole human race.

Military forces have been struggling with the issue of chemical and biological warfare for decades. Terrorist's attacks or accidents with chemical or biological agents can be the ecological bombs today and in the future.

Simulation modeling methods and techniques and their possible use in ecological modeling are presented in this work.

Because of that, different substances are investigated and described as the filters for danger chemical agents that can be used in laboratory or industrial scale. We measured few parameters that are important for the simulation modeling.

To control the entering parameters and to get the output simulation method we used one of the standard packages for discrete simulation, Service model v4.2 (ProModel Corporation), while for continuous control of the processes we used Extend v4 (Imagine That, Inc.).

INTRODUCTION

Military forces have been struggling with the issue of chemical and biological warfare for decades.

Attack of the Tokyo subway with the nerve agent sarin in March 1995 suddenly put the spotlight on the danger to civilians from chemical and biological attacks.

Terrorists' attacks or accidents with chemical or biological agents can be the ecological bombs today and in the future.

There is no way to prepare in an optimal fashion for a terror incident. There is too low an incidence to justify the enormous financial outlay it would take to optimally prepare every community for every possible incident. Also, there is a huge gap between detection technology and therapy. There are many biologic agents, and certainly many chemical agents for which there are no known treatments.

So, simulation modeling methods and techniques and their possible use in ecological modeling are presented in this work. Different substances are investigated and described as the filters for danger chemical agents that can be used in laboratory or industry scale.

The model for the simulation of absorption of paraoxon and DBS (dibutyl sulfide) on activated charcoal, ZA, SiO_2, TMAZ, ZSM-5 (with different kations) and Al_2O_3 are shown on Figure 1.

For both chemical agents, there are defined the specific rules about absorption of them, through the model Equation, in which it is written the rule/ the possibility for the absorption of every specific material.

To make "the real" picture of the process of the absorption, for every material, the influence (the dependence) of the absorption through the time (which is specific for every absorbing material) is counted, as the entering process.

This is fulfilled with the model for generating the values by the process of accidental numbers through "the best fitted distribution".

In this model we used empirical distributions. Used tool is Stat: Fit from the simulation pocket Service Model v4.2. Empirical distributions are written in the model built

in Extend v4. As the started values of the simulation experiment, initial value of the concentration of paraoxon (or DBS, or any other agent) in water were taken. This value is constant. So, this constant and generic value of the dependence of absorbency in time are the entering parameters for the simulation model which transform through the Equation to the output values of the concentration of paraoxon or DBS.

EXPERIMENTAL

Zeolites (ZA (Fluka), Klinoptilolite (IRB) and ZSM-5 (prepared by me, by the procedure described before)) and some other materials as SiO_2 (AnalytiCals, Carlo Erba), Al_2O_3 (neutral, 70-230 mesh ASTM, Merck) and activated charcoal (Riedel- de Haën AG) were used as adsorbents for DBS and paraoxon.

To study the process of absorption of DBS and paraoxon on ZA, klinoptilolite, ZSM-5, SiO_2, Al_2O_3 and activated charcoal, 2.0 g of solid (5.0, 7.5 and 10.0 g) were put into the reaction vessel containing 25.0 mL of DBS solution (10^{-4} M) or paraoxon solution (2×10^{-4} M) in water.

The moment the solid was added to the solution was taken as the zero time of absorption ($t_{ab} = 0$).

At various times after the process of absorption of DBS or paraoxon started (1,2,5,10, 20, 30, 40, 60 and 120 min), suspensions were drawn off for analysis, and centrifuged.

To determine the concentration of unabsorbed DBS in solution (or absorbed on different materials), the tytrimetric reaction with $AgNo_3$, or iodometric reaction were applied. The sorption of paraoxon was measured colorimetricaly (benzidine reagent, 420 nm). A spot test reaction, which produces a yellow color when an aqueous alkaline peroxide solution is added to a nerve gas (or an imitator) in the presence of an oxidizable amine base such as benzinidine, was first described by Schönemann in 1944.

Zeolite ZSM-5 was synthesized with three different cations (K, Na and NH_4).

RESULTS AND DISCUSSION

All "as made" samples of ZSM-5 zeolites (Na-, K- and NH_4-ZSM-5), using as starting materials in absorption studies, were fully crystalline powders, having an MFI structure, as revealed by X-ray difractometry.

Adsorption of DBS on ZA reached the maximum after about 30 minutes after the reaction started. The efficacy of ZA as the adsorbent depends on the mass used in the reaction, especially in first five minutes. When the time of reaction on the use of some chemical agent is important, this fact can't be ignored.

Figure 2 shows the absorption of DBS on silica (a) and charcoal (b) on 2.0 g, 5.0 g , 7.5 g and 10.0 g.

It is seen that the amount of adsorbent has less influence on the efficiency of adsorption than it is noticed with ZA.

Adsorption of DBS on silica is much faster than on activated charcoal. During the first five minutes more than 50 % of DBS were adsorbed on silica, and about 40 % on activated charcoal. The maximum of adsorption for silica is between 76 and 85 % (76 % using 2.0 g, 81- 82 % for 5.0 and 7.5 g and 85 % using 10.0 g).

Adsorption of DBS on alumina shows that there is no difference in adsorption using 5.0, 7.5 or 10.0 g of adsorbing material, and that 2.0g of that material for the concentration that was used is not enough.

Figure 3 shows the adsorption of DBS on 2.0 g of different adsorbing materials (ZA, klinoptilolite (TMAZ), activated charcoal, silica and alumina.

Adsorption of paraoxon on different materials also depends on the amount of adsorbent, but only after it is reached the plateau of adsorption.

Adsorption of paraoxon on ZSM-5, silica and activated carbon is especially fast in first few minutes (from 50 % for activated carbon to 70 % for ZSM-5), what makes these adsorbents very efficient for adsorption of paraoxon.

Using ZA or klinoptilolite, the plateau of adsorption is reached much slower and with the fewer efficacies. Main reasons for that is probably that the total surface is less for those adsorbents, because of the particle size.

Figure 4 shows the adsorption of paraoxon on 10.0 g of different adsorbing materials.

CONCLUSIONS

- With some materials (ZA, Al_2O_3) there is a great difference in adsorption of DBS and Paraoxon, depending on used mass of adsorbing materials.
- With the others there is almost no difference in the amount of used materials (especially charcoal, SiO_2 and klinoptilolite)
- Adsorption of DBS is especially small using Al_2O_3, and especially great when using SiO_2)
- There is almost no difference in the adsorption of POx on different amounts of ZA
- There is great difference in adsorption of POx on ZSM-5 at different temperatures (20, 30, 37 and 45 ^{0}C)
- For all materials except for ZA adsorption is quick in first few minutes, and in that time it is adsorbed almost 60 % (or even more) of the toxic material.
- About the model, after the model is made, its evaluation must confirm the possibility of its use in the real system. Evaluation is confirmed with statistical tests (hi square Kolmogorov- Smirnov test or Anderson- Darling test). Using this model it can be predicted in any time the concentration of the chemical agent in the solution and the amount of the agent that is absorbed. Comparing all adsorbents, it is possible to get the information which absorbing material is the most efficient. Beside that, the simulation experiments can be done even for the chemical agents for whom experimental adsorption measurements were not done.
- Also, it can be predict the most useful combination of adsorbing materials (in percentage).

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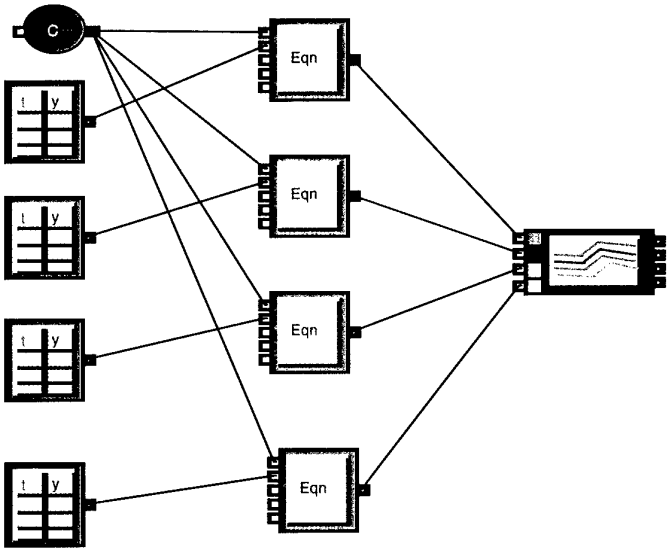
KEY WORDS

Chemical and biological warfare agents, terrorist's attack, modelling



Symbols (icons) that are used:

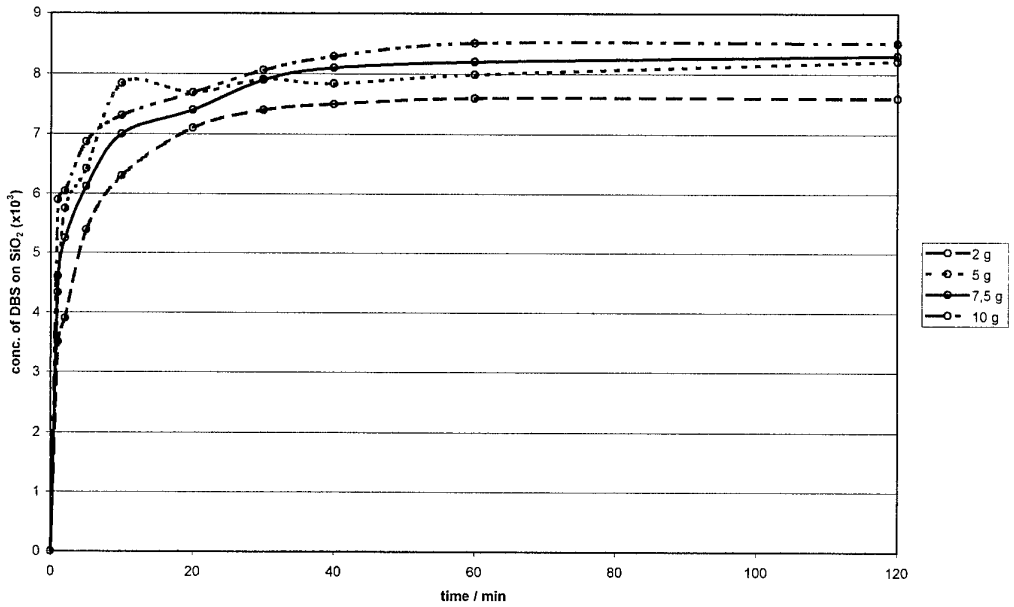
-Constant

-Input Data

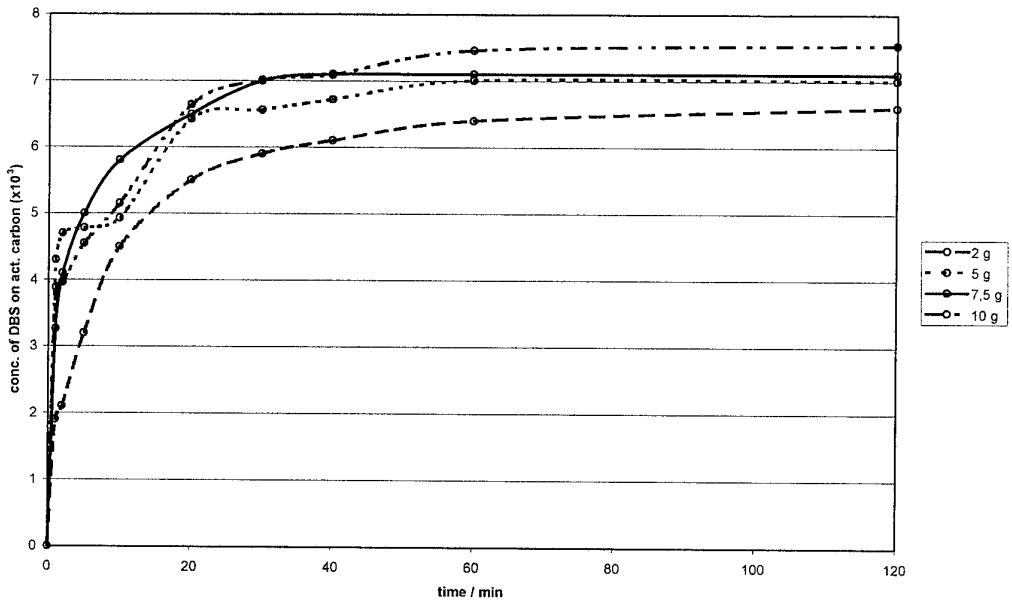
-Equation

-Plotter

Figure 1. Shematic presentation of the model



(a)



(b)

Figure 2. Adsorption of DBS on silca (a) and charcoal (b) on 2.0g, 5.0g, 7.5g and 10.0g

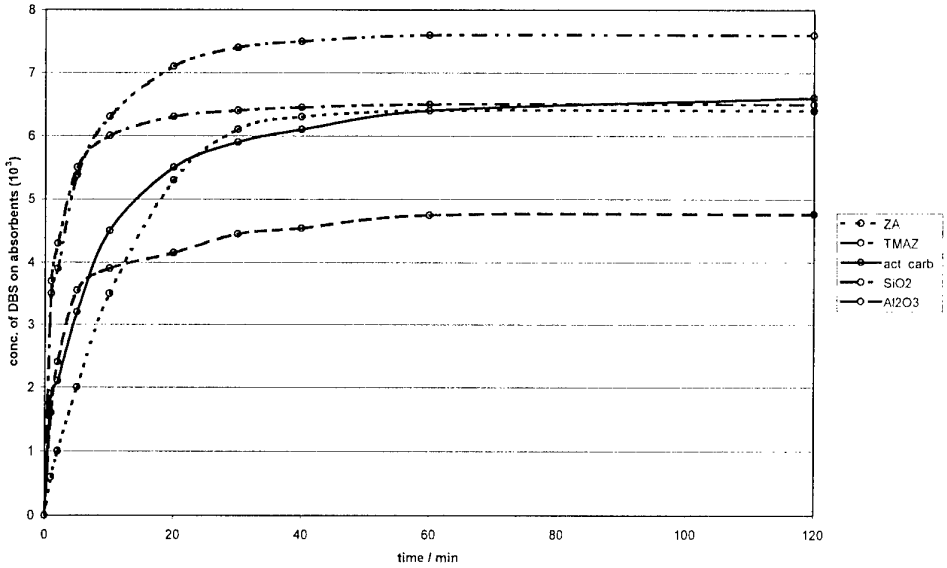


Figure 3. Adsorption of DBS on 2.0 g of different adsorbing materials (ZA, klinoptilolite (TMAZ), activated charcoal, silica and alumina.

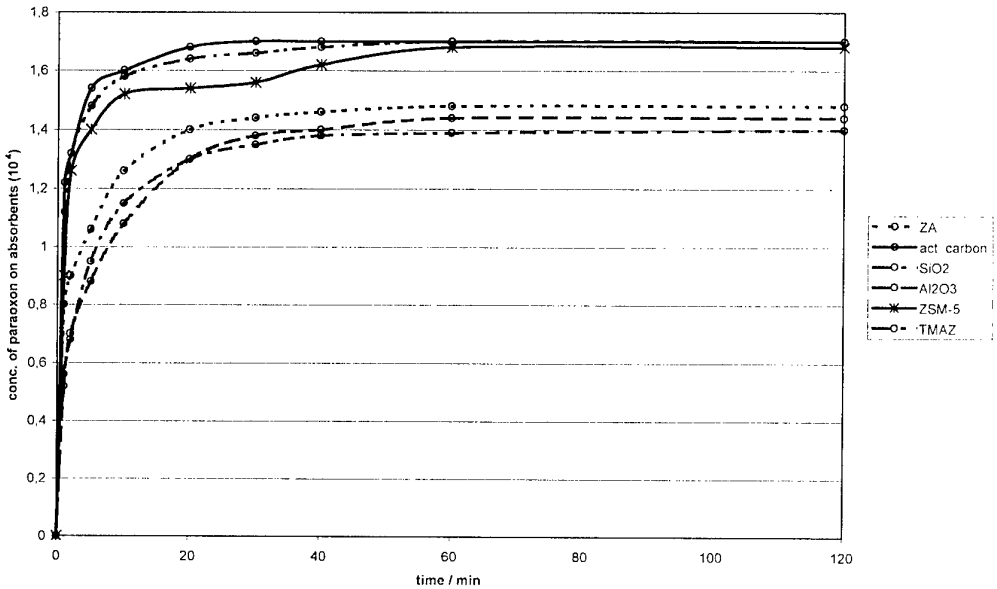


Figure 4. Adsorption of paraoxon on 10.0 g of different adsorbing materials.

12. THE ROLE OF NATIONAL POISON CONTROL CENTER IN ORGANISATION AND MANAGEMENT OF MASS AMMONIA ACCIDENT

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INTRODUCTION

Despite the frequent occurrence of incidents involving hazardous materials, organisation and management still pose some specific problems in chemical disasters. Most hospitals with emergency care are not fully prepared to handle contaminated or poisoned patients, which may have important impact on the outcome of poisoning (1). Following a hazardous chemical accident, providing early effective care to victims depends on the nature of the accident, the number of victims affected, the availability of medical care, the coordination of rescue teams and medical treatment. Poison Control Centres must have a crucial role in all phases of the disaster management.

METHODS

The objective of this paper is to review the role of the National Poison Control Centre (NPCC) in organisation and management of mass ammonia poisoning. It is an account of team work and experience in medical management of poisoning which was applied for the first time in such a major accident.

RESULTS

The accident happened on May 27th 1998 at 14:00 hrs in Belgrade`s suburb Borca, when a road tanker with 5 tones of ammonia exploded. A cloud of ammonia gas spread over the vast area causing mass exposition of local residents and wokers of "Lika system", a company located nearby. A man who was standing beside the truck was killed in the explosion. The Units of Urgent Medical Aid and Police Department were the first on the spot and before contacting NPCC, which is why it did not participate in the first phase of organisation of medical management. The duty physician in NPCC was informed at 14:40 hrs of the accident. He suggested that majority of victims should be transported to the Centre. Considering the fact that it was still the working hour, none of the staff left the hospital. A previously prepared plan regarding chain of command with triage physicians, a nurse in charge and the emergency staff call-up plan was put into motion. Additional hospital beds were provided by discharging from the Clinic of Toxicology and two other clinics of Military Medical Academy the patients who were hospitalised for various diagnostic interventions. Those patients who demanded further treatment were transfered to the Military Medical Centre. Additional supplies of drugs and other materials were provided. The patients started to arrive one hour after the accident and untill 22:00 hrs 98 patients were brought in. The Emergency Centre was not used for triage process because the number of patients was significant and they could overload and interfere with the care of severely poisoned patients. The entry for rapid access to triage and a separate, for that occasion specially formed area, near the entrance, for refreshment, observation and treatment of mild poisoning, was designated. Severely poisoned patients with vital threat were hospitalised immediately at the Clinic of Toxicology and Clinical Pharmacology. After admitting them, decontamination and copious eyes washing with isotonic saline were performed. During the next two days 45 patients with similar complaints reported to the Centre, so that total number of treated

patients with exposition or poisoning was 143, of which 54 were hospitalised. After first examination and triage, all the patients received a single dose of methylprednisolone (80 mg) *im* or *iv*. After six hours of observation 46 patients with mild poisoning or exposition only were discharged from the hospital. They remained under control during the period of one month on the outpatient basis. According to the severity of poisoning, hospitalised patients were divided into groups: mild (22 patients), moderate (13 patients) and severe poisoning (19 patients).

The majority of patients with mild poisoning had signs and symptoms of mild irritation of the upper respiratory tract (caughing, breathlessness, mild dyspnoea, mild bronchospasm, conjuctival hyperaemia). Those with moderate poisoning had prolonged caughing, chest tightness, carbonaceus sputum, wheezing and hypoxaemia requiring extra oxygen. Five of those patients had normal chest radiography and the rest bronchovascular markings. One of them had pneumonia. In patients with severe poisoning manifest respiratory insufficiency (due to severe bronchospasm, laryngeal obstruction due to pulmonary oedema, pneumonia), severe burns of eyes and skin were confirmed. Nine of them developed pulmonary oedema 6 hrs post exposure. In one of them oedema was a consequence of cardiac failure. Three patients had acute respiratory distress syndrome (ARDS) on admission and of those 2 were intubated and placed on mechanical ventilation (MV) with positive end-expiratory pressure. One of them deceased on the 6th day. Autopsy revealed severe haemorrhagic pulmonary oedema, bronchial mucosa destruction and multiple capillary thrombi. Second patient on MV developed pneumonia and pulmonary thromboembolism. He was hospitalised during the next 60 days and when discharged he still had restrictive-obstructive disturbances and mild hypoxaemia. His follow-up confirmed the development of pulmonary fibrosis.

Treatment included support of airway patency, frequent airway suction of bronchial and pulmonary secretion, application of humidified oxygen, intravenous fluids, bronchodilators, antibiotics and corticosteroids. For those with severe poisoning high doses of methylprednisolone (1.5-2.0 g) were administered in order to prevent the development of pulmonary oedema. They were reduced during next 72 hrs as the risk of oedema diminished. All patients but one survived. Hospitalization lasted for 2-60 days. Longterm follow-up confirmed sequelae in two patients. One of them had bronchial hyperreacitivity and pulmonary fibrosis and other patient had chronic obstructive bronchitis and cataract (Table 1).

DISCUSSION

Since the early 1980s several chemical disasters involving release of toxic substances and mass poisonings have focused the attention of different services on enchancing safety in processing, handling and storage of dangerous chemicals and other hazardous industrial materials. The terrorist sarin attack in Tokyo subway in March 1995 showed that using the highly toxic agents by terrorist is feasible now and indicated the need for careful planning of organisation and management of accidents (2). Medical management of major chemical accidents requires a close collaboration between rescuers (on site and in hospital) and the Poison Control Centre, which toxicological databases and risk assesment software are integrated in management to support information sharing. According to the 1995 World Disaster Report, chemical accidents that put general public and environment into a serious danger rank 10th, just after epidemics (3). Close communication with the public, emergency care facilities, other authorities and the media play a key role in each step. In 1985 Major Accident Reporting System was established by the Comission of the European Community

(4). There are no published data about chemical accidents in Yugoslavia and this accident with mass poisoning is the first that we are aware of.

This paper explains how the National Poison Control Centre responded to such a situation from the viewpoint of accident management, the problems encountered and how they were solved. The NPCC participated actively for the first time in massive ammonia accident. Ammonia, a common industrial and household chemical, has a characteristic odour, which is a warning of exposure. After the accident the, first on the scene were units of Urgent Medical Aid and Police Department and they transported the majority of victims to NPCC. Thinking that ammonia is not a chemical with serious potential for contamination, as chemical carcinogens and pesticides are, they were not properly equipped so several rescuers were poisoned, but fortunately mildly. After first triage on spot, patients were transported to NPCC, where final triage was accomplished.

Clinical presentation of ammonia poisoning is characteristic, with respiratory irritation ranging from mild to severe pulmonary disturbances including ARDS. The mechanism of poisoning is explained by high water solubility of ammonia, which produces ammonium hydroxide that, along with excessive local heating caused by this chemical reaction, lead to mucosal destuction and alkaline burns. Contact with skin can cause burns and vesication, irritation of eyes, conjuctivitis and pharyngitis. It is absorbed in the upper respiratory tract, but exposure to highly concentrated gas or prolonged exposure may cause tracheobronchial or pulmonary inflammation. Exposure to high concentration of any irritant gas may produce hypoxaemia analogous to that seen with exposure to the simple asphyxiants.

General approach to managing patients with ammonia exposure is support of airway patency and supportive care is the mainstay of therapy. Supplemental oxygen, bronchodilators and airway suctioning should be used if clinically indicated. It is important to reduce the inspired concentration of oxygen to bellow 50% as rapidly as possible, since patients with ammonia poisoning may be even more susceptible to oxygen toxicity, due to the depletion of endogenus antioxidant system. Early corticosteroid therapy designed to reduce the host inflammatory response provides little benefit to patients with ARDS, but it may reduce the late fibroproliferative phase. The majority of our patients with mild and moderate poisoning were exposed to ammonia gas for a few minutes. After treatment they fully recovered and none of them had sequelae. On the contrary, patients presenting with signs of severe poisoning and ARDS, had prolonged clinical course and developed sequelae. Disctinction could be made even in this group of patients, in which early onset of pulmonary oedema indicated the less severe form of poisoning and faster recovery.

All the victims were treated in NPCC, which might not be possible in the future, though statistics shows that many hospitals are not fully prepared to treat such patients. The survey of hospital-based facilities providing emergency care in the state of Washington, showed that only 44% of them reported the ability to receive any chemically exposed patient, while 70% had protocols for handling facility contamination and possible evacuation (1,6,7). However, regional medical management of chemical accidents with close cooperation with PCC is recommended because epidemiologic, laboratory and toxicological skills are needed immediately to evaluate and advise on chemical accident may not be available locally and delay an adequate medical response.

Our National Poison Control Centre consists of Clinic of Toxicology and Clinical Pharmacology, Institute of Toxicology and Pharmacology (Department of Analytical Toxicology, Department of Experimental Toxocology and Pharmacology, Toxicological Information Department) and Mobile Toxicological Unit. It has ten clinical toxicologysts who treated these hundred patients successfully during several hours. It also provided authorities and mass media with all the necessary information on ammonia during all that

time and in that way the psychosociological response to chemical disaster with mass psychogenic illness was avoided. This indicates that NPCC was capable to deal with major medical problem and this experience will be of great help in dealing with possible chemical terrorist attack.

SUMMARY

National Poison Control Centre participated actively in organisation and medical management of mass ammonia accident. The incident showed high quality of treatment in such emergency care facility with multispecialised medical teams. It also indicates that NPCC should have a leading role in coordination of chemical disaster planning, teaching and medical training, information support, incident recording and liesons between the regional medical institutions and the government authorities.

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KEY WORDS

Ammonia, poisoning, chemical disaster, organization and medical management

TABLE

Table 1. A degree of poisoning, acute complications and poisoning sequelae

Degree	N pts	complication N	sequelae N
Mild	22	pneumonia 2	
moderate	13	pneumonia 1	
Severe	19	pneumonia 2, ARDS 9, ACF 1, PTE 1	p. fibrosis 1, b. hypersensitivity 1, cataract1, COPD1

13. *Meso-* AND *racemic*-DMSA AS ANTIDOTES IN HEAVY METAL POISONING

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Lead, cadmium and mercury, well-known toxic metals, could be used in a chemical terrorist attack. Chelating agents are the only antidotes that promote toxic metals elimination from the body (1). At present *meso*-1,3-dimercaptosuccinic acid (*meso*-DMSA) is the optimal officially accepted antidote in lead or mercury poisoning that can be used orally (2). However, a racemic form of DMSA (*rac*-DMSA) seems to have higher stability constants with toxic metals than *meso*-DMSA but has not been yet thoroughly studied *in vivo* (3) and is not in human use. The results of our investigations presented in this paper have been obtained in experimental animal models *in vivo* to compare the efficacy of the mobilising potency of these two chelating agents in reducing toxic metal body retention (3-6).

The efficiency of these two DMSA isomers was tested after lead, mercury or cadmium poisoning in laboratory rats (female Wistar rats). Chelating therapy was started either immediately after or 3 to 5 days following metal application and lasted 2-4 days. Toxic metals were given either as a stable elements (Pb) or as radioactive isotopes (^{203}Hg or ^{109}Cd). At the end of the experiment stable lead was analysed by atomic absorption spectrometry (in tissues) and radioactive isotopes by measuring radioactivity in scintillation counters (separately in whole body and internal organs). Number of animals per group in each experiment was 8 to 11. The results were statistically evaluated by one-way ANOVA followed by *post hoc* Duncan's multiple range test (at $P<0.05$).

Lead

First experiment was carried out on 8-week-old female rats by Pb loading (in the form of acetate) during five consecutive days with 5 mg Pb/kg body weight per day (3). Oral treatment with *meso*-DMSA (Aldrich Chemical Co., Milwaukee, WI, USA) or *rac*-DMSA (synthesis described in ref. 7) was administered for four days at the dose of 0.5 mmol/kg per day. At the end of the experiment lead concentrations were analysed in tissues of control (lead-exposed and untreated) and treated groups administered one of the two DMSA isoforms (Figure 1). Femur lead concentrations (reflecting whole body burden of lead) were significantly reduced. This effect was significantly greater after *rac*- than after *meso*-DMSA treatment. Lead concentrations in the kidneys were markedly reduced by treatment with both isoforms of DMSA and the effect was greater after *rac*-DMSA. Neither compound was efficient in reducing liver lead concentrations. Brain lead levels were reduced by both chelators with no difference between *rac*- and *meso*-DMSA treated groups.

Lead mobilization was further tested in 7-day-old suckling rats (4). Very young are at a higher risk than adults for health effects of lead. Five mg Pb/kg body weight was given as a single intraperitoneal injection. *Meso*- and *rac*-DMSA were administered twice at the dose of 0.5 mmol/kg body weight, 24 and 48 hours after Pb. At the end of the experiment lead was determined in carcass (skeleton without organs and fur), kidneys, liver and brain (Figure 2). The results showed again that *rac*-DMSA causes a greater effect in reducing tissue Pb concentrations (kidneys) than treatment with *meso*-DMSA.

Mercury

Mercury mobilisation was tested in 7-week-old rats by giving a single intraperitoneal injection of 0.5 mg/kg of $HgCl_2$ labelled with radioactive ^{203}Hg (5). Chelators *meso*- or *rac*-DMSA were administered by gastric intubation during four days at the dose of 1 mmol/kg body weight per day. Results of whole body (Figure 3) and tissue retentions (Figure 4) showed that the lowest retention of ^{203}Hg was obtained after *rac*-DMSA treatment in the whole body, liver and kidneys.

Cadmium

In an experiment on 4-week-old rats cadmium chloride was administered intraperitoneally with 0.03 mg $CdCl_2$ x H_2O labelled with radioactive ^{109}Cd (6). Intraperitoneal treatment with chelators started immediately and was repeated 24 hours later at the dose of 1 mmol/kg. After 6 days both DMSA isomer treatments caused a decrease of whole body ^{109}Cd retention with *rac*-DMSA being more efficient (Figure 5). The same reduction of ^{109}Cd was obtained in the liver, but in the kidneys only *rac*-DMSA was effective (Figure 6). This reduction of cadmium in the body was modest by both isoforms of DMSA being slightly more efficient with *rac*- than *meso*-DMSA.

In conclusion, results of our investigations show that the racemic isoform of DMSA is more efficient in reducing the body burden and target organ retention of toxic metals - lead, mercury and cadmium - than *meso*-DMSA. The efficiency of metal body burden reduction with *rac*-DMSA was ordered: mercury > lead > cadmium. These studies will be continued to assess whether *rac*-DMSA could be applied clinically.

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KEYWORDS

Lead, cadmium, mercury, chelation therapy, 2,3-dimercaptosuccinic acid isoforms

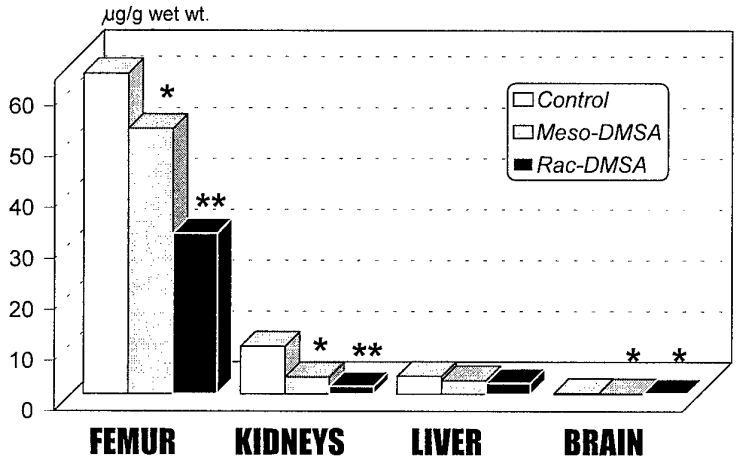

Figure 1. Lead concentration in femur and organs of 8-week-old female rats after treatment with *meso*- or *rac*-DMSA (3). Animals were loaded intraperitoneally with 5 mg/kg body weight of lead (as acetate) for five consecutive days. Treatment with *meso*- or *rac*-DMSA was administered for four days at the dose of 0.5 mmol/kg each day. Significant difference to the control is indicated by one asterisk; two asterisks denote difference between treated groups.

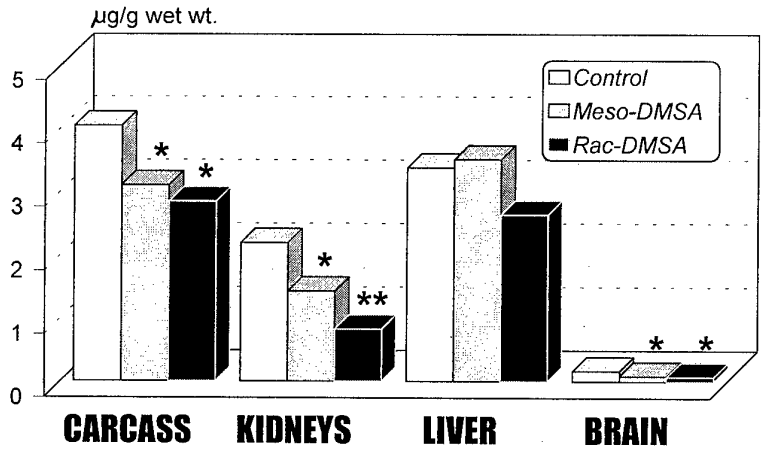

Figure 2. Lead concentration in carcass and organs of suckling 7-day-old rats after treatment with *meso*- or *rac*-DMSA (4). Animals were loaded with a single intraperitoneal dose of 0.5 mmol/kg of lead (as acetate). Chelating agents *meso*- or *rac*-DMSA were given orally twice 24 and 48 h later at a dose of 0.5 mmol/kg. Significant difference to the control is indicated by one asterisk; two asterisks denote difference between treated groups.

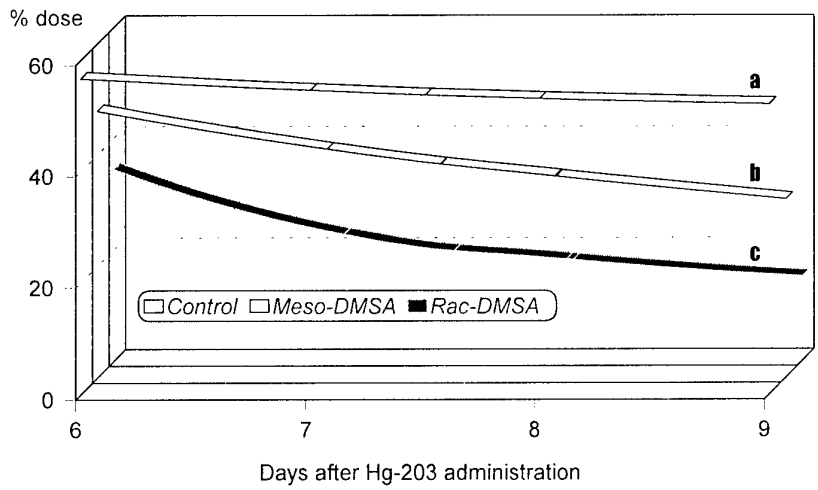

Figure 3. Mercury-203 retention in the whole body of 7-week-old rats after treatment with *meso*- or *rac*-DMSA (5). Animals received 0.5 mg $HgCl_2$/kg body weight labelled with ^{203}Hg by a single intraperitoneal injection. A four-day oral treatment with chelators started 5 days later at a dose of 1 mmol/kg. Significant differences between groups are indicated by different letters.

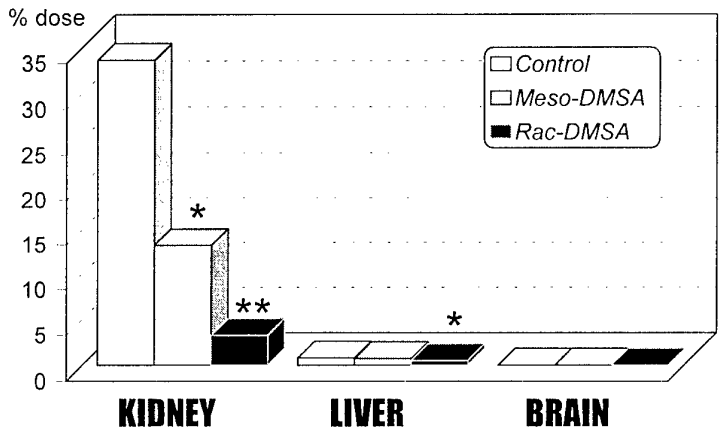

Figure 4. Mercury-203 retention in organs of 7-week-old rats after treatment with *meso*- or *rac*-DMSA (5). Animals received 0.5 mg $HgCl_2$/kg body weight labelled with ^{203}Hg by a single intraperitoneal injection. A four-day oral treatment with chelators started 5 days later at a dose of 1 mmol/kg. Significant difference to the control is indicated by one asterisk; two asterisks denote difference between treated groups.

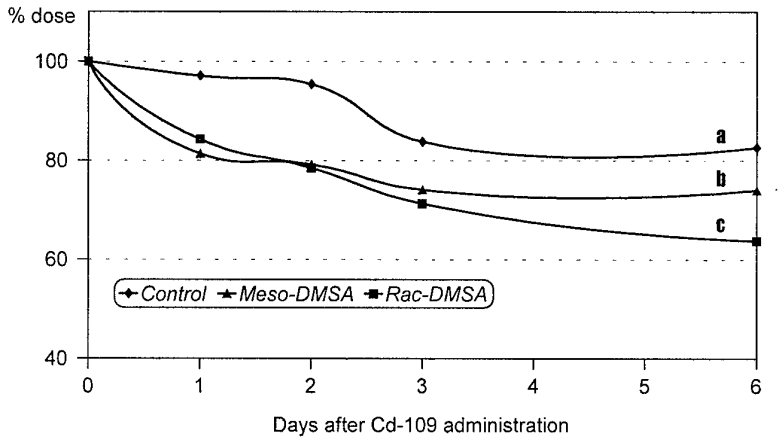

Figure 5. Cadmium-203 retention in the whole body of 4-week-old rats after treatment with *meso*- or *rac*-DMSA (6). Animals received 0.03 mg of $CdCl_2$ x H_2O labelled with ^{203}Cd in a single intraperitoneal injection. Two oral treatments with chelators started immediately and 24 hours later at a dose of 1 mmol/kg. Significant differences between groups are indicated by different letters.

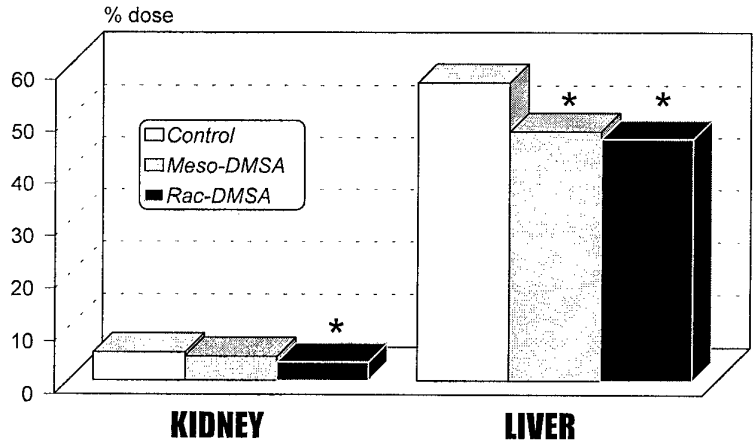

Figure 6. Cadmium-203 retention in organs of 4-week-old rats after treatment with *meso*- or *rac*-DMSA (6). Animals received 0.03 mg of $CdCl_2$ x H_2O labelled with ^{203}Cd in a single intraperitoneal injection. Two oral treatments with chelators started immediately and 24 hours later at a dose of 1 mmol/kg. Significant difference to the control is indicated by asterisk.

14. EVALUATION OF NIPAH VIRUS AS A HUMAN AND ANIMAL BIOLOGICAL TERRORISM AND WARFARE AGENT

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INTRODUCTION

In July 1999, the delegation of the Republic of Croatia to negotiations in Ad Hoc group of States Parties of BTWC proposed including Nipah virus in the list of animal pathogens. This paper describes an evaluation of Nipah virus as a biological agent for terrorism or warfare.

An outbreak of disease caused by Nipah virus occurred during October 1998 and April 1999. At least 258 persons developed Nipah encephalitis and 106 of them have died. The Nipah virus outbreak also devastated Malaysia's pig-farming industry.

The Nipah virus or so-called Hendra-like virus (*Paramyxovirus* strain) appears to have developed from the virus causing Nipah swine encephalitis (zoonotic infection). Virus is named after the village Kampung Baru Sungai Nipah in Negri Sembilian State, in western Malaysia where University Malaya experts first detected it on March 18, 1999. Nipah virus belongs to the *Paramyxovirus* strain, which shows similarities to the Hendra virus, which was discovered in Australia in 1994. Molecular analyses have confirmed that Nipah virus and Hendra virus are closely related, but different viruses. The N, C, P, V, M, F and G genes of Nipah virus have nucleotide sequence homologies ranging from 88% to 70%, and predicted amino acid homologies ranging from 92% to 67%, in comparison with Hendra virus. The intergenic regions and start/stop signals of the two viruses are identical. They are substantially different from, and have larger genomes than, previously known paramyxoviruses.

The name Porcine Respiratory and Encephalitis Syndrome (PRES) is proposed as the technical name because of the pronounced respiratory and neurologic syndromes associated with the pig disease. The unusual loud barking cough, is another characteristic feature of the disease that differs from the other known respiratory diseases of pigs found in Peninsular Malaysia and thus suggests 'Barking Pig Syndrome' as a common name of the disease. Pathogenesis is still undetermined.

The mechanism of transmission of Nipah virus has not been determined, although infection by direct contact is likely. Causes and contributing factors are movement of pigs and direct pig to pig contact either by mouth, by the respiratory route or aerosol from urinary excretions. The virus can be transmitted from pigs to humans via direct contact with sick pigs through the animals' blood, urine, bronchial secretion and amniotic fluid and other body fluids. Human-to-human transmission of the Nipah virus appears to be low, but may be possible. Because of that, people working in the pig industry or the hospital staff providing intensive care to patients must practice "barrier nursing." The incubation period is from 7 to 21 days. Clinical signs include respiratory disorder characterized by dyspnoea, convulsions and death occurring within several hours. In humans symptoms include rapid labored breathing and very harsh explosive cough. In sows disease may be more pronounced with severe breathing difficulties, pneumonia, mucopurulent discharges from the nose convulsions and death.

Generally mortality of infected pigs is low but morbidity is very high. Researchers believe that fruit bats related to the *Pteropus* species (Pteropus hypomelanus or Island Flying

fox and Pteropus vampyrus or Malayan flying fox or Large fruit bat), which carry Hendra virus, are natural hosts of Nipah virus and may be the original "reservoir" of the disease. Nipah encephalitis and Japanese encephalitis have similar symptoms but patients infected with the Nipah virus deteriorated very rapidly. The mortality rate for human disease caused by Nipah virus is 40% but with dual infection - Japanese encephalitis virus and Nipah virus is 52%.

Diagnose is by serological tests, virus isolation and identification. Laboratory tests include serological test using enzyme linked immunosorbent assay (ELISA) for Nipah, is currently available. Laboratory diagnosis using serum neutralization test (SNT); polymerase chain reaction (PCR) and virus isolation is recommended to be carried out in a biosecurity level BL-4 laboratory.

Treatment is not recommended at all since the disease is transmissible to human. So far, treatment using hyperimmune serum has also not been tried in human.

Animal pathogens as a biological terrorism or warfare agents have the capacity to cause disease and potentially be used to threaten animals. From a social-economic and significant adverse human health impacts, animal pathogens must be evaluated and prioritized. This paper is focused on evaluation of Nipah virus as an animal and human terrorism and warfare agent and compared with other pathogens. This evaluation can serve as the basis for scientific discussion and as help on defining the list of biological agents and toxins in relation to BTWC.

MATERIALS AND METHODS

The criteria we used for evaluation of Nipah virus as a human and animal warfare and terrorism agent, we compiled from several sources such as criteria for selection of biological agents used for negotiations in Ad-hoc Group of States Parties of BTWC, the Australia Group, the Centers for Disease Control and Prevention, Food and Agriculture Organization (FAO) and International Office of Epizootics (OIE). Rankings of Nipah virus as a human and animal warfare and terrorism agent are shown in the tables.

CRITERIA FOR HUMAN PATHOGENS AS WARFARE AGENTS

1. Agents known to have been developed, produced, stockpiled or used as weapons (+).
2. Likely methods and high level of dissemination or contamination a large area as a virulent agent in quantities that could effect large populations: by aerosol or spores in aerosol (+++), infected vector (++), and sabotage (food and water supply) (+).
3. Low infection dose and short incubation or latent period (+).
4. High level of morbidity: higher rating (++) if clinical disease requires hospitalization for treatment including supportive care and lower rating (+) if outpatient treatment is possible for most cases.
5. High level of contagiuousness or transmissibility man to man or high level of infectiousness/intoxication by contact (+), by respiratory route (++), or both (+++).
6. High level of mortality: agents with an expected mortality of ≥50% were rated higher (+++), and with lower expected mortalities (21-49%=++, and <21%=+).
7. Stability in the environment (+).
8. No effective prophylaxis (i.e. immune sera, vaccines or antibiotics) and/or therapy commonly available and widely in use (+).
9. Difficulty to diagnose/detect or identify at the early stage (+).
10. Ease of production and transportation (+).

CRITERIA FOR HUMAN PATHOGENS AS A TERRORISM AGENTS

1. Agents known to have been developed, produced, stockpiled or used as weapons (+).
2. Likely methods and high level of dissemination or contamination a large area as a virulent agent in quantities that could effect large populations: by aerosol or spores in aerosol (+++), infected vector (++), and sabotage (food and water supply) (+).
3. Low infection dose (+).
4. High level of morbidity: higher rating (++) if clinical disease requires hospitalization for treatment including supportive care and lower rating (+) if outpatient treatment is possible for most cases.
5. High level of contagiuousness or transmissibility man to man or high level of infectiousness by contact (+), by respiratory route (++), or both (+++).
6. High level of mortality: agents with an expected mortality of ≥50% were rated higher (+++), and with lower expected mortalities (21-49%=++, and <21%=+).
7. Stability in the environment (+).
8. No effective prophylaxis (i.e. Immune sera, vaccines or antibiotics) and/or therapy commonly available and widely in use (+).
9. Short incubation period (+).
10. Difficulty to diagnose/detect or identify at the early stage (+).
11. Ease of production and transportation (+).

CRITERIA FOR ANIMAL PATHOGENS AS BIOLOGICAL WARFARE AGENTS

1. Agents known to have been developed, produced or used as weapons (Weaponized);
2. Agents which have severe socio-economic and/or significant adverse human health impacts;
3. High morbidity and/or mortality rates;
4. Short incubation period;
5. Difficult to diagnose/identify at an early stage;
6. High transmissibility and/or contagiousness;
7. Lack of availability of cost effective protection/treatment;
8. Low infective/toxic dose;
9. Stability in the environment;
10. Ease of production.

CRITERIA FOR ANIMAL PATHOGENS AS BIOLOGICAL TERRORISM AGENTS

1. Agents which have severe socio-economic and/or significant adverse human health impacts (+);
2. High morbidity rate (+).
3. High mortality rates: agents with an expected mortality of ≥50% were rated higher (+++), and with lower expected mortalities (21-49%=++, and <21%=+);
4. Short incubation period and/or difficult to diagnose/identify at an early stage (+);
5. High transmissibility and/or contagiousness high level of infectiousness/ intoxication by contact (+), by respiratory route (++), or both (+++);
6. Lack of availability of cost effective protection / treatment (+);
7. Low infective dose (+);
8. Stability in the environment (+);
9. Ease of production (+).

CONCLUSION

Many animal and human pathogens can be used as terrorism and warfare biological agents and cause illness. Having a defined and good method for evaluating biological threat agents such as animal and human pathogens allows for more objective evaluation newly emerging potential threat agents. This method of evaluation can help focus public health activities, agriculture activities related to bioterrorizm detection and response. Nipah virus was deleted from the list of animal pathogens in the Rolling Text of the future Protocol of BTWC on 19th session of Ad-hoc group of States Parties of BTWC. Since Nipah virus satisfies the principle criteria, it can be recommended for inclusion in the lists of animal and human pathogens as warfare and terrorism agent.

KEYWORDS

Nipah virus, biological terrorism, and biological warfare agent

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Table 1. Human pathogens (viruses) assessment according to criteria for selecting pathogens as biological warfare agents.

Viruses	Weapo -nized	High level of dissemi -nation	Low infec- tion dose	High level of morbi- dity	High con- tagiousness (transmiss- ibility man to man)	Infection by variety of route (respira- tory route)	High level of mortality	Stability in the environ- ment	Difficulty of detection/ identifi- cation	No effective prophylax is and/or therapy	Ease of produ- ction	Totals +/-
1. Ebola virus	+	+	+	+	+	+	+	-	+	+	+	10/1
2. Crimean-Congo HF virus	+	+	+	+	-	+	+	+	+	+	+	10/1
3. Marburg virus	+	+	+	+	+	+	+	-	+	+	+	10/1
4. Variola major virus	+	+	+	+	+	+	+	+	+	-	+	10/1
5. Lassa fever virus	+	+	+	+	-	+	+	+	+	+	+	10/1
6. Machupo virus	-	+	+	+	+	+	+	-	+	+	+	9/2
7. Junin virus	-	+	+	+	-	+	+	+	+	+	+	9/2
8. Monkeypox virus	-	+	+	+	-	+	+	+	+	+	+	9/2
9. EEE virus	+	+	+	+	-	-	+	-	+	+	+	8/3
10. Tick-borne enceph. virus	+	+	+	+	-	-	+	+	+	-	+	8/3
11. VEE virus	+	+	+	+	-	+	+	-	+	-	+	8/3
12. WEE virus	+	+	+	+	-	+	+	-	+	-	+	8/3
13. Yellow fever virus	+	+	+	+	-	+	+	-	+	-	+	8/3
14. Sin Nombre virus	-	+	+	-	-	+	+	+	+	+	+	8/3
15. Hantaan virus	+	+	+	-	-	+	-	+	+	+	-	7/4
16. Rift Valley fever virus	+	+	+	+	-	-	-	+	+	-	+	7/4
17. Nipah virus	-	+	+	-	-	-	+	+	+	+	-	*6/5*
18. Chikun-Gunya fever virus	-	+	+	-	-	+	-	-	+	+	+	6/5
19. Dengua fever virus	+	+	+	+	-	-	-	-	+	+	-	6/5
20. Omsk HF virus	-	+	+	+	-	-	-	-	+	+	+	6/5

Table 2. Human pathogens (viruses) assessment according to criteria for selecting pathogens as biological terrorism agents.

Viruses	Weapo-nized	High level of dissemi-nation	Low infec-tive dose and short incubation period	High level of morbi-dity	High contagiousness/ transmissibility by contact, respiratory route, or both	High level of mortality	Stability in the environ-ment	Difficulty of detection/ identification	No effective prophylaxis and/or therapy	Ease of produ-ction	Total (17)
3. Ebola virus	+	+++	+	++	+	+++	-	+	+	+	14
9. Marburg virus	+	+++	+	++	+	+++	-	+	+	+	14
1. Crimean-Congo HF virus	+	+++	+	++	+	++	+	+	+	+	14
12.Variola major virus	+	+++	+	+	+++	++	+	+	-	+	14
7. Lassa fever virus	+	+++	+	++	+	++	+	+	+	+	14
8. Machupo virus	-	+++	+	++	+	+++	-	+	+	+	13
16.Monkeypox virus	-	+++	+	+	++	++	+	+	+	+	13
10. Rift Valley fever virus	+	++	+	++	+	+++	+	+	-	+	13
4. Sin Nombre virus	-	+++	+	+	+	++	+	+	+	+	12
2. EEE virus	+	+++	+	++	+	+	+	+	-	+	12
6. Junin virus	-	+++	+	++	+	+++	-	+	+	-	12
11.Tick-borne encephalits virus	+	+++	+	++	+	+	+	+	-	+	12
13.VEE virus	+	+++	+	++	+	+	+	+	-	+	12
14.WEE virus	+	+++	+	++	+	+	+	+	-	+	12
15.Yellow fever virus	+	++	+	++	+	++	-	+	-	+	11
5. Hantaan virus	-	++	+	+	++	+	-	+	+	-	9
17.Nipah virus	-	++	+	+	-	++	-	+	+	-	*8*
18. Chikun-Gunya fever virus	-	++	+	+	-	+	-	+	+	+	8
19. Dengua fever virus	-	++	+	+	-	+	-	+	+	+	8
20. Omsk fever virus	-	++	+	+	-	+	-	+	+	+	8

Table 3. Animal pathogens assessment according to criteria for selecting pathogens as biological warfare agents.

Animal pathogens	Weapo-nized	Severe socio-economic/ human health impacts	High morbidity/ mortality rates	Short incu-bation period	High transmiss-ibility/ contagi-ousness	Low infective or toxic dose	Difficult to diagnose/ identify at an early stage	Stability in the environ-ment	Lack of availability of cost effective protection/ treatment	Ease of produ -ction	Totals +/-
1. African swine fever virus	+	+	+	+	+	+	+	+	+	+	10/0
2. Avian influenza virus (Fowl plague virus)	+	+	+	+	+	+	+	+	+	+	10/0
3. Rinderpest virus	+	+	+	+	+	+	+	+	-	+	10/0
4. Bacillus anthracis	+	+	+	+	+	+	+	+	+	+	10/0
5. Classical swine fever virus (Hog cholera v.)	+	+	+	+	+	+	+	+	-	+	9/1
6. Foot and mouth virus	+	+	+	+	+	+	+	+	-	+	9/1
7. Pest des petits ruminants virus	+	-	+	+	+	+	+	+	+	+	9/1
8. Newcastle disease virus	+	+	+	+	+	+	+	+	-	+	9/1
9.Teschen disease virus (Porcine enterovirus type 1)	-	+	+	+	+	+	+	+	+	+	9/1
10. Vesicular stomatitis virus	-	+	+	+	+	+	+	+	+	+	9/1
11. Bulkholderia (Pseudomonas) mallei	+	+	+	+	-	+	+	+	+	+	9/1
12. Bluetongue virus	-	+	+	+	-	+	+	+	+	+	8/2
13. African horse sickness virus	-	+	+	+	+	+	+	+	+	-	8/2
14. Rift Valley fever virus	-	+	+	+	+	+	+	+	+	-	8/2
15. Brucella spp.	+	+	-	-	+	+	+	+	+	+	8/2
16. Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)	-	+	+	-	+	+	+	+	+	+	8/2
17. Nipah swine encephalitis virus	-	+	+	+	-	+	+	+	+	-	*7/3*
18. Camel pox virus	-	-	+	+	-	+	+	+	+	-	5/5
19.Contagious caprine (pleuropneum.) (M. capri-culum var. capri pneumoniae type F38) (CCPP)	-	-	-	-	+	+	+	+	+	+	5/5
20. Lumpy skin disease virus	-	-	-	+	-	+	+	+	+	-	4/6

Table 4. Animal pathogens assessment according to criteria for selecting pathogens as terrorism agents.

Animal pathogens	Severe socio-economic/ human health impacts	High morbidity/ mortality rates	Short incu-bation period	High contagiousness/ transmiss-ibility by contact, respiratory route, or both	Low infective/ toxic dose	Difficult to diagnose/ identify at an early stage	Stability in the environ-ment	Low effective or cost-effective prophylaxis/ protection/ treatment	Ease of produ -ction	Total (13)
1. African swine fever virus	+	+++	+	+++	+	+	+	+	+	13
2. Avian influenza virus (Fowl plague virus)	+	+++	+	+++	+	+	+	+	+	13
3. Vesicular stomatitis virus	+	+++	+	+++	+	+	+	+	+	13
4. Foot and mouth virus	+	+++	+	+++	+	+	+	-	+	12
5. Rinderpest virus	+	+++	+	+++	+	+	+	-	+	12
6. Newcastle disease virus	+	+++	+	+++	+	+	+	-	+	12
7. Classical swine fever virus (Hog cholera v.)	+	+++	+	+++	+	+	+	+	-	12
8. Bacillus anthracis	+	+++	+	+++	+	-	+	-	+	11
9. Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)	+	++	-	+++	+	+	+	-	+	10
10. Bluetongue virus	+	+	+	+++	+	+	+	-	+	10
11.Rift Valley fever virus	+	+++	+	+	+	+	+	-	+	10
12. Pest des petits ruminants virus	+	+++	+	+	+	+	+	-	+	10
13. Bulkholderia (Pseudomonas) mallei	+	+++	+	-	+	+	+	+	+	10
14. Nipah swine encephalitis virus	+	++	+	+	+	+	+	+	-	9
15. Teschen disease virus (Porcine enterovirus type 1)	-	+	+	+	+	+	+	+	+	8
16. African horse sickness virus	-	+++	+	+	+	+	-	+	-	8
17. Camel pox virus	-	++	+	+	+	+	+	+	-	8
18. Brucella spp.	+	+	-	++	+	-	+	-	+	7
19. Lumpy skin disease virus	-	+	+	+	+	+	+	+	-	7
20. Contagious caprine (pleuropneum.) (M. capri-culum var. capri pneumoniae type F38) (CCPP)	-	++	-	+	+	+	+	-	+	7

15. CONTAMINATION OF ENVIRONMENT AS POSSIBLE CB TERRORISM

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INTRODUCTION

Diseases of unknown origin affected the Canadian soldiers, present as a part of the UNPROFOR in Croatia during 1993-1995. The government of Canada expressed its concern and suspicions that xenobiotics in the environment or other still undetermined environmental conditions were the cause of the ailments that threatened the health of its forces. As the host country, the Republic of Croatia took responsibility to investigate possible indigenous sources of diseases. The first step was measuring of radioactivity and sampling of soil and material used to fill sacks and shelters at the places of soldier's stations. The sacks and shelters were filled with bauxitic material, red mud (waste material from the abandoned alumina plant), terra rossa red soil, brown soil and limestone debris. Sampling, measurements and chemical analyses were done independently by Canadian and Croation expert teams. No chemical warfare agents, PCBs, or other manmade toxic materials and no radioactivity above background levels were detected by these detailed chemical analyses. The expert teams, in turn, confirmed that the soldier's stations, as the places of everyday living activities and task performance, were inside bauxitic open pit mines, but unluckily placed downwind the open space disposal pools filled with caustic solution, waste of alumina production.

The Croatian side paid attention to analysis of the bauxitic material, red mud, limestone from the footwall rocks and caustic solution. The bauxites, used as filler of sacks and shelters, contain increased concentration of a series of elements, such as As, Pb, Cd, Cr, V, Hg, etc., but in highly immobile forms. Mobility of these elements in the red mud is negligible, but could be affected eventually by extremly low pH, not possible in the carbonate rich environment. In addition, in caustic solutions some toxic elements are enriched. It should be mentioned that no deleterious effects of raw material, products of wastes in alumina production have been recorded elsewhere.

The absence of deleterious matter raised the questions: "Could the chemical composition of bauxite ores be a cause of disease?" and "could natural environments become a medium for chemical and biological terrorism?" or "can the fear of the unknown in an environment be used as terrorism?" Once a cause and effect are linked, it is easier to deal with any harmful material.

Case history

The August 1995, according to confidential Canadian military reports, the Canadian peacekeepers serving in Croatia in the mid-1990s were repeatedly exposed to hazardous substances such as PCBs, uranium or bauxite. It was learned that Krajina Serb authorities had laid claim against the UN for the "stealing" of the bauxite, the material that was used to fill sandbags by the Canadian troops. The Canadian public awareness on growing number of ill veterans forced military officials to send a team of experts to Croatia to investigate the allegations of contamination. The need to characterize the hazard was emphasized in 1999 when allegations were made that unexplainable illnesses, being reported by Canadian Forces Personnel, deployed with UPROFOR, Croatia (1993-1995), were a result of being unknowingly exposed to toxic industrial chemicals. A review of scientific data could not

discount these accusations. The team was dispatched to Croatia during summer 1999 to conduct forensic environmental investigation of the Canadian occupation sites. A significant amount of time had lapsed since the last occupation and analytical program was restricted to contaminants that are persistent in the natural environment. A team of Croatian Ministry of Defence joined the Canadian team of experts in order to coordinate fieldwork on the ground with 1.5 million of landmines. Joined campaign of sample collection at the same sites was intended to avoid misinterpretation of the survey result.

The Canadian occupation sites were inside the open pit bauxitic mines, close to an abandoned alumina plant on the location of Zaton (near Obrovac). The plant was built in 1978 with the estimated production of some 300,000 tons of alumina per year. The ore potential was insufficient to satisfy capacity of the plant and production was not profitable. "The political plant" was shut down, but piles of ore were spread around negligently, and waste products, red mud and caustic solution, stored in two large basins. The Larger basin has a volume of 1.58×10^6 m^3, 2/3 being filled with red mud, covered by caustic solution, while the remaining area of the basin is covered with dried red mud. The smaller basin has a volume of 0.75×10^6 m^3 and is filled almost exclusively with the caustic solution. The estimated total amount of red mud is 0.85×10^6 m^3, while the amount of caustic solution is estimated to be 0.5×10^6 m^3 in the smaller basin and 0.3×10^6 m^3 in the larger one. The position of occupation sites was unluckily placed downwind from the abandoned alumina plant and two large basins filled with caustic solution. An adverse effect developed by strong, could, dry wind, named "bura", blowing great deal of a year from the continent, with a speed usually exceeding 100 km/h, produces efficiently water spray from the upper surface of the caustic solution basins. It evaporates immediately leaving high concentration of toxic particulates, as aerosol in the environmental air.

The target of the research was bauxites, red mud, limeatones and caustic solution as possible toxic material, a cause of the health problems.

Red mud

Detailed sampling plan was prepared with the aim to investigate the possible variations of the chemical properties of red mud. 43 samples of red mud were collected and analysed for 16 elements: Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Ga, As, Se, Rb, Sr, Y, Zr and Pb. The analytical method was tube excited XRF. In addition, major chemical compounds present in the red mud were determined by XRD method. Also, a weight loss on 105 °C and loss on ignition on 900 °C and pH value were determined in each collected sample. Percentages of exchangeable fraction were determined on two pH values and three different temperatures. Elemental concentration in resulting solutions was measured by both AAS and XRF.

The results of XRD analysis show that the main components in mineral composition of the red mud are hematite and calcite, while rhutile, goethite and bayerite have less important role. Relatively high amount of gibbsite was also found what points out to incomplete extraction of Al^{3+} during Bayer's process.

Measured concentrations of elements are shown in Table 1. The investigated material was chemically homogenous within the particular basin. Significant differences in elemental concentrations are found between samples from the large and the small basins. The pH values in samples from the dried part of the basin are between 8.2-8.5, while in samples covered with the basic solution are between 9-10. Mean value of Na_2CO_3 is 4.33% and the highest values were found in samples from the small basin (9.35 %).

Table 1: Mean value and range of elemental concentrations in red mud samples

Element	Range	Mean value
Ti (%)	1.6-3.8	2.4
V (ppm)	215.3-667.2	499.4
Cr (ppm)	243.2-406.1	325.5
Mn (ppm)	4240.4-7668.3	6240.5
Fe (%)	15.0-22.6	18.8
Ni (ppm)	12.7-115.0	59.0
Cu (ppm)	18.1-47.8	38.4
Zn (ppm)	65.0-176.1	135.5
Ga (ppm)	12.0-185.2	48.4
As (ppm)	43.7-666.4	246.6
Rb (ppm)	2.8-7.8	4.4
Sr (ppm)	65.0-115.2	91.4
Y (ppm)	116.6-249.8	184.6
Zr (ppm)	666.0-1769.8	991.9
Pb (ppm)	20.9-545.2	64.0

Caustic solution

From the results of chemical and statistical analyses (Table 2), on the basis of 41 samples of caustic solution taken at different depth (every 1 m) from the large and the small basin, it can be concluded that the caustic solution is homogenous in each particular basin, within the whole its volume, in chemical composition, pH (10.2) and alkalinity. Alkalinity results from CO_3^{-2} and HCO_3^- salts, a product of reaction of NaOH, liberated from red mud and CO_2 from air. Comparing the mean values of elemental concentration from the large and the small basins statistically significant difference can be found only for chemical elements: Cu, Ga, As, Se, Br and Pb. Elements Ga, As and Pb have higher concentrations in the samples from the small basin while concentrations of Se, Br and Cu are higher in the solutions from the larger basin. Concentration of V, Cr, Cu, As, and pH value are much higher then allowed for technical waste waters discharged directly into the environment.

Bauxites

The bauxite region of Dalmatia is situated in the middle of the Eastern coastal part of the Adriatic Sea. There are several marked mountains, Velebit, Dinara, Svilaja, Mosor and Promina, in a distinctive karst region, built up of carbonate rocks dominantly, in contrast to the karst fields (polje) of Sinj, Drniš and Knin. The flat terrains in the hinterland of Zadar (Ravni Kotari) and Šibenik, and the hilly Bukovica and Zagora area accomplish regional geomorphology. A few rivers run through almost dry, waterless, karstic countryside cutting their beds into canyons of particular beauty (Zrmanja, Krka, Cetina). The Dalmatian bauxite deposits were formed in several bauxitogenic phases in the Mesozoic and Cenozoic times. The oldest ones are of Triassic age and the youngest are formed in the Neogene, i.e. Miocene time (Šinkovec, et al., 1976; Šinkovec et al. 1989; Šinkovec & Sakač, 1991; Šebešić et al., 1985)

There are two kinds of Paleogene bauxites, Early and Late Paleogene ones. The Early and Late Paleogene bauxites are placed in the inner part of Dalmatia, at Bukovica and Zagora, in a region about 150 km long and 20 km wide (Šinkovec & Sakač, 1982). The bauxite deposits are concentrated around Obrovac, at Dračevac-Jasenica, Kruševo and

Bilišane villages, at the place where Canadian troops made their military camp. The deposits extend to Ervenik and Drniš towns, with well-known deposits on the Promina Mt. and in vicinity of the Moseć Mt. Bauxites of the same age can be found toward Sinj and Imotski towns, and further south-eastwardly in Herzegovina.

Table 2: Mean value and concentration range of elements and pH value in caustic solutions from the two basins and allowed concentration in technological waste waters

Element	Range, large basin	Mean value large basin	Range, small basin	Mean value small basin	Allowed concentration
Ti (ppb)	0-1265	890.4	713-1211	898.4	-
V (ppb)	0-1301	875.4	0-1348	977.1	50
Cr (ppb)	0-1314	406.5	0-1285	451.3	1000
Mn (ppb)	179-1325	897	729-1097	889.3	2000
Fe (ppb)	49-900	472.3	30-1600	477.6	2000
Ni (ppb)	0-545	362	0-588	365.7	1000
Cu (ppb)	331-517	434.5	298-522	397.2	100
Zn (ppb)	302-502	380.2	239-541	373.4	1000
As (ppb)	1800-5900	2578.7	4400-6400	5585.7	200
Co (ppb)	0-1342	296.1	0-1505	555.1	500
Ga (ppb)	300-4560	729.8	1100-3300	1387.6	-
Ge (ppb)	0-80	16.5	0-80	7.6	-
Se (ppb)	4-200	63.1	0-90	29.7	20
Br (ppb)	1600-3000	2233	300-2800	1661.9	-
Rb (ppb)	500-5700	4781.9	1500-5900	4876.2	-
Pb (ppb)	0-59	10.5	10-338	65.6	200
pH	-	10.2	-	10.2	6.5-8

The Early Paleogene bauxite deposits are small, interpreted as fillings in the paleosinkholes. The footwall rocks are Late Cretaceous limestones, mostly Senonian rudisted limestones. The hangingwalls are mainly freshwater-brackish, thin-layered Liburnian limestones, more rarely Eocene formaminiferal limestones.

Their mineral content, as determined by DTA and microscopic examination on the chosen samples is in decreasing order: boehmite, gibbsite, hematite, kaolinite, pyrite, marcasite, goethite, anatase, rutile, calcite, and accessory minerals: zircon, disthene, staurolite, garnet, tourmaline, sphene, corundum, hydromica, chlorite and amphibole. The average chemical composition based on 6 samples is: SiO_2 4.42 %, Al_2O_3 56.27 %, TiO_2 2.56 %, Fe_2O_3 19.42 %, L.O.I. 15.00 %. Average content of trace elements in the Early Paleogene bauxite (in ppm) is: Cu 54 (25-80), Ni 265 (140-500), Co 27 (14-36), Cr 1200 (640-2300), V 959 (550-1400), Zr 476 (310-790).

The average chemical content of accessory oxides and trace elements of the Cretaceous limestones, the footwall rocks of the bauxites, based on 4 samples is: Al_2O_3 286 ppm, Fe_2O_3 110 ppm, TiO_2 18 ppm, SiO_2 581 ppm, Cu 0.6 ppm, Ni 0.4 ppm, Co 0.03 ppm, Cr 0.6 ppm, V 2.1 ppm, Zr 0.7 ppm.

The Late Paleogene bauxite deposits differ in size and shape. Their form is usually like lenses or big nests, occurring mostly in groups. The lens-shaped deposits are irregular and several hundreds meter long and wide, and thick more than 10 m. One of the largest was

in the Jasenica village, where the Canadian troops organized the camp in the open pit mine.

Their mineral composition is following: gibbsite, boehmite, hematite, goethite, kaolinite, anatase, rutile, pyrite, hydromica, lepidocrocite, psilomelane and calcite.

The average chemical composition of the Late Paleogene bauxites based on 7 samples is: SiO_2 6.65 %, Al_2O_3 47.86 %, TiO_2 2.50 %, Fe_2O_3 20.50 %, L.O.I. 22.50 %. Trace element content in ppm is: Cu 82, Ni 427, Co 35, Cr 1177, V 1072, Zr 462,

CONCLUSION

Bauxite ore is a natural product of weathering of alumino-silicate rocks and carbonates. It is formed by natural colloidal precipitation of Fe and Al hydroxides under neutral or slightly alkaline conditions during early diagenesis, which facilitates efficient coprecipitation of trace elements, especially those with high valency state, like U, Zr, Ti, REE, Th,etc., and a number of highly toxic elements like As, Cd, Pb and Se. They are, however, firmly tight within bauxitic minerals, gibbsite, boehmite, hydrargilite, hematite and clayey minerals, under wide span of natural conditions, including highly alkaline or acidic. They are also insensitive on different redox-conditions. We may assume as granted, there is no natural conditions available in supergene (hypergene) environment in carbonate rocks, which can release deleterious elements from bauxites into mobile form to affect human health.

Red mud is an anthropogenic product, the waste after aluminium oxide production, bauxitic like material. It stores high concentration of toxic elements, firmly tight within freshly precipitated colloidal oxyhidroxides. The problem arises from the evaporitic crusts on the red mud particles, formed after evaporation of the caustic solution, which itself is enriched in toxic elements. It consists of sodium salts and hydroxides easily soluble, releasing toxic substances when inhaled. In this way the dust of red mud could be a bearer of mobile forms of toxic elements.

The alkaline, caustic solution, a byproduct of the alumina production in the waste disposal pools, highly enriched in toxic elements, easily remobilized by aerosols during windy days, especially the days of "bura", north-easterly wind from the continent, might be a potential hazard to humen health. There is a plausible conclusion that filling the sacks and shelters with bauxitic material, or camping in the bauxite open pit mine itself is not a cause of the troubles. Living prolonged time in the vicinity of the liquid waste disposal pools and inhaling aerosols developed by strong blowing of bura-wind as well as inhaling dust of red mud might be a source of health hazard.

KEY WORDS

Terrorism, chemical, biological, environmental contmination

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16. INTERNATIONAL ASPECTS OF TERRORISM WITH A SPECIAL EMPHASIS ON CHEMICAL TERRORISM

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ABSTRACT

Contrary to the past, in the last 20 years the motivation, strategy and weapons of the terrorists have considerably changed. Terrorists have started with an increased acquisition and even development of weapons for mass destruction. The fact that a large number of scientific and technological achievements in chemistry have a both civil and military use makes the danger even larger, because it is almost impossible to legally restrain the access of terrorists to certain chemicals. In addition to that, the inefficient border control, the inefficacy of certain government authorities, the lack of a strong political will, etc., are additional reasons that make it difficult to stop illegal transfer of dangerous chemicals.

From a strategic point of view, the approach to the chemical terrorism should be the same as to conventional terrorism: specific legal regulations, adequate intelligence, special equipment based on advanced technologies, physical security of weapon sources, and supervised and controlled exports. In this paper, we point out the existing international legal instruments, with the aim of answering the question of whether the existing general international mechanisms for fighting terrorism are sufficient and effective for fighting chemical terrorism. Moreover, we review the relevant provisions in Croatian legislation, as well as those in the relevant bilateral international agreements of the Republic of Croatia.

KEYWORDS

Terrorism, chemicals, legislation, international agreement, non-proliferation

(This paper was not presented)

17. ASSISTANCE AND PROTECTION UNDER ARTICLE X OF THE CWC

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ABSTRACT

With the acceptance of the Convention on prohibition of the chemical weapons, the State Parties (SP) have clearly stated their orientations to prohibit the development, production, otherwise acquire, stockpiling and use of the chemical weapons, as well as its destruction of the already produced chemical weapons within given period of time. However, since the danger from the chemical weapons pose a threat as long as it exist, the Convention includes the obligations and rights of every State Party to provide and to receive assistance in case of chemical weapons threat.

According to stated above, it is the obligation of the Organization to fulfill the task of mutual assistance of all their State Parties.

Under the objective to fulfill these tasks given to the Organization, it is necessary to define the system of directed attitudes and principles in the organization of preparations and use of the teams/units, material and technical resources and other forms of help, which can, theoretically speaking, be called "The OPCW Doctrine" in providing the assistance to the State Parties, according to the article X of the Convention on prohibition of the chemical weapons.

According to the OPCW Doctrine the Organization, as we believe, should assure coordinated operations of the joint international teams/units on the territory of the country that has requested help, according to unique plan to provide assistance to fulfill obligations according to article X of the Convention, and in the function of preserving dignity of the Convention and Organization in its entirety.

It is a very well known fact that the origin of every doctrine is in the strategy, which certain subject prescribes as its own basic orientations. The State Parties of the Organization on prohibition of the chemical weapons have clearly stated their orientations by accepting the Convention on prohibition of the chemical weapons and put their trust in carrying out the strategy into the Organization and their bodies. Among all it is put in trust to the Organization the conduction of the article X of the Convention which prescribes the obligation of giving the defined forms of help by the State Parties, as well as the right to be given that help as coordinated by the article X paragraph 8.

Congruently to the obligations, State Parties have put to the disposal of the Organization the equipment, teams and units which differ in assignment, size, rigging out, abilities and tactics. When we add to that the numerous legal and administrative obstacles while planning the use and actual use of the equipment, teams and units in providing assistance, we can only assume the size of the problem which the Organization might face while fulfilling its obligations emerged from article X of the Convention.

To solve problems as easier as possible and reduce them to the group of defined, developed and accepted basic regulations of operation and behaviour in practice, it is necessary to define, accept and prescribe "The Organization Doctrine in providing help to the State Parties according to article X of the Convention".

Theoretically, the Doctrine really is not anything else but a complete system scientifically set, worked out in detail and accepted basic regulations on activities, which give the direction in operations and actions in practice.

In accordance with the upper definition, the Doctrine should clearly respond and determine the directions on operations and actions in practice regarding the following questions:

a) Which are the objectives in providing assistance and protection?
b) To whom and when the assistance and protection should be given?
c) Where, how and under which conditions the assistance and protection should be given?
d) Which are the units and means of providing assistance and protection?
e) How are the objectives of providing assistance and protection realized?
f) Which are the regulations in providing assistance and protection?

Once the State Parties Convention has verified the Doctrine, it should be published through written forms, in the lineament of regulations of the equipment, teams/units, norms (minimal administrative, material, personnel and legal criteria), directions, guidance, instructions, manuals, textbooks, etc.

Even if all the answers on every question were completely clear, the Organization would still have an enormous job in preparation and verification of the Doctrine, as well as its publication and execution in the real world. We believe that the Organization would have a large support of the majority of the State Parties as well as some international organizations (UN, for example) that could offer some solutions already defined and verified in practice. Unfortunately, even then all the answers are not completely clear and the good will and additional effort to find answers acceptable for every State Party is needed.

The objectives of providing assistance are clearly prescribed by the preamble of the Convention and by the article X of the Convention and we believe that it has, considering this question, achieved full consensus of all the State Parties. But a problem appears when defining the answer to the question to "whom and when to provide help". According to article X paragraph 8 the Convention has emphasized that each State Party has the right to request and subject to the procedures set forth in paragraphs 9, 10 and 11 to receive assistance and protection against the use or threat of use chemical weapons if it consider that:

a) Chemical weapons have been used against it;
b) Riot control agents have been used against it as a method of warfare; or
c) It is threatened by actions or activities of any State that are prohibited for SP by Article I.

According to this definition of article X paragraph 8 of the Convention two problems are brought before the Organization and State Parties which puts under the question mark the meaning of providing assistance, and subsequently, the consensus of the State Parties on to whom and when to provide assistance.

The first problem is of conceptive nature and it is based on presumption that in regarding to the Convention every year there is going to be less and less chemical weapons and subsequently the need for providing assistance and protection will be decreasing, while there will actually be more and more chemicals from the list II and III and discrete organic chemicals (DOC), their manufacturing facilities and warehouses. That fact confirms that the danger for State Parties will be at least equal, if not larger, from the moment of destruction of all declared chemical weapons.

From what was said comes out the second problem of the definitional nature: what is really a chemical weapon and what is considered by chemical attack, from which is derived the interpretation on who has the right to be provide with assistance.

By the examination of the article I and II of the Convention clearly follows that every attack by chemical weapons, toxic chemicals and their precursors, ammunition and the

devices specially designed to cause death, is considered to be a chemical attack prohibited by the Convention, and the attacked SP has the right to ask for assistance and protection.

Likewise, it is also very clear that this toxic chemicals and precursors are on the list I, II and III of chemical as well as on the list of discrete organic chemicals, which are, according to article VI, subdued to the declaration altogether with the their manufacturing facilities and warehouses. The outcome is the paradox of the article I and article X paragraph 8 of the Convention according to which it is prohibited to use own chemical weapons and all defined by article II, but the attack on the manufacturing facilities and warehouses of the chemical weapons, toxic chemical and precursors on the territory other State Party with the use of conventional weapons or by terrorist act does not consider to be the use of chemical weapons. A lot of people are eager to interpret this as "common" disaster in which case the State Party has no right asking for assistance and protection.

Beside the problems the State Party has when struck by such common disaster, here appears one very dangerous precedent which was already used on the territory of the Republic of Croatia (during the war activities against the Republic of Croatia 1991-1995), which is not to act in aggression by using chemical weapons but using conventional weapons on chemical facilities with the objective of causing the emission of the toxic substances, the same which each SP, according to the article VI, has the obligation to declare.

Where, how and under which condition assistance and protection are provided are questions, which are relatively easier to answer when, through table exercises, every possible real scenario, and supposition, which may occur while providing assistance, is worked through.

According to the present reasoning, a SP has the right to ask for assistance and protection if it is attacked by a chemical weapons and there is no question about that. The question is what kind of assistance is possible, real and appropriate. It is certain that the assistance in the form of teams/units for decontamination questionable if the attack has happened between the forces in touch/conflict because the assistance could be considered as an intrusion into the conflict. It is also precarious which SP will offer their assistance in the form of teams/units in the zone of the conflict. However, that does not mean that the assistance is not possible in the form of means and equipment and in the form of medical teams.

The scenarios and training will show what is the real amount of forces and means needed for certain situation and define the time in which, from the moment of the actual attack, the assistance is still appropriate. This specially relates to the article X paragraph 8 subparagraph (b) because the assistance, in case of the riot control agents use, in form of teams/units actually becomes questionable, but not the protective equipment and teams for education as well.

Paragraph 8, subparagraph (c) is quite general in relation to previous subparagraphs and its clarification can also contribute stuff training and scenarios and suppositions.

Forces and means by which the Organization provides assistance to the countries and State Parties, which ask for it, is a very complex question.

When we review up-to date equipment, teams and units that are given on disposal of the Organization, it is very clear that they differ in its purpose, size, rigging out, possibilities, tactics, which significantly impedes achieving the mutual objective. At the same time more attention should be given to the series of basic presumptions as a prerequisites for fulfillment of that objective which we will define in this Doctrine as minimal administrative, material and personnel criteria, of which we feel that the equipment, teams and units should fulfill, before they are set to disposal to the Organization. Speaking about minimal criteria that should be prescribed by Doctrine when considering teams/units of State Parties, which are

offered as a form of assistance according to article X, we comprise, above all, the following criteria:

a) time of readiness of the teams/units for engagement from the time of the call unit the readiness for transport
b) choice and education of members of the teams/units
c) size and rigging out of the teams/units with regard to the tactical possibilities
d) size and rigging out of the teams/units with regard to the length of engagement
e) minimal logistic support to the units by their domicile country
f) criteria of health, legal and financial insurance of the members of the teams/units
g) criteria of rigging out personal equipment, equipment for self-protection, self-aid, self-decontamination and means and devices for chemical detection and monitoring
h) administrative measures and procedures.

The answer to the question how are the objectives of providing assistance and protection fulfilling has to start from a clear political platform of the Organization given throughout the Preamble of the Convention and all positive political and legal international acts which were the Organization's starting point while creating the Convention or which have been accepted as human acquirement.

The Organization Doctrine has to enable the fulfillment of its political objectives. Because of that, beside the defined ways of providing assistance as well as the defined procedure of seeking assistance, given through article X of the Convention, the Doctrine also has to offer the answer on so called "border way cases" defined through the second question of this paper.

Also the Doctrine should offer the answer about the ways of collaboration with all other international organizations that deal with humanitarian questions, and especially with competent bodies of the UN, UNHCR, etc. This is even more interesting while finding solution for border way cases in which two or more international organizations can achieve their political objectives united by already set procedure and regulations of collaboration.

Regulations which should be respected by the SP which participate in action of providing assistance and rescue are given generally through international legal acts which regulate war, humanitarian and common law as well as through the number of other international contracts, treaties, protocols and conventions, but they are not considered from the point-of-view of the Organizational needs and execution of the article X of the Convention.

In this category are also included all administrative measures and actions which are necessary while defining authority of the teams/units as well as their behavior, defining of neutrality and immunity.

For everything stated in this paper it would be very useful to create manuals which would contain all standard operative proceedings in every situation, from the request for assistance, transport, tactic of usage, behavior of the members, emergency situations to extraction of the teams/units.

CONCLUSION:

It is generally known that every organization, no matter whether they are governmental or international, longs to provide coordinated operation of all their subjects and components, according to unique plan and conception to fulfill obligations taken over, which are in the function of preserving the dignity of the organization. Those intentions are defined throughout the document, which is usually, called the doctrine.

We believe that it would be very useful that the Organization, in assistance with teams composed of SP experts, offer one such document to all SP for consideration, altogether with the suggestions for the solutions of the controversial question. Once such a document is accepted, which could be called "The Doctrine of providing assistance and protection of the State Parties according to article X CWC", the teams of experts set to disposal of the Organization by the SP, could prepare written forms in the lineament of regulations of the equipment, teams/units, norms (minimal administrative, material, personnel and legal criteria), directions, guidance, instructions, manuals, text-books, etc.

18. SIMULATION MODELLING OF ECOLOGICAL APPEARANCE

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Ecological processes that are happening in the nature are under strong influence of human act and behaviour (consciously or no consciously), having great consequences for different eco-systems. Transforming the fitted discontinuous distributions to continuous solves the problem of modelling the continuous processes, for which the observed values were measured in discontinuous time periods. One of asymmetric threats today is a terrorist act by which the terrorist (s) can contaminate the origin of the drinking water. Waters are in ecological point of view the most harmful and vulnerable, but also the most important part of the Global eco-system. On the planet Earth, land makes 29.2, and water 70.8 percent. There are 1.38 billions cubic kilometers of water, out of which 97.4 percent is salt water, and 2.6 percent fresh water; out of this, only 3 percent is potable water. The aim of this work is modelling of ecological appearance with the special emphasize to the water purification. Using the simulation modelling methods and techniques, matched for discontinuous processes, the efficiency of different absorbing materials (active carbon, zeolite A, zeolite ZSM-5, TMAZ) that can be used with different pollutants (dibutyl sulphide, different arsenic substances, different organophosphorus substances). With all collecting data it is possible to predict use of these materials in the accidents and in the situations of terrorist acts. To control the entering parameters and to get the output simulation method we used one of the standard packages for discrete simulation, Service model v4.2 (ProModel Corporation, while for continuous control of the processes we used Extend v4 (Imagine That, Inc.).

Water

1. Liquid without colour, smell or taste that falls as rain, is in lakes and seas, and is used for drinking, washing etc.
2. This liquid is supplied to homes, factories etc. in pipes
3. A mass of this liquid, esp. a lake, a river, sea etc. (Oxford English Dictionary).

INTRODUCTION

The effective dissemination of CB agents is generally considered to be more difficult than their manufacture. For example, the popular scenario involving the poisoning of the water supply of a major metropolitan area does not appear very feasible, given the large quantities of agent that would be required and various filtering or purification measures usually in place. On the other hand, the water supply for a discrete installation could be vulnerable, as would be air conditioning systems of even quite large public buildings or tunnel networks, such as subways. Similarly, domed sports stadiums have been described as "ideal" targets for a terrorist CB attack intended to kill tens of thousands of people.

Acquisition of CB materials

- A wide range of potentially deadly chemical and biological (CB) agents, including various insecticides, industrial chemicals and potent toxins such as ricin, may be relatively easy to produce or otherwise acquire.
- Some deadly pathogens can be obtained by mail from scientific supply houses; in other cases it is possible to harvest them from nature or to "grow your own" with relatively unsophisticated equipment and limited expertise.

- It may be possible to steal deadly agents from civilian research facilities or military stockpiles. Nor is it inconceivable that a state sponsor of terrorism would be deliberately wiling to provide terrorists with CB weapons or materials, if it could convince itself of "plausible deniability" while using a surrogate group to inflict a devastating blow on an enemy.
- However, the manufacture of modern, weapons-grade nerve agents by terrorists themselves may not be easy as often assumed: it requires a sophisticated laboratory infrastructure due to the use of high temperatures and the generation of corrosive and dangerous by-products.
- On the other hand, chemical blister agents, such as sulphur mustard, nitrogen mustard, and lewisite can be manufactured with little to moderate difficulty, although the acquisition of large quantities of the necessary precursors could arouse suspicious.
- As for biological agents, the principle obstacle is the development of a genuinely lethal strain in sufficient quantities to cause mass casualties.

What is softer than water?
What is harder than rock?
Still, soft water carves hard rock.
(Ovidius)

As already mentioned, ecological appearances are processes that are happening in the Nature under the great influence of human behavior (conscious or unconscious), which is the cause of the drastic consequences for them.

Although the processes are going continually, their course is not writing in continuity. Instead of that it is measured the state of their characteristics in the specific time. One of the asymmetric threats today also include the terroristic act by the source of potable water can be contaminated.

Waters are in ecological view the most jeopardized and the most loaded, but also the most important part of the global eco system.

On June 18, 1992 it was seen a lot of dead fishes in the river Bednja near village Stažnjevec. Nor far from that place is the drain channel of the sewage system of the town Ivanec. (Figure 1. Map of the place where the event happened)

After the water analyses it was confirmed that in water was found high concentration of cyanides, in the average value of 0.424 mg/L.

All around and downstream the river, in the distance of 5 km flora and fauna were destroyed.

That event was the target for us to try to investigate and find out the best apsorbing materials that can be used as ecological filters.

Modelling:

The digital process model for the simulation of absorption of paraoxon (as well as DBS and CN) on activated charcoal, ZA, SiO2, TMAZ, ZSM-5 and Al2O3 are shown on the picture.

For every material for absorption, it is defined the specific rules about absorption of paraoxon (or other agents) through the **model Equation**, in which it is written the rule/ the possibility for the absorption of every specific material.

To make "the real" picture of the process of the absorption, for every material, we count the influence (dependence) of the absorption through the time (which is specific for every absorbing material), as the entering process.

This is fulfilled with the model for gendering the values by the process of accidental numbers through the **"best fitted distribution".**

In this model we used **empirical distributions**. As the started value of the simulation experiment, started values of the concentration of paradoxes (an other agents) in water are taken.

This value is a constant.

These constant and generic values of the dependence of absorbance in time are the entering parameters for the simulation model which transform through the Equation to the output values of the concentration of paraoxon (DBS, KCN).

EXPERIMENTAL

Zeolites (ZA, Klinoptilolite (TMAZ)), and some other materials as SiO_2 and Al_2O_3 (because they are precursors in the synthesis of zeolites), and activated charcoal (already used as the absorbing material in some personal decontamination kits) were used as absorbents for the KCN.

To study the process of absorption of KCN on ZA, TMAZ, SiO_2, Al_2O_3 and charcoal 2 g of solid (5, 7.5 and 10 g) were put into the reaction vessel containing 25 ml of KCN solution (0.02 M) in water.

The moment the solid was added to the solution was taken as the zero time of absorption (t_{ab}= 0).

At various times after the process of absorption of KCN started (1, 2, 5, 10, 20, 30, 40 60, 120 min), suspension were drawn of for analysis, and centrifuged.
After that the tytrimetric reaction with $AgNO_3$ was used to calculated the concentration of absorbed KCN on different absorbing materials.

RESULTS AND DISCUSSION

Figure 2 shows the absorption of KCN on ZA, TMAZ, SiO_2, Al_2O_3 and charcoal (10g); a) concentration on absorbents, b) concentration in solutions.

With ZA it is not possible to absorb more than 50 % of starting concentration of KCN. With 2 g of ZA in first ten minutes, it is absorbed about 40 % of the starting concentration of KCN.

Using 5.0 g there is no great difference in maximum absorption of KCN. But, instead 5 min, in first two minutes it is reached the maximum of absorption, after which it is reached the plateau.

This plateau is for 5.0 g of ZA 45 %, and for 7.5 and 10.0 g 50 %.

Using klinoptilolite (TMAZ) the difference between use of 2.0 g or 10.0 g is in the time necessary to reach the plateau of absorption.

With 2.0 g, in first 5 minutes 40 % of the amount of KCN is absorbed, while in next 20-25 minutes it is reached the maximum of absorption.

Using 5.0, 7.5 and 10.0 g the time in which the plateau is reached is moved to the left. In first 5 minutes absorption of KCN using 5.0 g of TMAZ is 48 %, using 7.5 g 55 %, and using 10.0 g amount 65 %.

Using alumina for absorption of KCN there is no big difference when it is used 2.0, 5.0, 7.5 or 10.0 g.

The maximum is reached after 30 minutes and using alumina it is possible to absorb more than 55 % of initiated amount of KCN.

The use of silica and charcoal shows similar characteristics (Fig. 3 a, b and Fig 4 a,b). With silica (Fig. 3. a, b), even with only 2.0 g, it is possible to have the same characteristics as with the use of 10.0 g.

With charcoal, there is the difference in the time reaching the plateau (Fig. 4 a, b).

With 2.0 g, after 5 minutes the absorption of KCN is about 50 %, with 5.0 g and 7.5 g about 65 % and with 10.0 g 80 %, what is almost the maximum amount of absorbing KCN.

The maximum for 5.0 g and 7.5 g is reached after 20 min, and for 2.0 g after an hour.

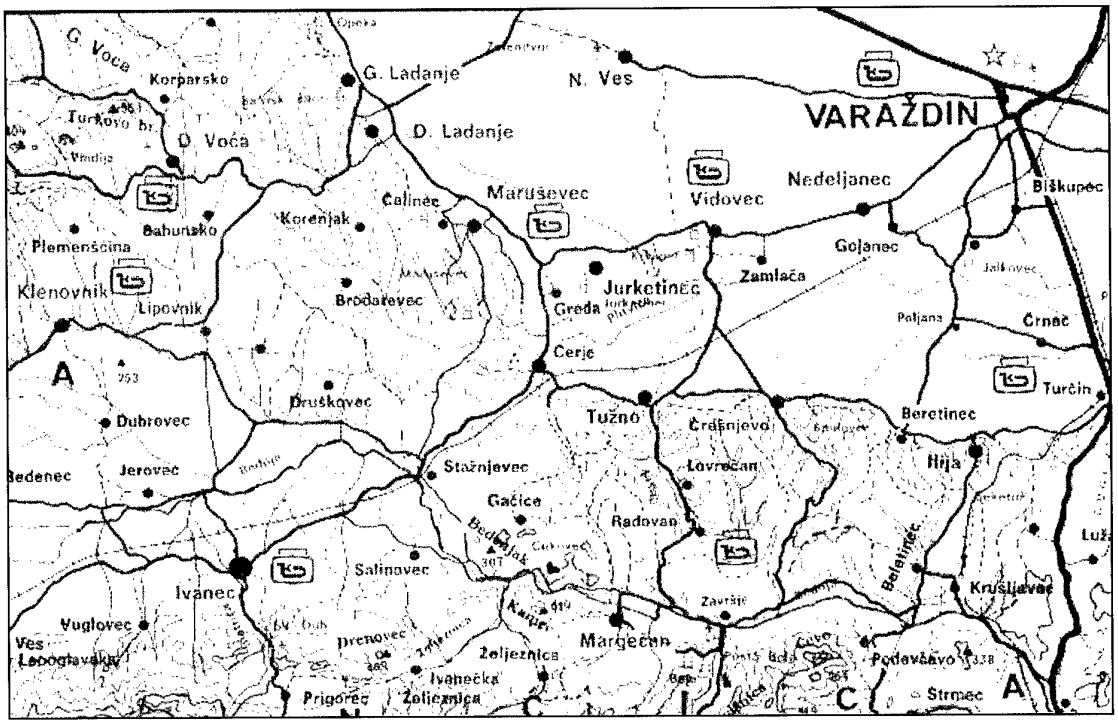
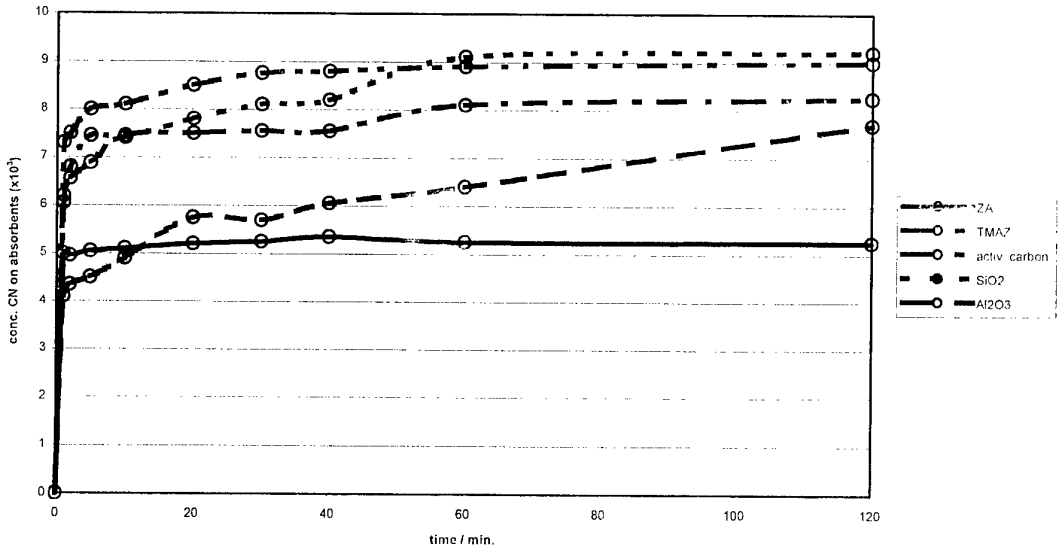
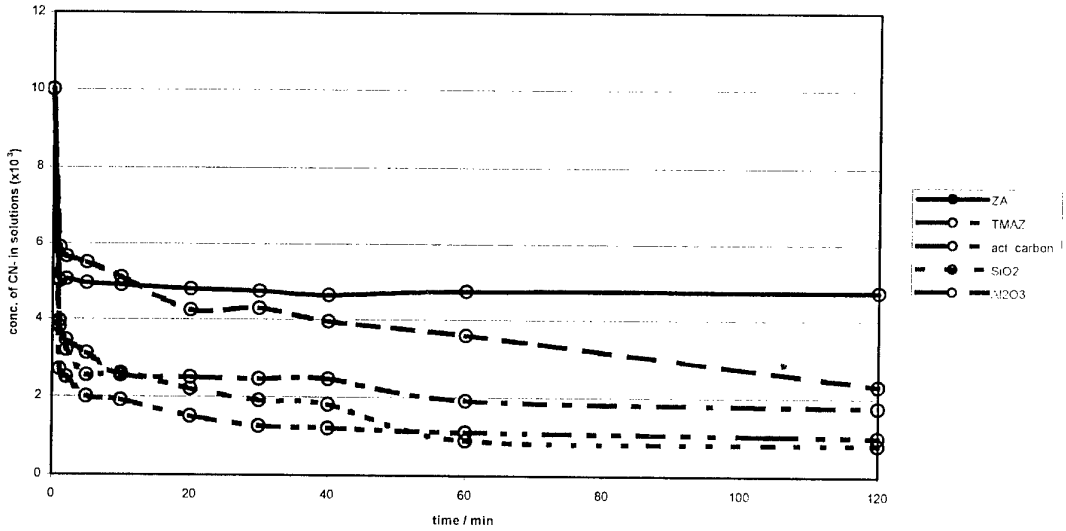


Figure 1. Map of the region and the place where the event happened.

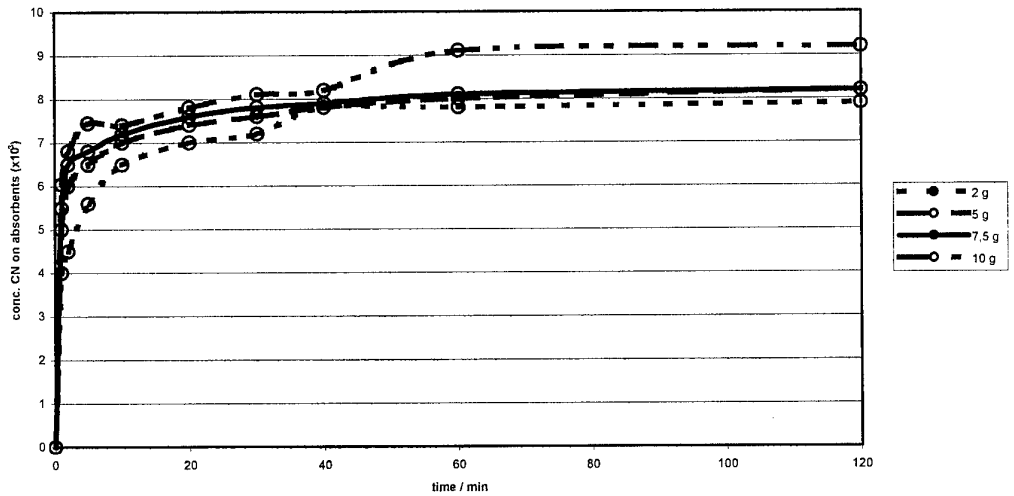


a)

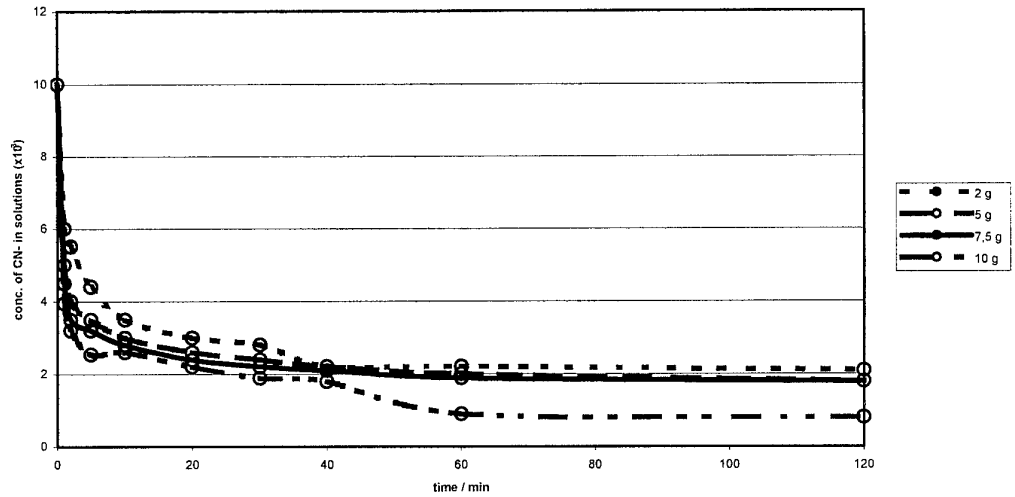


b)

Figure 2. The absorption of KCN on ZA, TMAZ, SiO_2, Al_2O_3 and charcoal (10g); a) concentration of KCN on absorbents, b) concentration in solutions.

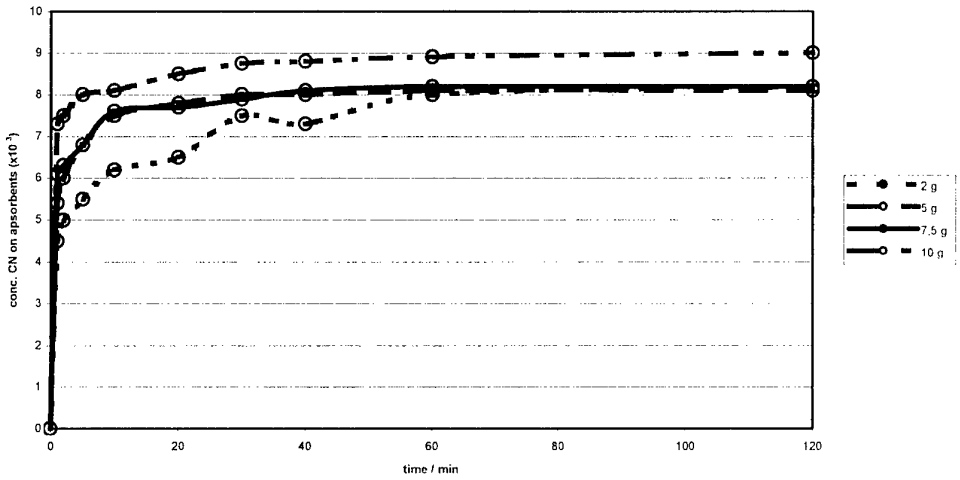


a)

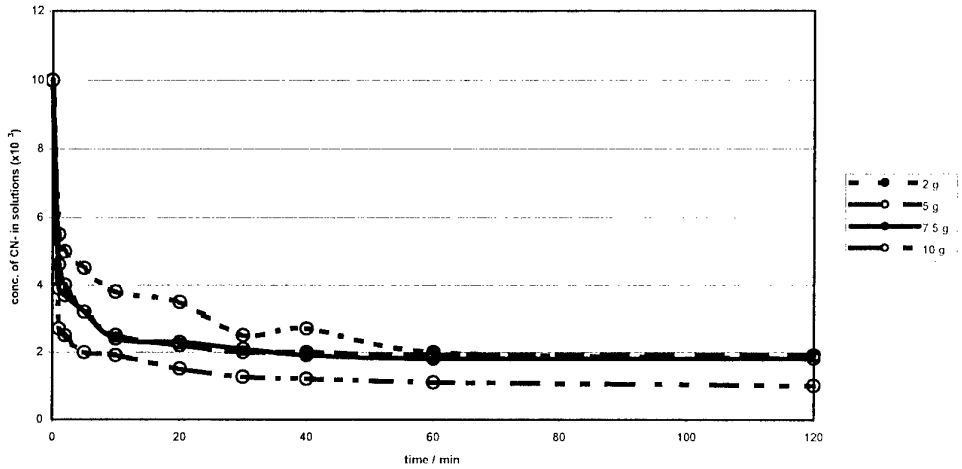


b)

Figure 3. Absorption of KCN on SiO_2 (2.0; 5.0; 7.5 and 10.0 g).
a) concentration of KCN on absorbent b) concentration in solution



a)



b)

Figure 4. Absorption of KCN on charcoal (2.0; 5.0; 7.5 and 10.0 g).
a) concentration of KCN on absorbent b) concentration in solution

CONCLUSIONS:

- There is great difference in absorption of KCN in different materials (ZA, TMAZ, activated charcoal, SiO_2, Al_2O_3)
- Using 2.0 g of absorbing material efficiency falls down in order ZA<TMAZ<Al_2O_3<activated carbon<SiO_2. The same order can be seen using 10.0 g of absorbing material.
- For ZA with 2.0 g of ZA the absorbing maximum is reached after 8-10 minutes and it is about 40 % of the initial concentration of KCN.
- For 5.0, 7.5 and 10.0 g the absorbing maximum is reached in 2-5 minutes, and it is between 45 and 50 % of the initial concentration of KCN.
- For other absorbing materials there is no great difference in use of different amount of absorbency (especially for 2.0, 5.0 and 7.5 g) and absorbing maximum is reached after 5 minutes. Taking into consideration all mentioned above, all the materials could be used as the absorbing materials in the kit for personal decontamination. Based on these results it seemed that the best results could be achieved with silica. Probably, even better results can be achieved with silica fumed, because of the available surface.
- About the model, after the model is made, its evaluation must confirm the possibility of its use in the real system. Evaluation is confirmed with statistical tests (hi square Kolmogorov- Smirnov test or Anderson- Darling test). Using this model it can be predicted in any time the concentration of the chemical agent in the solution and the amount of the agent that is absorbed. Comparing all adsorbents, it is possible to get the information which absorbing material is the most efficient. Beside that, the simulation experiments can be done even for the chemical agents for whom experimental adsorption measurements were not done.
- Also, it can be predict the most useful combination of adsorbing materials (in percentage).

KEY WORDS

Asymmetric threats, modelling, active carbon, zeolites

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19. BIOCHEMICAL STUDIES OF OXIMES SYNTHESIZED IN CROATIA OVER THE PAST DECADES

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About ninety new oxime compounds were synthesized in Croatia over the past two decades. These compounds contain one or two oxime groups on pyridinium, imidazolium or quinuclidinium rings, or on their derivatives, as shown on Figures 1 and 2. Almost all compounds were prepared in the Department of Organic Chemistry, Faculty of Science of the University of Zagreb. The syntheses of the major groups of compounds are described in references 1-14.

Biochemical studies of the compounds comprised the mechanism of reversible inhibition of cholinesterases, protection of the enzymes against phosphorylation by organophosphates (OPs) and reactivation of the inhibited enzymes. The enzymes were mainly human erythrocyte acetylcholinesterase (AChE; EC 3.1.1.7) and human plasma butyrylcholinesterase (BChE; EC 3.1.1.8). The OPs were primarily Sarin, Soman, Tabun, VX and DDVP. The evaluated biochemical parameters were compared with those obtained from studies with conventional oximes used as therapeutic agents against intoxication by OPs: PAM-2, HI-6 and Toxogonin (Fig. 3). Most biochemical studies were carried out at the Department of Biochemistry of the Institute for Medical Research and Occupational Health, Zagreb (11-27).

We have shown that the majority of new compounds, just like the conventional oximes, bind to two sites on AChE: the catalytic or/and allosteric site. The enzyme-oxime dissociation constants (K_d) were in the millimolar range for most compounds with only a few compounds having higher affinity (i.e. low K_d value) (Table 1). The affinities for the two sites on the enzyme were usually within one order of magnitude apart. The affinities of the oximes for BChE were different for different BChE phenotypes (Table 1); this property might be of importance, considering the effect of oximes on the therapy of poisoning by OPs.

All compounds protected AChE and BChE against phosphorylation by OPs. As the protection of the enzyme depends on the concentration of the oxime and on its affinity for the enzyme, it can be predicted from known K_d values. Theoretical equations for the effect of reversible inhibitors upon phosphorylation were derived for compounds that bind either to the catalytic or allosteric site, or to both sites on the enzyme. The equations were experimentally verified for the effect of bipyridine on the inhibition by several organophosphates (28). In the examples shown in Table 2, the protective index (PI) was calculated assuming that the protector binds only to one site of the enzyme. The higher PI measured than the calculated PI indicates however that the protector binds to both, the catalytic and allosteric sites.

Reactivation of the phosphorylated AChE was similar to reactivation by the conventional oximes with one exception BDB-113 (diimidazolium dioxime) that proved to be a better reactivator of the Tabun-inhibited enzyme than the other oximes (Table 3).

Finally, we have shown that the oximes react with thiocholine esters, like acetylthiocholine, whereby thiocholine is one of the reaction products (21, 24). This is a non-enzymic reaction that might even exceed the rate of the enzymic hydrolysis of thiocholine substrates. When enzyme activities are determined spectrophotometrically with thiol reagents (like DTNB) in the presence of an oxime, the overall rate of substrate hydrolysis must be corrected for this non-enzymic reaction because otherwise false higher activities will be reported.

The majority of new oximes was also tested *in vivo* (on mice or rats). The best effect against intoxication by Soman was obtained with a carbamate of the quinuclidinium-imidazolium oxime (29).

The efficacy of some prepared oximes as protectors and reactivating agents shown in the biochemical studies justifies their retesting and further extensive research.

SUMMARY

This paper gives a short review of biochemical research of oximes sythesized in Croatia over the past two decades. The synthesized compounds contained one or two oxime groups at various positions on pyridinium, imidazolium, or quinuclidinium rings. Aromatic rings of some compounds were substituted with aliphatic or aromatic radicals. Biochemical studies of the oximes focused on the mechanism of reversible binding of oximes to cholinesterases, reactivation of phosphorylated cholinesterases, protection of the enzyme against inhibition by the organophosphates (Soman, Sarin, Tabun, VX or DDVP), and interaction of oximes with thiocholine substrates.

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LEGENDS TO FIGURES AND TABLES

Pyridinium and dipyridinium derivatives

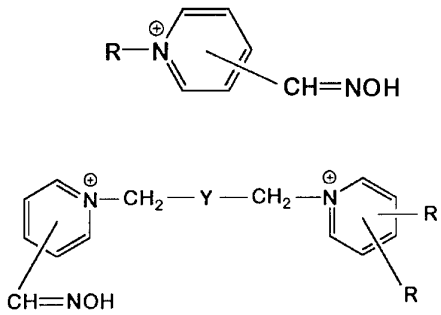
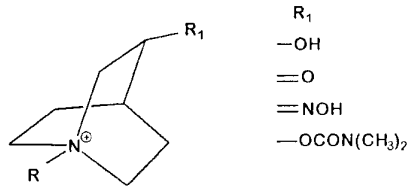


Figure 1.

General stuctures of pyrydinium and dipyridinium oximes Y stands for: - O -, $-(CH_2)_n-$ or -CO-.

Quinuclidinium derivatives



Imidazolium derivates

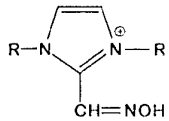
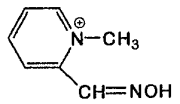


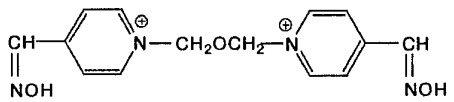
Figure 2.

General structures of quiniclidinium and imidazolium derivatives. They were prepared as oximes or these structures were combined with each other or with a pyridinium ring. Mono- or dioxime derivatives were prepared with different substituents on the rings.

PAM-2



TOXOGONIN



HI-6

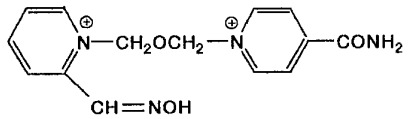


Figure 3.

Structure of the conventional oximes.

Table 1.

Dissociation constants of enzyme-oxime complexes (K_d) for the presumed binding sites evaluated from the effect of oxime upon activity of human erythrocyte acetylcholinesterase or serum butyrylcholinesterase. BDB-106 and BDB-110 are two 1-methyl-imidazolium oximes linked by $-CH_2-CH=CH-CH_2-$ (BDB-106) or linked by $(-CH_2-)_4$ (BDB-110). BDB-108 is a dipyridinium dioxime linked by $-CH_2-CH=CH-CH_2-$.

ENZYME	OXIME	K_d / mM		References
		Catalytic site	Allosteric site	
	PAM-2	0.13	0.76	21
	Toxogonin	0.16	2.0	21
	HI-6	0.031	0.16	23
	BDB-108(cis)	0.052	> 0.1	15
	BDB-108(trans)	0.045	> 0.08	15
	BDB-106	-	0.024	15
	BDB-110	-	0.011	15
Butyrylcholinesterase				
Usual	PAM-2	0.88	> 1.7	27
	HI-6	0.23	> 0.7	27
Atypical	PAM-2	1.1	> 3.4	27
	HI-6	0.47	> 2.5	27

Dash (-) means no binding observed to the catalytic site.

Table 2.

Protection of human erythrocyte AChE against phosphorylation by Soman (5nM) or VX (20 nM) (Ref. 14). PI denotes protective index. PI-measured = k_i / k_i', where k_i and k_i' are rate constants of phosphorylation in the absence and presence of the protecting compound. PI-calculated = 1 + (Concentration of the protecting compound / K_d). The PI-calculated refers to both, Soman and VX.

COMPOUND	OP	PI Measured	PI Calculated
3-oxo-1-methylquinuclidinium iodide / 1.4 mM	Soman	1.9	1.9
	VX	2.0	
3-oxo-1-methylquinuclidinium iodide / 6.0 mM	Soman	9.0	4.8
	VX	7.0	
3-oxo-1-[3-(2-hydroxyiminomethyl-3-methyl-1-imidazolio)propyl]-quinuclidinium diiodide / 0.2 mM	Soman	2.0	1.8
	VX	1.9	
3-oxo-1-[3-(2-hydroxyiminomethyl-3-methyl-1-imidazolio)-2-oxapropyl]-quinuclidinium dichloride / 0.3 mM	Soman	3.8	2.2
	VX	4.2	

Table 3.

Reactivation (%) of phosphorylated human erythrocyte acetylcholinesterase (Ref. 9). All compounds are dioximes and their aromatic rings are linked with $-CH_2-O-CH_2-$. BDB-101 and BDB-118 have pyridinium and imidazolium rings and BDB-113 has two imidazolium rings; the imidazolium rings are in all compounds substituted with benzyl.

OXIME	SARIN	VX	TABUN	SOMAN
PAM-2	66	61	0	0
Toxogonin	79	78	16	3.6
HI-6	73	85	0	2.6
BDB-101	57	4	13	1.4
BDB-113	68	22	44	0
BDB-118	82	54	12	9

KEY WORDS

Oximes, synthesis, cholinesterases, inhibition, organophosphorus compounds

20. IMPLEMENTATION OF THE CONVENTION ON TRANSBOUNDARY EFFECTS OF INDUSTRIAL ACCIDENTS IN THE REPUBLIC OF CROATIA

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INTRODUCTION

A strategic interest of the Republic of Croatia is entering European economic, political and other integrations. Major preconditions for it are the institutional strengthening and legislative harmonisation with the relevant UN conventions and agreements and EU directives in the field of hazardous substances and industrial accidents management, and emergency planning for the protection of humans and the environment.

Becoming a party to the Convention on Transboundary Effects of Industrial Accidents (Helsinki 1992), the Republic of Croatia has committed to developing regulations and mechanisms to promote, ensure and improve elaboration of measures, criteria and procedures in the field of responsibility and liability within the Convention, and to incorporating the provisions of the Convention into its legislative system.

Adopting the provisions of the Convention, Croatia has committed to fulfilling the following basic objectives of the Convention:

- reducing risks of industrial accidents and improving prevention, preparedness and response measures;
- encouraging operators of industrial facilities performing a hazardous activity to take measures to reduce risks of industrial accidents and supply all relevant information on the hazardous activity performance safety;
- giving all relevant information to the public and enabling public participation in relevant procedures related to industrial accident prevention, preparedness and response measures;
- developing harmonised emergency plans at all levels, including joint emergency plans for parties to the Convention, for hazardous activities likely to cause transboundary effects;
- establishing appropriate industrial accident notification systems at all levels;
- developing and harmonising legislation in the field of industrial accidents;
- joint training and advice in industrial accident prevention, preparedness and response;
- drills to verify industrial accident preparedness and response capabilities;
- providing mutual assistance in cases of industrial accidents;
- providing technical assistance for remediation of consequences of an industrial accident.

The first Conference of the Parties has adopted the programme of measures aimed at implementing the Convention.

Long-term measures:

1. Implementation of the Convention
2. Identification of hazardous activities.
3. Industrial accidents reporting
4. Prevention of industrial accidents, including risks for watercourses
5. Preparedness for possible accidents, responsibility and mutual assistance
6. Scientific and technical cooperation in the field of industrial accident prevention, preparedness and response
7. Reporting on industrial accidents within the existing EU Major Accident Reporting System (MARS) network

8. Information exchange and submission

Short-term measures:

1. Implementation of the Convention
2. Identification of sites with hazardous substances and hazardous activities.
3. Promoting industrial accident prevention measures, including prevention measures for accident–induced water pollution
4. Preparation of a joint implementation programme for the Convention on Transboundary Effects of Industrial Accidents and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, including legal instruments on civil liability for damage caused by hazardous activities covered by both conventions
5. Improving efficiency of industrial accident reporting systems
6. Reporting and analysis of past industrial accidents
7. Improving procedures on safer technologies information exchange

IMPLEMENTATION OF THE CONVENTION IN THE REPUBLIC OF CROATIA

Approximately 100 accidents involving hazardous substances (Appendix 1) that may cause environmental damage, endanger human lives and health, flora and fauna, as well as natural and cultural heritage, are registered in Croatia each year.

Import, export and transit of hazardous substances through the Republic of Croatia (Appendix 2) present additional burden and risk for the environment.

Data on sites with hazardous activities, especially in the chemicals industry (Appendix 3), and the fact that existing facilities mostly use outdated and obsolete technology, warn that Croatia needs a clearly articulated accident prevention policy.

Policy and measures

Consideration of the problem if accidental and uncontrolled discharges of hazardous substances into the environment has been clearly defined in a number of national regulations, international agreements and directives that are incorporated in the Croatian legislative system.

Environmental emergency plan

The Government of the Republic of Croatia has enacted the Environmental Emergency Plan (hereinafter: the Plan), which is based on the provisions of the Convention. The Plan became effective on January 1, 2000.

The Plan applies to possible environmental accidents or environmental emergencies likely to cause environmental risks and human health hazards.

The Plan defines types of risks and hazards, procedures and measures for mitigation and elimination of immediate environmental consequences, actors in charge of implementation of individual measures, implementation responsibilities and authorisations, and methods of coordination with contingency measures implemented according to other regulations.

The Plan does not apply to military establishments or storage facilities or cases of radioactive pollution.

The Plan is based on the principles defined in the Law on Environmental Protection: prevention, integrity, polluter pays, honouring rights, and public participation.

In line with the rights and responsibilities of the counties, towns and municipalities, for defining measures for predicting, preventing and limiting environmental pollution and methods of implementing contingency measures for environmental emergencies within their

environmental protection programmes, the Plan contains the elements of such programmes.

Legal and natural persons engaged in production, storage, treatment, transportation, collection or performance of other activities involving Appendix 4 hazardous substances, shall develop Operative Environmental Emergency Plans if the quantity of the hazardous substance on site equals or exceeds 1% of the threshold quantity for that hazardous substance. Outline contents of the Operative Plan include the following:

- list of hazardous substances, maximum expected quantity of hazardous substances, description of site and of the surrounding, list of possible sources of risk, assessment of possible emergency causes and risks;
- emergency prevention measures, including mandatory reporting (numbers, addresses, reporting);
- assessment of consequences of an emergency, including analysis of the worst possible case (worst-case scenario, EPA 40 CFR 68) and the risk zones assessment;
- hierarchy and implementation of measures for emergency cases;
- authorised individuals and experts necessary for the implementation of measures;
- participation of other legal and natural persons as contractors;
- methods of handling hazardous substances present and environmental mitigatory action;
- training and drills programme;
- informing the public of the cases of environmental pollution with off-site consequences;
- appendices – decisions on adoption and revisions, schemes, tables, calculations, address books, lists, procedures, relations to other plans, etc.

In the course of development of operative Environmental Emergency Plans, legal or natural persons must take into account the local circumstances, such as population density, water management zones, protected nature parts, economic, transport, cultural and tourism aspects, protective distances, etc.

Legal or natural persons are obliged to submit their operative Environmental Emergency Plans to county offices in charge of environmental protection, within the deadlines defined in the Plan.

Operative Environmental Emergency Plans developed by legal or natural persons form the basis for development of local environmental policy, i.e. for environmental emergency plans of counties, towns and municipalities and environmental protection programmes of local self-government units.

The Ministry of Environmental Protection and Physical Planning should create conditions for implementation of the APELL process (Awareness and Preparedness for Emergencies at Local Level) as a response to industrial accidents, and monitor its implementation. The APELL process in Croatia began on November 1, 2000. With expert backup of the Industry and Environment Office of the United Nations Environment Program, education on APELL implementation is being carried out. Local self-government units are obliged, within one year from the start of APELL process implementation, to develop emergency plans based on operative emergency plans of legal and natural persons, also taking into account other relevant aspects that may influence the effective implementation of such plans. Deadlines for coordinating all of the elements, conducting obligatory training and drills and informing the public of the Plan is two years from the start of APELL process implementation.

The Ministry of Environmental Protection and Physical Planning is in charge of analysis and coordination of plans with the provisions of the Convention on Transboundary Effects of Industrial Accidents.

In order to establish prevention and preparedness measures, as a party to the Convention Croatia shall undertake all necessary measures for identification of hazardous activities within the scope of its jurisdiction, ensure notification to all parties likely to be affected by such activities about all existing or planned hazardous activities, in line with the Convention, and shall develop a joint emergency plan for an existing activity likely to have transboundary effects, for cases of accidental and uncontrolled discharge of a hazardous substance into the environment.

As a party to the Convention, the Republic of Croatia shall ensure adequate level of public information in areas that may be affected by industrial accidents caused by some hazardous activity.

For purposes of delivery and transfer of industrial accident information, Croatia has developed effective information systems, both at local and national levels, and the State Center for Notification has been designated by the Croatian Government as a part of the notification system within the Convention on Transboundary Effects of Industrial Accidents. As a point of contact with the Convention, the State Center for Notification must ensure the fastest possible transfer of data and predictions according to the defined codes, applying synchronised systems of data transfer and processing for notifications on industrial accidents and replies to notifications. The State Centre for Notification has also been designated as the point of contact for mutual assistance.

Parties to the Convention must undertake regular efficiency testing of their notification systems, including regular staff training. This year, the Republic of Croatia volunteered to organise testing of the UN/ECE Industrial Accident Notification System, thus confirming its readiness to implement the Convention.

CONCLUSIONS

In the development of industrial accident prevention, preparedness and response systems in accordance with the Convention on Transboundary Effects of Industrial Accidents, the Republic of Croatia has made a number of positive steps, aided by the experience gained in the homeland war. Affirming its determination towards effective implementation of the Convention, the Republic of Croatia shall:

- maintain and regularly update the list of sites with hazardous substances;
- develop an information system on hazardous activities;
- establish an integrated chemicals management system;
- in the transport sector, undertake construction and reconstruction of certain traffic routes so as to direct hazardous cargoes outside inhabited and specially protected areas;
- develop emergency plans for cases of accidental and uncontrolled discharge of hazardous substances into the environment, and coordinate them with the commitments arising from international agreements and conventions;
- through the selection of adequate new technologies and the improvement of existing ones, prevent major industrial accidents and their transboundary effects.

Despite its determination to implement the goals of the Convention, the Republic of Croatia will not be able to handle their fast and effective realisation alone. Poor material and technical equipment coupled with inadequate professional training of response units is the first-rate problem and a threat both to humans and to the environment. Another major problem lies in the fact that Croatia currently does not have a governmental authority that would deal with hazardous substances in an integrated and consistent manner. Once such an authority is established, the priorities will be legislative and institutional harmonisation, development of an integrated chemicals management system, and centralised collection and

dissemination of information on hazardous substances, which would require an adequate hazardous substances information system, unavailable at the moment. The Republic of Croatia will be more successful in the preparation of joint implementation of the Convention on Transboundary Effects of Industrial Accidents and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, including legal instruments on civil liability for damage caused by hazardous activities covered by both conventions, after restructuring of the Ministry of Environmental Protection and Physical Planning, which is planned towards mid 2001. The newly restructured Ministry should then incorporate the water protection sector as well.

SUMMARY

A strategic interest of the Republic of Croatia is entering European economic, political and other integrations. Major preconditions for it are the institutional strengthening and legislative harmonisation with the relevant UN conventions and agreements and EU directives in the field of hazardous substances and industrial accidents management, and emergency planning for the protection of humans and the environment.

In July 1999 the Croatian Parliament ratified the Convention on Transboundary Effects of Industrial Accidents, thus incorporating it into its legal system.

Becoming a party to the Convention, Croatia enters into a harmonised system of protection in cases of industrial accidents and has committed to define its prevention policy for accidents likely to cause transboundary effects.

In line with the provisions of the Convention, Croatia should seek the establishment of policies on siting of new hazardous activities and on significant modifications to existing hazardous activities, with the objective of minimising the risk to population and the environment, to be applied in the entire territory of the country, and especially in areas likely to be affected by transboundary effects of an industrial accident.

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3. Law on Carriage of Dangerous Goods (*NN* #97/93)
4. Law on Toxins (*NN* #26/99)
5. National Water Protection Plan (*NN* #26/99)
6. Contingency Plan for Accidental Pollution of the Adriatic Sea in the Republic of Croatia (*NN* #8/97)
7. Environmental Emergency Plan (*NN* #82/99)
8. Convention on Transboundary Effects of Industrial Accidents (Helsinki, 1992), *NN - International Treaties* #7/99
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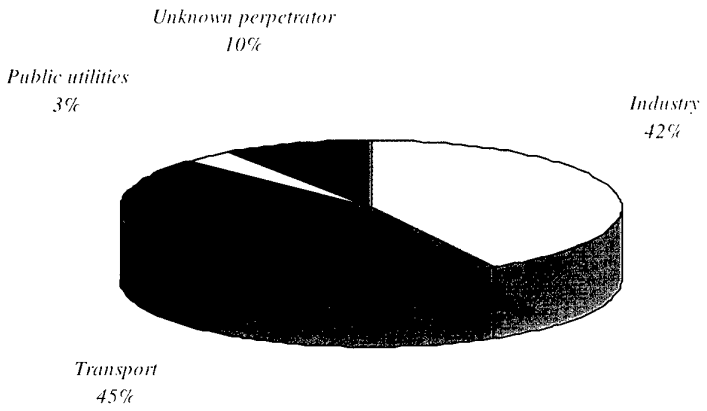
10. Agenda 21 (UN, Rio de Janeiro, 1992)
11. Directive 96/82/EC
12. Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), *NN - International treaties* #4

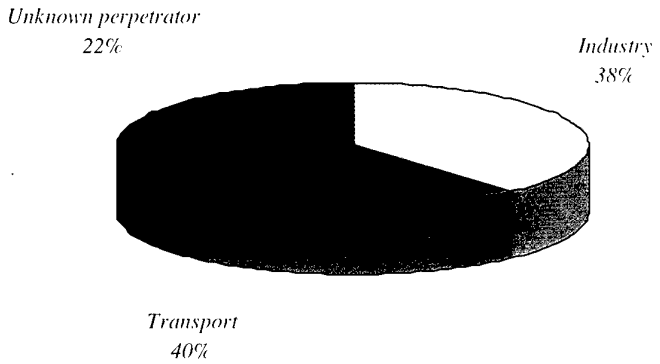
KEYWORDS
Industrial accident, hazardous substances, hazardous activities, emergency plans, contigency measures

APPENDIX 1: Accident distribution as per pollution source

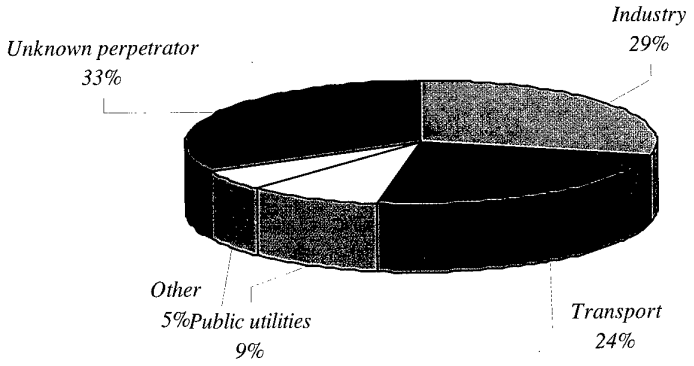
Pollution chart 1998:



Pollution chart 1999:



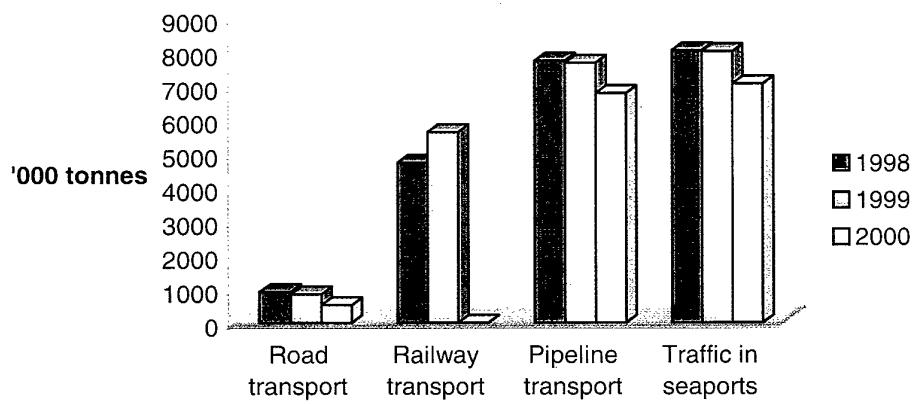
Pollution chart 2000:



APPENDIX 2: Transport of dangerous goods
('000 tonnes)

	Road transport			*Railway transport*			*Pipeline transport*			*Traffic in seaports*		
	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000
domestic transport	*798,4*	*769,4*	*	*2104,2*	*3895,6*	*	*4916,6*	*5668,1*	*	*1627,8*	*1401,2*	*
import	*84,5*	*50,5*	*	*1041,4*	*703,3*	*	*817,1*	*820,6*	*	*4981,9*	*4902,7*	*
export	*29,7*	*27,7*	*	*869,6*	*461,0*	*	-	-	*	*305,0*	*699,8*	*
transit	*1,5*	*1,3*	*	*722,6*	*565,0*	*	*1999,3*	*1189,3*	*	*1122,9*	*1009,3*	*
TOTAL	914,1	848,9	526,0	4737,8	5624,9	*	7733,0	7678,0	6774,0	8037,6	8013,0	7056,0

* Data for 2000 not yet processed



APPENDIX 3: Actual or potential hazard based on hazardous substance quantity (D) in accordance with Major Accident Reporting System (MARS)

County	*Number on sites with hazardous substances in chemical industry and possible consequences*				
	D=5 Disastrous	*D=4 Very serious*	*D=3 Serious*	*D=2 Significant*	*D=1 Insignificant*
City of Zagreb	8	1	1	3	3
Zagrebačka	3	1	1	1	1
Sisačko-moslavačka	3	1	1	-	-
Primorsko-goranska	1	1	-	1	-
Istarska	2	1	1	-	-
Splitsko-dalmatinska	1	2	-	-	-
Zadarska	1	-	-	-	-
Brodsko-posavska	1	-	2	-	-
Međimurska	-	-	-	-	1
Požeško-slavonska	-	-	-	-	1
Karlovačka	-	-	1	1	-
Osječko-baranjska	-	-	2	-	1
Dubrovačko-neretvanska	-	-	-	2	-
Varaždinska	-	-	2	-	-
Ličko-senjska	-	-	1	-	-
Koprivničko-križevačka	-	-	1	-	-
Krapinsko-zagorska	-	1	-	1	-

APPENDIX 4: Treshold quantities of dangerous substances for purposes of the Plan

Dangerous substances Directive 96/82/EC	Treshold quantities (tonnes) and possible consequences				
	100% D=5	10% D=4	1% D=3	0,1% D=2	<0,1% D=1
	Disastrous	Very serious	Serious	Significant	Insignificant
Ammonium nitrate (explosive)	350	35	3,5	0,35	0,0035
Ammonium nitrate (fertiliser)	1250	125	12,5	1,25	0,125
Arsenic pentoxide (acids and salts)	1	0,1	0,01	0,001	0,0001
Arsenic trioxide (acids and salts)	0,1	0,01	0,001	0,0001	0,00001
Bromine	20	2	0,2	0,02	0,002
Chlorine	10	1	0,1	0,01	0,001
Nickel compounds	1	0,1	0,01	0,001	0,0001
Ethyleneimine	10	1	0,1	0,01	0,001
Flourine	10	1	0,1	0,01	0,001
Formaldehyde (concentration >=90%)	5	0,5	0,05	0,005	0,0005
Hydrogen	5	0,5	0,05	0,005	0,0005
Hydrogen chloride (liquefied gas)	25	2,5	0,25	0,025	0,0025
Lead alkyls	5	0,5	0,05	0,005	0,0005
Liquefied extremely flammable gases including LPG) and natural gases	50	5	0,5	0,05	0,005
Acetylene	5	0,5	0,05	0,005	0,0005
Ethylene oxide	5	0,5	0,05	0,005	0,0005
Propylene oxide	5	0,5	0,05	0,005	0,0005
Methanol	500	50	5	0,5	0,05
2-chloraniline	0,01	0,001	0,0001	0,00001	0,000001
Methylisocyanate	0,15	0,015	0,0015	0,00015	0,000015
Oxygen	200	20	2	0,2	0,02
Toluene diisocyanate	10	1	0,1	0,01	0,001
Phosgene	0,3	0,03	0,003	0,0003	0,00003
Arsine	0,2	0,02	0,002	0,0002	0,00002
Phosphine	0,2	0,02	0,002	0,0002	0,00002
Sulphur dichloride	1	0,1	0,01	0,001	0,0001
Sulphur trioxide	15	1,5	0,15	0,015	0,0015
TCDD (and equivalents)	0,001	0,0001	0,00001	0,000001	0,0000001
Carcinogens	0,001	0,0001	0,00001	0,000001	0,0000001
Automotive petrol and other petroleum derivatives	5000	500	50	5	0,05
Very toxic substances (T+)	5	0,5	0,05	0,005	0,0005
Toxic substances (T)	50	5	0,5	0,05	0,005
Oxidising substances (Ox)	50	5	0,5	0,05	0,005
Explosives (Ex) and and pyrotechnic substances	50	5	0,5	0,05	0,005

Dangerous substances Directive 96/82/EC	Treshold quantities (tonnes) and possible consequences				
	100% D=5	10% D=4	1% D=3	0,1% D=2	<0,1% D=1
	Disastrous	Very serious	Serious	Significant	Insignificant
Explosives (Ex) creating extreme risks	10	1	0,1	0,01	0,001
Flammable substances (R10)	5000	500	50	5	0,5
Highly flammable substances (R17)	50	5	0,5	0,05	0,005
Highly flammable substances (R11)	5000	500	50	5	0,5
Extremely flammable substances (R12)	10	1	0,1	0,01	0,001
Substances dangerous for the environment (R50)	200	20	2	0,2	0,02
Substances dangerous for the environment (R 51-R 53)	500	50	5	0,5	0,05
R14 substances (R14/15)	100	10	1	0,1	0,01
R29 substances	50	5	0,5	0,05	0,005

21. ARTIFICIAL COBWEB: CHEMICAL AND PHYSICAL ANALYSIS

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INTRODUCTION

During the war period in Croatia between1991 and 1993 a new, unknown material was found at many locations in Croatia. This material appeared in the war operation zones, but also at distant places in the field, over broad areas. In appearance, it greatly resembles natural cobweb, but only from far away. On closer inspection, under the naked eye, and especially under a magnifying glass or a microscope, the differences become obvious. For example, in nature, there are no bundles of spider's cobweb having a diameter greater than 0.5 cm, as noticed at that time. A lot of other properties resemble those of natural cobweb, so the new material was nicknamed " artificial cobweb". This does not mean that "artificial spiders" attacked Croatia; no increase in spider population was noticed during the war, but the results of war operations, such as heavy mortar shelling and air raids, were strongly felt.

Artificial cobweb bundles were dispersed over kilometers of fields and meadows, stretched over rooftops, trees and bushes [1]. Such a matter having rather strange properties and shape was never previously observed in this part of Europe and therefore it caused an immediate public disturbance. However, no official or civil reports on its harmful activity were made, and therefore the disturbance faded soon. Since a similar appearance has not yet been reported in the scientific, technical or military literature, several civilian and government institutions, both inside and outside of Croatia, studied the properties of that matter. However, reports were rather rare and only preliminary [2-4].

Fig. 1. visualizes the morphology of artificial cobweb in the simplest way. Very fine, thin single-stranded fibers of different diameters are interwoven in bundles; occasionally, such bundles were found to be interwoven in very thick yarn. The matter stuck very easily to every other material (live, organic, inorganic and even metal) except to itself and it also floated on water.

Under the minute force of breeze or deliberate touch, the material extended extraordinarily. E.g., a part of a 5-cm long bundle could be stretched to a length of 20 m. The stretching was not a result of thinning of single fibers, but of their sliding and disentanglement. Therefore we speak about a virtual stretching.

SAMPLING AND METHODS

The samples of artificial cobweb were collected both
- by civilians, in an inadequate manner
- by professionals, in sterile vessels.

In all cases it was noticed that after 10 to 20 days artificial cobweb disappeared (at least virtually). The investigation of falling water and snow-water was very useful and, for that purpose, the samples were collected by professionals, but in nonsterile vessels, as usual.

In Croatia, several different experimental techniques for studying cobweb were applied:

- low- and high-magnification light microscopy (up and down illumination, polarized light)
- electron microscopy (SEM, TEM)
- Raman and micro-Raman spectroscopy

- Fourier-transform infrared spectroscopy (FTIR)
- X-ray diffraction
- C, H, N analysis
- proton induced X-ray emission (PIXE).

However, the most successful were light microscopy, infrared spectroscopy and electron microscopy. The samples were studied:

- as intact, nontreated,
- in water solutions, in other organic solvents,
- sometimes wet, or after drying,
- stained, or C or Au deposited.

The samples were also expedited by private, scientific and official channels to a number of institutions in different countries. As far as we know, the results of foreign analyses were, in general, only a confirmation of our cognition, unfortunately, without any new ideas.

During this investigation our laboratories noted numerous results (records by photo-, video- and digital camera technique, or by FTIR spectrometer) characterizing cobweb material that was delivered in the atmosphere above Croatia in respectable amounts. Among them only a restricted number is presented here.

RESULTS AND DISCUSSION

Light microscopy

Fig. 2. shows "fresh" bundles of artificial cobweb in free space under polarized light (illumination from below, crossed polarizer and analyzer, long-working distance objective, 50x). This is one of the oldest video records, where we noticed that single-fiber diameters range between some 0.5 μm and 10 μm. Under the same microscope in the Mol. Phys. Lab. it was noticed in 1992 that artificial cobweb partially dissolved in essential liquids of plants and animals, and that lung tissue rotted when came into *in vitro* contact with cobweb matter.

Also, by the end of 1992 the atmosphere above Croatia was full of dust, especially that of organic origin[4]. The investigation of snow-water, its floats and precipitates proved to be particularly useful for this research. For that purpose, the first snow surface was removed, and then, "clean" snow was collected letting it to melt in a closed vessel for floated and suspended impurities. Fig. 3. presents an artificial cobweb tuft obtained in that manner. A piece of artificial cobweb yarn collected another thick fiber of different origin. The total sample length exceeded by about 3 mm. Perhaps, this sample was crucial for the recognition of gelatinous substance and microorganisms. Namely, in order to quicken the snow melting, the sample was slightly warmed for a short time. Under higher magnification (Fig. 4.), one can observe different microorganisms (mainly bacteria), especially close to the fiber ends of the same sample. Microorganisms can also be well observed at the border of dried water droplet (Fig. 5.). Higher concentration of microorganisms at the droplet boundary and close to the fiber ends could be a direct consequence of a drying process. Water that originally, *in vitro*, covers the entire sample retreats from the sample top (little hill) towards the drop edges, rinsing the sample and carrying microorganisms towards the fiber ends and the droplet boundary. Probably, the surface tension plays an inportant role in this process. Very often the entire food chain of different microorganisms, like coccoides, anthracoides, actinomycetes and yeasts, was developed at such places that are rich in food necessary for their survival.

Electron microscopy

Very many accretions to single fibers were observed using scanning electron microscopy (Fig. 6.). However, it is still an open question whether these attachments are formed by dust particles from the atmosphere, by microorganisms arrived from the atmosphere, or by microorganisms developed in the yarn. SEM also confirmed the results of light microscopy on the existence of gelatinous substance that holds single fibers interwoven in bundles. Warm water (applied for a short time) makes gelatinous substance less viscous. Upon cooling and drying, gelatinous mass appears in the form of "rags" and "fringes", as presented in Fig. 7. Scanning and transmission electron microscopy were also used to determine a single fiber's thickness. The smallest diameters detected by these two methods ranged between 0.1 μm and 1 μm. For the observation of thicker single fibers, light microscopy was more useful.

Infrared spectroscopy

Fig. 8. shows characteristic IR bands of artificial cobweb. The untreated sample was pressed into a KBr pellet after an especially cautious milling. To obtain a good spectral quality, it was necessary to repeat the milling and pressing procedures several times. Positions of all important bands are given just for easier recognition of that matter for the case of its appearance in some other war or terrorist occasions. In Fig. 9. we compare the spectra of several samples collected at different locations at different times during the war. Only slight differences of relative intensities can be seen in the region of

- O-H stretching of water
- C-H stretching of aliphatic carbohydrates
- sharp band at 1390 cm^{-1}.

The overall spectral contour was always the same.

Comparison of the FTIR spectra of many materials revealed some that are spectroscopically very similar. Among them are man-made polymers such as nylons (especially 6/6), but here we compare only some of the spectra recorded for samples prepared in our laboratories (Fig. 10.) Obviously, materials such as polysaccharides, proteins and microorganisms could be mixed into the artificial cobweb and hardly distinguished from the basic substance by any method. In other words, the masking technique has been developed here almost perfectly.

CONCLUSION

Here we list only the most important chemical and physical properties of the foreign matter that was "delivered" in the Croatian atmosphere in respectable amounts:

- man-made product, organic fibrous matter
- composite structure of at least two materials
- hierarchic morphology similar to tendon
- interaction with essential liquids of plants and animals
- covering material: gelatinous (collagen, agar-agar,?)
- core, carrying material: much higher strength
- always followed by microorganisms
- complicated structure and morphology are very suitable for biochemical warfare and terrorism.

Why do we consider this part of the war affairs so dangerous and worthy of the present and future investigations? During the war an expensive ***full-scale biological experiment*** was conducted from outside, but in the atmosphere above Croatia. Finally, Fig. 11. shows a photograph of one sample which was delivered in the Croatian atmosphere ten

years ago, but this photograph was taken only ten days before the CBMTS congress. Ten years after the war, artificial cobweb does not disappear under laboratory conditions. The disappearance of the artificial cobweb, observed in the field, is an apparent illusion and means only dissemination of it from abroad. Because of possible consequences to public health, we invite all peaceful and independent scientists as well as all people of good will to disclose the true nature and aim of this substance.

KEYWORDS:
cobweb, biochemical warfare, composite structure

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FIGURES AND TABLES

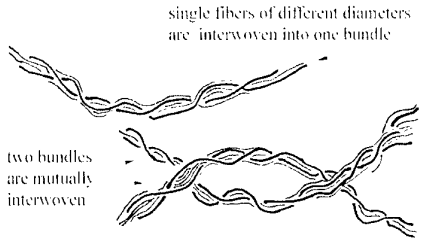

Fig. 1. Simplified drawing of artificial cobweb (yarn)

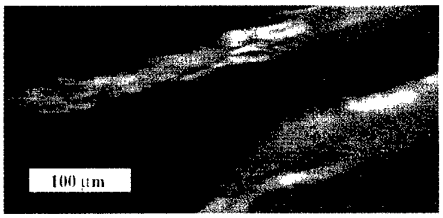

Fig. 2. Micrograph of two "fresh" bundles in polarized light

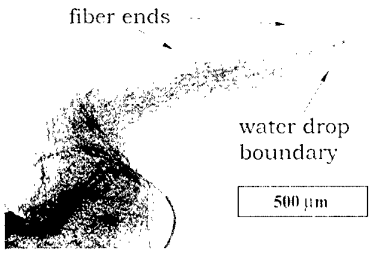

Fig. 3. Cobweb tuft from snow-water

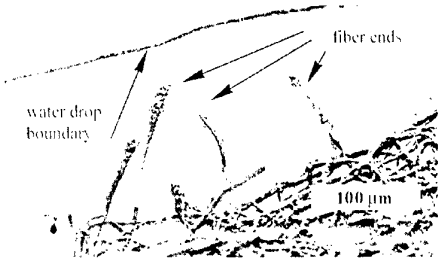

Fig. 4. Microorganisms appear close to fiber ends

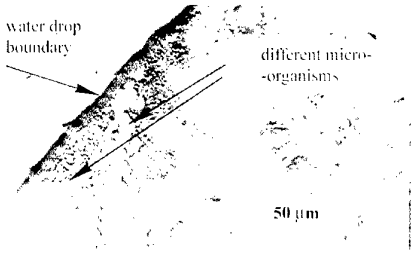

Fig. 5. Food chain of microorganisms is often

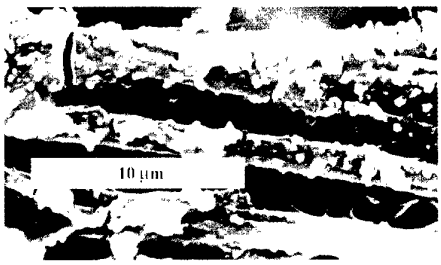

Fig. 6. SEM, agglutinated particles on cobweb yarn

Fig. 7. SEM, cobweb after 30' warming in water

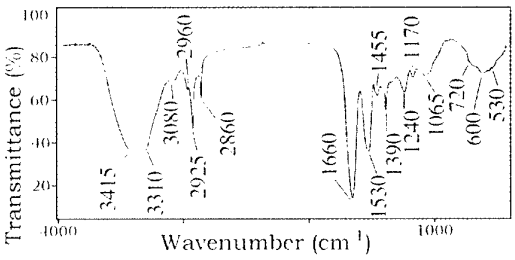

Fig. 8. Characteristic IR bands of artificial cobweb

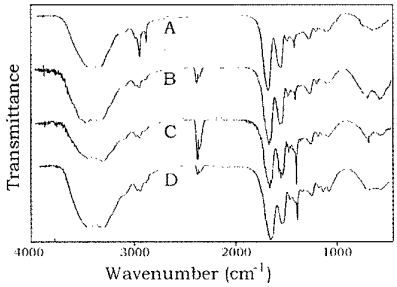

Fig. 9. Spectral comparison of different cobweb samples

A-D cobweb	G Bacillus sp.
E collagenase	H agar-agar
F crystalline	I yeast+bact.

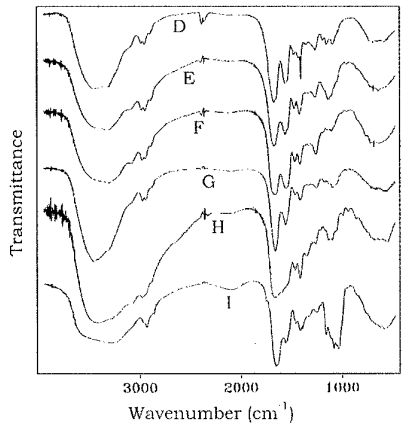

Fig. 10. Some spectroscopically (FTIR) similar materials

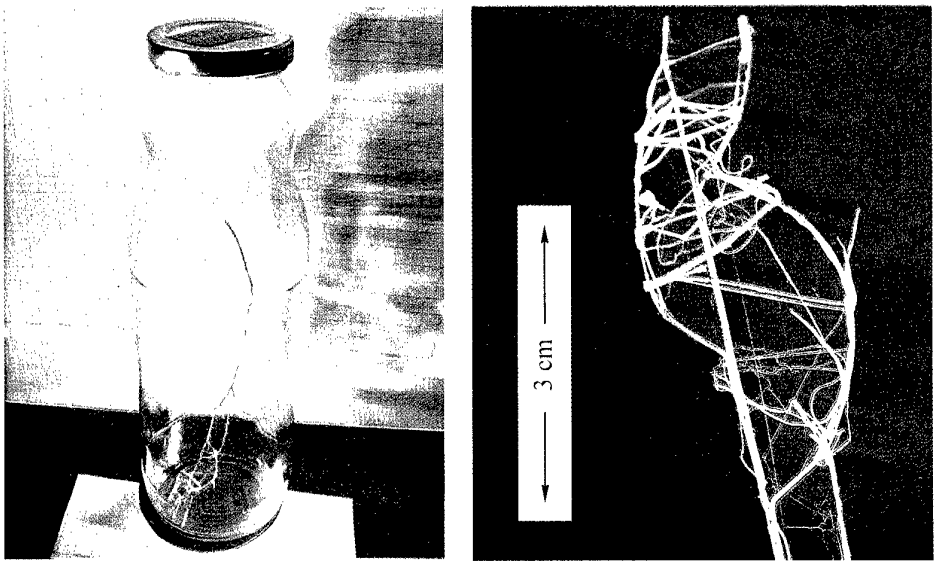

Fig. 11. Ten years latter artificial cobweb does not disappear in laboratory conditions

22. EMERGENCY MANAGEMENT EXPERIENCE IN CROATIA

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INTRODUCTION

What can endanger us, what is the highest hazard to us? How are these hazards distributed around the globe? Does the human treat to the nature higher than the nature treat to human? Can we with proper actions decrease these hazards? In which activities should be necessary to invest to obtain proper citizen protection? How to stop the worst crises - endangers of humans, goods and environment: the wars?

Ordinary man many times puts himself these questions and trays to find the answers. The answers can be different on the mentioned questions. Always present interests even more make difference in answers. In one part of the world there are some hazards in another are other. In the countries of former socialist world on the stage is destruction of former countries which has resulted like in many other countries with economy interesting natural resources often armed clashes which have endangered humans in these areas and threat to spread to the whole globe. Environmentalists in developed countries sometimes think only about hazard which is a result of human activities (if they are not endangered by war) and overlooked facts that nature can endanger them very high (droughts, earthquakes, floods...).

To replay at least to some of the above mentioned questions we tried to shown what are the primary hazards and how to withstand to them on example of one small European country Croatia. Generally speaking it is possible to make the array of some factors to survive for the people on some area. These factors are not essentially dependent of the state rules and are not essentially changeable in time, but sometimes in parts of the globe they are not fulfilled and endangers inhabitants in the case of the war or in peace (because natural phenomena or technology accidents). These factors are physical safety, to have roof over head, to supply food, and to have energy.

The inhabitants, goods and environment can be exposed to different hazards. The source of these hazards (Figure 1 Types of crises in Croatia) can be natural phenomena; technology or human work and the war like most danger human activity. In the war practically all so call induced technological accidents can be happened. Almost all mentioned kind of hazards can have for consequence apparition of epidemic. The primary interest of the protection and rescue systems is rescue and protection of human life and for these activities a high degree of organization is necessary.

WHAT ENDANGERS THE INHABITANTS IN CROATIA

In the recent Croatian history (from the year 1991) the war- aggression on Croatia and frequent threat of war are the highest risk for inhabitants of this small old European country.

WAR: Damages caused by the war in Croatia (a country of 4.8 million inhabitants and an area of 56.5 thousand square km.) are estimated at about $30 billion US$. In the war about 14,000 people were killed, and about 30,000 people were injured. The number of refugees and exiles from the Serbian-occupied parts of Croatia and from the neighboring country Bosnia-Herzegovina was about 520,000 in March 1984. About one third of the territory of Croatia was occupied by Serbian forces.

PEACETIME CRISES: In addition to war damages there are also usual peacetime damages; drought (42%), thunderstorms & hails (26%), and earthquakes (17%); fires (6%); floods (6%) and in addition to these, there are also potential industrial risks which are generally most frequent topic of environmental protection in the western democracies. These peacetime

damages are estimated (12 years statistics) at more than $800,000 per day ($300 million/year). This is very high amount for a small country. Damages of Natural Disasters 1981 to 1992 are shown on Figure 2. Shown are damages from natural disasters (considered as peacetime crises) in Croatia in the 12-year period 1981 - 1992. These damages are dominantly influenced by the fact that there was no efficient protection system in Croatia. The highest damages are from events that are prolonged (such as drought) but are not too attractive for mass media attention. These damages are in direct connection with those of agriculture. Our intent is to increase agricultural production in the future. One primary development for Croatia is the necessity to build new irrigation systems for fertile land and assure their storm & ice protection.

COMPREHENSIVE EMERGENCY MANAGEMENT:

Extraordinary experience (war) and everyday influence of nature and technology have shown to us that are necessary to establish very good emergency management organization. Emergency management (preparedness) for natural and man made disasters, like one necessary human activity for decrease damages, need be based on the factors: hazard analysis, authority, organization, communication, resources and emergency plans.

Under emergency management we assume all such crises conditions which can endangers inhabitants (hazard to life and health), goods and environment on a great scale. In all the phases (there are four phases in time cycle) to fight with crises it is necessary to engage mutual work of many organizations (military troops, medical organizations, fireworks, humanitarian organizations, policy and justice, etc.) and many different kinds of experts. These activities need to be managed by a group of experts (programming part of emergency management system) from state or county highest level administration.

In comprehensive approach in emergency management many different kinds of experts are needed. Usually the practice in the World is double use of military and civil segments (military in peace, civil in war) in defense and protection of inhabitants, goods and environment in crises. This assure: high efficient actions in crises, better use of resources in both segments, lower expenses because are no double baying of equipment and building of facilities, etc. By us like everywhere in the World there are many organizations which need to be bearers of many operative activities. Essential in problem of protection and rescue by us is necessity of binding all these organizations in comprehensive and efficient emergency system (everywhere this is task of emergency management agency – programming part of emergency system which is expert organization of government in case of crises).

For the every kind of crisis conditions there is an array of the specific activities - measures need to be taken in all phases of the emergency management process. All these activities necessary are analyzed in details for every kind of crises. Management analysis in different crises needs to make groups of experts of many educational backgrounds dependent about the kind of crises. Generally speaking in establishing emergency management system there are need to take into account segments which need to be analyzed by groups of experts for specific subjects (war, natural phenomena and technological accidents).

Comprehensive emergency management means all kind of crises in which people can be endangered, goods and environment, and is consequences of war and natural phenomena or technological accidents in peacetime. Former concept of emergency management (sometime called civil defense) have been usually based on preparedness for civilians defense in war and have not be appropriate. Solving the problem of protection and rescue in crises that are not in direct connection with war has resulted in concept of comprehensive emergency management. This concept has three mutually dependent components:

1. All types of crises: It is usually that different kind of crises - catastrophes: natural phenomena, technological and war need similar emergency management in the case

they happened, that similar strategies of emergency management's can be used for all kind of crises.

2. Partnership in emergency management: Responsibility for emergency management and resources for actions need close cooperation on all levels of government, private sectors, voluntary and humanity organizations and population.
3. Life cycle of crises: Catastrophes usually act not only one day. Usually they last long and have life cycle of occurring which need to be followed by many emergency management actions which included strategies of decrease of hazards - mitigation, preparedness, action in the case of occurring and recovery from consequences of catastrophes.

Before World War II emergency management often has been only preparedness. This primary role has been only defense from the enemy attack, but preparedness is only one phase in emergency management. Society needs to take care about crises also before their occurrence and need help in recovery process after crises. Like results of recent methodology four phases of emergency management have been defined: a) mitigation, b) preparedness c) action and d) recovery. Every phase cam from previous and make some conditions for next. Activities in one phase can be covered with some in previous. The preparedness became in action in the time of catastrophe occurring. The action turns into recovery in different time in dependence of the area influence and kind of damage. Similarly the recovery starts mitigation, the motivation to prevent or reduce occurring of next accidents. At least, phases of crises have no beginning or end. The treat recognizing can motivate mitigation similarly like real catastrophe.

Under the mitigation we assume all activities by which are moved or reduced probabilities of accidents occurring (crises). The mitigation also includes long term activities, which reduce consequences of crises the frequency of occurring, is non-reducible.

The preparedness includes all activities which follows a mitigation phase in which need be established all necessary for action in non-reducible crises. The governments, organizations and individuals in the preparedness phase make plans for life rescue, decrease of damage in the case of crises. By preparedness measures intent is to improve action in case of crises.

The action is the response on crises. It assumes all activities that are taken in case of crises. By this activities intent is also to reduce probability of secondary damage and make faster recovery process (return in status before crises).

The recovery - renovation includes all activities to return all into normal or better status than before crises. By the short-term recovery intent is to return essential function to obtain minimal life standard. By long-term recovery we assume return in previous status and can take many years after crises.

There are applied many activities - measures in the all four phases which are for all type of crises up to specific measures for some kind of crises. For example, some of general measures are:

- In mitigation: land use planning, building codes, inhabitants' education;
- In preparedness: preparedness plans for action, establishing of alert systems, evacuation plans, collection of resources data, and inhabitants' information;
- In action - response to crises: information of inhabitants about necessity of protection, operations participants mobilization, proclaiming of catastrophe / evacuation, temporary law suspension;
- In recovery: temporary housing, damage assessment and loans, reconstruction, information about health and safety of inhabitants.

By us like everywhere in the world there are many organizations which need to be bearers of many operative activities in the protection & recovery system. Essential in problem

of protection and rescue in Croatia is necessity of binding all these organizations in comprehensive and efficient emergency system. Everywhere this is task of emergency management organization (programming part), which is expert organization of government in case of crises. During the war such organization in Croatia was build, but in 1994 all was destroyed. In Croatia today do not exist most important programming part of emergency organization. Because it there is absent comprehensive hazard analysis, authority, organization structure, communication, resources and emergency plan. In the Figure 3 are shown potential structure of emergency organization of Croatia, which need be building again.

It is known what is need to be done in the field of organization, in the field of authority, collecting the data about resources, information & communication and in making plans. Only is necessary will of government to establish system of protection & rescue for inhabitants, goods and environment - on most developed countries models and on experience from country war. Reasons for this establishment are deeply justified

Experience shows that regarding up to date Organization of the United Nations fail in taking proper actions to protect human life and goods in some world crises area. Good example for this statement was UNPROFOR's request to Croatian emergency management organization to protect his 600-700 protection force members in Zagreb (1993) in which there almost have been no war actions. Question was who needs to be protected by whom and from whom? Are the United Nations protection forces sent to Croatia to protect civilians of Croatia or hostile country - does need to protect UNPROFOR? It seems that UNPROFOR headquarters has thinking that host country needs protect them. Because of that UNPROFOR was only additional expense in also without them shaken economy of the country.

CONCLUSION

Many kinds of endangering of inhabitants, goods and environment are present in recent World. Endangering is different from one part to another part of the world and because there are different interest for rescue and protection. The conditions for life in some area are dependent of harmonious use of natural resources - interrelations of nature with population. Interest for use of some natural resources in some part of globe produce conflicts that are the highest hazards for population. There is no efficient mechanism to stop these clashes. Because this every country needs to be trusted in they're own resources for inhabitants, goods and environmental protection from different hazards and make bilateral contacts with countries that have interest for cooperation. For this purpose is most important again to establish efficient governmental programming part of emergency organization like body of professionals - experts in highest-level country administration (president office or government).

SUMMARY

There are many hazards (natural and man made), which can endanger people, goods and environment. In the war about 14,000 people were killed and about 30,000 injured. Damages caused by the war in Croatia are estimated at about $30 billion US$ In addition to war damages, there are also usual peacetime damages caused by natural phenomena. These peacetime damages are estimated at more than $300 million/year. Extraordinary experience (war) and everyday influence of nature and technology have shown to us that are necessary to have own very good emergency management.

Emergency management organization for natural and man made disasters, like one necessary human activity for decrease damages, is based on the factors: hazard analysis, authority, organization, communication, resources and emergency plans. Such organization has been built during the war in Croatia, according USA practices (FEMA, EMI, NATO) but on the beginning of 1994 all was stop. Now is the time to proceed with this job again. It is

known what is needed to be down in the field of organization, in the field of authority, collecting the data about resources, information & communication and in making plans. Only is necessary will of government to establish system of protection & rescue for inhabitants, goods and environment - on most developed countries models and on experience from country war. Reasons for this establishment are deeply justified.

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KEY WORDS
Emergency management, programming part of emergency organization, hazard analysis, authority, organization structure, communication, resources and emergency plans

FIGURES AND TABLES
Figure 1 Types of crises in Croatia
Figure 2 Damages from natural disasters (considered as peacetime crises) in Croatia in the 12-year period 1981 – 1992
Figure 3 Potential structure of emergency organization of Croatia

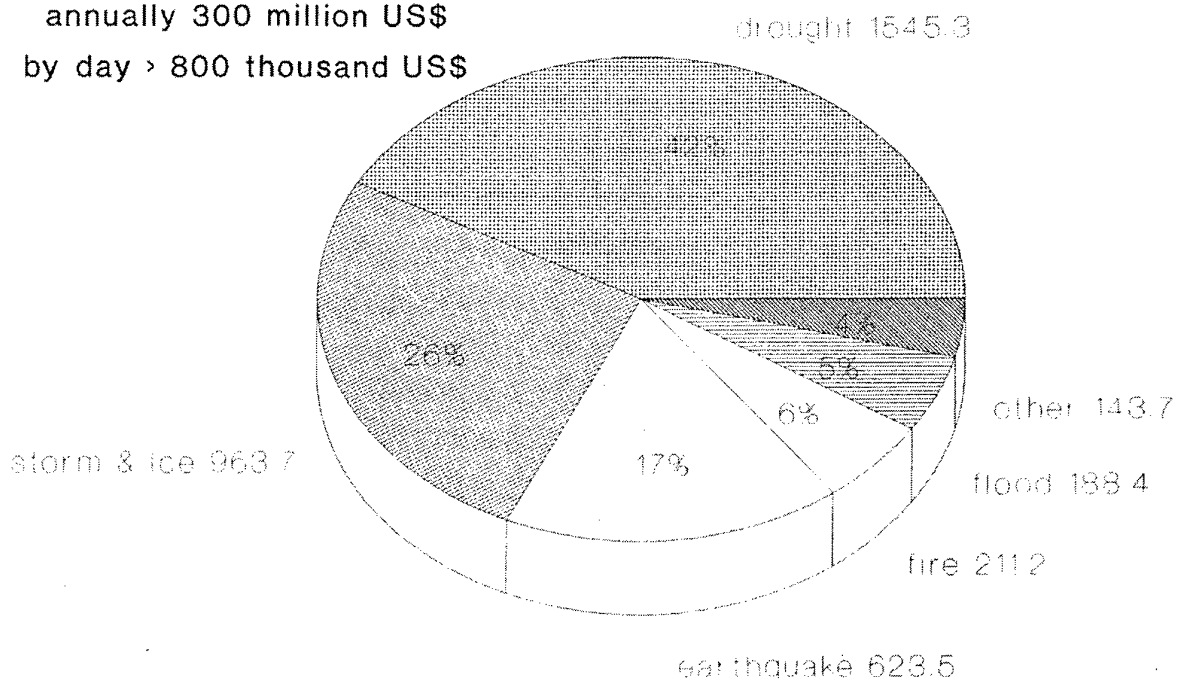
TYPES OF CRISES

CRISES

NATURE	TECHNOLOGY	WAR
FLOOD	HAZARD MATERIALS	*DESTRUCTIONS*
STORM	*FIRES AND EXPLOSIONS*	*INDUC.TEHNOL.ACC.*
EARTHQUAKE	*RADIOLOGICAL ACCIDENTS*	*CIVILIANS KILLING*
LANDSLIDE/MUDFLOW	*RESOURCE SHORTAGES*	
DROUGHT AND EXTREME HEAT	*TERRORISM*	*EPIDEMIC*
FOREST FIRE	*DAM FAILURES*	

DAMAGES OF PEACETIME CRISES IN CROATIA

TOTAL 3.7 billion US$ (12 years)
annually 300 million US$
by day > 800 thousand US$



millions US$ period 1981 - 1992 B.Molak
source: Drzavni statisticki zavod, NBH
Republicka komisija za procjenu steta

POTENTIAL EMERGENCY ORGANIZATION OF CROATIA

PRESIDENT OF CROATIA

PRESIDENT OFFICE (or GOVERNMENT)

↓

PROGRAMING PART
EMERGENCY ORGANIZATION

COUNTIES ORGANIZATIONS
LOCAL SUBJECTS

+ EXPERTS GROUPS

↔

OPERATIVE PART
LIST OF ORGANIZATIONS

COUNTY CHIEF

CRISES COMMITTE

23. HAZARD MATERIALS EMERGENCY EXPERIENCE IN CROATIA

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INTRODUCTION

Under the crises or emergency situations are assumed such phenomena which can massive endangered the inhabitants (life and health), goods and environment. In all phases in the emergency management mutual work of many governmental and communities organizations and persons of different specialties are necessary. Community needs work with crises before they are happened and need to help in recovery from crisis. Like result of modern development there are four phases in emergency management established: mitigation, preparedness, response and recovery. In the world practice governmental body for emergency management very high positioned in governmental hierarchy with high-qualified personal and high authority need be establish. For long time in Croatia experts wrote about it but up to now there are no improvement. Damages from natural hazards in Croatia are dominant in peacetime, but is necessary to prepare communities also for human cause / technological hazards.

Hazard materials (toxic chemical substances) are only one of group of technological hazards. Other are: fire and explosions, radioactivity, break of supply, interior disturbances (terrorism is one in-group) and dam failures. During the war in Croatia (1992/1993) was known what is necessary to do to protect people in case of chemical emergency. In all activities for decrease damages, based on the factors: hazard analysis, authority, organization, communication, resources and emergency plans was known. Only the problems has been the necessity of binding all operative organizations in comprehensive and efficient emergency system (everywhere this is task of emergency management agency which is expert organization of government in case of crises). The same situation in Croatia is up to now. Also there are not emergency plan in Croatia in the case of accident in NPP Krško near border in Slovenia relatively close to Zagreb.

COMMUNITY PREPAREDNESS AND UNCONTROLED HAZARD MATERIALS RELEASE

In the World and also in Croatia are many chemicals in use, which can endanger people, goods and environment in the case they are deliberated into environment without control. It can endangered people in zones of few hundreds meters up to few tens kilometers from the sources of deliberation of hazard materials. Necessary is to have community preparedness with preparedness of every inhabitant for the case of crises caused by uncontrolled release of hazard chemicals.

Community preparedness for hazard chemical release is important factor for rescue and protection of people, goods and environment. Community need be prepared for such crises to decrease their consequences. Preparedness mean that is known five segments in some geographical region (county) which is in analysis. They are also useful in all other type of crises, and these segments are:

1. Hazards Analysis
2. Authority
3. Organizational Structure
4. Communication
5. Resources

Of course, al these five segments are necessarily to be implanted in written document: Emergency plan, which in the case of hazards materials release in all communities (counties) need be established.

Results of solving the emergency management problems in hazard materials releases with some modification can be used also in other types of technology/human cause emergencies and also in natural hazard emergencies. Some results are also applicable in other fields of management.

Responsibility for safety of inhabitants, goods and environment in democratic societies are usually on government (president, or county chief) and necessary is that the government take care for preparedness of her area in crises.

There are many questions that need answers to assessing community preparedness in case of hazard materials release. These questions may be used for assessing the emergency plan as well as the emergency program in general. Resource limitations and results of hazard analysis will strongly influence the necessary degree of planning and preparedness.

Hazards Analysis

Hazard Analysis includes the procedures for determining the vulnerability of a geographical area to a hazardous materials release, for identifying potential sources of hazard materials release from fixed facilities that manufacture, process, or otherwise use, store, or dispose of materials that are generally considered hazardous in an unprotected environment. This includes an analysis of the potential or probable hazard of transporting hazardous materials through a particular area.

A hazard analysis is generally considered to consist of identification of potential hazards, determination of the vulnerability of area as a result of existing hazards, and an assessment of the risk of hazardous materials release (probability and consequences).

Figure 1 shows Hazards analysis and Figure 2 show Vulnerable zones a) fixed facilities b) along transportation routes. Figure 3 show Vulnerable zones: ammonia, chlorine, arsine and phosgene in relation to release rate, meteorology and terrain. On Table 1 shown are Results of calculations of vulnerable zones for some hazard materials in Zagreb. Results are determination of vulnerable zones by mathematical models for some chemicals (results are performed in the war in year 1992). Acronyms: LOC – Level of Concern, IDLH – Immediately Dangerous to Life of Health.

There are lot of questions which need answers to assess is the hazard analysis in some community performed on properly way. Some of these questions are Has the analyses been completed for the area? Does the hazard analysis include that are manufactured, processed, used, disposed, or stored within the appropriate area or safety along transportation routes? Final result of hazard analysis is the risk matrix.

Authority

Authority refers to those authorities or other legal authorities vested in any personal, organizations, agencies, or other entities in responding to or being prepared for responding hazardous materials emergencies resulting from releases or spills.

On Table 2 shown is example of an act for emergency planing and community right to know.

Also like for hazard analysis for the Authority can be given many questions to assess authority for response in case of hazard materials release in environment. Some are Does clear legal authorities exist to establish a comprehensive hazardous materials response mechanism? Does these authorities delegate command and control responsibilities between the different organizations?

Organizational Structure

Organization refers to the organizational structure in place for responding to emergencies. This structure will vary considerably from one area to other and depend about quantity of hazard materials and other factors of some area. There are two basic types of organizations involved in emergency response operations. The first is involved in the planning and policy decision process. The second is the operational response.

There are many questions for assessment of community organizational structure for the hazard materials emergency. Some of organizations, which need be connected, by emergency management organization (local or governmental emergency management body – does not exist in Croatia up to now) are health organizations, public safety (fire, police, health and safety), transportation, environmental organizations, natural resources organizations, education system, etc. For each organizations authorities, responsibilities, and capabilities must be determined for pre-response (planning and prevention), response (implementing the plan during an incident), and post-response (cleanup and restoration) activities.

Communication

Communication means any form or forms of exchanging information or ideas for emergency response with other entities, either internal or external organizational structure. There are important areas that need be assess by questions: coordination of information, information exchanges, information dissemination, information sources and database sharing, notification procedures and clearinghouse functions.

Resources

Resource means the personnel, training, equipment, facilities, and other sources available for use in responding to hazardous materials emergencies. To the extent that the hazard analysis has identified the appropriate level of preparedness for the area need be established. There is lot of questions for assessment of community resources (personnel, training, equipment, and facilities) for hazard material emergency.

Emergency Plan

The emergency plan is connected by all questions in before five sections. The plan is also special value document and is essential measure of community (local – county) government preparedness for hazard material emergency. Without plan there are no adequate response in case of emergency. There are many questions to assess emergency plan of community.

On Table 3 is shown possible content of hazard materials emergency plan

CONCLUSION

Accidents with hazardous materials releases or spills can make heavy consequence to life and health of people, goods and environment in zone of few hundreds meters to few tens kilometers around of sources of hazard material. It is necessary to inform population about real risk of such accidents (probability and consequences) because they're effective protection in case of emergencies. This is especially important in the case if emergency organization body is not established.

In the second part of article is shown how the rescue and protection system is complicated and need mutual coordinated work of many segments of communities and different subjects. Establishing of system for cope with crises, also such with uncontrolled releases of hazard materials is the role of every democratic society. Government need take care about inhabitants' life and health, about their goods and environment. Solving the

problem – finding the answers to the questions can give information about assessment of community (county) preparedness for hazard materials emergency. Every time when some of hazard materials accident occur in Croatia this make big noise in media, but after this nothing is happened in improving five segment of emergency management and preparing emergency plans.

SUMMARY

Hazard materials (toxic chemical substances) are only one of group of technological hazards. Other are: fire and explosions, radioactivity, break of supply, interior disturbances (terrorism is one in-group), and dam failures. During the war in Croatia (1992/1993) was known what is necessary to do to protect people in case of chemical emergency. In all activities for decrease damages, based on the factors: hazard analysis, authority, organization, communication, resources and emergency plans was known. Only the problems has been the necessity of binding all operative organizations in comprehensive and efficient emergency system (everywhere this is task of emergency management agency which is expert organization of government in case of crises). The same situation in Croatia is up to now. During the war we have tried to introduce in our practice SARA, Title III and emergency practice from Ohio State Hamilton County's LEPC. We have performed hazard analyses for most dangerous chemicals and chemical weapons (chlorine, ammonia, phosgene and arsine). It was known the LOC, IDLH values of chemicals and was not problem to determine hazard zones for different meteorological conditions. It was calculated (1992) hazard zones (for LOC and IDLH) for chemicals (gas, liquid, and solids) in city of Zagreb. Risk matrix can show us priorities in protection.

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KEY WORDS
Emergency management, chemical hazard analysis, vulnerable zones, risk matrix, emergency plan

FIGURES AND TABLES
Figure 1 Hazards analysis
Figure 2 Vulnerable zones a) fixed facilities b) along transportation routes
Figure 3 Vulnerable zones: ammonia, chlorine, arsine and phosgene in relation to release rate, meteorology and terrain.

Table 1 Results of calculations of vulnerable zones for some hazard materials in Zagreb. Results are determination of vulnerable zones by mathematical models for some chemicals (results are performed in the war in year 1992). Acronyms: LOC – Level of Concern, IDLH – Immediately Dangerous to Life of Health, 1.5 and 5.2 m/s - wind speed, F, D - meteorology stability classes, u – urban landscape.
Table 2 Example of an act for emergency planning and community right to know
Table 3 Possible content of hazard materials emergency plan

Table 2 **EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT**

Hazard materials emergency
Hazard chemical uncontroled release reporting (370 + 720 chemicals?)
Hazard chemical inventory reporting (370 chemicals?)
Toxic chemical release reporting - routinely releasing (320 toxic chemicals?)
Data protection - trade secrets
Lists of chemicals
Role of:
- Local emergency planning organizations
- Citizens
- Fire deparments
- Public institutions
- Health profesionals
- Industry and small businesses
- Farmers
- State emergency organization

Table 3 **HAZARD MATERIALS EMERGENCY RESPONSE PLAN - CONTENT**

A. INRODUCTION

1. Incident Information Summary
2. Promulgation Document
3. Legal Authority and Responsibility for Responding
4. Plan Content
5. Abbreviations and Definitions
6. Assumptions/Planning Factors
7. Concept of Operations
    a. Governing Principles
    b. Organizational Roles and Responsibilities
    c. Relationship to Other Plans
8. Instructions on Plan Use
    a. Purposes
    b. Plan Distribution
    c. Comments About Improvements

B. TELEPHONE NUMBERS OF RESPONDERS

C. RESPONSE FUNCTIONS

1. Initial Notification of Response Agencies
2. Direction and Control
3. Communications and Control
4. Warning Systems and Emergency Public Information
5. Public Information/Community Relations
6. Resource Management
7. Health and Medical
8. Response Personal Safety
9. Personal Protection of Citizens
    a. In-place Sheltering

b. Evacuation
c. Other Public Protection Strategies

10. Fire and Rescue
11. Law Enforcement
12. Ongoing Incident Assessment
13. Human Services
14. Public Works
15. Others

D. CONTAINMENT AND CLEANUP

1. Techniques for Spill Containment and Cleanup
2. Resources

E. DOCUMENTATION AND INVESTIGATION FOLOW-UP

F. PROCEDURES FOR TESTING AND UPDATING PLAN

1. Testing the Plan - Exercises
2. Updating the Plan

G. HAZARD ANALYSIS SUMMARY

H. TRAINING

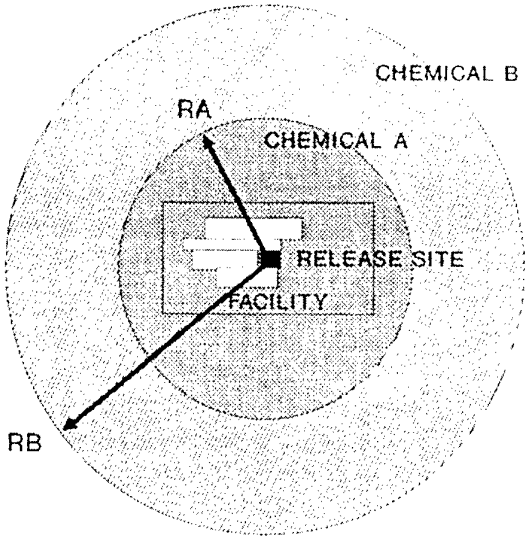
I. REFERENCES

1. Laboratory, Consultant, and Other Technical Support
2. Technical Library

VULNERABLE ZONES - ZAGREB

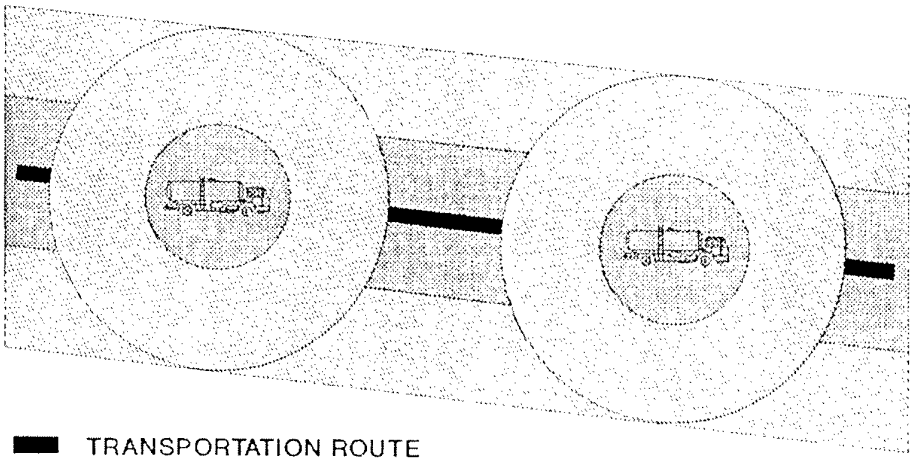
Chemical	**Ammonia**	**Chlorine**	**Pot. cyanide**	**Nitric Acid**	**Ethylamine**
Physical State	Gas	Gas	Solid 20%<100 mcm	Liquid	Liquid
Quantity (kg)	1000	5000	900	50000	50000
LOC (mg/m^3)	35	7.3	5	26	740
IDLH (mg/m^3)	350	73	50	260	7400
Rate of Release (kg/min)	100	500	18	140	1358
Vulnerable zone (km)					
1.5m/s, F, LOC	1.3	9.6	1.4	1.9	1.0
5.2m/s, D, LOC	0.5	2.4	0.5	0.6	0.3
1.5m/s, F, IDLH	0.5	2.1	0.5	0.5	0.3
5.2m/s, D, IDLH	0.2	0.6	0.2	0.2	0.2

a) VULNERABLE ZONES



RA - VULNERABLE ZONE RADIUS FOR CHEM. A (Conc. LOC A)
RB - VULNERABLE ZONE RADIUS FOR CHEM. B (Conc. LOC B)

b) VULNERABLE ZONES ALONG TRANSPORTATION ROUTE

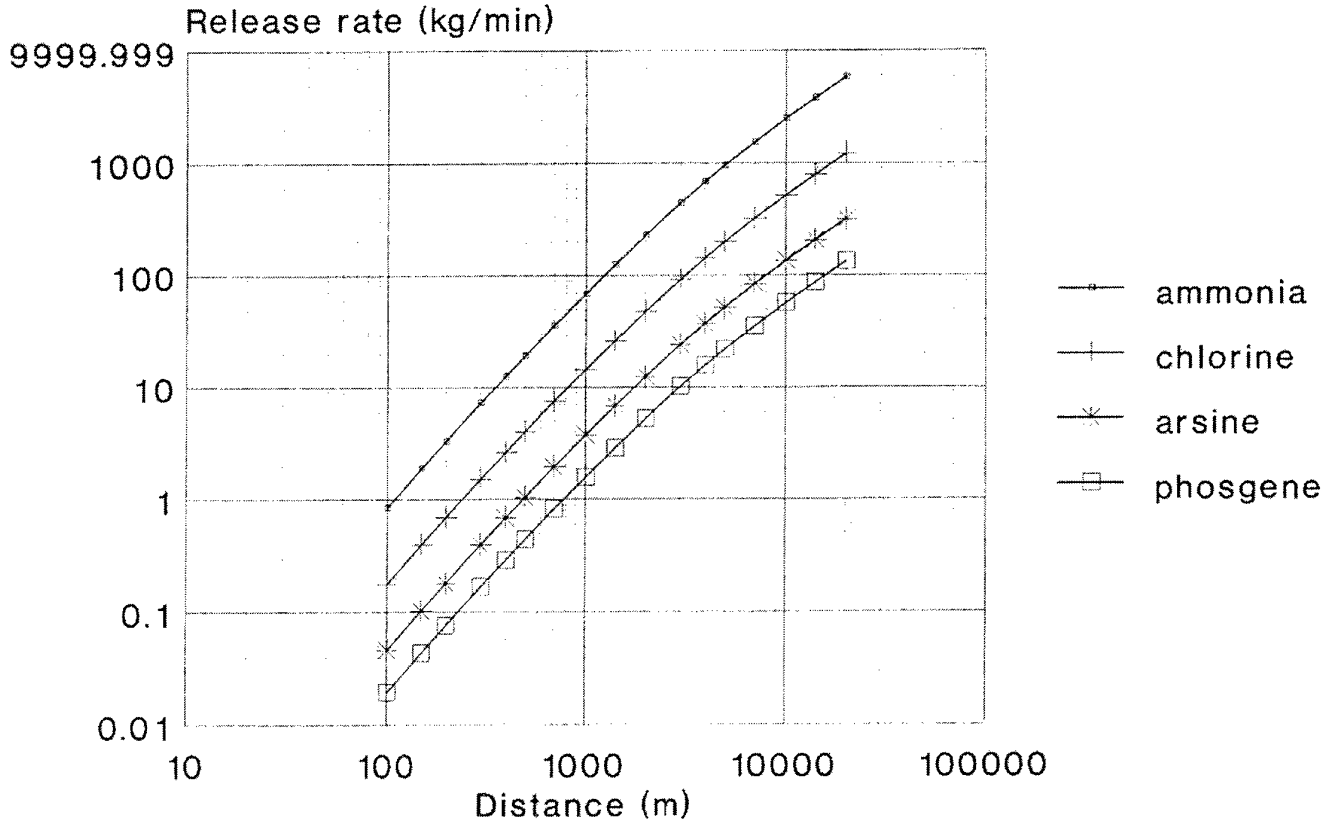


TRANSPORTATION ROUTE

VULNERABLE ZONE (CHEMICAL C)

VULNERABLE ZONE (CHEMICAL D)

VULNERABLE ZONES & RELEASE RATE
chlorine, ammonia, arsine, phosgene



meteorology: F, 1.5m/s landscape: u

24. POSSIBILITIES OF DETECTION AND EARLY WARNING IN CASE OF TERRORIST CHEMICAL ATTACKS IN SUBWAYS

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INTRODUCTION

In the last decade, major cities have had bitter experience with the disastrous damages, caused by terrorist attacks appearing as a result of religious, ethnic and political fanaticism of groups. There also have been cases of violent acts of perverse psychopathologic individuals. Public facilities, transport means and other densely populated areas are among selected targets. To intended results belong, beside material damages frequent human casualties. It must be expected that growing terrorism will be accompanied with increasingly sophisticated methods of violence, including employment of supertoxic lethal chemical agents (as shown by the known case in Tokyo subway) and highly contagious biological agents. It is obvious that underground transportation system of traffic and station tunnels, crowded with people within relatively narrow and closed space, is vulnerable to attacks with toxic chemicals, both industrial (easy accessible like chlorine, phosgene, hydrogen cynide, cynogen chloride and like) and military (including supertoxic lethal nerve agents) causing immediate casualties.

After having evaluated the experience from Tokyo subway, responsible authorities of the City of Prague decided to equip the Prague underground (METRO) with a detection system for toxic gases in order to enable early warning and adopting as early as possible protection and rescue measures in case of possible terrorist attack. This paper presents information on the technical solution of this problem.

MATERIALS AND METHODS

To assure optimum choice, number and localisation of detectors, representative station tunnels were chosen for experimental modeling according to the risk analysis of the whole METRO network and important junctions. The mathematical model of potential distribution of agents within the platform area included:

- Ambient air flow within the platform area,
- Ambient temperature,
- Coefficients of turbulent difffusion,
- Evaporation of anticipated agents,
- Amount of agent.

For these purposes, the most dangerous agent (sarin) was taken in consideration. The first two parameters were measured within the platform area of the representative METRO station, all other parameters correspond to the physical characteristics of the toxic agent.
Sensors were placed to follow the less favorable conditions from the point of view of agent's distribution velocity, as well as of probability to reach detector in a concentration above the detection limit.

For choosing suitable detectors and designing the system, following criteria were suggested:

- Spectrum of agents to be detected

- Detection limits for requested agents
- Detection velocity for requested agents
- Automatic operation of sensors
- Remote transmission of sensor's information
- Possibility to attach sensor to an automated network system
- Central operating and safeguarding
- Technical availability to install sensors within the METRO tunnels system
- No interference of the sensors with the METRO traffic operation
- Safe operating of this particular monitoring system and its compatibility within the overall traffic operation monitoring
- Possible further development.

As sensors for this monitoring system and experimental measurements at the first METRO station, the ion mobility spectrometers RAID-S (manufactured by BRUKER-SAXONIA GmbH) were chosen as the most appropriate, meeting the desired demands, as for the spectrum of detected agents, as well as for the assured detection limits:

Agents:	- nerve agents (GA, GB, GD, VX),	
	- vesicants (HD, L)	
	- generally toxic agents (AC, CK, CG)	
	- other harmful agents.	
Detection limits:	- nerve agents	1×10^{-5} mg/L
	- vesicants	6×10^{-5} mg/L
	- generally toxic agents	1×10^{-3} mg/L.
Speed of response:	- for the limit concentrations	5 - 30 seconds.

The other advance is the possibility of a relatively simple integration to an automatic transmission and evaluation monitoring system. To another very valuable advance belong the capability of modifying present laibraries of detected agents, as well as constituting new ones which makes the possibility of an open-ended solution even for the future.

Because of actual danger of employment of agents, differing from the standard CW agents, we have measured also spectra of some homologues of GB and GD. It is obvious that this detection system enables to detect these agents too. It is a matter of consideration how wide the list of agents should be inserted in the detector's library. The longer the list of compounds presumed for detection, the longer time for the detector's response.

The results gained with the RAID-S instrument are recorded by a computer localised at the METRO station. Data are proceeded and formatted to a form corresponding with an input of a central computer. The central computer is located in the Information and Control Centre (ICC). Taking into consideration a relatively intensive electrical interference resulting from the METRO traffic, it was necessary to give great deal of attention to a safe design of the whole system including transmission lines from both HW and SW in order to obtain summarised and displayed data in the ICC safely and clearly.

As a result of processing and evaluating of obtained data, the information for operator contains:

- Warning signal of detected agent, including concentration and time of detection
- Operating instructions for the case that toxic agent is present
- Information on working conditions of monitoring system, specifying possible failures.

All relevant data are stored in the central computer for possible re-evaluation.

RESULTS AND DISCUSSION

As a result of this experimental work, the first station of the Prague METRO was equipped with the above descibed monitoring system in 1997 as one of the first technical measures in the build-up of the complex system of early warning and rescue in case of terrorist chemical attacks in a very vulnerable underground mean of urban transportation, any daytime crowded by Prague citizens and beside nearly hundred million of foreign visitors a year.

It is obvious that detection is nothing more but nothing less that the first necessary measure in the whole complex. It is, of course unable *per se* to save intoxicated persons. But it allows to adopt necessary measures to at least limit the extent of casualties *via*:

- immediately informing public to prevent panic,
- preventing entry of newcomers from outside to contaminated area,
- alarming police units (security measures, regulation, police interventions against terrorists),
- alarming prepared and trained fire-brigade and civil protection units & technical rescue
- squads (regulation, extinguishing, protection, decontamination, technical repairs,
- maintenance etc.)
- alarming prepared and trained medical rescue squads (first aid, medical treatment,
- evacuation of injured and intoxicated persons)
- evacuating people from the endangered area,
- passing trains through the endangered station without stop if necessary,
- rescheduling trains deviating or stopping them outside of endangered areas,
- adopting other protective and rescue measures, both technical and medical,
- adopting restoration measures

SUMMARY

As a result of evaluating the experience from the chemical terrorist attack in the Tokyo subway, responsible authorities of the City of Prague decided to equip the Prague METRO with a detection and monitoring system to enable early warning and adopting immediate protection and rescue measures in case of possible terrorist attack. After experimental analysis of airflows and other conditions including modeling within the system of underground stations and assessment of available gas alarms to detect the widest possible spectrum of toxic chemicals (in consideration to be misused by terrorists) with desired detection limit and within the shortest possible reponse time and their feasibility to be incorporated into a network of remote signal transmission to the central checkpoint, the ion-mobility spectrometers were suggested as the most appropriate from the available choice. These monitors started to be introduced since the 1997.

KEY WORDS

Terrorist attacks, toxic chemicals, detection, monitoring, subway stations

ACKNOWLEDGEMENT

The authors express their thanks to Dr. Stach and Dr. Lippe, employers of the Bruker-Saxonia, Leipzig, Germany, for their valuable consulting assistance during designing the monitoring system

25. PERSONAL PROTECTION OF DECONTAMINATION AND RESCUE TEAMS ENGAGED FOLLOWING TO TERRORIST CHEMICAL AND BIOLOGICAL STRIKES

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INTRODUCTION

Terrorist chemical and biological attacks that can be envisaged in future will bring beside extent and degree of violence also new sophisticated methods including the use of supertoxic lethal chemicals and highly contagious biological agents causing increasing number and severity of casualties including lethal cases. This itself stresses requirements on chemical and biological protection in the widest possible sense, i.e. on the complex system of physical and medical protection and rescue means and methods and in the first line on the high-level personal protection of teams engaged in all rescue and recovery actions following to such attacks. Compared to e.g. police missions at street riot control or even to rescue operations after industrial or traffic accidents with release of toxic agents, the rescue teams acting after above mentioned terrorist strikes will be more probably in a much difficult position due to a wider variety of sometimes not exactly anticipated terrorist means and methods. This is why the equipment of these teams must envisage *any* expected possibility from *low hazard* (as for the character of agents, agents only in vapour state, short-term exposition) to *high hazard* (with high amounts/concentrations of supertoxic lethal agents and/or highly contagious agents, plume of agents with droplets, extensive spills etc., long-term operations, combined attacks with explosives or incendiaries etc., work in the environment with lacking enough oxygen or extreme concentrations of agents or smoke etc.) as the extreme, but probable eventuality.

The varieties of conditions under which the rescue teams will operate need to envisage corresponding variety of protective means to be ready for use on the spot.

The aim of this paper is to present the results of the Czechoslovak and Czech R&D, production, testing and use of the new generations of protective means, introduced into the Czech Armed Forces, Czech Civil Protection, as well as for employment at Fire brigades and in chemical and nuclear industry, some of them developed specially for other rescue missions, suitable for the rescue operations after terrorist CB strikes.

Present generations of the Czech means for personal protection, as the result of own R&D, benefit from the old tradition of development of chemical defence (starting in the 1920s) that was necessary to devote attention to, due to the possibility of Czechoslovakia being probable target of use of chemical weapons during its whole modern history after its foundation in 1918. In the pre-WW-II-period, this state was surrounded by two non-friendly countries, preparing offensive chemical assets, during the Cold War was a potential battlefield due to its location, together with then two German states, on the divide between two major Alliances.

CZECH MEANS FOR PERSONAL PROTECTION AFTER TERRORIST STRIKES

Rescue teams designated to operate after terrorist chemical and biological attacks can benefit from the wide variety of modern generations of means for personal protection, ready

for deliver and use in the Czech Republic, able to cover any tactical and technical requirement stemming from the risk analysis, risk assessment and risk management of the concrete situations the terrorist attacks could pose.

The main means of personal protection are represented by a wide sets of

- protective masks (respirators) (originally developed for armed forces, civil protection and industrial safety),
- air-permeable suits (in several modifications as for the cover fabric and accessories)
- air-non-permeable (isolating) suits (in several modifications as for the breathing oxygen source),
- air-non-permeable filtroventilated suits (in several modifications as for the construction material and filtroventilating unit).

It can be stressed that beside concrete *requirements* for individual types (sets) of protective means, general requirements for construction material were applied in order to assure long-term protection against penetration of toxic agents with lowest possible inward leakage and general requirements for long-term use of means under enhanced physiological comfort.

This means in case of *respirators (protective masks)* not only widest possible field of vision and sound/voice transmission, low pressure and impact on face and lowest possible harmful space (connected with expired CO_2 increase), but also possibility of drinking in contaminated area.

In case of the new types of *protective suits,* removal of heat and vapours from the sub-suit space is understood and in some cases also possibility of urine discharge without breaking seal, assuring thus long-term wearing in contaminated area.

Following description of individual means shows the variety of possible use, indicating that actually all possible requirements meeting the demands of use by rescue teams can be fulfilled. It can be noted, that all below mentioned means have been tested under a very strict testing system, according the standards, corresponding to the EN (ISO) standards [3].

RESPIRATORS (PROTECTIVE MASKS) [2,3,4]

For military uses:

M-10M Belong to the standard equipment for all servicemen of the Czech armed force, as well as for servicemen of Rescue regiments of the Czech Civil Protection. Developed during the 1970s by considerable upgrading of the original type M-10 introduced in the late 1960s. Contains 2 upgraded filtration elements in the facepiece. Enables safe drinking in contaminated area. Its design and basic properties are comparable to that of the protective mask M-17-A1 (USA). It was produced in grey colour.

OM-90 The newest model under current introduction. The facepiece possesses extraordinary resistance to penetration of toxic agents (bromobutyl rubber), design of a sealing gasket and low respiration resistance ensure longtime endurance of the mask with the canister made of high-resistant plastic. Computer-optimized field of vision (general field of vision 71 %), design enables correction of dioptrical defects and compatibility with basic military optical devices including the noctovisor CLARA. Hardened glass of visors is highly resistant to damage and scratching. The mask enables safe drinking in contaminated area. Built-in diaphragm assures easy communication and audibility. Screw filter canister with 40x1/7" thread can be fitted on both right and left side. Rubber-textile clamping system

assures optimum position on the user's head. Materials warrant their resistance to wear and damage, enable complete decontamination of the set and simply maintenance.

Main technical data:

Facepiece (produced in black colour) 500 g (average - 3 sizes). Pressure loss (30 ltr/min) - inhalation max 20 Pa, exhalation max 60 Pa. Plastic filter canister OF-90 250 g. Dimensions 110 x 80 mm, pressure loss at 30 ltr/min max 130 Pa. Coefficient of penetration KP 0.0001 %.

Producer of military protective masks: *Gumarny (Resin works) Zubri Co,* CZ-756 54 Zubri, Czech Republic.

For Civil Protection and other civilian (industrial uses)

The R&D of the modern series of the protective masks proceeded in the same main organisations, in the first case subordinated to the Ministry of Defence (Czechoslovak NBC Defence R&D Establishment bearing various depictions in its history, the latest two being Research Institute 070 and now Military Technical Institute of Protection) and in the second case subordinated to the Ministry of Industry (Research Institute of Resin and Plastics Technologies). Similarly, also the production was carried out in the same factory, built in the 1950s for manufacturing the oldest post-WW-II protective mask according to the Soviet-originated model BSS-MO-4u. It was therefore possible to use not only R&D, as well as the material and technological experience and skill, but to apply directly some construction elements, originally designed for modern military masks (mainly for M-10 produced on quite new resin technology) for civil protection and other civilian (industrial) masks. It can be seen, that e.g. visors, resin valves, internal „half-masks" fitted with additional valves, sound/voice transmitting element, drinking device and some construction details were applied as such (material, construction, form, size). This was the reason, why the civilian applications were introduced very quickly, following as the successors of the original military design and why one can observe many similar features on the first view. There is, of course, one exception: The civilian applications, even if derived from the M-10 (M-10M respectively) were designed in all cases with the central filter canister. Reasons for it were not only economic (e.g. the form for manufacturing the facepiece of M-10 with two filtration elements by the transfer moulding was extremely complicate containing altogether 13 parts) but also technical, to enable beside common CBW filter using other special filters against industrial toxic agents.

CM-4 is the basic type of the protective mask for the mass use in Civil Protection, introduced in the early 1970s for the whole general adult population of Czechoslovakia. It was produced, (like all other civilian protective masks) in grey colour and sufficient number (3) of sizes, reflecting the anthropometry of Czechoslovak male/female adult population

CM-4M as upgraded previous type was introduced in the 1980s. It was necessary to overconstruct the original plastic part containing the exhaust valves and air inlet to fit the mask with the drinking device. This upgrading have led to the up-to-date protective mask for general use. This type is widely available.

CM-4K is the modification of CM-4 for industrial use to be connected by means of a hose to the remote air delivery from the external source.

CM-5 is a typical industrial protective mask, derived from the CM-4. It was introduced in the late 1980s and belongs to the most modern civilian protective masks for general use. It is marked by its single wide panoramic visor. It is therefore extremely suitable for industrial operations under various conditions where good sight is required.

CM-5M is the latest model of civilian protective mask, being derived from both CM-4M and CM-5 combining the advantages of both types, i.e.single wide panoramic visor and

ability to drink in contaminatred area. It is therefore very welcomed for long-term work under heavy-duty conditions.

It is quite clear from this overview that the whole set of civilian protection masks, produced in huge quantities (actually for the whole 15 mlns of citizens of Czechoslovakia) is available in enough volume to be used for the purposes consistent with the title of this paper.

As it was stated above, there is a single producer of both military and civilian masks in the Czech Republic, named under the military protection masks.

AIR-PERMEABLE PROTECTIVE SUITS [1]

The R&D, started in the Czechoslovak NBC Defence R&D establishment in the late 1960s.

The main achievement was the adsorption fabric, based on tiny-particle sorbent pneumatically scattered and fixed on the multilayer non-vowen system of randomly oriented polymer fibers.

This enabled to develop and manufacture a large series of various modifications of air-permeable protective suits according to the customer's desire. The adsorption layer is the medium function part, fitted from inside by a light permeable linen and from outside by a cover textile fabric. Various modifications of suits differ mainly in the properties of the outer cover fabric. For the standard military use, it is designed as the oversuit and the cover fabric possesses a camouflage print and additionally also impregnation against moisture, fatty dirt, fire and light impulse of the nuclear explosion.

According to the desire of the customer, the material of the cover textile can be changed and all mentioned impregnations can be ommitted which significantly increases the air permeability. This is very important e.g. for the hot climate. So, e.g. for the Czech UNSCOM missions a special very light white cover textile was applied, what was admired by the members of all other inspecting teams operating in hot Iraq climate.

The standard Czech air-permeable protective suit POO and its properties has been already presented at various opportunities. It is available and suitable for the purposes discussed here under situations connected with low to medium risk operations.
Producer of the air-permeable protective suits: *BOIS-Filtry Ltd.,* Brno, Czech Republic

AIR NON-PERMEABLE FILTROVENTILATED PROTECTIVE SUITS [2,3,4]

The most progressive and reliable means for high-risk operations are represented by already a set of hermetic heavy-duty protective suits, derived from the basic type OPCH-90.

OPCH-90 is worldwide the first type of protective suit for military specialists, equipped with the filtroventilation unit FVJ-90 supplying enough regulated filtered air stream into respirator (protective mask) (60/120 ltr/min) and into the undersuit space (up to 300 ltr/min), continuously changing the microclimate, removing heat and water vapours, assuring thus overpressure (overpressure exhaust valves) and cooling, preventing overheating and inward
leakage. This suit, together with the Czech-made masks (M-10M, CM-4M, CM-5M and the new OM-90) enables drinking, assures the protection of respirator and the inward leakage index up to 99.99953 %, medium hard work (below 20^{0} C) up to 6 hrs. It was tested for wearing up to 24 hrs. This is achieved thanks to fitting with a special urine-discharge device, consisting from a special suspensor with discharge hose and a container, enabling the urine discharge in contaminated area without breaking seal. The material is highly CWA-resistant.

OPCH-90-PO is the civilian (Civil Protection respectively) modification made fromanother material resistant against industrial chemicals, produced in signal yellow, with modified form of the filtroventilation unit to enable entering narrow spaces.

There are several modifications of the above mentioned types, amended with various types of breathing devices, carried either ouside (for fire brigades and rescue teams) or also under the suit (for the use in heavy duty industrial operations in corrosive environment.

Any of those suits are suitable for the use following the terrorist attacks. They are envisaged for such purposes.

Producer: *EcoProtect, Ltd*, Zlín, Czech Republic.

SUMMARY

Contemporary Czech protective means, suitable for equipment of rescue teams engaged following the terrorist CB attacks are presented. They include in the first line *respirators (protective masks)* originally designated for armed forces (M-10M, OM-90) and for civil protection and industrial uses (CM-4, CM-4M, CM-4K, CM-5, CM-5M). They are further represented by *air-permeable suits* for lower risk level (POO) produced in several modifications (as for the properties of the cover fabric for different climate and other requirements, such as colour, camouflage, impregnation against water, fire, oil products etc.) and with various accessories, i.e. types of gloves, boots and overboots. The last element of the triad are the *air-non-permeable filtroventilated suits* for high risk level (OPCH-90 and OPCH-90-PO) providing with extremely high physiological comfort and long-term use (tested for up to 24 hrs wearing due to enabling drinking and urine discharge in contaminated area without breaking seal). Modifications of these suits are described as well. Experience from several decades of R&D, production, testing, training, peaceful applications in chemical and nuclear industries, as well as from Persian Gulf operations (1990-1991) and UNSCOM missions (the 1990s) is presented. All means have been tested in a strict system using EN (ISO) standards.

KEY WORDS

CB-terrorism, rescue operations, personal protection, respirators, protective masks, air-permeable protective suits, air-non-permeable filtroventilated protective suits

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26. ROLE OF INTERNATIONAL ORGANISATIONS IN COMBATTING TERRORISM

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INTRODUCTION

Growing extent and severity of terrorist attacks, employment of new sophisticated and dangerous methods including potential and actual use of the weapons of mass destruction, mainly CBW agents and increasing transnational character of terrorist organizations and groups need resolute actions of civil society and its governmental and non-governmental organizations on national, as well as international level. It seems that only joint coordinated effort can bring tangible results in combating terrorism, not to speak on the desired but maybe never reached final goal, to eradicate terrorism together with its causes.

There is no doubt that beside contemporary ethnic, religious, economic and political sources of terrorism as organized crime, the historically oldest roots of terrorism are connected with illicit drug and weapon trade achieving global extent. It is therefore obvious that those problems became point of attention of the most important international organization, UNO since its foundation.

This paper reviews the roots and development of the present UN system, growing from the first efforts to build a world system for combating drugs trade, long before foundation of UNO to the establishment of the UN Office for Drug Control and Crime Prevention (ODCCP) in 1997 including its Centre for International Crime Prevention (CICP) for combating organized international crime including terrorism (also in 1997). Because of growing terrorism as one typical face of organized international crime, the UN system for combating terrorism is developing in this direction that is witnessed by establishing Terrorism Prevention Branch (TPB) within the CICP in 1999.

The above mentioned UN system as a functioning network with is tasks, organization, field stations around the Globe and links to other international and national governmental agencies, organizations and NGOs is portrayed in this paper.

ROOTS AND DEVELOPMENT OF GLOBAL SYSTEM FOR COMBATTING ORGANISED CRIME

The roots of present UN system can be found just in 1909, when the Opium Commission in Shanghai was founded. To the most important milestones of build-up of the present system belong UN Commission on Narcotic Drugs and the Division of Narcotic Drugs (1946), the First UN Congress on Crime Prevention and Treatment of Offenders (1955), establishing International Narcotic Control Board (1968), adopting the Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances (1988) and establishment of the UN International Drug Control Programme, UNDCP (1991) and lastly of the above mentioned UN Office for Drug Control and Crime Prevention (ODCCP) with its Headquarters in Vienna (1997). Main data from this development can be listed as follows:

Main data on the development to present UN system for combating organized crime:

1909 - Opium Commission Shanghai
1912 - First Opium Convention
1946 - UN establishes the Commission on Narcotic Drugs (CND) and the Division on

Narcotic Drugs

1955 - First UN Congress on Crime Prevention and Treatment of Offenders
1961 - Single Convention on Narcotic Drugs
1968 - International Narcotics Control Board established
1971 - Convention on Psychotropic Substances
1979 - UN drug control bodies move from Geneva to Vienna
1979 - Crime Prevention and Criminal Justice Branch moves from New York to Vienna
1987 - Adoption of Comprehensive and Multidisciplinary Outline of Future Activities in Drug

Abuse Control

1988 - Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances
1990 - UN General Assembly adopts the Global Programme of Action against Illicit Drugs
1991 - United Nations International Drug Control Programme (UNDCP) established
1997 - UN Office for Drug Control and Crime Prevention (ODCCP) established
1997 - UN Centre for International Crime Prevention (CICP) established
1998 - 20th Special Session of the UN General Assembly devoted to countering the world

drug problem

1999 - Terrorism Prevention Branch established as a part of the CICP

THE ROLE AND FUNCTIONS OF THE UN DRUG CONTROL PROGRAMME

Illicit drugs are a global problem in connection with terrorism. More than 200 mln people abuse drug worldwide. The images span all segments of society: the urban professional snorting cocaine in a downtown nightclub, the glue-sniffing street children in the slums of developing world, the farmer addicted to the opium poppy he grows and the teenage Ecstasy user in a comfortable suburban home. Drug use is responsible for lost wages, soaring health care costs, broken families and deteriorating communities. Intravenous drug use is also fuelling the rapid spread of AIDS and hepatitis. There is a direct link between drugs and increase in crime and violence. Drug cartels undermine governments and corrupt legitimate business. In some countries, addicts supporting their habits commit more than 50 per cent of thefts. Revenues from illicit drugs fund some of the deadly armed conflicts. The financial toll is staggering. Enormous sums of money are spent every year to strengthen police forces, border patrols, judicial systems and treatment and rehabilitation programmes. The social costs are equally jarring: street violence, gang warfare, fear, urban decay and shattered lives.

After years of finger pointing between countries, the international community enters the new millennium with there unified will of governments to eliminate the illegal drug trade worldwide. UNDCP's approach is multifaceted. Besides prevention, treatment and rehabilitation programmes including alternative development assistance, UNDCP collaborates with Interpol and World Customs Organization sharing information on global trafficking trends, smuggling *modus operandi* and drug courier profiles. Illicit trafficking is further curbed through the delivery of expert training to improve interdiction and investigation techniques and supported through the provision of operational equipment.

To the important operational programmes of the UNDCP belong:

- *Global Programme Against Money Laundering* (This programme assists governments in confronting the criminals through the international financial system. The programme provides training in financial investigation to business, law enforcement and judicial professionals. It also builds stronger legal and institutional frameworks and undertakes the groundwork for the creation of Financial Intelligence Units).

- *Global Assessment Programme* (This programme, known as GAP supplies exact and current statistics on illicit drug consumption in order to find best preventive strategies).

- *Legal Assistance Programme* (This system cooperates with states to implement drug control treaties by helping to draft domestic legislation and train judicial officials. More than 1400 key personnel have received legal training and over 130 countries have received legal assistance).

On the UNDCP global network can be witnessed according its Field Offices, located in: Afghanistan (temporarily in Pakistan), Barbados, Bolivia, Brazil, Colombia, Egypt, India, Islamic Republic of Iran, Kenya, Lao PDR, Latvia, Mexico, Myanmar, Nigeria, Pakistan, Peru, Senegal, Thailand and Viet Nam.

For the coming years very important pledge was adopted by member states at the Special Session of the UN General Assembly on the World Drug Problem (held in June 1998): to significantly reduce both the demand and supply for illegal drug by the year 2008.

CENTRE FOR INTERNATIONAL CRIME PREVENTION AND ITS ROLE

The age of globalisation has opened up new forms of transnational crime. Organized criminal groups are expanding at an alarming rate bringing with them violence, intimidation and corruption of public officials. New challenges of crime prevention and criminal justice need cooperative action. Since its establishment within the framework of the UN Office for Drug Control and Crime Prevention (ODCCP) in 1997, the CICP has developed its activities (beside special activities in terrorism prevention) in following directions:

- *Legal instruments* (CICP supports member states in the elaboration of a Convention Against Transnational Organized Crime and three supplementary protocols, to be finalized in foreseeable future. It is envisaged that work on a universal Convention will commence thereafter).

- *Global Studies on Organized Crime* (Criminal groups have established international networks to better carry out their activities both in licit and illicit markets by employing sophisticated technology and diverse moods of action. The aim of the mentioned studies is to map latest trends of organized criminal groups and highlight their potential danger in order to setup preventive action).

- *Global Programme Against Corruption* (Corruption is a complex social, political and economic phenomenon. This programme targets countries with vulnerable developing or transitional economies by promoting anti-corruption measures and helping to make public sector actions more transparent).

- *Global Programme Against the Trafficking in Human Beings* (The smuggling of migrants and the trafficking of human beings for prostitution and slave labour are one of the fastest growing worldwide problems in recent years. Recent studies show a growing involvement of organized crime groups. This programme will enable countries of origin, transit and destination to develop joint strategies and practical actions).

The description of the CICP's role and activities is to be amended with the information that its headquarters is located at the UN Vienna Office. Its outpost is in Lebanon.

ODCCP, located at the Vienna International Centre (VIC) has approximately 360 staff members worldwide. It has 22 Field Offices worldwide, as well as two Liaison Offices in New York and Brussels. The ODCCP's Executive Director is Mr. Pino Arlacchi since 1997.

(ODCCP Headquarters postal address: United Nations Office for Drug Control and Crime Prevention, Vienna International Centre, PO Box 500, A-1400 Vienna, Austria.)

THE TERRORISM PREVENTION BRANCH

To the most recent directions in the work of the CICP, since 1999 established as an organized body belong the Terrorism Prevention Branch (TPB). This body is mandated to enhance international cooperation and government response to terrorism.

This department of CICP has been working for relatively short time but it has however established good cooperative links to the relevant governmental and non-governmental international and national organizations, not to speak on the whole network of UN agencies through the ODCCP (such as FAO, IAEA, ILO, UNAIDS, UNICEF, UNCTAD, UNDP, UNESCO, UNEP, UNHC, UNIDO, UNICJR, UNV, WFP, WHO). Important are the links in the framework of law enforcement and legal affairs, as well as in various forms and problems of organized crime.

Among the links of the Terrorism Prevention Branch, following addresses can be found *inter alia:*

- International Policy Institute for Counter-Terrorism (www.counterror.org.il)
- US State Dept, Coordinator for Counter-Terrorism (www.state.gov/www/global/terrorism/)
- Terrorism Research Center, Inc.(www.terrorism.com/)
- Political Terrorism Database: geographic areas (polisci.home.mindspring.com/ptd.html)
- International Policy Institute for Counter-Terrorismm (www.ict.org.il/default.htm)
- International Crisis Group (www.intl-crisis-group.org)
- Counter-terrorism bills and proposals (www.epic.org/privacy/terrorism)

SUMMARY

Roots and developments to present UN system for combating terrorism starting long before existence of UN are reviewed. Various forms of international crime as a base for terrorism are shown, *inter alia* illicit trafficking with drugs and weapons, money laundering, corruption, trafficking with human beings and like and response in build-up the UN system, headed by the
UN Office for Drug Control and Crime Prevention (ODCCP), its Centre for International Crime Prevention (CICP) and the Terrorism Prevention Branch (TPB) established recently. Information on the role, functions and programmes of those bodies are presented.

KEY WORDS

International terrorism, narcotic drugs, crime prevention, combating terrorism, terrorism prevention, UNO, UNDCP, ODCCP, CICP, TPB

REFERENCES & SOURCES

ODCCP Press Releases and other documentation: Speeches (Major statements and speeches by ODCCP Executive Director Pino Arlacchi), Events (Reports on recent and upcoming ODCCP events in Vienna, New York and elsewhere), Newsletters (ODCCP quarterly UPDATE), Multimedia (videos are provided on a non-commercial basis for education purposes. The ODCCP Film/Archive contains issues dealing with drug control and crime prevention), Publications (ODCCP publications cover themes such as Drug Abuse, HIV/AIDS, Global Illicit Drug Trends, Global Illicit Drug Traffics), Bulletin on Narcotic Drugs, CND Documentation, Resolutions etc.
Most of printed materials are also available via internet (http://www.odccp.org).

27. THE NEW INTEGRATED RESCUE SYSTEM IN THE CZECH REPUBLIC

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A COMMON INTRODUCTION

Use of sarin in the overcrowded metro of Tokyo in 1995 was a shocking and warning case for the whole wide world. The case was extremely alarming because it took place in democratic, well-off and socially stable society.

New technologies, especially in the field of genetic engineering, biological manipulation, but also chemical industry create premises for the results of scientific investigations to be used in ill manner for terrorist targets. Unfortunately, availability of know-how, own relatively simple and cheap production, use of basically simple methods of application have created such a situation that the ill use of chemical warfare agents (VX agent, soman, sarin, tabun, mustard gas, lewisite, phosgene, etc.) biological warfare agents (bacteria, viruses, rickettsia, toxins, etc.) can be expected anywhere and at any time all over the world for different reasons. Another possibility is the industrial toxic substances. A large series of industrial toxic substances - such as chlorine, ammonia, hydrocyanic acid, phosgene, formaldehyde and many others belong to widely spread substances as for both the number and contents.

Terrorists can and certainly will struggle to gain weapons of mass destruction or their effective components, such as toxic agents, toxins, bacteria and germs. These materials can easily be „home made" since technical and technological information necessary for synthesis of the most toxic agents (chemical nerve-paralytic warfare agents: VX agent, soman, sarin, tabun) is commonly available in special or patent literature. Particularly this refers to the new type of binary chemical ammunition. For example at least five methods of preparation is commonly known for toxic agent called sarin.

Besides, the danger, numerous security experts have said, is that impoverished weapon experts from the former Soviet Union could be tempted to sell their knowledge to rogue nations. But country seeking weapon knowledge may cloak their goal with legitimate jobs. Scientists have been offered university positions to teach about technologies that have both benign and malignant uses.

U.S. government assessments frequently cite the spread of chemical and biological weapons as one of the greatest security threats to the country and world, there is a serious gap between the threat and resources devoted to mitigating them. Moreover, there is no doubt about the reason for the considerable increase in smuggling radioactive materials from East to West. We should reckon with the fact that the most militant of the extremist groups are struggling for nuclear weapons. The „emigration of brains" and „purchase of necessary knowledge" from the former secret nuclear centers in the U.S.S.R. could help it. Unfortunately we cannot eliminate the work of nuclear experts for militant terrorist groups and organizations. In accordance with STARTs agreements a great number of Russian nuclear explosives is to be processed into nuclear fuel for nuclear power plants. This creates some questions, for example: Is Russia able to secure these explosives?

Another possibility is the industrial toxic substances. A large series of industrial toxic substances belong among widely spread substances as for both the number and contents are documented by, for instance, Civil Protection in the Czech Republic that specifies them in the

following order (from the point of view of their amount and toxicity): chlorine, ammonia, hydrocyanic acid, phosgene, and formaldehyde. Mainly ammonia and chlorine are produced, used and transported in huge volumes and can be met in both railway transport and industrial installations.

It is easy to imagine a situation when the armed terrorists get possession of a chlorine tank, for instance, and will menace with its opening and release of its toxic contents. Analogously it could happen that a group of armed terrorist will seize some stationary source – of a chlorine container in a water-treatment plant and will also menace with its drainage out. And, if the worst comes to the worst, they could use a toxic substance against unprotected civilian population – without any warning at all.

THE SITUATION AFTER VELVET REVOLUTION

In the Czech Republic, after 1989, the problems of terrorism are dealt with the Czech Republic's Police in cooperation with the intelligence services. Many of terrorist organizations have international nature that requires a very closed and effective international cooperation. Territory of the Czech Republic has served and it will continue to do it as a transit country for the move of different terrorist groups or individuals or – as the case may be – as a transit country for some kinds of goods whose sale can often finance the terrorist groups' activities.

In the Czech Republic, soon after 1990, special counter-terrorist units have been established. Up to now, nevertheless, these units have not been equipped with efficient means of high quality that could be used for fighting the nuclear, chemical, and biological terrorism such as, for instance: special monitoring instruments, means of individual protection, etc. Related to that is, naturally, so far missing efficient and purposeful training of high quality.

THE ESTABLISHMENT OF THE NEW INTEGRATED RESCUE SYSTEM IN THE CZECH REPUBLIC

There is totally new situation on the area of crisis management and emergency planning in the Czech Republic. The series of significant acts that represent the basic presumption for building up the new integrated system were declared in the Czech Republic in August 2000. In question are the following new and important Acts:

The Act on the Czech Republic's Fire Fighting Rescue Corps (No. 238),
The Act for the Integrated Rescue System (No. 239),
The Act on the Crisis Management, so called Crisis Act (No. 240),
The Act concerning Economical Measures for Crisis Statuses (No. 241),
The Act on General Fire Fighting has been amended significantly (No. 237).

These important Acts then have created a complex and full necessary legal environment for managing all main crisis situations promptly and in qualified manner. Mainly the Act about the Integrated Rescue System and its executing decrees are the basic tools and means for quick, effective, professional, and coordinated interventions by all rescue and emergency components, both state and private ones of that essential rescue system. These above mentioned Acts entered into the force from January 1, 2001. The created system will then also involve the indispensable answers to the new and very dangerous trends in terrorism such as nuclear, chemical, and biological branches of terrorism, including terrorism by industrial toxic chemicals. The created integrated rescue system must be furnished with such an amount of the means, technology, and material that it may cover the needs of all components of the process:

the quick and reliable detection and monitoring hazardous agents,
the fast and direct warning,
the protection of personnel of rescue components, forces and units,
the first aid and the ensuring medical care for affected people,
the fast and completed decontamination of persons, personnel, techniques and areas,
reporting system.

In the conditions of the Czech Republic, the complex solution of this problem consists, in principle, in concluding the establishment of so called "Integrated Rescue System" that involves, as the main and first-order components, the police, rescue fire brigades and fast rescue medical service that start the action practically immediately. Then the second-echelon components – such as the selected components of Armed Forces and many others are activated.

This naturally means to conclude the establishment of integrated rescue system in the Czech Republic also from the point of view of the possible terrorist attack including the ill use of industrial toxic substances against civilian population or even the NBC weapons. Implementation of multidisciplinary teams seems to be the indispensable first step. It is also necessary to harmonize and complete the technical outfit, to adapt the structure of organization in the integrated rescue system.

For the cases of terrorism it would be appropriate for the participating components to elaborate a unified information as a manual that ought to contain basic information concerning the "classic terrorism", but also the terrorism combined with the use of industrial toxic substances or, as case may be, NBC weapons. Further on operating procedures / methodology of interventions would be developed for solving the various cases as models for each case apart.

CONCLUSION

At present time, it is, unfortunately, indispensable to count with the possibility that the terrorist might be armed with even very modern weapons that, in the past, could be found exclusively in army stores or police units, in the national guards and other official state armed forces. These are, for instance, missiles, anti-tank weapons, mortars etc. It is just a question of time when the mass destruction weapons or the destructive components of chemical and biological weapons will enlarge or will become the main means of the terrorists' armament. It is also imminent the possibility that these weapons - threat of their use - will practice extortion with the state bodies for which it will be very difficult to manage such situations.

From the above statement it can be deduced that the problems of nuclear, chemical, and biological terrorism should be investigated on the basis of scientific methods and it should utilize the international cooperation as much as possible.

SUMMARY

A short common introduction of the area of chemical, biological and nuclear terrorism, including toxic industrial substances. The situation in the country after so-called Velvet Revolution on the area of counter-terrorism preparedness. The establishment of the new integrated rescue system in the Czech Republic including a couple of new acts concerning crisis management and emergency planning. A common requirements for the creation of the new system. The main and first-order components, rescue and emergency units.

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KEYWORDS

Crisis Management; Integrated Rescue System; Chemical Warfare Agents; Biological Warfare Agents; Industrial Toxic Substances; Rescue and Emergency Forces, Units and Components

28. THE TREATMENT OF INTOXICATION WITH SELECTED ORGANOPHOSPHATES AND A CARBAMATE: COMPARISON OF DIFFERENT THERAPEUTIC APPROACHES

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ABSTRACT

The treatment of intoxications (2xLD50) with sarin, DDVP and pyridostigmine (s.c.) was studied in rats. The animals were s.c. injected with toxic chemicals and treated (i.m.) with atropine, atropine and obidoxime (omitted for pyridostigmine), sodium bicarbonate (i.p.), atropine (i.m.) and sodium bicarbonate (i.p.). The start of treatment was at the onset of convulsions. Acetylcholinesterase (AChE) activity and pH in the blood (different time intervals) and AChE activity in the frontal cortex, basal ganglia, pontomedullar part and hippocampus were determined (after death or 24 h). In intoxications with all compounds studied, rapid decrease of the blood AChE activity was observed. In the brain, AChE activity was decreased with the exception of pyridostigmine. Detected pH in the blood showed its decrease following intoxication. In sarin intoxication, the only atropine and obidoxime showed minimal therapeutic effect (10% of survival). In case of DDVP, therapeutic effect increased in following manner: bicarbonate (80% lethality)< atropine (60% lethality)< atropine and bicarbonate (50% lethality)< atropine and obidoxime (30% lethality). Therapeutic efficacy in case of pyridostigmine was increased in the following manner: bicarbonate (80% lethality)<atropine (50% lethality) <(atropine and bicarbonate (20% lethality). The results indicate that administration of bicarbonate improves the therapy of organophosphate and pyridostigmine intoxication.

INTRODUCTION

Insecticides are widely used in agriculture, medicine and industry. The most common types are organophosphates (OP) and carbamates. Accidents as well as professional and suicidal intoxications are often occurring. The usual therapy of OP intoxications is based on administration of parasympatholytics (preferably atropine) and cholinesterase reactivators (pralidoxime, obidoxime, HI-6 etc.). Therapy of carbamate intoxication is limited to atropine administration only. However, there are some data on the treatment of OP poisoning using atropine and bicarbonate without use of reactivators either in experimental animals (1) or in humans (2,3). These data are limited and are not sufficient for detailed analysis of such therapeutic approach. The aim of this study is to get a more detailed insight in such a treatment.

MATERIAL AND METHODS

Chemicals: ***Sarin was synthetized at Chemical Facility Zemianské Kostolany (Slovakia).***

DDVP was obtained from Spolana Neratovice (Czech Republic) and pyridostigmine was produced by VUFB Praha (Czech Republic).

Animals: Female Wister rats (Konárovice animal facility, Czech Republic) weighing 200 ± 20 g were used. The animals were kept in air-conditioned room (20-22 °C) on 12 light/dark cycles with free access to food and tap water.

Toxicity determination and doses: The chemicals were administered subcutaneously and survival/death of animals was registered 24/48 hours (n=4-6). Method of Weil (4) was used for determination of LD50. For therapeutic experiments, 2xLD50 (s.c.) was applied:

- Sarin – 200 μg/kg
- DDVP – 20 mg/kg
- Pyridostigmine – 12 mg/kg

Treatment: The animals were intoxicated with dose of 2xLD50 (s.c.). The start of the treatment was at the onset of convulsions (T3). For the treatment, following groups (n=10) treated i.m. were used:

- Atropine only (21 mg/kg)
- Atropine (21mg/kg) and obidoxime (25 mg/kg)
- Sodium bicarbonate (3 mMol/kg) administered intraperitoneally (i.p.)
- Atropine (21 mg/kg) and sodium bicarbonate (i.p.)
- Saline applied i.p. as a control

In the case of carbamate, the treatment with atropine and obidoxime was omitted.

Time of symptoms: Time of following symptoms was registered: salivation, disturbed ventilation, fasciculations (T2), convulsions (T3), generalized convulsions, death (T4).

Other parameters: Blood acetylcholinesterase (AChE) and pH in blood was determined before intoxication (T1), at the time of fasciculations (T2) and convulsions (T3) and after death or 24 hours (T4).

AChE activity in the frontal cortex (FC), basal ganglia (BG), hypothalamus (H) and pontomedullar area (PM) was determined in interval T4. AChE was expressed as ncat/g wet weight tissue (brain) or ncat/ml (blood) The result of determination represents 71% of AChE and 29% of butyrylcholinesterase (5).

Statistical evaluation: The results were calculated as means with standard deviation

RESULTS

Sarin intoxication: Symptoms of intoxication were observed in a very short time finishing in death in time less than 10 min. Rapid decrease of AChE activity in blood was observed. After death, AChE activity in the brain parts (with exception of BG) was demonstrated. No changes were observed in blood pH. Therapeutic interventions were not successful with slight exception of combination of atropine and obidoxime (90% lethality) (Tables 1-3).

DDVP intoxication: Symptoms of intoxication were observed in longer period in comparison with sarin as well as the time of death. Rapid decrease of AChE activity in the blood as well as in the brain parts (with exception of BG) after death was demonstrated. However, the inhibition was not so high in comparison with sarin. Tendency to decrease pH in the blood was demonstrated. Efficacy of therapeutic interventions was increased in following manner: bicarbonate (80% lethality), atropine (60% lethality),, atropine and bicarbonate (50-60% lethality) and atropine and obidoxime20-50% lethality) (Tables 1-3)

Pyridostigmine intoxication: Time of symptoms was very rapid comparable with sarin. But time of death was prolonged.

The quality of symptoms was different in comparison with organophosphates convulsions: they were similar as „springs" followed by pauses with disturbed ventilation. Rapid decrease of AChE activity in blood was similar to that observed for OP. Brain AChE was resistant to pyridostigmine. Decrease of blood pH was also observed. Therapeutic interventions were successful for 2h period – atropine 50% lethality, bicarbonate 80% lethality, atropine and bicarbonate 20% lethality, however, 24 lethality was different: 80 % lethality for atropine only and 100% lethality for the last two combinations (Tables 1-3).

DISCUSSION

From the results obtained, comparison with results of Wong et al. (1) was possible only. His experiments with DDVP followed by intravenous treatment with bicarbonate are better than ours. It can be caused by different approaches to bicarbonate administration (i.v. - i.p.), nevertheless, it seems to us that i.p route of administration can also be used. From the results can be calculated more parameters, e.g. mean time of symptoms for each experimental animal, tendency to changes in blood pH and AChE and many other information.

It is of interest that (in some cases) treatment with atropine and bicarbonate increased survival or the time of death of animals in comparison with administration of atropine alone.

Administration of bicarbonate or atropine with bicarbonate improved in some cases pH of the blood. On the other hand, blood AChE was slightly influenced by atropine or bicarbonate. Combination of atropine and obidoxime increased blood AChE in case of OP. It is very probably caused by reactivation of the blood AChE.

Inhibition of the brain AChE demonstrated relative resistance of AChE in BG against carbamates and OP. Simultaneously, high sensitivity of AChE in FC and PM was observed for OP intoxication. For carbamates, this sensitivity was not observed. It is very probably caused by low penetration of carbamates through blood-brain-barrier.

CONCLUSIONS

1. Survival of experimental animals intoxicated with DDVP and Pyridostigmine is positively influenced by administration of bicarbonate and atropine with bicarbonate. However, in case of sarin, treatment with obidoxime and atropine is slightly more effective.
2. In some cases, administration of atropine and bicarbonate prolonged time of death.
3. Blood AChE was decreased in dependence on time and symptoms of intoxication.
4. Blood pH was decreased during intoxication with OP and carbamate.
5. AChE in the brain parts was inhibited differentially depending on type of such chemicals.
6. The results allow to determine values of different parameters with high accuracy because of high number of animals in experimental groups.

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KEY WORDS

Sarin, DDVP, pyridostigmine, rat, treatment

Table 1: Survival of experimental animals

Sarin

atr	10/10	10/10
bic	10/10	10/10
Atr+bic	10/10	10/10
atr+obid	1/10	1/10

DDVP

atr	4/10	4/10
bic	2/10 (2 h)	2/10 (24 h)
Atr+bic	5/10 (2 h)	4/10 (24 h)
Atr+obid	8/10 (2 h)	5/10 (24 h)

Pyridostigmine

atr	5/10 (2 h)	2/10 (24 h)
bic	2/10 (2 h)	0/10 (24 h)
atr+bic	8/10 (2 h)	0/10 (24 h)

Table 2: Changes in blood AChE

Sarin	T1	T2	T3	T4
atr	9.92	3.00	1.70	0.25
bic	9.90	3.05	1.94	0.55
atr+bic	10.05	3.27	1.99	0.60
atr+obid	10.20	3.26	1.99	1.42

DDVP	T1	T2	T3	T4
atr	10.10	4.02	2.57	0.57
bic	10.14	3.99	2.87	0.87
atr+bic	10.12	4.03	2.58	0.81
Atr+obid	10.07	4.11	2.57	3.87

Pyridostigmine	T1	T2	T3	T4
atr	9.7	3.35	1.85	0.64
bic	9.94	3.39	2.20	1.18
atr+bic	9.74	3.15	2.10	0.83

Table 3: Changes in pH of the blood

Sarin	T1	T2	T3	T4
atr	7.338	7.325	7.321	7.318
bic	7.333	7.331	7.327	7.324
atr+bic	7.333	7.329	7.329	7.326
Atr+obid	7.329	7.329	7.323	7.327

DDVP	T1	T2	T3	T4
atr	7.339	7.285	7.232	7.269
bic	7.343	7.330	7.250	7.206
atr+bic	7.338	7.314	7.272	7.287
Atr+obid	7.331	7.313	7.293	7.247

Pyridostigmine	T1	T2	T3	T4
atr	7.334	7.333	7.325	7.241
bic	7.336	7.328	7.299	7.303
atr+bic	7.335	7.330	7.288	7.235

In all Tables, means are given only.

29. PRION - NEW ANSWER OR THE OLD RIDDLE

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ABSTRACT

Life, like the eternal and unsolved riddle, and the Science, which tries to find the answers, are both the inspires to each other. The interrelations between live and live, and life and death, move us towards the question about the beginning (or maybe the end) of life.

Where is the place of PRION in all these philosophical thinking? It now appears that an infectious agent named a prion may stand out as a remarkable exception to the rule that every organism carries nucleic acid defining its own identity. The prion is known as capable of initiating the production of new prions, at least in certain mammalian cells.

Prion diseases are the group of neurological diseases known in humans as: curu, sCJD, fCJD, ICJD, nvCJD, GSS, FI, and in animals as: TME, CWD, FSE, BSE and SCRAPIE.

Most of these diseases became by ingestion of by products of sheep that have the disease to scrape off much of their wool. Changes brought on by the disease are confined to the central nervous system. A consistent indicator is abnormal proliferation of the astrocytes, a class of supporting cells in the brain. In neurons there is a depletion of dendritic spines, which have a role in the transmission of nerve impulses. In some of the disorders numerous vacuoles give the brain tissue a spongy appearance.

Prions contain protein and reproduce in the living cell, yet no DNA or RNA has been found in them. What is the nature of their genome?

Could these facts can be the possibility of creation of new agents for terrorists, and could the mechanisms of the most hidden secrets of the life be used to create evil?

Are prions potential BUG of the 21. century, and are we , humans, capable of making antidote for them?

INTRODUCTION

WHAT ARE PRIONS?

The prion protein (PrP^c) is a glycolipid-anchored, cell surface protein of unknown function, a posttranslationally modified isoform of which has been implicated in the pathogenesis of spongioform encephalopathies in man and animals.

The term "prion" was coined by Prusiner to indicate an infectious agent with protein like properties.. The unusual properties of the pathogen were demonstrated in early experiments in which conditions that degrade nucleic acids, such as exposure to ionizing and ultraviolet radiation, did not reduce the infectivity of scrapie fractions, on the other hand, treatments that degrade protein, such as prolonged exposure to proteases, correlated with a reduction in infectivity. A protein with relative resistance to protease digestion was found to be consistently present in the brains of animals and humans with TSE. Surprisingly, this protein was found to be one that is normally encoded by a chromosomal gene of the host.

Prion diseases are a group of fatal neurodegenerative disorders that can occur in hereditary, sporadic, and infectious forms.

These illnesses occur in humans and a variety of other animals. Prions are infectious proteins. The normal cellular form of the prion protein (PrP) designated PrP^c, contains three α- helices and has little β- sheet; in contrast, the protein of the prions, denoted the scrapie form of PrP (PrP^{Sc}), is rich in β- sheet structure. The accumulation of PrP^{Sc} in the central nervous system precedes neurological dysfunction accompanied by neuronal vacuolation and

astrocytic gliosis. PrP is highly conserved, host- encoded sialoglycoprotein that may play a role in normal synaptic function and circadian rhythms. This host protein (PrP^c) is present in the brain and other tissues and is sensitive to proteinase K (PK) digestion.

The spongioform encephalopaties are a group of transmissible, neurodegenerative disorders including kuru, Creutzfeldt-Jacob disease, and Gerstmann-Sträussler syndrome in man, and scrapie and bovine spongioform encephalopathy in animals.

The infectious agent (prion) responsible for these diseases is composed primarily, if not exclusively, of the protein PrP^{Sc}, which is a posttranslationally altered isoform of the normal cellular protein PrP^c (Prusiner, 1991.). Although the structural features that distinguish the two isoforms have not yet been identified, they differ in several biochemical properties, including resistance to protease digestion and solubility in detergents. Recent evidence also suggests cell biological differences. PrP^{Sc} is found primarily inside infected cells where it appears to accumulate, while PrP^c is a surface protein, which is degraded with a half-life of several hours.

The physiological function of PrP^c has remained elusive. It is abundantly expressed in the central nervous system and in several peripheral tissues beginning early in embryonic development, and it has been suggested that the protein plays a role in neural differentiation, lymphocyte proliferation or cell adhesion.

How does PrP^c convert to PrP^{sc}?

Potential mechanisms that initiate conversion of PrP^c to PrP^{Sc} include a germ line mutation of the human prion protein gene (PRNP), a somatic mutation within a particular neuron, and spontaneuos conversion of PrP^c to an aberrant conformation, that is not refolded appropriately to its native structure. Regardless of the initiating event, once an "infectious unit" has been generated, PrP^{Sc} appears to act as a conformational template by which PrP^c is converted to a new molecule of PrP^{Sc} through protein-protein interaction of PrP^{Sc} and PrP^c (Fig.1A and 1B). This concept is supported by several studies which show that mice with the normal PrP gene deleted (PrP knockout mice) do not develope prion disease after inoculation with scrapie. Further more, transgenic (Tg) mice that express a chimeric PrP gene made of human (Hu) and mouse (M) segments, designated Tg(MHu2M), develop protease-resistant chimeric mouse-human PrP^{Sc} (i.e., $MHu2MPrP^{Sc}$) in their brains, when inoculated with brain extracts from humans with prion disease. These findings clearly ilustrate that prions do not self-replicate but instead convert nonpathogenic PrP^c to pathpgenic PrP^{Sc}.

Conversion of the cellular prion protein (PrP^c) to an abnormally confirmed, aggregated, protease-resistant isoform (PrP^{Sc}) is a cardinal feature of a prion diseases. In humans, PrP^c comprises 209 amino acids, a disulfide bridge between residues 179 and 204, a glycosylphosphatidylinositol anchor, and two sites of non-obligatory N-linked glycosylation.

Bovine spongioform encephalopathy (BSE) is a transmissible spongioform encephalopathy (TSE) or prion disease of cattle first recognized in 1986. in the United Kingdom, where it produced a common source epidemic that peaked in January 1993 and has subsided markedly since that time.

The epidemic began simultaneously at many geographic locations and was traced to contamination of meat and bone meal (MBM), a dietary supplement prepared from rendering of slaughterhouse offal. It appears that the epidemic was initiated by presence of the agent of scrapie (a long-standing TSE of sheep) that was first transmitted to cattle, beginning in the early 1980s, when most rendering plants abandoned the use of organic solvents in the preparation of MBM. The epidemic was probably accelerated by the recycling of infected bovine tissues prior to the recognition of BSE. The NMR structure of the recombinant bPr (23-230) (Fig. 3) contains a globular domain that extends approximately from residue 122 to

residue 227, where the residues 128-131 form the β-strand 1,144-154 the α-helix 1 (which has 3 10-type structure from sresidue 153 onward), 161-164 the β-strand 2, 173-194 the α-helix 2, and 200-226 the α-helix 3. There is currently no effective therapy for human prion diseases, although several chemotherapeutic agents have been tested in animal models (Pocchiari et al., 1991.; Ingrosso et al., 1995.). Polyanionic glycans such as pentosan sulfate (PS) and dextran sulfate (DS) have been among the most intensively studied. These agents were initially tested because they were known to be active against conventional DNA and RNA viruses, but it was found that they were also infective in vivo against infection by scrapie prions, prolonging the incubation time, and in some cases, completely preventing the developement of simptoms when administered prophylactically to mice and hamsters. Also, the addition of copper facilitated restoration of both infectivity and protease resistance of PrP in a subset of samples that did not renature by the simple dilution of GdnHCl. These data demonstarte that lose of scrapie infectivity can be a reversible process and that copper can enhance this restoration of proteinase K resistance and infectivity.

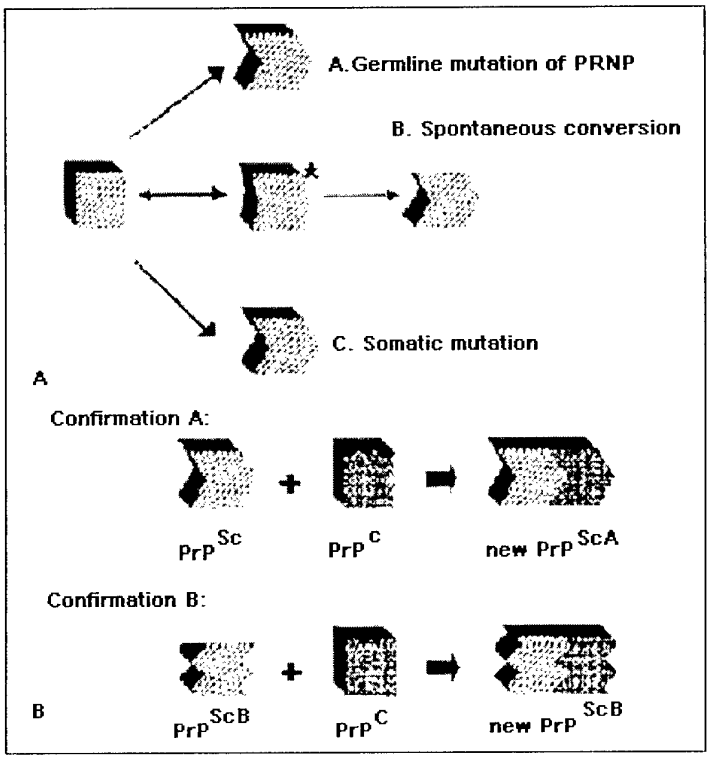
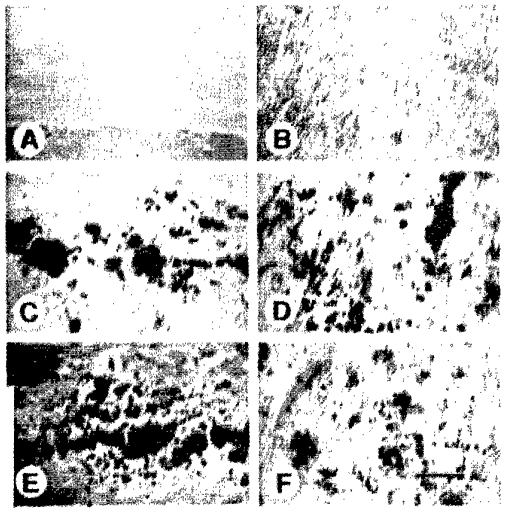
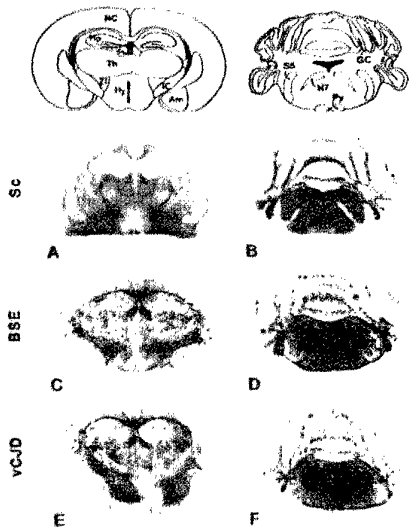


Figure 1. (A) Potential mechanisms by which conversion to PrP^{Sc} is initiated. In humans three potential mechanisms are postulated to give rise to PrP^{Sc}. A, Germline mutation: The genetic varietics of disease are most easily explained by a mutation of the PRNP gene that acts to destabilize PrP, which in turn leads to the generation of PrP^{C}. B, Somatic mutation: A mutation may occur withnin a single cell or group of cells in the brain to induce the disease-causing conformation of PrP. C, PrP may naturally adopt an intermediate unstable form (designated by the star) that can be converted relatively easily to the native state or the pathogenic state. This may depend on factors within the cell that help to stabilize or destabilize PrP. (B) PrP^{Sc} acts as a conformational template to generate new PrP^{Sc} with a similar conformation. PrP^{Sc} appears to acquire several pathogenic conformational subtypes, which may help explain the diverse phenotypes of prion disease. Once PrP^{Sc} is generated by any of the mechanisms described in (A) or through an as yet undetermined mechanism, it induces the conversion of nonpathogenic PrP^{C} to PrP^{Sc} by interaction of the two protein conformations. In this example, PrP^{Sc} is shown in two potential conformations. PrP^{Sc} with conformation A generates new PrP^{Sc} with conformation A, and PrP^{Sc} with conformation B generates new PrP^{Sc} with conformation B. This property helps to explain how prion strains with characteristic phenotypic properties are transferred and maintained.

Figure 2. Pathohistolic preparations at prion deseases





In these mice, the pattern of neuropathology differed markedly; inocula derived from sheep scrapie resulted in a mild degree of vacuuolation in virtuallyall brain regions and no amyloid plaquse (A)

Specifically, the nonamyloid PrP deposits with the latter were of the coarse type (D and F), whereas they were of the finely granular, "siynaptic" type with scrapie (B)

The vacuolation profiles with each prion inoculation correlated well with the PrPsc distribution profiles. Common to all three inocula was uniformly moderate degree of vacuolation in the brainsterm tegmentum and periaqueductal gray that coresponded to intense immunostaining for PrPsc in the same regions (compare B,D and F).A moderate degree of vacuolation found in the habenula in mice inoculated withBSE and nv CJD also correlated with intense PrPsc immunostaining (C and E) , whereas there was very modest vacuolation in the habenula of mice inoculated with scrapie prions, a result consistent with the lower intensity ofPrPsc staining observed (A).

One neuropathological difference was the presence of PrP-immunopositive amyloid plaques, primarily in the subcallosal region in the present study and their absence in the first passage (C)

Prp - immunopositive amyloid plaques vere also found in the subcallosal region (E)

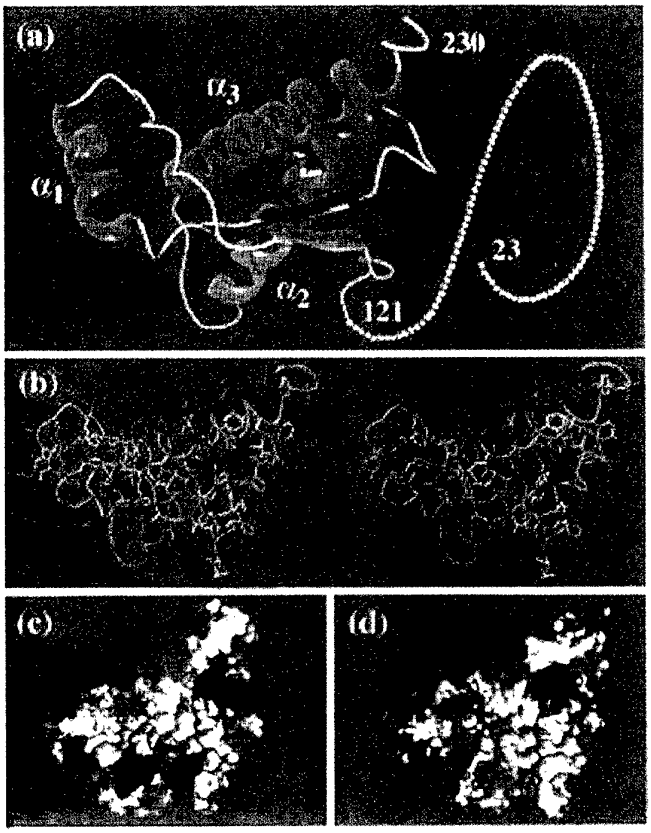


Fig. 3. (a) Cartoon of the three-dimensional structure of the intact bPrP(23-230). Helices are green, ß-strands are cyan, segments with nonregular secondary structure within the C-terminal domain are yellow, and the flexibly disordered "tail" of residues 23-121 is represented by 108 yellow dots, each of which represents a residue of the tail (the numeration for hPrP is used, and the insertions and deletions are placed according to the alignment in ref.23).(b) Stereo-view of an all-heavy atom presentation of the globular domain in bPrP(23-230), with residues 121-230, in the same orientation as in a. The backbone is shown as a green spline function through the C° positions, hydrophobic side chains are yellow, and polar and charged side chains are violet.(c and d) Surface views of the globular domains of the bPrP and hPrP, respectively. The orientation of the molecule is slightly changed relative to a, so that the residue 186 is approximately in the center. The electrostatic surface potential is indicated in red (negative charge), white (neutral), and blue(positive charge).
The figures were prepared with the program MOMOL (42).

Table 1. The Clinical Phenotypes of prion Diseases

Disease	Primary Features	Host	Duration	Mechanism of Pathogenesis
Kuru	Ataxia dementia	Human	3 months to 1 year	Infection through ritualistic cannibalism
iCJD Iatrogenic Creutzfeldt-Jacob disease	Ataxia, dementia	Human		Infection from prion-contaminated HGH, dura mater grafts, and so forth
sCJD Sporadic Creutzfeldt-Jacob disease	Demantia, ataxia, myocolonus	Human	< 1 y	Somatic mutation or spontaneuos conversion of PrP^{c} ionto PrP^{Sc}
fCJD Familial Creutzfeldt-Jacob disease	Demantia, ataxia, myocolonus	Human	1-5 y	Germline mutations in PrP gene
GSS Gerstmmann- Sträussler-Scheinker disease	Ataxia, late dementia	Human	2-6 y	Germline mutations in PrP gene
FI Fatal familial insomnia	Insomnia, dysautonomia, ataxia, dementia	Human	~ 1 y	Germline mutations in PrP gene (D178N and M129)
vCJD Variant Creutzfeldt-Jacob disease	Behavioral changes, late dementia	Human	~ 1.5 y	Infection from bovine prions=?
Scrapie	Behavioral changes	Sheep		Infection in geneticaly susceptible sheep
BSE Bovine spongioform encephalopathy	Behavioral changes	Cattle		Infection with prion-contaminated MBM
TME Transmissible mink encephalopathy	Behavioral changes	Mink		Infections with prions from sheep or cattle
CWD Chronic wasting disease	Behavioral changes	Mule deer, elk		Unknown
FSE Feline spongioform encephalopathy	Behavioral changes	Cats		Infection with prion-contaminated MBM
EUE Exotic ungulate encephalopathy	Behavioral changes	Greater kudu, nyala, oryx		Infection with prion-contaminated MBM

Table 1. The Prion Diseases - (Prusiner, 1998.)

Table 2. Reported cases of bovine spongiform encephalopathy in the United Kingdom and other countries (as of December 2000)

Country	Native cases	Imported cases	Total cases
United Kingdom	180,376[b]	0	180,376
Republic of Ireland	487	12	499
Portugal	446	6	452
Switzerland[c]	363	0	363
France[c]	150	1	151
Belgium	18	0	18
Netherlands	6	0	6
Liechtenstein	2	0	2
Demnark	1	1	2
Luxembourg	1	0	1
Germany	3	6	9
Oman	0	2	2
Italy	0	2	2
Spain[d]	0	2	2
Canada	0	1	1
Falklands (IJK)	0	1	1
Amres (Portugal)[c]	0	1	1

[a]Data from Organization of Internatioinal Epizootics(Paris) and Ministry of Agriculture, Fisheries, and Food (UK).
[b]Includes 1,287 cases in offshore British islands.
[c]Includes cases detected by active surveillance with immunotogic methods.
[d]Origin and dates of imported cases are under investigation.
[c]Case imputed from Germany.

Table 3 Summary of iatrogenic cases of Creutzeldt-Jakob disease from all causes (July 2000)

Mode of infection	No. of patients	Agenl entry into brain	Median incubation period (renge)*	Clinical signs on presentation
Corneal transplant[#]	3	Optic nerve	16, 18, 320 mo	Dementia/ cerebellar
Stereotactic EEG	2	Intracerebral	16, 20 mo	Dementia/ cerebellar
Nearosurgery	5	Inlracerebral	17 mo (12-28)	Visual/dementia/ cerebellar
Dura mater grail	114	Cerebral surface[$]	6 y (1.5-18)	Cerebeller(visual /dementia)
Growth hormone	139	Hematogenous	12 y (5-30)	Cerebellar
Gonadotropin	4	Hematogenous	13 y (12-16)	Cerebellar

*Calculated from the midpoint of treatment to the onset of disease.
[#]One defnite, one probable, and one possible case.

[$]In two cases, dura was used to embolize vessels of non-CNS tissues, rather than as intracranial grafts.

CONCLUSIONS

BSE were not noted down as new diseases. In fact, a man started playing with nature feeding plant-eating animals with proteins of animal origin and making in such a way causes of infection as well as making ways for expansion of the infection.

Is it possible to conclude that circumstances of rising of prion diseases (genetic, biochemical, infections, epidemiological, economic, and other) can be abused in making a "super BUG".

Some of conditions and criterions for BUG,s employment are:

- -Possibility of provocation action on as larger as possible territory, massiveness in fact;
- -Selectivity related on time, effects (medical, economical, safety, defensive) and population categories;
- -Usage of self-transferred agents either directly or indirectly (through vector-domestic animal or game, mischief-doer;
- -Masked of symptoms until wanted level of infection has been reached;
- -Non-existing of specific protection;
- -Hiding of the doer.

Modern science, especially biology (genetics, medicine) gives us deeper and deeper answers on life functions, relationships of kinds but also blame some new possibilities. Biotechnology of today promises rising of living quality, and imitating evolution, tries to make a human sure that is a self-sufficient sort.

However, non-perfection of global relations in society makes balance between those that have economical, political and military advantage and those that would like to have one much weaker.

This is a cruel battle on the old and new "battle-fields". Terrorism, in fact bioterrorism as his the most perfect form, may change the face of the world in the most literal sense of the word. If there is a political decision of any interested group, technical circumstances for doing this (bioterrorism) do not make any problem.

Prion diseases (TSE, BSE) as it is known threw down on their knees the most developed countries of Europe, which in economical, medical, justical and safety sense tries to find out the right answers.

If we, nevertheless, conclude that these events are the result of lack of judgement and coincidence, these prognosis are even worst, because if these tragedies are going on, even unintentionally, what we can expect when international terrorism get involved.

Certainly, now when the principle of men genetic function are known, and when it is easy act on some diseases it is also easy act on "SUPER BAG".

That because Prion and its diseases will be going on for some time and men have to approach on it like any other armies.

MAN has to be in the middle of the close attention and it is necessary to arm by knowledge and will for humanization and prosperity of person in society.

Only then we could prevent and isolate common safety system, where separate excesses (native and social) could not become a global danger.

KEY WORDS

Prion, TSE, mutation

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30. ROLE OF POISON INFORMATION CENTRE IN THE PREVENTION AND MANAGEMENT OF CHEMICAL ACCIDENTS

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INTRODUCTION

The Poison Information Centre (PIC) in Zagreb is the only one in Croatia serving a population of about 4,5 million inhabitants. It provides a 24-hour telephone information service on the management of toxic exposures to medical professionals and the general public. From 1985 to 1999 the Centre registered a total of 4736 calls due to acute poisoning incidents or suspected poisonings. Figure 1 shows the breakdown of calls according to the cause in three 5-year periods: 1985-1989, 1990-1994 and 1995-1999.

RESULTS AND DISCUSSION

Until 1990, i.e. the beginning of the war, there was little or no concern about the preparedness of the PIC and its staff for the management of the major chemical disasters or even chemical warfare attack. Then it suddenly became a toxicological priority and because of the mass media impact there were numerous calls both from the medical professionals and the public, requiring various information on the exposure to toxic chemicals and chemical warfare agents. We decided that, having no contingency plans ready; the main task of the PIC would be 1. Immediate improvement of our data-base with the protocols for the management of injuries due to chemical weapons, and 2. Education and training of our personnel on the medicalaspects of response to chemical accidents. However we failed to establish a more closer cooperation with health services and governmental institutions who were in charge of the emergency situations (for example police and fire departments, the army forces medical service, or the Ministries of Health, Environment etc.) and to take a more active part in the planning, education and training activities on the national level. We gathered some specific experience in dealing with toxic exposures involving multiple casualties that might not be a direct consequence of war operations but are rather characteristic for that period. A typical example was an outbreak of photodermatitis in a group of schoolchildren picking parsley in the vicinity of radar installations, which was initially diagnosed as a "mustard gas" poisoning. An outbreak of scombrotoxism in the refugee camp, with more than 100 people served a spoiled fish meal, including 20 symptomatic patients needing antihistamine treatment, demonstrated the inadequate supplies of emergency drugs and problems of rapid distribution of drugs to the incident area. There were several smaller incidents caused by inappropriate use of tear gas or due to smoke inhalation in firemen. The majority of calls that could be connected with the war operations were due to psychogenic reactions, when people detected an unusual odour in their homes or residential areas and experienced non-specific symptoms, which were suspected as poisoning with an unknown agent. Timely consultation with the PIC prevented unneccessary treatment and hospital admissions. The main problem in such cases was how to deal with general public and mass media without creating a panic, and at the same time provide a rapid and relevant risk assessment of toxic exposure. A post-war period brought an expected increase of multiple psychoactive drug overdose and an increased incidence of poisoning with drugs of abuse. Also, some typical cases of poisoning with auto-injectors and reagents used for the detection of radioactive contamination were referred to PIC. Although there is an improvement in the legislation and organization of chemical accident prevention and response in Croatia, the PIC needs to be more involved in these activities. The quality of advice given by a PIC will greatly depend on the preparedness of the

staff, previously established procedures, and coordination of the PIC with the national emergency response system. Unfortunately, the PIC is often the last to know about the circumstances of chemical accidents, but the first to be contacted by the hospital personnel dealing with casualties.

CONCLUSION

The more active role of the PIC in all aspects of management of chemical accidents in Croatia should be ensured.

SUMMARY

The Poison Information Centre (PIC) in Zagreb is the only one in Croatia, and it provides a 24-hour telephone information service on the management of toxic exposures to medical professionals and the general public. Although chemical accidents do not always involve poisoning cases, problems regarding prevention, treatment, contingency planning, environmental contamination and other aspect of such incidents are likely to be referred to a PIC. Obviously, providing appropriate information is the primary goal of PIC in any situation, but the quality and adequacy of advice given by a PIC in case of chemical accident will greatly depend on the preparedness of the staff, previously established procedures, and involvement of the PIC in the national emergency response system. This is especially important in case of armed conflicts, war or a post-war situation in the country. The staff of PIC often lacks specific knowledge and experience on chemical warfare agents. In addition, it may also have problems on how to deal with general public and mass media to avoid creating panic and, at the same time provide a rapid and relevant risk assessment of toxic exposure. This could be complicated when it relies only on scarce telephone information, which is often completely unreliable. Experience from the PIC in Zagreb during the last 10 years involves several different incidents or suspected poisonings during the war and post-war period in Croatia, some of which were consequences of mass psychosis or incorrect diagnoses. Also, some typical cases of poisoning with auto-injectors or chemical reagents used for the detection of radioactive contamination were referred to the Centre. Unfortunately, coordination with other national services responsible for emergency preparedness and response is not optimal, often leaving the PIC on the margin of events, or calling it only when the information is needed and the accident has already happened. The PIC is often the last to know on the circumstances of such accidents, but the first to be contacted by the hospital personnel dealing with casualties, so the more active role of the PIC in all aspects of management of chemical accidents should be ensured.

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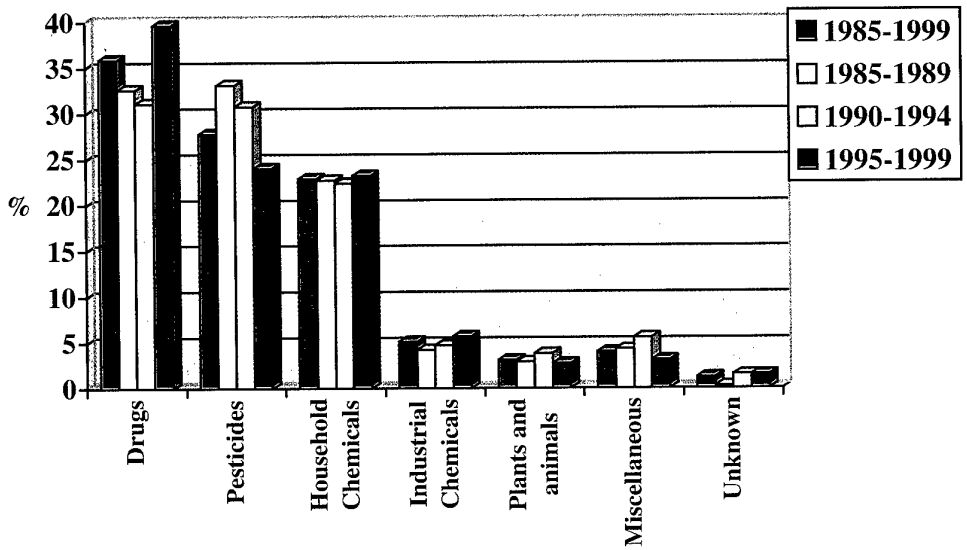
KEYWORDS

Poison Information Centre, chemical accidents, chemical warfare agents, mass psychosis, antidote

FIGURES

Figure 1. Causes of poisoning incidents reported to the Poison Control Centre in Zagreb between 1985 and 1999



31. AGGRESSIVE ATROPINIZATION AND PROLONGED ADMINISTRATION OF OXIMES IN THE TREATMENT OF SEVERE POISONING WITH ORGANOPHOSPHOROUS COMPOUNDS

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INTRODUCTION

Organophosphorus compounds (OP) are among the most toxic agents known today. As insecticides, they are indispensable in the production and storage of food, but as warfare agents they present a constant threat and danger. They cause more than 20.000 deaths and more than 3 million poisonings per year, mostly in underdeveloped countries. The most serious poisonings are usually intentional or accidental, and without adequate and specific treatment always have lethal outcome.

Essential point of specific treatment of OP poisoning is rapid atropinization with high doses of atropine, adequate continuation of atropine administration and gradual withdrawal, because of potentially threatening rebound effect. Early and adequate administration of oximes is an integral part of therapy, necessary for faster recovery and it also prevents so-called "intermediate syndrome" i.e. sudden respiratory arrest during the third or fourth day of poisoning.

RESULTS

During the 15-year period (1978-1992) the Emergency Medical Centre in Zagreb treated a total of 216.093 patients in a population of about one million inhabitants of Zagreb. There were 14.752 cases of poisoning, and 664 (4,5 of all poisonings) were pesticide poisonings. Among them 254 (38,2%) were caused by OP insecticides and 126 (49,6%) were suicide attempts. All severe poisonings were due to ingestion, and 83% of ingestions were suicidal. The highest dose ingested was 350 ml of concentrated insecticide (quinalphos and phosalon) in two cases. In 28% of cases there was a concomitant ingestion of alcohol (Brandy). In 72% of cases the victims were women and family or marital problems resulted with poisoning attempt. The most common cause of accidental OP poisoning was a mix-up with alcohol and usually occurred when the victim was already drunk. Poisoning in children younger than 14 years are not included because they were treated at the paediatrics clinic. In all cases we performed gastric lavage with activated charcoal administration, suction of bronchial secretion and the majority of patients needed intubations and artificial respiration for 30 minutes to as long as 24 hours, because of respiratory depression or arrest. In several cases excessive atropinization required decreasing dosage of atropine and diazepam and it usually occurred during a first few days of therapy. There were no cases of late respiratory arrest i.e. the so-called "intermediate syndrome", and we believe that this is the result of prolonged administration of oximes. There was one case of respiratory depression that started the first day of poisoning and lasted for 30 days, but with assisted ventilation the patient recovered without sequelae. It is well known that, contrary to OP insecticides, the OP warfare agents have an extremely quick onset of action and the survival depends on momentarily application of antidotes by auto-injectors. Because of the rapid metabolism of all OP warfare agents the treatment usually does not require massive doses of atropine (usually 4-25 mg) but because of fast "ageing" syndrome the reactivation of cholinesterase is very controversial.

Since 1980, in all serious poisonings we have used the method of aggressive atropinization initially 10-mg i.v. followed by 50-100 mg of atropine in the first hour of

treatment to maximally 130 mg during the first 24 hours. Average total doses of atropine were 50-650 mg, and the highest total dose of 780 mg in 10 days was administered during successful treatment of a 62-year female following a suicidal ingestion of 350 ml of concentrated quinalphos. We also know that in case of serious OP poisoning treated in city of Split a total dose of 3100 mg of atropine was used and the patient needed artificial ventilation for 40 days. Before 1981 we had three lethal outcomes. Two women, 89 and 90 years old died 8 days after ingestion of chlorpiryphos and phosalon, but post mortem toxicological findings were not available. A 48-year old men with a history of cardiac disease and severe arrhythmia's and VES after ingestion of phosalon, died soon after he was transferred to cardiology clinics probably because of abrupt cessation of atropine administration. None of those three cases was especially severe from the toxicological point of view. After 1981 we had no further deaths caused by OP poisoning. Since summer of 1993 the Toxicology Unit of Emergency Medical Center in Zagreb was closed, probably for financial reasons, and since then all adult poisonings are treated in 5 internal medicine departments in the city hospitals and clinics.

CONCLUSION

Serious OP poisoning is always directly life threatening. Prompt and accurate diagnosis, emergency resuscitation procedures and aggressive therapy reduce lethality to minimal. Priorities are cleaning and suction of airways, intubation, assisted ventilation and oxygenation, which should prevent cyanosis and diminish the risk of bronchospasm. Basic condition of survival is high initial dose of atropine and in cardiac arrest atropine should be introduced into circulation by means of persistent cardiac massage. Early and adequate administration of cholinesterase reactivators, oximes, contributes to faster recovery and helps avoiding the danger of late respiratory paralysis i.e. the so-called "intermediate syndrome".

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TABLES

Table 1 Pesticides and organophosphorous insecticide poisonings
Table 2 A case of suicidal poisoning with 100 mg quinalphos, treated with pralidoxime (male, 23years)
Table 3 A case of suicidal poisoning with 120 mg quinalphos, treated with hi-6 (male, 31 years) End of Example.

Table 1: Pesticides and organophosphorous insecticide poisonings (1978 - 1992) Toxicology unit/EMC Zagreb

Year	*Poisonings*	*Pesticides*	*%*	*Pest./ Suicides*	*%*	*OFI*	*OFI/Pest.[%]*	*OFI/Suicides*	*%*
1978	737	23	3,1	10	43,5	11	47,8	6	54,5
1979	786	28	3,6	10	35,7	11	39,3	5	45,5
1980	684	37	5,4	14	37,8	13	35,1	6	46,2
1981	902	44	4,9	16	36,4	20	45,5	6	30,0
1982	1009	50	5,0	19	38,0	24	48,0	8	33,3
1983	984	48	4,9	19	39,6	19	39,6	9	47,4
1984	1052	51	4,8	19	37,3	18	35,3	9	50,0
1985	988	46	4,7	18	39,1	19	41,3	9	47,4
1986	1131	51	4,5	19	37,3	19	37,3	9	47,4
1987	1116	46	4,1	19	41,3	15	32,6	8	53,3
1988	1110	51	4,6	20	39,2	19	37,3	8	42,1
1989	1108	70	6,3	38	54,3	24	34,3	16	66,7
1990	1025	48	4,7	22	45,8	14	29,2	10	71,4
1991	1042	35	3,4	13	37,1	16	45,7	10	62,5
1992	1078	36	3,3	14	38,9	12	33,3	7	58,3
Total:	**14752**	**664**	**4,5**	**270**	**40,7**	**254**	**38,3**	**126**	**49,6**

Table 2: A case of suicidal poisoning with 120 mg Quinalphos, treated with HI-6 (male, 31 years)

Time	*Atropine [mg]*	*Pralidoxime [g]*	*Diazepam [mg]*	*A-ChE*	*%*	*S-ChE*	*%*
1st hour	38	2,0	20	561	4,3	238	4,8
1st day	116	2,5	40	564	4,3		
2nd day	34	2,5		361	2,8	413	8,3
3rd day	21	2,0		513	3,9	352	7,0
4th day	17	2,0		631	4,9	344	6,9
5th day	15	2,0		2168	16,7	430	8,6
6th day	12	4 x 0,5 or.		988	7,6	438	8,8
7th day	12	-"-		1422	10,9	477	9,5
8th day	10	-"-		2750	21,2	626	12,5
9th day	8	-"-					
10th day	6	-"-					
14th day	4	-"-					
16th day	1	2 x 0,5 or.		3758	28,9	1110	22,2
Total:	**256**	**25**	**40**	**3758**		**1110**	

Table 3: A case of suicidal poisoning with 100 mg Quinalphos, treated with Pralidoxime (male, 23years)

Time	*Atropine [mg]*	*HI-6 [g]*	*Diazepam [mg]*	*A-ChE*	*%*	*C-ChE*	*%*
1st hour	30	0,5 im.	20	430	3,3		
12th hour	100	1 im.	20	930	7,2		
1st day	130	2 im.	50	4000	30,8	450	9,0
2nd day	23	2 im.		6500	50,0		
3rd day	20	2 im.					
4th day	18			9000	69,2		
5th day	10						
6th day	6						
10th day	1			11800	88,0	2200	44,0
Total:	**216**	**6**	**50**				

32. HIGH DOSE PRALIDOXIME (PRX) TREATMENT PROLONGS TIME TO EXTUBATION (TTE) AND INCREASES MORTALITY IN PARAOXON (POX) EXPOSED MINIPIGS

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ABSTRACT

Organophosphates are inhibitors of serine hydrolases. Oximes are clinically available enzyme reactivators.

To determine in vivo the effect of high dose PRX use on "time-to-extubation (TTE)" and mortality as compared to identical therapy without PRX.

12 anaesthetized minipigs were used. All pigs received iv-POX (1mg/kg BW) over 50 minutes. Group one (n = 6) received conventional intensive care therapy as described previously [J Appl Toxicol 18: 293 - 298]. Group two (n = 6) received in addition iv-PRX 10 g (≈ 300 mg/ kg BW). Before [base-line;BL], after POX application (50min) and then at 1,2,3,4,8 and 16 hours after POX AChE and BChE activities were measured. Statistics: rank order test; significance for $p \leq 0.05$.

In group one TTE was 7.2 ± 4.4 h after last measurement. Mortality was 0. In group two TTE was 14.7 ± 6.4 h after last measurement. Mortality was 4/6.

Pralidoxime therapy has no beneficial effect and its use can not be recommended.

KEYWORDS
Pralidoxime, reactivators, OP poisoning

(The paper was not presented)

33. IN VITRO DECONTAMINATION OF COBALT-60 EXPOSED PIGS EYES WITH DIPHOTERINE® VS. WATER

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ABSTRACT

Introduction: Diphoterine® is widely used in Europe to decontaminate occupational eye/skin chemical splashes. Previous in vitro experiments demonstrated efficacy of Diphoterine® decontamination of human skin fragments exposed to C14-labeled Sulfur Mustard (Agent HD), Uranium-238, Cesium-137, and Strontium/Yttrium-90. In fact, Diphoterine® decontaminates over 600 chemical substances including sulfur mustard (Agent HD) in vitro and in human skin fragments in vitro. A list of the chemical substances against which Diphoterine® has been tested can be found at www.prevor.com (the manufacturer is currently conducting negotiations to have the product further tested against sulfur mustard and organophosphate nerve agents in the US.) It is essentially nontoxic (LD_{50}s > 2,000 mg/kg by oral or ingestion routes in rodents), nonirritating to the skin or eyes in experimental animals and humans, and its decontamination products are not toxic to the environment. Materials and Methods: These studies were conducted in the French Army Laboratory for Radiotoxicological Control. Pig eyes were obtained from an abattoir, exposed in vitro for 3 minutes to 20 microliters of a Cobalt-60 (120 Bq) source (LMRI, Orsay, France), and radioactivity was measured by gamma emissions (Germanium HP, Canberra). Radioactivity penetration was measured in control eyes. Following exposure, eyes were decontaminated with water or Diphoterine® (PREVOR, Valmondois, France): 1) 150 mL over 3 minutes begun at 3, 10, or 90 minutes; 2) 3 separate 150 mL over 3 minutes lavages; 3) eyewash lavage with 100 mL over 1 or 5 minutes. Lavage fluid residual radioactivity was measured a mean of 5 or 6 times (variation </= 1%). Results: After 3 minutes of in vitro exposure of pig eyes to Cobalt-60, in controls > 98% of the measurable radioactivity remained on the cornea, 10 minutes later > 10% penetrated into the aqueous humor, and at 90 minutes > 45% penetrated into the aqueous humor and about 5% penetrated into the vitreous humor. With all 3 lavage protocols, Diphoterine® was significantly more efficacious than water for eye decontamination in this model ($p < 0.05$). Summary: with chelating and hypertonic properties was superior to water for decontamination of Cobalt-60 eye exposure.

INTRODUCTION

Diphoterine®is an hypertonic, polyvalent, amphoteric compound for eye/skin chemical splash decontamination. *In vitro* and *in vivo*, it decontaminates approximately 600 chemicals, including acids, alkalis, oxidizing and reducing agents, irritants, lacrimators, solvents, alkylating agents such as sulfur mustard, and radionuclides (U-238, Cs-137, Sr/Y-90). Its chemical bond energy for such agents is greater than that of tissue receptors. Its hypertonicity impedes chemical tissue penetration and may remove some amount of

skin/cornea-absorbed toxicants not bound to tissue receptors. Diphoterine chemical reactions are not exothermic. In experimental animals, Diphoterine® and its acid/alkali decontamination residues were not irritating to the eyes or skin. It is essentially nontoxic (LD_{50}'s > 2000 mg/kg by oral and dermal exposure routes in rodents).

In human volunteers, Diphoterine® did not irritate the eyes. Diphoterine® has prevented or decreased the severity of chemical eye/skin burns with 96% sulfuric acid, 100% acrylic acid, 50% acrylamide, solid sodium hydroxide flakes, and dimethylethylamine. In more than 600 workers in 4 European workplaces, Diphoterine® decontamination of acid and base chemical splashes was associated with significant decreases in lost work time and the need for additional burn treatment as compared with water lavage. Diphoterine® is an efficacious decontamination product for eye/skin chemical splashes. It washes harmful chemicals off exposed tissues as well as actively neutralizing them.

The purpose of the experiments reported here was to compare the effects of Diphoterine® versus water for decontamination of cobalt-60 in pigs eyes in vitro, thus comparing an active hypertonic and chelating decontamination fluid with the simple mechanical rinsing activity of water.

MATERIALS AND METHODS

These studies were conducted in the French Army Laboratory for Radiotoxicological Control, Clamart, France. Pig eyes were obtained from an abattoir just after slaughter, exposed in vitro for 3 minutes to 20 microliters of a standard Cobalt-60 (120 Bq) source (LMRI, Orsay, France), and radioactivity was measured by gamma emissions (Germanium HP, Canberra). Radioactivity penetration was measured in the cornea, aqueous humor, and vitreous humor of control eyes.

Following Cobalt-60 exposure for 3 minutes, test eyes were decontaminated with water or Diphoterine® (PREVOR, Valmondois, France) using 3 protocols: 1) 150 mL lavage over 3 minutes begun at 3, 10, or 90 minutes after exposure; 2) 3 separate successive 150 mL lavages over 3 minutes each as above; or, 3) bathing in an eyewash device with 100 mL over 1 or 5 minutes. Lavage fluid residual radioactivity was measured a mean of 5 or 6 times (variation </= 1%) and the Mean and Standard Error of the Mean were calculated for both the amount or radioactivity in the residual lavage fluid (in Bq) and the percentage of radioactivity removed.

RESULTS

A single lavage after a delay of 90 minutes following contamination: 150 mL of lavage fluid utilized (water or Diphoterine®) See Table 1. Distribution of radioactivity in control eyes at 90 minutes after contamination. There was little effect of lavage as the delay was too long. The radio-element had time to diffuse into the interior of the eye and become bound to tissues in an irreversible fashion.

A single lavage following a delay of 10 minutes following contamination: 150 mL of lavage fluid utilized (water or Diphoterine®). See Table 2. Distribution of radioactivity in control eyes at 10 minutes after contamination

Efficacy limitation of lavage: a part of the radioactivity is accessible to lavage. There was a tendency for Diphoterine® to be shown superior to water.

A single lavage following a delay of 3 minutes after contamination (minimal time to effect decontamination if the decontamination product is pre-placed at the accident site): 150

mL of lavage fluid utilized (water or Diphoterine®). See Table 3. Distribution of radioactivity following a delay of 3 minutes after contamination.

The lavages were efficacious. The performance of three successive lavages with water gave results on the same order as those with a single water lavage. The performance of three successive lavages with Diphoterine® gave clearly better results than with a single lavage as this molecule binds the Cobalt-60 due to its hypertonic and chelating properties.

Bathing the cornea with the aid of an eyewash device (containing 100 mL) following a delay of 3 minutes between contamination and treatment. The duration of bathing was 1 minute.

Number of trials to calculate the Mean and the SEM: n = 6.

Radioactivity of lavage with water = 41.13 +/- 2.09; % of radioactivity removed = 34.28+/- 1.74.

Radioactivity of lavage with Diphoterine® = 81.30 +/- 7.10; % of radioactivity removed= 51.08 +/- 6.92 ($p<0.05$).

Bathing with Diphoterine® is more efficacious than bathing with water, but the results are slightly worse than those obtained with three successive lavages because there is not the effect of mechanical rinsing.

Bathing the cornea with the aid of an eyewash device (containing 100 mL) following a delay of 3 minutes between contamination and treatment. The duration of bathing was 5 minutes.

Number of trials to calculate the Mean and the SEM: n = 6.

Radioactivity of lavage with water = 59.48 +/- 2.43; % of radioactivity removed = 49.67+/- 2.03.

Radioactivity of lavage with Diphoterine® = 90.92 +/- 3.29; % of radioactivity removed= 76.77 +/- 2.74 ($p<0.05$). Bathing with Diphoterine® was more efficacious than bathing with water.

CONCLUSIONS

It is necessary to intervene rapidly because Cobalt-60 rapidly diffuses into the interior of the eye and this a part of the total amount of the radio-element is nor accessible to surface decontamination fluids. For this reason, the treatment device should be pre-placed at locations with contamination risk, close to hand.

Diphoterine® used in the form of an eyewash was shown to be much more efficacious that water. In our experimental conditions, lavage with water can only remove about 40% of the radioactivity, while about 60% can be removed with Diphoterine®. When Diphoterine® is used in an eyewash device, it is possible to remove about 75% of the radioactivity. A specific product such as Diphoterine®, which has both hypertonic and chelating properties is this superior to simple lavage with water.

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KEY WORDS
Diphoterine®, eye decontamination, Cobalt-60, radionuclide, decontamination solutions

FIGURES AND TABLES

Table 1. Distribution of radioactivity in control eyes at 90 minutes after contamination

Part of the Eye	Radioactivity in Bq/Sample	Distribution in %
Cornea	39.84 +/- 3.41	48.1 +/- 4.13
Aqueous Humor	37.87 +/- 3.29	46.0 +/- 3.77
Vitreous Humor	4.91 +/- 0.65	5.0 +/- 0.79

Half of the radioactivity diffused into the interior of the eye.
Number of trials to calculate the Mean and the Standard Error of the Mean (SEM): n = 6.
Radioactivity of lavage with water = 9.44 +/- 2.36; % of radioactivity removed = 7.87 +/- 1.98
Radioactivity of lavage with Diphoterine® = 11.20 +/- 1.95; % of radioactivity removed = 8.33 +/- 1.63.

Table 2. Distribution of radioactivity in control eyes at 10 minutes after contamination

Part of the Eye	Radioactivity in Bq/Sample	Distribution in %
Cornea	78.41 +/- 8.54	86.24 +/- 9.39
Aqueous Humor	8.55 +/- 1.78	10.40 +/- 1.94
Vitreous Humor	3.12 +/- 1.75	3.42 +/- 1.28

The radioactivity was mainly localized on the cornea, but a small part had begun to diffuse into the interior of the eye.
Radioactivity of lavage with water = 19.85 +/- 2.58; % of radioactivity removed = 18.64 +/- 2.13.
Radioactivity of lavage with Diphoterine® = 28.80 +/- 5.53; % of radioactivity removed = 22.33 +/- 4.61.

Table 3. Distribution of radioactivity following a delay of 3 minutes after contamination.

Part of the Eye	Radioactivity in Bq/Sample	Distribution in %
Cornea	89.17 +/- 7.12	88.57 +/- 7.87
Aqueous Humor	0.83 +/- 0.48	0.92 +/- 0.53
Vitreous Humor	0.48 +/- 0.43	0.51 +/- 0.48

Number of trials to calculate the Mean and the SEM: n = 5.
Radioactivity of lavage with water = 53.15 +/- 7.31; % of radioactivity removed = 44.29 +/- 6.09.
Radioactivity of lavage with Diphoterine® = 58.45 +/- 1.04; % of radioactivity removed = 48.72 +/- 0.87.
Lavage was efficacious. There was little difference between water and Diphoterine®.

Three separate successive lavages following a delay of 3 minutes after contamination: 150 mL of lavage fluid utilized (water or Diphoterine®). This protocol corresponds to that applied in cases of external radiation contamination.
Number of trials to calculate the Mean and the SEM: n = 5.
Radioactivity of lavage with water = 52.08 +/- 3.78; % of radioactivity removed = 43.40 +/- 3.15.
Radioactivity of lavage with Diphoterine® = 71.44 +/- 8.49; % of radioactivity Removed = 59.63 +/- 5.41 ($p<0.05$).

34. AN OVERVIEW OF THE CZECH NBC EQUIPMENT

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INTRODUCTION

The Czech Republic is not an owner of mass destruction weapons (NBC weapons). On the other hand the Czech Republic (and the former Czechoslovakia) paid a high level attention to research and development of the equipment for monitoring, protection and decontamination of chemical warfare agents, biological warfare agents and radioactive agents. The Czech Republic (and the former Czechoslovakia) worked very intensive on the research and development of the protective means against NBC contaminants and it achieved good results in these areas. The protection means, means for detection and monitoring and for decontamination of the chemical warfare agents proved good during the Gulf War in 1990 – 1991.

AN OVERVIEW OF THE CZECH NBC EQUIPMENT
INDIVIDUAL PROTECTIVE EQUIPMENT

Protective Masks M-10, M-10M, M-90
Protective Mask for Specialists PRV-U
Protective Maks for Head Injuries SR-2
Breathing Apparatus PPS-500
Field Gas Chamber PZK-M-10
Protective Sets JP-75A, JP-90
Autoinjector Combopen with Antidote
Autoinjector Combopen with Diazepam
Individual Decotamination Kit IPB-80
Portable Water Tablets – Dikacid
First Aid Bandage M-90
Antimicrobial First Aid Bandage M-90
Chemical Protective Suits OPCH-70, OPCH-90
Permeable Protective Oversuits FOP-85, FOP-96

Collective Protective Equipment

Filter FMP-180M
Collective Filtrs KFM-2000, KF-1000M
Filtration Systems FVZ-100, FVZ-150

NBC Reconnaissance Equipment

Detection Papers PP-1, PP-3
Nerve Agent Detector DETEHIT
Detegas-1
Chemical Detection Kit CHP-71 (with Test Tubes)
Nerve Agents Detector BioNA
Automatic Detection Kits GSP-11, GSA-12
Chemical Detector RAID-1

Automatic Alarm GO-27
Dose-rate Meter IT-65, DP-3b, DP-86, DP-98, RDS-120
Automatic Alarm AS-67
Aerial Dose-rate Meter RL-75
Radiometer RBGT-62
NBC Reconnaissance Set SRCHP-75
NBC Reconnaissance Vehicle UAZ-469CH, Land Rover CH
NBC Reconnaisance Armored Vehicle BRDM-2rch
Sampling Kit SOV-99A
Sample Transport Kit STV-99
Mobile NBC Collection Center PRS-79A

Radiological Control Equipment
Reader of Dosimeters VDD-80
Personal Dosimeter RAD-50S
Group Dosimeter EDOS

Laboratory Equipment
Portable Chemical Laboratory PCHL-90
Spectrometer EM-640
Radiological laboratory RAM-II
Mobile Chemical Laboratory AL-1
Mobile Laboratory Sonda

Decontamination Equipment
Universal Decontamination Set UOS-1M
Personnel Decontamination Set SDO
Decontamination Kit OS-3
Vehicle Decontamination Kits AOS-1, AOS-2
Decontamination Vehicle ARS-12M, ACHR-90, ST T-815
Decontamination System LINKA-82, TZ-74

The article does not encompass smoke equipment, repair equipment, consumable items, special trainers and simulators. It is not possible to give basic information of designation, properties, main technical data about above mentioned and listed items. The reason is simple there is a limited space for publishing.

SEVERAL EXAMPLES FROM THE CZECH NBC EQUIPMENT

There are only several short examples:

Protective Mask M-90

Protective mask M-90 is a full face mask equipped with a head harness with a head net and a plastic protective filter. Equipment which provides a protection to the eyes, respiratory tract and face against chemical and biological agents in gaseous or aerosol form and radioactive aerosols. The face piece is made from bromobutyl rubber ensuring an high resistance against toxic agents. The filter can be left or right mounted.

Chemical Protective Suit OPCH-90

Chemical protective suit for a reliable and long-term protection of persons against toxic agents, bacteriological means and radioactive aerosols. The chemical suit is equipped with a filter-ventilation unit carried on the back and supplying 60 $l.min^{-1}$ of air into the mask and 240 $l.min^{-1}$ under the suit. The used material has self-extinguishing properties in case of a direct contact with flame or light impulse. It can be used for both military purposes and civil protection (nuclear and chemical accidents and disasters, etc.) Resistance time for gases and vapors: 7 hours, resistance time for mustard gas drops: 4 hours, for lewisite drops 2 hours, resistance time for soman and VX agent drops: 7 hours.

Chemical Detection Kit CHP-71

Chemical Detector Kit is compact, simple-to-use kit designated to detect blister, nerve, blood and choking agents. The kit enables simultaneous detection of all four classes of agents using the electrical pump with the test tubes in air, on surfaces and soil, detection of individual class of agents using the electrical pump. Principle of detection is based on chemical reactions running in the test tubes. One man operated.

Nerve Agent Detection Strip DETEHIT

Detection of nerve agents and organophosphate insecticides in air, water, extracts and on surfaces. Presence of agents is indicated when a detection zone colour remains white after a test. The plastic strip contains a white cotton cloth reaction zone with immobilized cholinesterase, paper zone with chromogene substrate and yellow cotton cloth as the colour standard.

Mobile Chemical Laboratory

Mobile Chemical Laboratory is designated for the following in-situ applications and namely monitoring of:

- Dangerous chemical agents leakage;
- Chemical agent quantities in the environment;
- Time change of chemical agent concentrations in the environment;
- Degree of the environment and protective equipment decontamination;
- Hazardous pollutant emissions and imissions;
- Observing the terms of the Chemical Weapons Convention;
- Testing of the premises and equipment sealing.

It is used especially for monitoring volatile organic compounds, but solid agents as well as liquids like drugs, amino acids and toxic industrial substances can also be analysed.

Mobile Laboratory is an equipment built on the Ford Transit 2,5 D chassis. The interior of the vehicle is so designated to enable working both inside the vehicle (especially under winter conditions when the instruments require optimum tempering) and outside the vehicle. The vehicle can be supplied from the external power source but it is also equipped with its own power source so the vehicle can be used also in the places without voltage sources.

The basic instruments of the Mobile Laboratory are:

- BRUKER EM 640 or 640S mass spectrometer;
- BRUCKER VECTOR 22 FT - IR spectrometer;
- Infrared microscope IRSCOPE II;
- SCENTOGRAPH Plus II portable chromatograph;
- RAID - S automatic warning equipment for chemical agent detection;
- ANAGAS gas analyser with exchangeable detectors;

- TRIPLE Plus portable gas detector;
- GX portable power station;
- Other simple devices for chemical agent detection.

Decontamination Kit OS-3

The Decontamination Kit OS-3 is intended for decontamination of mobile military equipment (tanks, armored personnel carrier, vehicles) by spraying decontaminants. Two variants of the basic kit are available: OS-3 (24 V) for nominal voltage DC 24 V in vehicle electric network, OS-3 (12 V) for nominal voltage DC 12 V in vehicle electric network.

The kits differ only in used electric motor of a spray gun and a cable length. All components and elements are identical and interchangeable.

Decontamination kit is universal, it can treat any surface with spraying all usually applied decontaminants (inclusively DS-2, hypochlorite solutions etc.). The utilization of any reservoir (for decontaminant to be used) is not excluded. It gives a possibility to decontaminate both the biological and the known chemical warfare agents or their precursors being present on surfaces of isolation type individual protection equipment and devices working in the contaminated area.

It facilitates the post-treatment of persons or devices by using detergent water solutions and it gives a possibility to apply cold water on surfaces, thus the persons being protected by unpermeable clothes in very hot desert conditions can be cooled.

Decontamination Solution OR-3

Decontamination solution OR-3 is a 2-components alcoholate-amine decontamination agent as a solution, and is used primarily for the decontamination of personal weapons, military technique and protective clothing, which have been contaminated by liquid warfare agents such as blister - or nerve agents. It is usually applied being sprayed by a spray gun of the decontamination kit OS-3.

CONCLUSION

To say in a time of worldwide political and military detension that a real threat caused by NBC weapons (weapons of mass destruction) still exists, which consequently requires the necessary measures in the civil and military sectors, including reliable and sufficient NBC equipment.

Moreover, it must be stress that the teoretical and practical basis for production, storage and employment of these weapons still exists. Besides, the consequences of the accidents in the chemical and related industries and nuclear power plants or affecting the infrastructure can have effects comparable to those resulting from an attack with mass destruction weapons. And finally we must consider the increasing possibility of nuclear, biological and chemical terrorism.

High quality of the equipment for protection, monitoring and decontamination of the chemical warfare agents, toxic industrial substances, biological warfare agents, radioactive agents must be used to provide with a high quality of defense and protection for persons, personnel, devices, materials, terrain, etc.

SUMMARY

A short introduction of the long tradition on the area of NBC equipment in the country. An overview (a list) of the Czech NBC equipment in several branches (protection, detection and monitoring, decontamination, etc.). A few examples of the reliable and

signifficant NBC equipment which can be used for both military purposes and civil protection.

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KEYWORDS

Individual Protective Equipment, Collective Protective Equipment, NBC Reconnaissance Equipment, Radiological Control Equipment, Laboratory Equipment, Decontamination Equipment

35. UNDERSEA DETECTION OF SEA MINES

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ABSTRACT

In this paper the authors tried to analyse the features of possible undersea threats, such as sea mines, available countermeasures and other activities. Detection, approach, inspection and destruction of an unidentified sunken object by a remotely operated underwater vehicle (ROV) is described. The authors tried to define ROV control parameters and optimisation criteria. ROV control simulation model is developed and tested with two different dynamic positioning algorithms. The paper includes results of ROV manoeuvres simulation. According to these results, the authors conclude that the use of ROVs in undersea detection and destruction of sea mines and other hazardous objects is an effective and efficient solution.

1. INTRODUCTION

Terrorist threats and ecological disasters are nowadays major concerns for virtually every country in the world. These threats are not limited to land or surface in general, but can also have dire consequences for sea depths and littoral, from ecological, as well as economic or military viewpoint. The maritime countries of the world all want to have clean and economically useful sea, and Croatia is no exception (the importance of sea and littoral to Croatia can be seen on Fig. 1). In order to provide response to such threats, a country must have some sort of rapid reaction service, which would be able to eliminate or mitigate hazards of ecological disasters, chemical or nuclear waste pollutions or sea mines.

To realise these tasks, the forces for first response at sea should be able to performthree tasks: sea routes surveillance, threat detection and threat elimination, either by eliminating or mitigating contamination, or by mine clearing.

A remotely operated underwater vehicle (ROV) is a suitable and effective solution for threat elimination. It can be used for:

a) search, identification and clearing of sea mines;
b) testing of underwater weapons (torpedoes, mines, etc.);
c) hydro-acoustical, hydro-geographical and hydrological surveys;
d) search, inspection and lifting of sunken vessels, planes and other sunken objects;
e) protection of vessels, harbours and the like against terrorist or special forces raids;
f) surveillance, inspection and repair of underwater installations;
g) laying of underwater pipelines, power and communications cables;
h) undersea exploration in archaeology, marine biology and cultural heritage protection.

In this paper the authors propose the possible use of ROVs in undersea detection and elimination of sea mines or other objects in shallow waters.

2. Characteristics of Mine Threats and Shallow Water Mine Countermeasures

Sea mines are a very effective underwater weapon. Compared to torpedoes and missiles they prove to be more cost-effective, because they are simpler, less costly to produce, more suitable for storage and handling, can be easily masked, and can be laid from any kind of vessel, either submerged or surfaced, or from low-flying aircraft. Irrespective of

their size and cost, sea mines produce considerable physical and psychological effects upon aggressor, and a lot of effort is needed in order to clear and destroy them.
Three types of sea mines are used for shallow water:

1. Contact moored mines - the mine can either float or can be by means of an anchor kept at a certain position and at a certain laying depth. It is activated when a vessel hits the mine.
2. Influence moored mines - the mine is by means of an anchor kept at a certain position and at a certain laying depth, but unlike contact mines it is activated under the action of acoustic, magnetic, hydrodynamic, electric signature, or any combination of these signatures.
3. Influence ground mines - the mine is laid on the sea bottom, and is activated in a way similar to that for the influence moored mine.

The complexity of mine threat has resulted with even more complex activities of mine countermeasures. The basic shallow-waters mine countermeasure activities are given in Fig. 2.

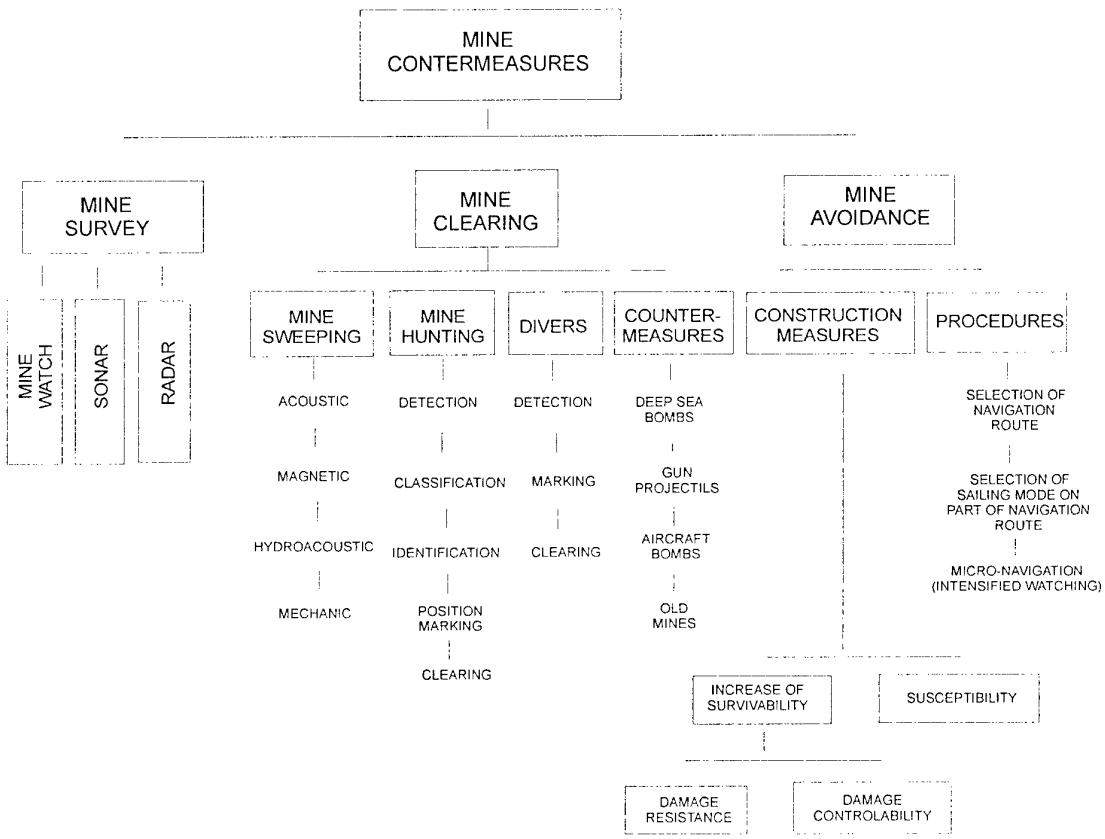


Figure 2. Mine countermeasure activities

There are two basic mine countermeasures procedures:

1. **Mine sweeping** - directed towards known mine field and known mine;
2. **Mine hunting** - directed towards unknown mine field and unknown mine. The clearing of mines by mine sweeping is done so that the mines are from a safe distance activated by means of mine sweeps.

In the case of mine hunting, the mines are cleared using the explosive brought by the ROV, or by hitting of the ROV into the mine, causing mutual destruction.

Mine hunting, thus, several steps of precisely defined order:

1. Surveillance of waterways, and correlation of previous and new bottom images;
2. Mine searching: detection, classification and identification;
3. Mine clearing or neutralization.

The critical point of mine hunting is a reliable and safe ROV which carries the explosive charge for mine clearing. The mine hunting by means of the ROV is illustrated in Figs. 3 and 4. Some commercially available ROVs are pictured in Figures 5, 6 , 7, 8 and 9.

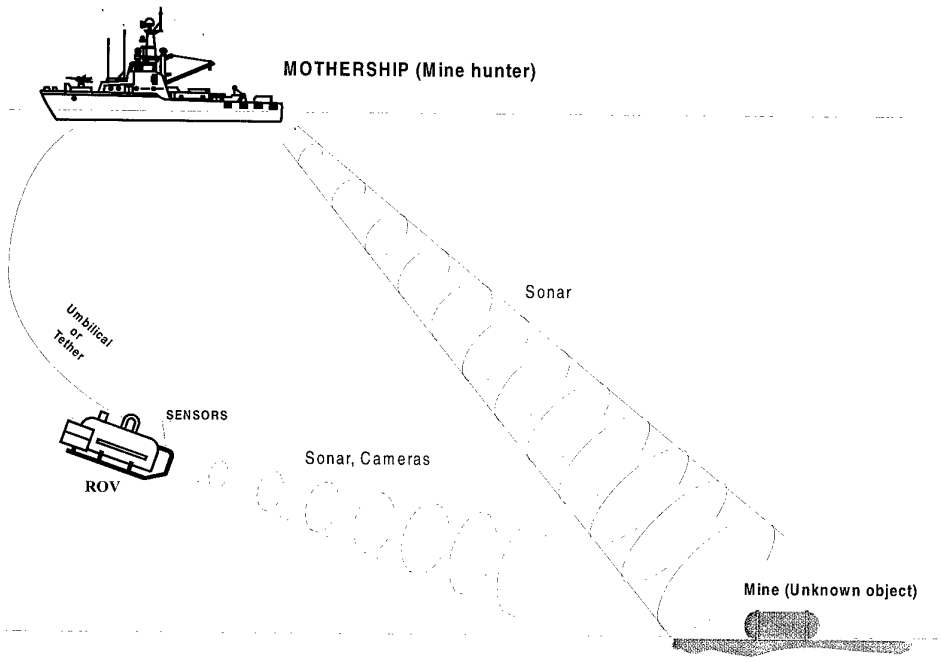


Figure 3. Mine hunting

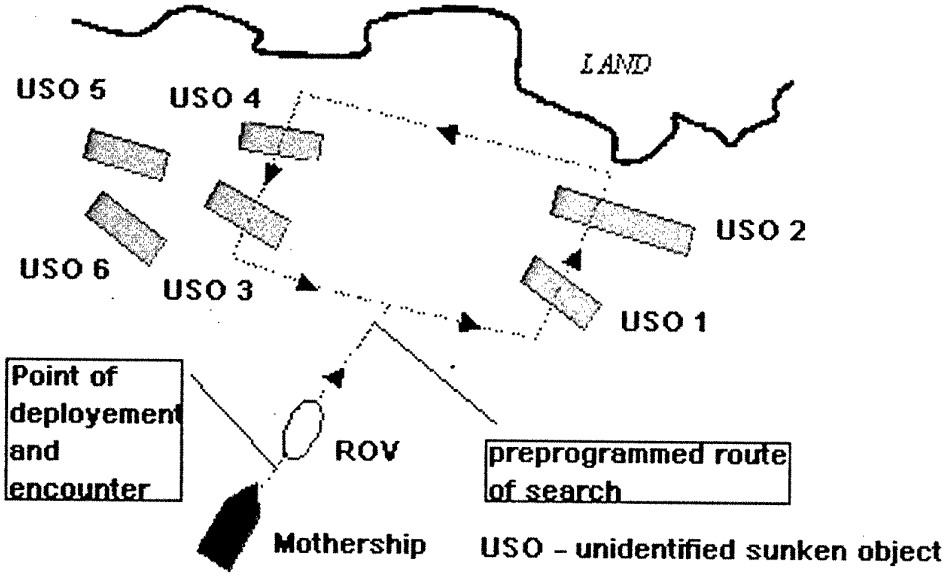


Figure 4. ROV deployment and search

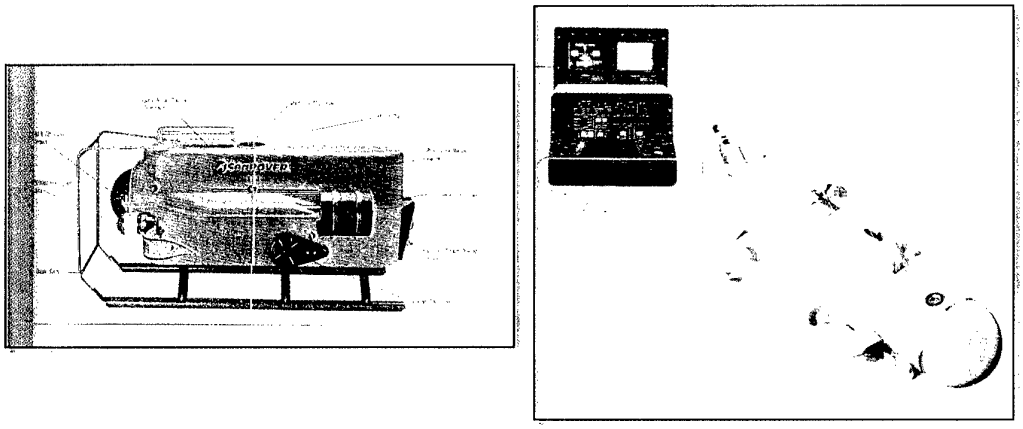


Figure 8. *Pluto* ROV

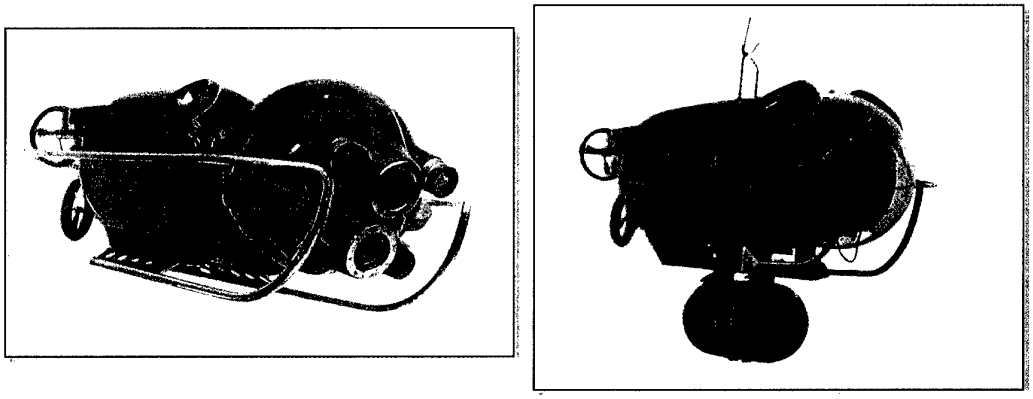


Figure 9. *Pluto* ROV in manoeuvre

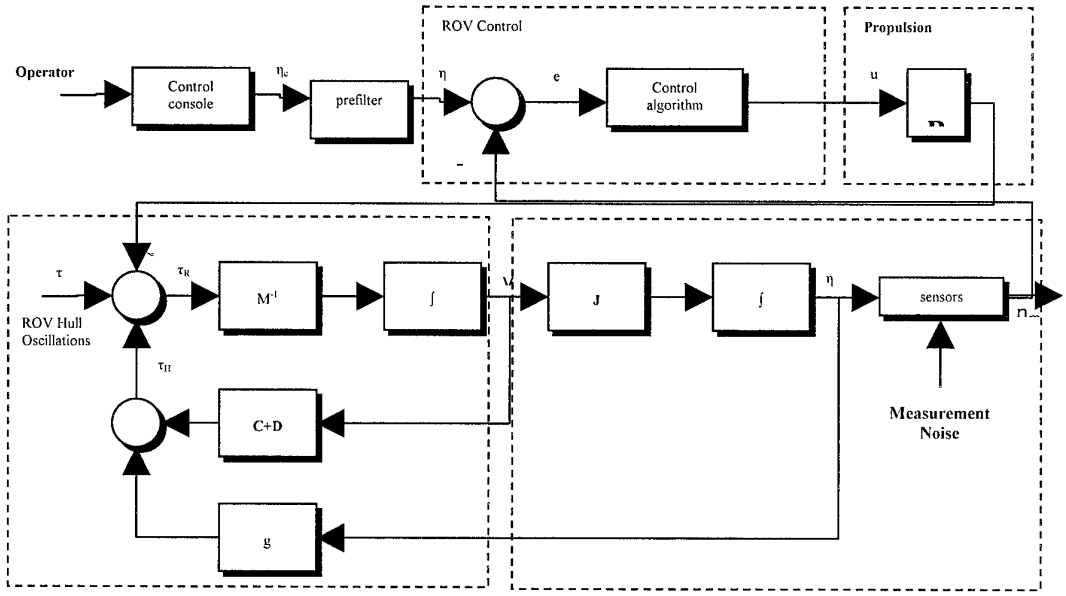


Figure 10. System Modelling

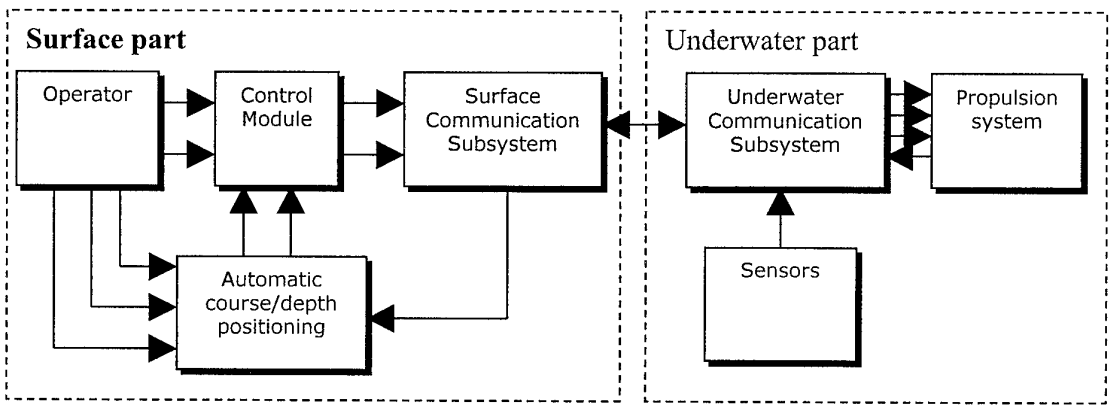


Figure 11. System Modelling - ROV Propulsion Control System

3. The Basic Mathematical Model of ROV Suitable for Dynamic Analysis

The manoeuvering of the ROV is done by the action of the forces and moments along and about x, y and z axes. The ROV propulsion system includes a number of thrusters fitted in adequate way on the hull. These thrusters are used both for propulsion and as actuators.

3.1 Mathematical model of thrusters

The mathematical model of thrusters from the control viewpoint can be generally considered as a nonlinear function

$$F = P(u_a) \qquad (1)$$

where:

u_a - armature voltage of drive, F -thrust force

Function P depends on thruster state variables, advance speed, and propeller revolutions.

For the needs of dynamic positioning system designing, the model of thrusters is often simplified and is described as a first-order transfer function with nonlinear gain.

3.2 Suitable mathematical model of ROV as a moving object

The mathematical model of the ROV kinematics and dynamics requires 6 equations, Table 1.

Table 1. - Degrees of freedom used to describe ROV dynamics and kinematics [1]

Degree of freedom	Type of motion (translation or rotation)	Forces and moments
1	SURGE	X
2	SWAY	Y
3	HEAVE	Z
4	ROLL	K
5	PITCH	M
6	YAW	N

The general form of the matrix equation for the ROV dynamics in 6 DOF according to [1, 4] is:

$$\mathbf{M}\,\dot{\nu} + \mathbf{C}(\nu)\nu + \mathbf{D}(\nu)\nu + \mathbf{g}(\eta) = \tau \qquad (2)$$

where:

- **M** -inertia matrix,
- **C**(ν) - Coriolis and centripetal matrix
- **D**(ν) - damping matrix
- **g**(η) - restoring forces
- τ - control forces

Inertia matrix **M** is given by the sum of the two matrices:

$$\mathbf{M} = \mathbf{M}_{RB} + \mathbf{M}_{A} \qquad (3)$$

where:

- $\mathbf{M}_{RB}$ -rigid-body inertia matrix;
- $\mathbf{M}_{A}$ - added inertia matrix

Coriolis and centripetal matrix **C(ν)** is also given by as the sum of the two matrices:

$$\mathbf{C}(\nu) = \mathbf{C}_{RB}(\nu) + \mathbf{C}_{A}(\nu) \qquad (4)$$

where:

- *$C_{RB}(\nu)$ - rigid-body Coriolis and centripetal matrix;*

- $\mathbf{C}_A(\nu)$ - hydrodynamic Coriolis and centripetal matrix

Total dumping matrix $\mathbf{D}(\nu)$ is the sum of partial damping matrices:

$$\mathbf{D}(\nu) = \mathbf{D}_P(\nu) + \mathbf{D}_S(\nu) + \mathbf{D}_W(\nu) + \mathbf{D}_M(\nu) \qquad (5)$$

where:

- $\mathbf{D}_P(\nu)$ - radiation induced potential damping due to forced body oscillations;
- $\mathbf{D}_S(\nu)$ - linear skin friction due to laminar boundary layers and quadratic skin friction due to turbulent boundary layers;
- $\mathbf{D}_W(\nu)$ - wave drift damping;
- $\mathbf{D}_M(\nu)$ - damping due to vortex shedding

The transformation of the velocity vector from the coordinate frame fixed to the vehicle to the earth-fixed coordinate frame, i.e. the ROV kinematics is obtained by the Jacobi transformation:

$$\dot{\eta} = \mathbf{J}(\eta)\, \nu \qquad (6)$$

where:

η - vector of positions and Euler angles in Earth's coordinate frame

$\mathbf{J}$ - Jacobi transformation matrix

The vector of gravitation forces and moments $\mathbf{g}(\eta)$ for the selected ROV (force of buoyancy equal to weight) is defined by the expression:

$$\mathbf{g}(\eta) = \begin{bmatrix} 0 \\ 0 \\ 0 \\ -BG_y \cos\phi\cos\theta + BG_z\, G\cos\theta\sin\phi \\ BG_z\, G\sin\theta + BG_x\, G\cos\theta\cos\phi \\ -BG_x\, G\cos\theta\sin\phi - BG_y\, G\sin\theta \end{bmatrix} \qquad (7)$$

where:

$$BG = \begin{bmatrix} BG_x & BG_y & BG_z \end{bmatrix}^T = \begin{bmatrix} x_G - x_B & y_G - y_B & z_B - z_G \end{bmatrix}^T$$

- $r_G = (x_G, y_G, z_G)$ - the distance of the center of mass from the origin of the body-fixed coordinate frame;
- $r_B = (x_B, y_B, z_B)$ - the distance of the center of buoyancy from the origin of the body-fixed coordinate frame.

Sea current is a constant parameter in the field of ROV action, and is therefore described via relative velocity:

$$\nu_r = \nu - \nu_c \qquad (9)$$

where:

ν_c - sea current velocity.

The ROV equation of motion under condition that $\dot{\nu}_c \approx 0$ assumes the form:

$$\mathbf{M}\dot{\nu} + \mathbf{C}(\nu_r)\nu_r + \mathbf{D}(\nu_r)\nu_r + \mathbf{g}(\eta) = \tau \qquad (10)$$

where:

v_r - relative velocity of ROV motion.

On the basis of the presented mathematical models of subsystems, the structure of the ROV control system was defined, and is shown in Fig. 12.

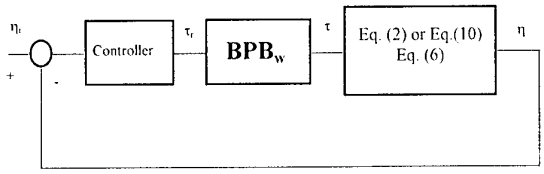


Figure 12. The structure of the ROV control

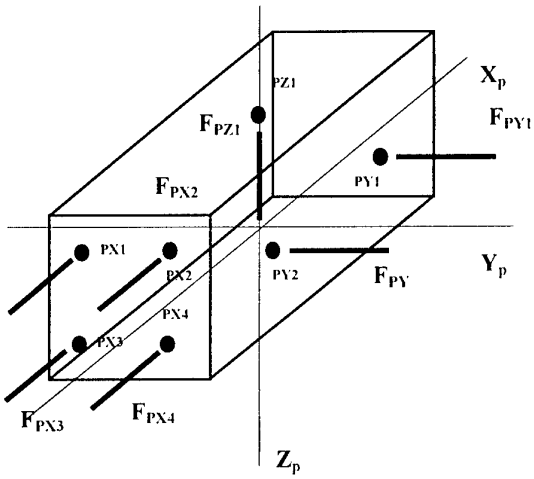
4. The Basic Simulation Model Suitable for Remote Control Algorithm Synthesis

In the considered case, it is not possible to control the ROV fitted, for example, with 7 thrusters by individual control of each thruster, in order to achieve desired manoeuvre. It is necessary to provide the coordinate control of the propulsion in a way that the operator determines intervention vector, and a special subsystem, controlled according to a pre-defined algorithm, determines the contribution of each thruster. All contributions together represent contribution matrix **B**. Matrix $\mathbf{B_W}$ represents the distribution of control signals to individual thrusters, and is usually taken as pseudo-inversion of matrix **B**.

4.1 Mathematical model of contribution - contribution matrix

The configuration of the ROV thrusters is shown in Fig. 13.

Figure 13. 3-D representation of ROV thrusters configuration



Forces $F_{P...}$ represent the thrust forces of individual thrusters and the moment is defined as:

$$\vec{M} = \vec{l} \times \vec{F} \qquad (11)$$

where:

- F - force
- l - force arm

It can be seen from Fig. 4 that the contribution matrix has the following form:

$$\mathbf{B} = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -l_{PX1-M} & -l_{PX2-M} & l_{PX3-M} & l_{PX4-M} & 0 & 0 & 0 \\ l_{PX1-N} & -l_{PX2-N} & l_{PX3-N} & -l_{PX4-N} & l_{PY1-N} & -l_{PY2-N} & 0 \end{bmatrix} \qquad (12)$$

4.2 Optimization criteria

The possibility of multiple solutions of contribution matrix $\mathbf{B_W}$ requires defining of certain optimisation criteria on the basis of which the ROV control system chooses the most favourable solution. The easiest way is to make the inversion, i.e. pseudoinversion of contribution matrix **B,** and get the ROV intervention vector which is in accordance with the operator's intervention at the control panel. The matrix $\mathbf{B_W}$ can be, however, optimized according to some specific requirement.

The special-purpose ROV optimization criteria are the following:

1. Minimum energy criterion
2. Peak load optimization criterion
3. i^{th} thruster's load optimization criterion
4. Criterion of optimization according to the number of active thrusters.

The optimization problem to be solved by the control system involves the synthesis of the appropriate control algorithm that will during the operation of the ROV coordinate control calculate the optimum contribution of each thruster in the operating propulsion system configuration, with the aim of generating the desired intervention vector.

The intervention vector has to overcome the ROV dynamics and environmental disturbances in order to perform the task of dynamic positioning.

The most convenient method for finding out the optimum solution to this problem in real time is the least squares method.

For the purpose of the realization of the target function, i.e. dynamic positioning of the ROV at a certain subsea point with required positioning accuracy, it is necessary to realize the algorithm for the control of the subsystem "propulsion configuration-coordinate control". It is further necessary to realize the algorithm for the distribution of the contribution of individual thrusters necessary for the realization of the required intervention vector. The propulsion configuration control can be achieved using conventional and unconventional algorithms.

4.3 Simulation model of ROV dynamic positioning in the vicinity of unidentified object

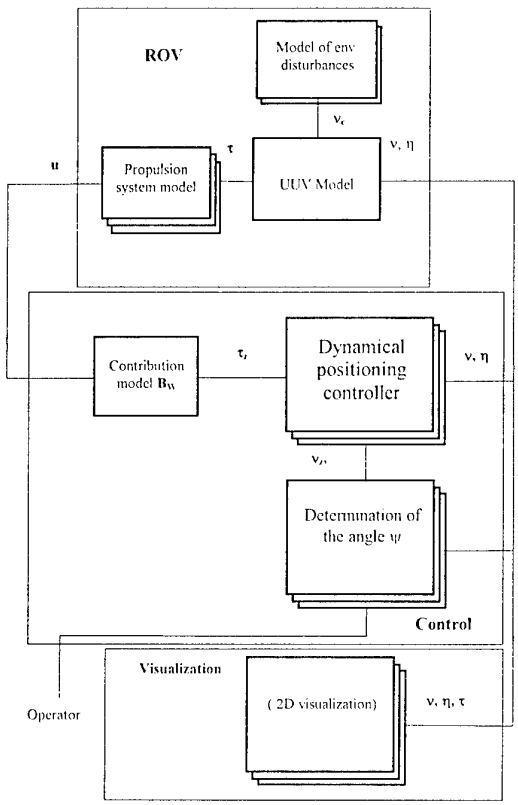
On the basis of the structure of ROV control (Fig. 12) and dynamic positioning control algorithms, the ROV simulation model is defined (Fig. 14).

As shown in the figure, the ROV simulator includes: ROV model, disturbances model, propulsion subsystem model, contribution model, control model, planning and decision making model, and visualization model. The last four models are of modular

character, which means that they can be changed in accordance with control system requirements. Also, individual modules can be, as the need requires, added or removed from the ROV simulator. The concept of the realized simulation model also allows making of extensions using additional modules, realization of particular software support, and education of operators.

On the basis of the simulation model presented in Fig. 17, the analysis of the ROV dynamic positioning in the software package MATLAB/SIMULNIK was made (Fig.18) for conventional and unconventional control of the thrusters. A fuzzy controller was, for instance, realized on the simulation model according to Fig. 24.

Figure 14. ROV simulation model during dynamic positioning



List of symbols in Fig. 14

- τ - intervention vector
- τ_z - given intervention vector
- v_z - given velocity vector
- η_z - given position vector
- v - instantaneous velocity vector
- η - instantaneous position vector
- **u** - control vector
- v_c - sea current velocity vector

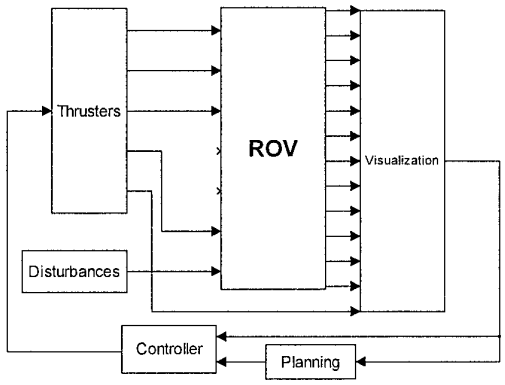


Figure 15. Simulation model in SIMULINK

4.4 Counter-mine manoeuvre scenario

The requirements on the ROV manoeuvering characteristics are determined by the combined mine searching manoeuvre. First, the mothership (mine-hunter), while sailing, searches a certain sea area for mines in the way shown in Fig.16.

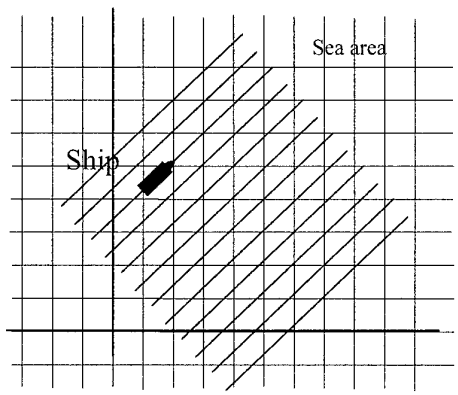


Figure 16. Searching of the sea area by a mine-hunter

In the event that ship sonars and/or other mine detection sensors detect a "dubious object" on the sea bed, that place is marked. In order to inspect the detected object, it is necessary to send a ROV to that place. The ROV manoeuvre has three phases, as illustrated in Fig. 17. These phases are the following: submerging (phase 1), approaching the detected object (phase 2), and inspecting the object (phase 3). The first part of the manoeuvre is not usually controlled automatically. After the necessary preparations, the ROV is submerged to a certain depth. Then follows the second phase during which the autopilot for course keeping switches on. When the ROV has come close to the object, the dynamic positioning system switches on (phase 2-phase 3)

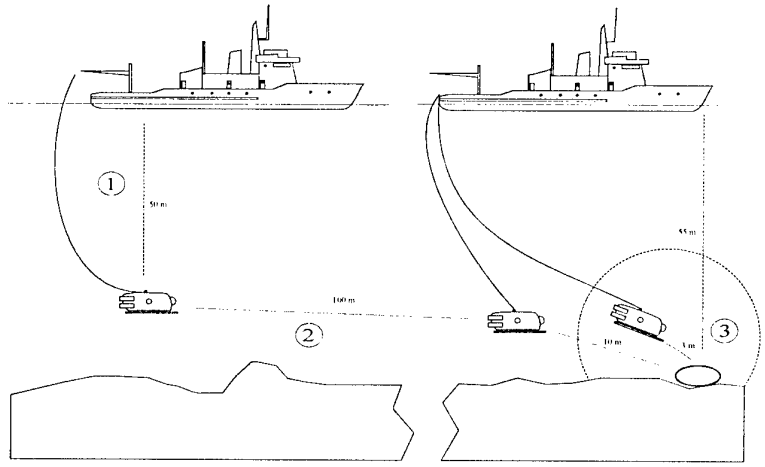


Figure 17. Mine clearing manoeuvre

The first part of the positioning manoeuvre is getting the ROV close to the object so that it can inspect it using a camera and sonars. That manoeuvre is illustrated in Fig. 18, the ROV from point A, at which the dynamic positioning system is switched on, comes to point B, where the sensor for the inspection of the object is switched on. In Figs. 19a, 19b and 19c, the results of

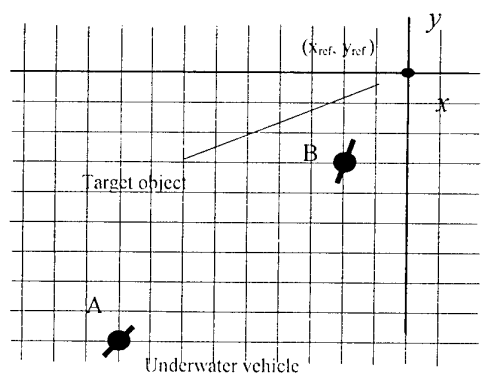


Figure 18. Approaching to the unknown object

simulation with a conventional (PID) algorithm for the control of thrusters configuration are given for the ROV having a mass of 185 kg. The results of simulation with the fuzzy control algorithm are shown in Figs. 20a, 20b and 20c, whereas the results of the simulation of ROV dynamic positioning for the manoeuvre of unknown object identification (Fig.21) are given in Figs. 22a, 22b, 22c, 23a, 23b and 23c.

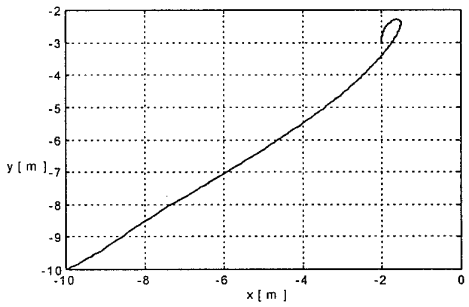


Figure 19a. Positioning in x-y plane (PID)

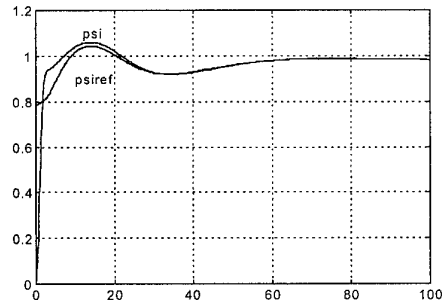


Figure 19b. Heading and reference heading(PID)

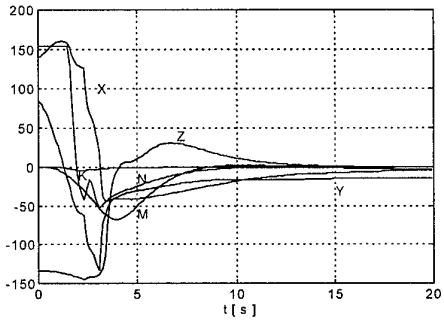


Figure 19c. Intervention vector (PID)

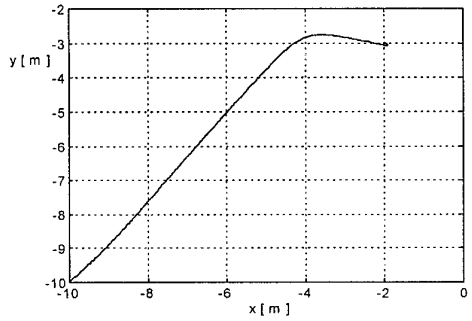


Figure 20a. Positioning in x-y plane (Fuzzy)

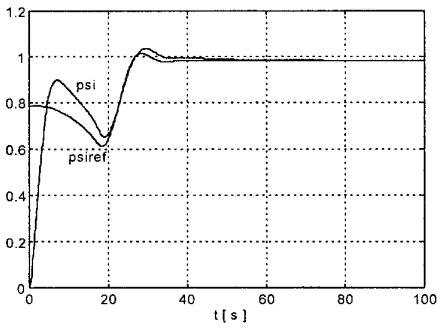


Figure 20b. Heading and reference heading(Fuzzy)

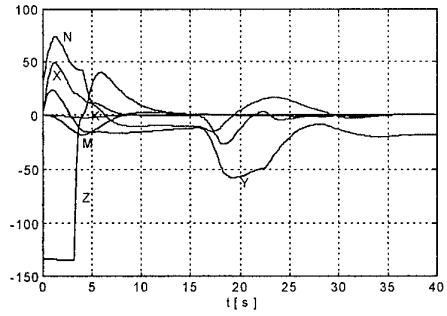


Figure 20c. Intervention vector(Fuzzy)

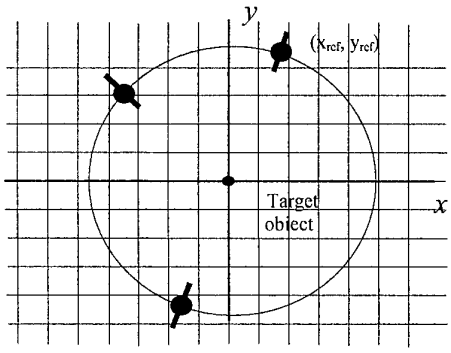


Figure 21. Unknown object inspection maneouvre

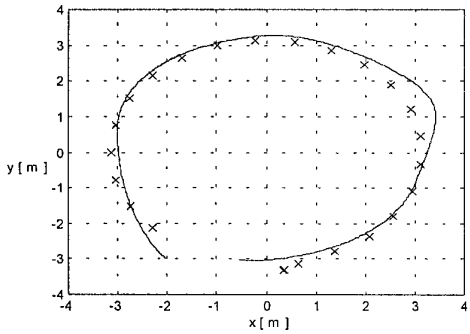


Figure 22a. Positioning in x-y plane (PID)

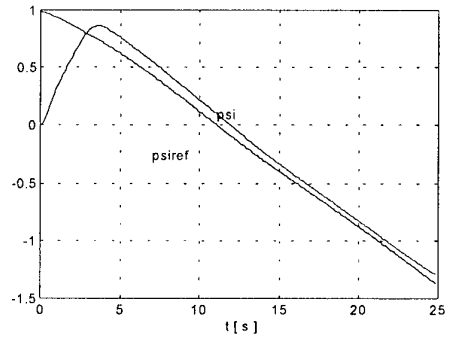


Figure 22b. Heading and reference heading(PID)

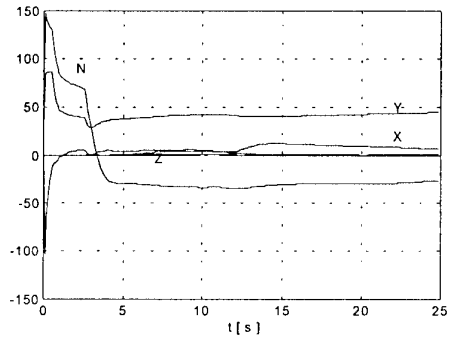


Figure 22c. Intervention vector(PID)

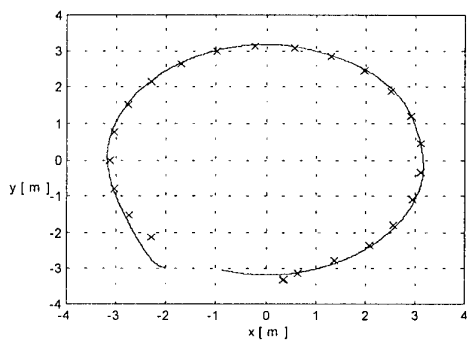


Figure 23a. Positioning in x-y plane (Fuzzy)

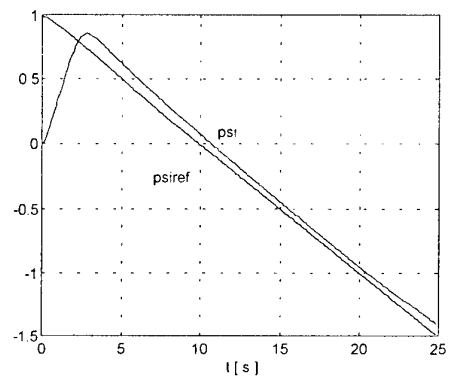


Figure 23b. Heading and reference heading (Fuzzy)

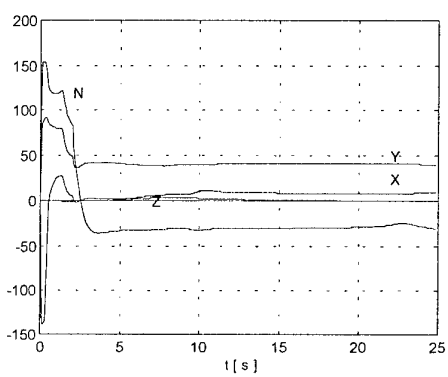


Figure 23c. Intervention vector(Fuzzy)

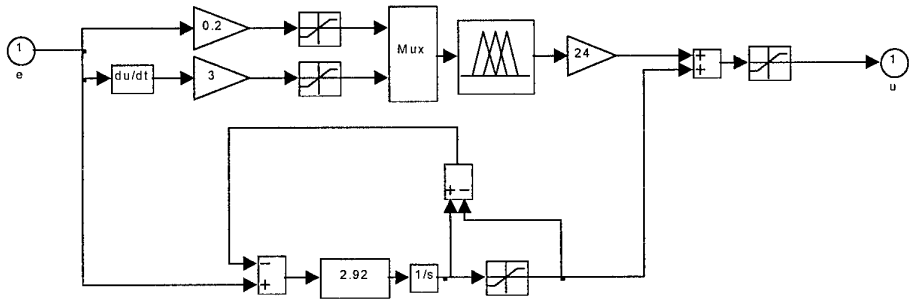


Figure 24. y-position fuzzy controller

4.5 CONCLUSION

On the basis of the presented mathematical model of ROV dynamic behaviour, and the realized simulation model and ROV dynamic behaviour simulation results for different modes of motion, it can be concluded that the application of ROV for mine detection and clearing in shallow seas proves to be a rather promising and efficient solution.

KEY WORDS

Mine threat, sea mines, mine countermeasures, remotely operated underwater vehicle, remote control, simulation model, control algorithms

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36. THE CZECH CHEMICAL MILITARY UNIT FOR FAST AND RELIABLE INTERVENTION

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INTRODUCTION FROM THE HISTORY OF THE CHEMICAL CORPS

The Chemical Coprs of the Army of the Czech Republic (and the former Czechoslovakia) was established at the beginning of 50s as a reaction on existing chemical and biological weapons in this period of time. Nuclear weapons have been implemented by the most military important armies as the U.S. Army, the Soviet Army and the British Army. The Chemical Corps of the former Czechoslovakia was build fully in the line with the examples of chemical units and chemical support in the Soviet Army, of course.

Especially the individual protection has a long and successful tradition in the Czech Republic (and in the former Czechoslovakia).

ESTABLISHMENT OF THE CZECH CHEMICAL MILITARY UNIT

The 9th Chemical Protection Company assigned to the North Atlantic Treaty Organisation (NATO) Immediate Reaction Forces (IRF) was formed by the decision of the supreme authorities of the NATO based on the realization that a single chemical protection platoon was not enough to cover the Allies' need for the IRF. The Czech military chemists have the necessary technical equipment and have demonstrated the ability to apply their knowledge and high level of their skills mostly in the Persian Gulf.

On October 1, 1998, the unit began to fully function as a professional body, able to immediately fulfil any given assigment.

MAIN MISSIONS AND TASTS OF THE CHEMICAL PROTECTION COMPANY

The main missions and tasks of the 9th Chemical Protection Company:

- radiological and chemical survey and surveillance,
- collection of samples and analysis of toxic substances and contaminants,
- decontamination of persons, combat technology, and materials,
- logistic support of own unit,
- command, medical, policing, security, and communication services.

The 9th Chemical Protection Company has the following organizational structure:

- Company Commander,
- Deputy Commander,
- Chief of Staff and Company Headquarters
- Command and Combat Support Platoon,
- Radiological and Chemical Survey Platoon,
- Dozimetric and Chemical Checking Platoon,
- Decontamination Platoon,
- Logistic Support Platoon,
- Group of Military Police,
- First-Aid Post

It is a matter of priority that members of the IRF attain a state of highly professional preparedness, both psychical and psychological. All the candidates are tested for physical fitness and have to undergo a thorough medical examination, including an interview with a psychologist. During the training period, attention is paid not only to professional and

specially orientated drills, but also such as swimming in military conditions, walking a 30 km distace while orienteering in unfamiliar terrain, using a map and English language learning.

The professional memebrs of the Company are able to provide assistance to other units in an emergency while simultaneously protecting themselves to ensure that it is effective. The Company is equipped with state.of-the art protective clothing and devices and utilises chemical and radiological situation monitoring techniques and modern equipment designed to remove the consequences of mass destruction weapons attacks.

CONCLUSION

The Chemical Corps may share in solution of situation after use NBC weapons (weapons of mass destruction) as well as after chemical and nuclear accidents and other industrial plant break-downs. The Chemical Corps posses reliable and sufficient equipment, procedures and materials for individual and collective protection, for NBC reconnaissance and for fast and effective decontamination of persons, personnel, devices, technical equipment, etc.

A selected parts of the Chemical Corps can significantly contribute in solution during and after emergency situations. These trained units may link up with other emergency forces, units and components.

Chemical corps personnel participated in the Persian Gulf War and helped destruction of chemical weapons in Iraq.

SUMMARY

A short introduction concerning the Czech Chemical Corps and its actions in the past time. Establishment of the 9th Chemical Protection Company. Main tasks of the unit, its organizational structure, company trainig and special equipment to fulfil its missions.

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KEYWORDS

Chemical Corps, Chemical Protection Company, Radiological and Chemical Survey, Dozimetric and Chemical Checking, Decontamination

37. LATE HEMATOLOGIC COMPLICATIONS OF MUSTARD GAS

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INTRODUCTION

Chemical warfare agents in general and mustard gas in particular were used by Iraq against Iranian combatants during the Iraq - Iran war from 1981 to 1988. Mustard affects many organs such as the skin, eyes, and lungs, as well as the gastrointestinal, endocrine, and hematopoietic system (1-6). Although some of these complications are transient or treatable in the early phases, late complications may remain for years. Alkylating effects of mustard gas disturb the DNA of hematopoietic cells (7-8). High-dose exposure has a cytotoxic effect on hematopoietic stem cells and pancytopenia has been seen in Iranian combatants (9). Low-dose effects on this system may appear years later and follow-up studies are needed to determine these adverse effects. One study showed initial marked lymphopenia in 36% of exposed patients while during the recovery phase, lymphocyte counts increased to greater than 40% in 18% of patients (10).Increase in lymphocyte protease activity in human peripheral blood due to mustard exposure has been reported(11). In another study, some neutrophil function tests remained intact despite mustard poisoning (12). There are thousands of handicapped patients who suffer from adverse effects of chemical warfare poisoning in Iran. We undertook this hematological survey to determine and assess the late complications of mustard gas poisoning.

MATERIALS AND METHODS

A case - control model study was undertaken from November 1998 to March 1999.
Patients: The case group was selected from chemical warfare victims of the Iran - Iraq war whose acute lesions had been diagnosed clinically at the field hospital based on known signs and symptoms of blistering agents. The case group had been under sulfur mustard (Lewisite) gas attacks, and revealing kits verified the gas in the field at the time of attack. All patients had certificates confirming their injury, issued by a medical commission.

Sampling was done randomly from 318 patients within 2300 male chemical warfare victims of the Isfahan province of Iran registered at the Center for Military Patients at the Amir Al-Momenin Hospital. Fifty-seven patients had had previous hematologic exams check - ups 3.2 years before our main examinations.

Controls: In order to disclude the effects of age and geographics, 700 male controls were selected from Isfahanian men referring to the Isfahan Thalassemia Prevention and Research Center for routine premarriage check-ups and thalassemia carrier screening. None had experienced contact with any chemical warfare agents.

Blood Tests: Blood samples of both groups were taken from venous blood, heparinized after sampling and tested within two hours. Just after sampling, two blood smears were prepared. The smears were studied after Gimsa staining, by an expert hematopathologist. CBC (RBC, WBC, MCV, MCH, MCHC, Hb, HCT) were done for all samples, using an automatic electronic cell counter (H*1,Technicon, France).

Statistical Analysis: Data was entered and analyzed (SYSTAT Win 5 software) using tests for means difference (two slope t- student test). P value less than 0.05 was considered significant. To evaluate qualitative variables relationships, chi- square test was used, and if

sparse cells (less than 5 in each cell) were observed, Fisher's exact test was preferred. Data was written in mean and standard deviation form. Decrease and increase in blood indices, beyond limits of the normal range , were evaluated compared to hematologic reference values of American males .

RESULTS

Blood indices of case group and controls are illustrated in table 1. Previous exam results of 57 chemical warfare victims are shown in a separate column in the table2.

RBC indices: Apart from MCV ($p<0.001$) no red cell index differed significantly between case and control groups. Macrocytosis was significantly higher in our main exams than the patient's previous exams (odds ratio = 15.8/0). Mean MCV and hemoglobin values were higher than previous examinations ($p<0.001$).

WBC indices: Apart from eosinophil count ($p=0.54$) other WBC related indices were found significantly higher in control group. Neutropenic condition (Odds ratio = 2.6) showed no difference in comparison with previous exams of the patients. Lymphocyte, monocyte, and eosinophil count were higher in the second examination.

Peripheral blood smear: Abnormal smears, observed in 42 cases, varied from hypochromasia in RBCs to 6.3 percent atypical lymphocyte visualization. In six patients atypical lymphocytes comprised more than 20 percent of the lymphocyte population and in the other patients atypia was less than 20 percent.

DISCUSSION AND CONCLUSION

Lungs, skin, eyes and bone marrow are the organs most involved in mustard gas poisoning. In some Iranian combatants pancytopenia has been an early complication of heavy mustard poisoning due to bone marrow involvement (10). The affected individuals presented highly over - rate B cells in parallel with the lowest percent of T cells in peripheral blood one week after exposure to mustard. After one year the B cell number fell to the highest of normal range while T cell number never reached even the lowest of the normal range (13). Studies on murine lymphocytes after in vivo treatment with mustard showed that B-lymphocytes were relatively more affected than T- lymphocytes (14). In our study although no evidence was found to show lymphocytosis or lymphopenia in our patients, decreased lymphocyte count in comparison to their previous results and the appearance of atypical lymphocytes suggest a lymphoid production disorder. Mustard alkylating effects cause reduction of stem cells to a critically low level. It may be due to DNA defects subsequent to mustard gas exposure (15). A decrease in count and dysfunction of pluripotent stem cells may occur after mustard poisoning and involvement of myeloid, lymphoid and erythroid cells in this study may be correlated with disarrangement in pluripotent stem cells. Neutropenia, decrease in neutrophil count and other leukocyte components, may also result by this mechanism. Stem cell failure can decrease marrow transit time of erythroid clones, and then elevation of erythroid concentration can increase erythrocyte mean corpuscular volume (16) and causes the production of large "stress" erythrocytes. Further studies on bone marrow cells and cell markers and long-term follow-up of patients are required to assess definite hematologic complications of mustard gas exposure.

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KEYWORDS
Hematologic, complications, mustard Gas, Iran, Chemical warfare

FIGURES AND TABLES

Table 1: Mean Value Of Hematologic Indices Between Case & Control Groups

Index	Control	Case	P.Value
Red blood cells (count)	5/66±0/82	5/64±0/51	0/35
Hemoglobin (gr/dl)	17/02±2/77	17/02±1/19	0/95
MCV (fentoliter)	90/38±8/25	86/67±5/46	<0/001
MCH	30/41±5/66	29/86±2/26	0/44
WBC (count/ml*1000)	6/70±1/31	6/98±1/16	0/03
Neutrophil (count/ml*1000)	3/60±1/31	4/09±1/39	<0/001
Lymphocyte (count/ml*1000)	2/26±0/62	2/09±0/62	0/001
Monocyte (count/mL*1000)	0/41±0/16	0/45±0/14	0/001
Eosinophil (count/ml*1000)	0/22±0/18	0/22±0/21	0/57

Table 2: Hematologic indices in case group

Index	First exam	Secound exam	P.Value
Red blood cells (count)	5/34±47%	5/52±%38	0/008
Hemoglobin (gr/dl)	15/52±1/06	16/91±0/98	<0/001
MCV (fentoliter)	84/45±6/51	91/76±5/9	<0/001
MCH	30/32±7/28	30/41±1/38	0/929
WBC (count/ml*1000)	7/36±2/34	6/72±1/73	0/059
Neutrophil (count/ml*1000)	4/46±2/33	3/68 ±1/73	<0/062
Lymphocyte (count/ml*1000)	2/51±0/64	2/17±0/68	0/001
Monocyte (count/ml*1000)	0/24±0/13	0/39±0/14	<0/001
Eosinophil (count/ml*1000)	0/24±0/16	0/2±0/13	0/047

38. LATE PULMONARY COMPLICATION OF MUSTARD GAS INHALATION

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ABSTRACT

Thousands of Iranian people were injured by mustard gas in the Iraq war. This injury results in chronic disabilities of eyes, lung and skin organs. Chronic cough, dyspnea and hemoptysis were the major presenting symptoms in these patients. We studied late pulmonary complications of these patients.

One hundred mustard gas victims were selected through a cross sectional study. All selected had documented criteria, pulmonary function tests, high resolution chest CT scan, bronchioscopy and routine blood tests, which were done in a well equipped center.

All patients had chronic bronchitis in their bronchial biopsy. Pulmonary fibroses, with different types of histology, were detected in 80% of patients. A cytologic study of bronchial lavage did not show neoplastic cells. HRCT findings were compatible with bronchial thickening and subpleural fibrosis with definite correlation with histologic data in all patients.

Late complications of mustard gas includes bronchial and paranchymal involvement. Although the causative agent is not present, the disease has a continuous nature and sometimes progressive course, with end-stage lung disease the outcome.

KEYWORDS:
Mustard, mustard gas poisoning, lung disease, pulmonary function

39. EMERGING INFECTIONS AND BIOTERRORISM

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INTRODUCTION

There have been events in the recent past that demonstrate that terrorist attacks on civilians are a real threat. These attacks have not always been successful, but they demonstrate that the threat is real: The World Trade Center bombing, New York, N.Y. (1993) Federal building bombing, Oklahoma City, Okla., Centennial Olympic Park bombing, Atlanta, Ga., Sarin release, Tokyo, Japan, Anthrax hoaxes, Washington, D.C., Las Vegas, Nev., and other locations, and the Embassy bombings, Kenya and Tanzania.

There are three important factors in the decision to use or not to use a biological weapon: motives, capabilities and financial resources.

BIOTERRORISM THREAT AGENTS

What are the agents that can be considered for use in a terrorist attack? There are eight "classic" biological warfare agents that can be considered the classic or core bioterrorist agents: these are the organisms or toxins that cause the diseases anthrax, botulism, brucellosis, plague, Q fever, smallpox, staphylococcal enterotoxins and tularaemia. Three other disease-causing agents that could be used are cholera, salmonellosis, and shigellosis. In addition to these diseases and agents, there are the "emerging infections", leptospirosis, chlamydial pneumonia, Lyme disease, Legionnaire's pneumonia, Ehrilichiosis, glanders, Vancomycin resistant enterococci and Escherichia coli strain O157:H7. Table 1 lists the new or emerging viruses and the diseases they cause. Some of the illnesses or symptoms that may result from using these bioterrorist agents are:

- Encephalitis
- Hemorrhagic mediastinitis
- Pneumonia with abnormal liver function tests
- Papulopustular rash
- Hemorrhagic fever
- Descending paralysis
- Nausea, vomiting, diarrhea
-

In addition to these, there is concern about the viral hemorrhagic fevers caused by a variety of viruses. These are listed in Table 2. Although these viruses come from different families or genuses, they have several properties in common and some differences as well. These are:

- Small RNA viruses
- Lipid enveloped and acid sensitive
- Aerosol infectivity
- Persist in nature, but different strategies
- Negative, positive, ambisense replication strategies
- Different morphology and morphogenesis
- Interactions with cells differ: cytopathic effects, interferon sensitivity
- Disease syndrome similar, pathogenesis differs
- Human immune response differs

EFFECTIVENESS OF BIOTERRORISM AGENTS

How effective can these bioterrorism agents be? Most scenarios involve releasing these agents in the air because the respiratory exposure route is the best way to reach the largest number of people quickly.

Effects of dissemination of 50 kg of a biological agent downwind from an airplane toward a city of 500.000 people:

Agent or disease	km	Dead	Iincapacitated
Venezuelan equine encephalitis	1	400	35,000
Tick-borne encephalitis virus	1	9,500	35,000
Q fever	>20	150	125,000
Tularemia	>20	30,000	125,000
Anthrax spores	>20	95,000	125,000

In order to release the agents in the air, the stability of the aerosol becomes important. The stability of aerosols is given by the amount of degradation in percent that occurs over time, often expressed as percent/minute. The smaller the number, the more stable the aerosol. Aerosol stabilities of some viruses are given below:

Virus	percent degraded/min
Vaccinia virus	0.3
Influenza virus	1.9
Venezuelan equine encephalitis	3.0
Marburg virus (saliva)	11.5
Marburg virus (+10% glycerin)	1.5

NATURAL OUTBREAK VS. BIOTERRORISM

Emerging disease agent could be used as bioterrorist weapons because little will be known about the disease as it emerges. Therefore naturally emerging infectious disease outbreaks could be mistaken for bioterrorism. Some examples of unusual outbreaks that could have been mistaken for bioterrorism are given below:

Event/Disease	Location	Year
Legionnaires' disease outbreak	Philadelphia	1976
Rift Valley fever	Egypt	1977
Urban Q fever	Nova Scotia	1987
Botulism	Egypt	1991
Vibrio Cholerae O 139	Bangladesh, India	1992
Hantavirus pulmonary syndrome	United States	1993
Plague	India	1994
Food-borne cryptosporidiosis	Minnesota	1995
Ebola virus infection	Zaire	1995
Antibiotic-resistant strain of Plague	Madagascar	1995
Monkypox	Zaire	1996
Antibiotic-resistant Anthrax	India	1997
Nipah virus encephalitis	Malaysia, Singapore	1998-1999

It may be difficult to differentiate between natural outbreaks emerging diseases and outbreaks of these same diseases that are caused by intentional releases of agents. Here is a list of some the characteristics of outbreak, which suggest the possibility of intentional use of

an emerging infectious agent. Especially in the case of newly emerging diseases, this type of assessment may not be able to be made until after the characteristics of the diseases and disease-causing agent are examined and understood.

- Outbreak of a rare disease
- Outbreak of a disease in an area where it is not normally endemic
- Occurrence of a seasonal disease during the wrong time of the year
- Attribution of an outbreak caused by a known pathogen to a strain with an unusual antimicrobial pattern.
- Unusual age distribution of persons involved in an outbreak
- Other unusual epidemiological features of an outbreak due to a known pathogen
- Unusual clinical presentation associated with a known pathogen

BIOLOGICAL AGENT PREPARATION

There are some common features to preparing a biological agent to be used in bioterrorism. First the initial bacterial or virus strain must be obtained. Then it must be cultured to a high titer in sufficient quantities to be effective when released. The cultured agent must be processed to permit dissemination as an aerosol or other form if desired. The cultured, processed agent must be stable enough for storage in the processed form. This processed form should be tested for effectiveness and dissemination. And then finally, it must be disseminated for effect.

FIGURES AND TABLES

Table 1. New and reemerging viruses

Viruses	**Date**	**Genus**
New		
Human herpesvirus 6 (HHV-6)	1986	herpesvirus
Human herpesvirus 7 (HHV-7)	1990	herpesvirus
GS viruses (hepatitis)	1994	Flavivirus
Human herpesvirus 8 (HHV-8)	1995	herpesvirus
Reemerging		
Cocoa swollen shoot		Badnavirus
Dengue		Bunyavirus
Ebola		Flavivirus
Equine morbillivirus	1994	Morbillivirus
Hantaan group		Bunyaviruses
Phocine distemper	1987	Morbillivirus
Rabbit calicivirus disease /Viral hemorrhagic disease	1985	Calicivirus
Rift Valley fever		Bunyaviruses
Tomato spotted wilt		Bunyavirus
Whitefly-transmitted Geminiviruses (group III Geminiviruses)		Geminivirus

Table 2. Viral Hemorrhagic Fevers

Family and/or genus	**Disease(s)**
Arenaviridae	Lassa fever, Bolivian HF (Machupo virus), Argentine HF (Junin virus), other South American HF
Bunyaviridae	
Phlebovirus	RVF
Nairovirus	Crimean-Congo HF
Hantavirus	HF with renal syndrome, hantavirus Syndrome
Filovirus	Marburg HF, Ebola HF
Flavivirus	Yellow fever, dengue HF, tick-borne flavivirus HF

KEY WORDS:
Emerging infections, biological and toxin agents, bioterrorism

40. ANTIDOTAL EFFICACY AND PHARMACOKINETICS OF HI-6 AND TRIMEDOXIME IN MICE POISONED WITH SOMAN OR PARAOXON

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ABSTRACT

The aim of this work was to examine and correlate the pharmacokinetic, reactivating and protective properties of HI-6 and trimedoxime in mice poisoned with soman or paraoxon.

Male albino mice were poisoned with 1.3 LD-50 *iv* of soman or paraoxon, at different time intervals after *iv* administration of the antidotes. Median effective doses and efficacy half times were calculated. In the biochemical set of experiments, brain, diaphragmal and erythrocyte acetylcholinesterase activities were determined. To obtain values of pharmacokinetic parameters, oximes were administered intravenously and analysed in plasma samples by HPLC method. Oxime concentrations versus time curves were estimated using a two-compartment open model.

When HI-6 was applied in soman poisoned animals, acetylcholinesterase activity recovered to 69.30 % and 34.67 % of the control diaphragmal and erythrocyte acetylcholinesterase activity, respectively. In paraoxon treated animals, use of trimedoxime produced significant increase of acetylcholinesterase activity in all examined tissues.

Plasma concentrations of oximes reached maximum values immediately after injection, and then decreased rapidly due to the transport of oximes to the peripheral compartment and elimination. From the calculated pharmacokinetic parameters, it appears that trimedoxime penetrates the tissues better, is slowly transferred back to the circulation and remains longer in the body.

In spite of pharmacokinetic data obtained for trimedoxime, it was practically ineffective against soman poisoning, indicating that antidotal efficacy depends much more on the reactivation potency of the oximes than on their pharmacokinetics. However, better insight into the pharmacokinetic profile of oximes is necessary in order to optimize the antidotal therapy.

INTRODUCTION

Pyridinium oximes are one of the cornerstones of the treatment of poisonings with organophosphate agents. There is no "universal oxime" that could reactivate acetylcholinesterase inhibited by any anticholinesterase. At present, the most efficient oxime against intoxications with nerve agents soman, sarin and VX is HI-6, while trimedoxime and obidoxime are the most efficient ones against tabun poisoning (1, 2, 3, 4, 5, 6). In addition, the mentioned bispyridinium dioximes exert significant reactivating potencies against various organophosphate insecticides (7, 8).

Antidotal efficacy of an oxime depends on its chemical structure, reactivating moiety, concentrations in target tissues and the duration of its maintenance, as well as on the inhibitory potential and toxicokinetic properties of an organophosphate (9, 10, 11, 12).

Therefore, the aim of this work was to investigate and correlate the pharmacokinetic, reactivating and protective properties of HI-6 and trimedoxime in mice poisoned with soman or paraoxon.

METHODS

Chemicals. Soman (98.5 %), paraoxon (99.0 %) and oximes (99.0 %) – pralidoxime (PAM-2), trimedoxime (TMB-4), obidoxime (LuH-6) and HI-6 were obtained from the Military Medical Academy, Belgrade. All the other chemicals of analytical or HPLC grade were purchased from the commercial sources.

Stock solutions of organophosphates were prepared in isopropanol. Oximes were dissolved in distilled water and diluted to the required concentration immediately before use.

Animal experiments. Male albino mice (18-24 g) were obtained from the Military Medical Academy, Belgrade, Yugoslavia. The mice were acclimatised for at least one week prior to use and received food and tap water *ad libitum.* All tested substances were administered intravenously via the tail vein at a volume of 0.1 ml/20 g of body mass.

Experimental animals were poisoned with 1.3 LD-50 *iv* of soman or paraoxon at different time intervals (1-60 min) after intravenous administration of the antidotes. Median effective doses were calculated according to the method of Litchfield and Wilcoxon (13), with 95 % confidence limits. These data were used to calculate ED-50 at null time ($ED\text{-}50_0$) and efficacy half time ($t_{1/2}$ eff.).

In the biochemical set of experiments, brain, diaphragmal and erythrocyte acetylcholinesterase activities were determined. Oxime HI-6 (17.36 mg/kg, 48.33 μmol/kg) and trimedoxime (24.43 mg/kg, 68.38 μmol/kg) were injected 5 min before 1.3 LD-50 of soman and paraoxon, respectively. Mice were decapitated and exsanguinated at different time intervals (10, 40 and 60 min) after antidote administration. Diaphragms and brains were removed and homogenised in isotonic saline. The brain and diaphragm enzyme activities were measured by the spectrophotometric method (14, 15) while the erythrocyte acetylcholinesterase activity was determined titrimetrically (16) by using acetylthiocholine iodide as substrate.

To obtain intravenous pharmacokinetics, mice (n = 4-6) were sacrificed at various times (2, 5, 10, 15, 20, 30, 40, 50 and 60 min) after administration of HI-6 (132.54 μmol/kg) or trimedoxime (55.98 μmol/kg). Whole blood of each animal (0.6-1 ml) was collected into the heparinised tubes. Oximes were analysed by ion-pair HPLC method in separated plasma samples (17, 18).

Data analysis. Oxime concentrations versus time curves were estimated by using a two-compartment open model. Statistical significance was determined by means of Student's t-test and Mann-Whitney U-test, and the differences were considered significant when $p < 0.05$.

RESULTS

In mice poisoned with soman, HI-6 afforded the best protection (Table 1). In paraoxon poisoning, calculated ED-50 values at null time increased by the following order: obidoxime < trimedoxime < HI-6 < pralidoxime. Efficacy half times in mice poisoned with paraoxon for pralidoxime, trimedoxime, obidoxime and HI-6 were 6.61, 11.96, 13.36 and 19.17 min, respectively. According to the calculated antidotal potency, the most efficient oximes were trimedoxime and obidoxime.

Following administration of organophosphates alone, some tissue acetylcholinesterase activities (about 4 % in brain and about 20 % in diaphragm) remained functional, while erythrocyte acetylcholinesterase activity was not detectable (Figures 1 and 2).

Administration of HI-6 significantly increased diaphragmal and erythrocyte acetylcholinesterase activities in soman-poisoned mice up to 69.30 % and 34.67 % of the control activities, respectively. Brain acetylcholinesterase activity remained the same or even lower, compared to that in animals treated with soman alone (Figure 1).

Trimedoxime, injected into mice before intoxication with paraoxon, induced a significant reactivation of acetylcholinesterase at all the times and in all the tissues tested, with maximum enzyme activities of 62.76 %, 80.91 % and 56.67 % attained in brain, diaphragm and erythrocytes, respectively (Figure 2).

After fast intravenous application, the concentration of oximes in plasma reached maximum values immediately after injection, and then decreased due to transport of oximes to the peripheral compartment and elimination.

During the distribution phase, the oxime concentrations in plasma decreased rapidly, while the corresponding half times of HI-6 and trimedoxime were similar and amounted about 9 min (Table 2). After the phase of distribution, the oximes were eliminated more slowly. Both oximes penetrated from the central compartment to the tissues at approximately the same rate. However, trimedoxime was transferred back to the circulation about two times more slowly. The rate constants of the oxime elimination from the central compartment (k_{13}) showed that this process proceeded practically at the same level for both oximes. The total clearance (Cl_{tot}) of HI-6 was about 25 % higher than that of trimedoxime. The central compartment distribution volume of HI-6 was about 35 % higher, indicating that the dose of trimedoxime should be increased in order to achieve concentration similar to that of HI-6. In the peripheral compartment, however, the ratio of distribution volumes of the tested oximes was completely the opposite. Consequently, the dose of HI-6 should be increased by about 35 % to reach the concentration range of trimedoxime.

DISCUSSION

There are numerous articles on the antidotal effects of HI-6 against soman poisoning published so far (1, 3, 5, 10, 19, 20). Based on our results, the protective effect of HI-6 in mice seems to be determined by the extent of acetylcholinesterase reactivation in respiratory muscles. These results are in agreement with those published earlier (11, 19, 21, 22, 23, 24, 25).

Lack of or minimal reactivation of brain acetylcholinesterase by HI-6 in experimental animals intoxicated with soman has been explained by the insufficient access of the oxime through the blood-brain barrier (11, 26). In our experiments, brain acetylcholinesterase activity determined 60 min after HI-6 application, was significantly lower than in animals treated with soman alone (Fig. 1). After an initial enhancement, a decrease of the brain and diaphragmal acetylcholinesterase activity was obtained. This phenomenon could be ascribed to the leakage of soman from its tissue depots (9, 27, 28).

Obidoxime and trimedoxime were superior to HI-6 and pralidoxime in antagonising the toxic effects of paraoxon in mice (Table 1). Trimedoxime caused a significant increase in the activity of both the central and peripheral acetylcholinesterase (Fig. 2). It is well known that trimedoxime and obidoxime have great reactivating potentials, which explains their antidotal efficacy against a number of organophosphate insecticides (7, 8). Worek and co-workers (8, 29) showed that obidoxime was better reactivator of human erythrocyte acetylcholinesterase inhibited with paraoxon than the equimolar concentrations of pralidoxime, HI-6 and HLo-7. In addition, ten times smaller concentration of obidoxime (10 μmol/l) was needed for restoring the contractility of the mouse isolated phrenic nerve-diaphragm *in vitro* preparation treated with paraoxon, in comparison with pralidoxime (100 μmol/l) (29).

For many years it has been accepted that the minimal plasma concentration of an oxime needed for effective reactivation of the inhibited cholinesterase is 4 mg/l (30). However, it was shown that this statement had been uncritically accepted, regardless of the oxime and inhibitor used (8, 29, 31, 32). Although all the pyridinium oximes are rapidly

eliminated from the circulation, they differ in some pharmacokinetic properties (33, 34, 35). According to the results obtained (Table 2), calculated distribution volumes (V_1, V_2 and V_d), rate constants of transfer from the peripheral to the central compartment (k_{21}) and total clearances (Cl_{tot}) suggest that trimedoxime penetrates better into the tissues, is slowly transferred back into the circulation and has longer persistence in the organism than HI-6. Nevertheless, trimedoxime was practically ineffective against soman poisoning, indicating that the antidotal efficacy of an oxime depends much more on the inhibitor-specific reactivation potency than on its pharmacokinetics. However, pharmacokinetic properties of pyridinium oximes are important for proper individualisation of the antidotal therapy.

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KEY WORDS
Organophosphates, HI-6, trimedoxime, efficacy, pharmacokinetics

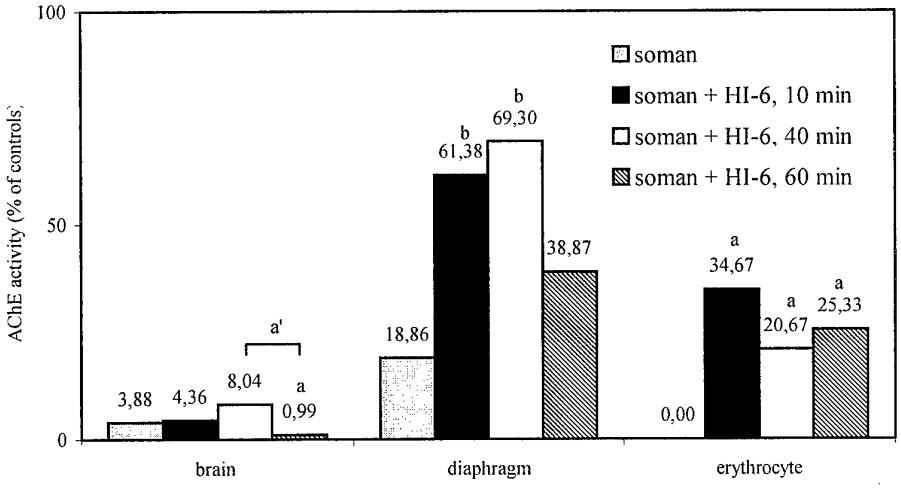
FIGURES AND TABLES

Table 1: Efficacy data on pyridinium oximes in mice poisoned with 1.3 LD-50 *iv* of soman or paraoxon

	PAM-2	TMB-4	LuH-6	HI-6
ED-50$_0$ (□mol/kg)				
Soman	329,57	4,65	25,78	7,96
Paraoxon	47,62	6,27	3,78	12,83
$t_{1/2}$ eff. (min)				
Soman	5,88	1,31	10,09	16,24
Paraoxon	6,61	11,96	13,36	19,17

Figure 1: Influence of HI-6 on brain, diaphragmal and erythrocyte acetylcholinesterase activity in mice poisoned with soman

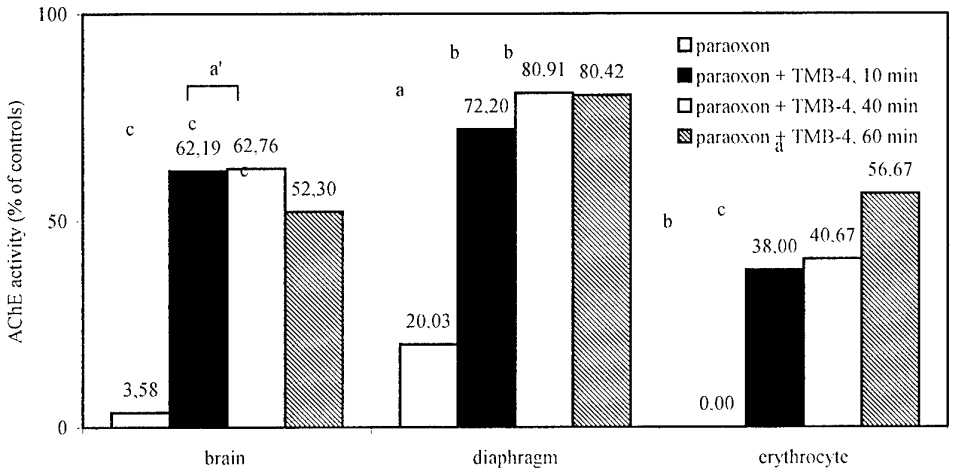
Figure 1.



a, b - $p < 0.05$, 0.01, significantly different from soman group
a' - $p < 0.05$

Figure 2: Influence of trimedoxime on brain, diaphragmal and erythrocyte acetylcholinesterase activity in mice poisoned with paraoxon

Figure 2.



a,b,c - $p < 0.05$, 0.01, 0.001, significantly different from paraoxon group
a' - $p < 0.05$

Table 2: Pharmacokinetic parameters of HI-6 and trimedoxime administered intravenously to mice

Parameter[a]	HI-6	TMB-4
Dose, mol/kg*	139,19	55,98
A, mol/l*	428,88	240,73
a, min^{-1}	0,0788	0,0773
$t_{1/2}$, min	8,79	8,96
B, mol/l*	34,56	8,71
b, min^{-1}*	0,0116	0,0064
$t_{1/2}$, min*	59,73	108,08
k_{12}, min^{-1}	0,0188	0,0191
$t_{1/2k12}$, min	36,9	36,3
k_{21}, min^{-1}*	0,0166	0,0089
$t_{1/2k21}$, min*	41,7	77,9
k_{13}, min^{-1}	0,0550	0,0557
$t_{1/2k13}$, min	12,6	12,4
AUC, mol/l min*	8421,9	4475,2
Cl_{tot}, l/min kg*	0,0165	0,0125
V_d, l/kg*	1,42	1,95
V_1, l/kg*	0,30	0,22
V_2, l/kg*	0,34	0,47

*$p < 0.001$a

Pharmacokinetic abbreviation used:
A - intercept of the distribution phase;
B - intercept of the elimination phase;
α - distribution rate constant;
b - elimination rate constant;
t1/2a - distribution half time; t1/2b - elimination half time;
k12 - rate constant of transfer from central to peripheral compartment;
k21 - rate constant of transfer from peripheral to central compartment;
t1/2k12 - half time of transfer from central to peripheral compartment;
t1/2k21 - half time of transfer from peripheral to central compartment;
k13 - rate constant of elimination from central compartment;
t1/2k13 - half time of elimination from central compartment;
AUC - area under the curve (0 to infinity);
Cltot - total body clearance;
Vd - apparent volume of distribution;
V1 - volume of the central compartment;
V2 - volume of the peripheral compartment.

41. TECHNOLOGICAL ASPECT OF REALIZATION OF A NEW CONCEPT OF CHEMICAL DISARMAMENT IN RUSSIA

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INTRODUCTION

In the middle of the year of 2000 the state customer of the Program of chemical weapon destruction was changed in the Russian Federation. It was caused by the fact that the functions, connected with the realization of the Program of chemical disarmament did not belong to the sphere of activity of the former customer, the Department of the chemical and biological protection troops of the Ministry of Defense of the Russian Federation. At present the responsibility for the realization of the Program under discussion is put upon the Federal Agency on ammunitions headed by Zinovy Pack.

At the present time this new state customer is changing the Concept, connected with the realization of the Program of chemical disarmament. A new Concept is directed to reduction of expenses for the Program realization. In connection with this fact the number of the chemical weapon destruction plants to be built is changed. The New Concept presupposes the construction of not more than three chemical weapon destruction plants. The alternative technologies for chemical weapon destruction are not going to be studied. The basic technologies, which are now in the process of thorough development, are going to be used.

As the number of the plants for chemical weapon destruction is planned to be reduced the expenses for the development of social sphere are going to be reduced as well. Despite of these advantages this new Concept presents certain risk connected with the necessity to transfer chemical weapons from the storages to the destruction facilities. In this case the transportation of chemical weapons will be performed over the distance equal to hundreds of kilometers through several densely populated settlements. As far as there is danger of terrorist acts under the present conditions in Russia the risk during transportation considerably increases.

Despite of this fact the presented approach under the present economic conditions seems to be quite justified. It precludes unnecessary expenses. In this paper certain technological aspects of realization of the new Concept in Russia are discussed.

DISCUSION

In Table 1 the general amount of chemical weapon in Russia and the sites of its storage are shown. From this table it can be seen that all the storage sites can be divided into three groups [1]. The first group includes the storages where chemical weapon containing blister-gases such as lewisite, yperite, yperite-lewisite mixtures are stored. They are settlement of Gorny (Saratovskaya oblast), and the town of Kambarka (the Udmurt Republic). At these storage site the poisonous substances are kept in stationary containers with capacity of several tons. The other two groups include the storage facilities where organic phosphorous substances such as sarin, zoman and V-gases are stored. These facilities represent air-forces bases and the poisonous substances there are kept in aviation shells, the mass of each shell makes up 200 kg. They are situated in the settlement of Maradykovsky (Kirovskaya oblast), the settlement of Leonidovka (Penzenskaya oblast), the town of Pochel (Bryanskaya oblast). At the other two bases that is in the settlement of Kizner (the Udmurt Republic) and the town of Shchuchye (Kurganskaya oblast), the chemical weapons are kept in artillery shells. This classification of chemical weapons according to their type and the way

of being stored will be taken into consideration when the decision will be made on what sort of facility should be constructed. If the facility is meant for blister-gases destruction it will differ from the others by the poisonous substances destruction technology. The difference between the other two will lie in the method of disassembly of the shells. This is a basic approach. However, as far as the technologies of organic phosphorous substance destruction have a lot in common, there might be only one facility constructed with the cycle including destruction and reaction mass neutralization. At the same time there is great difference between the amount of stored lewisite in the settlement of Gorny, which makes up about 200 tons of poisonous substances, and in the town of Kambarka, where there are about 6400 tons of lewisite. So there can be two facilities constructed for lewisite destruction. From what is said above it follows that the new Concept presupposes 2 or 4 destruction plants to be constructed.

Table 1. The general amount of chemical weapon in Russia and the sites of its storage.

Russian sites of CW storage	Type of Munitions	Type of Chemical Agents	Amount of CW (tons)
1.* Gorny (Saratovskaya obl.)	Bulk Containers	L, H, H-L mix	1160
2. Kambarka (Udmurt Rep.)	Bulk Containers	L	6360
3. Pochep (Bryanskaya obl.)	Air Delivered Munitions	GB, GD, Vx	6720
4. Leonidovka (Penzenskaya obl.)	Air Delivered Munitions	GB, GD, Vx	6880
5.* Maradykovsky (Kirovskaya obl.)	Air Delivered Munitions	GB, GD, Vx	6960
		L, H, H-L mix	800
6. Kizner (Udmurt Rep.)	Artillery Munitions	GB, GD, Vx	5680
7.* Shchuchye (Kurganskaya obl.)	Artillery Munitions	GB, GD, Vx	5440

General amount of CW in Russia - 40 000 tons
* - Possible sites for CW destruction in new Conception in Russia

CHEMICAL WEAPON DESTRUCTION TECHNOLOGIES

Lewisite. The new Concept precludes the development of the alternative lewisite destruction technologies, as it was thought previously [2]. The basic technology will be alkali hydrolysis [3], which has been better developed in comparison with any other one by the present time. But the problem of reaction mass utilization arises. The reaction masses present by themselves the solution of sodium chloride and arsenite. The process of arsenic electro-chemical reduction out of reaction masses [4] is not developed enough at present. There is the variant possible to vaporize the reaction masses till crystalline state [5]; and in this state the reaction masses may be stored till final treatment in the post-conventional time. It is also possible to utilize the reaction masses with arsenic sulphide and sodium chloride solution extraction, out of which caustic [6] can be received by electro-chemical method. To reduce the expenses on lewisite destruction it is possible to construct only one facility, which will have the complete cycle including utilization of reaction masses. At present the plant for lewisite destruction in the settlement Gorny is almost ready to be used, and in the year of 2001 it is planned to start the works on lewisite destruction. The question on the construction of the destruction facility in Kambarka is still under consideration. Right now the question of loading lewisite into transport-technological containers for further transportation is the only one, which is being under consideration.

Yperite. The yperite detoxification is planned to be performed with the use of the monoethanolamine and ethylene glycol mixture. The reaction mixture is going to be burnt [7]. The problem is that during this process there is a possibility of formation of such

toxicants as PCBs, PCDDs/Fs [8]. Therefore, strict attention should be paid to the special condition requirements of the process.

Yperite-lewisite mixtures. It is planned to melt these mixtures with sulphur and then to forward to the burial sites [7]. The main problem is safe burial of the wastes containing arsenic.

As far as yperite and yperite-lewisite mixtures are stored mainly in Saratovskaya oblast the facility for their destruction will be built there.

Organic phosphorous substance destruction. The Russian technology for destruction such organic phosphorous substances as sarin, zoman (which are according American classification GB, GD) presents by itself two-stage process; at the first stage at the temperature 110 C the interaction of reagent with monoethanolamine in the presence of water takes place [9, 10]. Then to the received reaction mass the mixture of bitumen and calcium hydroxide is added at the temperature of about 200 C, and this is the second stage. After cooling the product of the second stage hardens and the received material is called "bitumen-salt mass", which is supposed to be forwarded to the burial place, since it has been proved to belong to the IV class of danger it is possible to bury it at the polygon of burial of solid household wastes.

For V-gases destruction also the two-stage process is planned to be used. At the first stage the detoxification of these poisonous substances will be performed with the use of N-methylpyridilinon, kalium isobutylate and isobutyl alcohol mixture at the temperature of about 90 C. At the second stage the received reaction mass is added to hot bitumen and the process is conducted at the temperature of 180 C during 3- - 45 minutes. After the reaction is over the bitumen-salt mass is poured out of the reactor and cooled, it results in hard material, which can be also considered as belonging to the IV class of danger [10].

The second stages in the Russian technologies of organic phosphorous poisonous substance destruction puts forward a lot of questions: the process of bituminization followed by burial of bitumen-salt masses on special polygons, which will be located close to chemical weapon destruction facilities. Though these masses are classified as low-toxic substances, however it is known that during long-lasting storage bitumen matrix is destroyed after which various salts, including toxic substances can be washed out of it and penetrate into the environment, since according to some data [1] reaction masses after the first stage of the processes may be considered as belonging to the 1 class of danger. At the second stage final chemical weapon destruction is likely to take place, however it is not clear how toxicity of the formed substances can be lowered. It is possible that simple dilution of the first stage reaction masses with bitumen and reduction of their mobility because of formation of hard bitumen-salt matrix plays here a certain role. If at the second stage of sarin and zoman destruction the additional treatment with calcium hydroxide takes place, for V-gases destruction this is not done.

Then we can state that the toxicity of bitumen-salt masses during destruction of these substances can vary as well. The total amount of bitumen-salt masses is five or six times higher than the initial amount of poisonous substances. It seems that further use of these bitumen-salt masses is scarcely possible.

The alternatives to this technology or at least to its second stage might be certain thermal methods [11], burning [12], use of plasma [13]. It is connected with the fact that eventual treatment of the covers of chemical shells and containers where poisonous substances were held should be performed thermally. In this case the destruction technology of poisonous substances and the objects having been in contact with them will be performed within the framework of one and the same technological process, which can simplify

considerably the arrangement of works, and the amount of solid wastes will be significantly reduced as well.

As the second stage of the organic phosphorous substance destruction processes arise a lot of questions, it is quite possible that for realization of the conventional tasks only the first stage of the processes will be fulfilled. The received reaction masses will be stored and their destruction will take place only in post-conventional period of time. In particular, for this purpose the existing installations for damaged ammunition destruction KUASI can be used.

The organic phosphorous substance destruction facility is being built at the present moment in the town of Shchuschye. It is meant for destruction of the ammunition of barrel and reactive artillery. Probably, the chemical weapons stored in the settlement of Kizner will be transported to the town of Shchuschye for destruction, because Kizner chemical weapons are similar to the ones stored there. At present the question concerning air force bases elimination is not solved yet. In particular, the question of realization of the first stage of the process with the use of installation KUASI in the settlement of Maradykovky is being under consideration at the present moment.

The questions of safe transportation of chemical weapons

The problem of safe transportation of chemical weapons at realization of the new Concept is one of the most essential. Especially it is connected with the threat of terrorist acts. The case in Tokyo underground shows that on such an occasion the quantity of victims can be considerably larger, than in the case of terrorist act when chemical weapons are not involved [14], this might seem quite attractive for terrorists. If in Tokyo underground the self-made poisonous substance of low quality was used which led to death of comparatively small number of victims, in case if war chemical agents are used it may cause death of a great number of people. Taking into consideration that transportation of chemical weapons will be realized by the railroad transport, and they will be carried through the whole number of densely populated sites, such a threat is rather essential.

In connection with this problem it is necessary to consider the general approach to chemical weapon transportation. In fig. 1 the location of chemical weapon storages and the intensity of terrorist act occurrence in the present Russia are shown. From this figure it can be seen that the greatest intensity of terrorist acts takes place in western and southern part of European part of Russia. Thus, the general approach, reducing the threat of terrorist acts at chemical weapon transportation should be as follows: the directions of the routes of transportation in Russia should be from the West to the East and from the South to the North, since in this case the transportation of chemical weapons will be performed in the direction of the most quiet regions.

If we consider the existing facilities of storage of chemical weapons on the basis of which the destruction facilities are to be built according to the new Concept, then we can say that best of all this requirement is met by the facilities in Schuschye (Kurganskaya oblast) and in the settlement of Maradykovsky (Kirovskaya oblast) where organic phosphorous substances are being stored. In this case chemical weapon transportation from Udmurtia will be carried out to the East, and from Bryanskaya and Penzenskaya oblasts to the East and to the North. Therefore from the point of view of safe transportation it is quite reasonable that chemical weapon destruction plant is being built in the town of Schuschye, and the fact that some attempts to destruct chemical weapons in the settlement of Maradykovsky are being made seems to be reasonable as well. As for lewisite in this case the transportation from Udmurtia is supposed to be performed to Saratovskaya oblast, that means to the West and to the South. In this case the transportation is connected with a certain risk. Therefore, it is

necessery to consider the possibility of carrying out at least the first stage - detoxification of lewisite in Kambarka in order to transport only the reaction masses, which are much less dangerous in the case of a terrorist act.

Fig.1 The location of CW storages and the intensity of terrorist acts occurrence in the present Russia.

RUSSIAN SITES OF CW STORAGE

1.* Gorny (Saratovskaya obl.); 2. Kambarka (Udmurt Rep.).
3. Pochep (Bryanskaya obl.); 4. Leonidovka (Penzenskaya obl.);
5.* Maradykovsky (Kirovskaya obl.).
6. Kizner (Udmurt Rep.); 7.* Shchuchye (Kurganskaya obl.).

Intensity of terrorist acts:

- more then 10 incidents per year;
- less then 10 incidents per year;
, - territory without terrorism incidents

TRANSPORTATION OF CW

(2) $\longrightarrow$ 1* ; (3,4) $\longrightarrow$ 5*; (6) $\longrightarrow$ 7*.

* - Possible sites for CW destruction in new Conception in Russia

It is also necessary to consider certain technical question of transportation. The transportation of lewisite is to be carried out in special transport-technological containers, which are fire- and explosion-proof having the capacity of 1 cubic meter. In the old Concept it was supposed to use such containers for transportation of lewisite from the site of its storage to the destruction facility over the distance of 2 - 3 kilometers. Since according to the new Concept it is planned to transport over large distances, obviously we should reconsider technical requirements to the containers, which must be stricter. And it is obvious that the larger number of such containers should be made as the time of transportation will increase which means that the time of use of the containers will increase as well. The use of such containers for organic phosphorous substances arises certain questions. It is possible to use these containers for transportation of the artillery shells. In this case there is no need to disassemble them; they should be immersed into degassing solution. More complicated problem is transportation of substances from air force containers, which have the capacity of 200 kg of poisonous substances. In this case it seems more reasonable to carry out preliminary dissembling of the containers and to perform the first stage of neutralization. The reaction masses to be transported though having high toxicity are not chemical weapons any more.

MODERN SAFETY SYSTEMS

As we have mentioned earlier [15] at present in Russia there are no up-to-date safety systems, based on the use of computers, modern multi-channel means of communication and poisonous substance detection methods. For the new Concept the amount of such systems should be considerably enlarged. They should be created not only for the use at storage facilities but also for the places through which the chemical weapon transportation will be performed, especially for densely populated places. The mobile systems should be as well, which will move alongside with chemical weapons. The number of special groups of people responsible for safe transportation of chemical weapons must be increased. Besides, it is necessary to conduct special training course for the population of the towns through which the transportation will be carried out that people will have necessary skills for proper acting in case of chemical danger. Only these measures will reduce the threat of terrorist acts, technogenic and natural accidents, which can influence safety of chemical weapon transportation.

CONCLUSIONS

Despite of economic advantages offered by the new Concept on the chemical disarmament in Russia, there are still certain things, which must be considered in connection with safety of works on chemical weapon destruction and the threat of terrorist acts:

- The single safety system for transportation must be created, which will include the necessity of creation of safety systems at chemical weapon storages, at chemical weapon destruction facilities and at the places through which the transportation will take place; the number of groups of people responsible for safety and elimination of the consequences of accidents must be increased.
- It is necessary to make technical requirements to the transport-technological containers stricter and to enlarge the number of such containers;

- It is necessary to consider the possibility of carrying out the first stage of poisonous substance neutralization at a number of chemical weapon storages in order to make it possible to transport only the reaction masses.

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42. LIQUIFIED, TOXIC AND CORROSIVE GASES IN HAE`VILY POPULATED AREAS

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INTRODUCTION

Harmonization of the Croatian legislative with European directives on hazardous substances, and adoption of various international agreements and conventions such as APPEL program and Convention on Prevention of Transborder Transfer of Accident Sequences, have opened numerous problems related to the present situation with hazardous chemicals. One of such problems are risk facilities used for storage or use of gaseous toxins in densely populated areas. This presentation is limited to only two chemicals, chlorine and ammonia, as these are frequently found at high-risk sites. It is estimated that in Croatia, these two chemicals are found at more than 250 locations in amounts potentially risky for the population living close to the sites of their storage or usage.

The problem is not only where the chemicals axe found, but even more it is associated with the accident preventing measures, which as a rule are still quite inappropriate. In the Republic of Croatia, water disinfection is mostly done with chlorine, while ammonia is unavoidable in all large cooling systems (e.g., industry refrigeration plants and skating rinks). The facilities with chlorine and ammonia are generally located in densely populated areas of all Croatian cities, while the measures of accident prevention as a rule are quite poor.

METHODS AND RESULTS

The city of Zagreb with more than one million citizens is taken to exemplify the situation, emphasizing that the situation is identical in all other cities and towns in Croatia. At more than ten locations, chlorine is stored in amounts ranging from 150 kg to 2.5 t, while ammonia stores exceeding 5 t are found on at least ten locations. These data probably are not fully reliable, as these chemicals have occasionally been found at quite unexpected and poorly protected sites, sometimes even being forgotten. Two years ago, 300 kg of chlorine were detected in an old and abandoned pool for medical rehabilitation in a densely populated area of the city. In fact, it is difficult to find a site in the city of Zagreb, which has not been potentially endangered by either of the two chemicals in case of an accident due to any reason. An act of sabotage should by no means be ruled out, as it may provide an extremely efficient and simple way of causing damage or endangering human health.

The situation in the very center of Zagreb, i.e. in the residential area of Šalata, with a large sports complex with swimming pools, skating rinks and other sports facilities, may be taken as an example. These storage facilities have been flimsily built with poor protective and accident-preventing systems, while protection from a potential terrorist attack does not exist at all (as it does not exist in any other similar facility in Zagreb either). The two chemicals, chlorine and ammonia, produce a vigorous and explosive interaction, while each of them is extremely life- and health threatening. The chlorine storage has two 1000-kg chlorine containers situated right above a crowded and densely populated area.

Accident simulation with complete destruction of one of the chlorine containers in the present conditions of total absence of efficient measures for disaster prevention or disaster consequence reduction was performed, taking into account unfavorable weather conditions with a most common northeast wind of 2 m/s. In a densely populated area within 250 m from the site of accident, the risk of life would begin 2 minutes from the accident and would last for at least 30 minutes, when atmosphere concentrations would decline below those causing

death on the spot in those found outdoors. An area within at least b00 m from the storage would be highly endangered. Due to the high chlorine concentrations in the atmosphere, lethal chlorine concentrations would be reached indoors within the chlorine contaminated area of 250 m in a few minutes.

This means that at least 10,000 people would be at high danger, and hospital capacities of the city of Zagreb would be inadequate to provide care for such a great number of patients suffering from, e.g., lung edema due to chlorine exposure. On the same location, similar situation is also found with ammonia, especially so as the amounts of ammonia stored are considerably greater (about 7 t) than those of chlorine, and because the molecular mass of ammonia is at least half that of chlorine, thus yielding much greater volumes of gaseous toxin.

Furthermore, in case of chlorine the risk would be limited to lower floors and to the unprotected people on the streets. In case of ammonia accident, those found in upper floors of residential and nonresidential buildings within a wide area from the site of accident would also be involved. Locations of similar risk level are also found in other parts of the city of Zagreb as well as in all other regions of Croatia.

For example, chlorine storage of 300 kg is located at about 150 m above the Učka tunnel entrance, with the wind blowing in such a direction that it would drive chlorine into the tunnel for 70°!0 of the time during the year. Of course, before our intervention there was no plan of emergency action in case of an accident at the storage. Storages located at swimming pools highly frequented during summertime, poorly maintained and completely lacking any supervision have often been detected.

After all, the highest proportion of intoxication accidents has for years been recorded at swimming pools due to chlorine. On the other hand, it is petroleum products rather than chlorine that lead on our list of accident records.

DISCUSSIONS

Over the past year, in collaboration with sanitation department we embarked upon the study of risk locations with chlorine and ammonia storages, and attempted to set conditions for better accident prevention and regulations for procedures to reduce the consequences of such accidents. The following deficiencies were observed in a considerable number of such facilities:

a) poorly educated personnel and complete lack of their training in the procedures to be taken in case of accident;
b) lack of efficient plan of emergency intervention in case of accident or complete lack of any plan at all;
c) in most cases, inappropriate instructions (procedures elaborated in writing) that actually pose more serious threat than their nonexistence;
d) lack of a reliable burglary-proof system with alarm and telecommunication on increased storage concentrations of gaseous toxin;
e) lack of a system for limitation of accident consequences, e.g., hazardous substance neutralizers or water curtain device;
f) total lack of risk data in the local community, and especially on the procedures for health and life protection in case of accident; and
g) other (e.g., poor maintenance of liquefied gas containers).

All these factors increase the risk of accidents involving hazardous substances, with potential risk for human health within a certain area from the respective storage. We

considered proper education on the protection from toxins to be the primary and most important action in the country as a whole. A very ambitious plan of education was launched, and has still been under way. Most of those employed in the chlorine or ammonia storing facilities were included in the program of obligatory special education.

They still remains the problem of continuous training, which will probably be better solved by the development of mandatory intervention plans for prevention of accidents and reduction of their consequences. Intervention plans have been regulated as mandatory company documents by at least two acts, one from the field of health care and another from the field of environmental control.

The Croatian Institute of Toxicology is an institution authorized for the development and evaluation of intervention plans in the field of health care, thus being in a position to insist on improvement of the measures for accident prevention. Clear and properly written procedures for all activities during the work, accident prevention, and intervention in case of accident, first aid and decontamination, communication with all services in charge of intervention, notification and population protection, medical procedures in care for casualties, etc., have a crucial role.

Unfortunately, in a great number of cases, those in charge of these issues in the companies involved consider the development of written procedures mere formality. We started to collect and file such instructions to be able to point to the most common mistakes during education. Most serious mistakes were found in the first aid and decontamination procedures, as they would imply a threat to the life and health of the injured. For example, mucosal neutralization with acids is as a rule recommended on exposure to alkali.

Typical instructions for the procedures to be taken upon exposure to gaseous ammonia via respiratory system state that breathing should be done through a piece of cloth soaked in acetic acid, with similar instructions fox skin or eye decontamination upon acid or alkali spilling. Instructions for citizens on the procedures in case of accident with a gaseous chemical also are quite risky, especially when a decision on evacuation or confinement to airtight spaces is to be made.

We insist on mandatory simulation of the movement of a gaseous toxin cloud at most unfavorable weather conditions, which should be used as a basis to decide when and at what distance from the risk facilities particular population protective procedures should be performed. Of course, the population involved should be properly informed on the potential hazards in their neighborhood and on the modes of self-protection.

CONCLUSIONS

Besides education and clear procedures provided in writing, accident prevention includes many other factors. In addition to continuous and quality maintenance and service of the system, efficient prevention of uncontrolled entry in the facilities and telecommunication for all potential hazards such as attempted burglary or detection of gaseous toxin leakage within or outside the facilities are considered to be of utmost importance.

Development of neutralizers appears to be appropriate in case of usual liquefied gas evaporation on pipeline or valve accidents, however, various other possibilities should be anticipated for so-called worst cases when any neutralizer would turn inefficient. In such cases, responsible persons and services should be promptly notified, at the same time trying to buy some time and to prevent immediate release of all the amounts of liquefied gas, thus to be able to warn and protect the population on time.

We insist that each facility presents a specific case, and that all possible modes of delaying the development of the worst case should be carefully studied. For example, we have estimated that the best solution for the ammonia container at a skating rinks in Zagreb

would be the construction of a collecting basin under the ammonia container with hermetization of all outlets in the main engine-room of 1800 m3, except for one outlet on the building in front of which a device for preparation of a highly efficient water curtain should be mounted. In some other facility with another toxin, the situation would be different, pointing to a conclusion that each risk site should be approached individually on assessing the hazards and determining the measures for risk reduction.

Therefore, we presume that the initiated activities on the development of individual intervention plans for risk facilities in Croatia will take several years. However, most important of all is to change the awareness of those employed in risk facilities, and this issue should be paid most time and attention indeed.

KEYWORDS
Chlorine, ammonia, accidents, worst case

43. THE ZEOLITES AS SKIN DECONTAMINANTS AGAINST NERVE AGENT SARINE IN VIVO

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Keywords: Zeolites, Sarine, Skin decontamination

INTRODUCTION

Zeolites are natural or syntetic aluminosilicates with molecular structure in shape three – dimensional net. They have ion exchange and adsorption of active behevioural efficiency.

For this study mixture of zeolites **the KW** (code Name) preparing special procedure is used. Theirs possible decontaminations' properties against sarine tested on a mice model with monitoring of vital functions and surviving.

MATERIALS AND METHODS

Mice (NOD strain) were shaved before contamination and contamination were practising by skin of back applications solution sarine in isopropanol (c=100 mg/l). (5)

The dose of that solution for mice p.c. application got by the equotion 1 (6):

$$\mathbf{d = D \times m / c} \qquad (1)$$

where is
d - the dose which applies (ml)
D – the dose per kg mice (μg/kg),
m (mass mice) = 0,03 kg,
c (concentration of solution) = 100 mg/l

First dose of p.c. sarine solution in isopropanole application was due to limit of reliability of LD_{50} took little less then literature one (6), and this is d=0,240 ml per mice (this is D=796,29 μg/kg). Next doses were growing by geometric factor 1.26.

Lethal dose (LD_{50} p.c. sarine) was calculated by tables and equotion 2 (6). For calculation lethal dose LD_{50} (p.c. sarine) is applied 4 doses (μg/kg) : 915.15; 1153.06; 1452.86; 1830.60 and number died of mice per every dose (N): 2, 3, 3, 6. Factor f was calculated of number of died mice and tables (6).

$$\mathbf{\log LD_{50} = \log D_A + \log G_f (1+f)} \qquad (2)$$

where is
D_A (first effective dose) = 915.15 μg/kg
G_f (geometric factor) = 1.26
d = log G_f = 0.1004
f = 0.2500

95% limit of reliability (L_R) was calculated by equotion 3:

$$\mathbf{\log 95\%\ L_R = \log LD_{50} \pm 2d \times q\ \sigma} \qquad (3)$$

where is
σ - factor for N (2,3,3,6) from Weil's tables (6)

After contamination by doses (μg/kg): 1452.86; 1830.60; 2306.56; 2906.26; 3661.89 and 4613.98, decontamination was done immediately of the **KW**.

For a calculation LD_{50} (p.c. sarine) after decontamination by this mixture of zeolites are aplied doses (μg/kg): 2306.56; 2906.26; 3661.89; and 4613.98 by **equotion 2**.

Terapeutic effect was calculated by equotion 4:

$$\text{T.E.} = \frac{\mathbf{LD_{50}(with\ decontamination)}}{\mathbf{LD_{50}(without\ decontamination)}} \qquad (4)$$

All survival animals from experiment were returned in cages, in conventional conditions, and their survive were monitoring in next 24 hours.

RESULTS

For the purpose of this experimental work, we determined the lethal dose of sarine **percutaneous LD_{50} (p.c. sarine) = 1208,37 μg/kg** for this strain of mice. (5,7)

The mice that were decontaminated by the **KW** survived **3.03 LD_{50}** (circa three lethal doses) of sarine p.c. (4)

95% limit of reliability (95% L_R) for LD_{50} (p.c. sarine) is **945.60 – 1544.00 μg/kg,** what is in limit of literature data. (7)

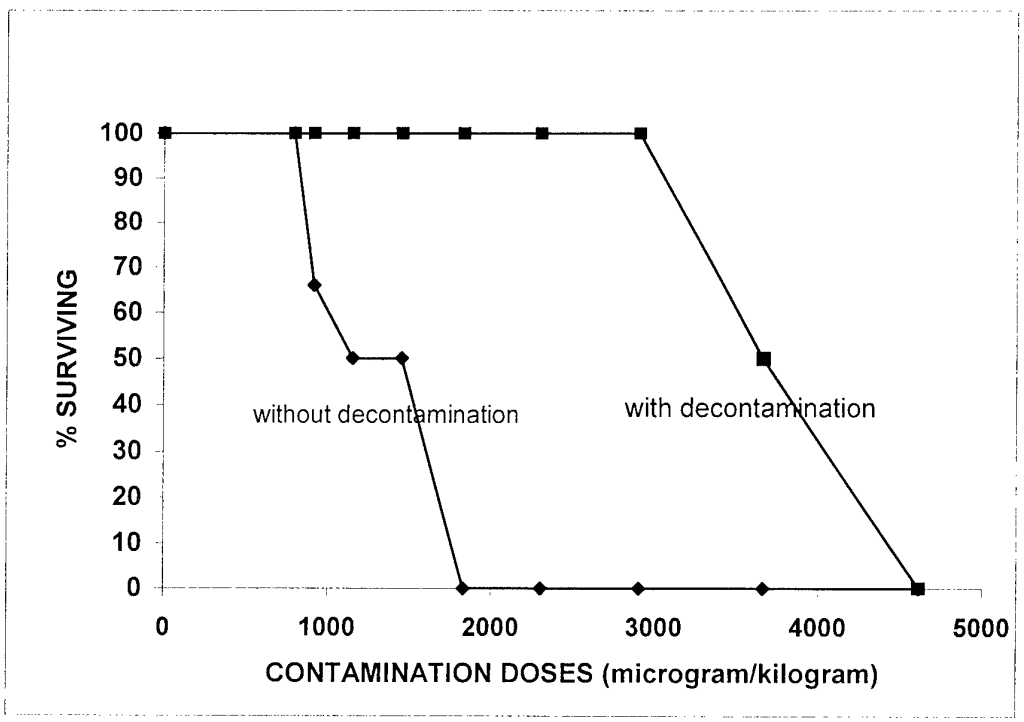

Figure 1: Surviving mice of contamination (solution sarine) with and without decontamination

CONCLUSIONS

The preliminary results show that it is possible to use **the KW** to skin decontamination sarine efficiently.

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44. AN INTEGRATED APPROACH TO SOUND MANAGEMENT OF CERTAIN "MULTIPURPOSE" CHEMICALS AND DUAL-USE MATERIALS IN CROATIA

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ABSTRACT

Croatia is a country experiencing economic and post-war reconstruction. Being a Central-European, Mediterranean and South Eastern European country, Croatia is neighbouring the still unstable part of Europe.

Its chemical industry is widely diversified, and it is predominantly dependent on the imported raw materials, mostly chemicals. Croatia is also rapidly developing its tourism and transport industry as important economic sectors.

To strenghten the security in the widest sense, especially to prevent global crime and terrorism, as well as improve its integration into global economy, Croatia has signed numerous international agreements that regulate the control and handling of certain (multipurpose) goods and chemicals (Chemical Weapons Convention/CWC/, Montreal Convention etc.). In addition, Croatia is very active in finalising the work on entering into several others (Rotterdams /PIC/Convention) or participate very active in preparing, for example, Stockholms /POPs/Convention, Protocol of BTWC.

In order to enable it to fuffill its international obligations in a timely and professional manner and adopt an integrated, more efficient and transparent approach to the sound management of chemicals, Croatia should revise its national implementing legislation and institutional organization, as current administrative and executive potential as well as financial strenght are limited.

The paper illustrates existing practices as well as discuss options for future work.

KEY WORDS

Chemical industry (wide diversification of production and products), prevention of global (universal) crime and terrorism, international agreements, national implementing legislation, sound management of certain "multipurpose" chemicals

45. PROPOSED MEASURES TO REDUCE HUMAN SUFFERING AFTER TERRORIST ATTACK: LESSONS FROM THE 1998 BOMB BLAST OF THE AMERICAN EMBASSY BUILDING IN NAIROBI, KENYA.

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ABSTRACT

The bomb blast, which rocked the US Embassy building in the center of Nairobi City, was executed by terrorists associated with Osama Bin Laden on 7th August 1998. Detailed account of what happened after the blast has been given by Mathenge et al, 1998. In this paper, lessons learnt after three years since the blast took place have been assessed. The review of the impacts of the blast provides good background for the assessment. Footprints of the blast since 1998 have been identified, thus setting stage for detailed assessment of the lessons learnt. Although the lessons call for urgent national action to counter future disasters, a number of constraints for such an action have been identified. In conclusion, the paper proposes recommendations for cost-effective way forward to ensure that Kenya is more prepared for any future disaster than it was in 1998.

1. INTRODUCTION

The bomb blast that devastated the American Embassy in Nairobi, Kenya, on 7th August 1998 was one of the worst disasters ever experienced in Kenya. The local limited resources could not cope with the disaster, and as such, international assistance had to be sought.

In this paper, the lessons learnt may be traced along the following key issues: Impacts of the bomb blast, foot prints, as well as national constraints and their results. Despite the observed constraints, Kenya has a lot of potential to ameliorate some of the sufferings resulting from such a calamity. These have been depicted in the proposed way forward.

2. IMPACTS

The bomb blast did not only adversely affect the lives of Kenyans, but it also affected other nationals; assets such as buildings, vehicles and other equipment; jobs; psychology of people; and relations between Kenya and other countries.

2.1 Lives: According to Mathenge et al, (1998), a total of 257 people including 12 American nationals who were members of the American Embassy died on the spot and more than 5000 people were injured. It is believed that a number of those who were injured may have died, but the figures are not available for this paper.

2.2 Assets: A seven floor Ufundi House which was located a few meters from the American Embassy collapsed into rubble, trapping most of the dead people. The American Embassy, the Cooperative Building and many other buildings within a radius of 150 meters from the American Embassy suffered structural failure and almost all the windows were shattered and grilles and frames were twisted into mangles (Mathenge et al, 1998).

A lot of vehicles including buses and cars, which were nearby at the time of the bomb blast, were torn into pieces and others were tossed a number of meters from the roads they were traveling on. Such impacts on vehicles claimed a lot of lives. A lot of plants and

equipment installed in affected buildings, worth millions of Kenya Shillings were damaged beyond repair.

2.3 Jobs: Many jobs were lost as a result of the destruction of the infrastructure on which people relied for jobs and as a result the number of job seekers and the sense of helplessness increased significantly in Nairobi City. Consequently the situation adversely affected the lives of the dependants of the people who lost their jobs.

2.4 Relations: The bomb blast exacerbated the tense relations that exist between the American Government and the terrorist groupings. This was demonstrated by the missile destruction of a chemical plant in the Sudan by American authorities. Today some of the members of the terrorist group that carried out the blast are undergoing trial in the United States and others are still on the run. As a result the groups associated with Osama Bin Laden have vowed to retaliate; and for sometime, the American and Kenyan embassies abroad were put on full alert.

3. FOOT PRINTS

Three years since the bomb blast, the year 2001 continues to witness a number of footprints of the blast, which include among others:

3.1 People

Although those who are not related to the dead and the maimed may have forgotten the incident, the relatives have lived with anguish in their memories and hearts because the dead and the maimed might have been the only bread winners of the family; or their lost contribution to the family in many ways may have left a gap which may be difficult to seal.

The disabled people in hospitals or at homes may not enjoy their normal life any longer and their struggle for a living has been exacerbated. Those who take care of the disabled have forsaken more important economic activities and thus they do not suffer less. It is even worse for those whose relatives are in hospitals as the bills are raising to proportions, which may not be met at the family, level but will require external donations or borrowing.

3.2 Assets

Buildings that collapsed like Ufundi House, including the equipment in it, as well as the nearby vehicles were a total loss to the owners. Some owners who may have insured their property may have been compensated but those who had not may have been reduced to beggars.

Although the shells of the American Embassy building and the nearby buildings remained, the cost of pulling down the embassy building and rehabilitation of the neighboring buildings was colossal. It is obvious that although the buildings may be rehabilitated to some extent, their original strength may not be restored and any other future calamity may not spare them.

The site has already been converted into a memorial park, where relatives of those who died lay wreaths, on the 7th of August every year, in memory of those who lost their lives in the bomb attack.

4. LESSONS

A lot of lessons were and continue to be learnt after the US Embassy bomb blast in 1998. Some of the main lessons include, but not limited to the following:

4.1 Preparedness:

It is noted that terrorist attacks may be very difficult to detect, considering that the American Embassy building was then one of the well equipped with modern detectors, yet the bomb could not be detected in time. This is an indication that other installation could be more vulnerable in terms of detecting impending disaster. Good examples include the Kyanguli Secondary School where fire caused death of 67 students (Daily Nation, April 4, 2001); the Kenya Oil Refinery fire of early March 2001; Gikomba Market and Freemark Market fire in late 2000 and early 2001. In the latter installations, no loss of life was reported but property worth millions of Kenya shillings was lost.

4.2 Rescue:

Massive destruction such as the one that took place after the bomb blast proved to Kenyans that the national capacity was too limited to cope with the phenomenon effectively; and thus international support was needed such as specialized and experienced personnel, equipment, coordination, supplies and transport.

4.3 Recipient Institutions:

The hospitals where specialized treatment for victims of the bomb blast could be offered and mortuaries had limited capacity and makeshift arrangements were required. Doctors and paramedical staff were also limited despite the effort of recalling many from leave. The staff had to work over long hours under difficult conditions. The supplies were too limited for the demand and the international community had to intervene (Mathenge, et al, 1998).

4.4 Other Post-Rescue Activities:

Many other activities took place after patients were put in hospitals and dead bodies were placed in mortuaries. These included, among others: -

- A disaster committee was set up to coordinate all the post-rescue activities.
- Counseling of patients and families that had lost their beloved ones was carried. Some of the exercises lasted for a short time while some took many months, depending on the case at hand.
- Assistance to families who had either patient in hospital or lost their beloved ones was offered in terms of waiver of hospital bills or funeral costs.
  Two years later the bomb blast site was change into a memorial park where the families of those who died could hold memorial meetings for their loved ones.

5. CONSTRAINTS

The foregoing events were and remain too painful to Kenyans to be forgotten so soon, and no Kenyan would like to be exposed to such events. Every Kenyan would therefore, like to see a situation whereby we have clear national policy on disaster and established mechanisms for preparedness and tools to counter such events if they ever happen.

However, it has not been easy for Kenya to develop such preparedness mechanisms due to a number of constraints, which include, among others:

5.1 National Economy:

The Kenya national economic status has been relatively poor since 1997, partly because of poor response of foreign donors to Kenya support for socio-economic development. This has resulted in a reduction of national expenditure with provision for only essential services and goods.

5.2 Poverty Reduction:

The level of poverty has increased for the past decade and it is the national policy to counter the trend by trying to allocate sufficient funds for poverty reduction. The pre-occupation in poverty reduction has left little room for such national concerns as disaster preparedness.

5.3 El Nino and Droughts:

The El Nino of 1997-1998 and the subsequent drought of 1999-2000 brought about damage of infrastructure and loss of crop resulting in famine in most parts of Kenya. The famine resulted in heavy national investment on food imports and supply. This situation significantly affected the general national allocation of resources to disaster preparedness and as a result the country lacks the capacity to address major disasters at the moment.

5.4 HIV/ AIDS:

The impact of HIV/AIDS on the social-economic development cannot be over emphasized. Employers are losing workers in the, the latter being in their most productive years. At the home front, parents are dying young, leaving behind dependent children. The Government is therefore allocating the part of the scarce resources to control and prevention of the pandemic.

Despite the aforesaid constraints it is worth noting that Kenya has learnt a lot about the bomb blast, which must have enhanced the country's efforts to support the Disaster Management Committee. The Committee is currently developing strategies for the formulation of the national disaster management policy. When the policy is in place it will set the stage for more focused mechanisms for addressing disasters in Kenya.

6. RECOMMENDATIONS

It will be appreciated that disasters do not wait until a nation is able to address them before they strike. After a disaster like the bomb blast strikes, there is urgent need for concerted effort for preparedness otherwise the subsequent disaster will have a more adverse effect as the nation is caught up in a more vulnerable position from the earlier disaster.

The country needs all the resources including funds and trained manpower to embark on preparedness. In this regard, the following recommendations are proposed for Kenya, as they do not call for heavy capital outlay, yet when implemented, they can place the country in a better preparedness position than before.

- Maintenance of under utilized equipment and space in hospitals, mortuaries, armed forces and charitable organizations.
- Awareness creation for personnel in large vulnerable facilities such as chemical plants, airports and water treatment plants. The awareness should involve drills and regular moke evacuation.
- Training for personnel in large facilities including alertness, handling of safety equipment such as alarms and extinguishers, use of escape routes and efficient rescue in the event of an emergency. Armed forces should be targeted for such training.

- Establishment and implementation of construction codes which provide for efficient escape routes and warning gadgets for imminent disasters.
- Cooperation between the local and international agencies who can supply goods, services and personnel should be nurtured through regular consultations and assessment of available capacities.
- The Government of Kenya should be fully supported by everyone in its efforts to sustain the Disaster Management Committee and to make the necessary budget allocation for national disaster management.

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46. R.A.P.I.D. - PCR (LightCycler) IN DIAGNOSIS OF BIOLOGICAL AGENTS

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ABSTRACT

Although the historic use of biological weapons has been infrequent, a belief that state sponsored armies or terrorist organizations will use this type of weapon has never been greater which demands a capability for rapid medical response and early intervention. Molecular diagnostic methods, based on DNA amplification known as PCR (Polymerase Chain Reaction) are promising tools in fast and specific detection and identification of biological agent(s).

The R.A.P.I.D.™ - PCR (Ruggedized Advanced Pathogen Identification Device) (fig.1), is a 32 sample capacity, automated instrument integrating Idaho Technology's LightCycler® technology into a portable, impact resistant package. This allows field identification of pathogens quickly. Monitoring the fluorescence from the double-stranded DNA dye SYBR® Green (fig.2), followed by differentiation of products by melting curves or from TaqMan® probes (6-FAM-oligo-TAMRA), allows inexpensive quantification of low initial template copy number. Cycle sequencing reactions done in the thermocycling module of the R.A.P.I.D. system are faster, cleaner and more readable than parallel reactions done in a conventional heat block cycler. The use of air as the cycling medium ensures temperature uniformity and rapid heat exchange with the sample loaded in thin micro-capillary tubes, which are ideally suited to temperature cycling, because of their extremely high surface area to volume ratio. A conventional PCR protocol takes up-to 3 hours to do 30 three-temperature cycles. The R.A.P.I.D. system can complete a 40-cycle reaction in less than 20 minutes (6 to 30 min.). This makes R.A.P.I.D. system the fastest thermal cycler in the world. The United States Air Force has developed over 50 assays for infectious agents on the R.A.P.I.D. system. Assays for infectious agents typically consist of two temperatures cycling for 40 cycles. Protocols for isolation of bacteria and viral DNA (or RNA) have been developed for clinical specimens, air samples and water samples. Protocols for food samples are being developed now. Assays in use for: *Bacillus anthracis, Yersinia pestis, Clostridium botulinum, Staphylococcus aureus, Francisella tularensis, Salmonella, Shigella, Vibrio cholerae, E. coli, Campylobacter, VEE, West Nile, Yellow Fever, Brucella spp., and many others.* The continuing effort and advances in testing design make this capability an asset for Army Commanders and Medical facilities alike.

INTRODUCTION

Of all weapons of mass destruction, biological weapons (BW) today present the greatest danger (1). Although the historic use of BW has been infrequent, a belief that state sponsored armies or terrorist organizations, groups or individuals, will use this type of weapon has never been greater which demands a capability for rapid medical response and early intervention (2). Approximately 17 countries, (including five implicated as sponsors of international terrorism), may have active research and development programs for BW (3). Protecting the armed forces against BW, is less difficult than protecting the civilian population. The armed forces are relatively small populations that can be vaccinated against the major threat agents. Aerosols containing biologic materials can be detected at a distance,

and protective masks and suits are effective. Military medical personnel are trained to recognize and treat casualties. The civilian population cannot be protected in the same manner as the armed forces. Terrorist organization may not be deterred, may evade detection and may succeed in releasing an aerosol of a virulent biological agents (BA) in a susceptible target area (4). The number of false alarms and hoaxes involving BA keeps increasing and cost societies a lot. The economic impact of bio-terrorist attack can range from $477.7 million per 100.000 persons (exposed to brucellosis scenario) to $26,2 billion per 100.000 persons (exposed to anthrax scenario) (5). Unusual outbreaks of illness might be essential suspicion in recognizing of deliberate releasing of a biological agents (6). The specter of potential BA is well known and includes: anti-human, anti-plant and anti-animal agents(7,8). There are many potential anti-human BA: I. Bacterial agents: *Bacillus anthracis, Brucella spp., Vibrio cholerae, Yersinia pestis, Francisella tularensis, Salmonella spp, Shigella spp,* II. Viruses: *Variola major,* Filoviruses and Arenaviruses, III. Rickettsiae: *Coxiella burneti*, III. Biological toxins: Botulinum, Staphylococcal enterotoxin-B, Mycotoxins. Certain agents incapacitate, whereas others kill (up to 90% mortality rate) (3). Routes of infection could be: respiratory (aerosols as most effective delivery method), skin and gastrointestinal (food, water).

Rapid response to BW attack depends on rapid identification of BA that includes different methods such as: immunofluorescence assay, enzyme-linked immunoassay, immunochromatographic assay and Nucleic acid detection.

METHOD AND DISCUSSION

Molecular diagnostic methods, based on DNA amplification known as PCR (Polymerase Chain Reaction) are promising tools in fast and specific detection and identification of biological agent(s). PCR is a technique for the *in vitro* amplification of specific DNA sequences by the simultaneous primer extension of complementary strands of DNA (9).

The R.A.P.I.D.™-PCR (Ruggedized Advanced Pathogen Identification Device) is a 32 sample capacity, automated instrument integrating Idaho Technology's LightCycler® technology into a portable, impact resistant package. This allows field identification of pathogens quickly. The R.A.P.I.D. system is capable of automatically analyzing samples for the presence of any nucleic acid sequence, collect the data, interpret the test data and report the results. Automatic pathogen detection can be done in either "Batch" or "Screen" modes. Batch mode allows to test multiple samples for a single pathogen (two positive and two negative controls, and 28 unknown samples for given organisms). Screen mode allows testing for multiply organisms in a single run (two positive and two negative controls, and four unknown organisms, per test).

Monitoring the fluorescence from the double-stranded DNA dye (SYBR® Green) followed by differentiation of products by melting curves or from TaqMan® probes (6-FAM-oligo-TAMRA,), allows inexpensive quantification of low initial template copy number. The fluorescent dye binds to the minor groove of the DNA double helix. In solution, the unbound dye exhibits very little fluorescence. The dye is very stable, only 6% of activity is lost during 30 amplification cycles. At the beginning of amplification, the reaction mixture contains the denatured DNA, the primers and the dye. The unbound dye molecules weakly fluorescence signal which is subtracted during computer analysis. After annealing of the primers, a few dye molecules can bind to the double strand. DNA binding results in a dramatic increase of the dye molecules to emit light upon excitation. During elongation, more and more dye molecules bind to the newly synthesized DNA.

Cycle sequencing reactions done in the thermocycling module of the R.A.P.I.D. system are faster, cleaner and more readable than parallel reactions done in a conventional heat block cycler. The use of air as the cycling medium ensures temperature uniformity and rapid heat exchange with the sample loaded in thin micro-capillary tubes, which are ideally suited to temperature cycling, because of their extremely high surface area to volume ratio. A conventional PCR protocol takes up-to 3 hours to do 30 three-temperature cycles. Thermal cyclers generally use micro centrifuge tubes or modified microtiter plates. These plastic containers insulate the sample. The temperature of a 100 μl sample within a microcentrifuge tube lags 20-40 sec. behind the block temperature. This, combined with sluggish temperature ramp rates of heating blocks, explains why they are so slow.

The R.A.P.I.D. system can complete a 40-cycle reaction in less than 20 minutes (6 to 30min.). This makes R.A.P.I.D. system the fastest thermal cycler in the world. Rapid cool-down (up to 20 °C/sec) favors the kinetics of primer annealing over the thermodynamic advantage of product re-annealing. This in turn yields a higher final concentration of product. The most important benefit of rapid cycling is cleaner product. Rapid cycling leaves less time for primer extension at non-specific annealing. The amount of nonspecific product is directly related to the time spent at low temperatures.

There is another major factor - temperature holds times. A common protocol for temperature cycling is 1 min at 94°C, 2 min at 55°C and 3 min at 72°C. Even if instantaneous temperature transitions were possible, one cycle would take 6 minutes. The actual enzymatic extension occurs in about 10 seconds for a 500 bp fragment. This leaves 97% of the total time wasted, not even counting ramp time. These machines are waiting for steady-state conditions to bring all the samples to roughly the same temperature. Unfortunately, because of the geometry of the heating elements and metal blocks, even the steady-state condition may not produce uniform temperatures across all samples. The R.A.P.I.D. uses micro-capillary tubes or thin walled microcentrifuge tubes, which are ideally suited to temperature cycling since they have very thin walls and extremely high surface area to volume ratio. Capillary tubes cut sample temperature lag to less than a second. The use of air as the cycling medium results in high temperature ramp rates. Tornado-like conditions inside the cylindrical reaction chamber ensure both temperature uniformity and rapid heat exchange with the sample. This allows the R.A.P.I.D. to spend less than one second at the high and low temperatures and still be certain that each sample has reached the target temperature. A fraction of a second adequate for the reaction.

The United States Air Force has developed over 50 assays for infectious agents on the R.A.P.I.D. system. Assays for infectious agents typically consist of two temperatures cycling for 40 cycles. Protocols for isolation of bacteria and viral DNA (or RNA) have been developed for clinical specimens, air samples and water samples. Protocols for food samples are being developed now. Assays in use for : *Bacillus anthracis, Yersinia pestis, Clostridium botulinum, Staphylococcus aureus, Francisella tularensis, Salmonella, Shigella, Vibrio cholerae, E. coli, Campylobacter, VEE, West Nile, Yellow Fever, Brucella spp., and many others.*

CONCLUSIONS

- The R.A.P.I.D. system, as a fully automated, molecular diagnostic method, based on nucleic acid amplification and detection, is a promising tool in rapid identification of biological agents, which is essential for rapid response to BW attack.
- The continuing effort and advances in testing design make the R.A.P.I.D. system an asset for Army Commanders and Medical facilities alike.

Acknowledgements

I would like to thank Idaho Technology and especially to Todd Ritter,IT co-director, for providing the R.A.P.I.D. system and their support to participate to the World Congress on Chemical and Biological Terrorism, Dubrovnik, Croatia, 22-27 April, 2001.

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FIGURES AND TABLES

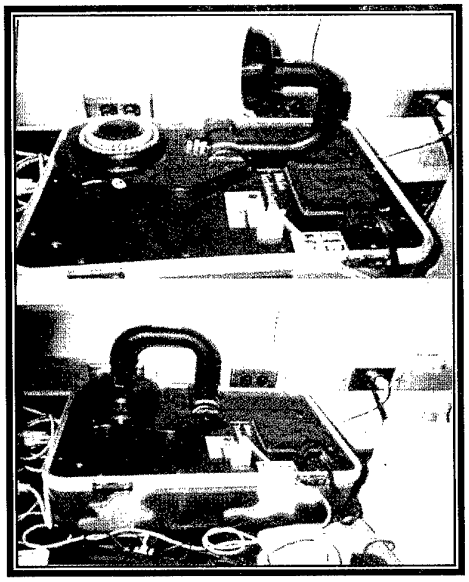

Fig.1. The R.A.P.I.D. system

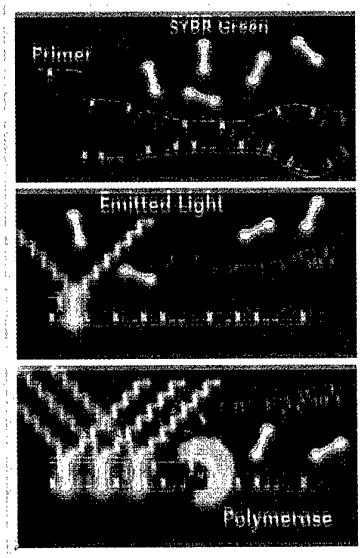

Fig. 2. Fluorescence

47. ANALYSIS OF CWC-RELATED COMPOUNDS IN A RUBBER SAMPLE

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ABSTRACT

Chemicals listed in the CWC schedules have been analysed from a rubber sample.

The sample was prepared and analysed using the Recommended Operating Procedures developed at the Finnish Institute for Verification of the Chemical Weapons Convention (VERIFIN). The spiked rubber sample and a corresponding blank were submitted to sample preparation procedures involving acetone extraction for direct analysis of non-polar compounds and acetone extraction followed by derivatization for analysis of polar compounds. Water extaction and subsequent derivatization were also performed for analysis of the polar compounds.

Then the samples were screened by two gas chromatography techniques with non-selective (FID) and selective detectors (NPD, FPD). First identification of spiked chemicals was based on the Retention Index Monitoring (RIM) method.

For each identified chemical, analyses were performed with at least two spectroscopic methods, in accordance to the OPCW rules: GC/EI-MS, GC/FT-IR and/or NMR. The analysed compounds were schedule 1 and schedule 2 chemicals and degradation products or by-products of some of them: O-Isopropyl methylphosphonofluoridate (Sarin), bis(2-chloroethylthioethyl)ether (O-Mustard), bis(2-chloroethyl)sulfide (Mustard gas), ethyl isopropyl methylphosphonate, isopropyl methylphosphonate and methylphosphonate.

(This paper was not presented)

48. CHANGING FACE OF GLOBAL TERRORISM

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ABSTRACT

Systematic manifestation of terrorism did not appear until the French Revolution and became pronounced in later part of the 19th century. Since then, terrorism has been continuously changing due to social, political and technological developments. Contemporary terrorism is widely different than its forebear.

Yesterday's terrorists could be vividly identified with legendary organizations possessing distinct hierarchical structure, well-defined command and control links and clear objectives. Their motivation could be unconvincing but their ideology and intentions were comprehensible.

Today, with less cohesive organizational structure and ambiguous objectives, terrorists' interest lies in the act of terror rather than the identity of the victim, leaving investigators befuddled and governments guessing. The bombing of US embassies in Tanzania and Kenya is a case in point.

Unchecked proliferation of sophisticated weaponry, secure communication, global transport network - once domains of sovereign states – have enhanced lethality of terrorist attack manifold. Societies having ethnic, cultural or religious conflicts; poor economies; weak governance and porous borders, are becoming fertile nurseries for the growth of terrorism.

Incidents such as the World Trade Center collapse, Oklahoma bombing and Tokyo Subway incident epitomize a trend away from constrained violence. Emergence of strong extremist groups, pursuing single issues, is also noticeable. Still growing in size, their methods may be appalling but their cause is appealing.

Though technology favors contemporary terrorism, sophisticated computer network and terrorist-related databanks permit intelligence gathering. States can share intelligence and cooperate for anti-terrorist activities more effectively.

With hardened targets becoming less cost effective, terrorists' preference is shifting towards softer targets. Property, business and industry may become the main focus of international terrorism followed by the diplomatic, government and military premises.

Effective countermeasures are possible only when we understand the current threat posed by the terrorism and its probable trend in the foreseeable future. There is an urgent need to arrest the deplorable situation before the world community becomes hostage to this ever-growing menace.

KEYWORDS

Terrorism trends, counter terrorism.

(This paper was not presented)

49. EVALUATION OF ANIMAL AND PLANT PATHOGENS AS TERRORISM AND WARFARE AGENTS, VECTORS AND PESTS

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INTRODUCTION

Animal and plant pathogens as a biological terrorism or warfare agents have the capacity to cause disease and potentially be used to threaten animals and staple crops. From a social-economic and significant adverse human health impacts, animal and plant pathogens must be evaluated and prioritized. This paper describes two methods of evaluation of animal and plant pathogens as terrorism and warfare agents and can serve as the basis for scientific discussion and as help on defining the list of biological agents and toxins in relation to BTWC. This paper also discuses and shows the main vectors that can be used as a terrorism delivery system or biological agents in hostile activities. The main pests that include the invertebrates such as insects and arthropods with potential terrorism and military use will be presented.

High level of dissemination is criterion we used in evaluation of animal and plant pathogens. High level of dissemination or large-scale contamination or cover a large area as aerosol for respiratory exposure plays the main role in evaluation of particular animal agent. One of the main criterions for evaluation of animal and plant pathogens is that are known to have been developed, produced or used as weapons. The second very important criterion is that agents have severe socio-economic and significant adverse human health impacts to be evaluated against a combination of the following criteria: high morbidity and mortality rates; short incubation period and difficult to diagnose or identify at an early stage; high transmissibility and contagiousness; lack of availability of cost effective protection and treatment; low infective dose; stability in the environment; and ease of production. The criteria we use today for evaluation of the animal and plant biological agents are based on the characteristics of the outbreaks of infectious diseases in "natural form". Genetic engineered and modified bacteria and viruses present a difficult problem. In the criteria should be inserted new characteristics of bacterial and viral strains enhanced for infectivity, transmissibility, virulence and antibiotic resistance. As biological terrorism or warfare agents, animal and plant pathogens have the ability to cause disease, which could be used to threaten animals and staple crops. From a viewpoint of social-economic and significant adverse human health affects, animal and plant pathogens must be evaluated and prioritized as possible threats.

This paper describes two methods of evaluation of animal and plant pathogens as terrorism and warfare agents and can serve as the basis for scientific discussion and as help on defining the list of biological agents and toxins in relation to BTWC. This paper also discusses the pests and main vectors that can be used as delivery systems. These include the invertebrates, such as insects and arthropods.

MATERIALS AND METHODS

The criteria we used for evaluation of animal and plant pathogens, vectors and pests we compiled from several sources: criteria for selection of biological agents used for negotiations in Ad-hoc Group of states-parties of BWC, the Australia Group, the Centers for Disease Control and Prevention, Food and Agriculture Organization (FAO) and International Office of Epizootics (OIE). Rankings of animal and plant pathogens, vectors and pests as potential warfare and bioterrorism agents are shown in tables. As a result of evaluation we

finally present lists of animal and plan pathogens, vectors and pests as warfare and terrorism agents.

CRITERIA FOR ANIMAL PATHOGENS AS BIOLOGICAL WARFARE AGENTS

1. Agents known to have been developed, produced or used as weapons (Weaponized);
2. Agents which have severe socio-economic and/or significant adverse human health impacts;
3. High morbidity and/or mortality rates;
4. Short incubation period;
5. Difficult to diagnose/identify at an early stage;
6. High transmissibility and/or contagiousness;
7. Lack of availability of cost effective protection/treatment;
8. Low infective/toxic dose;
9. Stability in the environment;
10. Ease of production.

CRITERIA FOR ANIMAL PATHOGENS AS BIOLOGICAL TERRORISM AGENTS

1. Agents which have severe socio-economic and/or significant adverse human health impacts;
2. High morbidity and/or mortality rates: agents with an expected mortality of ≥50% were rated higher (+++), and with lower expected mortalities (21-49%=++, and <21%=+);
3. Short incubation period and/or difficult to diagnose/identify at an early stage;
4. High transmissibility and/or contagiousness high level of infectiousness/ intoxication by contact (+), by respiratory route (++), or both (+++);
5. Lack of availability of cost effective protection / treatment;
6. Low infective/toxic dose;
7. Stability in the environment;
8. Ease of production.

CRITERIA FOR PLANT PATHOGENS AS BIOLOGICAL WARFARE AGENTS

1. Agents known to have been developed, produced or used as weapons (Weaponized);
2. Agents which have severe socio-economic and/or significant adverse human health impacts, due to their effect on staple crops, to be evaluated against a combination of the following criteria:
3. Ease of dissemination (wind, insects, water, etc.);
4. Short incubation period and/or difficult to diagnose / identify at an early stage;
5. Ease of production;
6. Stability in the environment;
7. Lack of availability of cost effective protection / treatment;
8. Low infective dose;
9. High infectivity;
10. Short life cycle.

CRITERIA FOR PLANT PATHOGENS AS BIOLOGICAL TERRORISM AGENTS

1. Agents which have severe socio-economic and/or significant adverse human health impacts, due to their effect on staple crops;
2. Ease of dissemination: by wind (+++), by insects (++), water, etc.(+);
3. Short incubation period and/or difficult to diagnose/identify at an early stage;
4. Ease of production;
5. Stability in the environment;
6. Lack of availability of cost effective protection/treatment;

7. Low infective dose;
8. High infectivity and causes severe crop losses: ≥60% (+++), 21-59% (++), and <21%(+);
9. Short life cycle.

CRITERIA FOR VECTORS OR CARRIERS OF BIOLOGICAL TERRORISM AND WARFARE AGENTS

1. Vectors known to have been produced, used or alleged to be used as weapons;
2. Vectors which cause significant impact on human health or animal resources;
3. Short life cycle;
4. Ease of production;
5. Resistance to insecticides or bio control agents;
6. Ease of dissemination.

CRITERIA FOR PESTS AS BIOLOGICAL TERRORISM AND WARFARE AGENTS

1. Pests known to have been produced, used or alleged to be used as weapons;
2. Pests which cause sever socio-economic and/or significant adverse effect to plants;
3. Ease of production;
4. Short life cycle;
5. Resistance to pesticides;
6. High reproducibility;
7. Ease of dissemination.

ANIMAL PATHOGENS AS BIOLOGICAL WARFARE AGENTS

Viruses

African swine fever virus
Avian influenza virus (Fowl plague virus)
Rinderpest virus
Classical swine fever virus (Hog cholera virus)
Foot and mouth virus
Newcastle disease virus
Pest des petits ruminants virus
Teschen disease virus (Porcine enterovirus type 1)
Vesicular stomatitis virus
Rift Valley fever virus
Bluetongue virus
African horse sickness virus
Nipah swine encephalitis virus
Lumpy skin disease virus
Camel pox virus

Bacteria

Bacillus anthracis
Bulkholderia (Pseudomonas) mallei
Brucella spp.

Mycoplasmas

Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)
Contagious caprine (pleuropneum.) (M. capriculum var. capri pneumoniae type F38 (CCPP)

ANIMAL PATHOGENS AS TERRORISM BIOLOGICAL AGENTS

Viruses

African swine fever virus
Avian influenza virus (Fowl plague virus)
Vesicular stomatitis virus
Classical swine fever virus (Hog cholera virus)
Foot and mouth virus
Newcastle disease virus
Rinderpest virus
Pest des petits ruminants virus
Bluetongue virus
Teschen disease virus (Porcine enterovirus type 1)
Rift Valley fever virus
Nipah swine encephalitis virus
African horse sickness virus
Camel pox virus
Lumpy skin disease virus

Bacteria

Bacillus anthracis
Bulkholderia (Pseudomonas) mallei
Brucella spp.

Mycoplasmas

Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)
Contagious caprine (pleuropneum.) (M. capriculum var. capri pneumoniae type F38) (CCPP)

PLANT PATHOGENS AS BIOLOGICAL TERRORISM AGENTS

Fungi

Colletotrichum coffeanum var. virulans
Puccinia graminis (Stem Rust, Black Rust)
Tilletia indica (Carnal Bunt)
Sclerotinia sclerotiorum (Sclerotinia Stem Rot)
Dothistroma pini (Scirrhia pini) (Pine Needle Casts and Blights)
Puccinia striiformis (P. glumarum) (Stripe Rust, Yellow Rust)
Pyricularia oryzae (Rice Blast)
Ustilago maydis (Corn Smut)
Claviceps purpurea (Ergot)
Peronospora hyoscyami de Bary f.sp. tabacina (Adam) skalicky (Downy mildew)

Bacteria

Xsanthomonas albilineans (Leaf Scald)
Erwinia amylovora (Shoot Blight)
Ralstonia solanacearum (Bacterial Wilt)
Xsanthomonas campestris pv. citri (Citrus Cancer)
Xsanthomonas campestris pv. oryzae (Rice Bacterial Leaf)

Viruses

Sugar cane Fiji disease virus (Sugar cane Fiji disease)

PLANT PATHOGENS AS BIOLOGICAL WARFARE AGENTS

Fungi

Puccinia graminis (Stem Rust, Black Rust)
Pyricularia oryzae (Rice Blast)
Colletotrichum coffeanum var. virulans
Tilletia indica (Carnal Bunt)
Ustilago maydis (Corn Smut)
Puccinia striiformis (P. glumarum) (Stripe Rust, Yellow Rust)
Dothistroma pini (Scirrhia pini) (Pine Needle Casts and Blights)
Sclerotinia sclerotiorum (Sclerotinia Stem Rot)
Peronospora hyoscyami de Bary f.sp. tabacina (Adam) skalicky (Downy mildew)
Claviceps purpurea (Ergot)

Bacteria

Ralstonia solanacearum (Bacterial Wilt)
Xsanthomonas campestris pv. citri (Citrus Cancer)
Xsanthomonas albilineans (Leaf Scald)
Erwinia amylovora (Shoot Blight)
Xsanthomonas campestris pv. oryzae (Rice Bacterial Leaf)

Viruses

Sugar cane Fiji disease virus (Sugar cane Fiji disease)

Vectors

Xenopsylla spp. Ctenocephalis spp. Leptopsilla spp.	Siphonoptera	Insecta
Ixodides Hyalomma marginatum Hyalomma Anatolicum Anatolicum	Acari	Arachnida
Dermacentor andersoni	Acari	Arachnida
Dermacentor varabilis Amblyimma Cajennese Rhipicephalus sanguineus		
Mansonia spp. Culex spp. Culiseta spp.	Diptera	Insecta
Pediculus humanus	Anopluraa	Insect
Ixodides Dermacentor spp. Rhipicephalus spp. Amblyomma spp.	Acari	Arachnida

Pests

Dociostaurus maroccanus	Orthoptera	Grasshoppers *CRICKETS* Cockroaches
Haplothrips Tritici Thrips Tabaci	Thysanoptera	Thrips
Eurygaster integriceps Lygus linecularus Acrosternum milleri	Hemiptera	Bugs
Chilo suppressalis Cirphis unipunctata Earias insulana	Lepidoptera	Butterflies Moths Skippers
Leptinotarsa decemlineata (Colorado potato beetle)	Coloptera	Beetles Weevils
Harmolita tritici	Hymenoptera	Ants, Bees, Wasps
Phytophaya destructor	Diptera	Flies
Terranychus takestani	Tetranychidae	Mites
Cenopalpus spp.	Errophyoidae	Mites
Diabrotica virgifera virgifera	Chrysomelidae	Western corn rootworm

CONCLUSION

The threat and use of biological agents for warfare and terrorism purposes has a long history. Many animal and plant pathogens, vectors and pests can be used as terrorism and warfare biological agents and cause illness. Transmissible animal diseases classified under A and B List have the potential for very serious and rapid spread, irrespective of national borders which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products. Those transboundary animal diseases are of significant economic, trade and security importance. Having a defined and good method for evaluating biological threat agents such as animal and plant pathogens, vectors and pests allows for more objective evaluation newly emerging potential threat agents. This method of evaluation can help focus public health activities, agriculture activities related to bioterrorizm detection and response.

KEYWORDS

Animal and plant pathogens, vectors, pests, and terrorism agents

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Table 1: Animal pathogens assessment according to criteria for selecting pathogens as biological warfare agents

Animal pathogens	Weapo-nized	Severe socio-economic/ human health impacts	High morbidity or mortality rates	Short incu-bation period	High transmiss-ibility/ contagi-ousness	Low infective or toxic dose	Difficult to diagnose/ identify at an early stage	Stability in the environ-ment	Lack of availability of cost effective protection/ treatment	Ease of produc -tion	Totals +/-
Viruses											
African swine fever virus	+	+	+	+	+	+	+	+	+	+	10/0
Avian influenza virus (Fowl plague virus)	+	+	+	+	+	+	+	+	+	+	10/0
Camel pox virus	-	-	+	+	-	+	+	+	+	-	5/5
Classical swine fever virus (Hog cholera v.)	+	+	+	+	+	+	+	+	-	+	9/1
Foot and mouth virus	+	+	+	+	+	+	+	+	-	+	9/1
Bluetongue virus	-	+	+	+	-	+	+	+	+	+	8/2
Newcastle disease virus	+	+	+	+	+	+	+	+	-	+	9/1
Pest des petits ruminants virus	+	-	+	+	+	+	+	+	+	+	9/1
Rinderpest virus	+	+	+	+	+	+	+	+	-	+	10/0
Teschen disease virus (Porcine enterovirus type 1)	-	+	+	+	+	+	+	+	+	+	9/1
Rift Valley fever virus	-	+	+	+	+	+	+	+	+	-	8/2
Vesicular stomatitis virus	-	+	+	+	+	+	+	+	+	+	9/1
African horse sickness virus	-	+	+	+	+	+	+	+	+	-	8/2
Lumpy skin disease virus	-	-	-	+	-	+	+	+	+	-	4/6
Nipah swine encephalitis virus	-	+	+	+	-	+	+	+	+	-	7/3
Bacteria											
Bacillus anthracis	+	+	+	+	+	+	+	+	+	+	10/0
Brucella spp.	+	+	-	-	+	+	+	+	+	+	8/2
Bulkholderia (Pseudomonas) mallei	+	+	+	+	-	+	+	+	+	+	9/1
Mycoplasmas											
Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)	-	+	+	-	+	+	+	+	+	+	8/2
Contagious caprine (pleuropneum.) (M. capri-culum var. capri pneumoniae type F38) (CCPP)	-	-	-	-	+	+	+	+	+	+	5/5

Table 2: Animal pathogens assessment according to criteria for selecting pathogens as terrorism agents

Animal pathogens	Severe socio-economic/ human health impacts	High morbidity/ mortality rates	Short incu-bation period	High contagiousness/ transmiss-ibility by contact, respiratory route, or both	Low infective/ toxic dose	Difficult to diagnose/ identify at an early stage	Stability in the environ-ment	Low effective or cost-effective prophylaxis/ protection/ treatment	Ease of produc-tion	Total (13)
Viruses										
African swine fever virus	+	+++	+	+++	+	+	+	+	+	13
Avian influenza virus (Fowl plague virus)	+	+++	+	+++	+	+	+	+	+	13
Camel pox virus	-	++	+	+	+	+	+	+	-	8
Classical swine fever virus (Hog cholera v.)	+	+++	+	+++	+	+	+	+	-	12
Foot and mouth virus	+	+++	+	+++	+	+	+	-	+	12
Bluetongue virus	+	+	+	+++	+	+	+	-	+	10
Newcastle disease virus	+	+++	+	+++	+	+	+	-	+	12
Pest des petits ruminants virus	+	+++	+	+	+	+	+	-	+	10
Rinderpest virus	+	+++	+	+++	+	+	+	-	+	12
Teschen disease virus (Porcine enterovirus type 1)	-	+	+	+	+	+	+	+	+	8
Rift Valley fever virus	+	+++	+	+	+	+	+	-	+	10
Vesicular stomatitis virus	+	+++	+	+++	+	+	+	+	+	13
African horse sickness virus	-	+++	+	+	+	+	-	+	-	8
Lumpy skin disease virus	-	+	+	+	+	+	+	+	-	7
Nipah swine encephalitis virus	+	++	+	+	+	+	+	+	-	9
Bacteria										
Bacillus anthracis	+	+++	+	+++	+	-	+	-	+	11
Brucella spp.	+	+	-	++	+	-	+	-	+	7
Bulkholderia (Pseudomonas) mallei	+	+++	+	-	+	+	+	+	+	10
Mycoplasma										
Contagious bovine (pleuropneum.) (M. mycoides var. mycoides type SC) (CBPP)	+	++	-	+++	+	+	+	-	+	10
Contagious caprine (pleuropneum.) (M. capri-culum var. capri pneumoniae type F38)(CCPP)	-	++	-	+	+	+	+	-	+	7

Table 3: Plant pathogens assessment according to criteria for selecting pathogens as biological warfare agents

Plant pathogens	Weapo-nized	Severe socio-economic/ human health impacts	Short incub-ation period	Ease of dissemination (wind, insects, water, etc.)	Short life cycle	Low infective dose and infectivity	Difficulty diagnose/ identify at an early stage	Stability in the environ-ment	Cost-effective protection/ treatment	Ease of produc-tion	Totals +/-
Fungi											
Colletotrichum coffeanum var. virulans	-	-	+	+	-	+	+	+	-	+	6/4
Dothistroma pini (Scirrhia pini)	-	-	+	+	-	+	+	+	-	-	5/5
Claviceps purpurea	-	+	+	+	-	-	+	-	-	-	4/6
Peronospora hyoscyami de Bary f.sp. tabacina (Adam) skalicky	-	-	+	+	-	+	+	+	-	-	5/5
Puccinia graminis	+	+	+	+	-	+	+	+	-	+	8/2
Puccinia striiformis (P. glumarum)	-	+	+	+	-	+	+	+	-	+	7/3
Pyricularia oryzae	+	+	+	+	-	+	+	+	-	+	8/2
Sclerotinia sclerotiorum	-	+	+	+	-	+	+	-	-	-	5/5
Tilletia indica	+	+	+	+	-	+	+	+	-	+	8/2
Ustilago maydis	+	+	+	+	-	+	+	+	-	+	8/2
Bacteria											
Erwinia amylovora	-	+	+	+	-	+	+	-	-	+	6/4
Ralstonia solanacearum	-	-	+	+	-	-	+	+	+	-	5/5
Xsanthomonas albilineans	-	+	+	+	-	+	+	-	+	+	7/3
Xsanthomonas campestris pv. citri	-	+	+	+	-	+	+	-	+	+	7/3
Xsanthomonas campestris pv. oryzae	-	+	+	+	-	+	+	-	+	+	7/3
Viruses											
Sugar cane Fiji disease virus	-	+	+	-	-	+	+	-	-	+	5/5

Table 4: Plant pathogens assessment according to criteria for selecting pathogens as terrorism agents

Plant pathogens	Severe socio-economic/ human health impacts	Short incub-ation period	Ease of dissemination (wind, insects, water, etc.)	Short life cycle	Low infective dose and infectivity	Difficulty diagnose/ identify at an early stage	Stability in the environ-ment	Causes severe crop losses	Cost-effective protection/ treatment	Ease of produc-tion	Total (14)
Viruses											
Colletotrichum coffeanum var. virulans	+	+	+++	+	+	+	+	+++	+	+	14
Dothistroma pini (Scirrhia pini)	-	+	++	+	+	+	+	++	-	+	10
Claviceps purpurea	+	+	+++	-	-	+	-	++	-	-	8
Peronospora hyoscyami de Bary f.sp. tabacina (Adam) skalicky	-	+	+++	-	-	+	+	+	-	+	8
Puccinia graminis	+	+	+++	+	+	+	+	+++	-	+	14
Puccinia striiformis (P. glumarum)	-	+	++	+	+	+	+	+	-	+	9
Pyricularia oryzae	-	+	++	-	+	+	+	+	-	+	9
Sclerotinia sclerotiorum	+	+	+++	+	+	+	+	+++	-	+	13
Tilletia indica	+	+	+++	+	+	+	+	+++	-	+	14
Ustilago maydis	-	+	++	-	+	+	+	++	-	+	9
Bacteria											
Erwinia amylovora	+	+	+++	+	+	+	-	+++	-	+	12
Ralstonia solanacearum	+	+	++	+	+	+	+	++	+	-	11
Xsanthomonas albilineans	+	+	+++	+	+	+	+	+++	+	+	14
Xsanthomonas campestris pv. citri	-	+	++	-	+	+	+	++	+	+	10
Xsanthomonas campestris pv. oryzae	-	+	++	-	+	+	-	++	+	+	9
Viruses											
Sugar cane Fiji disease virus	+	+	++	-	+	+	-	++	-	-	8

Table 5: Vectors assessment according to criteria for selecting vectors as terrorism and warfare agents

Vectors	Order	Class	Biological Agent	Disease	Weapo-nized	Significant impact on human health or animal resources	Short life cycle	Ease of produc -tion	Resistance to insecticides or bio control agents	Ease of dissemi-nation	Total (6)
Xenopsylla spp. **Ctenocephalis spp.** **Leptopsilla spp.**	Siphonoptera	Insecta	Yersisnia pestis	Plague	+	+	+	+	+	+	**6**
Ixodides **Hyalomma marginatum** **Hyalomma Anatolicum** **Anatolicum**	Acari	Arachnida -	Arbovirus	Crimean-Congo hamorrhagic fever (CHF)	+	+	+	+	+	+	**6**
Dermacentor Andersoni	Acari	Arachnida	Coxiella burnetti	Q-Fever	-	+	+	+	+	+	**5**
Dermacentor Andersoni **Dermacentor varabilis** **Amblyimma Cajennese** **Rhipicephalus sanguineus**	Acari	Arachnida	Rickettsia rickettsii	Rocky Mountain Spotted Fever	-	+	+	+	+	+	**5**
Mansonia spp. **Culex spp.** **Culiseta spp.**	Diptera	Insecta	Arbovirus	Eastern Equine Encephalitis	+	+	+	+	+	+	**6**
Pediculus humanus	Anopluraa	Insect	Rickettsia prowasekii	Typhus exanthematicus	+	+	+	+	+	+	**6**
Ixodides **Dermacentor spp.** **Rhipicephalus spp.** **Amblyomma spp.**	Acari	Arachnida	Francisella tularensis	Tularemia	+	+	+	+	+	+	**6**

Table 6: Pests assessment according to criteria for selecting pests as terrorism and warfare agents

Pests	Order	Common Names	Host	Weapo-nized	Severe socio-economic/signi-ficant adverse effect to plants	Short life cycle	Ease of production	Resistance to pesticides	High reprodu-cibility	Ease of dissemi-nation	Total (7)
Dociostaurus maroccanus	Orthoptera	Grasshoppers CRICKETS Cockroaches	Plants	-	+	+	+	+	+	+	6
- Haplothrips tritici **- Thrips Tabaci**	Thysanoptera	Thrips	- Wheat, maize - Tabacco, tomato	-	+	+	+	+	+	+	6
- Eurygaster integriceps **- Lygus linecularus** **- Acrosternum milleri**	Hemiptera	Bugs	- Wheat - Pistachio - Pistachio	-	+	+	+	+	+	+	6
- Chilo suppressalis **- Cirphis unipunctata** **- Earias insulana**	Lepidoptera	Butterflies Moths Skippers	- Rice - Rice, maize - Cotton	-	+	+	+	+	+	+	6
Leptinotarsa decemlineata (Colorado potato beetle)	Coloptera	Beetles Weevils	Potatoes	-	+	+	+	+	+	+	6
Harmolita tritici	Hymenoptera	Ants Bees Wasps	Wheat	-	+	+	+	+	+	+	6
Phytophaya destructor	Diptera	Flies	Wheat (Barley) Oats	-	+	+	+	+	+	+	6
Terranychus takestani	Tetranychidae	Mites	Plants	-	+	+	+	+	+	+	6
Cenopalpus spp.	Errophyoidae	Mites	Fruit trees	-	+	+	+	+	+	+	
Diabrotica virgifera virgifera	Chrysomelidae	Western corn rootworm	Maize	-	+	+	+	+	+	+	6

50. SOURCES OF CHEMICAL TOXICS AND THEIR PRECURSORS IN PHARMACEUTICAL INDUSTRY

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Pharmaceutical industry includes a lot of independent units specialized in synthesis of active substances, their processing as pharmaceutical forms, control of intermediate and final products, storage of all these as well of a lot of adjuvants. In this long chain almost all manipulated chemical substances are biologically active, some of it very active and toxic. Consequently, the fact that Drug Companies represents a potential risk of chemical pollution is a common place. The fact that there were created a lot of laws and methods for avoiding this, is also clear. The present paper wants, starting from some accidents, which happened in spite of all preventing measures, to put in evidence some particular circumstances increasing the risk.

CLASSIFICATION OF SOURCES OF "TOXIC ACTION"

A first classification separates direct from secondary sources. This is important to keep in mind since, if for direct sources are provided a lot of safety measures, the secondary ones, appearing only in exceptional situations, are usually forgotten.

Direct sources: chemical raw materials (ingredients), synthesis intermediates, intermediate forms (solutions, powders), analytical reactives, drugs itself, residues etc.
Secondary sources are represented by chemical substances which derive from compounds mentioned as primary sources in exceptional cases following combustion and/or chemical interactions, chemical degradation etc.

Another point of view in classification arises from the type of discharge of toxic compounds. We have to consider separately the measures to counteract in:

- massive contamination and
- continuous, low doses contamination which can be considered also as a acute pollution.

Last but not least, starting from causes of contamination we can distinguish between

- "accepted", technological restrictions
- accidental sources,
- deliberated ("terrorist") actions.

Even in the case of accepted risks we have to separate between risks accepted by the companies but hidden to the people for surrounding area and unavoidable risks.

In function of the combination of different types of the above-mentioned characteristics we have different models in evaluation the spreading of toxic agent and its danger. Also different will be the measures for prevention and limitation of the effects.

SPECIFIC PROVISIONS IN PHARMACEUTICAL LEGISLATION FOR PREVENTING HAZARDS

Specific legislation for pharmaceutical activity are grouped in two never ending codes: Good Manufacturing Practice (GMP) and Good Laboratory Practice (GLP). Every accident or only perception of such possibility in pharmaceutical industry leads to new "articles" and even to new versions of these two fundamental "book of books".

GLP1 in preventing contamination

GLP include in a special chapter "Environmental risk assessment / ecotoxicity" a special

Note: Environmental risk for medicinal products where is written:

"Applications for marketing authorizations should include in Part IIIR an indication of any potential risks presented by the medicinal product for the environment. This requirement is particularly applicable to new active substances and live vaccines. Applications for new active substances may include in the documentation provided, an indication of relevant environmental hazards, making reference to standard physicochemical tests and any appropriate testing they have conducted on biodegradability, including some testing in sensitive species. Applications for live vaccines should consider issues such as shedding, survival and capacity to disseminate.

The pre-clinical Expert Report should include an evaluation of possible risks to the environment from the point of view of use and/or disposal and make proposals for labeling provisions which would reduce this risk."

GMP2 rules in preventing "errors" ask:

- "prevent contamination and mix-up: some of the substances used in modern medicines are very potent indeed, even in small trace amounts, and some people are more sensitive than others to very small traces"
- "guard against labeling or packaging errors".

As a remark, both GMP and GLP rules are very strict it concerns cleanliness, even paranoiac, in a similar manner with the rules for nuclear plants, but ignores rules for avoiding the infinitely greater risks associated with deliberated wrong actions.

CLASSIFICATION OF TERRORIST MANIPULATION OF TOXICS AND THEIR PRECURSORS

We have to take in consideration both non-specialist terrorists and specialist terrorist.

Further, specialization can concern terrorist actions or industrial pharmacy or, why not, both.

There is a significant difference between actions from outside of from inside the system.

Non-specialist scenario

The simplest idea is to orient the attack against chemical synthesis facilities from where a lot of volatile solvents could be spread in the atmosphere, resulting a contamination on large area. For example, to put fire exactly in the points were large panels warns on fire danger. The action is not easy to undertake since all this points are very well guarded and plans for limiting the disaster are usually disposable.

Specialist acting from inside the system: "pharmacist-terrorist", "chemist-terrorist".

This is not a common case but is by far the most "efficient" method for obtaining the maximum of damages, victims and terror. Almost all preventing measures and safety systems become worthless if exactly the man responsible for their application and management, blocks all mechanism. All systems, more or less sophisticated includes at least a man which know how is possible to block their run. The reasons for undertaking such suicidal actions are not impossible to find. The vengeance would be an example. But there are also other more foolish ideas. In pharmaceutical folklore the story goes about a proprietary of company producing fruit juices which put poison in a juice batch in order to determine, from the distribution of deceased people the places where are used his products. From that moment, for entering in the production area in pharmaceutical industry, is compulsory to change clothes and leave at the entrance all personal objects.

CONCRETE EXAMPLES

A massive release of ammonium from a tank following the deficiency of the tap appeared at the greatest Romanian drug company 20 years ago. The smudge covered and was felt on 1/3 of Bucharest. Almost all people in immediate neighborhood died following a holocaust of the respiratory tract. The accident was not reported by communist authorities but in medical scientific media was discussed much about the impossibility to find a treatment for such cases.

In Romania in the past decade cyanide ion appeared three times as chemical hazard.

First one concerned a "terrorist announcement" made at the national TV program in the first hours of Revolution, about the poisoning with cyanides of the greatest water pool from the south of country - the lake of Arges hydro-electric plant.

A tremendous contamination of the river Tisa with cyanides was produced after a sudden, great rain fall and the crushing of the dam of a basin with residues from a complex of mines from the north of Romania, in 2000.

A connection with the pharmacist-terrorist can be made if we remember that it was statistically established that pharmacists use for suicide cyanides, physicians use morphine and veterinarians - strychnine. Hence, the pharmacists believe that the most toxic substances are cyanides and a "pharmacist-terrorist" could use this substance for poisoning of a river or a water basin in a madness "revenge action". It seems that such an action would imply a great number of victims.

But, in the above mentioned accident it was observed that, in spite of the predictions of the specialists from Ministry of Environment, it was not produced a quick dissipation of the cyan and a "wave" of concentrated solution traveled for some two thousand kilometers on Tisa and Danube, until Black Sea.

This is compatible with a model of diffusion from a reservoir in an infinite medium if we consider a "mobile origin of coordinates in the point of contamination". In this conditions the convection term in the diffusion equation disappears and it obtains3 an analytic solution for the concentration c of polluting agent at the distance y from origin, at the moment t:

$c(t,y) = c_0(1 - \mathrm{erf}\,\frac{y}{\sqrt{4Dt}})$ where erf(x) is the error function $\mathrm{erf}(x)= \frac{2}{\sqrt{\pi}}\int_{-\infty}^{x} e^{-\frac{\zeta^2}{2}} d\zeta$

The conclusion is that, at least in the case of contamination of great rivers, the evolution of the risk can be predicted.

Another accident is very conclusive it concerns appearance of a lot of unexpected new conditions to favoring accidents. After a dishonest privatization a chemical laboratory entered into liquidation being shared to a lot of new owners. Some gypsy men had the idea to cut a reservoir with natrium cyanide and to sell it as scrap iron. The result was a massive pollution of the Siret river and a lot of victims following the consumption of fish from river. The situation is characteristic to transition period in eastern countries. A lot of chemical factories became almost "ownerless" or used in entirely different aims that their normal utilization.

CONCLUSIONS

1. Following the great number of utilized chemicals and products, there are a lot of possibilities for chemical contamination of environment in pharmaceutical industry.
2. GMP and GLP rules impose safety systems, apparently able to eliminate all possible risk.
3. A permanent risk remains from the most weak chain-loop of these systems: the man from inside the system, potentially a high-specialized chemist or pharmacist terrorist.

4. Sociopolitical events, which perturb both man and ownership relations are factors favoring unexpected and undesired evolutions of chemical and pharmaceutical sources.

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51. STABILIZATION OF PYRIDOSTIGMINE AS PREVENTIVE ANTIDOTE

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INTRODUCTION

Pyridostigmine (3-hydroxy-1-methylpyridinium bromide dimethylcarbamate) facilitates the transmission of impulses across the myoneural junction by inhibiting the destruction of acetylcholine by cholinesterase. In current therapy pyridostigmine tablets are useful in the treatment of myasthenia gravis being put on the market by Roche with the name Mestinon). In the form of manganese bromide salt, Arzneimittelwerk Dresden produced pyridostigmine with the name Kalymin 60. As a preventive antidote, pyridostigmine was produced by DuPhar.

Design of oral antidotes based on pyridostigmine meet some scientific and logistic real challenges. The logistics challenge is common to almost all antidotes – scarce utilization in therapy, high cost and as a consequence, low interest it concerns its developing by the pharmaceutical companies.

Another problem is not associated to all antidotes but is clearly the common disadvantage of all decorporators and to all antidotes utilizable in chemical intoxication with organophosphorus compounds. Following their ionic character these compounds have a poor absorption, low permeability inside biological cell and a rapid elimination, in other words a very unfavorable pharmacokinetics.

But pyridostigmine does not have only "common" problems of antidotes. A supplementary, "distinguished" characteristic is the very high hygroscopicity of pyridostigmine, with associated problems it concerns technological process and stability in "field of battle" conditions. Our research program was oriented in the following directions:

- choice of excipients and working parameters in order to assure reproducible technology and stable antidotes, elaboration of an in vitro release test discriminatory it concerns the release profiles; study of the interfacial transfer as an in vitro model for the trans-membrane transfer of pyridostigmine paired with organic anions
- development of a bioanalytical method for separation of pyridostigmine from plasma and chromatographic determination study of the pharmacokinetics in healthy volunteers and correlation of the results with in vitro data .

This paper presents *mainly the pharmaceutical technology* aspects and their influence on the biopharmaceutical properties of resulted tablets.

METHODS

Pharmaceutical formulas for tableting

Different formulas were compared, which relate to tabletting technology properties:

formula I : pyridostigmine 11.11%, bentonite 88.89%;

formula II : pyridostigmine 5.55%, bentonite 44.45%, amidon 50%;

formula III : pyridostigmine 5.41%, bentonite 43.36%, amidon 48.78% and magnesium stearate 2.44%.

In vitro dissolution tests

apparatus 2 (paddle),

method : USP XXIV,

volume : 900 ml,

agitation : 50 U/min,
sample time : 15, 30, 45 and 60 minutes,
medium : water, pH = 6; HCl 0.1N, pH = 2; phosphate buffer, pH = 8
tolerances : not less than 80% Q dissolved in 60 minutes.

Extraction of pyridostigmine from plasma

Liquid/liquid (L/L) extraction[1] -1 mL plasma sample, mixed with 0.2ml phosphate buffer and 0.5ml picric acid 66mM, was extracted with dichlormethane (2 times 4ml). The organic extract was treated with 0.2ml tetrabutylammonium iodide 1mM. The aqueous layer was analyzed by HPLC, on a Zorbax-CN column, equipped with a pre-column of the same material. Isocratic elution at 40°C temperature has been preferred, using a flow rate of 1.2ml/min. Mobile phase consists in a mixture acetonitrile-triethylamine-acetic acid. Injected sample volumes were 200μL and chromatograms were monitored at 270 ± 2 nm.
It was tried solid phase extraction (SPE) with different type of stationary phase, cyane and Oasis-HLB - [poly(divinylbenzene-co-N-vinylpyrolidone)].

Evaluation of bioavailability of pyridostigmine

4 male young volunteers were enrolled in the pharmacokinetic study. All volunteers were healthy as assessed by physical examination and laboratory tests. After an overnight fast of ten hours, the volunteers received 2 tablets of 18 mg of pyridostigmine. Venous blood samples were collected through a catheter at 0,0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2, 2.5, 3, 4 and 6 hours after drug administration. Plasma samples were prepared by L/L extraction and analyzed by HPLC.

RESULTS

Tableting technology and storage in "field conditions"

As it was presented the main difficulty in achieving pharmaceutical forms with pyridostigmine arise from its hygroscopicity.

The first trials started from the formulas containing same excipients as Mestinon (lactose, magnesium trisilicate, calcium phosphate and magnesium stearate) or as Kalimyn (lactose, amidon, talc, magnesium stearate and polividon 25). Working in "open air" conditions it was not possible to avoid the absorption of water from atmosphere and the resulted mixture of powders was not directly compressible.

Lyophilization of pyridostigmine allowed direct compression in an interval of some hours but the resulted tablets were not stable in time.

A powder of only bentonite and pyridostigmine was stable and direct compressible for 10 years. Since the adsorption of pyridostigmine on bentonite was proved by in vitro dissolution test, it was tried to replace partially the bentonite by amidon. Replacing partially bentonite with amidon did not change the stability of tablets if the proportion of amidon remained less or equal with bentonite.

In vitro dissolution tests

In vitro dissolution test indicated a strong absorption on bentonite, whatever the dissolution medium (water, acidic or basic media), the quantity released in one hour being less than 40 % of the total pyridostigmine.

As it can be seen from figure 1, in acidic and neutral media the curves reach very quickly (practically after half an hour) a plateau. It was considered that is not necessary to follow the dissolution for longer time interval than that indicated by USP 24 (one hour).
At pH=8, which is approximately the intestinal pH, the dissolution is somewhat better, a slow further increase of the released amount could appear after first hour. Consequently, we

consider that replacing of deaereted water with phosphate buffer would result in a more discriminatory dissolution test for pyridostigmine tablets with bentonite matrix. See Figure 1.

Extraction of pyridostigmine from plasma

Since pyridostigmine reachs not enough high plasma levels to allow a direct injection of samples in the chromatographic column, the extraction and the enrichment of the drug content of samples appeared as unavoidable steps of analytical assay procedures in the pharmacokinetic study. Consequently it was tried both SPE and L/L extraction as methods for separation of drug from plasma matrix.

For a good reproducibility of SPE it is essential to have a good wettability of the sorbent. In the last years, it was developed new type of macroporous copolymer exibiting both hydrophilic and lipophilic retention characteristics[2]. This type of sorbent is theoretically more efficient in retaining hydrophilic pyridostigmine molecule than usual silica sorbents. Our expectetion were not fulfilled, the extraction yield from aqueous sample being 10% and only 5% in case of plasma samples.

Since best results in chromatographic separation of pyridostigmine were obtained in the case of CN columns, we thought that it deserves to use for SPE same type of sorbent.
The extraction yield was really 7 fold greater that in the case of OASIS. A possible explanation for this result could be connected with the bound of quaternary ammonium in the area of the high electron density of the CN group. See Figure 2.

Since use of good laboratory practice implies a single use of the separation cartridge, SPE methods remain enough expensive to be commonly used in pharmacokinetic studies.
Although less selective, the L/L extraction presents the advantage of a greater flexibility following the adjustment of parameters which control the process (pH, nature and volume of the extraction solvent, etc). Last but not least the L/L extraction is by far less expensive than SPE. Consequently, in pharmacokinetic study for sample preparation it was tried also L/L extraction.

Since pyridostigmine is practically insoluble in all organic solvents is not possible to obtain an acceptable recovery from plasma whatever the combination of extracting solvents. A solution of the problem is the "derivatization" of pyridostigmine by association with a negative ion to form a dissociable ion pair. Utilization of picrate as counter ion, allowed extraction in methylene-chloride of approximately 40% of pyridostigmine from spiked plasma samples.

Such type of extraction by intermediate of ion pair could be considered as a model for a type of "in vivo" facilitated transport across lipid membranes.

Evaluation of bioavailability of pyridostigmine from bentonite matrix

As we presented, "in vitro" experiments seem to indicate a retention of pyridostigmine from bentonite. Since there are many examples of drugs, which are bioequivalent though their in vitro dissolution profiles are enough different, we considered that final, definitive conclusion about the bioavailability of pyridostigmine would remain the in vivo experiment.

The plasma levels of pyridostigmine at healthy volunteers are presented in figure 3. It can be observed that the intersubject variability is high, though high C_{max} at volunteer II makes the other three volunteers to look very closely.

Pharmacokinetic study See Figure 3.

The same conclusion is supported by the examination of the calculated pharmacokinetic parameters. On other hand, if the variability of C_{max} and T_{max} is a normal phenomenon in conditions of "poor" absorption, the differences in $T_{1/2}$ are rather unexpected. See TABLE 1.

Whatever the explanations of these anomalies it is important for our study to note that plasma levels are of the same magnitude with that obtained in other studies [3,7], supporting the idea of a modification of the bentonite matrix structure at the intestinal pH, allowing enough absorption for obtaining measurable plasma levels for some hours.

CONCLUSIONS

I. Bentonite as excipient assures:

- good and stable technology conditions for tableting pyridostigmine even in "open air" conditions,
- stability of pyridostigmine tablets even in worse climatic conditions for more than 10 years

In vitro evaluation of tablets proves a strong adsorption of the active substance on bentonite. In vivo experiment on healthy volunteers indicates that the absorption is probably reduced but significant plasma levels are attained for some hours.

Pyridostigmine tablets with bentonite matrix are easy to obtain and stable even in "field" conditions. The exact dose of active substance to be used can be established only after in vivo pharmacologic experiments.

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FIGURES AND TABLE

Figure 1. Pyridostigmine release profile in different dissolution media

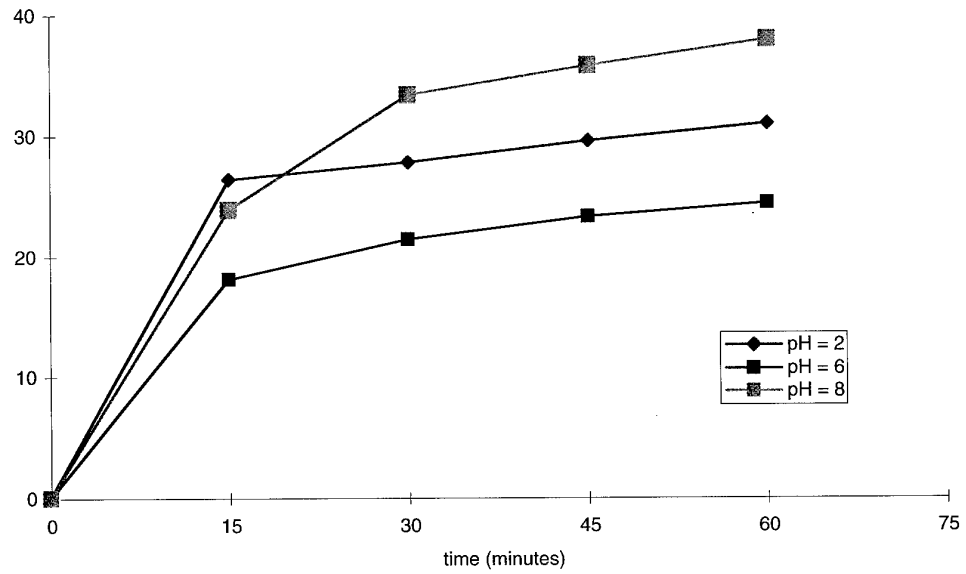

Figure 2. Pyridostigmine SPE on CN and OASIS columns

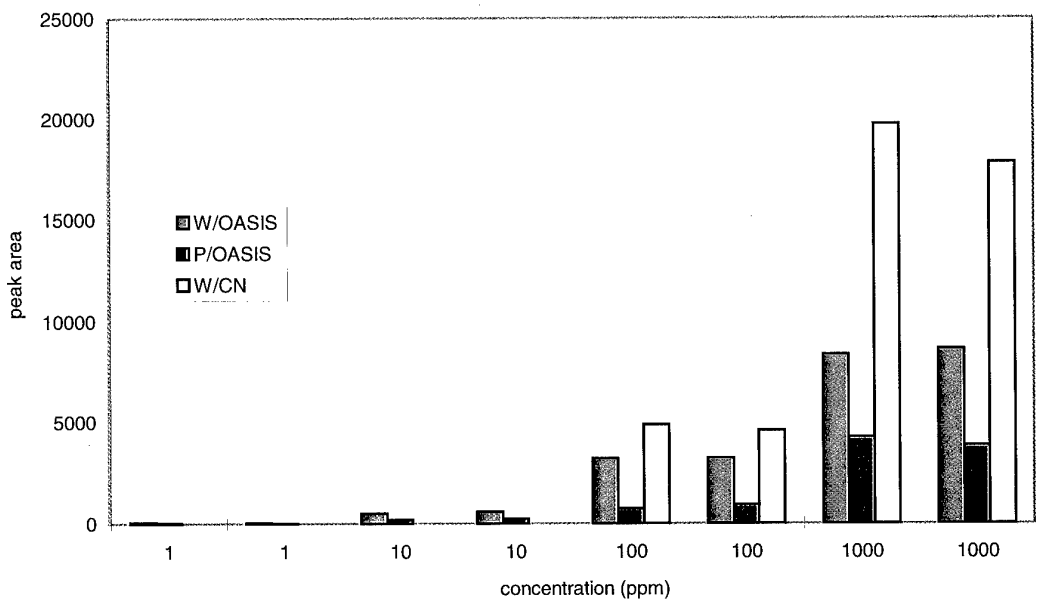

Figure 3. Plasma levels of pyridostigmine after oral administration to 4 healthy volunteers

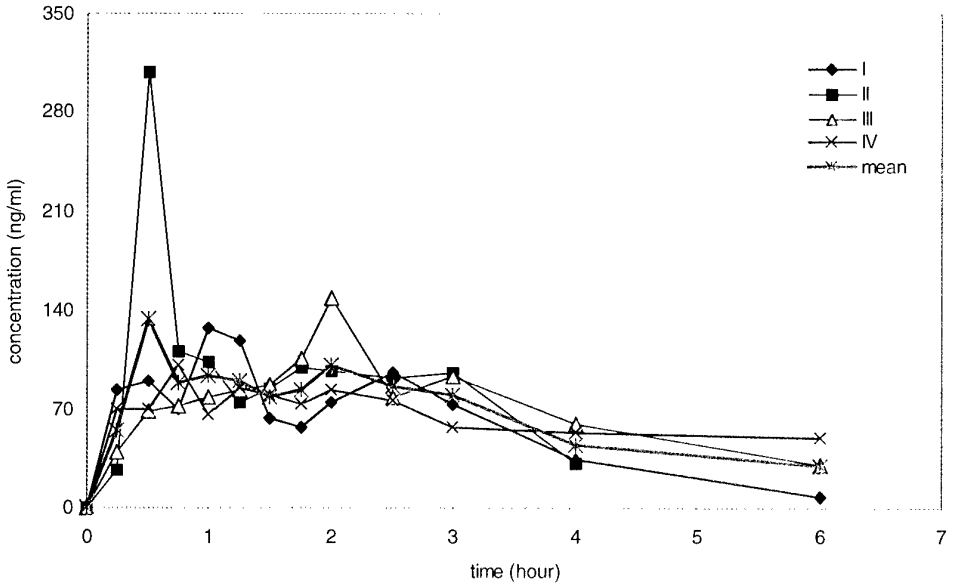

Table 1. Main pharmacokinetics parameters of pyridostigmine administered to 4 healthy volunteers

VOLUNTEER COD	CMAX (ppb)	TMAX (h)	T1/2 (h)	AUD (ppb* h)	AUC (ppb* h)	MRT	CIT	Vd
I	127	1	0.93	341.01	350.92	2.31	2370	192
II	309	0.5	0.83	410.4	419.2	2.11	1990	143
III	150	2	2.98	567.92	909.54	5.85	916	236
IV	100	0.75	2.86	375.05	576.55	5.33	1450	358
mean	134	0.5	2.85	433.06	619.24	4.91	1350	332

52. BIOCHEMICAL EFFECTS OF TOPICAL APPLICATION AND DECONTAMINATION OF T-2 TOXIN IN RATS

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ABSTRACT

T-2 toxin is a mycotoxin – a natural product of ***Fusarium fungi.*** It was used in the Indochina as a chemical warfare agent and certainly has a "terrorist" dimension. It is very complicated to treat; currently the best antidotes are corticosteroid hormones, compounds with significant adverse effects. These properties make T-2 toxin a very dangerous potential terrorist agent. This research describes our research in decontaminating T-2 on skin. T-2 toxin (1, 5, 50 and 100 μg/cm^2) was administered percutaneously in Wistar rats. In control animals its higher doses exerted progressive topical lesions, ranging from reddening (30 min), oedema and erythema (60 min) to skin necrosis (120 min). They were accompanied by increase in creatine kinase, lactate dehydrogenase, alanine- and aspartate-aminotransferase and decrease in alkaline phosphatase serum activities. Various decontamination agents were used 5, 10, 30, 60 and 120 min after poisoning. Polyethylene glycol 300 (PEG 300) or solution of 5 mg/ml dexamethasone in PEG 300 successfully decontaminated T-2 toxin 50 or 100 μg/cm^2, even if applied 60 min after poisoning. Soap solution 5% was effective only against 1 and 5 μg/cm^2 of T-2 toxin, provided not more than 10 min elapsed after poisoning. Suspension of activated charcoal in water (6:1) and PEG 300 were efficient in rats poisoned with up to 50 μg /cm^2 of T-2 toxin, if applied 10 – 30 min thereafter. When administered topically in control rats, 5% soap solution, activated charcoal and water and solution of dexamethasone in PEG 300 *per se* did not irritate the skin, while PEG 300 caused a mild irritation that lasted 10-12 h. It is concluded that solution of dexamethasone in PEG 300 is the most efficient and safest decontamination agent in rats topically poisoned with T-2 toxin.

INTRODUCTION

The trichothecene mycotoxins are a chemical group of fungal metabolites ⌋ntagonize⌋g⌋ by the tetracyclic 12,13-epoxy-trichotec-9-ene skeleton. There are more than 80 naturally occurring derivatives produced by various species of fungi, such as *Fusarium*, *Myrothecium*, *Trichothecium*, etc (1,2).

Besides their known systemic toxicity for parenchymatous organs (3,4), trichothecenes are also known as skin irritants, causing skin lesions varying from slight reddening to necrosis (5,6). The mechanism underlying this local effect is believed to reside in mediators with a more general cytotoxic effect on the skin (7,8). Histopathological studies showed that T-2 toxin directly affected the epidermis, thus producing apoptosis in basal cells (9). Besides the local effects on skin, T-2 toxin can penetrate the mammalian skin (10-12) and it has strong toxic resorptive effects after topical application (3,13,14).

This study was therefore undertaken to investigate and qualitative aspects of local irritation, serum enzyme activity and efficiency of decontamination by four decontamination formulations: 5 % soap solution, suspension of superactivated charcoal in water, polyethylene glycol 300 (PEG 300) and solution of 5 mg/ml dexamethasone in PEG 300.

METHODS

Chemicals. T-2 toxin was obtained from the Technological-Ecological Centre, Zrenjanin and it was purified at the Military Medical Academy, Belgrade. All the other chemicals of analytical or HPLC grade were purchased from the commercial sources.

Animal experiments. Male Wistar rats (180-220 g) were obtained from the Military Medical Academy, Belgrade, Yugoslavia. The rats were antagonized for at least one week prior to use and received food and tap water *ad libitum.* All the tested substances were administered topically 24 h after the hair was removed from the dorsal skin of each animal by using the electric clippers.

Experimental animals were poisoned topically with 1, 5, 50 and 100 $\mu g/cm^2$ of T-2 toxin and decontaminated at different time intervals thereafter (5, 10, 30, 60, 120 min). All of them were sacrificed 24 h after poisoning and their sera were used for the spectrophotometric determination of creatine kinase (CK), lactate dehydrogenase (LDH), alanine-aminotransferase (ALT), aspartate-aminotransferase (AST) and alkaline phosphatase (ALP).

Data analysis. Statistical significance was determined by means of Student's t-test and Mann-Whitney U-test, and the differences were considered significant when $p < 0.05$.

RESULTS

Since the preliminary results showed that the two smallest doses of T-2 toxin caused a delayed skin irritation and only mild biochemical changes, for further studies of the efficacy of various decontamination regimens only two higher doses were used. They induced very rapid local skin lesions: reddening (30 min), oedema and erythema (60 min) to skin necrosis (120 min). Time-dependency of the biochemical changes, induced by 50 $\mu g/cm^2$ of T-2 toxin indicate that LDH, CK and AST serum activities are significantly increased in comparison with the control animals (Figure 1). These changes became significant even after 2 h following percutaneous contamination. However, since they were much more accentuated in animals sacrificed at 24 h after T-2 toxin, we chose this time as the most appropriate one for the rest of the experiments.

Moreover, preliminary experiments showed that the soap solution 5% was effective only against 1 and 5 $\mu g/cm^2$ of T-2 toxin, provided not more than 10 min elapsed after poisoning, while the suspension of the activated charcoal in water (6:1) and PEG 300 were efficient in rats poisoned with up to 50 $\mu g/cm^2$ of T-2 toxin, only if applied 10 – 30 min thereafter. This is why we chose the first next time interval, i.e. 60 min as a more serious test of the decontamination efficacy. Table 1 contains data on the efficacy of four decontamination formulations in rats percutaneously exposed to T-2 toxin (50 $\mu g/cm^2$). It is obvious that only the 5 mg/ml solution of dexamethasone in PEG 300 afforded protection against the characteristic increase in AST, ALT, CK and LDH and decrease in ALP serum activity.

Since 5 % soap solution, water-activated charcoal suspension (6:1) and PEG 300, when used 60 min after topical skin contamination with T-2 50 $\mu g/cm^2$, were not efficient, we only kept the dexamethasone-PEG 300 combination for the next experiment. This time a doubled dose of T-2 toxin (100 $\mu g/cm^2$) was used (Figure 2). Dexamethasone solution in PEG 300 abolished the changes in AST, ALT and ALP and significantly alleviated those in CK and LDH serum activities. In addition, this decontamination procedure counteracted local skin lesions induced by T-2 toxin. If used under the same circumstances, but 120 min after T-2, this regimen became ineffective.

When administered topically in control rats, 5% soap solution, activated charcoal and water and solution of dexamethasone in PEG 300 *per se* did not irritate the skin, while PEG 300 caused a mild irritation that lasted 10-12 h.

DISCUSSION

These results corroborate the previous reports that T-2 toxin effectively penetrates mammalian skin *in vitro* (10, 11) and *in vivo* (12). The used dose range of T-2 toxin, i.e. 1-100 $\mu g/cm^2$ was the same as used in another study in rats (5). Like in our study, soap with water was less efficient than PEG 300 in □ntagonize□g the skin irritation, and necessitated shorter time interval between the contamination with T-2 toxin and decontamination procedure (5). Although in swines superactivated charcoal paste was less efficient than soap in counteracting T-2 toxin-induced skin lesions (6), the results of the present study suggest that the water-charcoal suspension (6:1) was better than 5 % soap solution.

Our by far the most effective decontamination formulation was 5 mg/ml dexamethasone solution in PEG 300. The addition of dexamethasone into the topical formula was based on the well-known efficacy of corticosteroids to block the arachidonic acid cascade (15) and thus decrease the systemic toxicity of T-2 toxin (2,8,16,17). Parenteral injection of corticosteroids, but not of non-steroidal anti-inflammatory drugs (NSAID) □ntagonize the changes in serum enzyme activities (18). A combination of the PEG-induced decreased penetration through the skin and the local and resorptive anti-inflammatory effect of dexamethasone could explain the similar effect obtained in the current study. This formulation could be of great importance, since significant efforts have been performed in order to increase the preparedness of the developed countries for the possible percutaneous contaminations with various chemical and biological agents, including the mycotoxins (19,20).

It could be concluded that, among the formulations tested, 5 mg/ml solution of dexamethasone in PEG 300 is the most efficient and safest decontamination agent in rats topically poisoned with T-2 toxin.

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KEY WORDS
T-2 toxin, topical use, poisoning, decontamination, dexamethasone

FIGURES AND TABLES

Figure 1. Time-dependency of biochemical lesions induced by T-2 toxin (50 μg/cm^2) in rats

0	65,8	23,1	79	240,4	212,5
0,5	67	23,8	77,4	246,13	214,8
1	78,12	26,72	70	273,44	287,57
2	117,34	39,87	57,43	381,28	415,88
24	191,2	49	38,62	414	560

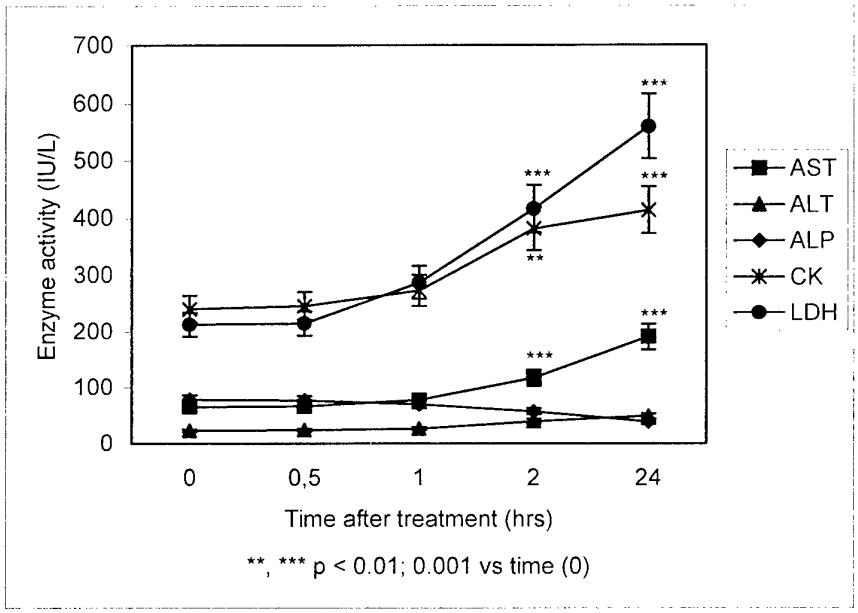


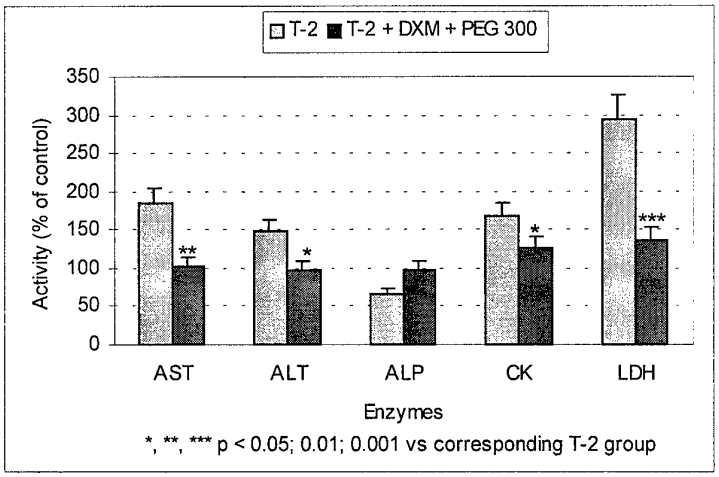
Table 1. The effect of decontamination procedures on serum enzyme activities in rats percutaneously treated with T-2 toxin (50 μg/cm^2)

Treatment	AST	ALT	ALP	CK	LDH
Control	65.8 ± 6.9	23.1 ± 3.1	79.0 ± 8.2	240.4 ± 27.0	212.5 ± 20.6
T-2	136.1 ± 16.9^{a***}	39.1 ± 5.8^{a***}	52.3 ± 8.7^{a***}	341.6 ± 59.6^{a**}	423.1 ± 70.6^{a***}
T-2 + soap solution (5%)	128.0 ± 15.4	33.5 ± 8.6	54.0 ± 9.9	321.0 ± 81.6	409.0 ± 101.2
T-2 + water-charcoal suspension (6:1)	118.7 ± 12.9	32.6 ± 5.9	56.4 ± 8.9	309.9 ± 87.6	398.7 ± 90.3
T-2 + PEG	113.6 ± 20.8	31.2 ± 7.7	59.3 ± 7.9	298.4 ± 65.3	389.7 ± 95.7
T-2 + DXM + PEG	70.5 ± 17.8^{b***}	25.2 ± 8.7^{b**}	74.8 ± 9.5^{b*}	257.3 ± 58.5 ^{b*}	251.8 ± 58.7^{b***}

a*, a**, a*** $p < 0.05$; 0.01; 0.001 vs control group
b*, b**, b*** $p < 0.05$; 0.01; 0.001 vs T-2 group

Figure 2. Antidotal effects of topical dexamethasone in PEG 300 (5 mg/ml) against percutaneous contamination with T-2 toxin (100 μg/cm^2)

121,18	67,43	184,16	102,47
34,08	22,68	147,53	98,18
52,44	76,6	66,37	96,96
402,43	301,2	167,4	125,29
625	288,64	294,11	135,83



53. TREATMENT APPROACH IN BIOLOGICAL CRISIS. AN EPIDEMIOLOGICAL AND ETHICAL POINT OF VIEW

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In the book *Genetics: the Clash Between the New Genetics and Human Value*, by David Suzuki and Peter Knudtson, biological warfare s defined as "the deliberate use of microorganisms or toxic substance derived from living cells for hostile purposes".

Many of the diseases most easily adapted to military use are infectious diseases, which have ravaged the human population for the centuries. Respiratory anthrax, pneumonic plague, smallpox, tularemia or botulism are diseases of which pathogen agents are suitable to be weaponized.

Biological warfare is generally regarded as highly unethical and morally repulsive.

The attraction for biological weapons, as well as for chemical or nuclear weapons in war and in terrorist attack is attributed to their devastating effects, due to their common property of wreaking mass destruction.

The particular attention focused on biological weapons is attributed to their low production costs and easier access to a wide-range of microorganisms that can be used in criminal purposes.

DaSilva considers that one of the main goals of biological warfare is the undetermining and destruction of economic progress and stability. The emergence of bio-economic warfare as a weapon of mass destruction can be traced to the development and use of biological agents against economic targets, such as crops, livestock and ecosystems.

Anticrop warfare, involving biological agents and herbicides, results in debilitating famines, severe malnutrition, destruction of the agriculture production. Defoliants in the Vietnam War have been widely used as agents of anticrop warfare. Cash crops that have been targeted in anticrop warfare are sweet potatoes, soybeans, sugar beets, cotton, wheat and rice. *Puccinia graminis tritici* and *Piricularia oryzae,* fungus *Tiletia caries* and *Tiletia foetida* were used as biological weapons against the targets mentioned above. Fungus *Fusarium* have been used as a source of the mycotoxin warfare in Southeast and Central Asia.

The use of such warfare agents in order to destroy the national economy of the targeted country, area or population is followed by serious health disorders in all population, in addition with economic crash. In the same area of food warfare agents there are very well known the bacterial and viral agent that contaminate food and cause a wide range of foodborne disease, like dysentery, cholera, hepatitis A, typhoid fever etc.
Such warfare can always be carried out under the pretexts that their effects are caused by natural circumstances as epidemics, with plausible denial.

Therefore, from the natural to manmade biological crisis is only an imaginative matter. Biological weapons have many features that makes them suitable for military or terrorist purposes. They have a large area of application, from incapacitating guerilla attacks to fatal epidemics that sweep enemy population.

Disadvantages of using biological weapons must be considered when we are thinking about a biological attack. The evolution of epidemics is difficult to be predicted and in the same time to be controlled, especially if the agents is human to human transmissible. Many external factors such as wind direction, temperature, humidity may influence the result of the attack. The threat of spreading the infection at long distance including the population that launched the attack is real.

Looking at particularities of biological warfare we must do understand that the model

is the nature itself. The natural evolution of a disease is the best teacher we have to learn and to understand the disease, how to diagnose, to treat and to prevent it. History of epidemic of plague, cholera, influenza, anthrax or smallpox witnesses that epidemics, especially with lethal agents are the most frightening events, may be similarly with earthquake or hurricanes, except that mortality is quite different.

Thinking about the West Nile epidemic in United States and Europe, or Bovine Spongiform Encephalitis or the most recent zoonozes in Europe, that cause not only economic disorders but confusion in population too, we must accept that anytime, anywhere a biological crisis could occur.

In the last twenty years a new problem occurred. Progress in biology, medicine, and immunology and genetic opened large and optimistic doors to treat and to save human lives. Genetic research broth a new and effective therapeutic arsenal in fighting with diseases, including infectious diseases too.

Genetic engineering techniques like DNA recombinant technologies are used to obtain vary effective vaccines, as hepatitis A and B vaccines, it is used to develop new diagnosis methods.

Unfortunately the same scientific discoveries could be used to develop modified warfare agents. Genetic techniques help to produce vaccine resistant strains for terrorist and warfare purposes, to modify the susceptibility of the germs to antibiotics or to enhance their invasiveness and pathogenity. Genetic engineered commensals became redoubtable pathogens against the " virgin" immune defense system of the host body. The end of this fight is very ease to be predict.

Genetic modified organisms can be used to produce a wide variety of potential biological weapons such as:

- organisms resistant to antibiotics, vaccines or immunotherapy;
- organisms with modified antigenic profile that do not match known identification and diagnosis standard procedures;
- organisms with enhanced resistance in hostile environment or to disinfectants;
- organisms producing modified toxin, venom or enzyme;
- organisms with modified targets and pathogenity.

Considering the facts above mentioned, to define a particular concept regarding the diseases caused by dissemination of biological warfare agent become a necessity.

This new clinical entity may be named *Biological WeaponBorne Disease* (BWBD). The concept is necessary in order to achieve the main aim of medical response to a biological attack, life saving and preserving of the patients and minimizing of all biological damages of the environment that are included in biological crisis. A unique concept will help all the governmental, local, political, medical organizations and professionals, involved in public health and medical support, to understand and to develop together the policy and the strategy of medical response. I want to emphasize that a unique conception is the key and the basement for an effective plan.

Having a generic name, BWBD, case definition must de define. The definition should notice the following details:

- the pathogen with its specific reservoir in the nature, vectors, natural way of transmission, entering way in the human body, pathogenesis and natural clinical symptoms of the disease and classic treatment of natural disease;
- the dissemination methods of pathogen as biological weapon (BW);
- changes of the incubation, clinical aspect and evolution;

- treatment requirement in severe form;
- general and specific prophylaxis and preventive measures in case of mass dissemination of the pathogen;
- possible changes made by genetic engineering;
- environment impact of spreading the pathogen.

All of these details, that are not the exclusive list, help to construct a properly medical response to biological attack.

In case of biological warfare casualties' huge questions are rising: who is treated first? Which is the most effective treatment? What stock of medicine we must have to face with a large number of victims? Do we choose the best solution? Could we treat all casualties? And many other questions.

Only a very reasonable plan, based on local realities and capabilities

These questions and other many additional are the clues in response to biological treatment.

In case of a natural disaster the intervention is influenced by several factors, including the disorganization of medical services. Despite that intervention is effective and safe for the emergency team. Biological attack means identification of the pathogen and until it is not characterized the external support is highly risky.

The education of all-medical personnel and people involved in emergency situation, primary care providers and emergency personnel in dealing with biological weapon victims is essential. Training should include basic epidemiological principles, like way of pathogen transmission from human to human, primary preventive measures, disinfection and self-protection against secondary contamination, clinical information on diagnosis and basic treatment.

Preparedness activities must be conducted from the public authorities level, including emergency network, facilities for medical assistance, communication and transportation. Reserves of medicine are crucial and involve huge funding that may be never will reimbursed. Antibiotics and vaccine are short shelves life products that require refreshing from time to time. Community must pay for that, otherwise all effort are useless.

Treatment in biological crisis is a very sensitive problem due to large variety of pathogenic agents and their different way of interaction with the human body.

In my opinion treatment in biological crisis must cover the following areas:

- medical treatment of victims;
- medical surveillance of population in the affected area;
- veterinarian surveillance livestock if situation requires that;
- cleaning and disinfection of the contaminated area;
- prophylaxis of contact people.

Medical treatment is a very large concept and very complex too. The aim is to save lives. Treatment does not consist only in antibiotics or vaccine or specific immune therapy.

Vital function sustaining, acute failure in renal or liver or cardiac, in case of chronic disease that victims are suffering, the proper way to administrate medicines, are only few areas that public health authorities must consider.

As example what are we doing in case of allergy to antibiotic choose for the treatment or the antibiotic is threatening for the victim du to its side effects? There is an alternative treatment? It is necessary to storage the alternative medicine and in what amount ?

My experience is not optimistic. An outbreak with *Shigella flexnery* resistant to almost antibiotics, except colimicine (polimixine B) was very difficult to be controlled and stopped because the lack of specific antimicrobial in the stockpiles. Practically the medicine

is used only in pediatric practice, 2-4 tablets daily. Adult dose is almost ten time more. How to treatment simultaneously 6-700 people is we have medicine for only 200 and that only for one day?

Considering the prophylaxis in infectious disease we have only few diseases fully preventable by vaccination. Other disease like anthrax or cholera is partially preventable and antibiotic treatment is required. Is mass vaccination useful in such situation? Problem is complex and may rise several questions? Way to be vaccinated if vaccine is not efficient? Or way to take antibiotic if I am immunized against infection? Confusion was always a very serious enemy for the people.

All of the aspects mentioned above and the list is much longer, reveal that medical treatment is a very sensitive problem that is not the attribute of medical support.
Scientific aspects must be in charge of professionals and academics but planning and response to threat are problems of the society.

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54. THE FIRST EPIDEMY OF TULAREMIA IN FR YUGOSLAVIA

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INTRODUCTION:

Tularemia is zoonotic disease caused by *Francisella tularensis*.The reservoirs of disease are the mamals of geni *Lagomorpha* and *Rodentia* and vectors are ixodic ticks and other haematophagic insects. Tularemia is predominantly disease of the northern hemisphere, and the form of the disease depends on the route of entry of *F.tularensis* in the organism. The ulceroglandular, tonsilopharyngeal, gastrointestinal and pulmonary form of disease occur most often. *F.tularensis* can be used as a weapon in biological warfare. Immunodiagnostic procedures, based on detection of specific antibodies on *F.tularensis* in sera are most often used in diagnostic of tularemia. Although FR Yugoslavia is an endemic region, the first epidemic of tularemia in our country broke out in 1998, in the region of mountain Rtanj, near Sokobanja. In that period thirty-eight people, between 7 and 77 years, had the disease. The most often appeared tonsopharyngeal form and rarely ulceroglandular form of tularemia. The epidemic lasted from 1999 through 2000, in the wider region of Sokobanja, including villages near Pirot and Aleksinac. During 1999. and 2000. tularemia appeared in the southern Serbian province, Kosovo and Metohia, but unfortunately we have not evidence nor any date about disease from that region. For the first time in FR Yugoslavia, in the beginning of 1999, *F.tularensis* was isolated from dead individuals of the genus *Apodemus* in the infected region.

This work is devoted to biochemical, genetic and immunochemical characterization of that isolate and the use of our isolate as antigen for preparation and standardization of homemade immunodiagnostic procedures, such as agglutination, immunofluorescence and immunoenzyme tests.

MATERIALS AND METHODS:

We developed the microagglutination test using the reference strain Schu (S84) of *F.tularensis tularensis*. This was used for examination of the sera of people from infected region. The biological essay on experimental mice was used for isolation of *F.tularensis* from dead animals of the genus *Apodemus* from infected region. *F.tularensis* was cultivated on the Francis medium enriched with cysteine. The virulence of isolated strain of *F.tularensis*, its erythromycin sensitivity, the metabolism of glycerol, glucose and cytrulin-ureidase activity were examined. rRNA hybridization was used for confirmation of the isolate and for its genetic typing. SDS-PAGE was used for immunochemical characterization of the isolate and its comparison to other *F.tularensis* strains. The domestic isolate of *F.tularensis* was used as antigen for preparation and standardization of homemade immunodiagnostic procedures, such as agglutination test, immunofluorescence test.

RESULTS AND DISCUSSIONS:

Examination of the sera of people from contaminated region by the microagglutination test showed that 38 persons (between 7-77 years) gave positive reaction. All of them had typical clinical signs of tonsylopharyngeal tularemia, except two who had the ulceroglandular form of disease. Agglutination titers ranged between 1:80-1:2560.

Using biological assays from dead individuals of the genus *Apodemus* from the contaminated region, *F.tularensis* was isolated at the Institute for Microbiology, Military Medical Academy, Belgrade (Lako B., Ristanovic E.) in the beginning of 1999. It was the

first isolate of *F.tularensis* in FR Yugoslavia. Although our country is in the endemic region for tularemia, there has not been an epidemic of this disease in FR Yugoslavia before, and the disease appears only rarely, so we had not isolated strain of *F.tularensis.* Until now, for diagnosis of tularemia in our country, we used only agglutination tests made by use of reference strain Schu (S84) of *F.tularensis* as the antigen. The domestic isolate of *F.tularensis* is high virulent for experimental animals, erythromycin sensitive, it metabolizes glucose and it has no cytrulin-ureidase activity. It is cultivated and stored on Francis media enriched with cysteine, which is necessary for growth of *F.tularensis*. Hybridization with fluorescent-labeled probes specific for rRNA of *F.tularensis* confirmed that isolated strain belongs to *Francisella tularensis* subsp.*palaearctica.* The results of SDS-PAGE show that both strains (isolated and standard laboratory strain) of *F.tularensis* have protein bands of the same electrophoretical mobility. Because of that, this method cannot be used for gene typing of *F.tularensis* strains (Fig 1.). The immunodiagnostic procedures made by use of domestic isolate of *F.tularensis*-Rtanj as the antigen are more sensitive and more specific than procedures based on use of laboratory strains of *F.tularensis*-Schu (S84).

The sensitivity of microagglutination test (MAT) made by use of isolated strain *F.tularensis*-Rtanj as the antigen is 86.36% and its specificity is 94.12%. The sensitivity and specificity of the same test (MAT) made by use of referent strain-Schu *F.tularensis* as antigen are lower, their values are 81.82% and 92.16%, respectively. The indirect immunofluorescence test (IIF) is generally more sensitive and more specific than microagglutination test. IIF test enables us to detect and determine each immunoglobulin class (not only IgM antibodies), and because of that it is better than agglutination tests. The sensitivity of IIF test using isolated strain *F.tularensis*-Rtanj, as antigen is 88.64%, and its specificity is 94.34%. The sensitivity and specificity of IIF test using the reference strain-Schu *F.tularensis* as antigen were the same. The preparation and standardization of homemade immunoenzyme (ELISA) test is in progress.

CONCLUSIONS:

The first epidemic of tularemia in FR Yugoslavia broke out at the end of 1998 in the region of mountain Rtanj, near Sokobanja. The epidemic lasted from 1999 through 2000, in the wider region of Sokobanja, including the villages near Pirot and Aleksinac. A detailed examination of these natural foci of tularemia is in progress. For the first time in our country, *F.tularensis* was isolated from dead individuals of the *Apodemus* genus. This isolate was confirmed by rRNA hybridization and identified as *F.tularensis* subsp. *palaearctica.* Immunodiagnostic procedures (agglutination and immunofluorescent) using the isolated strain *F.tularensis*-Rtanj as the antigen are more sensitive and specific than procedures using the referent strain Schu (S84). The preparation and standardization of homemade immunoenzyme (ELISA) test is in progress.

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SUMMARY:

Tularemia is zoonotic disease caused by *Francisella tularensis.* The reservoirs of disease are the mammals of geni *Lagomorpha* and Rodentia, and vectors are mainly ixodic ticks and other haematophagic insects. *F.tularensis* can be used as a weapon in biological warfare. Immunodiagnostic procedures, based on detection of specific antibodies on *F.tularensis* in sera are most often used in the diagnosis of tularemia.

Although FR Yugoslavia is in an endemic region, the first epidemic of tularemia in our country broke out in 1998 in the region of mountain Rtanj, near Sokobanja. In that period thirty-eight people, between 7 and 77 years, had the disease. The epidemic lasted from 1999 to 2000. The detailed examination of these natural foci of tularemia is in progress.

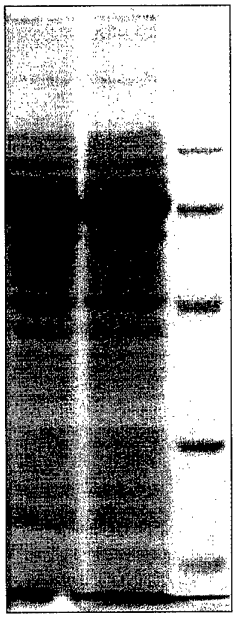
For the first time in FR Yugoslavia *F.tularensis* was isolated from dead individuals of the genus *Apodemus* from infected region in the beginning of 1999.This isolate was confirmed by rRNA hybridization with probes specific for genus *Francisella,* species *F.tularensis,* subs. *F.tularensis palaearctica.* The domestic isolate of *F.tularensis* is high virulent for experimental animals, erythromycin sensitive, it metabolizes glucose and it has no citrulin-ureidase activity. This isolate is used as antigen for preparation and standardisation of home-made immunodiagnostic procedures, such as agglutination (rapid- and microagglutination test), immunofluorescent (IIF) and immunoenzyme (ELISA) test.

KEYWORDS

Tularemia, *Francisella tularensis,* isolation, rRNA typisation, immunodiagnostic procedures

FIGURES:

Figure 1. SDS-PAGE proteins of *F.tularensis*



1 2 3

1-isolated strain of *F.tularensis palaearctica*-Rtanj
2-reference strain of *F.tularensis tularensis*-Schu (S84)
3-markers of molecular weight

55. EMERGING INFECTIONS, TRANSITION AND BIOTERRORISM

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ABSTRACT

Over thirty new infectious human diseases since 1980 have been identified for the first time. The World is in the process of increased globalization and transition. Pathogens are in transition as well. Infection knows no national boundaries and this is well known to bioterrorists.

In the competition between people and microbes eternal vigilance is the price of human survival. This imperative provides a renewed stimulus to maximize the synergies of existing scientific and health networks. If we are to control infectious diseases we have to rehabilitate and renovate existing public health systems in developing and developed countries and to improve infectious diseases surveillance systems. To prevent and deter bioterrorism requires top-quality medical laboratories for microbiological procedures and epidemiological analyses.

The Croatian public health services successfully served during the five war years (1991- 1995) and five years of transition (1996 -2000). There were no significant differences in infectious disease incidence rates during those periods. After the war and transition our public health services rehabilitated the system and renovated the infectious diseases surveillance system. The purpose of this presentation is to illustrate, with Croatian public health services experiences, what renovation efforts are necessary to meet bioterrorism as a new challenge and how to prepare the surveillance system to distinguish natural and intentionally spread infectious diseases.

KEYWORDS

Public health, transition, emerging infections, and bioterrorism

57. EBOLA VIRUS REPLICATION IN MACROPHAGES AND ITS RELATION TO THE VIRUS PATHOGENEICITY

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INTRODUCTION

Any infectious disease is a result of complicated interplay of both pathogen and organism factors. Identification of the most important events, which determine development of the disease is necessary for understanding of the basic mechanisms of infection. Much attention is paid to the most dangerous viral infections and Ebola hemorrhagic fever is among them. Ebola Zaire infection represents an example of the interaction of host with pathogen, when the virus kills humans and monkeys very rapidly and cruelly (1,2). Mechanisms providing such horrible abilities of Ebola virus are still unclear.

It is known that Ebola virus kills monkeys in 7-9 days post-infection, while guinea pigs develop non-lethal infection (3,4). Sequential passages lead to changes of Ebola virus pathogenicity and guinea pigs began to die. This effect of passages was called "adaptation" of Ebola virus to guinea pigs, and was described in early studies (5). Analogous adaptation of the Ebola virus to adult mice by sequential passages was reported recently (6). Detailed examination of the non-lethal Ebola infection and changes of the infection in the course of passages has been not performed. Meanwhile, comparison of lethal and non-lethal forms of Ebola infection may highlight the mechanisms of pathogenicity and virulence of dangerous Ebola virus. The aim of present study was to analyze differences between fatal and non-fatal infections caused by Ebola virus, and hunt dawn the changes related with transition of non-fatal infection to fatal in experimental animals.

MATERIALS AND METHODS

Ebola virus (Zaire strain), passaged two times in monkeys, was used. Twelve adult green monkeys (Cercopithecus aethiops) were subcutaneously infected with 100 LD_{50} and thirteen adult baboons (Papio hamadryas) were subcutaneously infected with 20-50 LD_{50} of Ebola virus. Eighty outbred young guinea pigs weighing 180-200 g were used for the studies. Animals received Ebola virus in a dose of $10^{6,5}$ LD_{50} for newborn mice. Adaptation of Ebola virus to guinea pigs was performed according routine technique of blind passages: animals were infected by 1 ml of 10% hepatic suspension prepared from the liver of guinea pigs on the previous passage. Only feverish animals were used for preparation of the inoculum and for examinations. Nine sequential passages of Ebola virus on guinea pigs were performed. Clinical observations and content of the virus in blood of monkeys and guinea pigs were determined by plaque forming units (PFU) technique or inoculation of newborn mice. Samples of the visceral organs were obtained for light and electron microscopic examinations. Details of the experiments were described may be found in earlier publications (7,8).

RESULTS

Infection of the monkeys with Ebola virus caused fatal disease finishing with death on days 7-9, while guinea pigs developed acute infection without death during the continuance of 28 days of the experiment. Monkeys developed a fever from day 4 postinfection, and showed precipitate drop in the temperature 5-5 h before death. Fever was registered only in

50% of guinea pigs on days 3-8, and on days 12-16 after inoculation with unadapted Ebola virus. The virus was detected in monkey blood from days 3-4 postinfection, and it's content rose up to 10^{7-8} PFU /ml at the end of infection. Attempts to find Ebola virus in blood of guinea pigs were unsuccessful even by most sensitive method of the inoculation of newborn mice. Guinea pigs showed anorexia, loss of excitability, weight and tufts of hair during the febrile phases of Ebola infection. Monkeys developed anorexia after fever onset, and 60-70% of baboons inoculated with Ebola virus demonstrated visible signs of the hemorrhagic syndrome: blood vomiting, bleeding from rectum and vagina, prominent hemorrhages into skin and mucous membranes at the infection terminal stages.

Microscopic examination showed clear differences in the pattern of organ pathomorphological changes between the monkeys and guinea pigs. Pathological changes were observed in all visceral organs of Ebola virus infected monkeys, with severe impact to liver, spleen, kidneys and lymphatic organs, and blood system, while guinea pigs showed only local inflammatory process in the liver. Numerous fibrin thrombi and clots were found in blood vessels of green monkeys during last days of the infection, whereas visceral organs of baboons showed multiple hemorrhages of various sizes. The most prominent feature of Ebola infection in guinea pigs was focal inflammatory reaction in the liver (Fig. 1). Visible pathologic changes were not found in another visceral organs except of splenic white pulp and lymphatic nodes, showed slight lymphoid depletion and damage to stromal and macrophage cells.

Examination of the visceral organs of Ebola virus infected animals by electron microscopy revealed different mode of interaction of the virus with host cells. Thus, replication of Ebola virus in all the studied monkeys was observed in macrophage cells, hepatic parenchymal cells, adrenal cortical cells, fibroblasts and endothelial cells. All monkey organs contained Ebola virus infected macrophages and fibroblast cells at the terminal stages of infection indicating the generalized pattern of the disease. In contrast, in guinea pigs Ebola virus replication was restricted to macrophage cells located inside the inflammatory foci in the liver (Fig. 2).

Examination of guinea pigs organs day by day established that Ebola virus was able to replicate only in the cells of macrophage lineage, including Kuppfer cells. It was also found that infected cells represented the cells, which induced focal inflammation in the liver. Inflammatory foci in the liver of Ebola virus infected guinea pigs differed in sizes and contained all varieties of leukocytes: large agranular lymphocytes, granular lymphocytes, monocytes, and neutrophils. Fibrin clots and bundles filled the spaces between the cells and bordered the foci around, and thereby prevented the access of Ebola virus into bloodstream. Each foci was isolated from surrounding tissue, and all viral progeny were arrested inside the foci. Ebola virus particles being blocked inside the foci were accessible for all affecting factors releasing by inflammatory leukocytes. It should be noted that hepatocytes were not involved in formation of the inflammatory foci. Hepatocytes remained unaltered even in close vicinity of the foci. Effectiveness of the virus blockage inside the foci was evidenced also by the results of virologic studies. Ebola virus was not found in the blood of a guinea pigs nor at the top of infection, nor in other periods, while hepatic homogenate contained the virus in a concentration of 10^4 - 10^5 PFU/ml (Table 1).

Examination of the liver of Ebola virus infected guinea pigs in light microscope revealed rare sole activated Kuppfer cells, which were not related to inflammatory foci. Studies by electron microscope found that few of these cells were infected. The cytoplasm contained specific Ebola virus inclusions with straight nucleocapsids (Fig. 3). These infected Kuppfer cells produced viral particles having "typical" morphology of Ebola virus, and did not induced inflammatory reaction. No neutrophil or another leukocyte were found in the

vicinity of these infected Kuppfer cells. Thus, these cells represent another kind of replication system for Ebola virus in the liver of guinea pigs providing unrestricted release of the virus into bloodstream and surrounding tissue. Sequential passages of Ebola virus on guinea pigs resulted in rise of the virus pathogenicity for these animals. Concentration of Ebola virus in the liver of guinea pigs was relatively small on first and second passages, then increased, and animals began die on third-forth passages on days 7-8 after the infection. Liver of guinea pigs at first and second passages showed rare inflammatory foci composed of few leukocytes. We could not find any infected cells in the liver of guinea pigs on first and second passages. Obviously, number of the infected cells was beyond of the sensitivity of electron microscopy, while biological methods showed presence of the Ebola virus in hepatic preparations at the same passages (Table 1). Signs of pathologic changes were not detected in another visceral organs.

Third passage displayed another pattern of the hepatic injury. Ebola virus replication were observed in the liver from days 5-6 postinfection until death. Main feature of the replication was infection of the hepatocytes, not only macrophages. Cells of hepatic parenchyma contained typical Ebola virus inclusions and nucleocapsids (Fig. 3). Total number of Ebola virus infected cells in the liver of guinea pigs on third passage was incomparably larger than in livers of guinea pigs infected with unadapted virus. Accumulation of leukocytes was evident in the hepatic tissue, but distinct inflammatory foci did not formed. Microcirculatory disturbances were observed in the liver from days 3-4, and small necrosis of hepatic cells were found from days 5-6 postinfection. Microcirculatory disorders were also detected in spleen, lungs, kidney, adrenals and lymphatic nodes in guinea pigs on the third passage of Ebola virus.

The next passages resulted in rise of the level of pathological changes, disease severity and mortality. Pathological characteristics of fatal infection in guinea pigs were in very close similarity to those in monkeys. The set of target cells supporting Ebola virus replication was identical in both guinea pigs and monkeys: macrophages, hepatocytes, adrenal cortical cells, fibroblasts and endothelial cells. The general pattern of pathological changes in visceral organs of monkeys inoculated with Ebola virus, and guinea pigs infected with adapted Ebola virus also was very similar, sometimes nearly identical. However, one significant exception was established: guinea pigs never showed such hemostatic changes as monkeys. Signs of hemorrhages and clotting were not observed in guinea pigs even at passages 7-9. Features indicating impairment of immunity were identical in monkeys and guinea pigs infected with adapted Ebola virus: lymphoid depletion, absence of mitosis in lymphocytes, lack of inflammatory reaction against infected cells. So, in consequence of Ebola virus adaptation to guinea pigs the virus acquired ability to infect additional cellular targets, pathologic changes of visceral organs increased, and the infection became fatal.

DISCUSSION

Pathology of the fatal Ebola infection in monkeys has been described in series of publications (1-4,8,10,11), while data concerning non-lethal infection are very fragmentary (5,6). The present study revealed distinct differences in ability of Ebola virus to replicate in cellular targets in the case of fatal and non-lethal infections. In both monkeys and guinea pigs macrophages were primary targets for Ebola virus, supporting productive infection resulted in formation of viral progeny. However, replication of the virus in monkey macrophages did not induce inflammatory reaction, and progeny viral particles had free access to blood and neighboring cells. In distinction from monkeys, infected macrophages of guinea pigs were surrounded with inflammatory leukocytes and densely encased by fibrin, which blocked Ebola virus progeny inside the foci. Formation of inflammatory foci in the liver prevented

dissemination of the virus and restricted viral replication to macrophages. Thereby, infection acquired the local pattern. Recent studies of murine cytomegalovirus infection showed that local reactions of immune defense may be crucial for the disease development and outcome (9). The results of our study of non-lethal Ebola infection in guinea pigs are in good agreement with this statement. Guinea pigs demonstrated operation of the effective defense mechanism, which provides blockage of Ebola infection in liver and thus determines the course and outcome of disease.

Examination of non-lethal infection found two kinds of interaction of Ebola virus with macrophages of guinea pigs: (1) related and (2) unrelated to development of inflammatory reaction. We suggested that this is an evidence for presence of two kinds of viral particles in initial population of the Ebola virus. The process of adaptation of Ebola virus in its essence is a selection of viral particles, which are able to replicate without induction of local inflammatory response. The initial population of Ebola virus should contain the particles which are able to kill guinea pigs. This is evident from the reproducibility of adaptation experiments. Quantity of these particles increased in the course of passages, and ability to kill guinea pigs became a characteristic feature of the virus population. Our studies traced the changes of infection in guinea pigs during the sequential passages of Ebola virus, and allowed to suggest that differences in interaction of Ebola virus with macrophages were responsible for outcome of the infection.

What a conclusion may be drawn from the results of Ebola infection studies? It is clear that Ebola virus is capable to infect cells of macrophage family in guinea pigs. Replication of the main portion of Ebola virus population induced local events of the immune defense reaction in a form of focal inflammation. Remaining portion of the virus population, very small portion, is able to replicate in macrophage cells without induction of the inflammatory reaction. It seems that immune system can not recognize these infected cells, and Ebola virus may replicate without restrictions. We suggested that just this portion of the viral population is responsible for changes in Ebola virus pathogenicity for guinea pigs during the passages, and organisms of guinea pigs act as a system for selection.

KEYWORDS
Ebola virus, guinea pigs, pathogenicity, passages, macrophages, monkeys.

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FIGURES AND TABLES

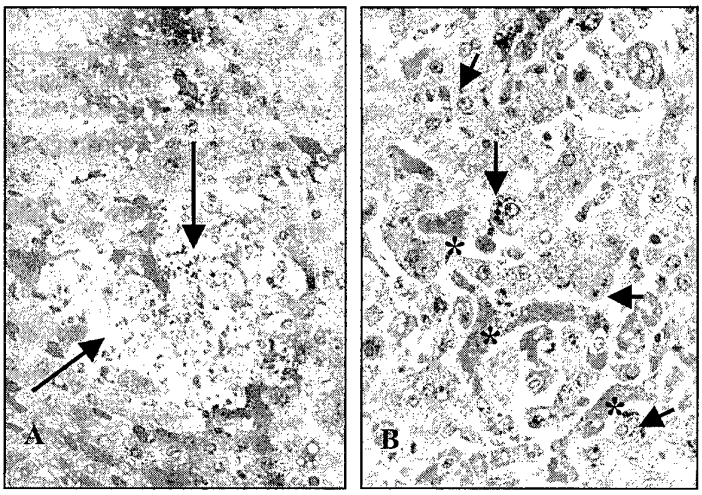

Fig. 1. A – a liver of guinea pig infected with unadapted Ebola virus. Day 7 postinfection. Arrows show large inflammatory focus. B – a liver of baboon infected with Ebola virus. Day 7 postinfection. Arrows show hepatocytes containing Ebola virus inclusions. Asterisks are pointed to sinusoids. Note absence of inflammatory reaction to infected cells. Short arrows are pointed to sinusoids. Semithin sections. Light microscopy.

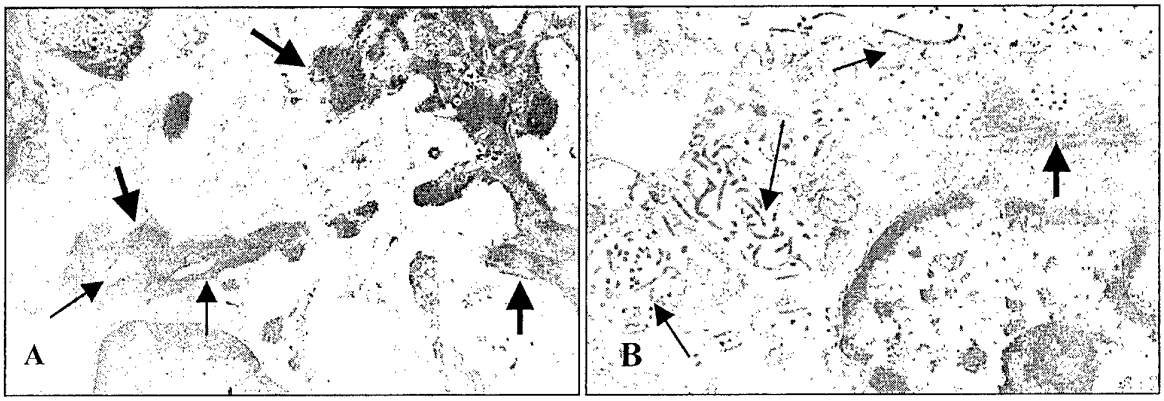

Fig. 2. Inflammatory foci in the liver of guinea pig. Day 7 postinfection with unadapted Ebola virus. A – fibrin (thick arrows) deposits between the cells. Thin arrows show viral particles blocked by fibrin. Magnification 10 000. B – part of macrophage cell infected with Ebola virus. Thick arrows show viral inclusion in the cytoplasm, thin arrows are pointed to viral particles. Magnification 18 000.

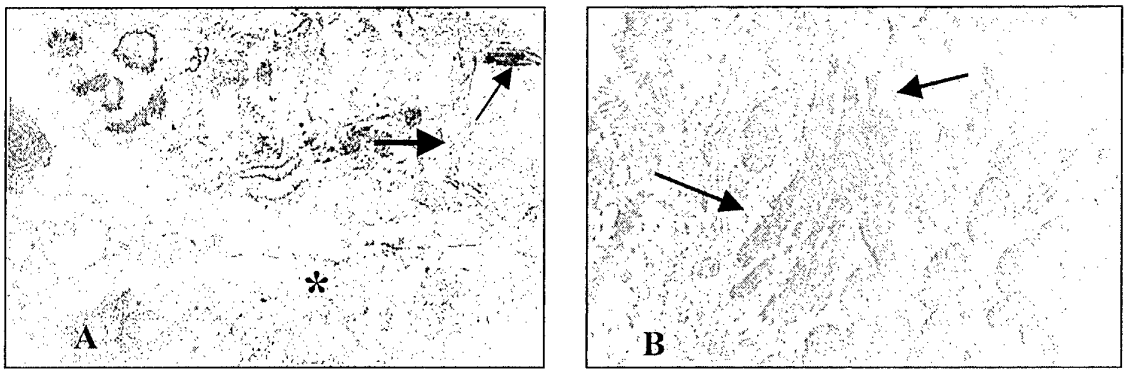

Fig. 3. A- a sole Kuppfer cell in guinea pig liver. Day 7 postinfection with unadapted Ebola virus. Thick arrow shows membrane structure specific for Ebola virus replication, thin arrow shows nucleocapsids. Asterisk is pointed to adjacent hepatocyte. Magnification 10 000.
B – a portion of hepatocyte infected with Ebola virus. Seventh passage of Ebola virus. Arrows show nucleocapsids in the cytoplasm. Magnification 16 000.

58. THE CROATIAN POPULATION AND RESPONSIBILITIES FOR MEDICAL PROTECTION

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INTRODUCTION

The population and territory of the Republic of Croatia are exposed to the dangers resulting from natural, industrial disasters, as well as crises caused by the war. In the period between 1991 and 1995, Croatia and its population were affected by war.

Apart from the Croatian Army, at the battlefields, frontlines and in the rear, some segments of medical services and civil defense (1,2,3,4,5) actively participated in the defense and protection of the population.

The war, which was imposed to Croatia, put many services, institutions, defense and civil protection systems (6,7,8,9) on test. The experience has shown that a positive level of safety and health status of the population should be a priority task of the organized forces of the Croatian society.

The knowledge of the factors defined of the whole health status should help the persons assessing and planning the health situations to make their assessments and plans of the defense and protection health segment convincing and realistic.

METHODOLOGY

Normative, analytical and comparative methods were used in this work.

DISCUSSION

No society is safe and protected against crises and their consequences. Many people, material goods and the environmental itself may be affected by a crisis.

In Croatia, in the period between 1991 and 1999, the responsibility for the defense and protection of citizens, their lives and health was taken on by the medical segments of the ordinary medical services, with 44,000 employees, as well as unspecified number of organized medical segments of the civil defense of the Republic of Croatia.

In 1993, at the national level, the responsibility for the activities of the Protection and Rescue System was taken on by the Government of the Republic of Croatia with its competent Ministries. At the local level, the responsibility for these activities was taken on by local crisis management authorities or, directly, by medical segments responsible for satisfying medical needs of citizens in peace or war times, as well as in the crisis conditions and the consequences of a crisis.

In the early 1994, the program and operational model of defense and protection of citizens against all kind of crises and consequences has been groundlessly given up. Therefore, in normative and practical terms, the activities were reduced to improvi sations. A large scope of defense and protection activities was being solved though sub-legal acts and discretion rights of the competent minister, Minister of the Interior. Therefore, the needs for medical segments were neither met nor sufficiently coordinated by the Minister of Health and his referral centres.

In spite of, in modern terms, undefined conditions of defense and protection of citizens against crisis and their consequences, and before including those institutions and

authorities, which are responsible and trained for medical care of citizens during crisis, crisis problem or manifest crisis, these actors should, in peace time and non-crisis period, from an initial team of professional coming from competent organizations, institutions and other actors. They would, intra-, and interdisciplinarily, on he bases of law, regulations, standards, conventions, treaties, abilities and needs, be able to create preconditions for determining the real status of the health level of the population of Croatia , its needs and abilities. Also, the status abilities and qualification would be established of the medical segment of protection in the society, which should the main actors of the protection of population against crises and their consequences, based on assessments, proposals, solutions and plans. The initial core team would lead the responsible civil defense and protection actors towards the formation of command and executive bodies of a designed system of defense and protection of the population against crises and their consequences, as its basic part and medical segment. This would prevent improvisation, disorientation, unresourcefulness, or credits to all participants in a crisis or a consequence of a crisis. What was achieved so far in this field was a result of engage ment of individual enthusiasts, rather than organized and legally regulated activities.
Therefore, there is need to organize a body in charge for management and coordination in crises and their consequences. This body would also serve all justified activities and demands in society. All services in the country should be engaged., which are in various manners included in and connected with the medical segment of the defense and protection of the Croatian population.

Good organization of medical defense and protection, of goods and environment, is a primary security and economic issue of Croatia. Therefore, activities should be organized more efficiently in order to achieve safety with minimum resources and expenses. This especially applies to economically underdeveloped countries and the Croatian population impoverished by the war.

A comprehensive approach to the protection of the population»s lives and health should be observed within the frameworks of definitions and actors, whose components are well-defined situation and health status of the Croatian population.

A positive level of health state of the country should be maintained with expert support, with appropriately set legal regulations, which certainly need to be improved. Crises and their consequences can be reduced by maximal coordinated use of the existing material and human resources. Positive results could be achieved in the medical segment of defense and protection of population because many peacetime resources of the regular medical services exist functionally and are compatible. They can rather quickly fit into the protection against crises and their consequences, with minor reinforcements of human factor recruited from their regular activities or civil defense

The efficiency of the medical segment of the protection in a crisis would be achieved if the anti-crisis elements were satisfied, such as constant and uninterrupted supplies, reparation, resources supplement, as well as education of donors and acceptors of general security and protection.

Following the typological, organizational and internationally accepted criteria, it is necessary to accept the definitions, contents, relations and factors of the health status, as well as their categories and levels. Not only isolated medical subjects are the ones who are responsible for the factors of individual»s or society»s health status, but also various governmental and intergovernmental organizations, which bear the responsibility and participate in improving the level and safety of individual»s or society»s health status; these organizations are also responsible for the definition and contents of those factors, which

define the health status.

Having respect for all kinds of achievements of human activities and a wide range of contents of the health status factors, WHO has proposed a structure of interconnected relations, relations, related to the connections between various medical partners/actors responsible, at the beginning of the 21st century, for the level and the health status itself of individuals or society.

Following its own presumptions, WHO, as an important factor, has presented its own values and the relations, which will be important in future for intergovernmental and governmental cooperation in many countries across the world, and whose task will be to take care of population»s life and health.

WHO and all other similar international associations will require general co-ordination, tolerance and openness to all common problems, which are important for the security of a society and its citizens. These associations shall require coordination and relations with ACC Task Forces and Inter-Secretariat Committees, such as IACSD, etc. (10).

The factors, which influence and will continue to influence the health status, vary in their contents and will affect many fields of human activities. They will be observed as aimed factors or macro-factors, biological or/and proximate factors and/or general factors influencing the population»s health status.

Pursuant to their definitions and contents, macro-factors will be of political nature, with characteristics affecting human rights, stock, social affiliation, social security, peace and wars. Economic macro-factor will be related to resources, production, consumption, level of production factors, statuses and relations.

Educational factor will be related to the level and status of knowledge and education. The environmental factor will define all the activities and relations related to the local and global living milieu.

Technological factor will be related to the status and level of technological processes and productivity, but also to the level of sources and distribution of exhaust or stored hazar dous substances in the environment or wider. It affects safe life and the living and health standards of the population, living in and exposed to a technical and technological environment.

Demographic factor will have significant contents in its definition of health status of an individual or a group of people, which is organized in a certain time and area, in order to satisfy their needs, to survive and rise future generations.

Croatia has approximately 4.5.million inhabitants. In this geo-strategic area, in average, there are 84.7 inhabitants per km2. The life expectancy is 68.6 years for men, and 77.5 for women. As for the age structure, the Croatian young population is decreasing; 27 %, according to 1951 census, was reduced to 19 %, according to 1991 census. The increase tendency has been recorded as refers to the old population.

The registered unemployment rate in the post-war period, in 1999 and 2000, has increased. In 1999, it was 19.1 %. Over a million of pensions users live in Croatia.

The number of actively employed population is the equal (11)

The migration and tourist factors will also be important for the assessment of the health status of the Croatian population. During tourist season, there will be an increased danger of imported contagious and other unhealthy states (drugs, alcohol, prostitution, physical and mental violence, traffic injuries, etc). There will be increased danger and the number of fires outdoor and in buildings. The number of traffic accidents will increase. More hazardous substances will be emitted due to the combustion of larger quantities of fuel, from motor

vehicles exhaust systems.

Due to strenghtened traffic connnections between the East and the West, open and soft borders, public and secret tourist and economic immigration will flow from the undeveloped East towards Western Europe , which will also affect the quality, contents and the level of security, as well as health status of the Croatian population.

Global trade and communication factors will also interact and influence the health status in Croatia.

Biological factor, especially increased import of, in medical terms, insufficiently adequate seeds and food, genetically modified goods, as well as liberalized import, will affect the health status (transglobal contagious diseases, BSE, gonorrhea, syphilis, measles, diphteria, AIDS, malaria, cholera, stomatitis aphtosa, antrax, tularaemia, brucella, trichinosis, rabies, tuberculosis, poliomyelitis, phytozoonoses, toxical infections, parasitoses, etc.). Healthy air, food, water, absence of noise and vibrations will be important positive factors of population»s health status (10).

Demolitions and terrorism will be estimated negative factors for security and health status of Croatian population.

The so called, proximate factors will have to be observed from the point of view of security and protection of population, control and surveillance over traffic, production and distribution of food, water and sanitation measures. Industrial factors will be obser ved from the point of view of industrial production possible accidents, or hazards.

Social network, social work and capital will have to be developed and perfected.

Social and cultural behaviour, with respect for and maintenance of tradition, culture, customs and the level of self-awareness, language, script, religion and rituals, nations and other social groups (10).

Medical actors in narrower sense will have to be developed through intergovernmental.intra- and intergovernmental cooperation of countries of origin and other countries. They will also have to harmonize their work and other activities through international associations, such as WHO, World Bank, OUN, UNICEF, UNDP, UNAIDS, UNESCO, UNIDO, UNHCR, FAO, UNEP and other UNS with wider attributes (10). Scientific services and servicing, defense and protection, together with politics, economy, education, environment protection, life, and health status of population, will be terms of reference of one or several definitions of health status, significant for the safety and life of individuals or organized society in general.

Therefore, with a good reason, in crises management, in the very process of facing crises and crisis situation, and during crises situations, solving of the crisis problem will be manifested through standard management phases, from its outburst to the final phase of its removal. All will be defined through the so-called crises management phases and the functions of the activities in crisis situation. The phases follow one another or go simul taneously. Phases will be recorded, i.e. alleviation, preparedness, response to incident, accident, phenomenon, recovery after a crisis and consequences, as well as improvement of conditions, socialization and restoration of the pre-crisis general security situation as well as living and working conditions.

Preparedness is one of the most important segments of functional activities of actors in the defense and protection in crises. Preparedness includes all the activities, which follow the alleviation phase, and which is provided with anything necessary for immediate reaction to alarm for crisis or critical phenomenon, In some crises, we cannot act preventively. But the hazards and consequences of a crisis are unavoidable. Therefore, in the preparation phase,

organized societies (Government, state, organizations, services and individuals) design and develop plans of defense and protection of citizens, their lives, health and environment, and all that with the aim of reducing losses, damages and consequences.

Preparedness is to improve and promote all activities with the aim of efficient and timely response to crisis situation, or in the state of developed crisis with consequences in a certain area, time and population.

Response is defined as the activities related to a certain manifest crisis phenomenon, situation, developed crisis, affected and non-standard situation or accident, whose actors are empowered organized and trained administrative and executive forces and actors, in charge of response, who react to a crisis through actions, immediately or in its course, during its manifest crisis situation. Response will reduce the probability of new and further secondary hazards, consequences and damages, with the aim of accelerating the sanitation process and restoring the peacetime living conditions and security status.

The activities aiming at restoring the normal situation or situation better then the previous one are defined as renovation or reconstruction .The aim of renovation is to restore all of the important functions that have to satisfy the minimum standards/norms of life in the short /shorter period of time. The renovation or reconstruction in the long/longer period will perform all of the activities and procedures that develop the restoration of the previous agreeable situation in the longer period of the time, and this can last even a few years after the crisis/accident, i.e. toxic or nuclear accidents etc.

The purposefulness of protection and defense of population from the crises is linked to the engagement of many factors of the society on all of its levels in protection of lives and health of the population and of the environment. The system of protection and rescue of the population would become more humane, logical, convincible and nationally affirmative factor of health in Croatia in the case of high level of care and protection and developed social and economical relations.

Social categories, together with economic categories, are contained in definitions of better social and economic exploitation of all resources in Croatia. All this is with the aim of maximum exploitation of the system man. resource- environment This might ensure rather good health protection of the Croatia population from various threats.

The older schools of economics considered humanism and efficiency to be the opposite goals. However, the recent researches show that these goals are mostly complementing each other. there are numerous interdependencies between defense, protection, economy, and vice versa. The general security at the same time influences personal security and vice versa. Individual security is a part of general security. This makes general security more qualitative, more important in social and safety aspect, and more humane

CONLUSION

The population and the territory of the Republic Croatia are exposed to threats that can be caused by natural, industrial and ecological accidents as well as war crises.

It has been recognized that feasible positive level of security and health situation of the population has to be the priority task for all of the organized forces in the Croatian society, especially in those subjects whose basic activity is health defense and protection of the population. The knowledge of defined factors responsible for general health situation might be of assistance to the persons charged with assessment and planning health situation, so that the assessments and plans health segment of defense might be applicable and realistic.

This is the reason why it is necessary to organize a body for management and coordination in crisis situation and in case of crisis consequences. This body would provide services to the activities and requirements of the society. All the services and the country that in various ways include and are linked to the segment of defense and protection of the population of the Republic of Croatia (12) should be engaged and harmonized.

The general approach in the protection of lives and health of the population should be viewed also within the framework of definitions and factors, whose component is the health situation of the Croatian population. The general level of health situation in the country should be protected.

The organization of the health defense and protection of the population, goods, and environment is the priority safety and economy issue for Croatia or any other state.

WHO and all similar organizations request absolute coordination, tolerance and openness towards all the problems that are common and of the interest for the security of any soci ety and its population.

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KEY WORDS:

Medical care, civil defense, health factors, Croatia

59. BLOOD NEUROPATHY TARGET ESTERASE AS BIOCHEMICAL MARKER FOR NEUROPATHIC ORGANOPHOSPHATES EXPOSURE

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INTRODUCTION

Organophosphate-induced delayed neurotoxicity (OPIDN) is a distal degeneration of sensory and motor axons that occurs 2-5 weeks after an acute poisoning by several organophosphates (OPs) with antiesterase activity and appears as flaccid paralysis of the lower and, in the most severe cases, upper limbs [1,2]. This process is totally independent of inhibition of acetylcholinesterase (AChE) and can be induced by OPs with low acute toxicity [3,4]. OPIDN has occurred in epidemic proportions through the world [5]. The high human susceptibility to OPIDN [6], its insidious onset and usually permanent debilitating effects make the problem of monitoring of neuropathic OP exposure to humans as well the problem of an early diagnostics of OPIDN highly important. It is necessary to bear in mind that ability of some OPs along with acute cholinergic toxicity initiate OPIDN may to be of interest for different terrorist groups.

There is considerable evidence that a neuronal protein with serine esterase activity, neuropathy target esterase (neurotoxic esterase, NTE), is the primary target molecule in OPIDN. It is thought now that OPIDN is initiated by the organophosphorylation of NTE with a subsequent specific modification (aging) of the inhibited enzyme [3,7,8]. In the experimental animals OPIDN is associated with > 70% threshold of brain NTE inhibition after single exposures. The threshold in man is not known, although there are indications that it is similar.

The relationship between NTE inhibition/aging and development of OPIDN has potential to be further exploited as a biomarker [3,8,9]: inhibition of brain NTE within hours of exposure to OPs predicts potential for developing OPIDN in susceptible animal models (the adult hens) after delay in 1-5 weeks. NTE has also been found in circulating lymphocytes and platelets [10-12]. Lymphocyte NTE has been proposed for use as accessible biomarker of animals and human exposure to neuropathic OPs. [7,13-16]. Furthermore, the desirability of exploiting of such an accessible source of human NTE in health monitoring of exposed people has been discussed [6,13,17-19].

Whereas it should be noted that isolation of lymphocytes requires a highly equipped laboratory and highly skilled personnel; it is time-consuming process that provides a relatively low yield of cells for assay. In addition, NTE assay in lymphocytes requires a large sample of blood, and lymphocytes isolated are unstable under storage. This all restricts considerably the use of lymphocytes to monitor routinely NTE activity among individuals exposed to OPs in field and industrial conditions as well the carrying out epidemiological studies.

NTE is determined as that part of phenyl valerate hydrolysing activity which is resistant to inhibition by O,O-diethyl-4-nitrophenyl phosphate (paraoxon, non-neuropathic OP) but sensitive to inhibition by N,N'- di-iso-propyl phosphoro-amido fluoridate (mipafox, neuropathic OP) [3]. Phenol released as a result of phenyl valerate hydrolysis is usually

determined spectrophotometrically by measuring absorbtion of red coloring after the oxidative coupling phenol to 4-aminoantipyrine in alkaline potassium ferricyanide [20].

The application of spectrophotometry is often limited in biological samples, especially in samples with low NTE activity when their turbidity and possible presence of coloring of a sample reduce the accuracy of measurements, as well when only small quantity of biomaterial is accessible. The additional problem occurs when somebody works with blood. In this case the colored reaction product of phenol with 4-aminoantipyrine and potassium ferricyanide should be measured on the background of a red color of blood. The optical density of the 10-fold diluted homogenized whole blood at 492 nm (close to the optimum for the spectrophotometric phenol detection) was shown to be approximately 0.75-0.8 [21]. A dilution of blood cannot be effective because the sensitivity of the spectrophotometric NTE assay decreases sharply and becomes negligible at 100-fold dilution of the blood [21] that makes NTE analysis in whole blood completely impossible.

These problems could be eliminated with use of amperometric technique instead of spectrophotometry for phenol assay.

To create fast and simple methods of monitoring neuropathic OP exposure to humans suitable for epidemiological studies and early diagnostic of OPIDN we developed a new approach to analysis of NTE activity by means of tyrosinase-based biosensors. Such tyrosinase biosensors involve the enzymatic oxidation of phenol *via* catechol into o-quinone, the reaction proceeding with oxygen consumption [22]. The change in the concentration of phenol was monitored by oxygen uptake when the Clark-type oxygen electrode covered with tyrosinase immobilized in polyvinylalcohol used as an electrochemical transducer [23].

Electroreduction of quinone on a graphite electrode can also be used as a detection reaction for the quantification of phenol [24]. The tyrosinase carbon-paste biosensor for phenol provides electrochemical reduction of quinone to catechol directly at the electrode when the required potential (-50 mV) is applied (Fig. 1). This regenerating process amplifies the electrode response and makes it possible more sensitive phenol detection compared to the measurement of the oxygen consumption [21,23]. We showed that the use of tyrosinase carbon-paste electrode improves 10-fold the sensitivity of NTE activity determination in comparison with a spectrophotometric method and amperometric method with the Clark-type electrode modified by tyrosinase [21,23,25]. The developed tyrosinase carbon-paste electrode is characterized by high sensitivity and stability for phenol detection in a flow-injection mode. Time of analysis for a single phenol sample in flow mode was 2-3 min when the flow speed was 0.25 ml/min [21].

In the present work we report the results of studies of possibility of application of biosensor methods to the NTE activity analysis in whole blood as well the results of OPIDN modeling in experiments on animals with acute administration of the increasing doses neuropathic OP O,O-dipropyldichlorvinylphosphate (PrDChVP) and studying the correlation between NTE inhibition in brain and blood using spectrophotometric and biosensor methods

MATHERIALS AND METHODS

Chemicals: Phenyl valerate (PV), mipafox (*N,N'*-diisopropylphosphorodiamido fluoridate), O,O-dipropyldichlorvinylphosphate (PrDChVP) were synthesized and characterized in the Institute of Physiologically Active Compounds Russian Academy of Sciences (Russia) [15] and in the Institute of Organic Chemistry Ukrainian Academy of Sciences (Ukraine). The purity of all substances was not less than 99% (by spectral, chromatographic and elemental analysis data). Mushroom tyrosinase (monophenol monooxidase, EC 1.14.18.1), activity 3800 U/mg for L-tyrosine, graphite powder, paraoxon (*O,O*-diethyl-4-nitrophenylphosphate), 4-aminoantipyrine, and potassium ferricyanide were

purchased from Sigma Chemical Co. (St. Louis, Missouri USA and Deisenhofen, Germany). Phenol was received from Merck (Darmstadt, Germany). A Coomassie protein kit was from Pierce (USA). All other chemicals were of analytical grade and used without further purification. Aqueous solutions were prepared using deionized water.

Preparation of tyrosinase carbon-paste electrode and assembly of biosensor. The tyrosinase electrode was prepared as described previously [21]. All measurements were performed with an applied potential of -50 mV vs. Ag/AgCl. The current was measured by means of a homemade amperometric detector "IPC2000" coupled to PC. The device operating and processing the results of electrochemical measurements were carried out with use of specially developed software.

Tissues

Neuronal NTE. The lyophilized hen brain (P_2+P_3) membrane fraction preinhibited with paraoxon (40 μM, 45 min) was used as a source of NTE. It was prepared as described in [26,27] and stored in sealed ampoules. Before use, the ampoule content was suspended at 25°C with a glass/glass Potter homogenizer in 2 ml of a work buffer (50 mM Tris-HCl, 0.2 mM EDTA, pH 8.0). The preparations of neuronal NTE have a specific activity of about 40 nmoles phenyl valerate/min per mg of protein.

Isolation of lymphocytes from human blood. Fresh human blood stabilized by citrate with EDTA was used. Lymphocytes were isolated as described in [21,28] and homogenized in glass/glass Potter homogenizer before NTE assay.

Blood preparation. Whole human and hen blood stabilized by citrate with EDTA was homogenized in Potter glass/glass homogenizer, then diluted by the work buffer up to the desired level of dilution.

Samples preparation for NTE activity determination by spectrophotometric and electrochemical methods. NTE activity was determined according to the differential method of Johnson [20] as a microassay version [29] with slight modifications [30]. The diluted with work buffer samples of lymphocytes or the homogenized whole blood were incubated at 37°C with 50 μM of paraoxon for 20 min (sample B) or with 50 μM of paraoxon plus 250 μM mipafox for 20 min (sample C). Phenyl valerate then was added. After 30 min incubation at 37°C, the reaction was stopped by addition of aqueous SDS. Phenol released was assayed spectrophotometrically or amperometrically. In the case of the paraoxon-preinhibited preparation of the hen brain NTE the samples were incubated in work buffer (sample B) and in buffer with 250 μM mipafox (sample C) for 20 min at 37°C, following the incubation with phenyl valerate and reaction termination by SDS as described above.

Spectrophotometric phenol assay. Phenol released as a result of the enzymatic hydrolysis of phenyl valerate was assayed in 96-well microtiter plates at 492 nm using Microtiter Plate Reader SLT 340 ATTS (SLT Labinstruments GmbH, Germany) after the incubation of 100 μl of final reaction mixture at room temperature with 4-aminoantipyrine and potassium ferricyanide. Each measurement was made in triplicate. The absorbance difference between samples B and C was used for specific NTE activity calculation using the phenol standard calibration curve.

Electrochemical phenol assay. Prior to measurements, samples were diluted 10-50-fold in 0.1 M NaCl + 0.05 M sodium phosphate buffer, pH 7.0. Enzymatically released phenol was measured amperometrically after an injection of the diluted final reaction mixture into a flow of 0.1 M NaCl + 0.05 M sodium phosphate buffer, pH 7.0 *via* injector with 50 μl sample loop (Valve V-7, Pharmacia, Sweden). The flow rate was 0.25 ml/min. Each measurement was made in duplicate. The concentration of phenol was determined according

to the phenol calibration curve obtained under the same conditions. The difference in the analytical signals found in samples B and C was used for specific NTE activity calculation.

Titration with inhibitors. For titration curves obtaining and I_{50} (the concentration of OP which inhibits 50% of a given enzyme activity under defined preincubation conditions) assessment a sample of enzyme was incubated with 10-12 different concentrations of studied OP from 10^{-9} to 10^{-3}M for 20 min at 37°C, pH 8.0. The residual NTE activity was then determined, hydrolysis of phenyl valerate was stopped by aqueous SDS. Phenol released was assayed spectrophotometrically or amperometrically (see above). Each measurement was made in triplicate (for spectrophotometry) or in duplicate (for amperometry). I_{50} values were calculated as described in [21]. Every value represents the mean ± SEM from 3 independent experiments.

Protein assay. Protein was determined using a Coomassie protein assay kit with bovine serum albumin as a reference standard.

In vivo studies.

Animals: Adult white Leghorn hens (18 months old, 1.5-2 kg) were from Noginsk poultry farm (Noginsk, Russia). Hens were kept 3 to a cage with food and water *ab libitum*. The hens were kept in room with 12-hr light cycle in which the temperature was controlled (20-23°C).

(I) Inhibition of NTE in hen brain and lymphocytes in 24 hr after acute i.m. treatment with increasing doses of neuropatic OP O,O-dipropyldichlorvinylphosphate (PrDChVP). PrDChVP was administered i.m. in doses 0.316, 0.4, 0.56, 1.0, 1.58, and 2.2 mg/kg to groups of 3 hens per every dose. All hens were pretreated with atropine sulfate, 20 mg/kg, 20 min before PrDChVP was administered. Control animals received atropine sulfate only. In 24 hr after PrDChVP administration hens were decapitated; blood was collected immediately in heparinized plastic vials, heparin was added to concentration 20E/ml, then blood was diluted 1.0/1.5 (v/v) with BSS (0.001% D-glucose, 5.0 mM $CaCl_2$, 98 mM $MgCl_2$, 14.5 mM Tris, 126 mM NaCl, pH 7.6).

Lymphocytes were isolated according to [14] by centrifuging in Ficoll-Verografin gradient density. NTE activity was determined spectrophotometrically in sonicated (10 min, power output 50W) lymphocytes by the Johnson differential method [20] using 40 min incubation with Phenyl Valerate.

Brains were rapidly removed; brain of every hen was homogenized at +4°C in 5 vol. of buffer (50 mM Tris-HCl, 0.2 mM EDTA, pH 8.0) with Potter homogenizer and centrifuged for 15 min at 9000 x g at +4°C. The brain 9S supernatant was used for NTE analysis [31].

NTE activity in brain and lymphocyte samples from hens treated with atropine and PrDChVP was determined by spectrophotometric method and compared to activity in tissue samples from animals treated with atropine only (control).

Protein was assayed by microbiuret methods with bovine serum albumin as a standard.

(II) Inhibition of NTE in hen brain and blood in 24 hr after acute i.m. treatment with four increasing doses of PrDChVP. PrDChVP was administered to hens i.m. in four doses have been chosen from the Experiment (I): 0.316, 0.4, 0.56, 1.0 mg/kg to groups of 3 hens per every dose. In 24 hrs after PrDChVP administration hens were decapitated, *blood* from every hen was collected immediately in a glass containing solution of 3,8% Sodium citrate and D-glucose (from the account 20 ml of anticoagulant per 100ml of blood), frozen in liquid nitrogen and stored at –20°C prior to NTE assay. After being allowed to thaw at room temperature the blood samples were used for NTE activity determination with biosensor method using the tyrosinase carbon-paste electrode.

Brains were rapidly removed, frozen in liquid nitrogen, weighted and stored at –20°C prior to NTE assay. After being allowed to thaw at room temperature they were used for 9S supernatant obtaining (see above) and spectrophotometric NTE activity determination.

NTE activity in brain and whole blood samples from hens treated with atropine and PrDChVP was determined and compared to activity in tissue samples from animals treated with atropine only (control). Linear regression analysis (Origin 5.0 software) was used to examine the correlation of NTE inhibition between tissues.

RESULTS AND DISCUSSION

An excellent coincidence of the data on titration of hen brain NTE (paraoxon-pretreated lyophilyzed preparation) by mipafox obtained by both spectrophotometric and amperometric methods were found. The calculated I_{50} are presented in the Table 1 in comparison with data described in the literature. Close values of I_{50} for human lymphocyte NTE were also obtained when spectrophotometric and amperometric methods were used (Table 1). NTE activity in human lymphocytes measured amperometrically was found to be 14±3 nmoles/min per mg of protein (n=3) for freshly isolated lymphocytes that is in a good agreement with the values reported earlier [11,12,13,16]. Data obtained indicate to validity of measurements carried out with the developed biosensor.

To study a possibility of using biosensor technique for NTE measurement in whole blood an influence of biological materials on phenol assay was studied [21]. A number of phenol-like compounds that are present in biological samples can be substrates for the immobilized tyrosinase and the corresponding analytical responses cannot be ignored. It was found that contacts of the homogenized hen and human whole blood with the electrode surface do not leads to any notable contamination of the latter and only high content of biological material in analyte affected significantly the phenol assay. However, sensitivity of electrode was sufficient to measure phenol in 100-200-fold diluted samples for which the influence on the phenol signals is not so great [21].

A sensitivity of hen and human blood to non-neuropathic OP paraoxon inhibition was investigated with biosensor method and were found to be quite similar. According to data obtained, approximately 30% of a total phenyl valerate hydrolysing activity found in blood represent a paraoxon-resistant part both for hen and for human blood preparations. NTE activity in hen and human blood was found to be equal to 0.10±0.03 and 0.19±0.02 nmoles/min per mg of protein respectively.

Curves of NTE titration in hen and human blood by standard delayed neurotoxicant mipafox were shown to be close to those for neuronal and lymphocyte NTE. Data on I_{50} for different preparations are summarized in the Table 1

Data obtained allow to conclude that the developed tyrosinase carbon-paste biosensor is suitable for NTE assay in whole human and hen blood when the usual spectrophotometric detection is impossible. The results look promising for using NTE activity in whole blood as biochemical marker of exposure to neuropathic OPs.

In order to use the measurement of blood NTE activity as a mirror of brain NTE, the correlation between the inhibition of the enzyme in brain and blood should be known. Assay of lymphocyte NTE was shown to provide a good monitor of exposure to axonotoxic OPs within 24 hr between exposure and measurement [14]. To study possibility of using blood NTE inhibition as biochemical marker of neuropathic OP exposure two series of experiments were carried out: the dependence between NTE inhibition in hen brain and lymphocytes as well in hen brain and blood was studied in 24 hr after acute i.m. injecting hens with increasing doses of model neuropathic OP O,O-dipropyldichlorvinylphosphate (PrDChVP). Data obtained in both series of experiments are presented in Table 2.

PrDChVP inhibited brain, lymphocyte and blood NTE in a dose-responsive manner (Fig.2).

There was good agreement between brain and lymphocyte NTE inhibition (Fig. 3, A) as well between brain and whole blood NTE inhibition (Fig. 3, B, C) and lymphocyte and whole blood NTE inhibition (Fig. 3, D). The data obtained suggest blood NTE activity as biochemical marker for neuropathic OPs exposure.

Taking into account a small volume and simplicity of blood sample preparation for biosensor NTE analysis as well as blood stability after freezing, the obtained results look promising for the development of systems for monitoring the occupational exposure of humans to neuropathic OPs, particularly, for in-the-field using, as well for epidemiological studies, and for development and improving the methods of early diagnostics of OPIDN.

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SUMMARY

NTE is a specific target for OPs that cause organophosphate-induced delayed neuropathy (OPIDN). The inhibition/aging of brain NTE within hours of exposure to OP predicts potential for the development of OPIDN in susceptible animal models. Lymphocyte NTE has also found some use as a biomarker of exposure to neuropathic OPs to man. Recently we developed a high-sensitive biosensor for the analysis of NTE as a combination of NTE catalyzed hydrolysis of phenyl valerate with phenol detection by a tyrosinase carbon-paste electrode. This biosensor was found to be suitable for NTE assay in whole human and hen blood when the usual spectrophotometric detection is impossible. NTE activity in hen and human blood was found to be equal to 0.10±0.03 and 0.19±0.02 nmoles phenyl valerate /min per mg of protein respectively. Sensitivity of hen and human blood NTE to standard delayed neurotoxicant mipafox were shown to be close to those for neuronal and lymphocyte NTE. Mipafox I_{50} values for hen and human blood NTE were found to be equal 4.22±0.12 and 6.27±0.43 μM, respectively. To study possibility of using blood NTE inhibition as biochemical marker of neuropathic OP exposure the dependence between NTE inhibition in hen brain and lymphocytes as well in hen brain and blood was studied in 24 hr after acute i.m. injecting hens with increasing doses of model neuropathic OP O,O-dipropyldichlorvinyl phosphate (PrDChVP). PrDChVP was shown to inhibit brain, lymphocyte and blood NTE in a dose-responsive manner. There was good agreement between brain and lymphocyte NTE inhibition as well between brain and blood NTE inhibition, and lymphocyte and blood NTE inhibition that suggest blood NTE activity as biochemical marker of neuropathic OPs exposure. Taking into account small volume and simplicity of blood sample preparation for biosensor NTE analysis the obtained results look promising for the development of systems for monitoring the occupational exposure of humans to neuropathic OPs, particularly, for in-the-field using, as well for epidemiological studies, and for development and improving the methods of early diagnostics of OPIDN.

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KEYWORDS:
Neuropathy target esterase, blood, tyrosinase carbon-paste biosensor, OPIDN, biomarker

FIGURES AND TABLES.

Fig1. Catalytical oxidation of phenol in the presence of tyrosinase

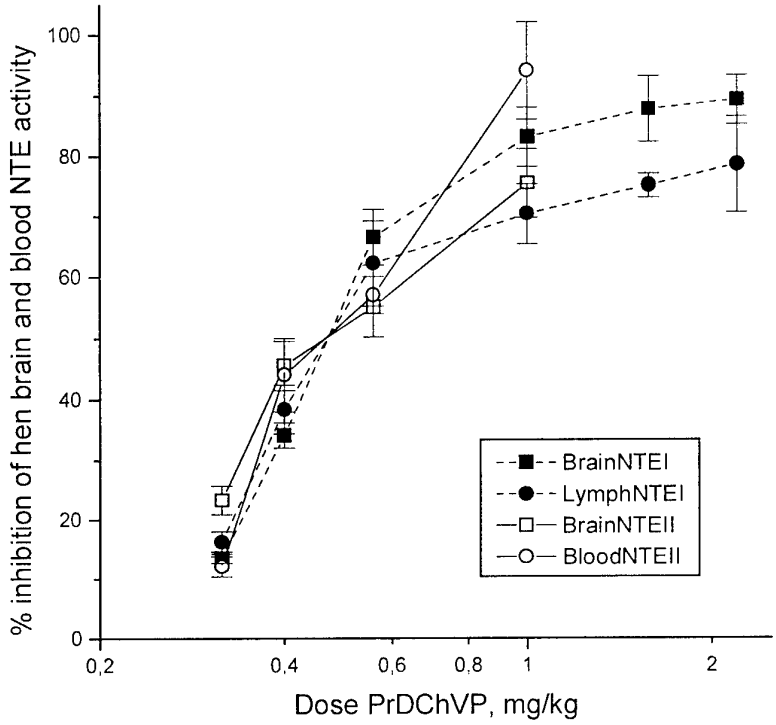

Fig.2. Dose-related NTE inhibition in brains, lymphocytes and whole blood of hens given neuropathy-inducing organophosphorus compound O,O-dipropyldichlorvinyl phosphate (24 hr after exposure). Results are expressed as means ± SEM, n=3. Brain (---■---) and lymphocyte (---●---) NTE from the experiment (I); brain (—□—) and blood (—○—) NTE from the experiment (II).

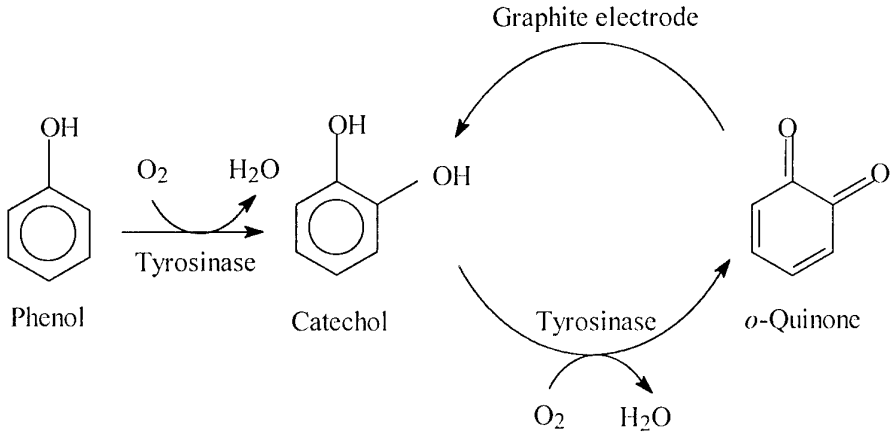

Fig. 3. A - correlation between hen brain and peripheral lymphocyte NTE inhibition (exp. I) (R = 0.991, SD = 5.02, N = 4, P = 0.00857); B – correlation between hen brain and whole blood NTE inhibition (exp. II) (R = 0.997, SD = 1.93, N = 4, P = 0.00267); C – correlation between brain (the mean from experiments I and II) and whole blood NTE inhibition (R = 0.982, SD = 6.11, N = 4, P = 0.01825); D – correlation between hens lymphocyte (I) and whole blood (II) NTE inhibition (R = 0.946, SD = 9.73, N = 4, P = 0.05444).

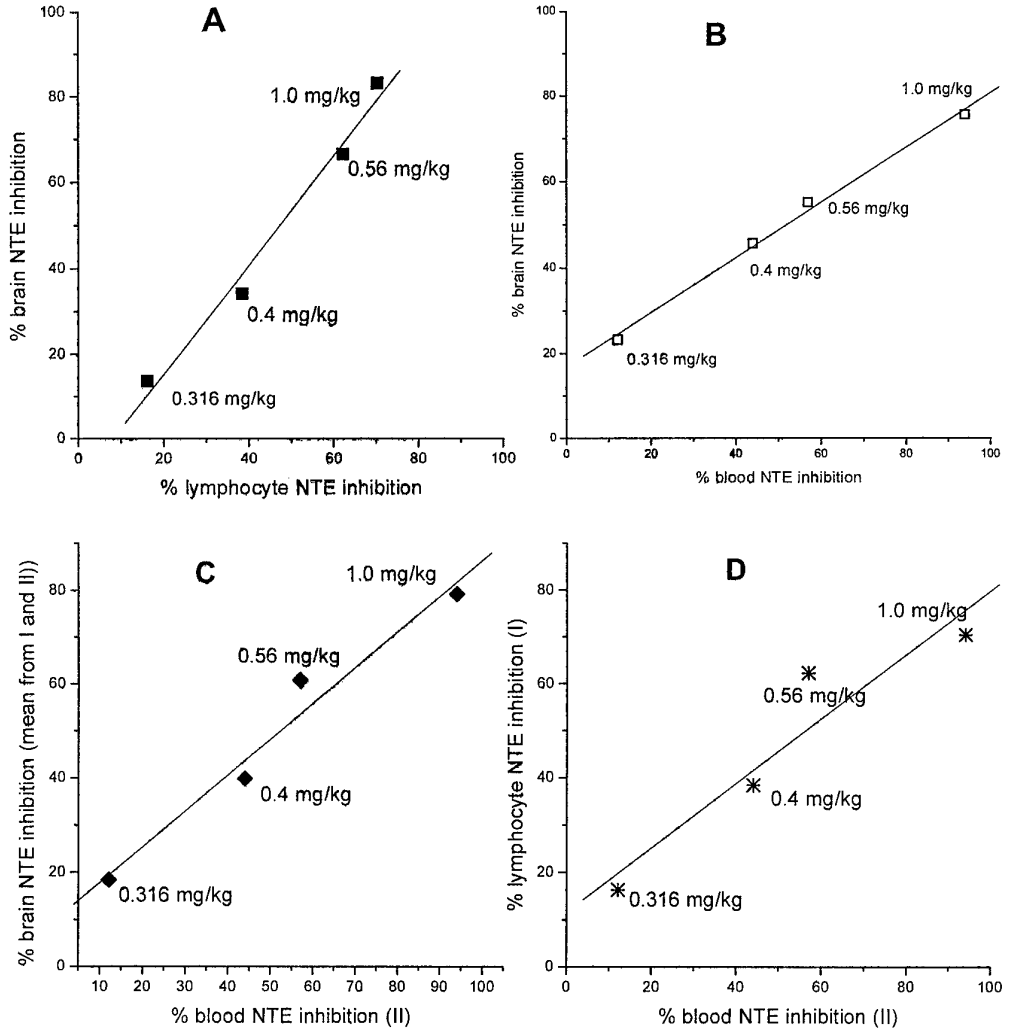

Table 1. Mipafox I_{50} values determined spectrophotometrically or amperometrically for NTE activity from different sources

Source	I_{50} mipafox, μM (microM) amperometry	I_{50} mipafox, μM colorimetry	I_{50} mipafox, mM literature data
Hen brain	4.32 ± 0.28	4.20 ± 0.54	3.80 ± 0.78 [27]; 7 [10,33]
			7.3 ± 0.8 [34]; 3.1 [35]
Hen whole blood	4.22 ± 0.12		
Human lymphocytes	8.38 ± 0.88	7.58 ± 0.79	9.6 ± 0.8 [13]
Human whole blood	6.27 ± 0.43		

[a] Each value represents the mean ± SEM for at least 3 independent experiments.

Table 2. Inhibition of Neuropathy target esterase (% from control) in brains, peripheral lymphocytes and whole blood of hens dosed with PrDChVP. (I) – results of the first series of experiments, (II) – results of the second series of experiments.

a) NTE inhibition in brain, lymphocytes and blood presented as the mean ± SD (n=3). Every measurement was made in duplicate. Control activities: (I) hen brain NTE = 30.9 ± 2.8 nmol PheVal/min/mg protein, hen lymphocyte NTE = 9.0 ± 1.4 nmol PheVal/min/mg protein; (II) hen brain NTE (brain after freezing) = 4.21 ± 0.22 nmol PheVal/min/mg protein, Hen blood NTE = 0.107± 0.013 nmol PheVal/min/mg protein

Dose, mg/kg	(I)		(II)	
	Brain NTE inhibition, % [a)]	Lymphocyte NTE inhibition, % [a)]	Brain NTE inhibition, % [a)]	Blood NTE inhibition, % [a)]
0,316	13,5±0,8	16,3±1,7	23,3±2,4	12,1±1,7
0,4	34,1±2,1	38,4±4,1	45,5±4,0	44,0±6,1
0,56	66,5±4,6	62,2±7,0	55,1±4,9	57,0±3,0
1	83,1±4,9	70,3±5,1	75,4±5,7	94,0±8,0
1,58	87,7±5,4	75,0±2,0	-	-
2,2	89,2±4,0	70,3±7,9	-	-

60. O-ALKYL-O-METHYLCHLORFORMIMINOPHENYL PHOSPHONATES DELAYED NEUROTOXICITY RISK ASSESSMENT. *IN VITRO* AND *IN VIVO* STUDIES.

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INTRODUCTION

Organophosphorus compounds (OP) with anticholinergic properties are widely used as insecticides. Some highly toxic OPs are also chemical warfare agents. These compounds are believed to be included in the arsenals of several nations and terrorist groups, as witnessed in 1995 when sarin was used against Japanese civilians during a terrorist attack on the Tokyo subway system, resulting in over 5500 casualties [1].

The immediate hazard associated with OPs, the acute toxic effect, arises from their inhibition of acetylcholinesterase (AChE) at the nerve ending [2]. The cholinergic syndrome appears at approximately 50% AChE inhibition whereas death is believed to occur at > 90% if adequate treatment is not provided [2,3].

Certain OPs, including compounds with low acute toxicity can also produce OP-induced delayed neurotoxicity (OPIDN) in man and other susceptible species [4-10]. OPIDN is a distal degeneration of sensory and motor axons that occurs 2-5 weeks after an acute poisoning [10]. Stringent regulations and rigorous premarket testing of OPs in the U.S. and in Western Europe have resulted in few neuropathic OPs reaching the market. However, there is a real possibility of OPIDN from incidental OP exposure in the States of the Former Soviet Union and developing countries [11]. Moreover, it is possible that OPIDN could arise from terrorists using neuropathic OPs to cause OPIDN intentionally instead of cholinergic toxicity, which is the conventional endpoint of standard nerve agents.

The high human susceptibility to OPIDN, its insidious onset and usually permanent debilitating effects make the problem of risk assessment for this aspect of OP neurotoxicology highly important.

Considerable evidence suggests that a neuronal protein, known as Neuropathy Target Esterase (neurotoxic esterase, NTE), is the primary target molecule in OPIDN. The disease is thought to be initiated by organophosphorylation and subsequent specific modification (aging) of the inhibited enzyme [6-9]. In the experimental animals OPIDN is associated with > 70% brain NTE inhibition after single exposures [2,6,8]. The threshold in man is not known, although there are indications that it is similar.

NTE has proven to be an excellent tool for *in vitro* assessment neuropathic potential of OPs [9,12]. The relative potency of an OP or its active metabolite to inhibit NTE *versus* AChE *in vitro*, k_i(NTE)/k_i(AChE), was shown to correlate with the ratio between LD_{50} and neuropathic dose and can be used as a convenient index of probable neuropathic potential of the compound [6,9,13]. Values of the ratio k_i(NTE)/k_i(AChE) > 1 indicate that the dose required to produce OPIDN is less than LD_{50}, whereas values < 1 correspond to doses greater than LD_{50} being required to produce OPIDN [6,9,13]. According to M.Johnson [6], compounds for which the ratio k_i(NTE)/k_i(AChE) ≥ 0.05 should be subjected to careful toxicological studying because neuropathies caused by intoxication with such compounds may develop after successful curing acute cholinergic poisoning.

A stable preparation of hen brain NTE, that is the lyophilized (P_2+P_3) hen brain membrane fraction preinhibited with paraoxon, was developed in our laboratory [14]. This preparation retains inhibitor features of the native enzyme during a year and rather high

specific activity of NTE and can be used as a readily available «off-the-shelf» source of NTE for assessing the anti-NTE activity of OP compounds [14]. Based on stable preparation of hen brain NTE the convenient methods for kinetics studies of NTE inhibition were elaborated as well as a method of *in vitro* express testing OPs for delayed neurotoxicity by comparing its inhibitory potency against two primary targets of OPs: NTE and AChE.

In the present work we report an *in vitro* study of NTE and AChE inhibition by a series of model phenylphosphonates of the general formula $(RO)C_6H_5P(O)ON{=}CClCH_3$ (PhP), the assessment of neuropathic potential for the investigated OPs using ratios k_i(NTE)/k_i(AChE) and comparison the obtained results with the ratios of the median effective doses (ED_{50}) for hen brain NTE and AChE inhibition obtained *in vivo*.

MATERIALS AND METHODS

Chemicals: Phenyl valerate (PV), mipafox (*N,N'*-diisopropylphosphorodiamido fluoridate), *O*-Alkyl-*O*-methylchloroformiminophenyl phosphonates were synthesized and characterized in the Institute of Physiologically Active Compounds Russian Academy of Sciences (Russia) [15]. The purity of all substances was not less than 99% (by spectral, chromatographic and elemental analysis data). Paraoxon (*O,O*-diethyl-4-nitrophenyl phosphate) was from Sigma Chemical Co. (St. Louis, Missouri USA).

Animals: Adult white Leghorn hens (18 months old, 1.5-2 kg) were from Noginsk poultry farm (Noginsk, Russia). Hens were kept 3 to a cage with food and water *ab libitum*. The hens were kept in room with 12-hr light cycle in which the temperature was controlled (20-23°C).

Enzymes. A stable lyophilized preparation of paraoxon-pretreated (P_2+P_3) hen brain membrane fraction was used as a source of NTE. The preparation was obtained according to [14,15]. Whole brains were removed from hens and homogenized in buffer (50 mM Tris-HCl, 0.2 mM EDTA, pH 8.0, 4°C) with a Potter homogenizer. Paraoxon was then added to achieve a concentration of 40 μM to inhibit esterases other than NTE. Homogenate was centrifuged at 1000 x ***g*** for 10 min. The supernatant was removed and centrifuged at 105,000 x ***g*** for 30 min. The two centrifuging procedures were carried out at 25°C and took about 45 min. The 105,000 x ***g*** pellet was then resuspended in a cold twice-distilled water; after that it was frozen quickly in liquid nitrogen and lyophilized in ampoules on a freeze dryers system LGA-5 (Germany). The lyophilized membranes stored in sealed ampoules under vacuum, at –20 °C.

A lyophilized (P_2+P_3) hen brain membrane fraction prepared as above except the paraoxon pretreatment [14,15] was used as a source of the hen brain AChE.

NTE assay. NTE activity was assayed colorimetrically according to Johnson [16] with slight modifications. Before the experiment the lyophilized preparations were suspended in the assay buffer (50 mM Tris-HCl, 0.2 mM EDTA, pH 8.0, 25°C) in Potter homogenizer with a Teflon pestle. The assay was carried out at 37°C in a final volume 1ml, protein concentration 0.1-0.14 mg/ml, using PV as substrate. NTE activity was measured as a difference between PV hydrolyzing activity of the used enzyme preparation, presenting PO-resistant esterase activity, and its activity after 20 min. incubation with 250 μM Mipafox.

NTE activity in 9S supernatant of whole brain homogenate was determined as the difference in PV hydrolyzing activity, between paired samples in the presence of either paraoxon (50μM), or 50 μM paraoxon plus 250 μM Mipafox.

Protein was assayed by microbiuret methods with bovine serum albumin as a standard.

AChE assay. AChE activity was determined with the method of Ellman [17] using acetylthiocholine as substrate.

Inhibitor activity determination. For kinetic studies of NTE and AChE inhibition a sample of corresponding enzyme was incubated with studied OP (acetone concentration 1%) for different times. The residual NTE or AChE activity was then assayed, each value was determined in duplicate. The slopes (k') of each semi-log plot were calculated by a linear regression procedure applied to each set of data points. These values of k' were then plotted against inhibitor concentration [I], and the slope (k'') of the line was derived by linear regression as above. Then the bimolecular rate constant of inhibition (k_i) was calculated using the relationship: $k_i = 2.303\ k' / [I] = 2.303\ k''$ [18]. Each value of k' was obtained from a line through 4-6 points.

The relationship between structure of PhP and their selectivity to NTE and, correspondingly, their neuropathic potential, was analyzed with multiple regression analysis using ORIGIN 5.0 software. Additive hydrophobicity Hansch's constants (πCH_2= 0.5) for substituents were used for modelling [19]. QSAR models for neuropathic potential of PhP were developed. A significance of the obtained equations was estimated with values of r – coefficient of multiple correlation, s – standard deviation of the fit, and F – Fisher's criterion, which characterizes a significance level of r under the selected confidence interval, and depends on a number of data points n and a number of basic functions in the applied equation.

Inhibition of NTE and AChE in a hen brain after acute i.m. administration of increasing doses of Me and Bu derivatives. Inhibition of NTE and AChE in a hen brain was studied in 24 hrs after acute i.m. hens injecting with increasing doses of Me (MePhP) and Bu (BuPhP) derivatives. MePhP was administered in doses from 0.6 to 40 mg/kg, BuPhP - in doses from 0.6 to 60 mg/kg. Compounds were administered i.m. to groups of 3 hens per every dose. All hens were pretreated with atropine sulfate, 20 mg/kg, 20 min before PhP was administered. Control animals received atropine sulfate only. In 24 hrs after PhP administration hens were decapitated and brains were removed for determination of NTE and AChE activities. Brain of every hen was homogenized at +4°C in 5 vol of buffer (50 mM Tris-HCl, 0.2 mM EDTA, pH 8.0) with Potter homogenizer and centrifuged for 15 min at 9000 x g at +4°C. The brain 9S supernatant was used for enzyme analysis [20].

Esterase activity in brain samples from hens treated with atropine and PhP was determined and compared to activity in tissue samples from animals treated with atropine only (control). Dose-response curves were analyzed with a four-parameter logistic function using ORIGIN 5.0 software.

RESULTS AND DISCUSSION

Structure of the studied phenylphosphonates is presented in Fig.1.

All compounds investigated were shown to be irreversible progressive inhibitors of both esterases. The time-course of NTE and AChE inhibition was found to follow first-order kinetics. For each OP the slopes of lines were proportional to inhibitor concentrations. The derived bimolecular rate constants of inhibition (k_i) are presented in Table 1.

Fig.2 presents the dependence of inhibitor activity of the studied phenylphosphonates to NTE and AChE on hydrophobicity of alkyl radicals. The differential effect of changing hydrophobicity on anti-NTE and anti-AChE activity suggests differences in the structure of the active sites of the two target esterases of the OP compounds, and correspondingly, their different inhibitor specificity.

Most of PhP were more potent inhibitors of NTE than AChE. Both antiNTE activity, selectivity for NTE and, correspondingly, the propensity of PhP to cause OPIDN raised with the increasing hydrophobicity (Table 1, Fig.2).

The relationship between structure of PhP and their selectivity to NTE was analyzed

with the multiple regression analysis. QSAR models were developed. The dependence of selectivity PhP to NTE on hydrophobicity of alkyl radicals (Fig.2) was found to be described with the equation:

$$\log [k_i(NTE)/k_i(AChE)] = (-1.89 \pm 0.17) + (3.22 \pm 0.25)\, \Sigma\pi - (0.65 \pm 0.08)\, (\Sigma\pi)^2 \quad (1)$$

$$(n=7,\ r=0.997,\ s=0.086,\ F_{2,4}=326.95) \qquad P < 0.001$$

High values of the ratio $k_i(NTE)/k_i(AChE)$ (Table 1) suggest that the studied PhP would have the potential to cause OPIDN at doses above (R = Me) or lower (R = Et – Pent) than LD_{50}.

To assess the validity of the obtained *in vitro* data on OP neuropathic potential prediction two series of experiments *in vivo* were carried out. Taking into account that activities of brain NTE and AChE are biomarkers for the respective toxic effects of OPs, OPIDN and acute cholinergic toxicity [9, 21], inhibition of NTE and AChE in a hen brain was studied in 24 hrs after acute i.m. administration of increasing doses of Me and Bu derivatives. These two PhP were chosen for studies *in vivo* because according to the data obtained *in vitro* (Table 1) they essentially differ in magnitude of neuropathic potential: BuPhP (ratio $k_i(NTE)/k_i(AChE)$ = 104.8) far exceeds Me derivative (ratio $k_i(NTE)/k_i(AChE)$ = 0.4) in OPIDN hazard.

Data obtained in both series of *in vivo* experiments are presented in Table 2.

Inhibition of both NTE and AChE in every series of experiments was dose-dependent (Fig.3). Inhibition of NTE to 70% that is known to be critical for OPIDN initiation [2,6,8] was achieved by Me-analogue in dose 35 mg/kg and by Bu-analogue - in dose 4 mg/kg.

Dose-dependence curves for NTE and AChE inhibition by MePhP were relatively similar, whereas the detectable AChE inhibition by Bu derivative was seen at considerably more high doses than NTE inhibition (Fig. 3), as is consistent with the results obtained *in vitro* (Table 1, Fig.2) and indicates to the potential delayed neurotoxicity of BuPhP in doses much lower than LD_{50}.

By analyzing dose-response curves (Fig.3) we assessed ED_{50} values - median effective doses for inhibition of NTE and AChE in hen brain by Me and Bu derivatives: for MePhP $ED_{50}(NTE)$ = 15.06±5.13 mg/kg, $ED_{50}(AChE)$ = 12.91±0.91 mg/kg; for BuPhP $ED_{50}(NTE)$ = 2.53±1.16 mg/kg, $ED_{50}(AChE)$ = 55.82±39.5 mg/kg.

To characterize neuropathic safety of OP compounds an index based on the *in vivo* susceptibility of the relevant targets, NTE and AChE, to OP inhibitors has been supposed by Richardson [9]. This index was called the neuropathy target index (NTI):

$$NTI = ED_{50}(NTE) / ED_{50}(AChE).$$

Because we analyzed the *in vitro* data as ratios $k_i(NTE)/k_i(AChE)$, according to Johnson [6], we consider in our study the reverse values: $1/NTI = ED_{50}(AChE) / ED_{50}(NTE)$ – the larger is this value, the more hazardous is the OP compound with respect to its ability to produce OPIDN. The obtained ratio $ED_{50}(AChE) / ED_{50}(NTE)$ for MePhP is equal to 0.86 and for BuPhP is equal 22.1 that shows Bu derivative to be much more neuropathic than Me-analogue. The results, which reflect *in vivo* susceptibility of the target enzymes, NTE and AChE, agree with those obtained *in vitro* (Table 1) and provide support for *in vitro* approach to OPIDN prediction.

Use for *in vitro* testing a stable lyophilized preparation of hen brain NTE allows essentially to lower the charge of experimental animals (hens), reduces the price and accelerates and standardizes a biochemical estimation of neuropathic potential of OPs. The obtained with the lyophilized NTE data on anti-NTE activity and selectivity of OPs are homogeneous that makes possible creation of valid and predictive QSAR models [22,23].

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SUMMARY

The inhibition of the two target esterases acetylcholinesterase (AChE) or neurotathy target esterase (NTE) by organophosphorus compounds (OPs) is followed by distinct neurological consequences in exposed subjects - acute cholinergic toxicity or OP induced delayed neurotoxicity (OPIDN). Ability of some OPs along with acute cholinergic toxicity initiate OPIDN may to be of interest for different terrorist groups. The relative potency of an OP to react with NTE or with AChE *in vitro* suggested to be predictive for its capability to produce OPIDN. The kinetics of NTE and AChE inhibition by phenyl phosphonates $(RO)C_6H_5P(O)ON{=}CClCH_3$ (PhP, R = Me, Et, iPr, Pr, iBu, Bu, Pent) was studied with stable lyophilyzed preparations of hen brain NTE and AChE, neuropathic potential of PhP was assessed using ratios k_i(NTE)/k_i(AChE) and compared with ED_{50} ratios obtained *in vivo*. Most of PhP was more potent inhibitors of NTE than AChE. Both antiNTE activity, selectivity for NTE and, correspondingly, the propensity of PhP to cause OPIDN raised with the increasing hydrophobicity. High values of the ratio k_i(NTE)/k_i(AChE): 0.6(Me), 3.6(Et), 15(iPr), 36(Pr), 69(iBu), 104(Bu), 124(Pent) suggest that the studied PhP would have the potential to cause OPIDN at doses above or lower than LD_{50}. Inhibition of NTE and AChE in hen brain was studied in 24 hrs after acute i.m. hens injecting with increasing doses of methyl and buthyl derivatives. Inhibitions of both NTE and AChE were dose-dependent. By analyzing dose-response curves ED_{50} values - median effective doses for inhibition of NTE and AChE in hen brain by Me and Bu derivatives were assessed and ratios ED_{50}(AChE)/ED_{50}(NTE) were calculated: for MePhP ED_{50}(NTE) = 15.06±5.13 mg/kg, ED_{50}(AChE) = 12.91±0.91 mg/kg, ratio = 0.86; for BuPhP ED_{50}(NTE) = 2.53±1.16 mg/kg, ED_{50}(AChE) = 55.82±39.5 mg/kg, ratio = 22.1 that shows Bu derivative to be much more neuropathic than Me-analogue. The results, which reflect *in vivo* susceptibility of the target enzymes, NTE and AChE, agree with those obtained *in vitro* and provide support for *in vitro* approach to OPIDN prediction.

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KEYWORDS:
Neurotathy target esterase, acetylcholinesterase, organophosphates, OPIDN

FIGURES AND TABLES

Fig.1. The structure of O-alkyl-O-methylchlorformiminophenyl phosphonates (PhP).
R = alkyl group as listed in Table 1.

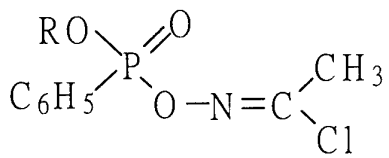

Fig. 2. The dependence of logarithm of inhibitory activity of PhP against NTE and AChE and the dependence of logarithm of selectivity PhP to NTE on hydrophobicity of alkyl radicals ($\Sigma\pi$). Data were derived from Table 1. The continuous line for NTE selectivity is calculated by equation 1.

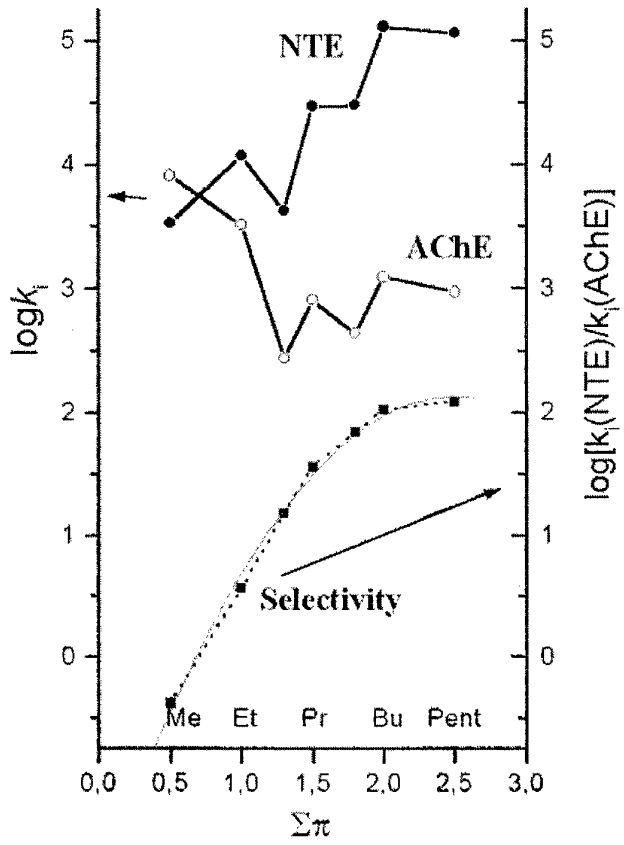

Fig.3. Dose-related NTE and AChE inhibition in hens given methyl (MePhP) and buthyl (BuPhP) derivatives of the studied phenylphosphonates. Results are expressed as means ± SEM, n=3.

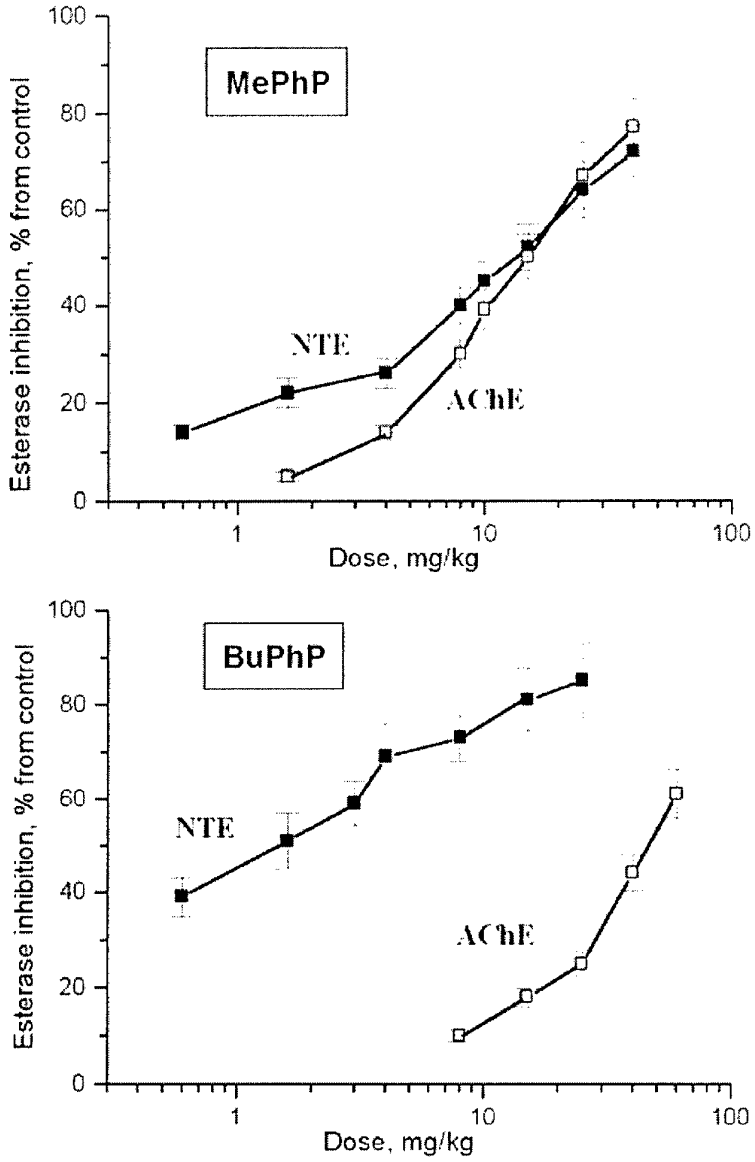

Table 1. Bimolecular rate constants of inhibition (k_i) of NTE and AChE by phenyl phosphonates (PhP), $(RO)C_6H_5P(O)ON{=}CClCH_3$, Hansch's hydrophobicity constants of alkyl substituents ($\pi CH_2 = 0.5$) and relative inhibitor potency of PhP against two OP primary targets - NTE and AChE

R	CH_3	C_2H_5	iC_3H_7	C_3H_7	iC_4H_9	C_4H_9	C_5H_{11}
π	0,5	1	1,3	1,5	1,8	2	2,5
$\log k_i$(NTE)	3,53	4,07	3,62	4,47	4,48	5,11	5,06
$\log k_i$(AChE)	3,91	3,51	2,44	2,91	2,64	3,09	2,97
k_i(NTE)/k_i(AChE)	0,4	3,6	15,1	36,3	69,1	104,8	123,8

Table 2. Neuropathy target esterase and acethylcholinesterase inhibition (% from control) in brains of hens dosed with MePhP and BuPhP.

Dose, mg/kg	MePhP		BuPhP	
	Brain NTE inhibition, % [a)]	Brain AChE inhibition, % [a)]	Brain NTE inhibition, % [a)]	Brain AChE inhibition, % [a)]
0,6	14,1±1,6	n/d	39,0±4,2	n/d [b)]
1,6	22,2±3,1	5,1±0,9	51,1±6,0	n/d
3	-	-	58,9±4,8	n/d
4	25,9±2,9	14,0±1,5	69,0±7,0	n/d
8	40,0±3,9	29,8±2,9	73,2±4,9	10,0±1.2
10	44,8±4,1	39,1±4,0	-	-
15	52,1±4,8	49,9±4,7	81,1±6,6	17,8±1,9
25	64,1±5,8	67,0±7,1	85,0±7,9	25,1±2,5
40	72,0±5,4	77,1±5,9	n/d	44,0±3,9
60	-	-	n/d	61,0±5,3

a) Esterase inhibition in brain presented as the mean ± SEM (n=3). Control activities (100%): hen brain NTE = 30.9 ± 2.8 nmol PV/min/mg protein, Hen brain AChE = 215 ± 17 nmol ATCh/min/mg protein;
b) n/d – activity has not been determined

61. GLOBALIZATION, THE INFECTIOUS DISEASES AND CROATIAN CIVIL DEFENSE

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INTRODUCTION

Man's natural progress, including development of global science and technology increase. Republic of Croatia, like other countries in central, southern and eastern Europe, undergoing a war period, and a period of political, economic, social and the other transition. Change, however, has not been confined only to these various areas, but has affected all sectors economic, social, civil and military defense and specially, the health sector where a various infectious diseases play one of major role. One of areas where the effect of change is certainly being felt is in the global and health sector. The main feature of infectious diseases comes from their global occurrence. Infective diseases are permanent danger for population, environment and determinant of health status. In the past, infective diseases and great epidemics of infective diseases resulted in high incidence, morbidity and mortality and dominant ireverse effect. Therefore, the world community has to study these infections and try to develop efficient approaches to their diagnosis, prophylaxis and treatment. Civil defense, Health policy, the structure and organization of defense and health services and most importantly, health status have all been affected by the transition, which started in 1990 and still continuing.

METHODOLOGY

Working methods imply normative, analytical, comparative and system analysis method (1).

DISCUSSION

In the "global village" of the late twentieth century it is increasingly evident that the health of populations is dependent on numerous external factors, which include market forces, environmental hazardous accesses to as communications and technology and cultural influences (2). At the end twentieth century global transnational factors as macroeconomic prescription e.g. structural adjustment policies and "downsizing", trade, travel, migrations and demographic e.g. increased refugee populations growth, food security issues, environmental degradation and unsustainable world consumption patterns, global and local environmental health impact-long- term impact negative, technology, foreign policies based national self-interest, communication and media e.g. global advertising of harmful commodities such as tobacco, alcohol, psychoactive drugs - long-term impact negative marketing of health damaging behavior, erosion of cultural diversity and social cohesion, with various consequences and possible negative impact on health will be permanent danger for the Croatian population for life, environment and determinants of health status (2).

As a result of its geostrategical, general and defensive characteristic, the population and territory of Republic of Croatia can be exposed to danger from effect of natural, technological and war disasters. The effect of these disasters (including droughts, floods, fires and chemical contamination) can manifest in increased diseases and susceptibility to epidemics. Larger epidemics can occur in wartime as well as in peace (1). A part of continuing monitoring of Croatian populations health status and quality of life, in 2000, CNIOPH registrated ninety-six (96) larger epidemic of outbreaks with 2035 cases (3). In Republic of Croatia, the immunizable diseases have either totally disappeared (diphtheria,

poliomyelitis) or their incidence has been drastically reduced by more than 95% (morbilli, parotitis, rubeola, pertussis, tetanus, tuberculosis) (4.3). In recent years the incidence of diseases of low standards of hygiene or living, i.e. typhus, bacillary dysentery and hepatitis A, has clearly regressed to the levels typical of developed countries. Stagnation of the incidence of tuberculosis in the past few years (due to war and its aftermath) was succeeded in 1999 by a favorable trend of continuing decline in the incidence (3.4). A very favorable low permanent and sporadic incidence is noted in venereal diseases syphilis and AIDS with gonorrhea also exhibiting a favorable decreases in the incidence and its maintenance too at a low sporadic level (3.4).

Very extensive diseases prevention measures through meat control taken by the Veterinary Service and antiepidemic interventions and preventive measures taken by the Health Service, have resulted in markedly fewer trichinosis cases (though still a sizable number) than in the previous time/years (4). In Croatia, the bacteriological diagnosis of tuberculosis had continued the declining trend in the number of new cases and relapses. Compared with the previous years, the number of resistant has declined (3.4). Today, in April 2001, in Croatia non-registrated diagnosis of BSE or diagnosis of Stomatitis aphtosa infectiosa, epizootica. Assessments and Plans for protecting civilians from the consequences of larger epidemic of infectious diseases and the other diseases requires the permanent engagement of health protection services in Croatia. From the technical standpoint, all anti epidemiological measures and parameters for threat assessment and planing for protection and consequences of larger epidemics of infectious diseases (preventive, operative, technical and organizational) will become even more significant. These measures can only be drafted through coordinated utilization of medical doctrine, legislation, international agreement and conventions and modern international standards (1). Communicable diseases or infectious diseases unknown in Europe for decades have re-emerged (Diphtheria) or imported cases (cholera, malaria) and whereas in the past epidemics were rare and confined mainly to other regions, they now contribute significantly to the overall incidence of such diseases worldwide. At the same time, new diseases have been spreading, and microbial resistance to some drugs makes the control of infectious diseases difficult. New diseases in animals also pose increased risks, one example being BSE (bovine spongiform encephalitis). In many countries, the incidence of tuberculosis is increasing and drug-resistant strains of the disease are spreading. AIDS incidence appears to have stabilized in most countries in western Europe, but an epidemic related to injecting drug use stills one the rise in some of these countries. In the NIS (newly independent states), HIV infection has been spreading rapidly to countries that were barely affected a few years ago. The incidence of syphilis and other STDs has also increased dramatically in almost all the NIS. Hepatitis B continues to have a large health and economic impact on all countries in the European Region. Overall mortality from infectious and parasitic diseases demonstrates a typical east-west gap.

Medical segment is a constituent part of the civil protection of the Republic of Croatia (1). The scope of work and field of competence of the civil defense is legally regulated by the Law on Internal Affairs, II A Civil Protection and those tasks stand in agreement with the II Additional Protocol of the Geneva Conventions from August 12th 1949. (Protocol II, 1977) (5) and they implicitly include giving first aid, mitigation of the ground or epidemiological protection etc. Apart from those tasks, Civil defense had especially in peacetime and wartime the task to protect and rescue civilians during natural disasters and catastrophes in cases when the usual defense forces are not sufficient. The protection in those cases includes various activities in range from epidemiological protection to protection and rescuing in the case of contaminated ecosystem etc. Apart from medical contents of the civil defense implying first

aid and terrain rehabilitation, the civil defense also includes protection of civilian's outbreaks (1).

CONCLUSION

Infectious diseases will be a lingering transnational problem. Numerous recent trends favor the spread of communicable diseases. These include: new and re-emerging infectious agents, new drug resistant strains, pharmaceutical research not keeping pace with microbial resistance, erosion of disease surveillance systems, increased urban population density and number of persons living in poverty, increased susceptible populations e.g. the aged, wider distribution of communicable disease vectors due to global worming (6). Health implications of Global and Local trend require the own national level action cooperation and partnerships. The information in this paper is drowning from results and discussions with services in the health and defense sectors in Croatia, during in post wartime in 2000/2001. Today in Croatia, especially after the War (1991-1995), war crisis with secondary war effect such as epidemic diseases have proven to us that the epidemic factor is important and permanent risk for life and environment especially in period of various transition. The epidemiological protection with health services will have to include in usual protection. Therefore, a protection plan needs to be developed, based on a high-quality assessment. The assessment, as a warning on he onset, development and consequences of a diseases; the assessment of the probability of the onset of the disease, as well as the definition of the scope of a possible danger, need to include the presumption on the development of the disease in its acute, developmental and final stages, as well as the degree of its impact on people, material means and environment. The Republic of Croatia must is to establish the new emergency management organization for various nature and man-made disasters because the present organization of the Civil Protection in Republic of Croatia is not modern and efficiency.

SUMMARY

Infective diseases are permanent danger for population environment and determinant of health status. In the past, infective diseases and great epidemics of infective diseases resulted in high incidence, morbidity and mortality and dominant ireverse effect. Civil defense, Health policy, the structure and organization of defense and health services and most importantly, health status have all been affected by the transition, which started in 1990 and is still continuing. Assessments and Plans for protecting civilians from the consequences of larger epidemic of infectious diseases and the other diseases requires the permanent engagement of health protection services in Croatia.

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KEY WORDS

The infectious diseases, civil defense, Croatia

62. THE NEED FOR CREATION OF THE INTERNATIONAL CENTER IN NOVOSIBIRSK, RUSSIA FOR COMBATING INFECTIOUS DISEASES AND BIOTERRORISM THREAT IN ASIA

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Our State Research Center of Virology and Biotechnology VECTOR was established back in 1974 as an All-Union Scientific Research Institute of Molecular Biology [1]. Its task was to conduct basic and applied research on extremely pathogenic viral agents such as less-studied Marburg, Ebola, Lassa and other viruses related to potential BW agents in order to evaluate the potential threat posed by these agents and develop means of their diagnostics, prevention, and therapy. Maximum biological containment laboratory facilities, the most modern in Russia, were built as well as an engineering infrastructure and a set of scientific and supporting capabilities. The total area of existing buildings and facilities amounted to 250,000 square meters.

In 1989, VECTOR already employed over 4,000 staff, including more than 250 Ph.D.'s and Doctors of Sciences. At that time, VECTOR received practically all of its funding from the federal budget and just began to establish manufacturing activities.

Access to workplaces by and communication with foreign scientists were practically impossible. The same situation was with the participation of VECTOR scientists in the international conferences and publication of scientific papers.

In 1989, it became obvious that VECTOR should undergo restructuring to try to adapt itself to changing economic conditions that ultimately resulted in a significant cutback of federal budget funding. A program of VECTOR's long-range development was prepared that focused on conducting much more public health and veterinary medicine oriented research on infectious diseases and development of diagnostic tests, vaccines and antivirals as well as a set up of manufacture of diagnostic, therapeutic and prophylactic products.

In 1993, VECTOR became a Russian State Research Center and started to receive federal budget funding to support its R&D activities through civilian government programs. The development of pharmaceutical manufacturing activities was supported by government investments and credits, which allowed us to renovate and upgrade several facilities and purchase some equipment necessary for drug production.

Currently VECTOR is a scientific center consisting of six scientific research institutes and three daughter companies manufacturing a broad range of products. However, we should admit that the restructuring process was difficult and troublesome since the economic situation in Russia, especially the fluctuations of the ruble in 1992-1996 and 1998, produced a detrimental impact on science and production in Russia. The number of employees at VECTOR decreased more than two times: currently we employ at VECTOR 1887 staff. Of these, 1212 are those directly involved in or support of scientific research and 675 are employed in the manufacturing area. Over 50 VECTOR researchers left VECTOR for abroad during 1993-1998 and are doing a successful job at prestigious scientific research centers in the United States, Canada, France, Germany, Italy, Australia, New Zealand and Sweden.

However, VECTOR did manage to maintain most of its key scientific personnel and establish sustainable manufacturing activities. During the recent years, VECTOR's income pattern has changed dramatically. If in 1990 78% of funds came from the federal budget, in 2000 77% of the total income was accounted for by the sales of products.

It should be specially mentioned about the role of international assistance provided to VECTOR in its reorientation towards public health and agriculture-oriented programs.

In 1992, an International Science and Technology Center (ISTC) was established as a nonproliferation-targeted program for the Newly Independent States. The similar goal was set for the US Civilian Research and Development Foundation (CRDF) that was established by the U.S. National Science Foundation in 1995, and for the Newly Independent States Industrial Partnering Program (NIS-IPP, currently more known as Initiatives for Proliferation Prevention) that is being carried out through the US Department of Energy with the involvement of the United States Industry Coalition (USIC).

In 1995, the first projects with these agencies were launched. During 1995-2000, we completed 29 projects, including 15 ISTC projects. Today, we have 26 active projects, including 23 ISTC-funded projects. In 1998, these projects began to play a significant role in VECTOR's budget whereas the contribution they made amounted to 30% of the Russian federal budget funding of VECTOR. As of today, the size of funding under the project agreements concluded is US$ 9,910,936, including US$ 9,610,936 provided under the ISTC-funded projects.

We can hardly overestimate the importance of ISTC for our Center because ISTC has made a tremendous contribution to VECTOR and VECTOR scientists' integration into the world's scientific community. Grant funding allows us to receive our foreign colleagues and, in turn travel ourselves to get acquainted with foreign laboratories. VECTOR employees have attended dozens of international conferences and workshops using ISTC support. Hundreds of our scientists have visited their foreign counterparts on site. It made it possible to create an atmosphere of openness and transparency at VECTOR, which is critical to science and scientists. Thanks to support provided for our scientific staff, we have been able to renew and maintain our relationships with NIS scientists and scientists from other regions in Russia.

Our employees attend all the refresher courses: English language, patent, R&D commercialization program; GLP, GCP and GMP training programs. It helped us realize that without constant implementing international quality standards in science and production we could hardly hope for our R&D products' being competitive on the world market.

Thanks to grant funding, our scientists are able to conduct research using up-to-date equipment and supplies as well as the latest techniques to gain world-class results.

Thanks to grant funding, technology of hepatitis A vaccine production, that of production of a diagnostic kit for opisthorchiasis and other infections have been developed. Technology of oral measles vaccine production and that of influenza vaccine are in the final developmental stages. These developments, besides many others, allowed us to establish manufacturing activities at our daughter enterprises that have become totally self-sustainable.

There were opinions in US press that grant-funded research is poorly coordinated and chaotic. We cannot agree with it. During the most recent years, the coordination of projects has improved dramatically when the so-called *Partner Projects* appeared. Currently at ISTC, Partner Projects have been initiated with US DHHS (BTEP/FETP), USDA (ARS USDA), DOD (DTRA, DARPA). With these projects, the Partner and the Russian institute jointly formulate high-priority goals and tasks for which the projects are being tailored individually.

For instance, with BTEP it is the study of infections representing serious public health problems such as HIV/AIDS, multi-drug-resistant tuberculosis, hepatitis, measles, etc. And these investigations are being started with establishing the international ethical standards at VECTOR in accordance with international GCP regulations. Two very perspective projects will be started soon in the field of development of fast and very sensitive PCR-microchip detection of dangerous pathogen genomes in blood and other biological samples. The variola virus is being studied now in collaboration with U.S.scientists also because of this BTEP

program. The study of the latter infection is of special importance to current efforts to encounter the bioterrorism threat.

Very focused are also the efforts that are being planned and implemented under the U.S.A. Cooperative Threat Reduction (CTR) program that relate to upgrade the physical security and biosafety systems at the maximum biocontainment facilities at VECTOR up to the highest modern standards. Serious efforts are being taken to bring laboratory work, involving research animals, and pharmaceutical manufacture at VECTOR's daughter enterprises up to the GLP and GMP standards, respectively.

A few papers were published mentioning about the criticisms concerning the possible alleged use of US Government funds by Russian institutes for whatever prohibited purposes. These concerns have been voiced in the study prepared by the US General Accounting Office during the revision of five-year work of different U.S.government agencies funding of Russian biological centers [2], and in the study conducted by the Henry L. Stimson Center [3], and some others. In spite of the lack of evidentiary support of these statements, we should admit that it could change the situation in principle if the recipient institution working with the most dangerous pathogens was operating on an international regimen ensuring confidence and transparency. For several years already, we have been discussing this problem with representatives of the US State Department, US DHHS and Russian authorities. Now we are in the process of finalizing an ISTC proposal, "Development of Concept of an International Center for the Study of Emerging and Re-emerging Infectious Diseases", with our US collaborators [12].

By an *International Center* we mean an international organization established by an intergovernmental agreement, similar to those of ISTC (website www.istc.ru) or the Joint Institute for Nuclear Research in Dubna (see website http://www.jinr.ru), CERN in Switzerland (website http://www.cern.ch/) or International Center for Genetic Engineering and Biotechnology in Trieste, Italy (website http://www.icgeb.trieste.it/). Nonproliferation and threat reduction goals can only be achieved through transparency and confidence building when the *International Center* is established and operated with access to the program and results obtained, and with free access to financial information and to all facilities and all staff of the *Center*. Continuous involvement of foreign scientists in work at this *Center* would be a powerful instrument of confidence building. It is critical, therefore, that all high containment capabilities and necessary supporting facilities be incorporated into the *Center* to alleviate concerns over possible prohibited activity.

Though the process of establishing the *International Center* is complex and may take several years to complete, the proposed arrangement would provide for a long-term strategic collaboration, which is far less subject to political or economic conjuncture fluctuations in Member States. International efforts would accelerate both the study of dangerous pathogens and the development of state-of the-art public health products for diagnosis, prophylaxis and therapy.

The vital need to establish an international regimen to support research on pathogenic microorganisms is driven not only by political considerations. To date, both policy makers and scientists came to understand the global threat posed by infectious diseases to the humankind [4-8]. Nature has been leading a biological war against us that we can hardly win but we can work to ensure the safety of the humankind but only by global efforts of the countries worldwide. During the past 20 years, 30 new infectious diseases have emerged, e.g. HIV, Marburg, Ebola viruses, legionnaires' disease, drug-resistant TB forms, and many others. Death rates as a result of infectious diseases amount to 30% of the total fatality rates worldwide and these figures have been growing during the recent years [7]. It also should be mentioned that the situation with infectious diseases in Russia is not improving during the

last ten years ([8], see also Table 1). Tuberculosis increase is becoming a real threat to the nation's health (Fig.1), and, especially, its drug-resistant forms. It is an exponential increase of HIV cases (Fig.1), which is becoming now a real threat to the young people in Russia. There was a dramatic outbreak of diphtheria in the middle of 90's which seems to be caused by sharp decrease of revaccination among adults; this outbreak was managed only by unprecedently wide revaccination campaign on the state level for all the population. The big increase of measles cases (Fig.3) was caused by shortage of money for vaccines and was managed by a wide revaccination of teenagers. Mumps incidence (Fig.3) began to decrease only two years ago because of the start of mumps revaccination program. It is a constant growth in parenteral hepatitis B and C, mainly because of intravenous drug usage (Fig.4), but also because of mistakes in blood testing. These non-precedent outbreaks are needed to be thoroughly studied, for further usage of this experience for elaboration and maintenance of the most effective vaccination strategies for these infections.

Infections mind no borders nor they distinguish between the rich and the poor [9]. Therefore, global monitoring over outbreaks of infectious diseases is required. To remind you, a concept of international collaboration in the area of pathogens research was developed in 1997 by an expert group of the US National Academy of Sciences (NAS) under the leadership of Prof. Joshua Lederberg and Dr. John Steinbrunner [10]. Unfortunately, at that time it did not receive financial support. In general, the need for international collaboration to combat infectious disease is beyond all doubt and supported by policy makers and scientists. More detailed proposals are now being considered by WHO known as the Strategic Alliance against Infectious Disease Program.

The geographical location of the Center – near the geographical center of Russia - is very suitable for the most effective collection of natural viral and bacterial strains and diagnostic procedures for the study of specimens from Asian Russia, Central Asia FSU republics, Mongolia and other neighbor countries, if needed, because Novosibirsk is the largest in the area transportation hub. This location of the proposed *International Center* would also allow us to join international efforts to control and deter potential bioterrorists.

The establishment of the International Center for Emerging Infectious Diseases (ICERID) here, in Vector would, in our opinion, be a qualitatively new step towards implementing agreements on the cooperative threat reduction and this approach then could be applied at other institutions.

The unique features of Vector facilities, staff and achievements are presented in the numerous publications and in the web [1, 11] but it will be helpful to present here some details.

The research and technical staff of the VECTOR (1,200) is represented by highly qualified personnel specializing in the field of genetic engineering, molecular biology, virology, theoretical virology, immunology, epidemiology, ecology with an extensive experience in highly dangerous viruses research and in production of diagnostic and prophylactic preparations for public health and veterinary needs. 157 of 340 researchers have now Candidate (Ph.D. equivalent) and Doctor of Science's degrees.

The Collection of Cultures of Microorganisms available in the Center comprises over 10,000 deposit entries: various viral strains, including the national collection of variola virus strains and strains of viral BSL-4 pathogens. The Collection received an international recognition in 1995 when it was affiliated with the European Culture Collection Organization (ECCO).

VECTOR houses one of the two WHO Collaborating Centers (WHO Collaborating Center for orthopoxvirus diagnosis and repository for variola virus strains and DNA), supplied with all required conditions for work with human highly pathogenic viruses,

including variola virus. One of the terms of reference of this WHO Collaborating Center is to preserve and study the Russian collection of variola virus isolates, to develop modern diagnostic kits, improved vaccines and new therapeutic means. The other WHO Collaborating Center for Smallpox and Other Poxvirus Infections is located at CDC in Atlanta, USA. Research collaboration that is established between these two Centers is promising in terms of basic science and, which is of equal importance, in terms of confidence building.

VECTOR has a Breeding and Holding Facility for laboratory animals, including primates that are used in trials on therapeutic and diagnostic preparations being developed at VECTOR. Facilities for the performance of preclinical and clinical trials of new medicinal preparations are available at VECTOR. It is important that Center has a long-term experience in ecology research: one of the divisions of the Center, actively participated in studying the environmental situation in different cities of Kuzbass (Kemerovo Region) coal mines region and developed recommendations for diminishing pollution there. This department continues this study now using for this purpose modern and unique tailor-made equipment and modern mathematical methods.

VECTOR houses a Chair of Basic Medicine of the Novosibirsk State University which makes it possible to involve students and undergraduates of the University in research work of the International Center.

At VECTOR we have a Novosibirsk Regional Center for the Prophylaxis and Prevention against AIDS located on the territory of a specialized clinical isolation department with Biosafety Level 3; at our base, we also house a children's TB hospital.

As objects for research to be carried out at the proposed *International Center* could be arboviruses, including tick-borne encephalitis virus which is endemic in Russia; HFRS virus, Omsk hemorrhagic fever virus – both also endemic in Siberia; filoviruses: Marburg and Ebola; orthopoxviruses: smallpox virus, monkeypox, and cowpox viruses; viruses causing hepatitis A, B, C and HIV-1; measles, mumps, rabdoviruses, influenza viruses, etc. This list of viruses could be extended by bacteria and parasites, and already includes tuberculosis, which is increasing sharply now in Russia, and opistorchiasis – human parasitic disease, which affect liver and is endemic in Siberia too. It also makes sense to address another viruses causing zoonotic and anthropozoonotic diseases critical to public health and veterinary in the region. As a result of this research, the proposed *International Center* can have as one of its strategic scientific goals such as making prognosis, based on the data of global monitoring, of what new infections might emerge in the future. It should be noticed that the most of these infectious agents are considered to be possible bioterrorism agents, and therefore the proposed ICERID could develop the preventive research in anti-bioterrorism direction.

Research areas should cover fundamental aspects of genetics, physiology, and biochemistry of pathogens; pathogenesis studies, including those on human immune response to an infectious disease; development of diagnostic methods; development of drugs and vaccines; epidemiological studies, including the investigation of environmental factors and their effect on rodents and insects; the effect of human behavior and demography, etc.

It is also important to carefully address the issue of enrolling the staff in various training and exchange programs, with invitation for research work at the Centers of foreign scientists and training of our scientists abroad. It is critical to consider the issue of an appropriate handling of microorganisms.

The special attention would be paid to the investigation of the unusual outbreaks of infectious diseases in the region (Asian part of Russia, Central Asian republics – members of C.I.S., possibly – another countries of the region). This investigation may be conducted using

molecular epidemiology approach, which allows to determine the sero- and genotypes of infectious agents, the source of primary infection and even to help distinguishing whether it is intentional or natural outbreak. It was an outstanding example of such an investigation in USA two years ago, when the intentional HIV infection of former lover by physician through injection had been proved by molecular epidemiology methods, and this physician had been put into prison. Such investigations may be made on regular basis for a wide list of pathogens. This type of research would be extremely useful both for monitoring of the evolution and spread of infectious agents and for the investigation of possible bioterrorism cases.

Of course, these are only some baselines for possible scientific program that will be refined and finalized by the Scientific Councils of proposed Center if a positive decision is made that the proposed *International Center* be finally established. In conclusion we would like to address the advantages that come with the creation of the *International Center*:

1. The proposed *International Center* will be able to provide the modern fast diagnostics and monitoring of infectious disease agents in the vast territory of Northern Asia which would be extremely helpful for prognosis of evolution and possible emerging of infectious diseases which are endemic here.
2. The Center will help the public health institutions in the North and Central Asian Countries in investigation of infectious diseases transmission ways and in development of prevention measures and modern diagnostics introduction.
3. International efforts will provide for the highest level of knowledge and accelerate both the study of dangerous pathogens and the development of state-of-the-art public health products for diagnosis, prophylaxis and therapy.
4. The proposed *International Center* in Vector could provide a long-term strategic collaboration, which is far less subject to political or economic conjuncture fluctuations in Member States.
5. The creation of the proposed *International Center* will make it possible to join our efforts to gain knowledge that is essential to control potential bioterrorists.

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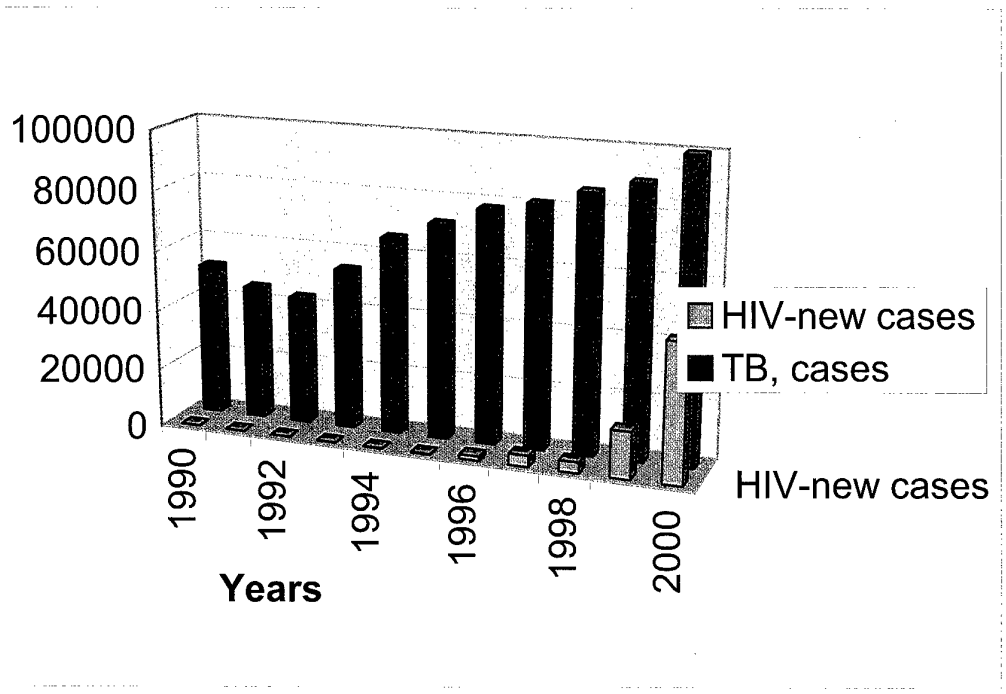

Figure 1. The Tuberculosis and HIV-1 morbidity data in Russian Federation in 1990-2000 (absolute amounts of cases).

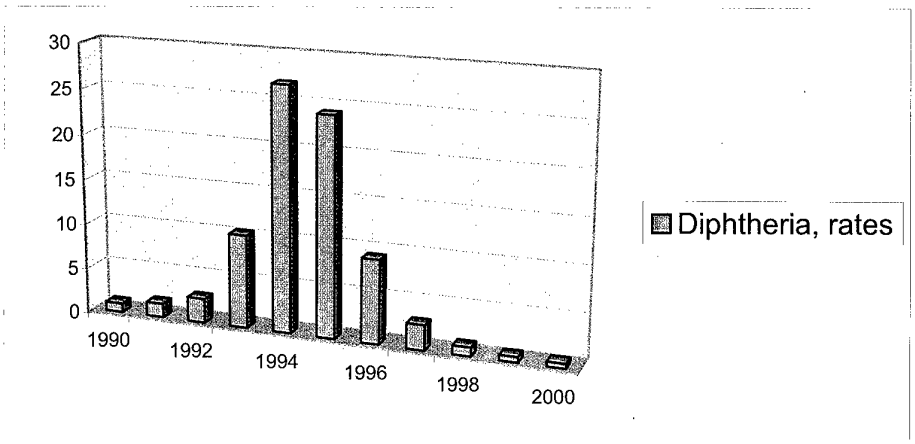

Figure 2. The Diphtheria Morbidity in Russian Federation during 1990-2000, cases per 100,000 (rates)

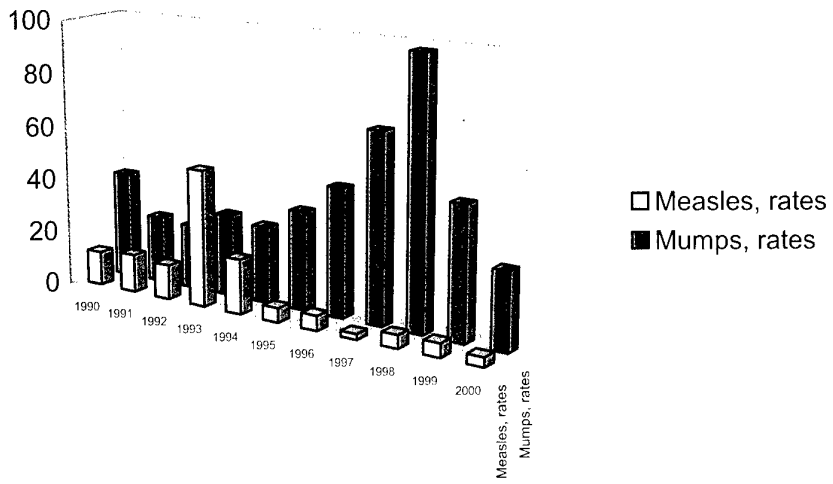

Figure 3. The Measles and Mumps Morbidity data in Russia in 1990-2000, cases per 100,000 rates).

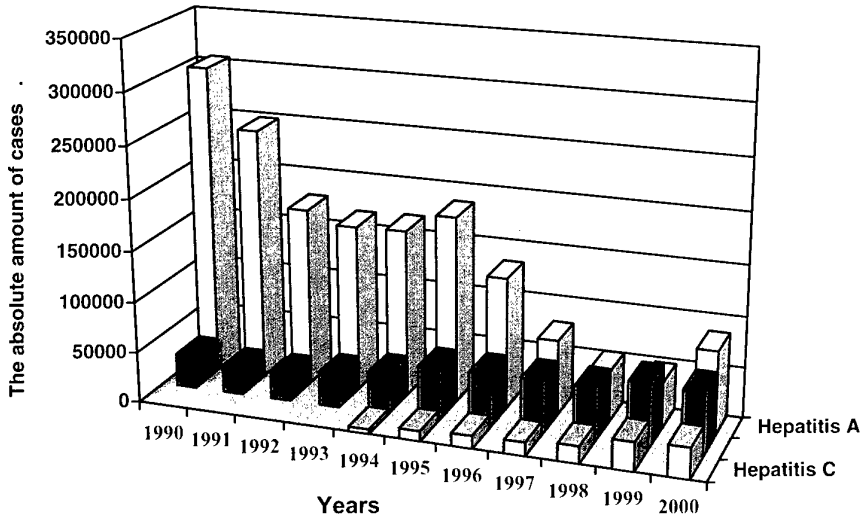

Figure 4. The Acute Viral Hepatitis Morbidity Data in Russia, 1990-2000, cases per 100,000.

Table 1 Selected reportable Diseases, Russian Federation, 1990-2000

Years **Diseases, per 100,000 if not shown other**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Diphtheria	0.98	1.53	2.65	10.25	26.9	24.1	9.2	2.76	0.98	0.6	0.53
TB, cases	51,000	45,000	43,000	54,000	66,000	72,000	78,000	81,000	86,000	90,044	99,932
TB-all	34.2	34	35.8	42.9	48	57.9	67.5	74	76	n.a.	n.a.
TB-MOH	34.3	30.5	29.4	36.5	45.1	48.7	52.8	55.1	58.5	61.14	68,47
TB-mortality	7.9	8.1	9.3	12.6	14.6	15.4	17	16.7	n.a.	n.a.	n.a.
Syphilis	5.4	7.3	12.6	32.3	82.3	172.1	254.2	266.8	226.1	179.3	157.3
Shigella	130.4	146.6	127.3	102.4	149.9	184.2	82	57.1	78	148.4	123.5
Hepatitis A	204.3	165.5	117.9	109.3	111.2	122.6	86.9	50.1	33.8	30.6	56.49
Hepatitis B	21.9	17.9	18.2	22.2	27	35.2	35.8	36.5	35.8	43.3	42.14
Hepatitis C	nd	nd	nd	nd	3.2	6.8	8.4	9.1	11.6	19.3	20.73
Measles	12.4	13.8	12.6	50.1	20	5.2	5.4	2	4.7	5.0	3.38
Mumps	39.2	24.6	23.6	30.1	28.1	36.1	47	69.2	97.8	48.2	27.91
Rubella	192.6	141	na	127	245.7	186.2	115.5	121.1	304	407	310.3
TBEV	3.7	3.5	4.3	5.3	4	4	6.5	4.4	5	6.7	4.03
Influenza	3,719	4,823	6,097	3, 721	2,339	3,870	2,450	5,060	2,516	4,059	5,220
HIV-new cases	95	66	72	99	146	169	1,433	3,853	3,709	15,908	46,438
HIV, rates, new cases	0.06	0.04	0.05	0.07	0.1	0.11	0.97	2.6	2.5	10.84	31.82
Omsk hemorrhagic fever, cases	29	41	7	19	11	5	2	na	7	n.a.	n.a.

Rates /100,000 population

63. PROTECTION FACTOR OF FIRST RESPONDER'S GARMENT

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PROTECTING OUR FIRST RESPONDERS

First responders to a chemical release at a civilian site need to understand the level of protection offered by its existing equipment. As part of DSO National Laboratories' effort to assist these first responders in responding to chemical release, we conducted a study on the chemical protective properties of some fireman garment. These garment were tested against chemical in both liquid and vapour forms.

TEST MATERIALS

The fireman garment tested was made up of 4 different fabric composites. For instance, at some locations the fabric is 3-layered, while some are 6-layered. Test swatches were obtained from 4 different parts of the garment that have different fabric composites (Fabric Composites A, B, C & D).

CHALLENGE CHEMICAL

The challenge chemical used was 2-chloroethylphenyl sulphide (CEPS), which is a simulant for sulphur mustard (HD). Figure 1 illustrates the structural similarities between the two compounds.

TESTING AGAINST LIQUID CHEMICAL: LIQUID SPOT TEST

About 4 cm2 samples were cut from the firemen garment for testing. 1(l droplets of challenge chemical were spiked onto the test sample at contamination level of 10 g/m2 (NATO standard). An air stream was passed through the test sample at a flow rate of 200 ml/min and the chemical penetrating through the test material was collected onto a Perkin-Elmer sampling tube packed with Tenax TA adsorbent. The sampling time was 60 minutes. The sampling tubes were analysed using the Perkin Elmer Automatic Thermal Desorption System (PE ATD 400) coupled to Hewlett Parkard 6890 Gas Chromatograph equipped with flame ionisation detector (FID).

TESTING AGAINST CHEMICAL VAPOUR: STATIC DIFFUSION TEST

Circular swatches (diameter 4 cm^2) of the garment material were used to evaluate their effectiveness as a physical barrier against the chemical vapour of CEPS. The outer side of the suit material is contacted with static, saturated CEPS vapour while the inner side is lined with an indicator paper which changes from red to blue in the presence of CEPS.

The indicator paper is made from coating filter paper with Congo red and 2,4-dichlorophenyl benzoyl nitrogen chloride $C_{12}C_6H_3N(Cl)C(O)C_6H_5$. Reaction between CEPS and the nitrogen chloride caused the evolution of an acidic product, which turns the red Congo indicator blue.

The indicator paper is observed for colour change at intervals of 30, 60, 90, 120 and 240 minutes. Full penetration is marked by complete colour change of the indicator paper, which happens when about 0.02 ug/cm2 has penetrated. This value corresponds to the US standard for maximum allowable amount of HD for skin contact.

RESULTS

The results of the liquid and vapour tests against the 4 fabric composites are tabulated below. The maximum allowable penetration level for the Liquid Spot Test is 0.02mg.

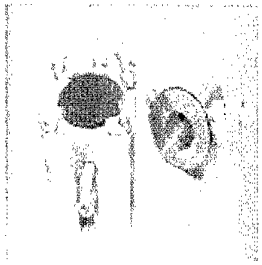
CONCLUSION

The firemen garment as a whole does not provide any appreciable protection against liquid chemicals, even though some parts of the garment (those made from Fabric Composite D) are particularly protective. It is recommended that in situations involving liquid chemical threats, the firemen garment must not be used as a substitute for proper chemical protective suits.

On the other hand, the garment provides protection against chemical vapour for about 30 minutes. Thereafter, ingress of toxic chemicals begins. It is therefore recommended that great caution be exercised when firemen wearing these garments are to operate in a chemical vapour contaminated environment.

FIGURES AND TABLES

Figure 1. The Liquid Spot Test
Preparing the Liquid Spot Test



Liquid Spot Test Underway

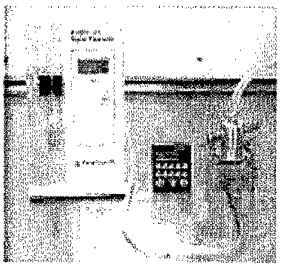
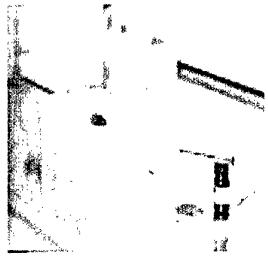


Figure 2: The SD test set-up
SD test Set-up



Blue coloration indicates agent breakthrough.

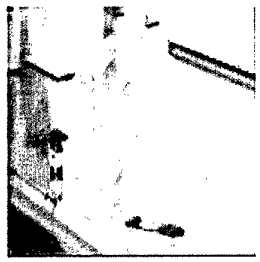


Table 1. Results of liquid spot and static diffusion tests.

Liquid Spot Test

Fabric	Amount Penetrated in mg
Fabric Composite A	0.75
Fabric Composite B	1.25
Fabric Composite C	0.1
Fabric Composite D	0.01

Static Diffusion Test

Fabric	Initial breakthrough	Complete breakthrough
Fabric Composite A	30 mins	120 mins
Fabric Composite B	30mins	120 mins
Fabric Composite C	> 240 mins	>240 mins
Fabric Composite D	> 240 mins	>240 mins

64. COUNTERTERRORISM, SECURITY AND STABILITY IMPROVEMENT - CROATIAN EXPERIENCE FOR THE NEW BEGINNING

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SUMMARY

Military and political scene within Europe greatly changed during the last decade of the 20th century. Times of threat of a large-scale conventional conflict between two large and opposite military powers are over, however new challenges for the people living on this continent and sharing the same strategic environment emerged. But it seems that many differences between the East and West Europe in some areas are still present even after the fall of the Berlin wall. While some European multinational countries dissolved peacefully, Croatia experienced war, and had to win its freedom and democracy by fighting as the ex-Yugoslavia disintegrated. In the course of the last decade we in Croatia witnessed some events that may be qualified as terrorism. Being a society "in transition", the Republic of Croatia shares the same problems with many other states of the Central and Eastern Europe. Overall stabilization of a society takes a lot of effort, especially the effort to consolidate country's economy, which is our top priority. Beside this, high priority is given to defense building issues as well as to threat reduction. This work will present some efforts and steps Croatia has already taken in order to support security and stability, giving its contribution to the overall European Security Concept. It will also present some specific views relating to the internal need for military-civilian cooperation, emergency planning activities and coordination, highlighting the importance of this cooperation for the military commanders within their areas of responsibility.

INTRODUCTION

After the fall of the Berlin wall, some European multinational countries, on theirs path to democracy, dissolved peacefully. New countries and its old nations recognized their common interest as building democratic societies as enjoying advantages of the new security environment. Ex-Yugoslavia as multinational and non-allied country during the cold-war era "expressed" more democracy than some Eastern European states. However, because of congested contradictories that weight federal relationships, it dissolved by the most difficult way – by war. Some political leaders understood positive democratic and security changes of environment as a good opportunity to use military and other advantages to achieve their political goals. As a result, we in Croatia experienced terrible and uncivilized war and had to win our freedom and democracy by harms way.

During the war we noticed many attacks on chemical industry facilities by conventional weapons. Among others, aggressor targeted Oil Refinery in Sisak, Chemical Industry Herbos in Sisak (producing pesticides) and Petrochemical industry Petrokemija in Kutina as targets of multiple attacks. Because of numerous damages of the chemical industry facilities, the citizens of The Republic of Croatia faced extremely high threat.

Beside some events that may be qualified as terrorism, which posed threat by chemical means to population and environment, in this paper are presented some documents and information for a clearer picture of the contribution of the Republic of Croatia to overall security and stability.

SOME EXAMPLES OF ATTAKS ON CHEMICAL INDUSTRY

CHEMICAL INDUSTRY IN KUTINA

Chronology of major attacks on Petrokemija Kutina

- December 31, 1991. Air raid – two "Orao" planes rocketing
- September 12, 1993. MRL "Orkan" – type missiles with cluster war-heads
- August 6, 1995. Air raid – two "Orao" planes rocketing
- September 8, 1995. MRL "Orkan" – type missiles with cluster war-heads
- September 18, 1995. "Luna" missile
- September 26, 1995. "Dvina" aerosol explosive missile

Hazardous materials and threat evaluation

Petrochemical industry facility "Petrokemija" is located in the central part of the Republic of Croatia, near small town of Kutina with about 40 000 population.

The Petrokemija production is made up of 1,800,000 tons per year of installed capacity of fertilizers, 33,000 tons of carbon black and 59,000 tons of bentonite clay-based products. Besides these finished products, four basic chemicals are produced as intermediates but also as possible final products: ammonia (448,000 t / y), nitric acid (415,800 t / y), 98% sulfuric acid (495,000 t / y) and phosphoric acid (165,00 t / y). There are large storages for final products as for intermediates.

This kind of industry with its normal production procedures is balanced and safe. However, any kind of external violation impact can cause a high threat to the facility as well as to the wider area around facility. Experts say that toxic substances in themselves are not the only primary danger, but concentrated extreme amounts of energy brought from the outside in a short period of time, from the thermodynamic point of view, can shift the entire system out of balance and make a sudden emission of large amounts and concentrations of toxic substances possible. As they have noted, the additional danger lies in energents and piled energy in terms of heat, pressure, etc. at the time of the operation of such facilities. A sudden release of that energy and ignition or explosion of energents can be so powerful that an attack or an act of aggression becomes only the initial explosive for things to come. For example, "Petrokemija Kutina" uses over 92 000 standard cubic meters of gas per hour. Such combined action of all dangerous factors contribute to possible enormous quantities of toxic substances, carried by wind, leaving the area of industrial facility very quickly and starting to endanger surrounding settlements, population and animals.

The attacks on industrial facilities using any kind of conventional weapons or terrorist acts are equally dangerous when conducted with a final intention – to cause the threat to people and to the environment.

Not only the factory with its more than 3.000 employees was highly endangered, but also the town of Kutina with all of its population, as well as the wider area and environment. As a conclusion on this issue I quote experts: "Consequences for the people and the environment that followed, or could have followed, can be compared with those from chemical weapons."

INA OIL REFINERY SISAK

Chronology of major artillery attacks and their consequences

- September 2, 1991. 10,000 m^3 oil tank was hit by artillery in storage area, roof was damaged and penetrated, fire broke out and was put out by firemen and workers.

- September 22, 1991. 10,000 m^3 gasoline tank was hit with a grenade. The fire broke out. After the intervention of firemen, the fire was put out.
- October 7, 1991. Outgoing pipeline of full 10,000 m^3 gasoline tank was hit and penetrated with grenade. Massive outflow of large quantities of gasoline in the pipeline channel occurred. Area of fire rapidly spread to 400 meters in length and approximately 20 m in width while the height of flames was higher than 40 meters at the moments producing strong noise at the same time, which made communication during organization of intervention and fire-fighting tactics even more difficult. The fire was put out in 9.5 hours by organized participation of 40 fire-fighting vehicles and teams and that have organized logistical support inside the refinery as well,
- October 18, 1991. After a long and intensive shelling almost 40% of tanks were damaged in the main storage area of the refinery, as well as the retention tank for oiled exhaustion waters, 30,000 m^3 oil tank and tanking area for road tankers, with consequences of five simultaneous fires. Three workers were wounded and ten others had been poisoned by carbon-monoxide,
- November 3, 1991. Gasoline tampon tank of unifying production facility, exhaustion water pool and pipelines on different locations in the refinery were hit with grenades. Fire-fighting lasted for 8 hours while hundreds m^3 of gasoline, oil and diesel fuel leaked out.
- November 4, 1991. two fuel tanks of 10,000 m^3 each, were hit with grenades. Fires were extinguished shortly after,
- November 20, 1991. 10,000 m^3 crude oil tank, fuel oil tank and railroad tanker were hit with grenades almost at the same time. All fires were localized but fire on crude oil tank was not possible to put out and it burned down with all of its contents,
- December 13, 1991. 10,000 m^3 gasoline tank was hit by artillery grenade, which caused fires and damages on nearby tanks as well. Fire was put out after 4 hours of fire-fighting,
- June 26, 1992. 20,000 m^3 fuel oil tank was hit and damaged. About 3000 m^3 ran out and devastated the surroundings.

There were noticed 27 major artillery attacks on the Refinery with evident secondary consequences on 109 facilities. About 90,000 m^3 of crude oil, semi-products, products and chemicals spilled out on the ground and into rivers Kupa and Sava. Due to well organized emergency response teams, good cooperation with local and wider community officials and prepared shelters, the loses were reduced to minimum. Refinery officials noticed five workers wounded by artillery shells and ten others poisoned by carbon monoxide. But still, amount of gases thrown into atmosphere and the consequential damage to the environment was immeasurable.

OTHER EXAMPLES

Beside two factories attacks noted above, many other chemical and other industry facilities all over the Republic of Croatia have been attacked or endangered by attacks. For example "Herbos", pesticide industry in Sisak was attacked with shells and grenades; "Pliva" pharmaceutical industry could have been hit when Zagreb, as Croatian capital was attacked by aggressor with cluster-head missiles, which caused civilian victims but did not cause a chemical disaster; and many others.

Also, as noticed in September 1991, Yugoslav Ministry of Defense officially published in Yugoslav newspapers their intention to destruct rocket oxidants storage in a village of Kerestinec close to Zagreb. JNA personnel managed this location in that time and Croatian authorities did not know the exact quantities of fuming nitric acid being stored at that time. According to the computer simulation, quantity of 60 t was very dangerous for population of Croatian capital if dispersed in the air, depending of wind direction. Ministry of Health Emergency Response Authorities and Toxicological Service worked in close cooperation with Croatian Police and Armed Forces as with emergency response experts of INA - oil industry company. First aid and medical care teams were organized; reserved beds in hospitals were prepared; and necessary stockpiles of antidotes and medicines were also ready. The problem was solved through negotiations in a way that JNA moved the entire base together with rocket oxidants to Bosnia.

Another example dates back to summer of 1991, when JNA occupied the big dam and hydroelectric power plant on the river of Cetina and left that position to paramilitary Serbian troops. Later in the autumn that year Ministry of Health Emergency Response Authorities and Toxicological Service had to response on another kind of threat when "during the cessation of hostilities drunken paramilitary Serbian troops destroyed an electric power transformer situated on the dam and the transformer oil have spilled during a week slowly into the river." As the two water-well systems in Dalmatia used the water from Cetina river, emergency response teams in wide cooperation with other governmental organizations had to protect water-well systems by collecting oil from the river. Fortunately, that oil did not contain PCBs.

RESPONSE

Civilian emergency response teams and industrial experts, including military support, had to take actions on locations to minimize victims and damages, but as the lasting solution for this kind of threats, police-military operations also had to be undertaken.

At the conclussion of operations, the remaining one third of Croatian territory that was still occupied was liberated and Croatia was free. Also, co-operation with Bosnian Armed Forces helped to liberate the Bihać area in Bosnia and Herzegovina, which had been surrounded by the enemy for a long time, and the aggressor threatened to take it just like they had taken Srebrenica earlier that year. In a wider area, new balance between Bosnian and Croatian Forces on one side and Serbian Forces on the other was established and some kind of peace agreement was possible. As a result, the Dayton Agreement was signed, paving the way for further sub-regional stabilisation.

During last decade, the Republic of Croatia has faced large problems of displaced people and refugees, war victims, tens of thousands of destroyed homes, large impact of land mines and devastated economy. This war posed a large impact on every single Croatian citizen.

Being a society "in transition", the Republic of Croatia shares the same problems with many other states of Central and Eastern Europe, and overall stabilization of the society still takes a lot of efforts, especially the effort to consolidate country's economy as a top priority. Beside this, high importance is given to defense building issues as well as to threat reduction. Croatia is continually making aditional efforts and taking steps in order to support security and stability giving its contribution to the overall European Security Concept.

In the Republic of Croatia, terrorism is an act punishable by law. The Croatian criminal Law, which came into force in 1998 outlines punishment for all types of terrorist acts, particularly under the section on the values protected by international law.

Futhermore, the Republic of Croatia strongly believes that terrorism is a global, common security problem, which can only be resolved through active participation of the international community.

The Republic of Croatia is a party to the eight international conventions on terrorism:

- Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil aviation (Montreal, February 24, 1988), supplementing the September 23, 1979 Convention on Suppression of Unlawful Acts Against Security of Civil Aviation;
- Convention on the Physical Protection of Nuclear Materials (Vienna 1979);
- Convention on the Prevention and Punishment of Crimes Against Internationally protected persons, including diplomats (New York, December 14, 1973);
- Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation (Montreal, September 23, 1971);
- Convention for the Unlawful Seizure of Aircraft (The Hague, December 16,1970);
- Convention on Offences and Certain other Acts Commited on Board Aircraft (Tokyo, September 14, 1963);
- International Convention Against the Recruitment, Use, Financing and Training Mercenaries (New York, December 4, 1989);
- Convention on the Safety of United Nations and Associated Personnel (New York, December 2, 1994).

In the Ministry of Foreign Affairs, as the competent Ministry in that respect, two more conventions are considered: Convention Against Taking Hostages and Convention on Prevention of Bomb Attacks.

In accordance with the OSCE Document on Code of Conduct, the Republic of Croatia does not attempt to impose military domination over any other country, but also it actively participates in *building a favorable security environment* in accordance with its commitment to peace, stability, cooperation and the strengthening of mutual confidence among states.

The Ministry of Defense has an important role in accomplishing this mission. Specific importance is given to implementation of internationally accepted commitments in the area of arms control, primarily the Agreement on Sub-Regional Arms Control (Article IV. Annex 1-b of the Dayton Agreement), full implementation of Confidence and Security Building Measures (CSBMs) within the framework of the Vienna Document 1994/1999, along with additional regional and other CSBMs, based on reciprocity; implementation of the accepted conventions, global and regional agreements, programs and measures in the area of international security (e.g., combating terrorism, organized crime, drug trafficking, cyber terrorism and environment protection).

The Republic of Croatia is a member state to CWC, BTWC, CTBT, NPT, CCWC, Ottawa Convention, and is committed to its full implementation.

CONCLUSION

To achieve freedom and democracy, the Republic of Croatia had to win a war. In order to establish lasting peace in wider area, we are now looking for friends all around. Implementing Agreement on Sub-Regional Arms Control we could notice that large efforts were done to reduce the conventional weapons. As the result of reducing more than 6.500 larger weapons and the democratic changes in surrounding countries, today we are much closer to a real balance and lasting peace. As a result of stability improvement it is to expect

additional reductions of military forces by all countries in region, which could have major importance from economy point of view, as well as for additional confidence, stability and security improvements. And, finally, I underline again that the Republic of Croatia strongly believes that terrorism is a global, common security problem, which can only be resolved through active participation of the international community.

KEYWORDS
Counterterrorism, emergency planning, civil-military cooperation, threat reduction, security

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65. TERRORISM AND COMMUNICATION WITH THE PUBLIC

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ABSTRACT

Terrorism has become a reality of the modern world, and it shall remain so for some time to come. The scientific, technical and technological developments make terrorism even more dangerous because of the possibilities of contemporary weapons and equipment, which can reach and have effects almost unimaginable.

The use of chemical, biological and nuclear materials as means of terrorist activities has, as a result, the same effects on the population as, for example, natural disasters, explosions, etc. have.

It often happens that people, who are not in any way immediately linked with the aims and interests of terrorist organizations, get hurt because of terrorist activities. They die simply because they have found themselves at the location of or in the object of terrorist activity. Given the fact that terrorism is always directed to attracting attention of possibly greatest number of people, in other words overall local and international public, one other effect of terrorist action inevitably becomes pronounced and that is fear of the public. This fear is not only a by-result of terrorism, moreover, it is an intended effect. Regarding that terrorism "likes the public", to set oneself successfully against it would exactly mean directing action towards that very public. Namely, on time, regular, considerate and objective informing about terrorism through the mass media can lessen the fear, and thus increase the effect of protection activities.

KEYWORDS

Terrorism, disaster, public, fear, informing

66. DETECTING ILLICIT TRAFFICKING

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INTRODUCTION

In today's society acts of terrorism must involve in some stages the illicit trafficking either of explosives, chemical agents, nuclear materials and/or humans. Therefore the society must rely on the anti-trafficking infrastructure, which encompasses responsible authorities: their personnel and adequate instrumental base.

Modern personnel, parcel, vehicle and cargo inspection systems are non-invasive imaging techniques based on the use of nuclear analytical techniques. The inspection systems are using penetrating radiations (neutrons, gamma and x-rays) in the scanning geometry, with the detection of transmitted or radiation produced in investigated sample.

Explosives and chemical agents detection systems are based on the fact that the problem of identification can be reduced to the problem of measurement of elemental concentrations. Different nuclear analytical techniques could be used for this purpose, however the use of neutrons has some specific advantages. Of special interest is the design and functioning of a transportable gamma-ray system for inspecting cargo vehicles and containers for contraband, explosives, weapons or humans.

The risk of nuclear terrorism carried out by sub-national groups is also considered not only in construction and/or use of nuclear device, but also in possible radioactive contamination of large urban areas. An ever-increasing danger of terrorist actions involving theft and unauthorized proliferation of fissionable and radioactive materials makes it imperative to develop and manifacture reliable equipment for detection of explosive, fissionable and radioactive materials concealed inside various objects and hand luggage.

MATERIALS TO BE CONTROLLED

The list of materials, which are subject to inspection with the aim of reducing the acts of terrorism, includes explosives, narcotics, chemical weapons, hazardous chemicals and radioactive materials. To this we should add also illicit trafficking with human beings.

Explosives: The first explosive known was gunpowder, also called black powder. In use by the 13th century, it was the only explosive known for several hundred years. Nitrocellulose and nitroglycerin, both discovered in 1846, were the first modern explosives. Since then nitrates, nitro compounds, fulminates, and azides have been the chief explosive compounds used alone or in mixtures with fuels or other agents. Today we have a list of some 100 explosive materials. However, the most often used explosives are: Trinitrotoluene (TNT), Trinitrophenylmethylnitramine (Tetryl), Pentaerythritoltetranitrate (PETN), Ciklotrimetilentrinitramin (RDX), Tetrytol, and Hexatol; their elemental compositions are shown in Table 1.

Drugs: Similarly, Table 2 shows the atomic composition of some chemical weapons agents. Old generation chemical agents are chlorine based, while new generation are phosphorous based.

Fissionable and radioactive materials: There is a real risk that sub-national groups will in the future acquire fissile material – particularly plutonium – and construct a nuclear explosive. Equally disturbing, and perhaps more likely, is the possibility that plutonium may be acquired by a group who will threaten to disperse it, by an explosion, and radioactively contaminate a large urban area.

These risks exist because: a large amount of civilian plutonium is being produced and stockpiled; a relatively small amount of such plutonium is needed for a nuclear explosive; the technical information required to fabricate a nuclear device is available in the open literature; and only a small number of competent people are necessary to fabricate a primitive nuclear device.

The design of a "first generation" nuclear weapon, such as the bomb that destroyed Nagasaki in 1945, is no longer secret [1], a competent nuclear physicist can find the relevant information in the open literature (see also ref. [2] and [3]). Several types of these devices are possible: (i) Gun type and (ii) Implosive types. Implosion seems to be a favourite "first try". For example Iraq's importation of explosives and electronics suggested development of an implosion-type bomb. For this last type high-explosive charges are required. The amount of high explosive used in a fission weapon has decreased considerably since 1945 – from about 500 kg to about 15 kg or less. Explosive lenses and detonators adequate for an implosion-type atomic bomb are commercially available [4].

Although a sub-national group could choose to use either plutonium or highly enriched uranium as the fissionable material for nuclear explosives, plutonium is increasingly, the more likely option. A sub-national group that in the future decides to manufacture a nuclear explosive is, therefore, most likely to try to steal or to buy plutonium.

INSPECTION

Modern personnel, parcel, vehicle and cargo inspection systems are non-invasive imaging techniques based on the use of nuclear analytical techniques. The inspection systems are using penetrating radiations (neutrons, gamma and x-rays) in the scanning geometry, with the detection of transmitted or radiation produced in investigated sample.

Explosives and chemical agents detection systems are based on the fact that the problem of explosive identification can be reduced to the problem of measurement of elemental concentrations. Different nuclear analytical techniques could be used for this purpose. Of special interest is the design and functioning of a transportable gamma-ray system for inspecting cargo vehicles and containers for contraband, explosives, weapons or humans and the use of neutrons.

NUCLEAR MATERIAL MONITORING

Portal monitoring for the movement of nuclear material is a common practice. Pedestrian and vehicle portal monitoring for Special Nuclear Materials (SNM) can be used for entrances and exits from nuclear facilities. When gamma rays from the SNM interact with the plastic scintilator, light pulses are generated. The light pulses are amplified and compared with the background radiation level. An alarm sounds if an event is statistically different from the background.

The aim of the control of passengers and goods for radiation at customs is to prevent the illegal or unintentional import and export of radioactive material. Automatic pedestrian and vehicle portal monitors have been used since the 1970s at US nuclear facilities to prevent the unauthorized movement of SNM. There are several recognized manufacturers of these equipment items. Of special interest are Vehicle Portal Monitors, which normally consist of two, self contained, weather resistant pillars placed on either side of the entrance to be protected. Each pillar contains two plastic scintillator detectors, an occupancy detector, and an amplifier/controller. The master pillar also has a battery and power supply. These monitors are designed to automatically scan vehicular traffic without the need for frequent calibration. They are intended for applications where the relatively low energy emissions from ^{235}U and ^{239}Pu are the main concern. They are currently in use in installations such as uranium

enrichment plants, weapons manufacturing and storage plants, nuclear laboratories, and nuclear waste disposal and storage sites where protection of SNM is essential. Development of a combined device for the detection of unauthorizesed transportation of explosive, fissionable and radioactive materials are in progress (RATEC, St. Petersburg, Russian Federation).

It is a reasonable assumption that only State authorities could be responsible for detecting and responding to illicit nuclear trafficking activities on their territory. However, no clear minimum requirements exist on what measures are necessary to meet this responsibility [5,6].

DETECTION

The use of X-rays

The usual instruments, which are using x-rays, are based on the measurement of x-ray intensity reduction while passing through the investigated object. For a given x-ray energy the adsorption of x-rays depend on the object thickness and its average atomic number, Z. In the case of x-ray energy above 100 keV the adsorption depends primarily on material density, independently of its atomic number. Therefore the materials with higher density absorb more x-rays what results in the darker image. This is the principle used for the detection of arms in suitcases in airports. However, using this approach one cannot detect explosive device, which is in the luggage together with the high-density object [7].

In order to increase the probability of explosive detection one needs to increase the method's sensitivity with respect to the material atomic number. This could be achieved with excitation of the same sample with another (smaller) x-ray energy. For smaller x-ray energies the absorption depends on both atomic number and thickness. In such a way one may distinguish iron, which has a Z_{ef} =25 from the explosive having a Z_{ef} =7. The combination of two x-ray energies (system with double energy) allows identification of explosives having high density and small Z. There are several systems with dual energy on the market (American Science and Engineering, EG&G Astrophysics, Vivid Technologies and SAIC). These instruments are providing the ability to quickly and efficiently search for weapons, drugs, and contraband in areas too difficult or time-consuming to search by hand. In addition they can be used to investigate suspicious packages in a mailroom scenario, as well as point-of-entry examination of personal belongings. Instruments can be mounted on full-size bomb disposal robots, as well as on standard photographic tripods.

Another device of interst is SAIC's CDS-2002i contraband detector providing X-Ray vision for law enforcement professionals. The CDS-2002i is an improved portable contraband detection system used to detect contraband hidden within areas such as automobile tires, doors, fenders, bumpers, fuel tanks as well as aircraft structures, boat hulls and building walls. The CDS-2002i is a lightweight, hand-held system, which utilizes a microprocessor, a self-contained low-level radioactive source (100 μCi of ^{133}Ba), and a sensitive detector to measure backscatter through solid surfaces. As surfaces are scanned, concealed objects and materials including weapons, narcotics, alcohol and explosives reflect the low level radiation, which is measured by the very sensitive detector.

Gamma ray technology

Gamma ray technology has proven itself to be fast, reliable, effective and inexpensive way to identify and deter the contraband transportation business. Because they use commonly available isotopic sources, gamma-ray systems are able to provide greater inspection capability while eliminating the need for large, costly, high-maintenance x-ray sources and accelerators. Gamma rays have a much higher effective energy than commonly used x-ray

sources. This higher energy translates to superior penetration and the single-energy output of the source results in a sharper image. Commonly used sources are ^{60}Co (E=1.3 MeV) and ^{137}Cs (E=662 keV).

SAIC, San Diego, California has put on the market several gamma ray based systems, the best known is called VACIS (Vehicle and Cargo inspection System). There are four main components to any such inspection system: the source, the detectors, the computer and the infrastructure. In terms of speed and throughput, a gamma-ray system is the only practical method of achieving 100% container inspection. While comparable x-ray based systems take only minutes to scan a container, the entire inspection cycle time can be 7-15 minutes. This translates to less than 100 vehicles per day. In contrast, gamma-ray based systems can scan a standard 40-foot container in as little as a few seconds, with an inspection cycle time of less than a minute. This leaves the flow of commerce unhindered by the inspection process, an important consideration for customers.

Neutron sensor

Nuclear techniques have been applied in the detection of hidden explosives for a number of years [8]. Basically, they work on the principle that nuclei of the chemical elements in the investigated material can be bombarded by penetrating nuclear radiation (mainly neutrons). As results of the bombardment, nuclear reactions occur and a variety of nuclear particles, gamma and x-ray radiation is emitted, specific for each element in the bombarded material

The problem of material (explosive, drugs, chemicals, etc.) identification can be reduced to the problem of measuring elemental concentrations. Nuclear reactions induced by neutrons that can be used for detection of chemical elements, their concentrations, and concentration ratios or multielemental maps, within the explosives are listed in the following Table 3.

In this respect, several nuclear systems have been proposed, developed and tested so far. All efforts performed so far can be grouped with respect to the type of neutron source and the type of detected radiation and detector type. The neutron source can be either an accelerator: sealed tube or pumped system; the detected radiation is either gamma radiation or scattered neutrons.

The use of radioactive sources:

Usually two types of sources are used: ^{252}Cf that decays by spontaneous fission and Be(α,n) sources, where as an α emitter americium, or plutonium, is used. The source of ^{252}Cf is preferred because of its low specific activity (low yield of gamma rays) and known shape of neutron spectrum. On other hand, Be(α,n) source delivers higher energy neutrons as well as a gamma ray of the 4.43 MeV energy, which is the result of decay of an excited state in ^{12}C.

Detection of gamma rays: The use of ^{252}Cf source in an apparatus designed to detect the presence of explosives was the first method tried [8]. In this case the outgoing gamma rays were detected. In this work the ^{252}Cf source delivered $2x10^6$ n/s/microgram. When neutrons hit the material investigated they loose energy by inelastic scattering. Neutrons with the energy less then 0.025 eV (thermal neutrons) are captured by nitrogen nuclei, which afterwards emit gamma ray of the 10.83 MeV energy, being the signature of nitrogen presence. Since the number of emitted gamma rays is proportional to nitrogen concentration in the sample, it is possible to quantify the amount of nitrogen in the sample. This method has resulted in an apparatus, which was installed on several airports immediately after the Pan Am flight 103 tragedies. One of the drawbacks of this method was nonspecifity. Starting the year 1992 the US Army is using so called PINS (Portable Isotopic – Neutron Chemical Assay

System) for the identification of chemical shells and containers with chemicals (made by ORTEC, USA). In this system the gamma ray spectra are measured by high resolution Ge spectrometer. The source used is 5 micrograms (or 99 MBq) of ^{252}Cf; all the system has a weight of some 50 kg. The software determinates the type of material by using intensities and ratios of intensities for the following chemical elements: As, B, C, Ca, Cl, Fe, H, K, Na, P, S, Ti and Zn.

Several systems are described in the literature (ref.14): for small parcel detection (SP-EDS), vehicular detection system (V-EDS), mine detection (M-EDS). SP-EDS utilizes TNA technology for inspection of small parcels like briefcases, postal packages and handbags. SP-EDS can be deployed alone or used as a part of a larger, comprehensive existing security system. For example, the product is proving useful in airports when used inline with traditional X-ray machines. Instead of unpacking a bag, when the X-ray machine detects items of specific shapes, liquids or laptops, the bag is put into the SP-EDS machine to automate the inspection process. X-rays flag the item, then SP-EDS determines whatever it contains anything of concern. Similar system is also available frm RATEC and some other manufacturers. The other system, V-EDS, also based on TNA, is usually mount4ed in a vehicle, moved alongside parked cars and trucks, scan the contents of these vehicles and instantly detects explosives. It can be installed at the in trances of vulnerable parking areas.

Neutron detection: For detection of explosives a different type of sensor can be obtained by looking at the low energy neutrons that are back scattered from the soil in presence of large hydrogen content, as is the case in a landmine. This process is certainly less specific compared to the detection of characteristic gamma rays because hydrogen is also contained in the soil moisture. Nevertheless, the presence of material with high hydrogen content can be taken as an indication of an anomaly in the soil, in the same way actually done by other systems as metal detectors or GPR systems [9].

The use of accelerators:

Different types of charged particle accelerators can be used as a neutron source. The accelerators are producing a beam of charged particles, which bombards a suitable target where neutrons are produced via a nuclear reaction. The charged particle beam can be pulsed, and as a consequence the resulting neutron beam can have time dependant shape (see Fig. 1). Neutron beam energy depends on the type of nuclear reaction used in the neutron production as well as the energy of charged particle beam. The small sealed tube neutron generators are of special interest because they could be used in the construction of transportable instruments. The use of accelerators allows more degrees of freedom in device construction.

For a simultaneous detection of several elements, and for an efficient analysis, high-energy neutrons in pulsed mode are required. During one short pulse of 14 MeV neutrons, high energy neutrons are emitted and interact with the material, leading to elastic scattering with prompt emission of characteristic gamma-rays, and also to nuclear reactions with prompt and delayed emission of gamma rays and/or particles, see Fig.3. [10]. During the pulse, it is then possible to detect mainly inelastic scattering and prompt emission from nuclear reactions, with a background at low level from residual activation. System using pulsed fast neutrons and time of flight measurement (PFNA-TOF) is described in the report issued by US Office of National Drug Control Policy [11]. The system is using 8.2 MeV pulsed neutron beam to scan the material in the cargo container. The neutron beam interacts with the atomic nuclei of material in the container; the nuclei excited in the inelastic processes emit gamma rays of the characteristic energies. The measured gamma ray spectrum depends on the elemental composition of the material in the container. The system, which emits the neutrons, also defines their paths. The exact location of the object is additionally

defined by the measurements of time interval between neutron pulse and the detected gamma ray. In order to distinguish drugs (for example cocaine) from the rest of material, the system is measuring the amounts of oxygen and carbon in volume elements (voxels) of the container. The system produces the elemental picture of the whole volume what enables finding of the drug in the hidden locations.

Several systems based on the use of pulsed sealed tube generator have been reported. The investigated object is identified by comparison of its "elemental fingerprint" with the "elemental fingerprints" of number of materials in the library in computer memory. SODERN, in France has studied the possibility for realization of a sensor for gamma ray detection produced either by fast neutron or slow neutron activation [12].
The experimental configuration which should be realized in the new system should include neutron generator used in both continuous and pulsed modes, with detection of gamma rays from neutron inelastic scattering, from thermal neutron capture and from fast or thermal neutron activation.

There is at least one commercial system described in the literature [13] which uses pulsed fast neutron analysis to detect the presence of contrabands and drugs. System for cargo inspection, ACI system, based on PFNA technology, has been designed specifically for the wide range of needs related to cargo inspection. As a vehicle or container pulls through a scanning area, the ACI sends pulses of neutrons that stimulate unique elemental signals from the materials in small segments, voxels. These measurements are used to generate 3D element maps on a computer screen. From there, characteristic elemental signals identify the cargo and pinpoint any suspect material present.

EXPERIMENTAL ARRANGEMENTS

The present experimental arrangement is constructed using an 150 keV deuteron accelerator at the Institute Ruder Boskovic. The accelerator has been modified to be an pulsed 14 MeV neutron source with the possibility of detection of associated alpha from the $d+t \rightarrow \alpha+n$ reaction. A computer-controlled wagon (controlled position and speed) contains an object (which could be a landmine in a soil at the variable depth, or something else like explosive in a suitcase on the conveyer). The detector is planned to be both gamma and neutron detector with the n-γ separation, allowing simultaneous measurements of both gamma and neutron spectra. Geometry of object excitation and radiation detection could be changed according to technique requirements. The recognition software with signatures database will be developed so that the system can recognize a series of materials, which are usually subject to control. Details of experimental set-up are shown in Fig. 2.

NEW DEVELOPMENTS

With modern techniques such as neural-networks, feature extraction, computer vision, statistical and syntactical pattern recognition, anomaly detection, and knowledge discovery, computers have the ability to extract information from multiple sources and identify and track patterns of activity that are inconsistent with "normal" operations. Warning systems can then be activated to alert human operators and recommend actions. These automated decision aids can facilitate such things as intelligent surveillance of areas where normal human monitoring is unsafe, administratively difficult, or economically impractical to meet the challenges of ever increasing interpretation of large amounts of complex data. Research in advanced surveillance and monitoring technologies is producing more fully automated and integrated systems that will be applicable to the requirements of the future. For example the research of Intelligent Computer Vision includes the characterization and recognition of shapes of objects in moving and still images, both real-time and archival. A new algorithmic

framework for image segmentation, object recognition, and image understanding allows an automated system to distinguish human shapes from other objects.

Based upon the normal behavior patterns ascertained through Pattern Recognition, anomalous activities, such as an individual's entry into an area in which he's never been before, may now be identified. Anomalous activities that are detected can be communicated to appropriate security personnel for immediate response or archived for subsequent development of deterrence strategies. The goal is to learn from the data and adapt to changes automatically. Based on learning "normal" activities, the system will alert all anomalies and not just those that have been previously identified. This produces the most reliable and secure anomaly detection capabilities. Los Alamos is working with Motorola Corporation on a joint project to design and develop a digital camera with such advanced surveillance features.

SUMMARY

Modern personnel, parcel, vehicle and cargo inspection systems are non-invasive imaging techniques based on the use of nuclear analytical techniques. The inspection systems are using penetrating radiations (neutrons, gamma and x-rays) in the scanning geometry, with the detection of transmitted or radiation produced in investigated sample.

Explosives and chemical agents detection systems are based on the fact that the problem of explosive identification can be reduced to the problem of measurement of elemental concentrations. Different nuclear analytical techniques could be used for this purpose. Preventing nuclear smuggling is crucial to preserving a world free of nuclear terrorism.

Today's technology allows establishment of an effective system for prevention of illicit trafficking of either explosives, drugs, chemical agents, nuclear material or humans.

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KEY WORDS
Illicit trafficking, explosives, drugs, nuclear materials, x-rays, gamma rays, neutrons.

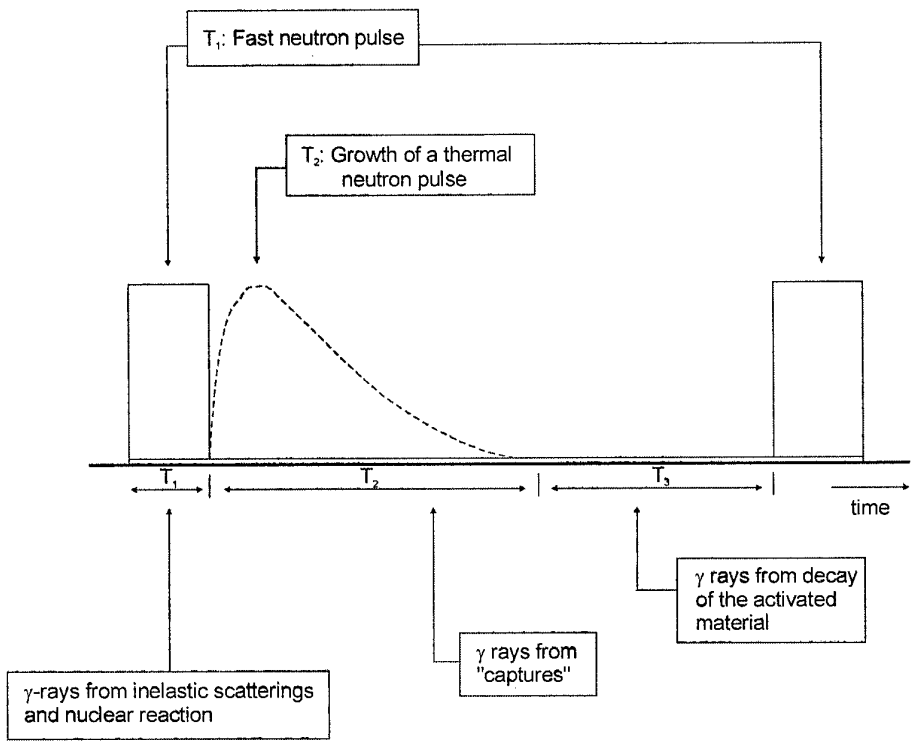

Fig 1.
Time structure of neutron beam and resulting radiation from the investigated object

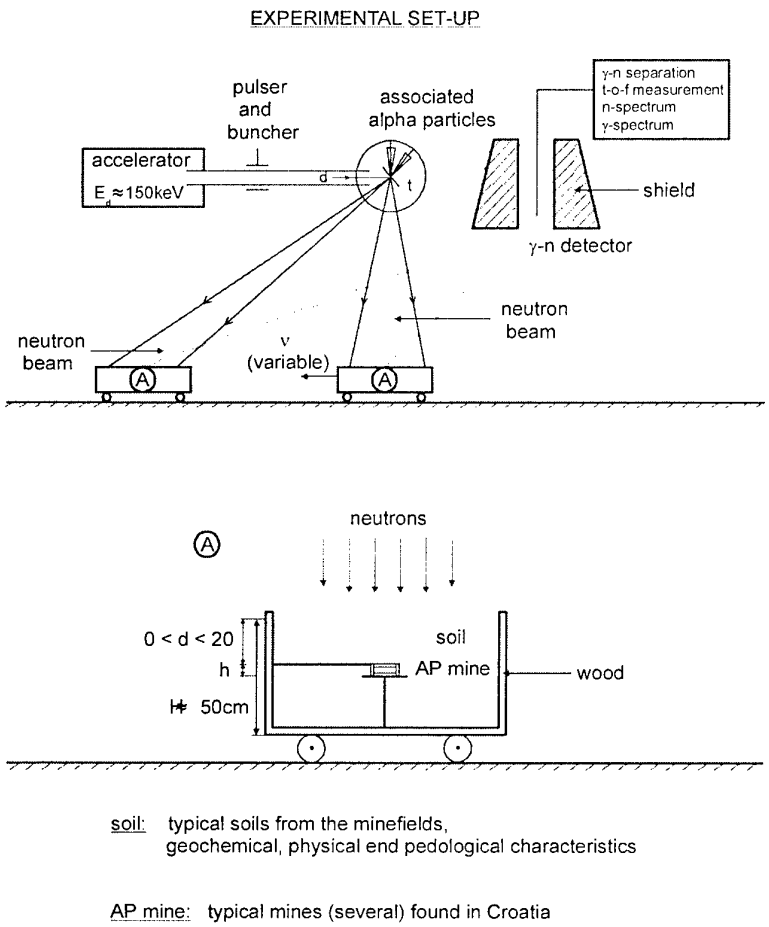

Fig 2. Experimental set-up.

Table 1. Nitrocompound Explosives.

Formula	Molar Mass	Density (g/cm^3)	Name	Vapour Pressure (rel./Torr at 25°C)	Detonation speed (m/s)
$C_7H_5N_3O_6$	227.1	1.65	TNT	7.7 ppb / 5.8×10^{-6}	6,94
$C_7H_5N_5O_8$	287.2	1.73	Tetryl	7.5 ppt / 5.7×10^{-9}	7,65
$C_5H_8N_4O_{12}$	316.0	1.78	PETN	18 ppt / 1.4×10^{-8}	8,31
$C_3H_6N_3O_6$	296.0	1.83	RDX	6.0 ppt / 4.6×10^{-9}	8,64
$C_3H_5N_3O_9$	227.1	1.59	Nitroglycerin	0.41 ppm / 3.1×10^{-4}	7,6
$C_4H_8N_8O_8$	296.2	1.96	Octogene	3.95 ppt / 3×10^{-9}	9,1

Table 2. Elementary composition of some CW agents (atom number/molecule).

Agent	Cl	P	As	S	F	O	N	C	H
S-Mustard (HD)	2			1				4	8
N-Mustard (HN)	3						1	6	12
Yperite	3						1	6	12
Lewisite (L1)	3		1					2	2
Lewisite (L2)	3		1					4	4
Lewisite (L3)	3		1					6	6
Tabun (GA)		1				2	2	5	11
Sarin (GB)		1			1	2		4	10
Amiton(VX)		1		1		2	1	11	26
Clark I (DA)	1		1					12	10
Clark II (DC)			1				1	13	10
Soman (GD)		1			1	2		7	16
VX		1		1		2	1	11	26

Table 3. Neutron induced nuclear reactions which can be used for elemental concentrations determination.

c	Reactions	Neutron energy	Reaction type
H	$^{1}H(n,\gamma)^{2}H$	thermal	prompt
C	$^{12}C(n,n'\gamma)^{12}C$	5 MeV and up	prompt
N	$^{14}N(n,\gamma)^{15}N$	thermal	prompt
N	$^{14}N(n,n'\gamma)^{14}N$	3 MeV and up	prompt
N	$^{14}N(n,2n)^{13}N$	14 MeV	activ.,9.9 min
O	$^{16}O(n,n'\gamma)^{16}O$	7 MeV and up	prompt
O	$^{16}O(n,p)^{16}N$	9 MeV and up	activ.,7.13 s
Cl	$^{35}Cl(n,\gamma)^{36}Cl$	thermal	prompt
Cl	$^{35}Cl(n,n'\gamma)^{35}Cl$	3 MeV and up	prompt
Cl	$^{37}Cl(n,p)^{37}S$	14 MeV	activ.,4.9 min

67. SYSTEM OF HUNGARIAN SYSTEM MANAGEMENT

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INTRODUCTION

Characteristic feature of terrorism is to destabilize, disturb or threaten social and political conditions. Terrorist acts cause extensive materials damages and threatens human life and health. Increasingly threatened establishments are factories with the risk of explosion, mineral oil industrial facilities, hazardous goods deliveries, processing units and stores as well as chemical factories and nuclear facilities.

As a consequence of international expansion of organized crime and partially uncontrolled proliferation of mass destruction weapons, the committing of such acts– particularly in densely populated urban agglomeration and in the neighborhood of great hazardous chemical factories and institutions - cannot be excluded in Hungary, either. Because of sources of threats appearing in close and complex interaction, the risk of development of domino effects is great and so is the possibility of development of secondary and tertiary threatening effects, which can hardly be forecasted. Therefore it is evident that the committing of terrorist acts carries always with it the escalation of threat and the risk of development of disaster threat. The scope of threat can only be estimated the vulnerability of the population however, can be very great in these cases.

Conscious planning of management of threats and disaster situations developing as a consequence of occasional terrorist acts is an important tasks of organizations concerned. In order to decrease effects the most important opportunity is – beyond the reconnaissance and preventive activity of special agencies – the development of the institutional system of protection and the improvement of the security and safety of possible threatened establishments.

In Hungary, as a result of political, economic and social processes which have been taking place for about a decade, new, up-to-date statutory provisions and systems have been developed which meet also the Euro-Atlantic requirements. Economy has become stabilized, industry strong and with this, production, use and storing of hazardous materials have become more extensive. At the same time, however, in Hungary and neighboring states the transformation of economy has not been in every case followed by the taking, that is, introduction of necessary security measures. In our region threat is increased by the high density of population, especially in the vicinity of industrial establishments: the structure of industry developed is basically focused on big cities. Consequently civil security has become more and more important and crisis situations, such as, civilian accidents, nuclear emergencies, natural disasters and in this context, the role of international assistance, have come to the fore.

The increased feeling of threat has changed the attitude of citizens about sources of threat around them. This makes a harmonized state functioning and legal system necessary, which responds to circumstances, developed and establishes a regulation system in the framework of which citizens accept participation on voluntary basis and cooperation in the management of emergencies.

INSTITUTIONAL SYSTEM OF HUNGARIAN DISASTER MANAGEMENT ADMINISTRATION

Main objective of the security policy of the Republic of Hungary is the full

enforcement of civil and human rights and the assurance of safety of life, property and social security. Under the aegis of this, Hungarian Parliament adopted an Act in summer 1999 on the Direction and Organization of Protection against Disasters and Protection against Major Accidents Involving Hazardous Materials.

The Act, which entered into force on 1 January 2001 determines and provides a uniform frame for tasks and responsibilities of different level state, government and local government systems for the prevention of civilian, natural, human and ecological disasters and in the event of occurrence of such events and defines the activity of individual organizations during recovery. The necessity of crisis management and integrated rescue system based on uniform principles appears also in the activity of the Directorate General XI. of the European Union dealing with environment protection, nuclear safety and civil protection and of the NATO Civil Protection Committee and of the NATO Senior Civil Emergency Planning Committee related to coordination of international assistance regarding disaster relief and to the organization of civil-military cooperation.

Scope of disaster protection includes natural and civilian, human and ecological disasters and emergencies. Its means are legal regulation, institutional system, measures taken and tasks fulfilled.

The three main fields of competence of disaster management are: prevention of emergencies and disasters, elimination thereof and recovery from damages occurred. From among the three phases – which dissever also in time – prevention is destined, through analysis of occasional emergencies and preliminary planning and preparation, to decrease the possibility of occurrence of disasters to the minimum extent possible. Protection is destined for the decrease of the effects of damages and disasters occurred. Task of the last, that is, recovery and reconstruction period is to eliminate the consequences of disasters.

Disaster protection is, also formulated by the act, a national cause. Subjects of implementation include organs established for this purpose, state and local governmental organizations, voluntary associations, economic formations and even individual citizens. We regard the best possible use of local possibilities as a basic principle whereas we can reckon not only with own forces and assets but also with international assistance based on bi- and multilateral agreements. Precondition of successful implementation is the establishment of a regulatory system, which does not make the operation of direct direction systems necessary. Direction based upon responsibility takes over the role of direct direction, which means that each office, state administration and elected function has tasks well defined and formulated in statutory provisions.

Governmental or other organs, persons, officials participating in the management of different emergencies participate in the management of emergencies through the fulfillment of tasks falling within their own sphere of competence (responsibility). So aims defined can be achieved only if each participating organ fulfils its task at the highest level that can be expected, through adequate coordination and awareness of interdependence. In this regulatory system citizens accept participation based upon citizens' voluntaries and cooperation in the management of crisis situations and consider it a moral value. Regarding the variety of tasks and partner organizations the elimination of emergencies needs continuous strictly regulated and harmonized cooperation. For the task of harmonization of the activity of individual state, local governmental and non-governmental organizations a professional disaster management organization was set up through the integration of the Hungarian civil protection and state fire guard organizations.

In recent years, in Hungary, civil protection has been modernized both as to its concept and scope of tasks and approached to the European norms to a considerable extent. It has become suitable for coordination of the tasks of civil emergencies. From 1996 the State

Fire Guard which was organized in the former military command and operation system was replaced by the fire guards of local governments and in this way actual primary intervention has been taking place on local - settlement level. State responsibility of the Fire Guard is primarily professional direction.

The new organization established through the integration of organizations responsible for coordination of tasks of emergency situations and primary intervention performs tasks of the predecessor organizations as well as new duties. Personal conditions of operation of the organizations are available. Professional organizations of disaster protection are completed by workplace, settlement and regional civil protection organizations established from citizens designated upon civil protection duty requirement and the personnel of the professional fire guards of local governments and – based upon agreements on cooperation – cooperating charitable organizations.

Support and assistance necessary for local and regional organs are provided and the fulfillment of international assistance obligations are supported by a voluntary action team consisting of 50-80 persons which can be employed internationally and a Rescue Organization of Central Function which perform tasks which cannot be fulfilled by the normal (basic) activity of other organizations.

In the event of occurrence of terrorist acts the professional disaster management organization harmonizes the activities of other participating organs depending on the type of threat: fire-guards, public utility service providers, rescue organizations, police organs, transportation organizations, etc. On places where special circumstances exist and hazardous materials are present and which are hardly accessible we can rely on voluntary special rescuers and rescuers of factories, using experts of these fields and special and heavy equipment available at branches and facilities. In the fulfillment of these tasks technical, chemical, radiological, biological, anti-terrorist, mine-lifting, etc. special services of the army, law enforcement and other state organs may be involved ensuring optimal dislocation, a grouping according to individual threats.

Beyond coordination tasks, disaster management organs participate in prevention and mitigation of effects through alarming, information, temporary displacement, evacuation of the population and supplying them with protective devices and the introduction of measures aimed at the protection of sources of subsistence. They plan their tasks following terrorist acts related to participation in rescue, first aid, decontamination, disinfection and liquidation of damages as well as to continuous supervision and supporting assessments during the period of returning back to normal life.

IMPROVEMENT OF SECURITY CONDITIONS

The Hungarian Act on Disaster Management deals in a separate Chapter with protection against major accidents involving hazardous materials. The complex activity includes technical conditions of prevention and mitigation of damaging impacts of accidents as well as measures serving population protection.

Directive SEVESO II. elaborated for the prevention and mitigation of the threat of serious industrial accidents, then modified on the basis of experiences of the Bophal and Basel accidents has become in the countries of the European Community a basic document in the field of industrial, environment safety, area utilization and information of the public.

Directive SEVESO II. will enter into force in Hungarian legislation at the end of this year. The Act obliges an operator to prove that his/her activity does not represent unacceptable risk to population, material property and environment. Depending on threatening effect, an operator may be obliged to deliver data, prepare security report and inner protection plan of establishments, to provide for conditions of fulfillment of tasks

defined in inner protection plan, inform the public of hazardous activity and occasional threats to the public and protective measures taken.

Heads of local governments prepare outer protection plans in which they define tasks related to protection of population, material property and environment. For the population hazardous establishments represent a risk therefore it has the right to learn threatening effects, methods and possibilities of protection against them and the rules of conduct to be applied in the event of serious accident. Operator of a hazardous establishment is obliged to give credible information of the establishment, sources of risk existing there and measures taken in order to prevent and eliminate major accidents. The state is responsible for the performance of tasks determined in outer protection plans and conditions of fulfillment are provided also by the state.

During overall preparation for disaster management we stress the importance of the principle that organs participating in the elimination of disasters should consider, - in addition to ways of response, - the means of disaster prevention and the methods of preparation of the community concerned to this end as well as organs that can be involved in recovery. In practice, this means the tasks of prevention – preparation – response – recovery which build upon one another.

During targeted preparation planning for all types of emergencies, preparation of the population, training of organizations participating in the elimination of disasters and of professionals, organization of exercises and scientific conferences, continuous modernization of theoretical and practical procedures, signing of agreements on cooperation, establishment and operation of disaster-alarming and notification and early warning system of the population are of primary importance.

As far as response is concerned, we attach special importance to preparation for the implementation of plans, introduction of extraordinary measures related to placing into preparedness and activation of authorities, activation of emergency operation centers, setting up of operative groups, immediate start of intervention necessary for elimination and of direct liquidation of damages, organization of search and rescue and mobilization of further resources as need be.

One of the prerequisites of response – and often, of actual disaster prevention – is the existence of an adequate system of assets. Therefore, a survey was made on the vulnerability of individual regions of the country and its probable development and directions of development in accord with the deepening of emergency situation. On the basis of the analyses a program for the establishment of a network providing for engineering (technical rescue) embracing the whole of the country has been elaborated. On the basis of this program which has, according to the plan, three phases, the first three rescue bases will begin operation this year. Their fitting – technical rescue assets (equipment), heavy crane, chemical accident prevention vehicle – may be suitable, beyond elimination of traffic accidents and disturbances of chemical plants, for the liquidation of the consequences of terrorist acts.

EXPERIENCES OF THE OPERATION OF DISASTER MANAGEMENT SYSTEM

The new disaster management direction and responsibility system and the professional disaster management organization were tested last year in practice. Perhaps liquidation of consequences of terrorist acts was the only threat, which it did not need to face in practice.

The Hungarian disaster management system has been basically equal to expectations. It has fulfilled its daily fire-fighting and rescue tasks at high standard and ensured reliable domestic and international background for protection tasks of great scope during management of inland waters, floods, blows and water pollution. It has organized local protection of local governments in the event of natural calamities and mobilized its own

organizations and the resources of the country and the international community. It has coordinated successfully recovery and reconstruction work. We have managed successfully – without any toll (of human life) – the fighting of extensive forest fires, protection against flood the greatest ever since, the taking off of the 100 thousand cubic meter cyanide pollution at the river Tisza as well as the evacuation of 18 thousand persons because of dike burst. International reputation and recognition of Hungarian Disaster Management Administration is shown by the International Sasakawa Certificate of Merit awarded by the UN.

68. SOUTH AFRICAN MILITARY HEALTH SERVICE INVOLVEMENT DURING OUTBREAK OF CHOLERA IN KWAZULU-NATAL

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INTRODUCTION

Cholera is an acute diarrhoeal disease endemic to Africa, which is caused by the bacterium *Vibrio cholerae.* It may cause a formidable epidemic, and even a single case of cholera needs to be notified within 48 hours to the World Health Organization. Epidemiological features of the disease include inter alia:

Cholera is spread by the ingestion of water and food contaminated by the excrement of persons with symptomatic or asymptomatic infection.

Epidemics are characteristically explosive and abrupt, and can cause an acute public health problem, but outbreaks may also be protracted.

In endemic areas, outbreaks usually occur during warm months, and the incidence is highest in children.

The epidemic reaches a peak and subsides gradually, owing to the acquisition of temporary immunity as well as the occurrence of large numbers of sub-clinical cases.

Elimination of contaminated water does not immediately bring an outbreak to an end, owing to the continuation of transmission through contact.

Since 1817, seven cholera pandemics have been reported worldwide, of which the seventh originated in 1958 with endemic disease in Sulawesi in Indonesia. The dynamic spread of this pandemic can be subdivided into three geo-chronological periods, viz. South East Asia (first), Mainland Asia (second) and Middle East, Africa and Europe (third). Cholera in South Africa can be traced back to the third period, when South Africa was considered to be at risk as early as 1971, with sporadic outbreaks between 1980 and 1987. More recently, 68 cases of cholera were reported during 1999 in the Durban metropolitan and surrounding area, while the current epidemic started at Empangeni along the KwaZulu-Natal north coast during August 2000. The total population at risk in the affected areas is estimated at more than 1,8 million, while by the end of October 2000, more than 4000 cases had been recorded, of which some 22 victims had died.

Subsequently, the Department of Health formally requested the Surgeon General of the South African National Defense Force to provide health support via the South African Military Health Service (SAMHS). Although not directly or indirectly related to acts of terrorism in this particular case, the problems and challenges presented by massive outbreaks of disease may be very similar to those associated with incidents involving the deliberate use of biological agents by terrorist groups. In support of the stated objective of this "First World Congress on Chemical and Biological Terrorism", this contribution will provide insight into the first South African experience of large scale Public and Military Health Service co-operation in dealing with such a situation.

Foremost in the planning of support and response operations of such magnitude was the need to consider the socio-economic and environmental profile of the affected areas, as outlined below.

SOCIO-ECONOMIC AND ENVIRONMENTAL FACTORS

There are currently two districts north of Durban that are mainly affected by the epidemic, namely the Lower Umfolozi district around Empangeni and the Eshowe/Nkandla district, covering an area of approximately 2500 km^2. Owing to a combination of factors such as lack of economic activity, overpopulation, illiteracy, unemployment, political unrest and high HIV/AIDS figures, these areas represent some of the most deprived and poverty-stricken in South Africa. Subjected to an economy of subsistence, people live under dire circumstances and are literally compelled to "live off the land". High population densities place tremendous demands on the overburdened infrastructure, particularly in respect of education, health care facilities, piped water and sanitation, and it is extremely difficult to provide and maintain such services adequately with a national economy in transition. The inevitable result is overexploitation of natural resources, particularly water sources, which in many instances, are limited to small mountain streams that must provide for all needs such as for drinking by man and beast, cooking, and washing. These problems are compounded by mismanagement of such resources through ignorance and carelessness, political distrust and suspicion, and in general, low standards of personal hygiene prevailing among most of the population. The topography of the region is such that communities are isolated and restricted to remote villages, in most instances separated by hills and valleys that are virtually inaccessible by road, particularly during the rainy season. Severely dehydrated patients often need to be transported to health care canters over long distances, using wheelbarrows as the only means available.

PLANNING AND EXECUTION

Against the above background, planning and execution of support and response operations were conducted by the KwaZulu-Natal Health Department in collaboration with the SAMHS. This involved inter alia:

Establishment of sub-district, regional and provincial Joint Operational Crisis Committees/Centres (JOCC's) with daily meetings.
Assessment of situation.
Prioritization of requirements.
Acquisition of essential medical and other supplies.
Involvement of community stakeholders.
Briefing and deployment of suitably qualified personnel.
Establishment and maintenance of temporary Rehydration Centres.
Provision of field ambulances, water tankers and containers for potable water at strategic locations.
Record keeping.
Promoting increased health care knowledge and awareness among the local population.

The first SAMHS members reported for duty on 13 October 2000. The first deployment consisted of two groups, one in Eshowe and the other in the Empangeni area, under a Medical Task Team Commander with the rank of Major and two platoon commanders with the rank of Major and Captain respectively. The Task Team consisted of fourteen Registered Nurses, fourteen Operational Emergency Care Orderlies (OECO's) and fourteen drivers, while seven 2x4 LDV ambulances were made available.

REHYDRATION CENTRES

The Department of Health was responsible for setting up ten Rehydration Centres in the affected areas with all necessary stock and equipment, manning these centres together with SAMHS personnel, and for transport of personnel to and from their point of duty. At the peak of the epidemic, there were a total of twenty-five of these Rehydration Centres in the affected areas, and an additional twenty in other areas outside of the Lower Umfolozi and Eshowe/Nkandla districts.

The Rehydration Centre is the first line of defense and the most important facility in the cholera campaign, and consists of a 4x4 m square tent, equipped with:

Lighting installation;
Examination couch;
Bed and drip stand;
Cupboard;
Benches;
Bedside lockers;
Canvas chairs;
Generator;
Gas lamps;
Emergency gas bottles;
Bulk container with toilet paper, soap and household bleach for distribution to the local population.

Other equipment include a diagnostic set, stethoscope, thermometers, equipment for infusions, containers with oral rehydration solution (ORS), catheters, urine drainage bags, bio-hazard containers, gloves, disposable aprons, masks with visors, cleaning materials and plastic buckets for hand washing. A cellular phone is available for communication at each center, and an ambulance is stationed at centers where there is no such service available, while information leaflets are kept at each center. At least one cleaner is assigned to each center for each shift of 12 hours. At some centers, a second tent is used as a holding facility, store room and rest room for personnel.

The establishment of Rehydration Centers was the result of joint planning. Although the idea originated at the Department of Health, most of their personnel lacked the necessary expertise, and SAMHS personnel were requested to physically erect and secure the tents. This was a once-off exercise, and unfortunately, lack of proper maintenance by Department of Health personnel as well as vandalism by criminal elements resulted in large scale deterioration at some centers. As the crisis developed and resources were depleted by sheer numbers of patients, Rehydration Centers were also installed in community halls and other buildings. This came also as a result of adverse weather conditions such as heavy rainfalls flooding the tents from time to time, so that the tents have to be evacuated periodically. The installation of Rehydration Centers in buildings made life easier for personnel because of the availability of running water, toilets and electricity. In contrast to the tents, where sharing of portable chemical toilets with patients may create a health hazard to personnel, these facilities are clearly marked and allocated in the buildings.

TREATMENT OF PATIENTS

The Rehydration Center is seen by the population as the symbol of treatment. The challenge is however, that patients do not necessarily report to the tents at the first sign of illness. There is a definite "rush hour", because elderly patients must wait for children to

return from school at approximately 3:00 pm before they are assisted to the centers, while others may start their journey at first light, arriving at the center around 10:00 in the morning. Upon arrival, all patients are assessed, and if not diagnosed with cholera, they are referred to the nearest Primary Health Care Clinic. This may imply that non-cholera patients are sometimes also transported with SANDF ambulances to the nearest hospital, causing confusion. Those who are diagnosed positively are treated according to the severity of dehydration, based on a treatment regime recommended by the WHO. Specific details of this regime are out of context here, but in broad terms, may be summarized as follows:

1. **Severe dehydration**
   Intra-venous fluid replacement
   If no improvement after 6 hours, hospitalize and treat with IV antibiotics (No oral antibiotics are issued at the Rrehydration Centres)
   If improvement after 6 hours, health education and discharge home

2. **Moderate dehydration**
   Oral rehydration
   Observation for 6 hours
   Health education and discharge home

3. **Little or no dehydration**
   Health education and discharge home

WORKING ENVIRONMENT

Bearing in mind the socio-economic and environmental factors outlined above, it stands to reason that working conditions are exceedingly difficult. These difficulties originate from various factors, as listed inter alia below:

1. Weather and climate

The affected areas fall within the summer rainfall region of South Africa, i.e. between October and March. The summer climate in the affected areas is extremely hot and humid, and the tents do not provide adequate shelter against adverse climatic conditions. Poor ventilation leads to extreme temperatures in the tents where patients are already dehydrated.

2. Location of Rehydration Centers

The placement of the tents was determined by community nursing staff together with the community leadership, without proper consideration of the physical environment. This is the cause of many problems such as communal water holes and domestic animals close to the centers, while no running water is available. The Department of Water Affairs provided a 5000 litre water tank at each center for use by both the staff and the patients.

3. Working hours

Personnel from the Department of Health often work their 12 hour shifts in the hospital, and then report for duty at the Rehydration Center, probably because they are being paid overtime. SAMHS personnel work 4 x 12 hour shifts per week, while ambulance drivers change shifts every 12 hours.

4. Relaxation areas

Initially, no separate shelters were available for health care workers where they could relax or have lunch. An additional tent was since provided for this purpose at each center.

5. Insects

The affected areas are notorious for a variety of crawling and other insects such as mosquitoes and ticks, which cause severe inconvenience and may endanger the health of personnel.

6. Safety of personnel

Crime, violence and faction fighting are rife throughout the whole of the Province of KwaZulu-Natal. Ensuring the safety of nursing staff, particularly during the night, is a matter of concern. Vandalism resulted in the placement of an armed guard at each center by a private security company, in consultation with the tribal leadership.

OTHER COMPLICATING FACTORS

Apart from adverse working conditions, personnel have to cope with a number of complicating problems and challenges on a daily basis, caused by factors such as ignorance, carelessness and distrust. Some examples are given below:

Irrespective of extensive health education and awareness programmes, there is still much confusion among the population regarding the procedures and formulations for water purification with household bleach, and the preparation of oral rehydration fluids that have been demonstrated to them. This may be attributed to cultural differences, distrust and a reluctance to adapt to higher living standards.

Very few SAMHS personnel can speak or understand the Zulu language, which causes severe communication problems.

In rocky areas, pit latrines are shallow and infected waste is washed by heavy rain into nearby rivers and streams. Inhabitants tend to believe that the water is now clean, and continue to drink such water without precaution. Some youths continue to play and swim in infected pools, streams and rivers, having been told by certain health educators that it would be safe as long as they keep their mouths closed!

Household bleach (provided free of charge) is being used for purposes other than water purification such as washing, while many inhabitants believe that water purified in this way may cause "internal" bleaching.

Clean water provided at various locations is often collected in contaminated containers.

Despite on-going health education, poor standards of personal hygiene persist. Inhabitants continue to prepare food with soiled hands, while the habit of several people eating simultaneously from a communal food container without using cutlery, prevails.

Political distrust causes reluctance to use water supplied by tankers, because of fear that such water may have been deliberately contaminated by opposing factions.

Large numbers of mild and asymptomatic cases occur who may remain untreated and may continue to spread the epidemic.

Some cases are infected and report for treatment more than once.

High incidences of non-bacteriological diarrhea cases are encountered during the summer rainfalls who also need to be assessed.

Mass gatherings of religious groups who perform traditional baptizing ceremonies in potentially contaminated and positively tested rivers present a constant threat of looming disaster, particularly with regard to spreading the disease to other areas. In some cases, the population were convinced to use portable swimming pools for such purpose.

Incorrect statistics as well as manipulation thereof by certain parties for political or personal gain, resulted in wrong decisions at the planning level.

Encumbering factors such as the above demonstrate the complexity of response and support operations in underdeveloped areas, and underscore the necessity of health awareness through continued education and training of the local population.

LESSONS LEARNED

An extensive and comprehensive response and support operation such as described above can never be expected to proceed smoothly in all respects, and the SAMHS, together with the Department of Health, proceeded through a steep learning curve with many pitfalls and obstacles. From a SAMHS viewpoint, a number of important lessons were learned in the process, as summarized below:

1. Early involvement of the SAMHS at all levels would have resulted in more purposeful planning of acquisitions and operations.
2. A deployment period of two weeks for SAMHS personnel before they are relieved causes administrative and logistical difficulties and was subsequently extended to one month.
3. Four wheel drive ambulances are essential in remote areas with limited infrastructure.
4. Duplication and manipulation of statistics encumbers proper planning.
5. Timeous treatment with oral rehydration fluid may result in 80 - 90% of patients recovering completely.
6. Antibiotic treatment shows only moderate success owing to resistant strains.
7. The most basic requirements for preparedness are: reliable surveillance and reporting systems, availability of essential supplies, and trained workers.
8. Health education alone has little effect, but practicing the knowledge by deliberately changing an unhealthy way of life is the key to prevention of disease.
9. Command and control structures, channels and procedures for a support operation of this magnitude need to be streamlined and simplified as far as possible to avoid over-reporting and confusion, and should be supported by an HQ element with at least a 2IC, a personnel clerk and a log clerk.
10. An exit point for withdrawal should be established beforehand, to prevent military personnel being used as cheap labor ("mission creep").

CURRENT SITUATION AND CONCLUSION

At the time of writing, the cholera epidemic in KwaZulu-Natal was typified as advanced, and in spite of intensive and on-going efforts by all parties concerned, appeared to proliferate. As many as 1007 new cases have been reported for a 24 hour period during March 2001. Up to 13 March 2001, a total of 69761 cases have been reported for the region, of which 139 have died, indicating a case fatality ratio of 0.199 %, while 660 patients were still in hospital at that stage. The low case fatality ratio indicates a very high standard of support by the SAMHS to the Department of Health during the whole period, despite extremely difficult operational conditions and circumstances prevailing in the affected areas.

Finally, there is no evidence that the current cholera epidemic in KwaZulu-Natal originated outside the borders of South Africa. However, increasing globalization and its possible effect on the spread of disease across international borders may have significance for the overall theme of this Symposium, particularly with reference to planning of emergency preparedness and response programmes throughout the world. This is borne out by the spread of foot-and-mouth disease through large parts of Europe and the UK during the past two months, and failure by international authorities to install timeous precautionary measures against such events may eventually result in global catastrophe. It is hoped that the CBMTS-

Industry II Symposium will enhance international awareness and co-operation, and thereby contribute towards the prevention of looming disaster.

REFERENCES/ACKNOWLEDGEMENTS

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KEYWORDS

Cholera, health care, planning, preparedness, response

INTRODUCTION

Cholera is an acute diarrhea disease endemic to Africa caused by *Vibrio cholerae.*

EPIDEMIOLOGY

- Ingestion of water and food contaminated with feces of infected persons
- Epidemics characteristically explosive and abrupt, also protracted
- During warm months in endemic areas - highest incidence in children
- Reaches a peak, then subsides - temporary immunity, sub clinical cases
- May continue through contact after elimination of contaminated water

HISTORY AND BACKGROUND

- Seven cholera pandemics since 1817
- Seventh pandemic originated during 1958 in Indonesia, spread to Mainland Asia, Middle East, Africa and Europe
- South Africa at risk in 1971 - sporadic outbreaks between 1980 and 1987, facilitated by:
  - Hot, humid summers
  - Over-crowded communities
  - Low standards of sanitation and scanty and unprotected water supplies in certain areas
- Current South African epidemic
  - KwaZulu Natal north coast, August 2000
  - 1,8 million inhabitants at risk
  - Over 4000 cases reported by end October 2000, 22 fatalities
  - SAMHS involvement since October 2000

SOCIO-ECONOMIC AND ENVIRONMENTAL PROFILE OF AFFECTED AREAS

Two major areas affected, viz:

- Lower Umfolozi district (Empangeni)
- Eshowe/Nkandla district

AREA MAP

Affected areas are deprived and poverty- stricken

- Lack of economic activity
- Overpopulation
- Illiteracy
- Unemployment
- Crime, violence, political unrest, faction fighting
- HIV/AIDS
- Overburdened infrastructure (Education, health care, water, sanitation)
- National economy in transition unable to provide adequate services

PLANNING AND EXECUTION

- Establishment of JOCC's
- Assessment
- Prioritization
- Acquisition
- Deployment
- Establishment of Rehydration Centres
- Provision of ambulances, water tankers and containers
- Record keeping
- Continued health education

REHYDRATION CENTRES

69. PHARMACEUTICAL WASTE DISPOSAL IN CROATIA

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ABSTRACT

In the framework of secured significant financial support provided by the World Bank the implementation of project that will solve the problem of large quantity of unusable or outdated pharmaceutical materials, donated during the period of war, has started in March 2001 in Croatia. Expired pharmaceuticals are scattered across the country in about 250 locations, of which 25 sites contain over 70% of the total quantity. Present estimates of quantities are 3500 tones of pharmaceutical materials mixed with other medical supplies. As the large volume of waste has been currently stored in a variety of different conditions, and occupied in the unsatisfactory and disorderly manner in many storage places, the first step necessary to be undertaken is sorting and repackaging of the stockpiles to reduce the volume of waste that requires special treatment for disposal. Waste should be put into safe containers that can be sealed, and are suitable for transportation to a final disposal facility. Project implementation requires the expertise and organized human resources, time, suitable treatment facility and other resources to complete all the steps necessary to remove this one-time accumulation of unwanted materials. Pharmaceutical waste that has represented a hazard to segments of population and the environment for many years would be now disposed of using methods consistent with international environmental best practice and standards and so far gained experiences.

INTRODUCTION - chronology of preparatory activities for project launching

Project of "Pharmaceutical Waste Disposal in Croatia" implementing from March 2001 in Croatia is the result of extensive years-long preparation. Its final implementation has been requested by the World Bank, which put stringent requirements relating to all project activities. Large quantities of expired pharmaceuticals, as a result of unused or unusable humanitarian donations received during the war period in Croatia, have been stored about ten years in inadequate locations all over Croatia (railway stations, empty hospital buildings, various shelters, health care institutions...), waiting in such conditions for final disposal. Due to frequent break-ins into temporary warehouses and several fires, which broke out on several sites expired pharmaceuticals pose a potential hazard to environment and human health. In addition, they occupy large parts of serviceable storage spaces in almost all the sites in Croatia. Already in 1997, APO Ltd. initiated and performed a great number of preparatory project activities with an aim to establish and implement final activities for permanent pharmaceutical waste disposal in the country. Previous APO's reference activities undertaken from the own APO funds are:

1. *Reliable and precise determination of pharmaceutical waste quantities from donation on the locations of Splitsko-Dalmatinska and Šibensko-Kninska Counties, August* 1997;
2. Preparation of *"Working Protocol - Guidelines for Pharmaceutical Waste Sorting and Repackaging Aiming at Reducing Waste Quantities"*, May 1998, applicable for every location in Croatia;
3. WHO representative mission organization and drafting project proposal: *"Recovery and Disposal of Expired Pharmaceuticals in Croatia, Outline proposal for collaborative involvement, July 3, 1998";*

4. Preparation of *"Programme for the Entire Pharmaceutical Waste Sorting and Repackaging in Split"*, November 1998.

Records on received quantities and types of pharmaceuticals were not kept systematically on all sites and there was no real data on waste quantities and types requiring final disposal. Since every site in Croatia is specific, in co-operation with the World Health Organisation (WHO), which has successfully realized similar activities in Mostar, APO Ltd. accomplished the expert detailed characterization for specific sites in Split and Šibenik. These sites surveys were chosen for assessing the stockpiles of great quantities of expired pharmaceuticals and medical supplies/equipment, which were stored in some 20 railway wagons that were kept without adequate surveillance. According to the assessments made, the overall quantity of expired pharmaceuticals have shown that only on the sites in Split and Šibenik it could be expected about 250 tons of expired pharmaceuticals. For their final disposal it would have been necessary to undertake the previous necessary step, sorting and repackaging, i.e. conditioning in order to minimize the waste volume and quantities requiring special treatment for final disposal.

At the beginning of 1998, Croatian Institute for Toxicology performed the first extensive survey of all sites in Croatia and assessed quantities, following the methodology developed during characterization of the Split and Šibenik locations. During the survey, it was identified and registered 250 warehouses, but most of the waste was stored in approximately 20 big stocks, situated besides important hospitals. At that time, it was roughly estimated that cca 3 500 tons of various donated pharmaceutical and other medical supplies required final disposal. Further, it was estimated that after previously undertaken separation (sorting and repackaging) only approx. 2 500 tons would refer to expired pharmaceuticals, and the rest of approx. 1 000 tons would relate to unused disposal consumable material (gauze, bandages, needles, sharps, syringes, catheters), homeopathic and herbal preparations, diet products and packaged food items, and other medical supplies and equipment (beds, various orthopedic accessories and wheel chairs, instruments, detergents, antiseptics...). Different types of chemical wastes were identified on various sites also requiring special treatment. General characterization of sites in Croatia has shown that only a few number of sites have followed Guidelines previously issued by Ministry of Health and kept the waste properly separated (for example - stocks in Karlovac and Pula). In the remaining stocks, waste from donation was only partially separated or mixed, and in such a state that it was not possible to assess more reliable estimate of expected quantities.

In July 1998, the mission of WHO representative with representatives of authorized institutions in Croatia (Ministry of Health, State Directorate for the Environment, Croatian Institute for Toxicology, County Office for Work, Health Care and Social Welfare in County Splitsko-Dalmatinska, Croatian railways, Center for the Receipt and Distribution of Drugs and Medical Supplies, and APO Ltd.) developed the outline proposal as a background for further guidance and the beginning of more concrete project implementation. Expert mission considered that the pharmaceutical waste stockpiles in Croatia should be dealt with as a matter of urgency and that the problem is definitely solvable within approx. one year because there is enough expertise to undertake the necessary work. It was concluded that the problem has to be systematically considered at the state level, with the approach requiring good organization and harmonized programme of final disposal.

In September 1998, in organization of County Splitsko-Dalmatinska, the pilot project in two railway wagons in Split was implemented in compliance with the WHO recommendations. The aim of the pilot project was to evaluate the parameters of necessary

labor, time, ratio of reduced waste volume and quantities, and necessary cost serving as a basis for project implementation at the state level.

Although a small number of health care institutions successfully managed the quantities of expired pharmaceuticals through their internal funds, the majority of health care institutions and authorized institutions could not have been able to secure funds for disposal of all estimated quantities. For this reason, the Ministry of Health entered into negotiations with the World Bank, during 1999.

METHODOLOGY OF PROJECT IMPLEMENTATION - basic project data

Funding of the project estimated at approx. USD 3.8 million was provided at the end of 2000, within the loan of the World Bank supporting on Health System Project in the Republic of Croatia. Croatia was obliged to fulfill all the required prerequisites for financial support defined by the Loan Agreement, in compliance with internationally most acceptable environmental methods and recommendations of the World Bank.

The World Bank accepted to finance the implementation of defined project activities: pharmaceutical waste separation and sorting from medical supplies at 25 priority sites with prior consolidation of pharmaceutical wastes from out-of-site locations, transport from 25 defined sites throughout Croatia, incineration of delivered waste in "PUTO" incinerator (as the only incineration plant in Croatia fulfilling all the requirements with respect to environmental and industrial safety, and necessary capacity), and disposal of the resultant fly ash.

Warehouses, as defined sites, were selected primarily on the criteria: to keep relatively large quantities of pharmaceutical waste, to have good road connection with Zagreb, to be geographically close to small warehouses, to have adequate sanitary conditions for sorting on the site, to provide protection against adverse weather conditions, to provide enough space for sorting activities on the site. Secondary criteria for selection of defined locations were applied for areas in which the pharmaceutical waste was in a poor condition: warehouses affected by fire, as the ones in Split and Zadar, and warehouses exposed to adverse weather conditions and burglaries, as the case was with the railway wagon in Split.

In compliance with the World Bank rules, the international tender was invited for the selection of the company to perform sorting and transport activities to the incinerator "PUTO". Tender has stringently defined a great number of requirements that the eligible company must submit and fulfill in order to be entrusted with project activities (for example: necessary authorities for performing hazardous waste collection; previous work experience in hazardous waste organization in the past three years; qualification and experience for technical personnel proposed for work including health fitness; technical documentation for every vehicle forecasted to transport; performance security in the amount of 5% of the contract price during the whole period of project implementation, etc.).

APO Ltd. and PUTO Ltd. are two companies under contractual obligations for envisaged four project phases. Project implementation is time scheduled for a total period of nine months.

In the first phase, sorting activities have included separation of medical equipment from pharmaceutical waste, and large packaging material from the pharmaceuticals. Following sorting, waste is disposed of at the closest local municipal disposal facility, close to the site where sorting activities are performed.

In the second phase, separated pharmaceutical waste is sorted and prepared for transportation to the incinerator as a dry waste capable of packing into cardboard boxes and as a liquid waste, solid wet waste, ampoules, vials, needles and sharps, which should be stored and transported in plastic or metal barrels hermetically sealed.

Sorting and transport of waste in sealed pressurized gas containers, cytostatics and narcotics is performed under special surveillance and with separate labeling. Each sorted box or barrel should be sealed shut, labeled, marked according to the waste category and weight, number of site and palette, and movable by forklift. Personnel in charge of sorting should have toxicologically educated and be properly protected during sorting by proper worker attire.

Transport activities have included pharmaceutical waste transport from defined sites to the incinerator, and transport organization of other sorted materials to the closest local municipal disposal site. The vehicles should be equipped and labeled in compliance with ADR, and labeled and secured during transport in compliance with the recommendations of Croatian Institute for Toxicology. Procedures should be defined in case of an accident. Drivers should be educated pursuant to legal provisions defining transportation of hazardous chemicals. For every single transport the written permission should be issued by County Office for Work, Health Care and Social Welfare. During the loading of each vehicle responsible person from local authority (local sanitary inspector) must be present. After the loading is complete on the cargo compartment of the vehicle, the official seal is put that can be removed exclusively after the official weighing in the incinerator. After the last quantities of waste are transported to the incinerator, and other sorted materials are disposed of, the site has to be cleaned and decontaminated.

This project requires keeping the following records: weekly reports on performed sorting, reports on each shipment of pharmaceutical/other sorted materials, and monthly sorting and transport reports that are submitted to the Ministry of Health (World Bank) and Croatian Institute for Toxicology. All the activities relating to the implementation of this international project are performed under surveillance of the WB/WHO, Ministry of Health, Croatian Institute for Toxicology, Department for sanitary inspection, respecting all safety measures relating to environment, health of humans and relevant regulations of the Republic of Croatia, and in the co-operation with County Office for Work, Health Care and Social Welfare. Ministry for Environmental Protection is involved in the project within its competence

STATUS OF PROJECT IMPLEMENTATION

Project implementation has started at the beginning of March 2001. As a co-coordinator, APO Ltd. with its four subcontracting companies (Dezinsekcija d.o.o. of Rijeka, Cian d.o.o. of Split, ZIV Trade of Zagreb and MC Čišćenje of Sisak) is performing in a harmonized manner sorting and transport activities according to contractual project time schedule. The first activities were completed on priority sites in Dalmatian area, prior to this year tourist season and taking into account sites in bad conditions. In this way, sorting and transport activities are conducted from different part of Croatia simultaneously. It is anticipated that the project will be finished even before the term stipulated by the contract because by the middle of September activities have been completed on almost 20 sites. Over 1200 tons of hazardous pharmaceutical waste has been accepted by "PUTO" out of which some 85% of waste have been incinerated.

Experience gained during this project implementation in the Republic of Croatia, covering all its phases and all the partners involved, will for sure serve as positive guidelines for establishment of the successful health care waste management system.

KEYWORDS

Outdated pharmaceuticals, pharmaceutical waste disposal

70. SWEDISH CHEMICAL SUPPORT TEAM FOR THE OPCW, A SURVEY OF THE OFFER ACCORDING TO ARTICLE X IN CWC

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INTRODUCTION

Sweden signed and ratified the Chemical Weapons Convention (CWC) in 1993. After the convention had entered into force on the 27 April 1997 the Swedish government decided to declare its assistance to the convention and the OPCW. The Swedish offer consisted of a contribution to the OPCWs voluntary found according to art X paragraph 7a. The government also decides to declare that the country is prepared to consider extending assistance under paragraph 7c including expertise in detection, detection equipment and alarm systems, protective equipment, decontamination and decontamination equipment, medical antidotes and treatments and rescue services and protection of population in a CW environment. In this decision the government also gave the Rescue Services Agency the commission to develop, organize and to be prepared to send special Chemical Support Teams to assist and support the subjected country and the OPCW.

The Swedish Rescue Services Agency (SRSA) is a governmental central authority with responsibility to co-ordinate all rescue activities. This also means a responsibility to prepare the simple man, the municipalities and other organizations involved in rescue activities in prevention of accidents to work for the same goal in civil protection.

The SRSA have in this context been given the special commission to create, develop, organize and maintain a special chemical support team. In the following I will display: the assignment, assumptions, organization, tasks and personnel, preparedness, equipment, safety, transport, planning, training, exercise and state of readiness.

The **assignment** in general is to support the OPCW on scene of operation. The Chemical Support Team should be organized with personnel and equipment and the task to support the subjected country with protective equipment. This task includes equipment for detection and warning as well as prophylactic and decontamination resources. The support team must have a high preparedness and a short time to action. The Swedish government will make a special decision in every case to send these teams on a mission.

ASSUMPTIONS

The Support Team should have high level of preparedness and a short time to action. It should consist of professional rescue responders from the municipalities and the Coast Guard. The safety level should be maintained with personnel from the medical services and the Defense Research Establishment. The support must be given directly on scene of operation to the needing country. The overall activities must be made with the highest level of safety for the personnel. Equipment used in the teams must cope with the demands required for the normal organization in Sweden. The equipment will come from the normal preparedness stock, central or municipalities. The team should be prepared with help from different scenarios, displaying different situations from the start in Sweden to situations in the operations area. A special plan for the Swedish team with a SOP should be prepared.

The teams should be self-supporting concerning all things related to chemical protection equipment and systems, communication, base camp facilities, food, water and medical safety.

ORGANISATION AND PERSONNEL

On the scene of operation the tasks for a team should be possible to maintain with two sub-teams at the same time. Each sub-team will have personnel and equipment for safety and security assigned. Each sub-tem is built up with 8 persons. The team staff commands the sub-teams.

Most of the personnel come from the municipal rescue services and the Coast Guard. Specialists are recruited from the Defense Research Agency, police and medical services. Here you can see the set up of personnel. The Support Team consists of aprox. 36 persons.

TASKS AND ASSIGNMENT

The team should support the subjected country with individual protective equipment such as protective masks, jackets and bags (for small children). Personnel from the receiving country have to deliver the equipment. The team will support the organization of this handout with information and training. The persons responsible for the handout must be trained initially and given protective equipment in the first place.

The team should support the receiving country with risk assessment, help in evacuating the population, rescue activities, first aid and decontamination.

Continuously system for detection of CW-agents and industrial chemicals together with warning-systems should be set up and working.

The team will be able to inspect and investigate a working area and in this sense take samples to verify the presence of actual agents.

The team also will be able to give logistics advice and help with transports in the effected area even in cases of destruction of CW-agents.

PREPAREDNESS

The requirement of preparedness for the team is high. Personnel from the "team-staff" should be able to leave as a reconnaissance-team in 3 hours, if notification of a situation is received beforehand. The complete team with equipment and vehicles should be able to leave Sweden in 12 hours.

EQUIPMENT

The team bring with them two sets of equipment. **SET 1** - includes civilian people's protection (for 5000 people in families) in protective masks for adults and jackets and bags for children. In this set the team brings additional 1000 special protective equipment for personnel from the receiving country together with simple detector papers and badges. Decontamination agents (powder) and medical counteract ant also is brought for civilian need.

The team is equipped with the Swedish protective system 2000, which consists of breathing- and body protection concerning CW-protection in different shapes. Here you can see Rescue Suite 90 with heat and flame protection as well as Protective suite 95 for decontamination work. In this system splash-suits and breathing apparatus also is included.

Warning instruments for detection and warning in case of CW-hazards as well as industrial chemicals is used. These instruments are used together with CW-detection instruments in a system for monitoring ground contamination from a vehicle.

The GARDS, **G**round **A**rea **R**econnaissance **D**etection **S**ystem is designed for rapid detection of liquid surface contamination together with detection of air contamination, weather information and a rapid geographical reporting system.

BASE CAMP

In the "SET 1" equipment for self-supporting the team for 14 days is included. This means that a base camp can be put up. The camp is completed with sleeping quarters, hygiene arrangements with shower, kitchen and a mess tent as well as staff facilities and a communication container. An arrangement with a self-supporting electrical facilities and supplies with drinking water and food is included. The base camp can also have an additional communication center like this mobile container.

TRANSPORTATION - VEHICLES

There is always means of transportation in the team. If the team can't bring the equipment in truck the team will have 4-weel or 6-weel vehicles. There are at least 2 motorcycles and one land cruiser in the equipment. For detection capabilities and transporting decon equipment we have ATV 206.

All equipment in SET 1 should be possible to bring in the first transport to scene of operation.

ADDITIONAL EQUIPMENT IN SET 2

In **SET-2** we have included rescue equipment such as drills and lifting devices. Decontamination and cleaning equipment in container, trailer or ATV 206. In this set also includes more decon powder (Fullers Earth), decontamination emulsion and if needed additional of SET 1. System for decon of used clothes in included.

SAFETY

The safety includes security and protection on scene of operation as well as medical protection and safety, communication-, transportation- and evacuation safety as well as body protection.

SAFE AREAS

One of the objectives for the advanced party and later the team staff is to locate safe working areas as well as **safe places for base-camps**. The local situation concerning **safe roads** and passages meaning both structural and safe from attacks.

In some cases on scene of operation there will be established **protection forces** for the safety and the protection of deployed organizations. Communications and co-ordination systems will be established to these forces by the team staff.

For **evacuation** situations in case of causalities, the theme staff will make special plans.

Personal protective equipment (PPE) for the team members includes a variety of breathing apparatus with, of course, the Swedish protective mask 90 (or F2) and its accessories. The protective system 2000 with Rescue suite 90 and Protective suite 95 for decon work together with the Light impermeable Chemical protective suite represents the variety of protection that that team bring for different tasks.

Training in **mine-awareness** and using/wearing protective body armor with west and helmet is included in the team training activities.

In the operation area the team will have close communications to the **coordinating staff** operated by the OPCW in Assistance Co-ordination and Assessment Teams (ACAT) or with the On Site Operating Coordinating Center (OSOCC).

MEDICAL SAFETY

For the team a special safety unit is organized. The unit is responsible for the medical safety during work in contaminated areas as well as for the daily medical care.

Risk assessments and analysis are made in beforehand as well as on spot for different tasks. **Medical goals** for treatment, equipment, medicine and personnel are set up.

In the team normally **one medical doctor and three nurses** are working.

The team is equipped to **treat and if necessary isolate** and transport casualties and sick team members.

The medical personnel as well as the team members are **trained** to take care of each other in case of an accident or an emergency concerning CW-agents or related substances.

VACCINATION

Each team member is vaccinated for Polio, Diphtheria, Tetanus, Meningitis, Typhoid, Hepatitis A, B, Yellow fever, TBE and Cholera. A special vaccination is taken for Anthrax.

MEDICAL RESOURCES

The team will have medical **equipment** to treat casualties from medical accidents and accidents related from CW agents. There will be **medicine, antidotes and drugs** related to this type of accidents as well as normal traffic accidents and illness. The medicine and drugs will be **stored in portable refrigerators** during transport and work. Medical equipment for **protection of the personnel** in connection with casualty and infectious patients includes the medical resources.

Preparations to send casualties to **hospital** in different steps are made in beforehand.

MEDICAL EVACUATION

From the accident the casualties are planned to bee evacuated to the base-camp or directly to an emergency hospital nearby. The patient will be stabilized and treated before transport back to Sweden.

COMMUNICATION SAFETY

Every team member will have access to a **WHF-radio** constantly. The system is used in special arrangement protected by the suit when working in contaminated area. The members also use the system as a fast communication system day and night. It is possible to differentiate the communication to groups or to single members.

Communication to units is done by HF-radio (3-30 MHz).

The team staff has at their disposal different types of communication. Here are **CAPSAT** (Inmarsat C) a type of satellite fax.

Normal **satellite telephone** and if available even Iridium.

The systems are programmed for fast connection to the "home central" or other needed connection such as medical experts or chemical- or biological experts.

The team staff has a special designed communication container available if needed.

TRANSPORTATION

For **fast transport** to the scene of operations air transportation is needed. The team with "SET 1" is to be transported with two C 130 (Hercules). Just to give you an example of the dimensions. "SET 2" needs another two C 130 for transporting the equipment. In the first transport route at least one staff vehicle is brought together with the equipment.

Normally we use C 130 Hercules for transport but other types of aircrafts or even civilian commercial aircrafts can be used for personal transport.

The Swedish civilian protective equipment (5000 for families) gives you an idea the capacity needed.

If it is possible the team will bee **transported by road** and then use trucks and Land cruisers carrying all equipment from both SET 1 and SET 2.

Evacuation transports can bee carried out by helicopters for rapid deployment.

PLANNING, TRAINING AND EXERCISE

After the team members been recruited by the agency a training system starts. The members are trained in courses on our Rescue Colleges in Sweden. Here you have the largest Rescue College Rosersberg situated in a castle just outside Stockholm. The courses are conducted for Swedish participants and for foreign (SP) participants together with Swedish. The training course (Assistance and Protection Support) consists of three weeks with mixed theoretical and practical training.

The courses are scheduled with introduction, toxic substances and personal protection. The participants are trained in handling warning and detection instruments and monitors, CW-tactics and communication services.

The training also includes operational techniques and decontamination tactics as well as decontamination equipment and CW-special exercise.

The different blocks are concluded with a practical exercise.

The aim of the course for foreign participants is to show the Swedish system with personal protection and the support, which can be made possible with a designed team.

For Swedish team members there are a special training and exercise during one week. Here are the objectives to give general training in building a team and a base-camp. Also living under camp conditions, building up experience in convoy driving and checkpoint training. All personnel are given training on different vehicles as trucks, jeeps, 4-weels and ATV's. The exercise is completed with preparations for loading and departing.

The situation concerning the state of readiness and preparation for the Swedish Chemical Support Team is stated below. All preparations are made to give the government a possibility to decide if a team should be dispatched. The state of employment and insurance of the participants is clarified. The equipment needed is in a storage area and prepared. The equipment is not insured as all equipment for the Swedish system.

Today there are two operational teams available for rapid deployment prepared with personnel and equipment.

The first preparations were made in 1998. All activities including **recruiting of personnel** and vaccination have been made by the Agency.

Planning activities including a SOP (Standard Operating Procedure) is going on constantly.

Together with teams from other countries and coordinating staff from OPCW the teams will have the opportunity to participate in **international exercises** in the future.

SUMMARY

The Swedish Chemical Support Team is designed, organized, prepared and trained for rapid response and support in situations with CW-agents threats or attacks. Teams are after request and decision by the Swedish government available to support the OPCW.

KEY WORDS

Chemical Support Team, assistance, protection, GARDS, peoples protection, self-supporting

71. MANAGING CHEMICAL AND BIOLOGICAL AGENTS

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ABSTRACT

Though the Biological Weapons Convention (BWC) prohibits the development, production and stockpiling of biological and toxin weapons, during the war in Croatian we saw unknown artificial materials, which appeared to be like spider cobwebs. We expect that during the peaces time domestic and international acts of terrorism may use chemical and biological pathogens with such an ideal delivery device as the cobweb with their polyvalent characteristics. Today the terrorists use very sophisticate chemical and biological weapons and such as anthrax, sarin or cyanides. In our approach we review delivery device and packaging of biological agents, and we address some technical difficultics in maintaining chemical and biological agents.

KEYWORDS

Artificial cobweb, delivery biological and toxin warfare and terrorism agents

72. VISUAL PURPLE, THE NEXT GENERATION CRISIS MANAGEMENT DECISION TRAINING TOOL

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INTRODUCTION

No one should have to face a crisis without proper training. For years, pilots have relied on flight simulators to ensure realistic, top-quality training. Unfortunately, this type of training and simulation has not existed for first responders and their leaders who must prepare for all types of crisis and consequence management especially chemical or biological terrorism. With proven technology, Visual Purple (VP) develops and deploys interactive, video rich, computer-based role-playing simulations designed to increase and to accelerate the ability of individuals to make appropriate crisis-related decisions. Visual Purple's stand alone or Internet deployed simulations (described by some as "interactive movies) leverage role-playing and its time-proven effectiveness for immersing individuals in an realistic, information-intensive, and challenging world where key decision-making is exercised in accordance with preferred procedures, theory and doctrine. Up to now, civilian first responder training has consisted of little more than traditional classroom lectures – decidedly inefficient and expensive. Now with VP's products, the learner is immersed in an information-intensive and challenging simulation environment, forcing many decisions, and demonstrating the consequences resulting from those decisions. Incorrect or untimely decisions within the simulation can often results in disaster, just as in the real world—but without the real world costs! Visual Purple's technology-based training simulations accelerate the mastery of complex material and increase performance in decision making by simulating the high stress of making decisions with life and death implications while having incomplete, or conflicting information. Numerous government reports have highlighted the requirement for improved training and simulations. This is the design principle recently addressed by General William W. Hartzog, USA (ret). If a simulation can offer conditions that are more stressful than the live environment but are still realistic, why would we not want to pursue the 'overload' principle for at least a portion of, if not for all of, our preparation?[1]

MATURITY OF VISUAL PUPLLE'S SIMULATION TECHNOLOGY

Role-playing is a time-proven, effective means for employees to exercise decision-making in accordance with preferred procedures, theory and values of the organization. VP's products fully engage the learner within an information-intensive and challenging simulation environment, forcing many decisions, and demonstrating the consequences resulting from the logical pathway selected. Visual Purple packages its services and products in the form of consulting services for course content creation, software licenses for stand-alone CD and DVD-based simulation products and with usage-based, turnkey, web-hosted, Application Service Provider ("ASP") arrangements. Visual Purple's multi-path decisional simulations set the standard for realistic training engagement. There is nothing else like it in the marketplace. These features make VP's training simulations not only user-friendly, but fun:

- realistic full-motion video,
- sound and text messaging computed dynamically ("on-the-fly"),
- accurate intervening informational inputs (either canned or injected contemporaneously from the web),

- a user interface rich in stimuli,
- information collection and tracking capabilities to help a user remember, synthesize and apply to the next decision what he or she has learned thus far,
- hot-links to client-defined, catalogued source authorities and supplementary glossary and descriptive material, and
- the ability to keep the simulation "evergreen" with accurate terminology, acronyms, and place names.

Under Visual Purple's web-based system, a Java-based applet/application provides a graphical user interface for the interactive video content. The applet is truly "thin", and can achieve "zero footprint" in a browser environment where the network bandwidth is good. In situations where the network bandwidth is slow, or if the customer wishes to separate content from scenario logic for security reasons, the applet has the ability to access raw local assets used by any training scenario. This, coupled with the inherent communications security already provided by Java, ensures a responsive and well-protected training session.

MATURITY OF VISUAL PURPLE'S MODELING TECHNOLOGY

Previous Experience with Similar Efforts in Modeling. Visual Purple retains rights to certain technology under United States Patent #5,326,270. Mr. David L. Ostby, one of the Patent's three inventors, was responsible for the project's genesis, scope, direction and management. The research encompassed the creation of custom software and the assessment of over 300 individuals in a controlled laboratory environment. Their data was statistically analyzed and formed the basis upon which the patent was granted. A later implementation of the technology came in 1996 with the release of an entertainment business simulation title by Tsunami Media, Inc., *Free Enterprise*. The title incorporated a "light" implementation of the technology described in the patent and was dubbed, I^2, or Interactive Intelligence. The I^2 technology allows the simulation player the option of "injecting" one's cognitive strategies into "Sims" - characters within the simulation. This allowed simulation characters the ability to emulate cognitive strategies in a manner designed to create a more realistic simulation.

Current Modeling Applications. Visual Purple may implement the I^2 technology in many ways depending on the client's needs. Some of the more conventional applications of this technology empower the simulations to adapt to a user's unique decision-making style in real-time. In essence the simulation plays the user, creating an individualized experience. Other general applications of the technology can provide insightful feedback on an individual's decision-making style, useful in screening and selecting trainees for future assignments. Basically, as the simulation proceeds, a digital recording is made of the participant's choices and actions. This recording, or data-stream, is passed through patented algorithms for either collection or feedback into the simulation.

VISUAL PURPLE PROJECT APPROACH

Content research and validation is key to ensuring accurate information resulting in and realistic scenario development. In addition to the client experts, the Visual Purple team relies on both formal and professional education, and real-world experience in domestic and international counter-terrorism. They have amassed a comprehensive database of source material, and are conversant in the subject matter. Over 45 experts were used on the recent law enforcement project. To translate the accurate information into a meaningful training tool, Visual Purple employs the talents of professional Hollywood screenwriters during the scripting and writing process of the simulations. Additionally, cinematic techniques learned in the filmmaking industry are brought to bear during the production phase of Visual Purple's simulations, resulting in a quality unprecedented in the industry. Finally, the simulations can

be tailored to meet the delivery and security needs of the client. Visual Purple's simulations can be accessed on CD-ROM, DVD, across a LAN or the Internet. They can employ an Application Service Provider (ASP) system that when combined with CDs can eliminate bandwidth restrictions, guarantee a high level of security and a high-fidelity experience for the user. To meet international needs for simulation, Visual Purple has teamed with the Global Technology Applications (GTA) company. GTA augments the Visual Purple team with the necessary content, cultural, and language experts for research development. Additionally, GTA provides country specific support in script writing and cinematic resources as required.

THE RBIT SOFTWARE ENGINE

The key to Visual Purple's simulations is its Reality-Based Interactive Training (RBIT) proprietary software engine. The engine allows the simulation to stream video and audio images on-the-fly, essentially rendering an "interactive movie," in which the simulation role player is immersed. The RBIT software engine permits the simulation to present multiple onsets, and an almost infinitely variable menu of opposition forces actions. After viewing numerous counter-terrorism and WMD simulations, the consensus of multiple government agencies: Visual Purple's simulations are "far more sophisticated" than any other product in the market place. The technology of the overall RBIT Software Engine can be broken down into three parts: the Animation Engine (interface, video, XML), the core RBIT Engine and the Communication Engine. The third part is the glue that binds the first two together and includes the web, server and other technology. Looking at figures 1 and 2, screen captures of the tool in action, the modular strength of the RBIT is apparent. This approach is one of the key cost saving features of Visual Purple's training since it allows for rapid prototyping of the scenario, identification of the necessary video (VT) clips and can be used later by script writers, animators and directors as a program management tool.

COST-EFFECTIVE TRAINING

Visual Purple's approach to scenario development and production provides many cost benefits to the clients. In addition to the rapid prototyping mentioned above, the project planning ensure that the expensive filming and animation modules are not begun until the scripts are thoroughly vetted by the client and outside experts. By using the latest Hollywood discoveries, Visual Purple has developed techniques to reduce the costly filming portion ever more. With the Visual Purple tools, the experienced Visual Purple programmers can work in English while the content experts can develop the script and scenario in whatever necessary language. Many of the cost savings are not as easily quantified as others. Although one obvious training effectiveness is the savings in time and costs associated with live training. Further, only a very few actually benefit from participation in live training (a lot of standing around for most), many more will benefit from using a Visual Purple simulation. Technology-based training does not require specialized sites and can be conducted in an individual's office on a commonly available PC. Since this is often the actual place where the decision-making skills are required during a crisis and/or consequence management this begins to approach the "embedded" simulations that are the long term goals of the military. General Hartzog's description of the various simulations and my assessment of Visual Purple's current capabilities are contained in Table 1. It shows that the Visual Purple current state-of-the-art is on par with flight simulators and the future military goal of embedded simulators can be met once the Visual Purple decision modular (discussed below) is added to the simulation.

LAW ENFORCEMENT CASE HISTORY

In 1997, as the various law enforcement agencies continued to look for new means to accomplish their counterterrorism mission a senior official realized that the technology in a computer game called *Silent Steel* (created by what became the Visual Purple development team) offered a new method for teaching and training. In the game, video clips are woven together to create a complicated story. The player assumes the role of a submarine captain whose submarine and crew face threats from two countries' submarines. As captain, the player then directs his crew to take various actions, and either revels in his success or watches helplessly as the enemy wins.

Law enforcement decided to adapt this technology for training their officers. To this end, Visual Purple produced a simulation for preparing law enforcement officers for radiological, biological and chemical scenarios involving the American homeland. In the first of three simulations designed for local/national law enforcement, participants must respond to a terrorist threat involving a radiological dispersal device. The participant must also learn how to effectively manage the vast resources at his or her disposal (see a simplicity organizational wiring diagram in figure 3^2) while limiting adverse reactions from the public. The simulation utilizes a video collection of training footage, specially prepared acting sequences, and a vast library of relevant material from law enforcement and other government sources. The result is an entirely new dimension of realism that traditional exercises often fail to capture.

The scenario requires the participant to make the tough calls as a potential crisis unfolds, for better or worse. Twenty completely different beginnings can lead to over 160 different outcomes with varying degrees of success or failure. The simulation demands strict adherence to both the rules of law and common sense. Actions require contacting the proper agencies and then waiting for these resources to be deployed. And while the participant makes his decisions, the terrorists are watching. If operational security is breached, for example, the "bad guys" may change strategy or even launch the attack ahead of schedule! The program acts like an attentive instructor, who monitors the progress of his students and adjusts the scenario to make lessons more valuable. The learning process continues even when the scenario is completed, by providing a critical "feedback" function. This feature identifies each step of the participant's decision-making process, objectively critiques performance and offers solutions for the future. By incorporating these learning points into his or her thinking, the individual becomes more innovative and adaptive to future challenges.

FUTURE DECISION AID MODULE

Visual Purple is preparing to go to the next logical step in its simulation tools development, decision aid support. During the process of simulation development, wide ranging information and facts are collected from national and international experts and reference material. Using this expert-knowledge developed for the scenarios and the vast reference information digitized into the simulation, Visual Purple can develop a decision aid module that will meet the needs of it clients. The module can be as sophisticated as desired by the client, ranging from being a simple reminder tool (i.e. "Did you notify the hospital of possible agent contaminated casualties?") to a digital "intelligent assistant" that monitors the crisis as it unfolds (i.e. all communications, situations developments, information queries, etc.) and can act as another team "member." It can operate in several different modes. For example it can be developed to remain waiting in the background until called upon to recommend a course of action. Another more active design would have the module interject a recommended course of action if certain previously approved criteria is met. This would

insure all factors are considered during the "heat of battle." In any case, the client would have extra value from the information and expertise used to develop its decision training simulation.

CONCLUSION

The Counter- Chemical and Biological Terrorism training challenges facing all nations at the national, state and local government agencies are formidable. However, funding and time constraints limit traditional answers to this problem. Visual Purple's revolutionary, yet proven technology will provide 21st century solutions to 21st century challenges. Visual Purple has developed an exciting learning simulation tool that has unlimited replay ability and is scalable to meet the needs of its clients. Painstakingly researched and using Hollywood techniques of screenwriting and film production, Visual Purple's simulations are unique in the industry. After solving the multi-language/cultural training challenge of collation forces, and bringing increased training with overall reduced training costs, Visual Purple is ready to embark on development of decision support systems to meet domestic and international client's needs.

REFERENCES

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2. The United States Interagency Domestic Terrorism Concept of Operations Plan

KEY WORDS

Computer simulation, decision aid, crisis and consequence management, emergency planning

FIGURES AND TABLES

Table 1. Simulation Categories

Categories	Definitions	Military Hardware Examples	Crisis Management Training
Strap-on Devices	Item that can be added to fighting platforms to depict scenarios or to provide an emulation of that piece of equipment's combat capabilities	Infrared infantry firing simulators	Table top exercises
Re-Configurable Simulator	These are computer-based devices that can be tailored either electronically or digitally to emulate a weapon system.	Artillery firing signatures used by counter fire artillery radar.	Visual Purple's new product, *Lethal Sky*, for hospital executive training to deal with the aftermath of terrorist NBC use.
Stand-alone Device	These systems are nearly as complex as the fighting platform itself and are designed to teach complex life and death skills/decisions	Pilot flight Simulators	Visual Purple's current products for the U. S. law enforcement.
Embedded System	Integrated so that the systems operator can truly use the primary machine interface points to activate the simulation.	Some of the projected fire and control systems aboard new naval ships.	Visual Purple's "Decision Aid Module" being developed in 2001
Table 1. Simulation Categories	(Based on Reference 1)		

Figure 1. Screen Capture of RBIT Tool Showing Branching Decisions

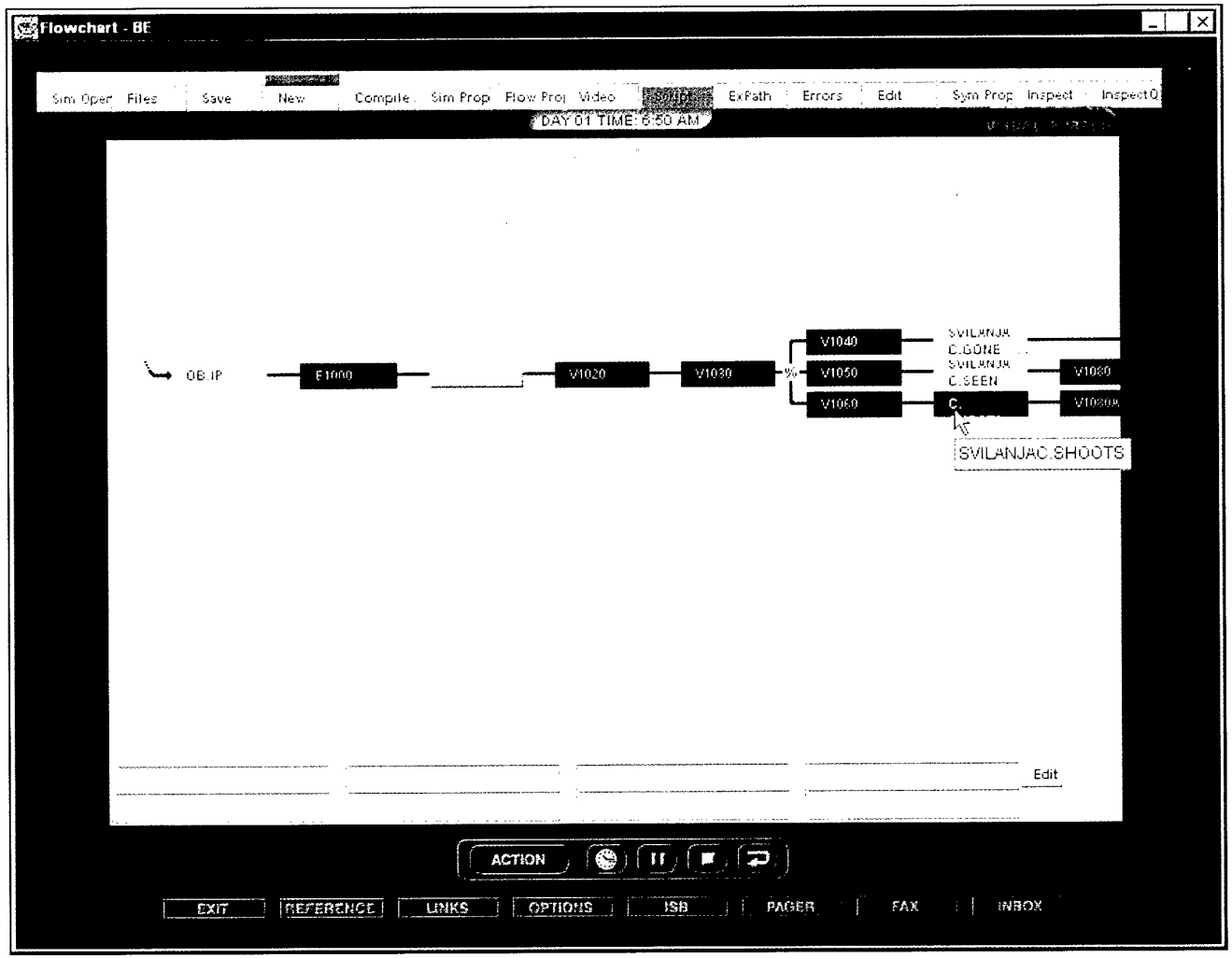

Figure 2. Screen Capture of PBIT Tool Showing Consequence Tree

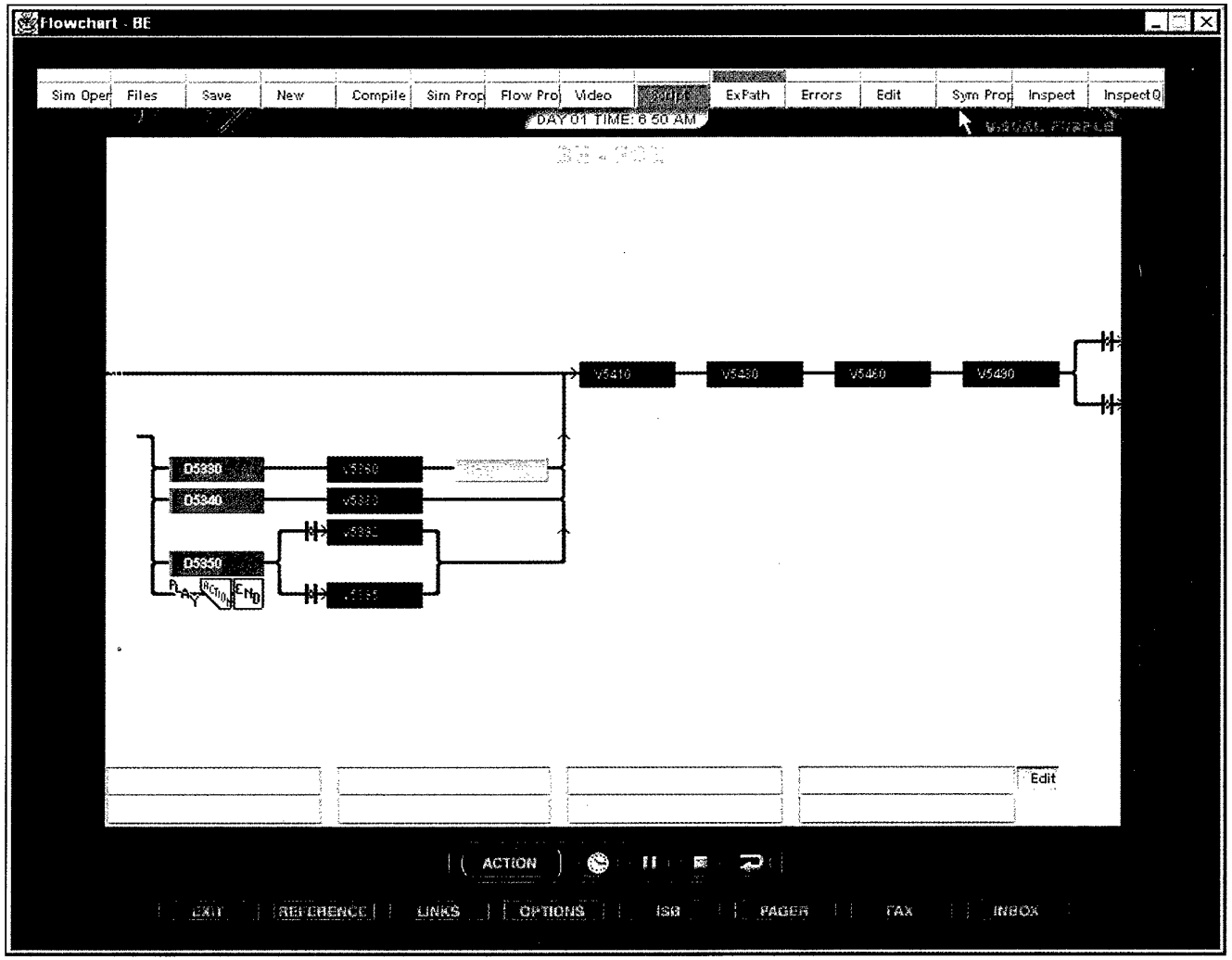

Figure 3. Unified Incident Command System

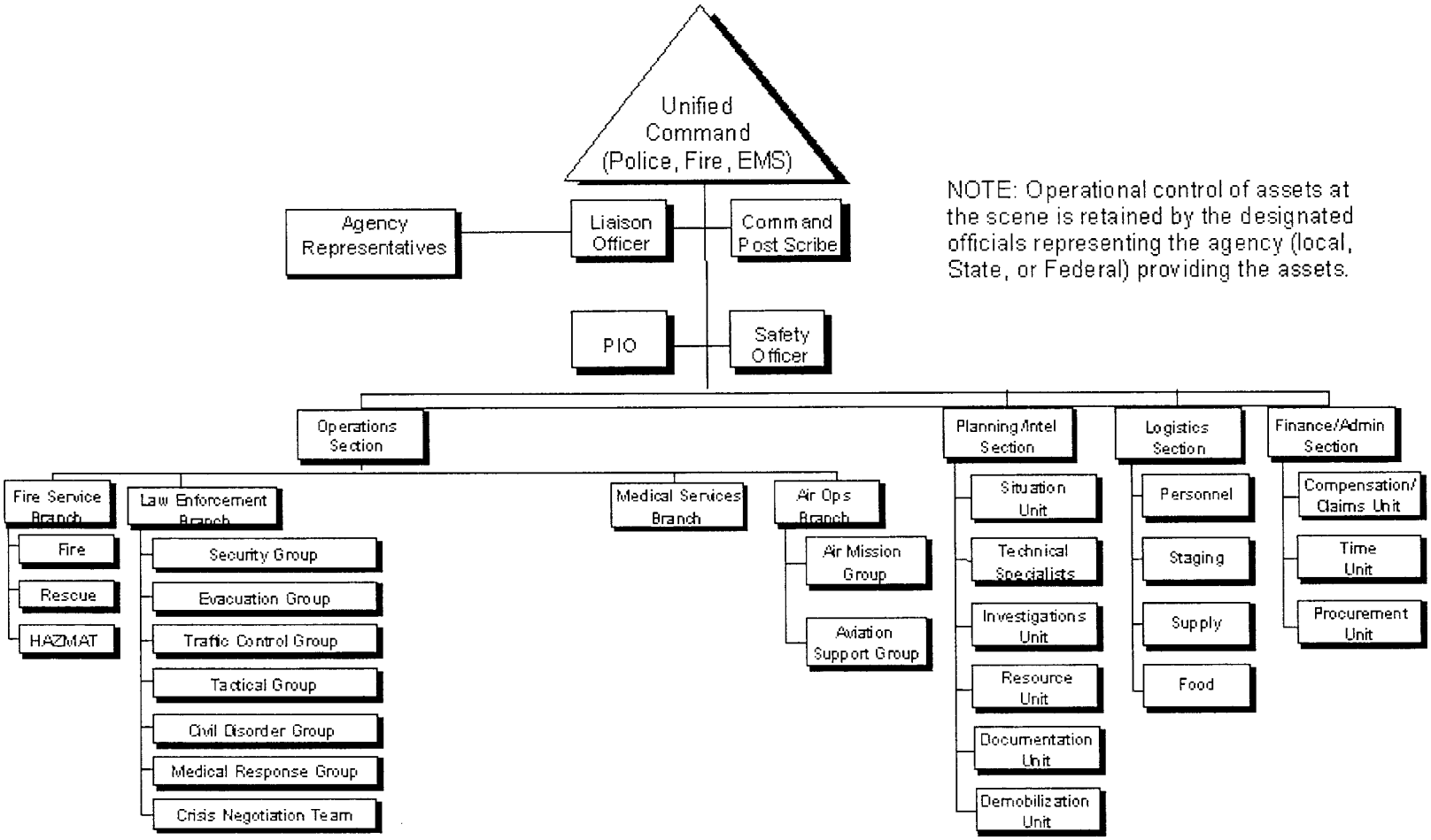

Figure 1 – Incident Command System / Unified Command

73. REHABILITATION AFTER A CHEM/BIO INCIDENT

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SUMMARY

After a chemical/biological incident, triage and initial treatment will need to be followed by extensive periods of rehabilitation, in respiratory, cardiac, wound care, pain and psychiatry orthopedic, stroke, spinal cord, and head injury. The areas of most concern will be dependent on the agent used. If mustard is used, rehabilitation will be similar to burn patients with the emphasis on care of the skin, respiratory function and eye care. The effects on heart muscle and therefore cardiac function will also be a priority, but this care will be similar to those with cardiac problems without a chemical/biological event. As the skin is the first barrier to infection, care of wounds will be ongoing until healed. Skin heals in a progressive, structured way, and again this will be the same without a chemical/biological event. If phosgene or choking agents were used, respiratory care will be a priority, and an ongoing rehab concern. Respiratory care will be a continuation of initial treatments, with the addition of breathing exercises to enhance the ability of remaining lung tissue to be productive. Cardiac rehab will be essential to enhance the viable heart muscle with the goal of improving cardiac output. If nerve agents are used the effects on behavior including paranoia, as well as catastrophic victim behaviors of shock, depression, helplessness, and loss of life as it was prior to the incident.

INTRODUCTION

After a chem/bio event, hospitals will be overloaded with casualties. The immediate emergency care and triage will admit the most medically needy and choices will have to be made regarding which cases will be appropriate for out patient services or Visiting Nurses Association (VNA). Decisions and plans need to address early on how out patient clinics and the VNA will be able to provide services for those who need ongoing care. The reality is that more patients will be in their home settings rather than be hospitalized. Many of the less extensively hurt will need follow up to prevent complications and to ascertain normal healing and progression to wellness. In my readings of previous papers submitted in 1998 Symposium, I discovered a lack of insight and discussion into long-term care and treatment to bring the population back to a functioning, productive society. Immediate treatment is essential, however lack of support for long-term issues could prevent development of a viable society after such an event. Education of the populous is essential: who do you think will be able to help all the casualties? Emphasis should be placed on the education of professionals now and also their essential helpers who will be doing the hands on care. There will never be enough professionals, and to empower their helpers is imperative. Do the local communities encourage entry-level medical personal? Do they provide ongoing, current education of those who will be doing the actual "hands on care"? How can communities increase now, the numbers of long-term and visiting nurse care professionals, who will be the caregivers of those in need of rehabilitation? Are there health care professionals who are able to effectively teach and educate potential caregivers?

ALL PATIENTS WILL FALL INTO THE REHABILITATION CATEGORY

Whether their needs are cardiac, pulmonary, wounds, pain, orthopedic, spinal cord, stroke, head injury or psychiatric, all patients will need follow up care.

Has Rehabilitation been addressed in any long-term program? Cardiac and pulmonary Rehab programs use a comprehensive interdisciplinary approach to achieve positive patient

outcomes. The Rehab programs help patients make lifestyle adjustments, decrease risky behaviors, maximize physical status without endangering life and reduce morbidity and mortality. Rehab is a continuous process that begins in the critical care period and extends to a life long program of lifestyle adaptation. The focus here will be on outpatient, home care and life long recovery of bath cardiac and pulmonary patients. Assessments, interventions, exercises and goals are set up for individual patients to achieve positive outcomes. General guidelines for increasing physical activity include warm up exercises, pacing exercises, scheduling breaks and along with assessment of heart rhythm and rate, blood pressure and body signals (including shortness of breath, diaphoresis, fatigue, nausea, dizziness and chest pain). There is a step-by- step program suggested by the American Heart Association that is progressive for the de-conditioned patient.

Much progress has been made in healing wounds that involves new techniques and new dressings that provide a moist, undisturbed healing environment. Instruction on how to use them and what to look for in the normal progression of healing is essential to their effectiveness. Diet and nutrition of the population will be critical to their wellness. Are there uncontaminated food storage warehouses for any biological/chemical event? Where will the uncontaminated life essential water come from?

CONCLUSION

As discussed, in order to bring about a productive society after a chemical/biological event, rehabilitation of possibly large numbers of patients will be essential. Planning now for such an eventuality is critical in the rebuilding of any society. As informed, knowledgeable professionals, it is your responsibility to include rehabilitation in your long-term plans for treatment of all patients after such an incident or event.

KEYWORDS:
Rehabilitation, long-term care, outpatient care

TABLE 1. AREAS OF EXTENSIVE REHABILITATION

RESPIRATORY REHAB - will include but not be limited to:
Maximizing breathing capacity and function with medications, inhalers, nebulizers, ventilators Maintaining and improving functional status
Enhancing coping skills (identifying stressors and modifying behaviors) Maintaining and improving nutrition
Educating re: disease process

CARDIAC REHAB - will include but not be limited to:
Maximizing cardiac function with medications, surgical interventions, and exercises Maintaining and improving functional status
Focusing on risk factors including: smoking, control of BP, weight and cholesterol, increasing physical activities and managing stress

WOUNDBURN CARE - maximizing wound care
Controlling vascular supply and wound stabilization to improve wound healing
Use of different types of dressings including: film, hydrocolloidal, hydrogel, foam, calcium alginate, composite, debriding agents and impregnated gauzes
Maintaining and improving nutrition
Exercises to reduce immobility due to scar tissue

74. AND WHAT ABOUT NUCLEAR AND RADIOLOGICAL TERRORISM?

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1. INTRODUCTION

In the context of chemical, biological, radiological and nuclear terrorism, so-called CBRN terrorism, radiological and nuclear terrorism is widely considered as a major if not the ultimate terrorist threat for modern societies. Highly industrialized countries could be extremely sensitive to terrorist aggressions of this kind. This assertion nevertheless needs to be scrutinized. Furthermore the reasons have to be assessed why up to now there has been no record of any credible blackmail or similar acts, threatening man and environment.

This paper considers some possible answers, focusing on an analysis of the **technical feasibility** of nuclear and radiological terrorism and address further the question of the actors and their motives.

Nuclear terrorism is often associated with nuclear proliferation. Strictly speaking, nuclear proliferation deals with the spread of nuclear weapons into states which doesn't possess them.

But proliferation can also be understood as the spread of radioactive material or even nuclear explosives into the hands of non-state organizations, such as sub national terrorist or criminal organizations as well as any kind of extremist groups for sabotage, blackmail or any other destabilization or destruction purposes. This is one aspect of nuclear terrorism: the other one deals with terrorist actions against nuclear facilities or transport of nuclear material.

The US spent about 10 billion$ in the FY 2000 to fight terrorism and, of this, about one billion alone to counter terrorism with WMD, that means Chemical, Biological and Nuclear Terrorism. Is this unprecedented effort related to an imminent and real threat? This survey on nuclear terrorism should help to clarify this question.

2. THE KNOTTY DEFINITION OF NUCLEAR TERRORISM

In the following considerations, nuclear terrorism is understood as the use of radioactive materials or even nuclear explosives as well as any terrorist actions against nuclear facilities by individuals or groups outside state control in order to create fear or terror with a credible threat.

In contrast to the numerous and effective measures of the Non-Proliferation Regime aimed against the classical nuclear proliferation, the international community has no coordinated effort to respond to a violent nuclear crime by a sub national group. An attempt to negotiate a UN convention aimed at nuclear terrorism in 1998 aborted as the participants were not able to agree on a definition of nuclear terrorism, the difficulty being not the word "nuclear" but the different perception of what "terrorism" is. To some terrorists are criminals, to others they are heroes!

3. NEW DRIVING FACTORS FOR NUCLEAR TERRORISM

- **The emergence of a new kind of terrorists**

Terrorists are principally willing to use violence in order to gain attention and have become increasingly ruthless as well as more sophisticated and operationally competent.

In addition to the traditional form of internationally organized terrorism as a means of the political fight, a new extremist threat is emerging as documented by the nerve gas attack by the Aum Sect in Tokyo, where the only goal was to create unimaginable disorder and chaos.

Although one occurrence does not constitute a trend, this act signalizes that some kind

of ethical taboo has been broken and a precedent been set. Some observers believe that the act by the Aum Sect was an aberration not likely to be repeated, others believe that the incident illustrates a fundamental change in the proliferation threat. In the context of a possible use of nuclear material or explosives, such a fact is highly disturbing.

- **The consequences of the break down of the Soviet Union**

Two factors have predominantly contributed to an enhanced perception of the nuclear terrorist threat in the last decade following the end of the cold war: First: the fear of a possible loss of control over nuclear material, sensitive technology, nuclear weapon related know-how in Russia and in the states of the former Soviet Union, taking into account the chaotic economical situation in these countries. The same applies to the many unemployed nuclear specialists who could be recruited by potential proliferators or terrorist organizations and accelerate their illicit nuclear activities. Second: the rise of smuggling activities with radioactive substances in the early nineties.

- **"Radioactive" smuggling and black-market**

The illicit trafficking of nuclear materials and other radioactive sources started after the breakdown of the Soviet Union in 1991. Previously, as a consequence of the pervasive internal security of the Soviet Union, incentives for nuclear theft were practically non-existent. In the early nineties the growth in the number of nuclear related incidents was indeed impressive. Probably due to the fact that the market definitively misses buyers, the tendency is sharply decreasing since 1994. As the "Bulletin of the Atomic Scientists" pointed out in 1997: *" The biggest problem for smugglers has been finding buyers who aren't police or journalists"!* This illicit trafficking originated principally from the nuclear industry, the nuclear research and from the nuclear medicine of the CIS, especially of Russia. Fortunately it didn't come from its military nuclear weapon complex. It is interesting, and reassuring by the way, to ascertain that only a very few incidents involve weapon usable materials. There is no verified incident involving weapon-grade material, which means fissile material directly usable for weapon purposes.

Under the auspices of the UN, the international co-operation has markedly improved, involving intergovernmental agencies, such as the World Custom Organization, Interpol, Europol, the International Civil Aviation and Marine Organizations, the International Road Transport Organization, Euratom, Minatom, etc...Nowadays the International Atomic Energy Agency (IAEA) operates a database on illicit trafficking of nuclear materials and other radioactive sources and provides furthermore help and assistance for prevention, detection, response, training and exchange of information among the member states. A similar data base is operated by the US Department Of Energy (DOE).

But there is still the disturbing facts that the number of the undiscovered smuggling cases might largely exceed the number of the discovered ones: the well known story of the "tip of the iceberg" and that the smugglers might have learn from their past mistakes!

4. THE PROTAGONISTS

The acquisition and handling of radioactive substances remain costly, difficult and dangerous They are therefore reserved to well organized groups with large financial resources.

On the one hand, there are the traditional politically oriented terrorist organizations, possibly sponsored by a state, and on the other hand the new kind of irrationals such as extremist and fanatic groups of all kinds, including zealots, ethnic and politically disaffected groups with a particular mention to religious minded cults.

5. THE NATURE AND THE IMPACT OF NUCLEAR TERRORISM

Basically there are three ways for terrorists to go nuclear. First: they could use fissile material, Plutonium-239 or highly enriched Uranium and try to build a so called "improvised nuclear device". Second: they could use radioactive material, disperse it in the environment with some kind of a "radiological dispersal device" in order to create a radioactive contamination. Finally they could attack a nuclear facility e.g. a nuclear power plant with the aim to induce a radioactive contamination of the environment or to steal radioactive material for purposes of radiological terrorism.

Multiple problems stand in the way of the terrorists: usually the radioactive materials needed are very well safeguarded, they are inherently dangerous and highly detectable, therefore extremely difficult to procure, they are difficult to handle and to keep secret. Thus, in any case, an act of nuclear terrorism requires a specific high-level technical expertise. Nuclear terrorism is definitively "high-tech-terrorism" in a much broader sense than B- or C-terrorism.

- **The case of an "improvised nuclear device": The "home-made nuke"**

It belongs to the category "extremely high risk - extremely low probability"

In recent years, the homemade bomb case has been largely addressed in the open literature. Experts agree that a small group of physicists, engineers, chemists, metallurgists and explosive specialists could indeed be able to build a device with a considerable nuclear yield up to one or more kilotons. The principles of construction of nuclear weapons are common knowledge today and available in the open scientific literature. The hurdles are on the engineering side: specific, sophisticated and very expensive equipment would be needed, which are furthermore under international control.

But the main, the ultimate difficulty of such a project would be the procurement of enough weapon grade fissile material, let's say at least 20 kg of Plutonium or 50 kg of highly enriched Uranium needed for a low-technology nuclear device. Despite all the cases of smuggling reported in the last years many consider that an undiscovered diversion of such quantities of fissile material is extremely unlikely or even impossible for non-state organizations.

Another option would be the use of a stolen warhead, e.g. a tactical warhead from the former Soviet Union. But these weapons have built-in technical safety and security safeguards, which could only be overridden by a specialist with specific knowledge about the particular device.

Experts agree that this is not likely to happen and that the security of the Russian nuclear weapons is healthy, according to official statements by the US government on this particular matter.

This on the short term. But what about the long term, if the economic and socio-political situation does not improve in Russia? This question remains open!

In addition to these technical limitations, there are other aspects, such as the rationale and finality of such acts, which further lower the likelihood of this extreme form of nuclear terrorism. What price at all could be asked for the blackmail of possibly killing thousand or even million of people?

Nevertheless if a terrorist organization would, contrary to all expectations, succeed in such a homemade bomb project, all scenarios one may think of would have unimaginably disastrous and possibly existential consequences. Even in the case of a malfunction of the device, a massive radioactive contamination would render the vicinity of the detonation site – probably a big city – uninhabitable for a long time.

- **The case of radiological terrorism**

Although still a "High-Tech"-business radiological terrorism is much easier to realize than an IND, and therefore much more likely to happen. Radioactive sources are widely in use in the civil industry, research and in the nuclear medicine with usually satisfying safety but relatively low security level. Radioactive material in the nuclear industry and of course in the military nuclear weapon complex is much better safeguarded. The procurement of radioactive substances either from the "black market" or through the theft of civil sources should not pose an unsolvable problem for terrorists with some insider knowledges. Radiological Terrorism is therefore principally feasible.

Let's consider for instance the scenario of a truck filled with tons of ANFO, an explosive made of a common fertilizer, mixed with fuel oil, doped with some kilograms of a radioactive cocktail of Pu, Cs and highly radioactive waste, remotely detonated within a gasoline storage facility near a big city. A firestorm would result, lifting the radioactive particles thousands of feet in the air and producing a downwind radioactive contamination, which could extend over square miles of the city.

There are still many open questions about the extent and actual dangerousness of such fallout. In fact, preliminary calculations shows very large quantities of radioactive material would be needed in order to contaminate significant areas or volume of air with activities leading to acute damages for man health. Such quantities could not be handled without extensive protective measures. This strongly limits the possible quantities involved in an act of radiological terrorism, which thus remains a local event, whose extension is comparable to those of an act of chemical terrorism. Despite these limitations any act of nuclear terrorism would definitively create an unprecedented psychological and finally economical trauma.

A final remark

Conventional High Explosives and weapons, or even B- or C-agents would be easier and cheaper to produce or procure and to use: therefore probably a better choice for terrorists!

- **The case of the attack or of the sabotage of a nuclear facility**

There are different kind of nuclear facilities, that could be targeted by terrorists: first of all probably nuclear power plants (NPP) but all kind of storage facilities for military and civilian nuclear material and radioactive waste, reprocessing plants for nuclear fuel, uranium enrichment plants and nuclear research reactors. Although not a "facility" the transport of nuclear material belong to this category too.

As an example lets consider the case of a nuclear power plant.

Terrorists could attack a NPP in order to provoke a release of radioactivity in the environment, some kind of an ultimate radiological terrorism or terrorists could steal nuclear material such as unirradiated or irradiated and therefore highly radioactive spent fuel with the aim to extract later the fissile material contained in the rods for any purposes of radiological terrorism.

Compared to other civilian industrial facilities NPP are extremely well protected. To some extent a NPP can be in fact compared to a military fortress. First there are all the safety measures designed to prevent any release of radioactivity in the environment in the case of a malfunction of the plant. Reinforced concrete and steel containment structures coupled with redundant safety and shutdown systems are designed to permit the facility to further withstand the impact of earthquakes, hurricanes, tornados and flood as well as airplane crashes. Second: in addition to these extensive safety measures there are the quite as much extensive security measures taken to protect the facility against any sabotage or malevolent criminal or terrorist actions. The physical protection of a NPP bases according to the

recommendations of the IAEA on the concept of a defense in depth that requires an adversary to overcome multiple obstacles in order to achieve his objective. The adversary threat takes into account the attackers from outside the plant as well as insiders, who could help the outsiders. Third: all nuclear material in a NPP is comprehensively safeguarded, according to the prescriptions of the IAEA. And finally: with the exception of the unirradiated fuel all other nuclear material stored in the plant is extremely radioactive and dangerous to handle.

Taking into account the safety and security aspects as well as the self-protective characteristics of radioactive material it is difficult to imagine a credible scenario of a successful terrorist attack or sabotage of a NPP leading to a important release of radioactivity in the environment or to a theft of radioactive material. Actually the case of a terrorist attack against a NPP is characterized by its very low feasibility and therefore by a corresponding low probability of occurrence

So much for the "Western-style" NPP's. What about the NPP in the countries of the former Soviet Union? Their safety stays on a lower level. A containment is usually not provided and cannot be installed afterwards. In the Soviet Union the physical protection was assured essentially by strong police, if necessary also by military forces. This is no more the case or at least strongly reduced. There were almost no technical security measures foreseen. Today this lack of security measures makes these "Eastern-style"-NPP much more vulnerable to any terrorist actions

Despite this low feasibility of terrorist actions, at least against NPP of western concept, the impact of a successful attack could be tremendous. In the worst case it could reach "Tschernobyl-like" dimensions. Even in the case of an attack on a NPP, which doesn't lead to a release of radioactivity in the environment, the psychological effects on the public would be enormous and even damaging for the whole nuclear industry.

6. ARE THERE ANY OPTIONS?

Talking about terrorism in general and about nuclear terrorism in particular, one should not forget that all the choices and options where and when to do what, are in the hands of the terrorists. In the best case, it would be blackmail, linked to an ultimatum which would leave some time for countermeasures, if any , or, more probably, time for evacuation. But terrorists could act without warning, as in Tokyo or Oklahoma.

Real options in the case of a credible nuclear blackmail or an attack are thus very limited. A long term and internationally coordinated prevention seems to be the only way to counter the threat.

The international terrorism, as well as the illicit traffic and smuggling of radioactive substances must be intensively opposed and fought. Fissile nuclear material, including the "civilian" one, should be better controlled, especially in the states of the former Soviet Union. The cooperation on the technical level with already existing organizations must be extended. (For instance, the US have special units trained to handle nuclear emergencies and acts of nuclear terrorism. Such "Nuclear Emergency Search Teams" (NEST) have special technical equipment for identifying unknown radiation sources, might be able to defuse nuclear weapons and decontaminate irradiated areas. NEST can move in the US and all over the world on very short notice.) Governments must be prepared and trained to respond to such extreme situations, information concepts for the population and relations with the media must be elaborated and emergency measures and emergency management foreseen. Finally, since radioactivity is a highly confusing and emotional issue for the public, the consequences following a nuclear event might extend to widespread civil disorder and public health problems, fear, and distrust because of unfamiliarity with the risks and effects of radiation. Therefore prevention includes public education and understanding radiological hazards.

7. AN ASSESSEMENT OF THE RISKS OF NUCLEAR TERRORISM

Technically speaking the risk of an event is defined as the product of the probability of occurrence of the event considered and the effects or damages it produces. The probability of occurrence can be assessed by statistical methods e.g. for tornados, falls of meteorites etc. or by an analysis of the feasibility respectively of the occurrence of the event, the latest being relevant for an assessment of nuclear terrorism. The effects or damages are determined by selecting different criteria and trying to quantify the effects. In the qualitative risk assessment of terrorist presented in the **Figure 1** the criteria chosen for the effects are: the area affected, the health effects on man, the damages on the environment and the effects on economics. The psychological effects are usually not included in a risk assessment, but are of essential importance in such a consideration since radioactivity is a highly emotional issue for the public.

Case	**Technical feasibility** /Probability of occurence **(P)**	**Effects/Damages (E)**				**Risk (R)**
		Area affected	Man	Environment /Economics	Psychological	
IND-case (home made bomb)	Extremely **low**	large (>50km^2)	very large to catastrophic	disastrous	traumatic	**extremely low**
Radiological terrorism	still difficult but **feasible**	mainly local	small to medium	large, especially on economics	in any case (very large)	**medium**
Attack or sabotage of a nuclear facility	Security makes it (very) **difficult**	very large (> 100km^2)	limited	very large	tremendous	**very low**

Figure 1: Qualitative assessment of the risks associated with acts of nuclear terrorism

Despite the fact that the damages of a successful IND-case would be disastrous the risk is essentially determined by the extremely low technical feasibility and therefore extremely low probability of occurrence. An identical conclusion can be drawn for the case of an attack or a sabotage of a nuclear facility, the difference between "extremely low" and "very low" is gradual and a question of interpretation! Although still difficult and an high-tech-business radiological terrorism is incomparably more feasible than the other cases. The scale of possible effects is much lower but the incidence on the economics could be large, that means very costly and the psychological effects on the public are guaranteed and in any cases important. Radiological Terrorism represents indeed the dominant threat in the context of nuclear terrorism.

8. IS NUCLEAR TERRORISM THE ULTIMATE FORM OF TERRORISM?

As a tentative conclusion it can be stated that nuclear terrorism could indeed be the ultimate form of terrorism, but it's not likely to happen. Nevertheless, since the probability of nuclear terrorism, especially of radiological terrorism, is low but not zero, the theme has to be addressed very seriously by the international community.

75. THE COOPERATION BETWEEN POISON CONTROL CENTER AND ORGANIZED INDUSTRIAL DISTRICT FOR CHEMICAL DISASTER PREVENTION

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ABSTRACT

Industrial Districts have many plants that use or produce toxic substances. Thousands of healthy technicians and employers work at important and powerful equipment. The plants in these districts may cause many dangerous fires, explosions, a spillage of disposal in an accident or during earthquake in peacetime. Industrial Districts are also targets of the terrorist attacks in peacetime or soldiers during a war. Another danger may emerge when these districts are built near overcrowded urban regions of the cities.

Our project involves the Bursa Organized Industrial District's chemical disaster prevention efforts.

A hotline line between center and district was established, while Tomes Plus and Intox Programmes adding Micromedex Computer Programme were provided by the district administration. A-17 question survey was distributed to 76 plants. Among them, 66 plants with a total of 10342 workers responded to the survey. This survey revealed 47 different chemical agents. As a result 'safety diskettes' were prepared in DOS and Windows 95 formats . Each diskette contains information about the properties and the toxicity of the chemicals that are used in that plant. Preventive measures and a first aid sections were also included in each diskette. Fire Department was warned about the kind of properties of chemicals that may be subject to combustion, ignition or explosion. The medical group of district was trained about exposure of toxicity, acute and chronic toxicity, and related first aid measures.

INTRODUCTION

Bursa was the first capital of Ottoman Empire and located on the South East of Marmara Sea and founded on the foot of Uludag , the third highest mountain in Turkey. Location of the city has been since 2500 B.C. and it have had important role on the traditional 'Silk Road' from China to Italy.

Bursa was described as 'Green Bursa' or as 'A city for retired people'. But in the last thirty years, it was rapidly transformed to an 'Industrial City'.

Organized Industrial District of Bursa had been established officially in1966.Enlarged area of the District now has been reached 3.7 million square of meters. The number of firms were 163 , number of employees were 25500 in the year of 1997.

The oldest industrial sector of Bursa is the textile sector and it has played a very important role in the beginning of industrial growth. More recently developed motor-car sector, and sub suppliers of it are also the other important sector of industry (1).

METHOD

A questionnaire was prepared for computer diskettes to be used in the prevention and treatment of the toxicity of chemicals commonly used or produced in the plants located in the Organized Industrial District in Bursa, Turkey. It consists 17 questions about firm, doctor,

people and chemicals. And these surveys were distributed to 76 plants by the management of the Industrial District. Table:1

Completed questionnaires were returned from 66 (86.8 %) plants.

The total numbers of employee in these plants was found to be 10342.

Questionnaires revealed 47 different chemical agents.

Two Safety discettes for each plant were prepared with reference to Micromedex Tomes, Tomes Plus and Intox programmes and in DOS and Windows 95 formats. One of them was given to the Manager or Doctor of the plant. Pack of diskettes about 66 plants was delivered to the Management of Industrial District.

Each diskette contains information about the physical properties, physical and chemical dangers (fire, ignition, explosion and pollution effect), type of exposure (inhalation, skin, eyes and ingestion) , results of short-term and long-term exposure, clinical findings of disease , storage, disposal methods of the chemicals used in that plant. Preventive measures against contamination and intoxication, first aid sections were also included in each diskette.

RESULTS

We classified the hazardous properties of these 47 chemical substances as 23 combustible, 12 ignitive, 24 explosive and 40 pollutant (Graphic 3)

Exposure of toxicity was through inhalation route (n: 42), dermal route (n: 26), mucosal and eye (n: 36) and gastrointestinal route (n: 30) (Graphic 4).

Respiratory system (n: 42), central nervous system (n: 15), skin (n: 33), eye (n: 36) and metabolic organs (n: 15) were predisposed to acute toxicity (Graphic 5).

Chronic toxicity was found to affect respiratory system (n: 16), skin (n: 16), genitourinary system (n: 4) and liver (n: 10). 4 of 47 toxic chemical substances had genotoxic and 4 others were cancerogenetic effects (Graphic 6)

The data of the plants and chemicals were shown, Fig: 1, 2, 3, 4, 5, 6.

DISCUSSION

Eco-Terrorism was first described Bokan S and co-workers in 1977. Authors pointed out to the dangers of Industrial districts in below: The plants which use or produce the toxic substances have many dangerous hazard as fire, explosion, an accident as a spillage of disposal in the peacetime. Industrial Districts are also the targets of the terrorist attack. Although a country may not posses chemical weapons (CW) , the forces destroy the chemical plants, petrochemical plants, oil and gas well, pharmaceutical plants, biotech industries and other facilities by using the conventional weapons during the war. This special method of conducting chemical war - not by attacking with CW, but by attacking an industry which uses tens and hundreds of thousands tons of hazardous chemicals could kill and/or poison tens of thousands of persons ,could contaminate the waters, ruin forests and agriculture (ECO - TERRORISM) (2).

As seen in figures, plants have many ignitive, explosive, pollutant substances that will set on fire, burst and pollution in surrounding areas. Serious diseases will occur early and later depending on the kind of substance and exposure period, after disaster. An another important point is that the workers, manager and even doctors in that plants or the people living near the districts are not aware of these dangers.

Poison Information Centers can be helpful by teaching for medical and fire person before accident or by hotline during emergency situation.

CONCLUSION

A hot line and preparation of Chemical Safety Diskettes will be useful adjunct in acute or chronic Toxicological Emergencies and Disaster Planning of the Industrial District, both of Peace and War purposes.

KEY WORDS

Industrial District, Chemical Disaster, Prevention

REFERENCES

1. Industrial Directory of in Bursa 1996 , Barışcı Ajans -Rota Ofset, p.20
2. Bokan S, Orehovec Z, Jukic I, Taborsky V, Eco - Terrorism, Chemical War by Conventional Weapons, ASA 97 - 6, p.7

Table 1: BURSA INDUSTRIAL DISTRICT CHEMICAL SAFETY PROJECT QUESTIONNAIRE

Firm Name:
Address:
Owner:
Doctor of Medicine:
Number of people working:
Number of people working in the chemical hazard area:
Work hours: Work time:

-Has there been any accident , intoxication or occupational health problems in the firm until now ?
-Chemicals used.
-Generic names of the chemicals.
-Physical properties of the chemicals (solid, liquid, gas, powder).
-Annual amount of chemical used.
-Measure taken the prevent intoxication or contamination.
-Material and methods used to prevent intoxication and contamination.
-Disposal methods of the chemicals(incinerate, wash out, sewage, smoke).
-Which program do you prefer for at the diskette.

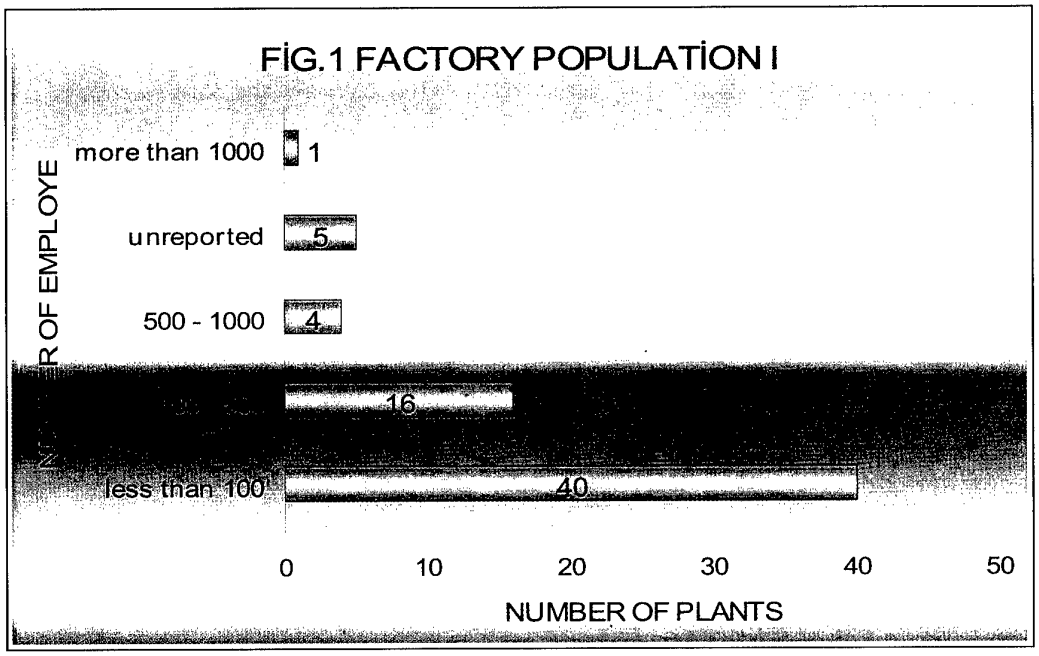
FİG.1 FACTORY POPULATİON I
more than 1000
1
unreported
5
500 - 1000
4
16
less than 100
40
0
10
20
30
40
50
NUMBER OF PLANTS

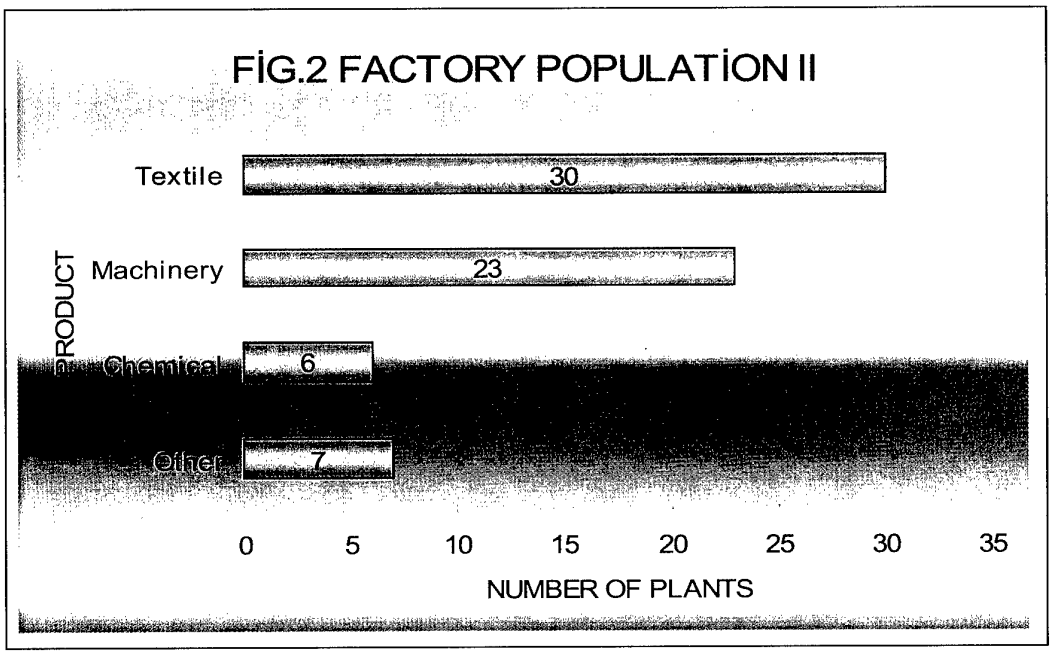
FİG.2 FACTORY POPULATİON II
Textile
30
Machinery
23
Chemical
6
Other
7
0
5
10
15
20
25
30
35
NUMBER OF PLANTS

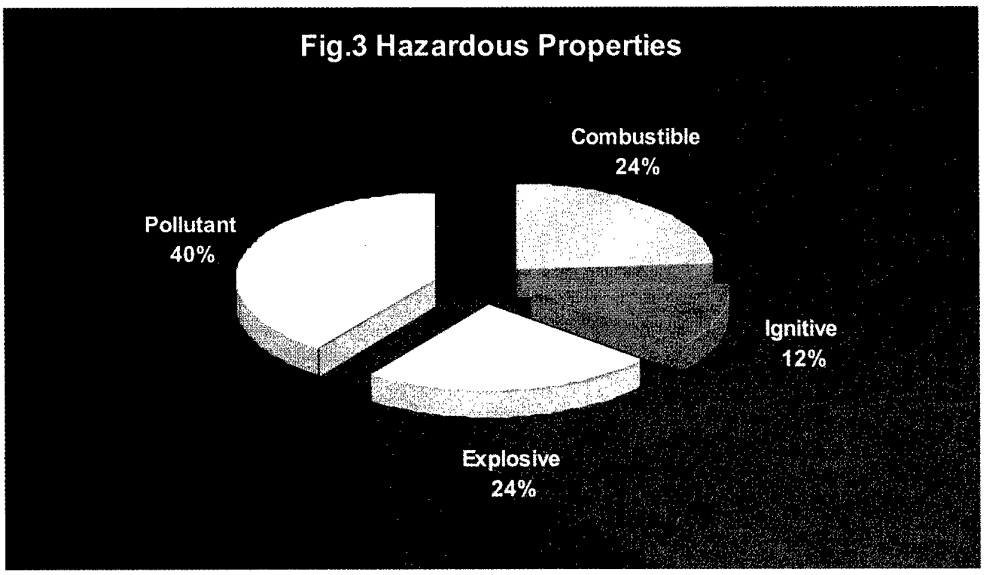
Fig.3 Hazardous Properties
Combustible
24%
Pollutant
40%
Ignitive
12%
Explosive
24%

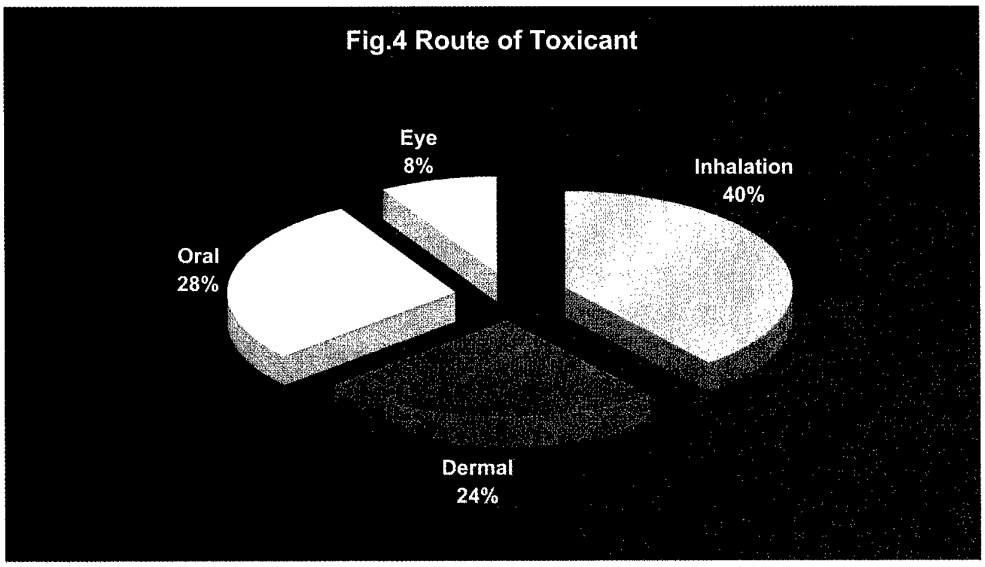
Fig.4 Route of Toxicant
Eye
8%
Inhalation
40%
Oral
28%
Dermal
24%

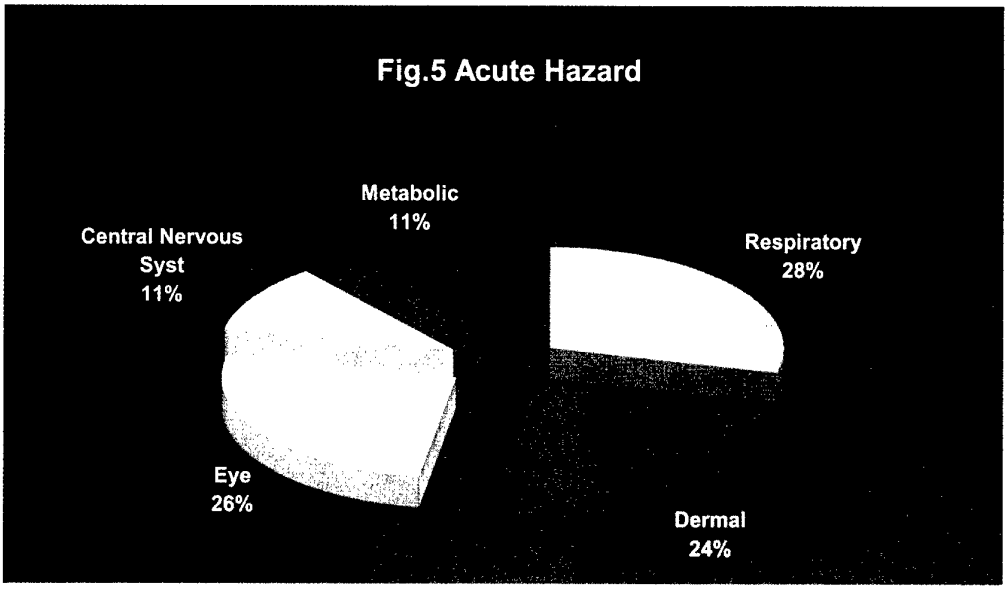
Fig.5 Acute Hazard
Metabolic
11%
Central Nervous
Syst
11%
Respiratory
28%
Eye
26%
Dermal
24%

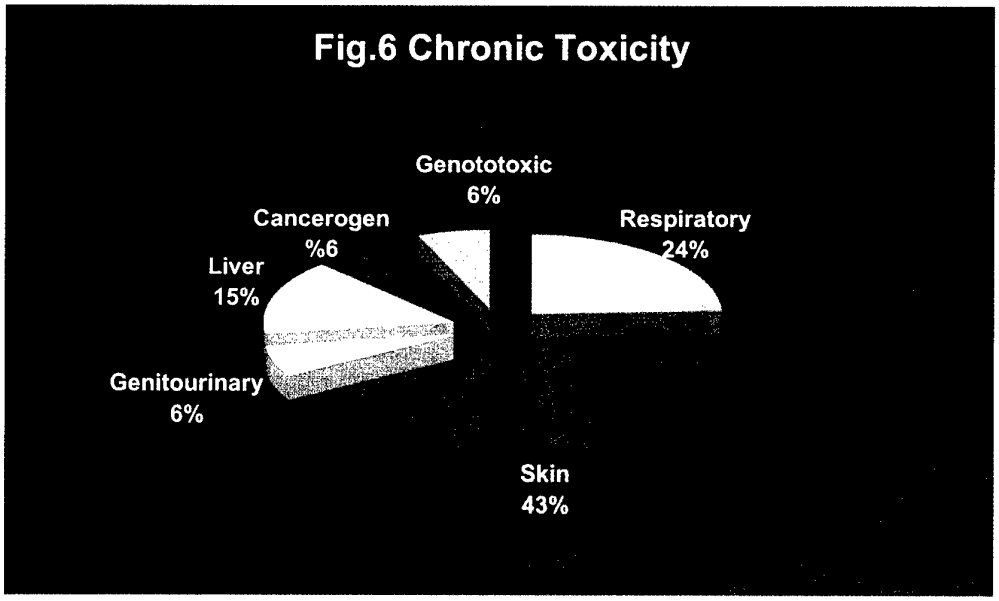
Fig.6 Chronic Toxicity
Genototoxic
6%
Cancerogen
%6
Respiratory
24%
Liver
15%
Genitourinary
6%
Skin
43%

76. THE NEW GLOBAL STANDARD: WMD COMMUNITY PREPAREDNESS

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In 1993 an explosion rocked the World Trade Center and for the first time the American public realized its perception that terrorism only happens "over there" might be outmoded. In the wake of this, the Oklahoma City bombing, and the nerve gas attack in the Tokyo subway system, the WMD Community Preparedness Program was born. SBCCOM, the center of the U.S. Department of Defense's chemical and biological expertise, developed a WMD Community Preparedness Program to improve the capability of the civilian sector to prepare for and respond to terrorist incidents involving chemical, biological, radiological, or nuclear (CBRN) weapons of mass destruction.

BACKGROUND

The WMD Community Preparedness Program is just one part of the overall Homeland Defense (HLD) Program, which melds past experience with future thrusts through technical expertise. The HLD program also includes the Domestic Preparedness Program, which SBCCOM has been conducting since 1997, and a newly created but similarly structured program for military installations and the surrounding civilian communities, both at home and abroad.

THE DOMESTIC PREPAREDNESS PROGRAM

The Domestic Preparedness Program (DPP) objectives are: to provide enhanced support to improve the capabilities of state and local emergency response agencies to prevent and respond to terrorist incidents involving weapons of mass destruction at both the national and local levels, and to enhance the capability of the federal government to prevent and respond to such incidents. The program consists of four main elements critical to effective preparation and response: training, exercises, response planning, and technical assistance.
A series of training courses provides local emergency responders such as fire fighters, law enforcement personnel, emergency medical specialists, hospital providers, HAZMAT technicians, emergency operations center personnel, and senior elected officials with the knowledge about chemical, biological, radiological and nuclear materials necessary to effectively deal with terrorist incidents. Tabletop and functional exercises conducted in local venues with scenarios specific to those locations allow the response elements to practice what they've learned from the training courses, as well as to develop synergistic working relationships with personnel from other functional areas and with supporting organizations that provide local mutual aid. Full-scale annual Federal, State and local exercises conducted over the past four years served to exercise the full range of support which could be provided to a local community from State and Federal response organizations when requested by local officials. During the course of the DPP, from 1997-2000, SBCCOM trained and exercised over 28,500 individuals in 105 of the most populated cities in the US, and conducted 336 exercises and workshops in those localities. This training and exercise program is continuing this year under the auspices of the US Department of Justice.

IMPROVED RESPONSE PROCESS

During the course of the city training and exercise program, first responders surfaced

tough problems and issues related to chemical and biological agents which required development of detailed technical solutions which had to be validated before they could be put into practice by the responders. This was done via the Improved Response Process (IRP). Through a series of workshops, technical investigations and exercises, SBCCOM developed practical solutions to these tough problems, which responders could use with minimal change in their normal procedures and equipment. These solutions were then validated by functional exercises involving the actual responders such as SWAT teams or fire fighting companies. These solutions were then fed back into the city training program to ensure the most recent information on best practices was provided. Through this process, which is a systematic analysis of concepts, plans, procedures and equipment, our first responders are able to enhance their effectiveness when dealing with chemical and biological terrorist incidents.

The IRP was used to provide solutions related to personnel protective equipment and detection capabilities, mass casualty decontamination techniques, crime scene preservation, and responder asset management. In addition, the IRP team has expertise in developing and tailoring response templates, building protection and decontamination procedures, both for civilian communities and military installations.

WMD PREPAREDNESS PROCESS

The WMD Preparedness Process is depicted in Figure 1. After a program overview meeting, a series of modular exercises, training, and planning workshops are provided which all work in concert to establish a baseline of current preparedness via a tabletop exercise, deliver tailored training based upon the established baseline, and re-evaluate preparedness with tabletop and functional exercises. Technical assistance and response planning tie training and exercises into a single, comprehensive package providing "cradle to grave" service to those who need it most. This process can be applied to military installations as well as local communities, and has been tailored for specific application to the medical community, as shown in Figure 2.

SUMMARY

A full range of products and services is available from SBCCOM to enhance the capability of the international community to effectively respond to chemical or biological terrorism. Along with the training and exercise program discussed above, technical assistance offers building and fixed site protection and the evaluation of commercially available protection, detection, and decontamination equipment. Response planning assists planners and responders in establishing response roles, identifying limitations with current assistance requests, and developing a community CBRN Response Plan consistent with unique community procedures. The WMD Community Preparedness Program's approach of providing "cradle to grave" services through a single, comprehensive program has resulted in a proven and effective method of improving preparedness and response capabilities nationwide, and in the international arena as well.

KEY WORDS

Terrorism, biological terrorism, biological agents, chemical terrorism, chemical agents, chemical warfare, CBRN, weapons of mass destruction, SBCCOM, community preparedness, homeland security, Homeland Defense, Domestic Preparedness Program, Improved Response Program, emergency management, emergency medical services, hazardous-materials, public health, medical response, medical surveillance, bioresponse template, personal protection, decontamination, medical treatment, training.

FIGURES

Figure 1. WMD Preparedness Process

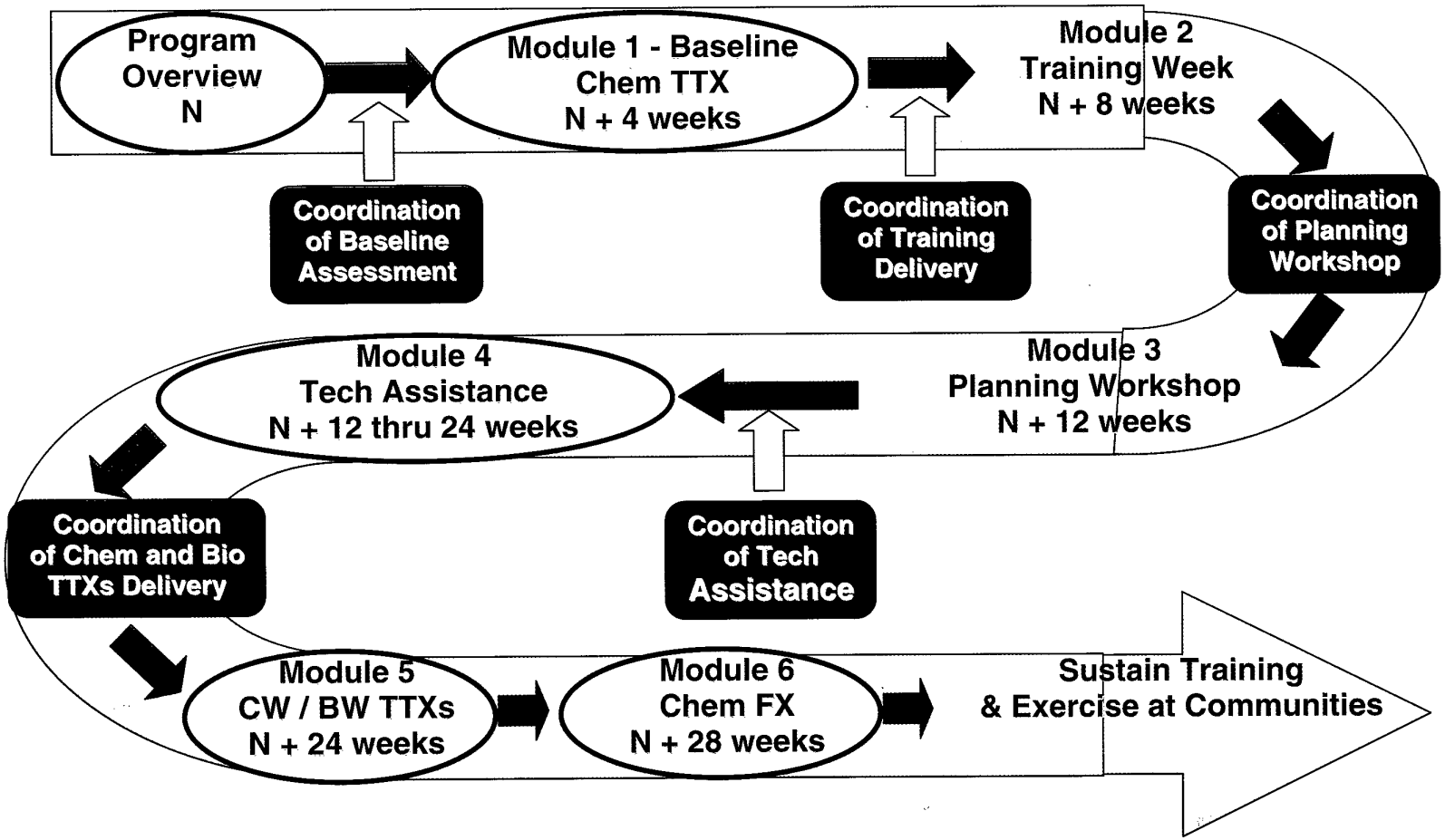
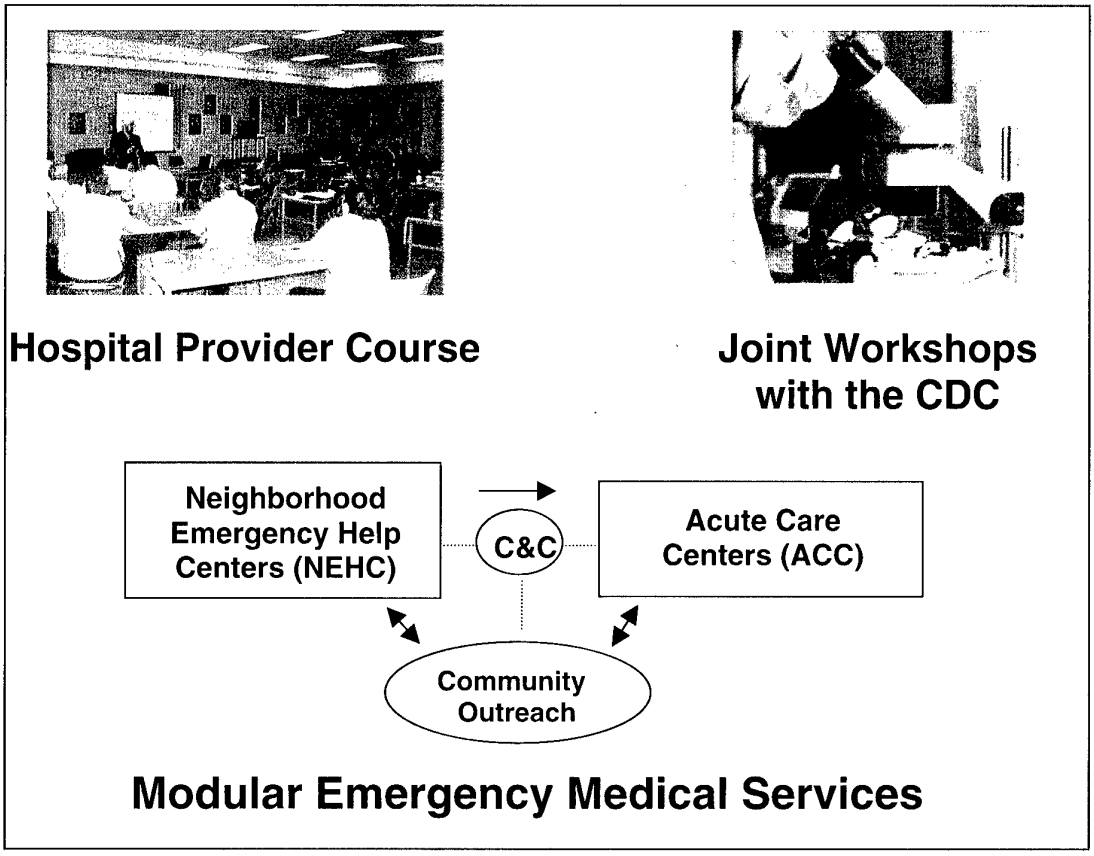


Figure 2. Medical Services Application



77. THE COMPONENTS OF THE BIO-RESPONSE TEMPLATE

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INTRODUCTION

When responding to a bioterrorist attack, the following aspects of response must be timely and well coordinated: medical surveillance to detect the attack; making quick, rapid and appropriate response decisions; implementing the pre-existing response plans; distribution of prophylaxis; ability to keep up with the flow of sick and "worried well"; and ability of response system to receive and rapidly utilize outside help. In consonance with these aspects of response, the following major functions comprise a full-spectrum and integrated response approach. This approach is called the bio-response template.

MEDICAL SURVEILLANCE

Medical surveillance improves the chances of quickly detecting unusual medical events. This initial, non-specific detection of medical activity above an established baseline would trigger other response actions. Several American communities are now monitoring hospital admissions, emergency calls, and unexplained deaths as indicators of an unusual medical event. When baselines are exceeded, city health and emergency management officials will decide if an unusual event has occurred. If this is the case, they then would initiate the four *active investigation* components of the response template (see Figure 1). Medical surveillance could be expanded to actively poll emergency departments, pediatricians, infectious disease doctors, and other infection-control practitioners to ascertain the context and possible cause of the non-specific indicator(s). Medical staff should be trained to be alert to unusual clusters of disease symptoms that are indicative of bioterrorist activity.

MEDICAL DIAGNOSIS

If medical surveillance indicates that an unusual event may be occurring, local officials should have established procedures for confirmation and definitive diagnosis. Preliminary medical diagnosis of suspected biological samples should be undertaken locally with samples sent for verification to other qualified laboratories. Veterinary diagnosis also should be considered in the verification process. If a potential biological weapons (BW) health problem arises, the medical and public health community should notify the senior local elected official, emergency manager and local law enforcement. Likewise, any selected infectious disease laboratory results that are reported to the public health department also should be reported to the senior local elected official, emergency manager and law enforcement.

EPIDEMIOLOGICAL INVESTIGATION

An epidemiological investigation could determine, using a variety of tools including interviews and diagnoses, the distribution of cases and sources of disease outbreak. Such an investigation would support the development of recommendations for containment, prevention and treatment.

If an epidemiological investigation is initiated, law enforcement should be notified and provided with data collected as needed. This way, criminal investigators can visit the original site to collect data when epidemiologists identify the location of the disease source.

The key to successful epidemiological and criminal investigations of potential BW events is a good working relationship between law enforcement, epidemiologists and the public health department. Developing procedures to facilitate sharing of information between these agencies is highly recommended.

CRIMINAL INVESTIGATION

The criminal investigation would be a joint effort involving many agencies and could complement the epidemiological investigation. It likely would entail conducting interviews with the sick in hospitals, fellow sick officers, and others in the affected population groups. To facilitate these interviews, a checklist of basic questions to ask should be developed. These interviews can help determine the cause, perpetrators and other details of the attack.

Other types of evidence include biological or clinical samples, heating, ventilation and air conditioning samples, surface samples, and food or water samples. Local communities should develop sampling protocols for law enforcement officials investigating potential bioterrorist events. These protocols should include coordination with the local laboratory to ensure appropriate specimen collection and handling.

If a potential BW health problem arises, sharing of the information described above between the health/medical community and law enforcement officials may help in the apprehension of the responsible individuals/groups. Communities should discuss mechanisms to identify and share pertinent information with each other, paying particular attention to patient confidentiality and operational security issues. For a credible biological threat, law enforcement should notify predetermined public health officials. Safety concerns such as agent hazards, secondary devices and/or booby traps left at the scene should be considered when planning response procedures for the criminal investigation team.

MASS PROPHYLAXIS

The results of the medical diagnosis, epidemiological and criminal investigations could be used by local officials to assess whether a major health event was occurring, to help determine the potential cause(s) and to identify the population at risk. Local officials could then make informed decisions on medical prophylaxis and treatment, containment and quarantine measures as required. In many cases, these decisions may need to be made on a presumptive basis and then acted on immediately to achieve timely prophylaxis and to keep pace with the onset of casualties.

Mass prophylaxis, the first *emergency response* component of the template, involves the distribution and medical application of appropriate antibiotics, vaccines, or other medications in order to *prevent* disease and death in exposed victims. For example, giving antibiotics to people shortly after exposure to anthrax can significantly reduce the occurrence of disease and save lives. However, the speed with which medical prophylaxis can be implemented effectively is critical to its success.

Application of medical prophylaxis requires identification of the population at risk. Because this identification cannot be verified immediately, treatment may have to be applied to a much greater number of people than those actually exposed.

Distribution of medications could occur through existing medical institutions or through other medical emergency response systems.

In addition, local policy should be developed that provides priority emergency antibiotic prophylaxis for use by "essential" emergency personnel, including law enforcement personnel conducting the criminal investigation, in order to allay their fears and help assure their continued presence during the response. A specific list of such personnel should be developed in advance.

RESIDUAL HAZARD ASSESSMENT AND MITIGATION

Residual hazard assessment and mitigation involves activities that would assess and protect the population from further exposure to potential environmental hazards. Normally the risks from residual BW agents are small compared to those from the actual attack, but they still warrant attention once the more immediate threats have been addressed. Public health officials, coroners and/or medical examiners and criminal investigators would need to work together to mitigate residual hazards and identify potentially large numbers of fatalities. Assessment and mitigation may include environmental sampling of air, water, and soil, as well as surface swipes and insect and animal screening for the BW agent.

Vector and animal control measures may be used as applicable. Decontamination would be site specific and may be required for certain "hot spots" around the area of release or for the interior of buildings and other enclosures.

CONTROL OF AFFECTED AREA/POPULATION

Control of affected area and population is divided into two major sub-elements: 1) physical control, and 2) public information and rumor control. Together, these two elements help maintain order, inform the population, and facilitate organized emergency response. Physical control includes crowd control and security at hospitals, emergency medical facilities, fatality handling sites and other vital installations such as airports, utility sites, bridges and tunnels. In addition, activities that control the affected area also provide excellent opportunities for isolation and preservation of the crime scene, if one is identified.

Traffic management could provide ingress and egress control for essential personnel, equipment and residents within the affected city and to and from staging areas. The affected areas within the city could be patrolled to maintain security as warranted.

Public information and rumor control are vital for informing and instructing the population in ways that enhance emergency response and avoid panic. Activities could include establishing and operating a city hotline, providing information to the media and distributing self-help fact sheets. Strict management of information as well as ensuring that all information disseminated is timely and accurate are crucial activities of the local command structure in order to prevent panic and maintain public cooperation.

MODULAR EMERGENCY MEDICAL SYSTEM (MEMS) – CARE OF PRESENTED CASUALTIES AND WORRIED WELL

Care of presented casualties and worried well, along with medical prophylaxis, form the backbone of the bio-response template. Other components of the template support and enable these two.

The worried well are individuals who believe that they have been exposed to a biological agent, when in fact they have not. They may magnify the number of patients by 5 to 15 times and will require triage and evaluation to distinguish them from the truly ill. Many will fall out of the patient count as their clinical status remains unchanged over time. Unfortunately, they will seek medical assistance during the most critical time of the incident, and thus, will impact the delivery of care to the victims of a biological attack. For example, in the case of the Aum Shinrikyo subway attack in Tokyo, the number of worried well was approximately 4500 of the 5500 casualties.

In order to manage this huge casualty load the BW Improved Response Program (IRP) team developed the Modular Emergency Medical System (MEMS) to address shortfalls in hospital space, equipment and medical personnel. The MEMS concept was developed to address the need of a BW response plan to expand and contract in size, based on casualty counts and acuity.

Public and private area hospitals could admit BW casualties until they approach full capacity while operating under their internal emergency operations plans. As the hospitals become full, local officials would determine that the medical emergency is overwhelming the community's medical care system and could decide on appropriate activation of a system similar to the MEMS, which is described below and is graphically represented by Figure 2. Area hospitals would form their own internal emergency medical command centers (MCC) to coordinate all assigned sector health care operations. Acute care centers (ACC) would be established in structures close to the area hospitals to provide definitive and supportive care to acutely ill BW patients who exceed hospital capacity.

The current health care management system includes public and private area hospitals, clinics, and private physicians. These components could be integrated and expanded during emergency operations by activating pre-planned components and applying additional resources.

Local clinics, schools and shopping centers of suitable size could be expanded into Neighborhood Emergency Help Centers (NEHC) to provide the primary point of entry into the emergency medical system for BW patients and worried well and to distribute medical prophylaxis medications. Local volunteers could be used to assist the medical staff in these centers. Private medical doctors would send their BW patients and worried well to the NEHCs. Community outreach could be performed by police, firefighters, community health personnel, and other officials to link home-bound patients to the NEHC.

If the acute care centers and clinics became overwhelmed because of the extreme numbers of casualties or are delayed in being set up, community outreach personnel would distribute information, appropriate medication (after victims were triaged by trained medical personnel) and medical supplies to victims at their homes. They also could provide limited medical care by mobilizing a citizen home care effort and augment NEHCs in quickly distributing medical prophylaxis.

Casualty relocation units could transfer non-BW hospital patients to remote locations in order to provide additional hospital space for BW patients. Only non-critical patients would be relocated. The patients could be moved by ground, water, or air transports.

The rapid and large-scale expansion of facilities has a critical companion effect: the rapid and large-scale expansion of staffing needs. A large-scale BW disaster would quickly overwhelm the existing medical staff, even in our largest and best-staffed cities. Therefore, until sufficient staff are available, cities may want to consider the use of "physician and nurse extenders" to cover medical staff shortfalls. When using physician and nurse extenders, it is important to address the legal issues. These persons may include dentists, veterinarians, final-year medical students, nursing students and other medical specialists. These extenders could, through necessity, assume broader roles in providing medical care to mass casualties.

FATALITY MANAGEMENT

Medical prophylaxis and care of casualties according to established health protocols will reduce death and suffering following a BW attack. However, fatalities still are likely to occur and may occur in large numbers with a lethal agent like anthrax. Therefore, fatality management must be planned.

The template includes the use of morgues to provide rapid central processing of remains and the establishment of long-term storage facilities using refrigerated trucks, rail cars or other containers to hold remains until final disposition. Local officials would need to make a decision on the final disposition of remains. Options for the final disposition of remains could include (1) mass cremation, (2) mass burial and (3) release of remains to

families for normal disposition. Temporary interment is an option that might be used while awaiting final disposition.

Remains contaminated with biological agents could present health concerns and may need to be disposed of according to established protocols.

EMERGENCY MANAGEMENT OPERATIONS

When local officials determine that a major health event is occurring, they will likely activate their emergency operations center (EOC). They might also implement an incident/unified command system. A unified medical branch could be established within this command structure, and representatives from local, state and federal agencies could be requested at the local EOC. The emergency operations plan, including application of medical prophylaxis and use of the modular emergency medical system, could be activated. Local officials could declare a state of emergency and request mutual aid from surrounding municipalities. The key is early coordination among all departments and forging early relationships between police, medical practitioners, emergency management and public health officials. Planning and conducting joint training exercises are effective in preparing strong unified command structures. Activating the emergency public information system must be an early and continuing action throughout the response in order to help prevent panic, further injuries and deaths.

LOGISTIC AND RESOURCE SUPPORT

The resource and logistic support component of the bio-response template would establish staging areas and distribution points for incoming personnel and supplies. Statements of needs and prioritization for equipment, personnel and services would have to be established. Supplies would be delivered to the response sites from the staging areas and distribution points. A central reception center would receive incoming mutual aid and personnel and provide instructions, accreditation, and assignments.

CONTINUITY OF CRITICAL INFRASTRUCTURE

The continuity of infrastructure component of the response template would activate local continuity of operations plans when disaster-related absenteeism exceeds critical thresholds. Critical infrastructure facilities would implement emergency staffing plans to sustain response operations at a high tempo. Telecommunications would activate their emergency communication plan to establish priorities, call blocking and cellular augmentation. Electrical power generation, water and transportation would activate their emergency staffing plans as required based on absenteeism. Sanitation would augment disposal of biohazard material and provide sanitary facilities and pest control at Acute Care Centers and other emergency facilities.

KEY WORDS

Terrorism, biological terrorism, biological agents, weapons of mass destruction, SBCCOM, Improved Response Program, emergency management, emergency medical services, hazardous-materials, public health, medical response, medical surveillance, bioresponse template, personal protection, decontamination, medical treatment, Modular Emergency Medical System

FIGURES

Figure 1. BW Response Template Components and Key Decisions

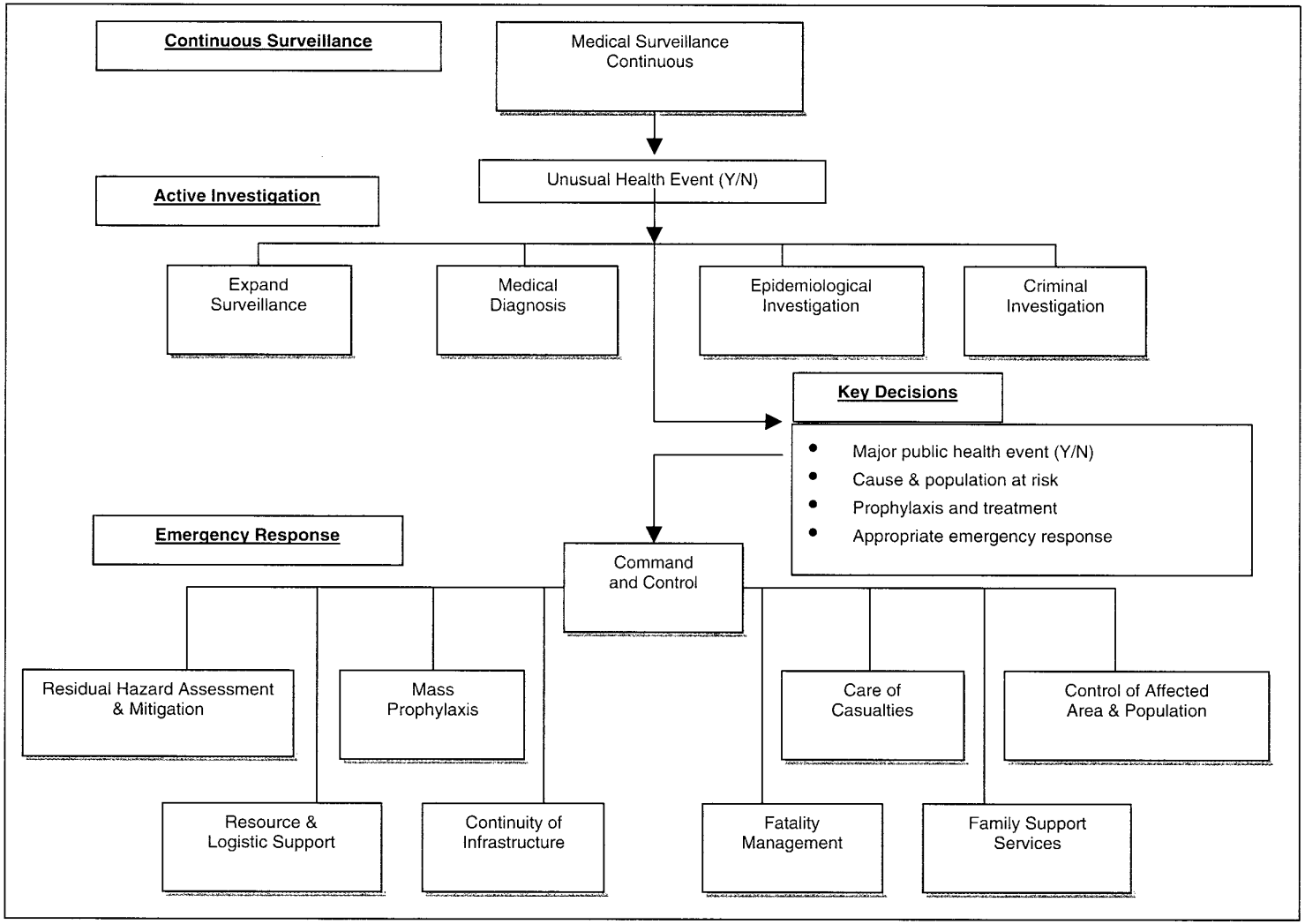
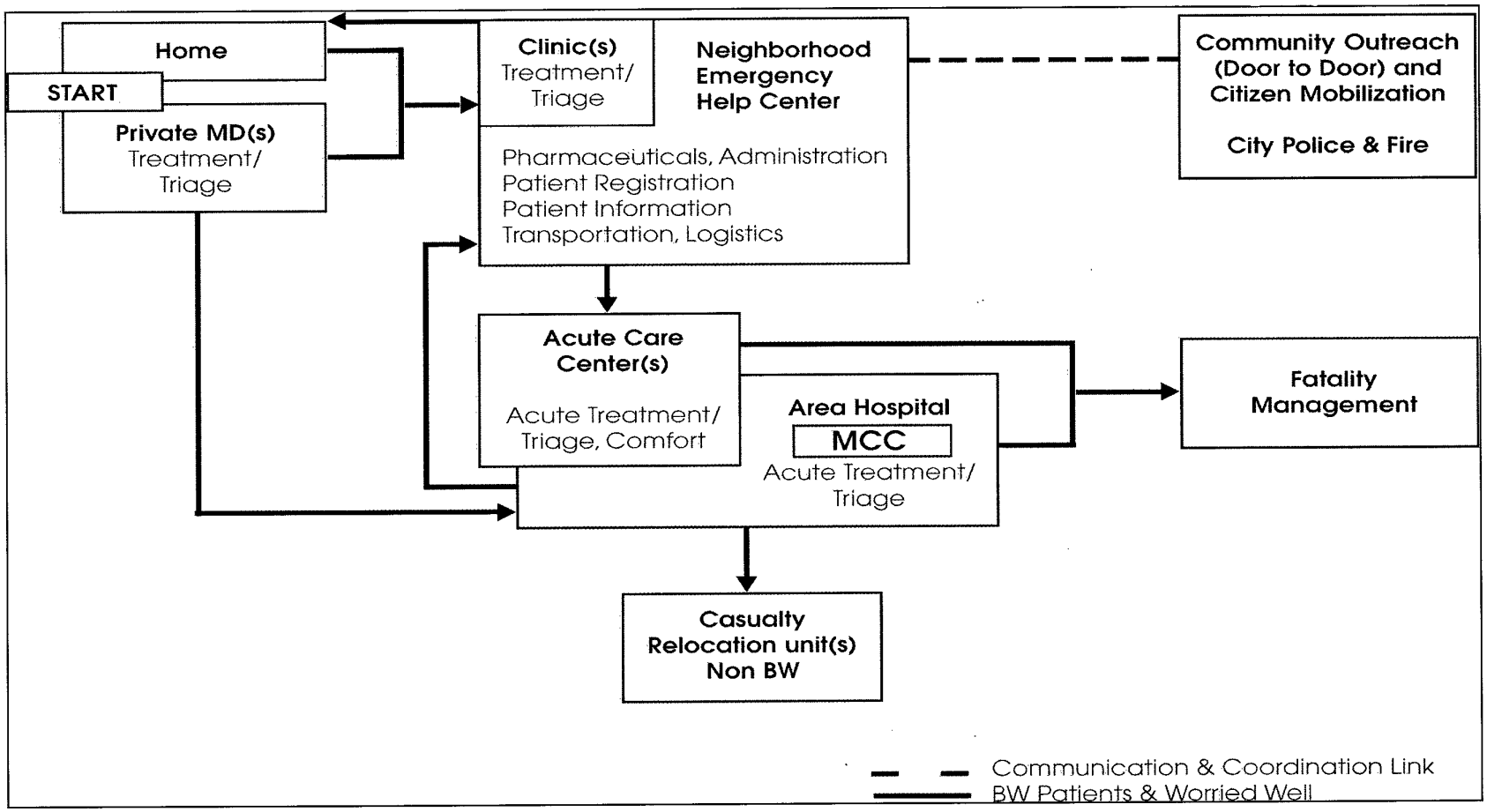


Figure 2. Modular Emergency Medical System



78. ANALYSING THE TERRORIST THREAT

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INTRODUCTION

It could be argued that there have been three phases in the last century during which particular concern has centered on the evolution of chemical and biological weapons (cbw); first, from the first world war to the end of the second; secondly, from the early fifties to the mid-eighties. In that second phase assessment of the level of risk of enemy use of chemical and biological agents depended largely on the state of east-west relations; in other words still within the military context. The third phase, and the one with which we are most concerned today has an entirely different perspective: the risk, particularly to civilian populations, of terrorist usage, 'State sponsored' or otherwise. Potential users of cbw are frequently - and probably correctly - referred to as acting within "The New Terrorism". While including 'classic' terrorist groups (of which there are at least twenty-nine listed by the United States alone), the term "New Terrorism" has wider implications, incorporating for the first time those referred to as "millennium" and 'single issue' activist organizations (such as animal rights) and individuals bent on revenge for whatever personal reason. The goal posts are perceived to have moved over the last fifteen years from inter-state conflict situations, or battlefield scenarios, in which military tactics would have been the main consideration, to ad-hoc possible use by any individual or organization with a grievance. Greatly improved communications, enhanced access to data and the relative ease of cross-border travel add to the potential for acquisition and eventual use. There have been several incidents that mark the new trend within the industrialized nations and on which government policy of containment and protection of population must be based; yet it is not only the industrialized world at risk. The psychological repercussions within society of the threat of use or actual use is a major consideration and one that has not been assisted by wild and emotive press stories, some based on fact, some partially correct and some totally fictitious. All aspects collude in making a threat assessment a difficult task to achieve.

The problem with analyzing a subject such as ours is that it often invokes more questions than it answers and highlights several factors on which one cannot rely. For example, analyzing historical data and establishing precedence of terrorist use of weapons of mass destruction (WMD) will give, at best, an incomplete picture. Playing the 'numbers' game is dangerous to findings as well. For instance, what is the true definition of the term 'mass destruction'? Nuclear weapons would certainly be categorized in that manner. It is arguable whether the same can be said for chemical weapons, but it is somewhat more realistic to use the term in relation to biological weapons. In the public perception, all have been confounded into the one alarming WMD title. The Aum Shinrikyo incident in Tokyo in which twelve people were killed and up to a thousand needed hospital care, had a disproportionate psychological affect across the globe in comparison to terrorist bomb outrages that have slain ten times as many.

What, then, is "New Terrorism"? In analyzing the level of threat, one has to start by posing several crucial questions such as "do such groups or individuals have the skill to complete their aim"? "Who are these groups and individuals", "how does one categories them" and crucially "what is their motivation"? Why would any group, organization or individual opt for use of chemical or biological weaponry in preference to any other weapon?

Answers to such questions are key to "new terrorist" motivation and key to the assessment of risk level.

If analysis of the "new terrorism" is one side of the coin, the other is just as daunting. Who or what would be targeted by "new terrorism"? Industry, in which pharmaceuticals and petrochemicals are high profile, is an obvious target; yet, paradoxically, there has been little evidence to date of threat becoming reality in that sector although industry is vulnerable due to its manufacture of an extensive range of every-day products, many of which are precursors to most chemical weapons. Food contamination is the one area in which there is evidence of continuity of criminal/terrorist interest, acquisition and use.

Many take the view that the world has entered into a Century of Biology in which biotechnology will see much development and change, particularly within the bio-molecular engineering range, genetic engineering etc. Evolution of the threat of the future means we must look at the positive and negative threat, not just focus on what might catch the news headlines. Technology change is but one part of the conundrum in threat assessment, the other includes ethnic, religious, social and political issues.

METHOD

Who, what, where and when are naturally the fundamental aspects to be considered. Included in each one, however, has to be regard for other aspects such as (a) are the potential users capable of achieving their aims? (b) are there any examples on which to draw? (c) an overview of the role of emotive press stories and how this interacts in administrative decisions and (d) the worrying rise in hoax incidents.

WHO/WHAT/WHEN/HOW.

Every nation has its own perception of what constitutes a terrorist threat, and their own perception as to which groups are categorized as such. There is a large consensus of opinion nonetheless. In the United States for instance, the list of Foreign Terrorist Organizations compiled by the Office of Counter-terrorism in October 1999 includes the Spanish ETA, Japanese Red Army, the PKK and Tamil Tigers. Of this sample of four groups only one, the Tamil Tigers, is known to have used toxic chemicals to achieve a tactical success against the Sri Lankan Armed Forces in June 1990. The official list contains several Islamic fundamentalist groups, such as Hamas and Hizballah, all of which are known to either have direct links to Osama Bin Laden or countries known to have sponsored state terrorism yet, unlike the Tamil Tigers proof that the fundamentalist groups have utilized WMD is not evident. So what groups or individuals are known to have used WMD?

(a) **Have used or who had potential to do so**.

- Aum Shinrikyo
- The Rajneeshees
- The Covenant, the sword and the arm of the Lord
- Minnesota Patriots

The Rajneeshees - so named after its Indian leader Bhagwan Shree Rajneesh, is a religious cult that developed widely in Europe - particularly in the United Kingdom and in the United States. In September 1984, the largest settlement based in Oregan, opted to use biological agents against the inhabitants of the nearest town with whom they were in litigation. The agent used was Salmonella. The targets were twelve restaurants in the town; the method of application was by spray of the bacteria into the restaurants' salad bars. The action, which took place in two separate phases throughout the month was conducted by

fourteen specially selected Rajneeshees, including Ma Puja, a Filipino, who had perfected the culture. In total 751 people were incapacitated, and most required some hospitalization. The Rajneeshees had sought large scale incapacitation.

The Covenant, the sword and the arm of the Lord - a 'survivalist religious' group - originally intended to poison water supplies in major US cities in the mid-eighties, using contents of a drum of potassium cyanide they possessed. Their motivation was to "hasten the return of the Messiah by 'carrying out God's judgments' against sinners". The aim was to achieve mass casualties.

Aum Shinrikyo - a Japanese apocalyptic religious sect, perhaps the best known group resorting to the use of WMD. The cult has experience in both biological and chemical agents. Its first product was botulinum toxin in 1990. By 1995, Japanese authorities believe the cult had produced anthrax as well and was looking at the possibility of manufacturing Q fever. Under the guise of assisting the victims of Ebola, a group from the cult visited Zaire in 1992 in an attempt to obtain the virus for culture in Japan. By 1993 the cult was producing small batches of nerve agents sarin, tabun, soman and VX. There was an intention to produce hydrogen cyanide, phosgene and mustard gas although these latter do not appear to have materialized. According to Japanese police, the cult produced VX on four occasions and made use of it during at least three assassination attempts. By the time of the cult's arrest and subsequent police investigations 'on site', installations were found to have been perfected that would have enabled the production and storage of up to 70 tons of sarin alone, at a daily pdn rate of 2 tons. The group had obtained its production facilities and assembled them, from open sources, from Teflon tubes to coil-method heat exchangers. The decision to place 600 gm.bags of sarin in several places within Tokyo's subway system in March 1995 had been motivated by the cult's belief that Armageddon was about to arrive with the imminent descent upon their location by police. Twelve people were killed in the incident and about one thousand affected to varying degrees.

Note: Although the above examples represent religiously motivated cults, their aims were different. The Rajneeshees for instance wanted to achieve an objective; Aum Shinrikyo sought the realization of an apocalyptic prophecy.

The Minnesota Patriots Council (MPC) - an anti-US government tax-resistant activist group which, in the mid 1990's had acquired ricin, the deadly protein toxin derived from castor beans. The materials - and instructions on formulation - had been obtained by open source, from a right-wing publication. The ricin, some 200 times more potent than cyanide, had been intended for individual assassinations - in this case against an Inland Revenue officer. Four leading members of the group were arrested before their intention could be put into operation, and they were sentenced under the Violation of biological Weapons Anti-Terrorism act.

(b) **Are rumoured to possess or have the potential**

The Weather Underground - a radical left-wing group operating during the 1970s. The group was widely (internationally) said to have acquired incapacitating agents from the US Army's defense research center at Fort Detrick, Maryland. The persistence of the rumours have lead to the erroneous acceptance of the theory as fact. The group's history was one of attack, including with bombs, against federal buildings.

R.I.S.E. - remains obscure on several aspects. Its title is probably derived from Reconstruction, Society and Extermination and based on the ideology of its originator Allen Scwandner that mankind is destroying itself and the planet the remedy for which was elimination of mankind excepting for a chosen few. Although some have claimed he and his followers were right-wing nazis, the most likely orientation is that of left-wing eco-terrorist.

For a 'cult' that is relatively unknown, R.I.S.E. had a remarkable propensity to obtain pathogens. Via a well-educated co-cultist, R.I.S.E sought eight microbial cultures but ended up with possessing five - Salmonella typhi (typhoid fever), Neisseria meningitidis (bacterial meningitis), Clostridium botulinum (botulinum toxin), Corynebacterium diphtheriae (diphtheria) and Shigella sonnei (dysentery). The vehicles for dissemination were to have been by aerosol and contamination of water and food supplies. R.I.S.E. was raided by police and subsequently folded but the question remains (a) could they have achieved their aims and (b) how close were they to doing so? To both points the answer is negative. What remains alarming with the R.I.S.E. saga is the nature of and amount of pathogens they were able to obtain.

The Baader-Meinhof Gang (Germany). An extreme left-wing German group operating in 1970/1 throughout Europe, it was widely believed that they had obtained mustard gas as a result of a raid on an US ammunition dump. Regarded as "New Left" and manned mostly by students, the Gang was otherwise known as the Rote Armee Faktion (Red Army Faction, or RAF). The range of its activities and willingness to resort to criminal activities, including physical attacks, led to its prominence along with other mainstream terrorist groups of the time, including the IRA, PLO, ETA etc. Yet the rumour that mass-casualties were the order of the day via water contamination for example, was eventually discounted as just that, rumour. The habitual targets for the group, individual assassinations and attacks on state property and personnel were not seen to have changed. This conclusion, doubtless correct, did not halt the rise in public concern during extensive press coverage.

Note: Of the three examples above, only one had the potential even though this was limited. The lessons are that (a) a group or individual can obtain the constituents and (b) the owners of such potential would find themselves severely restricted in effective use by lack of knowledge of some part of the programme. The other two examples were unfounded rumour that nonetheless had an emotive psychological impact on society.

(c) **Individuals**

Individuals with a personal grievance have been known to infect foodstuffs. For instance; a doctor in England injected atropine into bottles of tonic water in a supermarket is a case in point. The killing of Georgi Markov in London with a ricin pellet embedded into the tip of an umbrella is arguably another although this involved state sponsored assassination. Most recent is the case of Larry Wayne Harris who was arrested in February 1998 while carrying what he claimed to be enough anthrax spores to wipe out Las Vagas. (It was found to be harmless vaccine strain). Harris, a member of the neo-Nazi organisation "Ayran Nations" in Idaho, had obtained, through subterfuge, several vials of Yersinia pestis (bubonic plague culture) which he stored along with explosives in his home. None of his 'equipment' was used, yet his ability to obtain it has to be cause for ongoing concern.

CONCLUSION

"The New terrorism" is already in existence and works in several directions for religious and political/social reasons but mainly with one target: the civilian population. In many instances the aim is to exert either political or economic pressure on authorities or both. State bodies responsible for turning threat assessments into programme parameters that would be effective, have still some way to go, not least due to the fact that there has been little incorporation of the concerns of biotechnology and pharmaceutical industries in their deliberations. The threat, stripped of rumour and persistently incorrect and emotive press items on the issue, remains low where chemical weapons are concerned and would not in any event constitute a "mass" killing scenario. There is, however, a growing risk on the biological

front. Police, ambulance - first-call response teams - local, regional and national authorities have a hard task still ahead of them. The upside is that industrialized nations have acknowledged the need to reassess where we are and what the risk is. The bottom line has to be "who is likely to want to resort to such methods and what the likelihood of them succeeding would be". It is hoped that the indications given today will have helped in an understanding of the assessment.

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Several points have been taken from two excellent studies on risk factors. These are "Toxic Terror" - Assessing Terrorist Use of Chemical and Biological Weapons, edited by Jonathan Tucker, ISBN 0-262-70071-9 and "Hype or Reality?" The New Terrorism and Mass Casualty Attacks, edited by Brad Roberts, published by the CB Arms Control Institute, Alexandia, Virginia, 2000. Other readings recommended include: "Measures for controlling the threat from biological weapons" published by The Royal Society (UK), July 2000 and "Contagion and Conflict - Health as a Global Security Challenge" - a Report of the CB Arms Control Institute, published by CSIS, January 2000.

79. NEW ADVANCED OXIDATION TECHNOLOGIES FOR DESTRUCTION OF POLLUTANTS IN WATER

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ABSTRACT

The use of the set of advanced oxidation technologies (plasma, bio- and photochemical) for the purification and desinfaction of the heavy contaminated water is proposed. The plasma and photochemical techniques are used for the destruction of complicated organic molecules such as phenols and cation-active surfactants (cetylpiridinium bromides) as well as for the inactivation of pathogenic microorganisms such as Pseodomonas fluorescens, Bacillus cereus B 4388 and Escherichia coli. The gram-negative bacteria and gram-positive spore cultures are used for the biological desinfection of water from the secondary toxic substances after the plasmachemical treatment. The pulse UV treatment is applied for the inactivation of mutant microorganisms after the biotechnological treatment. The efficiency of a complex approach to the wastewater treatment is demonstrated.

INTRODUCTION

The advanced oxidizing technologies (AOT's) are necessary for using, if pollutant is toxic substance. Destruction of high active and toxic substances (HATS) in AOT's occurs under action of advanced oxidizing processes (AOP's). Basic AOT's are radiochemical, plasmachemical, ozonization, and photochemical technologies. Apparently, radiochemical and plasmachemical technologies are represented by most perspective, as allow to achieve the greatest speeds destruction of substances at the expense of high energy concentration.

However, it is necessary to take into account, that toxic substances are, frequently, the complex high-molecular compounds. Therefore destruction of HATS results in occurrence not only products of disintegration, but also wide spectrum more complex high molecular of compounds /1,2/. The chemical reactions both in radiochemical and in plasmachemical systems can proceed with participation of the electronic-exited particles, which practically are not investigated today. It is specified that by high probability of occurrence unknown before substances at the data AOP's. Therefore now the transition to complex technologies on a basis AOP's begin. The opportunities of plasma-bio technology were considered at water clearing from chlorophenols in work /1/ and was shown, that the transition to complex technology of water clearing results to synergism.

However, the destruction of toxic components by microorganisms can result in occurrence the mutants. It means, that after biochemical destruction of high active products of preliminary plasma water clearing from initial toxic pollution it is necessary to provide inactivation of microorganisms in water. The given work is devoted to development of similar multistage technology on base AOP's (plasma-bio-photochemical).

EXPERIMENTS

The base scheme of the proposed technology includes the plasma module for the preliminary treatment of initial wastewater, the biochemical modules (biodestruction, biosorption and biosedimentation) and the modules for photochemical or plasma inactivation of microorganisms in water. The sources of plasma in experimental plasma modules of preliminary HATS destruction were the secondary discharge with a liquid electrode /3/ and the barrier discharge (Fig. 1). The barrier discharge glowed between two quartz cylinders - 1, which divided metal electrodes - 2. water - 3 flowed between quartz cylinders.

RESULTS AND DISCUSSIONS

1. The surfactant and phenol destruction in water solutions by plasma treatment

The surfactants are the dangerous and widespread contaminations in the environmental. Their stable molecules are not distracted upon the natural factors influence. It is important to explore the new methods of the surfactant breaking and neutralization. The plasma influence on the molecular structure of the surfactants in water solution was studied.

The alcylpiridinium salts (pentadecyl piridinium bromide, cetyl piridinium bromide, tetradecyl piridinium bromide) and quaternary ammonium salts (tetradecyl three ethyl ammonium bromide, cetyl threemethyl ammonium bromide) have used as cationic surfactant models in the present work. The reference solutions with 10^{-3} M concentration were prepared by distillate water solution of the purity crystal matters. Other solutions were prepared by water diluting. The sensitive and selective sorption-photometric method has been using for surfactant detection in solutions after plasma treatment. This method permits to determine less than 1 μg/l cationic surfactants for all types of it.

The power of barrier discharge system is 10 W during all experiments, but the speed of treatment. The destruction rate of the surfactant molecules as function of plasma treatment time is submitted in Table 1. The all solutions before treatment: 200 μg cationic surfactant was added in the 60 ml of water.

Phenol destruction in water solutions was investigated in a range of concentration 10^{-6} - 2 10^{-3} M with use the spectrophotometer analysis in UF area of a spectrum (200 - 500 nm). The typical absorption spectra of water solutions of phenol measured during 10 mines after their processing by barrier discharge plasma are given in a fig. 2 (curves 2 - 4) at initial concentration: 2 - 2 10^{-3} M, 3 -5 10^{-4} M, 4 - 2 10^{-6} M, curve 1 - spectrum of the raw solution 2 10^{-3}.

Was noticed that the phenol solutions begin to darken after plasma processing. Therefore absorption spectra of solutions investigated after end of plasma processing within several day. Some of these spectra are given in a fig. 3 for a solution with initial concentration 2 10^{-3} M - curve 2 (spectrum is measured at once after processing), 3 - in day after plasma processing, 4 - two day, 5 - three day (1 - raw solution 2 10^{-3} M). Pays on itself attention, that the absorption spectra for the solutions processed by secondary and barrier discharges plasma and measured at once after processing are very similar. There is also wide band in long of wave area at these spectra except for a phenol band with a maximum on 275 nm.

The absorption spectra of the processed solutions very strongly change within the first day that is connected to course with oxidation and polymerization processes after the discontinuance of plasma processing.

2. Photochemical and plasma

The cultures of Bacillus cereus B4368 and Pseudomonas fluorescens B894 were used as test cultures for study of opportunities of the developed photochemical section on

inactivation of micro-organisms. The influence of suspensions UV - processing on survival of cultures was investigated. D_{540} of initial suspensions was 0.07 in dB.

The survival degree - N after UV - radiation processing of bacteria suspensions estimated by sowing of control and photochemical processed tests on rich agared environment. The Luria-Bestani environments (LB, Scotland) were used. The influence of specificity of each of cultures on them survival at photochemical processing is not revealed. It is doubtless advantage of the developed UV-module of microorganisms inactivation at last stages of complex treatment of water.

Escherichia coli was used as test culture at study of decontamination action of plasma processing. The plasma processing was carried out in the experimental module with the secondary discharge with a liquid electrode at low pressure ~ 10 torr /3/.

As have shown researches the degassing of a solution as a result of an exposition it at the lowered pressure (10 - 30 torr), the burning of the auxiliary independent discharge above a surface of a solution did not influence on vital functions of Escherichia coli culture. The essential influence of thickness of a solution above an electrode shipped in a solution was not noticed also on vital functions of Escherichia coli culture. Last is connected to effective mixing of a solution at gas bubbling that to evolve on shipped in a solution electrode.
Some results on plasma decontamination are given in the table 2, where U_d - secondary discharge voltage, Id - secondary discharge current, P - gas pressure in system, H - height of solution pole above the shipped in a solution electrode, t - exposition time of a solution, N - share of inactivation micro-organisms.

The complete inactivation can occur at low enough power inputs ~ 6 kW hour $м^{-3}$, as follows from experimental results of plasma inactivation with use of the secondary discharge at low pressure with a liquid electrode in optimum modes: at negative polarity of a liquid electrode.

3. Growth of cultures in water after plasma treatment

Cultures cultivated within 18 hours on nutritious environment № 284 containing 5 g/l gluconate. Then these cultures accommodated in distillate water past plasma processing and investigated intensity of their growth. The various secondary discharges of low and high pressure with a liquid electrode used at plasma treatment. The spore culture of Bacillus cereus B4368 and the Gram-negative culture Pseudomonas fluorescens B5040 were used as test cultures.

The results of experiments have shown: Gram-negative culture more intensively cultivates in water after low-pressure plasma treatment, spore culture - after plasma treatment of atmospheric pressure.

4. UV-radiation influence on the surfactants in water solutions

The UV-radiation influence on the surfactant molecules in water was explored with using the impulse UV-radiation system. It was detected that the impulse UV-radiation breaks down the cationic surfactant molecules and the destruction rate is a function of the treatment time and the initial concentration of surfactant solutions before treatment. UV-radiation influences equally on any type of the cationic surfactants. The surfactant solutions (V=500 ml) are on the rest state during the treatment by UV-impulses. If the initial solution has 10^{-3}M concentration of cationic surfactant the all molecules of this matter are distracted after treatment during10 minutes. They lose the ability for ion associating with sulfophthtalein reagent and for adsorption on the silica gel surface. But the radical fragments of surfactant molecules are complexing with the reagent and detecting by spectrometry. The radical concentration dilutes the maximum after treatment during 20 min. The destruction rate of the surfactant molecules as function of the initial surfactant concentration before UV-radiation treatment is submitted in Table 3 (V=500 ml, treatment time is 20 min).

CONCLUSIONS

The results of our investigation indicate the efficiency of plasma destruction of phenol and surfactants, inactivation of micro-organisms at plasma and pulse photochemical treatment of water and allow to make a choice of cultures for designing of biodestructeres of products of preliminary plasma treatment in complex plasma - bio - photochemical technology of waste water treatment.

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KEYWORDS

Pollution, water, purification, desinfection, plasma, UV radiation, bio-technology

FIGURES AND TABLES

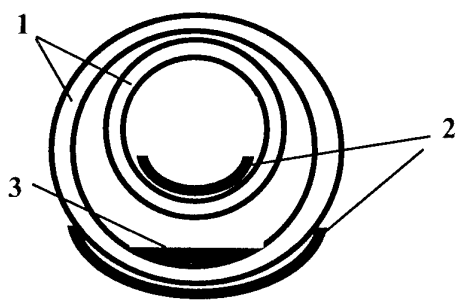

Fig. 1. Cross-section of an interelectrode interval of the barrier discharge.

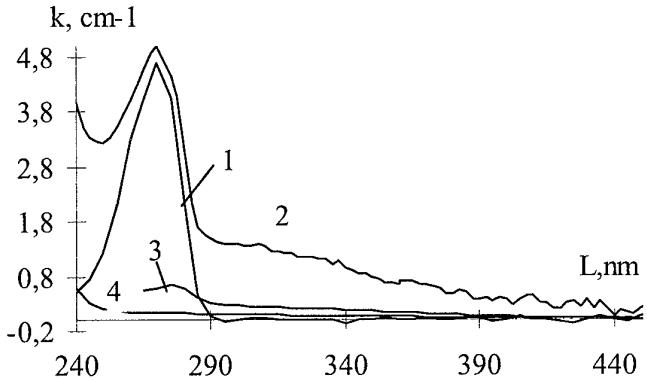

Fig. 2. The absorption spectra of water solutions of phenol measured during 10 mines after their processing by barrier discharge plasma at initial concentration: 2 - 2 10^{-3} M, 3 -5 10^{-4} M, 4 - 2 10^{-6} M, curve 1 - spectrum of the raw solution 2 10^{-3}.

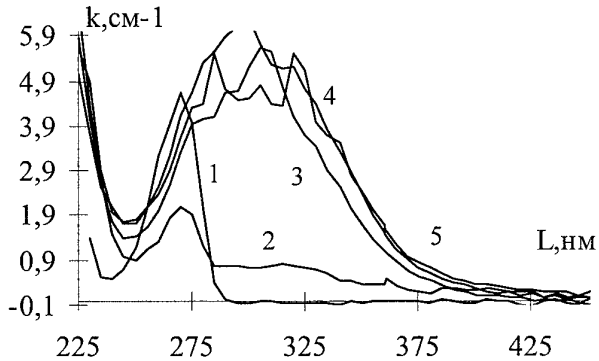

Fig. 3. The absorption spectra of solutions with initial concentration 2 10^{-3} M - curve 2 spectrum is measured at once after processing, 3 - in day after plasma processing, 4 - two day, 5 - three day (1 - raw solution 2 10^{-3} M).

Find after plasma reatment, m	Stream speed, ml/min	Time treatment, min	Destruction rate, %
200	0,87	0	0
90	5,00	12	55
40	2,40	25	80
20	1,80	32	90
0	0,87	70	100

Table 1. The destruction rate of the surfactant molecules as function of plasma treatment time.

№	Ud, V	Id, mA	P, torr	H, mm	t, s	N, %
1	400	100	10,8	10	300	99,99
2	400	100	10,8	19	300	99,99
3	400	100	10,8	25	300	99,99
4	-400	100	10,8	10	300	100,00
5	-550	100	14,4	19	5	100,00
6	-550	100	14,4	19	300	100,00
7	-700	100	14,4	25	300	100,00

Table 2. Results on plasma decontamination.

Add surfactant, mkg	Find, mkg	Distract, mkg
183	0	183
910	800	110
1830	1750	80

Table 3. The destruction rate of the surfactant molecules as function of the initial surfactant concentration before UV-radiation treatment (V=500 ml, treatment time is 20).

80. HOW TO ACHIEVE BETTER PROTECTION FROM CHEMICAL TERRORISM EFFECTS BY PREVENTIVE ACTIONS

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Losso Ivica was presented this paper

INTRODUCTION

Next to progress and development, chemical industry also brings about the burden of constant risks for human lives and material assets in its surroundings. Although accidents are not uncommon in time of peace, they are several times more probable to occur in times of wars, particularly as a result of air or missiles attacks on chemical facilities. Petrokemija d.d. Kutina is one of the chemical companies with such technology, conditions and media that could be extremely dangerous in case of uncontrolled release, due to the prevailing high temperatures, pressures and toxicity. During the Homeland War against the great-Serbia aggression on Croatia (1991 – 1995), the company was several times exposed to missile and air attacks with substantial material damage, but fortunately without human losses. Among other things, it is also the result of adequate preparations and implementation of preventive measures, tasks and procedures for such emergency situations among the company employees as well as among local residents. The purpose and the objective of this paper is to share the experience in organization and implementation of preventive activities, essential in reducing the consequences of war actions.

EDUCATION

Training of employees and local residents on implementation of the protection and rescuing measures in cases of uncontrolled release of hazardous materials into the environment, caused by war actions, terrorism or technological accidents is the best way of protection. That is why it is essential for local authorities to implement a system of continuous education and training of residents in the vicinity of such large industrial facilities, producing or processing hazardous materials.

The education and training of the Petrokemija d.d. employees is an integral part of the sophisticated protection and rescue system and is carried out continuously the whole year round.

Since the existing technological processes take place at high temperature and pressure, the released hazardous material would spread at very high speed. That is why special attention is devoted to education and training of employees and local residents in implementing protection and rescue measures for cases of air-borne hazardous materials.
The education of local residents should include the following:

- properties of hazardous materials
- impact of hazardous materials on people and environment
- characteristic reactions of people to certain concentrations and possible consequences
- protection measures by zones of distance from accident source
    - remaining in closed spaces
    - use of shelters
    - evacuation
- protection means
    - for protection forces (gas masks)
    - at hand (wet cloth)

- first aid

forms of education
- lectures
- brochures
- information leaflets
- local radio and TV
- special audio and video recordings for schools and kindergartens

education of employees according to jobs:
- at plants (accident source)
- at plants technologically directly connected with accident source plant
- at other plants
- administrative staff

education of professional protection and rescue forces
- technical facilities and equipment for bringing down poisonous clouds
- tactics of bringing down poisonous clouds
- protection equipment for work in high-concentration conditions
- tactics of rescue forces operation in high-concentration conditions
- procedures for means of transportation
- first aid
- at outskirts of the affected zone
- in health centers in closer and wider surroundings, technically and professionally trained for this kind of danger
- ways of removing hazardous materials from people and land (decontamination)

PROVIDING WITH EQUIPMENT AND TRAINING

Equipping and training of protection and rescue forces in modeling conditions of possible events caused by war actions, terrorism or chemical accidents is an important factor in the protection and rescue system.

The protection and rescue system of Petrokemija d.d. Kutina implies interaction between process staff and protection and rescue forces (firemen, security staff and other).

Operational protection and rescue plans are tested during the year in exercises carried out by process staff, firemen and security staff organized by modeling real-life situations. The protection and rescue forces (firemen and security staff) must be trained well in order to act quickly and efficiently to prevent spreading of danger and to limit it in the least possible space.

The management and the relevant departments of the company should take constant care of providing process plants with reliable equipment and measuring instruments and equipping the staff with safe and good-quality personal protection equipment, as follows:
- intervening process staff should be equipped with protective clothing breathing apparatus
- other staff should receive gas masks
- instruments for detection of hazardous materials
- water hydrant net of appropriate capacity, in accordance with the possible extent of danger
- means for neutralization at locations determined beforehand
- communication systems

Equipping professional firemen with:

- protective clothing and breathing apparatus
- equipment for bringing down poisonous cloud
- means for pouring hazardous liquids and prevention of spreading spills
- multi-purpose foams
- special vehicles for operation in high concentrations of hazardous materials

TECHNICAL DEVICES AND EQUIPMENT

The upgrading of technical devices and equipment makes possible safer and better protection of employees and local residents through:

- installing the system for alarming employees and local residents in direction of danger (by telephone and speaking sirens)
- providing shelters with appropriate filters and additional air reserves for longer stay
- installing monitoring system (stationary and mobile) for monitoring and measuring the concentrations of hazardous materials in air and water
- installing automatic systems for bringing down and prevention of spreading hazardous materials
- possibility of communicating of protection and rescue forces in protective clothing and breathing apparatus
- development of good-quality foams for covering the spill and preventing its evaporation
- good quality doors and windows that due to lower air exchange in housing space makes it air air-tight.

REAL-TIME PREDICTING

The development of software for real-time predicting of events in the present area enables:

- estimation of approaching speed of danger taking into consideration the configuration of the surroundings (plants, buildings, hills, etc.)
- estimation of range of danger in depth and width in direction of its movement and the height of hazardous material concentration at different distances from the source.
- timely and good decisions in undertaking protection and rescue measures (whether to stay in air-tight space or evacuate in defined directions)
- knowledge of existing facilities for technical protection and protection and rescue forces in preventing of spreading the danger into the surroundings and their optimum number
- practical training of process staff, protection and rescue forces for every possible real situation

RELEASE OF SO_2

Scenario:
Chem. substance: SO_2
Aggregate state: gas
Kind of release: continuous
Amount of release: 2700 kg/min
Duration: 30 min

METEOROLOGY

TIME:
AIR TEMPERATURE:
WIND SPEED:
WIND DIRECTION:
STABILITY CATEGORY:
SUN RADIATION:
HUMIDITY:

81. DESCRIPTION OF THE U.S. NATIONAL PHARMACEUTICAL STOCKPILE PROGRAM

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ABSTRACT

A release of selected biological or chemical agents targeting the U.S. civilian population will require rapid access to large quantities of pharmaceuticals and medical supplies. Few U.S. state or local governments have the resources to create sufficient pharmaceutical stockpiles on their own. The Centers for Disease Control and Prevention, under U.S. Congressional mandate, has developed and implemented a National Pharmaceutical Stockpile (NPS) to address this need. The NPS Program is a key component of the Nation's plan to mitigate health consequences of biological and/or chemical terrorism. CDC's NPS Program is organized into a two-phased approach that includes pre-positioned caches of pharmaceuticals and medical materiel standing ready for immediate deployment to a terrorism incident—with plans in place assuring delivery within 12 hours of a decision to deploy. Each NPS cache contains enough pharmaceuticals and medical supplies for the treatment and prophylaxis of hundreds of thousands of persons for agents such as anthrax, plague, and tularemia for several days. If the incident requires additional pharmaceuticals and/or medical supplies, the second phase of the Program will be implemented, and large quantities of follow-on supplies will be shipped within 24 to 36 hours to support the emergency response efforts at the incident site.

INTRODUCTION

A release of selected biological or chemical agents targeting the U. S. civilian population will require rapid access to large quantities of pharmaceuticals and medical supplies. Such quantities may not be readily available unless special stockpiles are created. No one can anticipate exactly where a terrorist will strike and few state or local governments have the resources to create sufficient stockpiles on their own.

As part of the Department of Health and Human Services 1999 Bioterrorism Initiative, CDC was designated to lead an effort working with governmental and non-governmental partners to upgrade the nations' public health capacity to respond to biological and chemical terrorism and establish a Bioterrorism Preparedness and Response Program. Criticalto success of this initiative is to ensure that capacity is developed at U.S. federal, state, and local levels.

The National Pharmaceutical Stockpile (NPS) is a national repository of pharmaceuticals, antidotes to chemical poisons, supplies for administering drugs, and emergency medical equipment for rapid deployment to the site of a biological or chemical terrorism. The NPS Program is designed to supplement and re-supply state and local public health agencies in the event of a biological or chemical terrorism incident anywhere, at anytime within the U.S. or its territories.

APPROACH

The NPS is segregated into several packages. First, there are several immediate response Push Packages that are caches of pharmaceuticals, antidotes, and medical supplies designed to address a variety of biologic or chemical agents. These Push Packages are positioned in secure regional warehouses ready for immediate deployment to an airfield close to the affected area within 12 hours of the federal decision to release the assets.

If the incident requires additional pharmaceuticals and/or medical supplies, follow-on vendor managed inventory supplies known as VMI Packages will be shipped to arrive within 24 to 36-hours. The follow-on VMI packages can be tailored to provide pharmaceuticals, equipment, supplies and/or products specific to the suspected or confirmed agent or combination of agents.

DETERMINING AND MAINTAINING NPS ASSETS

The Centers for Disease Control and Prevention (CDC) partnered with U.S. intelligence experts who evaluate chemical and biological terrorism to ensure that the NPS formulary reflects current, potential biological, and/or chemical threats to the U.S.— as determined through national security analyses. CDC and its U.S. federal partners use this information to prioritize the potential biological and chemical agents and to determine NPS contents. NPS assets are stored at strategic locations throughout the U.S. to assure the most rapid response possible. CDC ensures that all medical materiel will be rotated and kept within potency shelf life limits.

RAPID COORDINATION & TRANSPORT

CDC commits to have the first NPS Push Package delivered anywhere in the continental U.S. within 12 hours of a Federal decision to deploy. CDC also plans to reach sites beyond the continental U.S. in 12 hours (delivery may take longer in some circumstances). The Push Packages are configured to facilitate immediate loading onto trucks or cargo aircraft-- to ensure the most rapid transportation. Concurrent to NPS transport, CDC will be coordinating with state and/or local officials so that the NPS can be efficiently received and distributed upon its arrival at the site.

WHEN AND HOW IS THE NPS DEPLOYED?

The decision to deploy NPS assets may be based on evidence showing the overt release of an agent or credible intelligence information. It is more likely, however, that subtle indicators, such as unusual morbidity and/or mortality identified through the Nation's disease outbreak surveillance and epidemiology network, will alert health officials to the possibility (and confirmation) of a biological or chemical terrorism incident. To receive NPS assets, the affected state can directly request the deployment of the NPS from the Director of CDC. Once requested, the Director of CDC has the authority, in consultation with the Surgeon General, the Secretary of Health and Human Services, the Federal Emergency Management Agency (FEMA) and the Federal Bureau of Investigation (FBI), to order the deployment of the NPS.

TRANSFER OF NPS ASSETS TO STATE AND/OR LOCAL AUTHORITIES

In a biological or chemical terrorism event, state, local, and private stocks of medical materiel will deplete quickly. The NPS Program can support local first response efforts with a Push Package followed by quantities of materiel specific to the terrorist agent used (VMI). The NPS is not a first response tool— state and local first responders and health officials can

use the NPS to bolster their response to a biological or chemical terrorism attack— thereby increasing their capacity to more rapidly mitigate the results of this type of terrorism.

CDC will transfer NPS materiel to the state and/or local authorities once it arrives at the airfield. State and/or local authorities will then repackage and label bulk medicines and other NPS materiel according to their state terrorism contingency plan. CDC's technical advisors will accompany the NPS in order to assist and advise state/local officials in putting the NPS assets to prompt, effective use.

TRAINING AND EDUCATION

The NPS Program is charged with leading a nationwide preparedness training and education program for state and local health care providers, first responders, and governments (to include Federal officials, Governors' offices, state/local health departments, and emergency management agencies). This training not only explains the NPS mission and operations, it alerts state and local emergency response officials to the important issues they must plan for in order to receive, secure, and distribute NPS assets.

KEY WORDS

Pharmaceuticals, medical supplies, stockpile, emergency response, repository, national asset

82. THE U.S. NATIONAL PHARMACEUTICAL STOCKPILE PROGRAM: "BUYING IS THE EASY PART"

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INTRODUCTION

The Centers for Disease Control and Prevention's (CDC) National Pharmaceutical Stockpile (NPS) is a key component of the Nation's plan to mitigate health consequences of biological and/or chemical terrorism. U.S. intelligence authorities project an increased likelihood of an organized bioterrorism assault anywhere in the world. The NPS was initiated in response to a U.S. public policy decision to defend and potentially deter such an attack on U.S. civilians via minimization of resultant death and disease, and to help reduce the burden upon health-care infrastructure and limited assets. The mission of the NPS Program is to help save lives by promptly bringing needed medical materiel to the scene of a bioterrorism event.

The NPS Program is responsible for managing the two major components of the NPS: 12-hour Push Packages and Vendor Managed Inventory (VMI). Program responsibilities include:

- materiel management
- quality assurance/control
- security
- training and education
- technical assistance
- transportation to any designated U.S. location

Since the Program's inception in January 1999, CDC has made significant headway into developing innovative approaches and solutions to difficult challenges associated with the acquisition, storage, stock rotation, transportation, and security of Program assets. With the help of its Federal and commercial partners, CDC successfully tackles obstacles that range from the "easy part," which is the actual purchase of pharmaceuticals and medical supplies, to more difficult hurdles, such as; storage concerns (i.e., physical location, environmental conditions, and security); stock rotation quandaries (e.g., switching out fresh stock for aging stock and the ability to rotate all stock while maintaining adequate inventory levels); transportation dilemmas; and the most challenging component, "timeliness," (i.e., timeliness of transport, timeliness of rotation, and the time between storage site and transport site. To date, CDC has developed a state-of-the-art rotation and storage plan; transportation agreements with U.S.-based major air freight transport firms and the U.S. Department of Defense; and implemented a quality assurance/evaluation model, to assure the quality of materials sent to the field and the quality of mechanisms to get it to the scene of a biological and/or chemical terrorism event.

The primary purpose of this paper is to pose questions concerning issues surrounding the purchase, maintenance, delivery and distribution of a pharmaceutical stockpile for intervention in the event of a catastrophe involving chemical or biologic agents. There are many obstacles to overcome: the CDC, in its efforts to develop the U.S. National

Pharmaceutical Stockpile, has a unique story to tell in the evolution and maintenance of such a stockpile. The CDC story yields many lessons-learned and suggestions. By posing such questions in this paper (and accompanying workshop), the CDC hopes to frame a "checklist" for others (government and industry) who are involved in a similar effort-the establishment of either government or privately owned pharmaceutical stockpiles.

PURCHASING

In order to facilitate the procurement and maintenance of the U.S. National Pharmaceutical Stockpile, it was necessary for CDC to establish an interagency agreement with other U.S. federal agencies, such as the Department of Veterans' Affairs (VA) and the U.S. Department of Defense. CDC, primarily a public health institution, had no mechanisms in place to facilitate the purchase of the thousands of tons of pharmaceuticals and medical supplies needed to establish a national stockpile able to serve the U.S. civilian population. The innovative partnership CDC established with the VA, for example, allowed CDC to take advantage of the VA's existing contract pricing arrangements with its prime vendors of pharmaceuticals, medical/surgical supplies, and other goods and services.

A "procurement powerhouse," the VA routinely purchases over $2.4 billion dollars of supplies and services annually. This partnership continually saves a vast amount of time, money and resources by allowing CDC to take advantage of existing contract pricing arrangements VA has in place with its prime vendors of pharmaceuticals, medical/surgical supplies, and other goods and services. This partnership allows CDC to purchase pharmaceuticals and medical supplies at costs lower than those CDC would have been able to negotiate had CDC worked alone. Still, there remains a multitude of considerations surrounding the topic of "purchasing." For example, when working with private pharmaceutical manufacturers, one needs to consider what each manufacturer can produce, manufacturer's costs and if there are incentives and/or partnerships that one can tap into (for example, existing partnerships between other government agencies and private organizations).

The entire questions related to the subjects of "what to buy?" and "how much?" require careful consideration and methodical "behind the scenes" effort in order to determine the answers. The answers are tied into estimating the requirements, the numbers of potentially exposed and the numbers requiring treatment. In addition, special populations must be considered-- to include children, immune compromised patients, frail elderly and institutionalized persons, migrant populations, etc.

Currently, a single 12-hour Push Package within CDC's stockpile has the capacity to provide post-exposure prophylaxis to many thousands of persons. The number varies with such factors as the threat agent, the condition of patients who need specific care, the antibiotic, or antibiotics, to be used, the proportional dose(s) of antibiotic(s) that will be dispensed, and the treatment time interval. NPS antibiotic proportions are based on assumptions about the most likely weaponized biological threat agents, taken from expert advice and available literature on the subject. CDC's purchasing decisions were made assuming the largest proportion of persons exposed to any biological threat agent would require oral medication for post-exposure prophylaxis. In addition, CDC calls for follow-on inventory to supplement a 12-hour Push Package with specified medical materiel in several orders of magnitude greater than the all eight NPS initial response packages.

OVERSIGHT AND MAINTENANCE

There are many questions associated with the oversight and maintenance of a pharmaceutical stockpile. The challenges associated with storage, quality assurance, quality

control, inspections, and inventory management are boundless—encompassed by the overall questions, "Who is responsible?" and "Who does what and when?" Under these are many layers of complex questions, for example, when product reaches its shelf-life end-date, "What do you do with it?"

The systems CDC uses to manage the inventory in the NPS were developed through months of trial and error and intense "brain storming" sessions. The inventory management system, for example, is very detailed. It captures: item description, unit of measure, total Push Package amounts, individual Push Package amounts, quantity-on-hand, quantity-on-order, difference between on-hand and on-order, rotation months left on item, estimated cost/unit, overhead costs, current push package expenditures, total push package cost, individual push package cost, source, ID number, cubic feet/unit, cubic feet/total push packages, cubic feet/individual push package, unit weight, weight of total push packages, weight of individual push package, and readiness status. The process of developing and managing such a system is laden with difficulties that can only be overcome with a systematic process.

To address stock rotation issues, the CDC's NPS Program adopted a unique, state-of-the-art rotation and storage system that will ensure that NPS assets remain "fresh" without using the traditional "buy and dispose" rotation methods used in the management of other pharmaceutical stockpiles. Through this system, CDC will be able to exchange most of the nearly expired pharmaceuticals within the push packages for "fresh" inventory. The NPS Program's storage and rotation contractor will then sell the nearly expired inventory to their customer base—to those customers who have immediate need. This system solves the problematic issues associated with a fixed budget and a need to keep fresh inventory. The system is expected to save millions of dollars.

CDC relied on extensive transportation and logistical research performed by major worldwide transportation carriers, the U.S. Department of Defense and consultants to determine permanent Push Package storage sites. Sites were chosen to enhance and provide maximal response timeliness and coverage. Comparative elements of this research included: air hub aircraft availability, traffic volume, air courier staff availability, population densities, regional weather characteristics, and U.S. Department of Defense assets and their availability, etc. Because of this research, CDC's NPS Program teamed with the public, federal and private airfreight carriers so that timeliness is ensured.

LOGISTICAL CONSIDERATIONS, TRANSPORT AND DELIVERY

"How is a stockpile delivered?" "What will it look like when its delivered?", "Who knows what products are located where?", "Why are things packaged the way they are?", "What is the loading plan?", "What are the timeframes for delivery?", and "How should we unload the cargo once it arrives?"

The logistical issues associated with the delivery of a stockpile are numerous and confounding. The decisions that the CDC made concerning its stockpile were made after months of inventive logistical thinking and solicitation of expert advise. CDC remains open to exploring better and more efficient methods for transport and delivery— to ensure life-saving redundancies are built into the Program. To date, the NPS Program is organized around a two-tiered response: 12-hour Push Packages and Vendor Managed Inventory. The 12-hour Push Packages consist of identical assemblages of medical materiel. They are pre-positioned at strategic locations nationwide, which facilitate transport by air or ground. They can reach any city in the continental United States, Alaska, Hawaii, and most United States Territories within 12 hours of the notification to deploy.

CDC established tentative agreements with the U.S. Department of Defense and private air cargo transporters to meet the transport needs of the NPS Program. CDC chose

these partners and the U.S. Department of Defense to build in redundancies in air transport capability: when one option fails, another is available. CDC also chose to go with more than one partner to reduce or eliminate shortcomings with any one partners' capabilities. In addition, all partners have agreements in place with several subsidiary companies--agreements that give the transporters access to several hundred additional cargo aircraft. Finally, all partners offer CDC a wide assortment of ground transportation capabilities that can move the 12-hour Push Packages on those occasions when air cargo is infeasible or impractical. All of this puts CDC's ultimate goal within reach—which is to reduce the time it takes to prepare and transport any or all of the 12-hour Push Packages to the scene of a biological and/or chemical terrorism event.

As the first response, a 12-hour Push Package may be deployed amidst uncertainty about what threat agent has been used, and whether more than one has been released. The NPS cannot be an affected area's first response to a chemical and/or biological terrorism event; however, a 12-hour Push Package can thereafter serve as the potential lifeline in responding to any of several biological, chemical or conventional weapons.

To meet this broad challenge, a single 12-hour Push Package contains more than 90 product categories which include adult and pediatric oral drug preparations; intravenous drug preparations; chemical antidote preparations; different emergency medications; several thousand cases of various sized IV catheters and administration sets; items to help establish and maintain patient airways; fluid for re-hydration; bandaging, and trauma supplies. This all translates into important facts about the size and scope of the NPS that have planning implications. These facts are that:

- One 12-hour Push Package will arrive in over 100 specially designed cargo containers.
- These containers transport more than 10,000 cubic feet of materiel.
- One 12-hour Push Package weighs 100,000 pounds (50 tons), filling a wide body cargo aircraft, such as a Boeing 747 or 767.
- One 12-hour Push Package carried by ground will fill four 48-foot semi tractor-trailers.

DISTRIBUTION

When the NPS Program evaluated available options for manufacturer packaging of oral antibiotics, consideration was given to the questions, "Why not unit or single patient dosing instead of bulk product?" and "How will bulk product be broken down in a crisis situation?"

The CDC put much thought into these questions and in the "unit-dose" system, commonly used in the hospital setting. These individually wrapped tablets (i.e., "blister packs") provide immediate dispensing capability without the need to repackage. Each NPS 12-hour Push Package does contain a quantity of "blister packs" of the oral drugs for selected biological agents— in order to meet the immediate needs for post-exposure prophylaxis of the first responder community and their immediate family members, or as a means to get an immediate dose to persons in the affected area. However, most of the NPS comes in bulk packaging rather than in unit doses. CDC found that putting the entire NPS into unit doses was cost (and coverage) prohibitive. The cost of procuring that type of packaging was higher than the bulk bottle form, and that would limit the extent and speed with which the NPS Program initially could prepare for bioterrorism events involving thousands to millions of persons. Second, as this packaging form is limited to hospital (non-retail) settings, it provides limited stock rotation capability, forcing CDC into the costly option of destroying/ replacing expired stock. That would limit CDC's ability (in future years) to expand the number of

persons able to receive post-exposure prophylaxis in a bioterrorism event. Finally, consideration was given to purchasing bulk form and repackaging in advance, before any request for NPS activation. FDA regulation requires repackaged bulk tablets be given an expiration date 6 months from the date of repackaging. This greatly cuts the average product shelf-life of 2 years. CDC viewed these disadvantages and decided to keep tablets in their manufacturer bulk bottles.

This brings us to more questions. "How are points of distribution established?" "What are the criteria used to establish of point of distribution?" "What do health care providers need to know and how can private corporations help?", "What do you tell the victims?" , and "How do you inform or educate the patients to ensure or enhance compliance in taking medications and overall understanding?" Many of these questions are still undergoing development at CDC. CDC's first priority was to purchase and "stockpile" the materiel – that accomplished, we are working on addressing these questions that will prompt further planning crucial to the successful distribution of NPS materiel in the event of a crisis.

KEY WORDS
Pharmaceuticals, medical supplies, stockpile, emergency response, repository, national asset

83. THE IMPROVED RESPONSE PROGRAM

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INTRODUCTION

In March 1995, the Aum Shinrikyo cult attacked the Tokyo, Japan, subway system with sarin nerve agent. The incident captured international attention and sensitized world leaders to the threat of terrorist use of weapons of mass destruction (WMD). Recognizing this increasing threat, the Congress of the United States passed the National Defense Authorization Act for Fiscal Year 1997, which provided for preparedness training against WMD for the United State's first responders. Because the Department of Defense (DoD) is experienced in defending against chemical and biological agents, Section 1415 of Title XIV stated, "The Secretary of Defense shall develop and carry out a program for testing and improving the responses of federal, state, and local agencies to emergencies involving biological weapons and related materials and emergencies involving chemical weapons and related materials." As a result of this legislation, the U.S. Army Soldier and Biological Chemical Command (SBCCOM) developed an improved response program (IRP).

The IRP is an analytical program designed to identify and demonstrate the best practical approaches to improve the overall preparedness of the United States to respond to domestic acts of terrorism involving C (chemical) B (biological) or CB-related materials. This article describes the IRP's mission, major products, and future.

IRP MISSION

The U.S. military has unique national resources in CB defense technologies. The IRP uses resources to enhance the overall preparedness of civilian emergency responders and managers to respond to and mitigate the consequences of a domestic CB terrorist event. As such, the IRP maintains a partnership between military CB experts and civilian responders and emergency managers. Civilian participants represent functional specialties including emergency management, law enforcement, firefighting, emergency medical services, hazardous-materials management, and public health.

Through this diverse team, the IRP identified, prioritized, and developed solutions to the most pressing response issues associated with domestic CB terrorism. By engaging civilian emergency managers and responders from the program's inception, the IRP has retained an analytical focus bounded by the real-world needs of these civilian response professionals.

CHEMICAL AND BIOLOGICAL AGENTS, FUNCTIONAL DICHOTOMIES

According to the Centers for Disease Control and Prevention, a significant difference between C and B events is the way medical consequences will unfold over time. The medical casualties of chemical terrorism would usually be "immediate and obvious."[1] Alternatively, biological terrorism "will not have an immediate impact because of the delay between exposure and onset of illness."[2] Because of these time differences in effects, chemical terrorism will usually have an identifiable incident scene while biological terrorism will not. The casualties of chemical terrorism will be readily observable, whereas the casualties of biological terrorism may not know that they are infected until days after initial exposure.

Because of these differences between the consequences of C and B terrorism, different disciplines of first responders will be engaged in managing the consequences of each kind of incident. Chemical terrorism will likely engage firefighters, law-enforcement personnel, and emergency medical services that converge at an incident scene. Biological terrorism will likely engage nurses, physicians, and other medical providers who treat patients at hospitals and clinics days after the initial event. Because of the differences B and C agents, the IRP focuses separately in these two areas.

BIOLOGICAL TERRORISM

CHARACTERISTICS OF DOMESTIC BIOTERRORISM

The overriding consequence of a large-scale, unannounced bioterrorist attack will be the anomalous occurrence of a large number of medical casualties.[3] Response systems must provide the appropriate types and amounts of medical treatments and services. However, the full spectrum of potential consequences is broader than medical casualties.

A well-conducted bioterrorist attack will strain the public-health medical-surveillance systems. It will require responders to make quick, accurate medical diagnoses and disease identifications. A bioterrorist event is a criminal act that requires a complex criminal investigation. Depending on the agent used in an attack, such an incident could result in residual environmental hazards that would require mitigation. A significant portion of a metropolitan area's population may have to be medically managed and physically controlled. The aforementioned medical-treatment, criminal-investigation, environmental-hazard-mitigation, and population-control activities will require a nationally coordinated and integrated command-and-control function.

DESIGNING THE BIOLOGICAL WEAPONS (BW) IRP TEAM

The above considerations influenced the makeup of the BW IRP team. Because the problems inherent in a bioterrorist attack are multifaceted, the final team consisted of more than 60 civilian response professionals, eight federal agencies, six Department of Energy national laboratories, and 11 DoD organizations. Having assembled a strong team, the SBCCOM began to define broad parameters of the overall process for the BW IRP. The process first had to provide a forum to educate the entire team on the offensive and defensive aspects of bioterrorism. Second, the process had to yield an initial set of integrated response activities to manage and mitigate the full spectrum of consequences that would emerge from a large-scale bioterrorist attack.

THE BW IRP PROCESS

The BW IRP process was designed around five 3-day technical workshops. Day one of each workshop consisted of a series of 1-hour tutorials on preselected topics such as the physics of aerosol dispersion, pathogenic microbiology of BW agents, biodetection, medical prevention and intervention, and decontamination of and physical protection against BW agents. Although the topics remained the same, the depth and complexity of the tutorials increased as the team progressed through each of the five workshops. Day two of each workshop began with the presentation of a selected BW terrorist-attack scenario. From Workshop 1 through Workshop 5, the respective terrorist-attack scenarios increased in scale from an attack on a single building to an attack on an entire metropolitan area. After reviewing each scenario, workshop participants identified a series of specific response activities designed to mitigate the emerging consequences of the given bioterrorist-attack scenario.

On day three of each workshop, the team reviewed and integrated the complete set of response activities. The team also analyzed the integrated activities to identify response shortfalls and possible response improvements. Throughout the reviews, the team took a "bottom-up" approach and *let the problem drive the solution.*

BW IRP PRODUCTS

The BW IRP team identified a myriad of response activities spanning multiple functional areas. To be useful and understandable, these activities needed to be organized into a logical and integrated response system. Thus, the team formulated a generic bioresponse template (see table 1) that embodied the concepts and work breakdown structure a city needed to respond to effectively in a bioterrorist event. This template serves as a useful starting point for cities to prepare their own local plans to respond to a bioterrorism.[4]

CHEMICAL TERRORISM

DESIGNING THE CHEMICAL WEAPONS (CW) IRP TEAM

The SBCCOM possesses world-class technical experts knowledgeable in defense against chemical warfare agents on military battlefields, but not necessarily in civilian environments. SBCCOM needed to involve civilian emergency responders to identify and solve many of the unique difficulties in civilian response to chemical terrorism. This involvement contributed to the ready acceptance of response guidance developed by the chemical weapons (CW) IRP and made the program a success across the national emergency-response community. The CW IRP is organized into four groups that address distinct functional areas in an emergency response. These groups are: law enforcement, public health and safety, emergency management, and emergency response. Each group conducts exercises that help identify the difficulties encountered in civilian response to chemical terrorism. Once identified, these difficulties are addressed using a think-tank approach involving the overall CW IRP.

THE CW IRP PROCESS

In developing solutions, the CW IRP relies on technical studies conducted by its chemical-defense experts. Solutions often involve novel applications of equipment and techniques that emergency responders already employ in other emergency situations. The CW IRP's unique combination of chemical-warfare-agent expertise and operational know-how in civilian emergency response enable it to develop improved response guidance and methods that are scientifically accurate and operationally practicable. To ensure that new response concepts are workable, they are operationally tested in functional exercises. Civilian responders have found that they can readily incorporate the CW IRP's response concepts into their own response plans.

ACCOMPLISHMENTS OF THE CW IRP

Improving civilian response to chemical terrorism requires addressing personal protection, decontamination, and medical treatment of chemical-agent victims. The CW IRP team has performed technical initiatives in each of these areas and has developed improved guidance and response methods. The SBCCOM does not dictate emergency-response requirements and procedures. The emergency-response community holds the authority to adopt or reject the CW IRP's improved response guidance and methods. To date, the guidance and methods have helped many jurisdictions develop emergency-response procedures that can maintain the safety of the emergency responders while minimizing the impact of chemical terrorism and maximizing the effectiveness of emergency-response

assets. For decontamination of chemical-agent victims, the CW IRP team examined previous research reports and studies on the removal of chemical agent from the skin and found that rinsing with large amounts of plain water is the best way that firefighters can most rapidly decontaminate chemical-agent victims. The CW IRP team has developed guidance on how firefighters can use their fire-fighting equipment to decontaminate large numbers of chemical-agent victims quickly.[5] Fire rescue personnel were recognized as likely to encounter chemical-agent vapors during early response to a chemical terrorism event, and it was initially not known whether or not brief vapor exposures would be highly lethal to firefighters using normal personal protective equipment (PPE), including a self-contained breathing apparatus. This uncertainty threatened a fundamental firefighter mission—saving lives by rapid reaction.

The CW IRP tested firefighter's PPE and determined how much protection the equipment offers. Using this information, the CW IRP team demonstrated that firefighters could arrive on scene and proceed with reconnaissance and rescue, with known and minimal risk of any significant chemical-agent effects.[6] The CW IRP team showed how firefighters can use positive-pressure ventilation fans to further reduce the risk associated with rescue in an enclosed space containing chemical-agent vapors.[7] Firefighters often use positive-pressure ventilation fans to remove dangerous gases from buildings. The CW IRP team demonstrated that these techniques and procedures apply equally well to chemical-agent contamination.

ON-GOING IRP INITIATIVES

The IRP team is continuing its efforts to develop improved response capabilities. For biological events, the IRP is to validating and improving the BW response template through tests and exercises. The BW IRP team analyzed the overall structure of the bw response template to identify the key decisions that public officials will have to make to respond effectively to a biological threat.[8] The response template was evaluated as a total, integrated response system in three national regions. The regions were of varying populations and geographically dispersed. These evaluations provided feedback on the general applicability of the template and validated how it could be adapted to various localities in different regions and with different population bases. In addition, the bw team is identifying useful "triggers" or "flags" that could guide decision makers in determining if a covert biological attack has occurred.

The BW IRP team is also working to develop biodecontamination techniques, subway biosurveillance technologies, emergency response management software, and biocasualty projection methods to assist civilian emergency managers in assessing the consequences of a bioterrorist attack. Last, the combined BW and CW teams are developing chemical and biological protection measures for buildings.

The CW IRP team is currently working with the law enforcement tactical teams to perform PPE assessments similar to those that have helped fire departments. This work measures the protection that law-enforcement personnel receive from various PPE systems and assesses the risk of receiving chemical-agent symptoms from missions in chemically contaminated environments. This information allows law-enforcement personnel to match PPE configurations with mission activities to effectively manage the risks of potential chemical threats.

The CW IRP team is developing the operational plans for an off-site triage treatment and transportation center (OST3C) to provide medical care of chemical victims. The OST3C plan is designed to keep contamination out of existing medical facilities. An OST3C will help the community deal with large numbers of chemical victims, without dangerously

contaminating and having to close its valuable medical facilities. Once decontaminated and given initial medical care at the OST3C, more severe chemical victims can be safely moved to existing medical facilities.

The CW IRP team is continuing to develop guidance on handling chemically contaminated fatalities and follow-on medical care and handling procedures for victims who suffered acute exposure to chemical agents. These efforts will help medical examiners and professionals safely manage chemical fatalities and exposed victims.

CONCLUSIONS

The IRP has provided civilian emergency managers and first responders logical response solutions that they can use as a starting point to improve their overall preparedness for CB terrorism. Through the IRP, first responders identified pressing response problems and solutions that work in the real world. The IRP's solutions are based on equipment and expertise already possessed by the first responders.

Continuing IRP efforts will focus on the requirements of military installation responders and response units. From experience, the U.S. military knows that being prepared to defend against CB warfare is the most effective deterrent to such warfare itself. The efforts of the IRP can not eliminate CB terrorist threats. However, it is hoped that improved preparedness to defend ourselves against these threats will lead terrorists to realize that their desired ends will not be achieved because our civilian emergency response community is prepared and capable of effectively defending against such incidents.

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[4] A more detailed description of the BW response template and its response components can be found in SBCCOM's "Improving Local and State Agency Response to Terrorist Incidents Involving Biological Weapons – Interim Planning Guide," August 1999. Available: http://dp.sbccom.army.mil/.

[5] SBCCOM, "Guidelines for Mass Casualty Decontamination During a Terrorist Chemical Agent Incident," January 2000. Available: http://dp.sbccom.army.mil/.

[6] SBCCOM, "Guidelines for Incident Commander's Use of Firefighter Protective Ensemble (FFPE) with Self-Contained Breathing Apparatus (SCBA) for Rescue Operations During a Terrorist Chemical Agent Incident," August 1999. Available: http://dp.sbccom.army.mil/.

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KEY WORDS

Terrorism, biological terrorism, biological agents, chemical terrorism, chemical agents, chemical warfare, weapons of mass destruction, SBCCOM, Improved Response Program, emergency management, emergency medical services, hazardous-materials, public health, medical response, medical surveillance, bioresponse template, personal protection, decontamination, medical treatment

TABLES AND FIGURES

Table 1. BW IRP Response Template

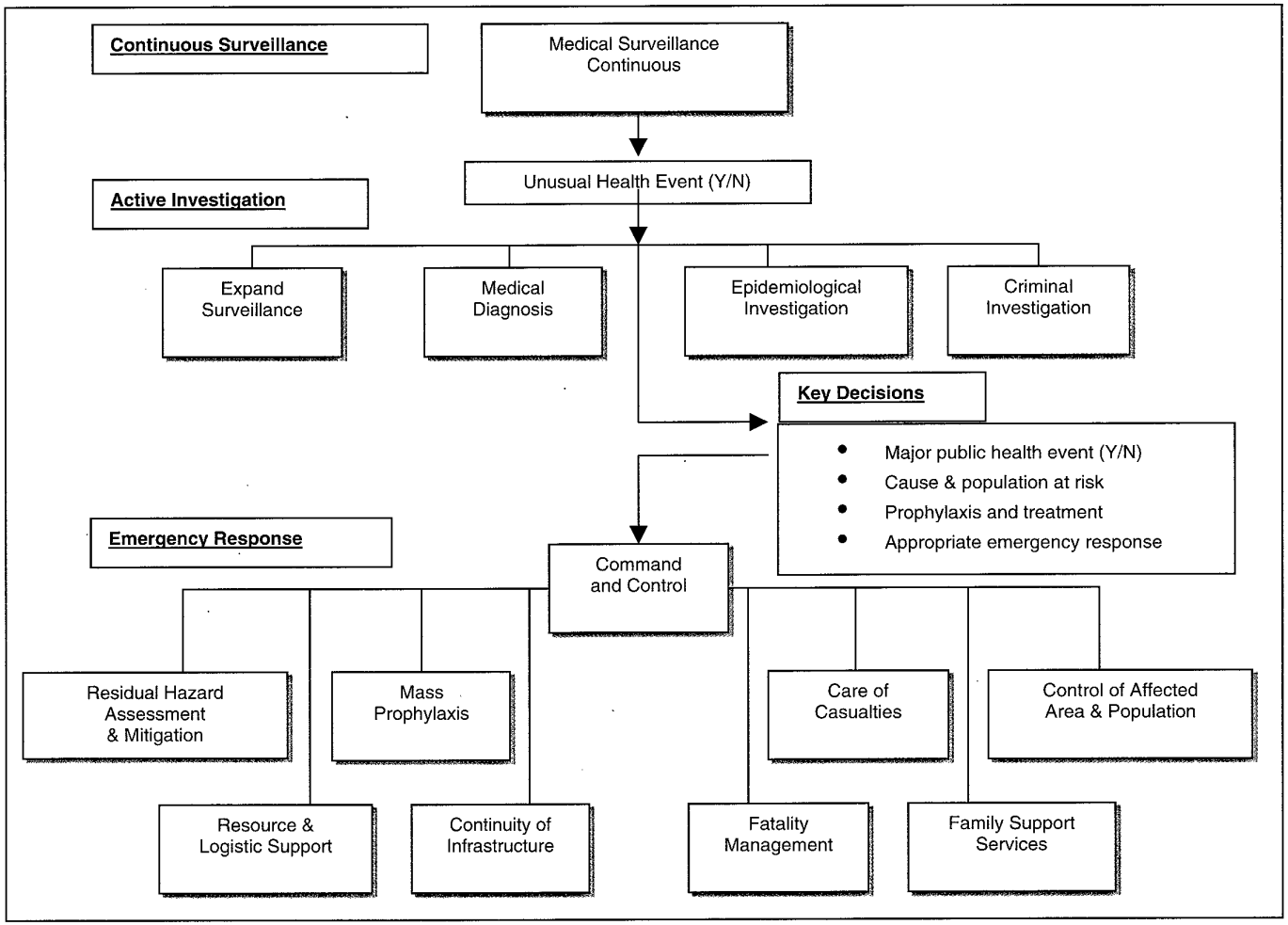


Figure 1. BW Response Template Components and Key Decisions

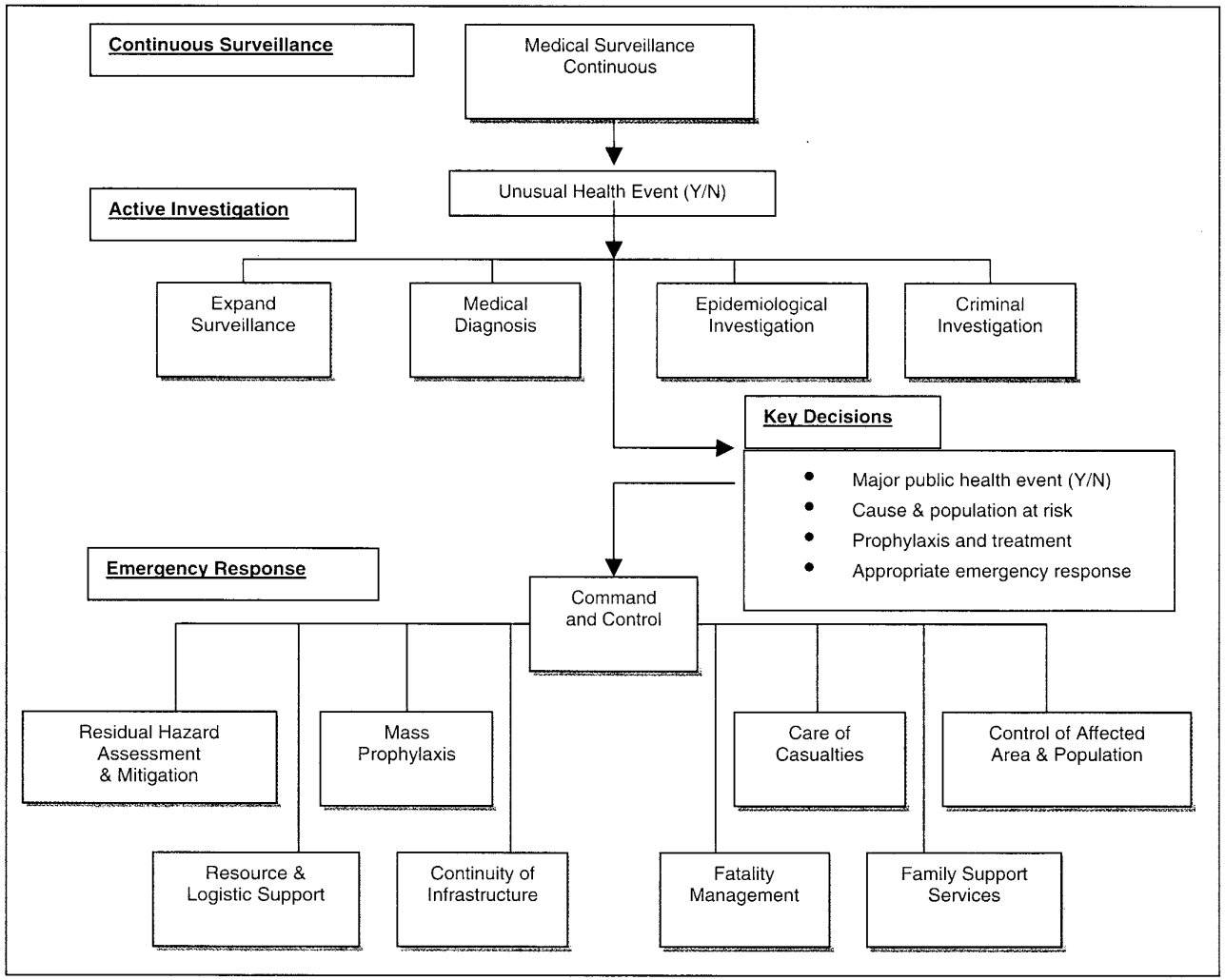
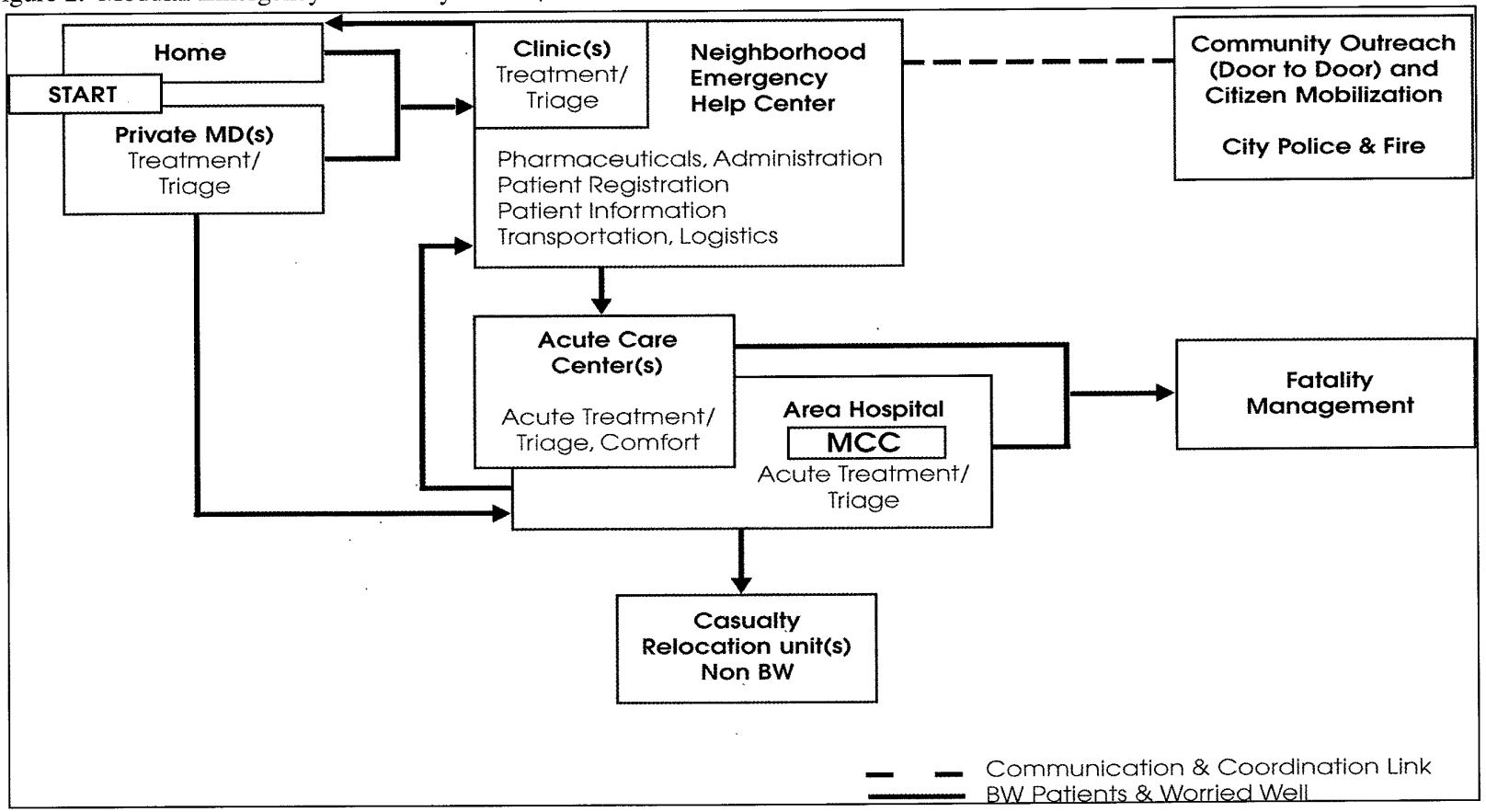


Figure 2. Modular Emergency Medical Syste



84. BIOHAZ: Rapid On-Site Biological Detection for First Responders

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ABSTRACT

There exists an urgent need for emergency responders to rapidly detect the presence of biological materials in a suspect sample. The BioHAZ™ Kit has been recently developed to fill such a need. It is intended to give the emergency responders an integrated capability to collect an environmental sample and to rapidly screen that sample on site for the presence of biological material. This allows the incident commander to be aware of a potential biological hazard and call for the proper response to the situation.

This kit consists of both sampling and detection equipment. It has a variety of sample collection and processing packets to obtain solid, liquid, or air samples. Samples are then screened using multiple, complimentary technologies that are well-proven to determine the presence of biomarkers such as ATP, DNA, and protein within the samples. A simple algorithm allows the operator to determine if the sample may contain bacteria, spores, or protein. Samples can then be further analyzed on site with immunoassay tickets before being sent to a laboratory.

This system provides the emergency responders with a capability that they do not have. The adoption of this kit could result in savings of time and money by debunking biological hoaxes and providing timely warning of the presence of actual biological materials. The BioHAZ™ Kit may also deter the use of biological agents when used as part of a system to mitigate the effects of a biological incident.

INTRODUCTION

As the result of an increasing number of bioterrorism hoaxes and incidents throughout the United States, there is a recognized deficiency among the emergency response community to rapidly detect the presence of biological materials at the site of an incident that is suspected of involving a biological agent. In the late 1990s, the U.S. Army Edgewood Chemical and Biological Center initiated an effort to develop an expedient capability for first responders to sample, detect, and identify the presence of hazardous biological materials in the environment.

The first step in this effort was to identify user requirements and to develop a concept of operations for the use of the kit. Design goals and performance specifications were then established with assistance from the responder community to develop the first prototype, called the Biological Detection Kit (BDK). The performance goals of the BDK were adopted from the first generation Biological Integrated Detection System (BIDS) that is currently fielded by the US Army for biological detection. The requirements of the kit were that it should be able to collect all forms of samples, but work primarily with surface samples to answer the question: "Does that device contain a biological material? If it is bacteria, is it viable?" Additional goals of the development effort were that the total cost of the kit should not exceed $20,000 apiece, that all of the components had to be commercially available, and that the entire kit had to be portable.

DEVELOPMENT OF THE BIOHAZ KIT

MARKET SURVEY AND APPROACH

A market survey to identify technologies that would meet the mission requirements of the BDK was performed and, upon completion, the problem was re-evaluated. It was then decided to change the focus of the effort. The original concept consisted of a kit with sampling devices and a library of immunoassay test tickets for identification purposes. The concept was changed to a more generic approach for a variety of reasons, some of which were:

1. A limited library of test tickets capable of identifying "military threat" biological agents is available. The tests may miss other pathogenic biological materials that could be used by a terrorist but might not otherwise be thought of as a battlefield biological agent.
2. Immunoassay test kits have to be used within concentration and pH guidelines. Tests of samples that are outside of these guidelines may give erroneous results. It would be more useful for field analysis to have the means to determine if the sample was within these guidelines necessary for accurate use of the test kits.
3. Genetic engineering of organisms or other treatments may compromise the ability of antibody-based or nucleic acid probe-based tests to detect and/or identify pathogenic materials.

Based on the market survey, a BIDS-like approach was then adopted in which multiple, complimentary technologies are used as generic tests for biological traits. By comparison, the BIDS uses a particle counter to measure fluxes in the quantity of threat sized particles (1-10 μm) in the environment. Upon alerting to a spike in the particle flux, the BIDS operators collect a sample and analyze the sample for adenosine tri-phosphate (ATP) content and for deoxyribonucleic acid (DNA) content. If the sample possesses certain criteria, it is subjected to immunoassay techniques for further analysis. This scheme is based on the:

1. Particle size and count determination. Most intentionally man-made particles that have viable organisms and/or biological activity are typically above three microns (3 μm) in diameter.
2. ATP determination - detects the presence of living things.
3. DNA test - most all biological materials have DNA. Although purified proteins are assumed to contain no DNA, they are often contaminated with sufficient residue DNA from the protein source to be detectable.
4. Immunoassay test - the antibody-antigen reaction of immunoassay tests give a confirmation of the presence of specific biological agents within the available library of tests.

Tests similar to those are used in the BIDS are used in the BioHAZ kit, but because of cost, size, and weight constraints, the approach on how these tests are used was changed. For example, the BIDS uses a flow cytometer to do DNA detection. This instrument is capable of distinguishing between spore and vegetative cell DNA. The cytometer weighs 300 pounds and has a price tag of $100,000. The BioHAZ approach will detect DNA in the sample using a hand-held fluorometer, but does not distinguish what type. The BioHAZ luminometer is similar to the one in the BIDS. The BIDS luminometer measures total ATP and cannot differentiate among non-bacterial ATP, vegetative bacterial ATP, and spore ATP. The model used in the BioHAZ Kit has the capability to differentiate among these sources of ATP. Therefore, the BIDS uses the cytometer to differentiate among types of biological material and the BioHAZ Kit does it with the luminometer. Unlike the BIDS, a generic protein detection capability was added to the BioHAZ Kit for detection of proteinaceous toxins, such

as Botulinum toxin and Ricin. Also, the design of the BioHAZ Kit eliminated the use of the particle counter used in the BIDS. With the BIDS, this instrument is used as a real-time aerosol sampler to trigger further actions of sample collection and subsequent analysis. The use profile of the BioHAZ Kit presumed that, if a biological attack had occurred in conjunction with an incident that resulted in an emergency response, any biological materials disseminated as an aerosol would have precipitated onto surfaces from which they can be collected using the surface sampling components of the kit.

Since there are a variety of sampling systems in the commercial marketplace for use in different applications, it was decided to integrate some of these into the kit for specific purposes. Individually sealed, expendable sample collection kits were developed to enable the user to collect environmental samples in various forms. Specific kits are included to collect samples from large surfaces (Swipe-1 Kit), small surfaces (Swipe-2 Kit), liquids (Swipe-3 Kit), and from air using filter systems designed either for air sampling or asbestos monitoring (Swipe-4 Kit). In addition, sample processing kits (SPK) were added to allow the user to refine the collected sample for testing on site.

TECHNICAL CONSIDERATIONS

Hand-held particle counting instruments. Small, hand-held particle sizers, including: the Met-One models 227A (2 channel) and 237A (6 channel) and the Bio-Test AG (4 channel) were obtained and evaluated for use in the BDK. They were tested extensively during several joint field trials held in the U.S. They compared relatively well to some of the more expensive instruments currently available. As the approach for the BioHAZ Kit differed from that of the BIDS and the original BDK development, the use of a particle counter Kit was eliminated from further consideration.

ATP luminescence detection instruments. Three luminometers were evaluated for detection of bioluminescence: the IDEXX Lightning System, the New Horizons Diagnostics Model 4700, as it is used in the BIDS, and the New Horizons Diagnostics Model 3550. Although other systems exist and are mainly used in food safety and sanitation monitoring, these three units offered some distinct advantages. The IDEXX system has all of the reagents packaged in a swab device. The Model 4700 is used in the BIDS and would be representative of some of the other luminometers that read total ATP. The Model 3550 has a separation step that allows the operator to eliminate non-bacterial sources of ATP. This process was further used to develop a test capable of detecting spores. This test could not be easily achieved with the other instruments. The New Horizons Diagnostics Model 3550 was therefore implemented for the following reasons:

1. Tested by the USDA and several other organizations [1, 2, 3] under field conditions and found to be the only luminometer that showed good correlation with culture results.
2. Approved by the FDA for detection of bacteria in human urine.
3. Used by several commercial companies to measure bacterial contamination in process control measurements.
4. Shown to be the least prone to interferences.
5. Allows the operator to use a variety of sample volumes for analysis.

DNA detection. For DNA determination, the Hoefer DNA Quantitation Kit from Pharmacia Chemicals, Inc., was initially evaluated. The instrument analyzes in the UV. It was not sufficiently rugged to be of use in the field and the dye was highly prone to interferences from the sample that could not be controlled. The PicoGreen dye kit from Molecular Probes was also evaluated [4]. This kit is readily available and gives detection limits at the required level. It is routinely used in reference labs to quantify DNA in samples prior to PCR analysis. It does not seem to be prone to matrix interferences and has a related dye that detects RNA

(single-stranded nucleic acids). To utilize the PicoGreen dye, the Turner Designs TD-360 fluorometer was initially considered for the BDK. It performed well within the required detection limits. The BioHAZ Kit incorporates the newer, smaller Turner Designs instrument, TD-00, which operates at the same performance specifications as the TD-360.

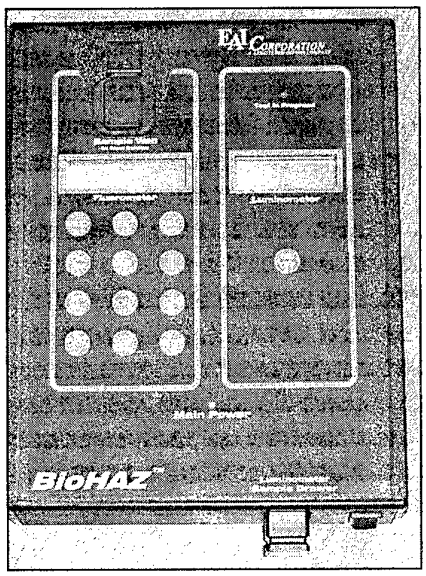

Figure 1. BioHAZ instrument

Protein detection. The Coomassie Blue protein test was initially evaluated, since it was the only protein test that met the time and other mission requirements. Other tests either took one hour or required boiling of the sample. Interference from detergents was found with this test. Field experiences with the test showed that an adoption of a cut-off of 10 μg/ml of protein from surface samples was necessary to minimize false positive test results. Likewise, a value of 2.5 μg/ml protein was chosen as the cut-off value for air samples. Several colorimeters were evaluated for use, types that are used for water analysis and typically range in price from $200-600. The ChemMetrics VVR colorimeter was initially accepted for use with the BDK. An improvement with the BioHAZ Kit is the replacement of the Coomassie Blue reagent and the colorimeter with the colorimetric protein test strips commonly used for urinalysis.

Although the detection limit is increased to about 50 μg/ml with Bovine Serum albumin, these strips are less prone to interference, far less expensive, and easier to perform than the Coomassie test.

Instrument integration. At the conclusion of the laboratory development phase, the instruments were given to emergency responders for field trials. Based on their experience and advice, it was decided that an integrated instrument housing both the luminometer and the fluorometer functions should be built. The resulting instrument is depicted in Figure 1. Since this dual instrument consists of the Model 3550 luminometer and the TD-00 fluorometer components in a single outer housing, the performance of each instrument is the same as the original components.

SUMMARY OF TESTING RESULTS

A variety of tests were performed both in the laboratory and in the field [5]. The luminometer was evaluated with five different types of bacteria, including gram positive spores, cocci, and bacilli, and gram negative bacilli and cocci. Laboratory tests showed that using the BioHAZ system protocols, the luminometer could routinely detect 10^5 colony forming units of vegetative bacteria per milliliter of solution (CFU/ml), 10^6 CFU/ml of spores using the spore test procedure, and could differentiate between spore forming and non-spore forming bacteria. This was demonstrated during a recent joint field trail in the U.S. Interferences from common household, laboratory, and environmental chemicals were also evaluated. The ATP test showed no interference from any of these materials, although timing was crucial as to when the sample was tested relative to when it was collected. The DNA test did exhibit false positive results when tested with phosphates; however, in the scenarios under which the kit would be used, this should not be a problem since the presence of phosphate may be another indicator of biological material. The urinalysis test strips were not subject to interference from these materials.

The results in Table 1 list the performance capabilities of the BioHAZ Kit for each test. Table 2 shows a comparison of the BioHAZ Kit to the BIDS.

Table 1: BioHAZ testing performance capabilities.

Original Goal	ATP Test (1)	DNA Test	Protein Test
Bacteria - $5x10^5$ CFU/ml	$<10^5$ CFU/ml (vegetative) $\sim10^6$ CFU/ml (spores)	$\sim10^5$ CFU/ml (vegetative) $\sim10^6$ CFU/ml (spores)	N/A
Viruses - 10^6 PFU/ml	N/A	$\sim10^7$ PFU/ml	N/A
Toxins - 500 ng/ml	N/A	See note (2)	~50 μg/ml

Notes: CFU: Colony forming units; PFU: plaque forming units.

(1) The ATP test measures only live bacteria. The DNA test can measure the presence of either live or dead bacteria. It was also noted that the signal increases, hence the detection limit decreases, if detergents are used to disrupt the bacteria.

(2) At protein concentrations greater than 10 μg/ml, there is detectable DNA present that is typically $1/1000^{th}$ of the protein concentration.

Table 2: Comparison between BIDS and BioHAZ Kit

Specification	NDI BIDS	BioHAZ Kit
Measure changes in biomass	Measure total ATP with Model 4700 luminometer	Measure change in DNA concentration with fluorometer
Differentiate vegetative cells and spores	Uses DNA dye with flow cytometer	Measures ATP flux with luminometer after incubation
Bacterial detection limit	$5x10^5$ CFU/ml	$<10^5$ CFU/ml
Generic detection	Bacteria , probably virus, no protein	Bacteria , probably virus, protein
Cost	~$1,300,000	$20,000
Size and weight	1-1/4 ton HMMWV (~12,500 lbs.) with trailer (generator)	~ 50 lbs., ~5 cu. ft. total

These results indicate that the BioHAZ Kit sufficiently meets the specifications to do what it is designed for, to indicate the presence or absence of biological materials, and it does so for a much lower cost than the BIDS, after which it was designed.

USING THE BIOHAZ KIT

The emergency responders at an incident may be called upon to use the BioHAZ Kit. There are several reasons or scenarios that might prompt an Incident Commander to initiate the use of this kit, but the end result will be to provide additional information about the possibility of biological materials being present at the incident scene. Responders and other operators can use the kit to check specific locations for suspected agents (e.g., the material inside of an anthrax letter or the area surrounding the release of a suspected biological agent), survey areas of interest for hot spots, determine the extent of contamination, measure the relative effectiveness of decontamination operations, monitor water, or for other inspection purposes. If the kit indicates the presence of biological materials, this information can help to:

1. Determine the extent of additional response required. For example, there may be requirements for protection, decontamination, or evacuation of potentially exposed personnel for medical evaluation.
2. Determine the type of biological materials that are present. This information can be passed to supporting medical facilities to help them decide on treatment protocols for the victims and to supporting laboratories to narrow their efforts in identifying the specific biological agent used.
3. Determine the type of immunoassay that can be performed on site. The results of these assays help to identify or eliminate specific biological agents from further consideration.

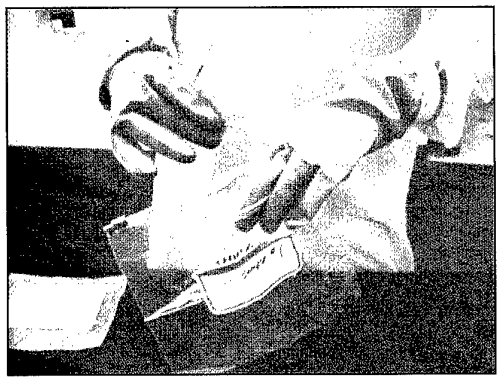

Figure 2. Swipe sampling kit

If the BioHAZ Kit tests indicate that no biological materials are present, the Incident Commander can scale back the response efforts toward termination of the incident. This is the case with the responses to hoaxes, such as the ubiquitous anthrax scare letters.

Using the BioHAZ Kit is a simple process of collecting the samples, processing them for testing, testing the samples for biological materials, and evaluating the results for further action. Sample collection is facilitated by the use of individually sealed collection kits. One example is pictured in Figure 2. Once the sample has been collected, the operator can elect to forward the sample to a federal agency, or to test it on site with the BioHAZ Kit testing components. The kit contains the necessary components to package samples for transfer off site and to process samples for testing on site. A sample to be tested is refined into a clear, aqueous solution suitable for testing by using the SPK. The operator then performs quick tests using the instrument and the test strips. Table 3 indicates the type of results that can be expected from using the test equipment of the BioHAZ Kit. Depending on the results, the

operator can perform assays specific to the type of biological materials found in the sample. For example, if toxin were likely to be present, assays for toxins (e.g., Ricin, etc.) would be used in lieu of other available assays. So too, if spore-forming bacteria were found, the appropriate assay (e.g., anthrax) would be warranted.

TABLE 3: Expected results of testing.

Indicates Sample Contains	ATP Test	DNA Test	Protein Test
Bacteria	Positive	Positive	See note (1)
Virus	Negative	Positive	See note (1)
Toxin	Negative	See note (2)	Positive

Notes:

(1) Possibly present from culture media or lysed cells.

(2) If protein concentration is above 10 μg/ml, will probably detect contaminating DNA.

The final results of any field testing must be verified by a laboratory. Even if an immunoassay indicated the presence of a specific biological agent, these results must be confirmed for positive identification. If other agents not detected by the available assays were used, the BioHAZ Kit will detect and categorize their presence but not provide any further information. For emergency response purposes, this indication alone is sufficient to determine the next series of response actions.

CONCLUSIONS

The BioHAZ Kit successfully does exactly what it was designed to do. It can provide emergency responders and other users the means to rapidly screen and determine the operationally significant presence or absence of biological materials in suspect samples.

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85. STRATEGIES FOR THE DETECTION OF UNKNOWN BIOLOGICAL MATERIALS

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ABSTRACT

Current strategies for the detection and identification of biological agents depend on known biological properties – specific biochemistries, specific antigens, and specific nucleic acid sequences. But what about unknown agents, either natural or man-made? Can these agents elude current or proposed detection/identification schemes? Are there strategies that can be implemented for detection?

Using the current template of trigger, detector, or identifier, strategies will be discussed that can be used to detect unknown materials of biological origin. Generic detection schemes may have a role in this area. Several recent efforts have investigated both the use of pathogen receptors, such as the Gm_1 ganglioside, or specific nucleic acid sequences, which are known as "islands of pathogenicity". Perhaps these types of approaches might be exploitable in future detection/identification efforts.

Detection and identification strategies, as they might be applied to the detection of unknown materials, will be reviewed as to speed, complexity, and information generated. Trade-offs among these parameters and the introduction of new detection and identification schemes in concert with current, proposed, or future technologies will be discussed.

The intent of this paper is not to solve the problems, but to provoke new ideas, so that effective biological detection capabilities for the 21st century can be developed.

INTRODUCTION

One of the keys to deterring the use of biological weapons is real time detection and warning. In the event that these agents are utilized, it is even more important to classify and eventually identify the type of agent so that appropriate countermeasures can be initiated. Several systems have been developed to provide detection and alarm of a biological agent attack. These first generation systems detect the characteristics of an aerosol in order to measure changes in the aerosol content against a background. This may be indicative of a man-made (not naturally-occurring) event that could indicate a possible attack with a biological agent. These first generation systems then use antibodies to provide a means of characterization of the aerosol for specific types of biological materials. This approach presupposes a knowledge of what an adversary may have in their arsenal. With the advent of genetic engineering and the potential proliferation of these techniques to design new types of agents that may defeat current detection and identification strategies, additional or alternative signatures need to be exploited to reliably indicate a possible biological attack. This paper explores some additional signatures that can be used in this context. Some approaches to improving medical intervention are also discussed.

Bio/non-Bio Determination

Parameter	Test	Rationale	Status
DNA/Protein Determination	Flow Cytometer	Unknown agents will probably be present in particles that have measurable protein/DNA.	Available(Field) – System used on several platforms. Taken out of JBPDS.
	Fluorometer	Same as above. Measures total flux not associated with particles.	Available(Field) – System demonstrated.
	Luminescence (intercalating peroxyoxalate esters)	Same as fluorometer.	Available (Lab) – Could be developed into a field system.
Heme Determination	Luminol Luminescence	Biological materials will have heme present.	Available (Field) - US BDWS Program.
Viability Determiantion	ATP Luminescence	Viable biological materials have ATP present.	Available (Field) – System demonstrated.
	Fluorescein Diacetate	Measures presence of lipases.	Available (Field) – Routine reagent used in FCM and fluorescence.

Currently particle size is the most widely used parameter that triggers an alarm, although technologies that measure particle shape, fluorescence from biological markers (tryptophan or NAD/NADH), or ATP luminescence are being actively developed. There are additional signatures that can be exploited. For example, elemental analysis can be performed to evaluate if a change in the ratio of various elements has occurred. Organic analysis can simultaneously be performed to evaluate if materials that are consistent with various propellants, encapsulants, and aerosol additives are indeed present. Changes in either the inorganic (elemental) or organic signatures could be highly indicative that a biological agent or agents have been used. These parameters can be used as an initial approach to determine if the background aerosol characteristics have changed; however, further characterization is warranted.

CHANGE IN BIOLOGICAL FLUX

For example, it might be useful to see if there is a dramatic change in the biological flux of the environment. This is currently performed on existing, such as the US Army's Biological Integrated Detection System (BIDS) units through the use of DNA measurements by flow cytometry and changes in the flux of Adenosine-Tri-Phosphate (ATP) by luminescence techniques. However, there are additional parameters that can be measured. For example, simultaneous DNA and Protein measurements have been shown to be effective to measure changes in the biological flux. Other parameters, such as heme measurements,

viability changes, and a version of the Gram stain may also prove to be useful.

PATHOGENICITY DETERMINATION

If a change in the bioflux is determined to be significant, the next step would be to determine whether this change is a biological material that is dangerous, i.e., may cause death or poses a threat to health. Thus we need to make a determination as to whether or not the material is a pathogen or a non-pathogen.

Various approaches can be used to make such a virulence determination. For example, many pathogenic materials bind to the Gm1 ganglioside, and this has been used as the basis for assays of several toxin materials for close to thirty years. More recently, DNA fragments, called aptamers, have been described, that can potentially be made to recognize specific pathogenic structures. Nucleic acid analysis may also be performed to detect specific nucleic acid sequences that could code for pathogenic markers. Siderophores have also been proposed to be used in this context. Lastly, assays can be performed for products of virulence plasmids, such as the determination of the PA component of *B. anthracis* toxin or some of the various YOP proteins of *Y. pestis.*

CLASSIFICATION OF AGENT

The final step in this detection process would be to classify the threat material as a bacterial, virus, proteinaceous toxin, or non-proteinaceous toxin. The most expedient way to make this determination could be through mass spectrometry. Pyrolysis mass-spectroscopy does have this capability, but there are some alternative methods that can be used. Bacteria can be determined through the use of a Gram stain and specific enzyme activities may prove useful. For example, beta-galactosidase is an enzyme that is widely used to detect and presumptively identify the presence of *E. coli* in water samples. Some other bacteria also possess similar activities.

In the context that these bacteria are used as weapons, one may assume that antibiotic resistance has been introduced into them. There are various tests that are currently available clinically to make these determinations. Most of them use a colorigenic substrate that measures a lytic enzyme, such as penicillinase. More current techniques could utilize nucleic acid probes to measure the presence of DNA sequences in plasmids or plasmid constructs that code for these lytic enzymes.

A similar approach can be taken to determine the presence of virus. For example, some viruses possess specific enzyme activities that can be measured. The neuraminidase of Influenza virus is such an example. The properties of this enzyme were studied and were exploited in a rapid assay for detection.

Since viruses are intracellular parasites, one may be able to assume that there would be carrier cells or culture components present concurrently with the virus. One might be able to use an assay for ovalbumin in cases where eggs are used as the carrier. If conventional cell culture is used as the means to grow the virus, the mitochondria from them might be measurable by using a fluorescent dye, such as Rhodamine 123. Histocompatibility antigens, which are species-specific antigens that are present on cell surfaces, may also prove useful as a means to detect the presence of viruses.

Proteinaceous toxins can be determined by several means. Conventional protein determination approaches, such as the Biuret, Coomassie Blue, and others, could serve as an initial screen. This could be followed by more stringent analysis, such as capillary electrophoresis and sequencing. This sequence could then be introduced into a bioinformatics tool, and a possible function could be determined. In the event that the toxin may have some

type of enzyme activity associated with it, substrates for the enzyme can be determined and used in subsequent analyses.

Some of the approaches described in the virulence determination section can also be used to determine if the toxin is dangerous to life and health. For example, the Gm1 ganglioside is found on many cells and many of the pathogenic toxins bind to it. Specific examples include SEB and cholera toxin.

The final type of potential weapon is the non-proteinaceous toxin. These materials would probably require mass spectrometry for detection and identification, although there are some alternative approaches. Live cell assays can be used to measure the effect of the compound on a cell, such as a neuron, and from this activity some information on its activity can be determined. Lastly, the current activity on bio-chips can also be exploited to detect these types of materials. It is conceivable that these chips can serve as substrates for receptor-based assays. An array of various receptor types can be coated to these substrates and used for detection.

From these approaches, detectors with improved capabilities to detect and warn may be developed that improve one's abilities to protect both troops and assets. As can be seen by these approaches, some of these technologies exist today and can be implemented into the field with some success. However, with the improvements in coating technologies and the integration of biological polymers with electronics, the next 50 years should see the development of detectors that utilize several of these approaches in concert.

IDENTIFICATION AND MEDICAL COUNTERMEASURES

Once a determination has been made in the field that a biological event has occurred, the next step would be to retrieve the suspect samples and return them to a lab for further identification and classification. There are a plethora of techniques that are available for identification, such as metabolic tests, carbohydrate or fatty acid analysis, phage typing, immunological assays, and nucleic acid probe technologies. Current identification techniques use rigorous analysis to identify microorganisms according to complex taxonomic schemes, using both DNA and RNA analysis. The degree of relatedness among genus, species, and strains can thus be determined. The use of chip technology, although now in its infancy, will play a crucial role in the future in these determinations.

RAPID ANTIBIOTIC SUSCEPTIBILITY TESTS

A current rationale, that one needs to know the identity of the particular agent so that the proper treatment modality can be employed, needs to be re-evaluated. In classical medical approaches, when one knows the identity of the organism, one can typically prescribe the appropriate course of antibiotics or other therapies. However, with the advent of genetic engineering and the relative ease that this allows an adversary to impart resistance to antibiotics, one can no longer assume that the mere identification of the organism would be sufficient for treatment. Even in conventional medical approaches, there has been an increase in the use of susceptibility tests to determine the appropriate course of treatment. In the case of an intentional release of a biological agent by an adversary, the use of antibiotic susceptibility testing is crucial.

In the event that a biological attack has occurred, particularly with a bacteria or a toxin, a viable sample is crucial for initiation of medical countermeasures. Although koch's postulates will have to be demonstrated for legal purposes, the viable sample will be necessary so that antibiotic susceptibility testing can be performed. Currently these tests involve isolating the organism and eventually obtaining it in pure culture for further analysis. In the case of a bacterium, the kirby-bauer procedure is usually used and takes 8 or more

hours to complete. In the event of a biological attack, there may not be sufficient time to do this. What is needed is a rapid method to do these determinations on environmental samples.

Several approaches have been proposed to approach this. One utilizes flow cytometry and rapid determinations in 20 minutes have been achieved. This approach uses a classical approach where the viable cells are mixed with an antibiotic mixture. The effect of the antibiotic on the cells is then measured by changes in scatter or DNA-specific dye uptake. Alternatively, analysis with nucleic acid probes that are specific for sequences that code for antibiotic resistance can be used. This has the added advantage over conventional techniques in that viable samples are not required.

A similar paradigm can be assumed for viruses, but toxins are a different case. Specific identification needs to be obtained so that the proper antidotes, if available, can be administered. In the case of real unknown entities, bio-informatics will eventually play a role so that the possible physiological activity of the material can be obtained. However, we are several years away from this being a field consideration.

IMMUNE STATUS DETERMINATIONS

Up until this point, the agents themselves have been discussed; however, the other part of the equation is the troops that have been attacked. It may be desirous to make a determination as to who has been attacked so that the field commander may not have to compromise his military posture. One possibility is to measure the status of immune function of the individuals who were involved in the attack. There are several approaches that may be used to assess immune status, from the classical blood cell counts to measuring individual lymphocyte status by flow cytometry analysis. As our ability to measure these functions improves, they may prove to be viable assets in the field.

DEPLOYMENT STRATEGIES

The previous discussion dealt with the types of technologies that one could conceivably use to detect the presence of biological materials; however, concepts of employment still need to be determined. This is the difficult part because it is here where the considerations are more cost/benefit, logistics, and personnel driven, rather than science. If we were to determine the types of scenarios that one would get in a potential terrorist scenario, there would be 2 cases: high value, fixed assets (buildings, stadiums, etc.) and hoax scenarios. In both of these cases, the scenarios are quite different. Another consideration is responding post attack. Here we need to determine of areas are contaminated and then perform quality control on personnel and materiel decontamination.

If there are some high value, fixed assets where a threat is credible, then some type of continuous monitoring system is probably worthwhile considering. These types of systems could utilize one or more of the triggering/detection technologies. For example, particle size and shape analysis coupled with fluorescence, could be an effective system. Systems such as the CDC 4WARN or the BAWS system under development in the US could be likely candidates. To minimize false alarms, this approach could be coupled with a detector system that utilizes some of the detector schemes, such as bio/non-bio or pathogen/non-pathogen. An ideal candidate for this type of approach is a flow cytometer since it can couple several of these parameters in one platform (Particle size, shape, bio/non-bio, viable/non-viable, pathogen/non-pathogen) in one platform. However, the down side of this approach is that it would require some degree of maintenance by building personnel.

Hoax scenarios can be dealt with by relatively simple equipment. One initially needs to make a bio/non-bio determination, and if positive by say a DNA test or protein test, a viability test could then follow to determine if live materials are indeed involved. Samples

can then be further analyzed by identification technologies, either on or off site.
Responding to an attack, however, requires an echelon of response. One first needs to determine if there is indeed a biological agent present. This can be determined by the same means discussed in the hoax scenario. If it is determined that indeed live biological material is used, then the area can be sampled to determine the extent of contamination. Lastly, the area can then be decontaminated and the effectiveness of this process can be determined by several simple tests, such as luminescence.

CONCLUSIONS

From this brief discussion, it can be shown that the problem is not insurmountable; however, several things need to change. We first need to become aware that the possibility does indeed exist that "unconventional" biological agents be encountered in the field. There are a variety of strategies that could be implemented in either trigger or detection platforms that could be used to detect signatures from biological agents and possibly determine that they could present a danger to health and life.

However, we need to change our paradigms on how we think about the problem. The most important thing is to provide detection and warning system that exploits a credible signature so that those in peril can take the appropriate protective measures.

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86. PARTICLE SIZE AND ORGANISM NUMBER: IMPACT ON BIOAEROSOLS

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INTRODUCTION

There exists a global concern regarding the potential for an attack with a biological weapon (BW) within the next several years. This is amply demonstrated by efforts to develop highly advanced detection instruments and warning systems, produce innovative clothing to protect against weapons of mass destruction (WMD), determine methods to mitigate possible effects, and provide effective consequence management. Obviously, it is most important to properly assess the threat of a biological weapon and to understand the potential impact to apply the best defensive and protective measures to thwart a BW attack.

Although there are several potential dissemination scenarios to describe an attack with a biological weapon, the greatest concern is directed at the potential release of a bioaerosol. Aerosol dissemination, stemming from the development of large military-affiliated offensive BW programs, has been recognized as the most efficient method for spreading a biological agent. The 1995 incident on the Tokyo subway by the Aum Shinrikyo in their use of aerosolized sarin, albeit crudely designed, demonstrated clearly that terrorists would now achieve enough technical sophistication to employ recognized methods with WMD use.

To defend against a bioaerosol attack, there is much to be gained in understanding and predicting the anticipated effects of an aerosolized agent on an exposed population. Such knowledge will provide greater insight into the design of a variety of materials and protocols under development to respond to such an attack. Detectors, rapid response teams, predictive dispersion codes, protective clothing, and decontamination equipment are just a few items in the growing arsenal to protect against a WMD attack. The widely recognized proliferation of biological weapons mandates, in particular, the necessity for protection against bioaerosols.

PARTICLE SIZE EFFECTS

Particle size is likely the single most important element in the design of a bioaerosol. Humans are seriously affected by bioaerosols with a characteristic particle size range (i.e. mass median diameter or MMD) of one to five microns because these particles are most likely to reach and be retained in the deep tissues (i.e., the alveolar region) of the lungs during respiration. Bioaerosols with larger particle sizes (i.e., 5 to 20 microns MMD) are generally much less likely to cause serious infection because the upper respiratory tract easily clears such particles. Depending on the agent such large particles, however, might infect the trachea, pharynx, or eye. Figure 1 shows the essential characteristics of particle deposition – not retention – in the respiratory system. Aerosolized particles with a MMD up to 10 microns are deposited in the respiratory system, but only those particles with an approximate MMD of one to five microns reach the pulmonary spaces. Although deposition of particles up to 10 microns in diameter in the respiratory system is highly effective, removal of the larger particles in this range is also effective. The upper respiratory tract removes essentially 100% of the particles with diameters $\geq$10 microns, and this decreases to approximately 80% for particles with diameters of five microns. As the particle diameter is reduced to one or two microns, virtually none of the particles are removed from the respiratory tract (1)

PARTICLE SIZE AND INFECTIVITY

The parameters for description of a bioaerosol include the particle size range or MMD and microbial infectivity described as the lethal dose (LD_{50}) or infective dose (ID_{50}) that causes a probable clinical response in 50% of the exposed, unprotected subjects. Based on the human respiratory response to aerosolized particles of a particular size range as described above, it is critical to assess the relationship between the MMD of aerosolized particles with the infectivity of the agent contained within the particles. Certain aspects of the relationship are not obvious. These might include atmospheric effects on the viability of aerosolized organisms as varying particle sizes, the effects of different MMDs on long-range dispersion and rates of settling of aerosols, and the potential for infection outside of the lung (i.e. the upper respiratory tract or eye). Although it is not possible to perform such an assessment for every microbial threat, defending against and effectively managing an attack imposes an obligation of understanding as to how to characterize the aerosolized agent.

Characterizing a particle aerosol using MMD dictates variation in absolute particle size. The range of particle sizes will provide a basis for susceptibility based on the human respiratory response. Ultimately, this will, of course, depend on both the viability and infectivity of the microbe, as well as the finite range of particle sizes. Knowing the stability and pathogenic character of an organism, the relation between particle size and infectivity is dependent in large part on the number of organisms within a given particle, a value difficult to determine.

It is important to note that exposure to a bioaerosol is often expressed as a function of mass within a given volume. Providing that the particle size is within a finite range and the infectivity of the agent is known, the units (i.e., mg • min/m^3) commonly employed for exposure are acceptable. However, as described above, particle size contributes significantly to the clinical response during exposure to a bioaerosol. Using the value of mass, alone, does define particle size and, subsequently, the likely distribution within the respiratory system.

Table 1 shows the number of small spheres of unit radius that will occupy the space of a large sphere. Figure 2 shows conceptually the organizational structure of many small spheres packed into a large sphere or particle. There are two possible packing arrangements, face-centered-cubic (FCC) and hexagonal-close-packed (HCP), depending on whether a unit sphere is placed at the center of the large sphere or is tangential to the center point of the large sphere. Fortunately, as it concerns this discussion, there is little difference between the two arrangements. As the size of the large sphere increases, filling fractions show a considerable increase reaching a maximum of more than 70%, and show little difference in the filling fraction between the FCC and HCP packing arrangements (see Table 1 and Figure 3). Although the radius sizes for the large sphere shown in Table 1 are well above those sizes of concern with respect to bioaerosols, it should be realized that these are idealized calculations. When attempting to apply these principles to microbes, organism size will vary within a finite range providing a significant difference in filling fraction. It should also be appreciated that the filling fraction will change depending on the relative size of the small particle and also if there are minor size and shape variations in the small particles filling the large sphere.

PARTICLE LD_{50}: *Bacillus anthracis*

For the purposes of this discussion, spores of *Bacillus anthracis* will be used to describe concepts associated with particle size and organism number. The spores, known to be resistant to many of the effects likely to impact a bioaersol, are assumed to be rigid spheres.

One of the important concepts to characterize a bioaerosol is the relationship of organism number to particle size. This helps to reconcile the potential number of particles required to establish an infection. The LD_{50} for spores of *Bacillus anthracis* is estimated at 8,000 to 10,000 spores. Providing there is one spore per particle, this LD_{50} would be considered accurate. However, an agent preparation will contain substances to promote agent dispersal and will likely consist of particles that contain more than one spore. The number of spores per particle in a dry agent aerosol will yield the number of particles that contain enough spores to account for the LD_{50}. The number of spores per particle will obviously vary based on particle size.

By means of an ultrastructural morphometric analysis, the mean diameter for spores of *B. anthracis* was found to be 0.966 ± 0.205 microns.(2) The spores varied in shape from spherical to slightly ovoid. Allowing for a spore to be a sphere, spore volume based on the mean diameter is 0.472 microns^3. The volume of a spherical particle with a diameter of five microns is approximately 65 microns^3. The fractional filling volume is required to determine the number of spores that could occupy the volume of a given particle size. This is necessitated by the fact that spores, as spheres, are considered rigid and will not deform as packed within a spherical particle. Considering variation in spore size and shape, a reasonable estimate for the fractional fill is approximately 0.4 (i.e., 40% of the volume of the particle). Without the fractional fill parameter, about 137 spores would occupy the space in a given particle with an MMD of five microns. With the fractional fill, this number is reduced to an average of 55 spores per particle.

Because microbes as dry agents will often clump because of attractive surface effects (i.e., electrostatic charge, "hairy" endosporium, etc.), it is most important to add hydrophobic materials or other dry diluents to retain a uniform particle size. Although some of these chemical additives might occupy some of the space resulting from the fractional fill, the number of spores in a given mass will be reduced, although not necessarily in direct proportion to volume. Assuming that 50% of the mass of a dry agent preparation consists of additives to promote effective dispersion and 10% of these materials occupy the void volume created by the fill fraction within a five-micron particle, five-micron particles might contain an average of 33 spores per particle. In this case, the "particle LD_{50}", as opposed to the infectivity of *B. anthracis*, in terms of five-micron particles that would contain a total of 8,000 to 10,000 spores is estimated to be between 242 and 303 particles. Using similar calculations for three-micron particles, the "particle LD_{50}" would be from 1111 to 1388 particles. Thus, the LD_{50} value based on particles would be less than the typical LD_{50} value by one or two orders of magnitude depending on particle size. These types of calculations to characterize bioaerosols provide valuable tools for defensive measures, especially for the development of items such as detectors and dispersion codes.

PARTICLE INFECTIVITY AND VIRUSES

Although the use of *B. anthracis* spores in a five-micron particle demonstrates the principles that govern particle size as it relates to infectivity, it does not show adequately the increase in efficiency of packing small particles into a relatively large spherical volume. The increase in efficiency is based on the fill fraction as shown in Table 1. Viruses are typically 100 to 1000x smaller than bacteria and are often characterized with infectivity values of 100 virions or less. Although subject to many of the same bioaerosol parameters described previously, virus infectivity can often be reduced to a single particle within a bioaerosol.

Figure 2 shows a large sphere or particle with a diameter 16x greater than that of the individual small spheres. If the large sphere were a particle with a MMD of three microns, the volume of the large sphere would be approximately 14.1 microns^3. The MMD of each

small sphere would be approximately 0.19 microns, much larger than that of most viruses. With a fill fraction of 0.6, the three-micron particle would contain approximately 2450 virions. Therefore, for most viruses, this would easily yield a clinical response by inhalation of a single particle from an aerosolized agent.

SUMMARY

The effects of particle size on retention within the respiratory system and the relationship between infectivity and particle size are important concepts with respect to bioaerosols. Microbial infectivity measured as particles within a bioaerosol as opposed to the typical infectious or lethal dose may be reduced by one or two orders of magnitude to that of a single particle, depending on the agent. These considerations should be useful in the development of detection and protection devices needed to predict the occurrence or limit the effects of a BW attack.

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KEY WORDS

Bioaerosol, infectivity, microbe, particle size

FIGURES AND TABLE

Figure 1. Total and regional deposition of inhaled particles in relation to the aerodynamic particle size. (*from Hatch, 1961*).

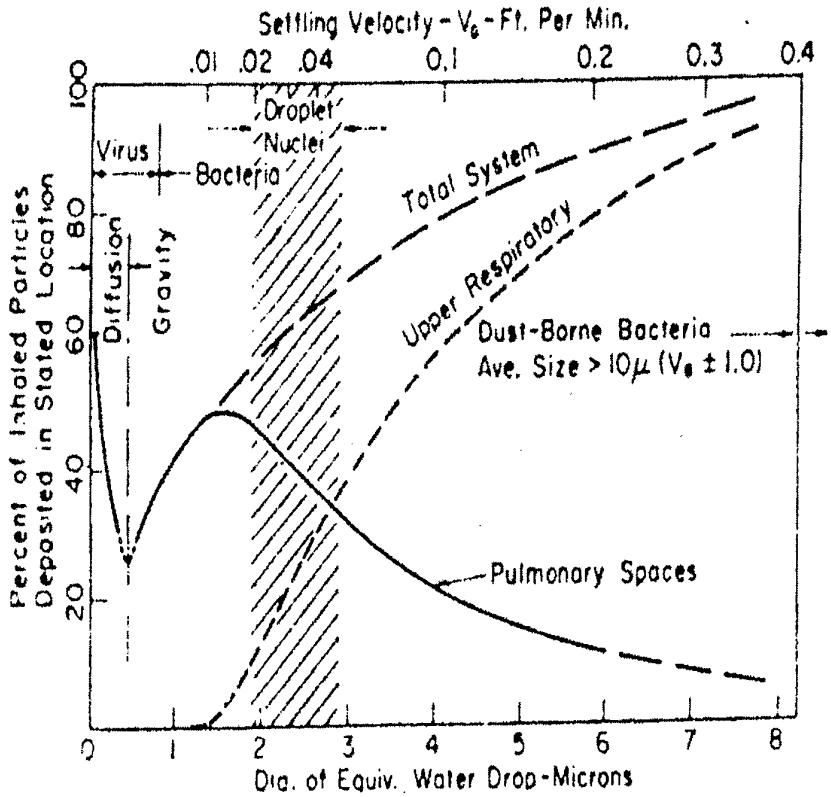

Figure 2. FCC lattice with outer sphere 16x diameter of small spheres

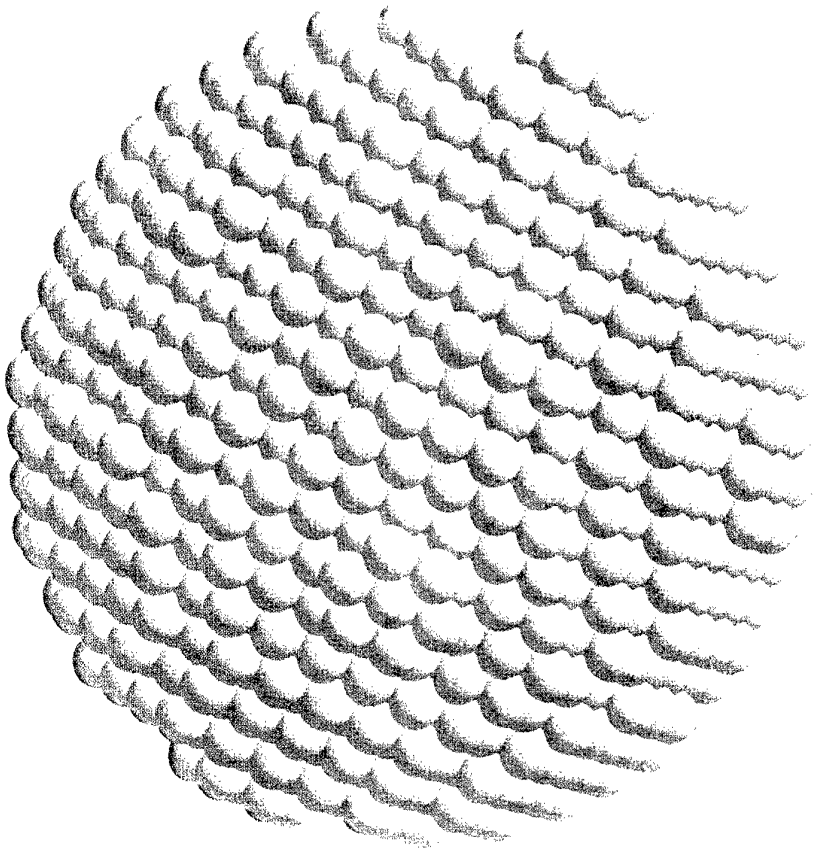

Figure 3. Filling fraction of the hcp and fcc lattices as a function of the relative radius of the outer sphere.

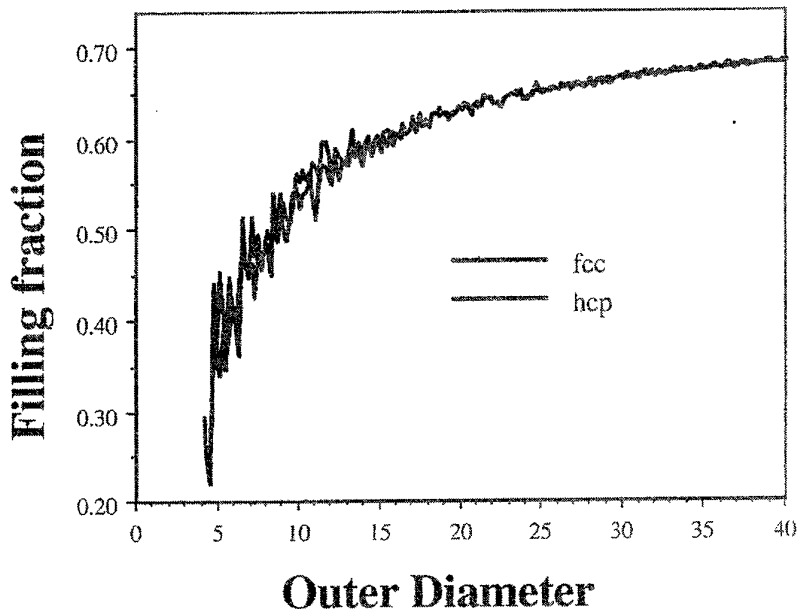

Table 1. Number of spheres of unit radius placed inside a larger sphere of given radius. Filling fraction is the total volume of small spheres divided by the volume of the large sphere.

Large Sphere Radius	FCC Number	HCP Number	FCC Fraction	HCP Fraction
4	19	19	0.2969	0.2969
5	43	57	0.3440	0.4560
6	87	87	0.4028	0.4028
7	177	159	0.5160	0.4636
8	249	257	0.4863	0.5020
9	369	389	0.5062	0.5336
10	555	527	0.5550	0.5270
11	683	763	0.5131	0.5733
12	959	955	0.5550	0.5527
13	1289	1261	0.5867	0.5740
14	1601	1639	0.5835	0.5973
15	1985	2037	0.5881	0.6036
16	2491	2493	0.6082	0.6086

87. PROTECTING FIRST RESPONDERS TO ACTS OF TERRORISM

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INTRODUCTION

Responders to an act of terrorism will face the challenge of saving lives and property while protecting their own health and safety. Responder safety and health issues in traditional disasters, such as hazardous materials responses, are compared with those presented by biological and chemical terrorism, and challenges for worker protection are described.

Early discussions of the response to terrorism considered chemical and biological terrorism events together. This approach tends to blur the very different risks and safety challenges that these events present. It is therefore more useful to consider separately the challenges of chemical versus biological events.

CHEMICAL TERRORISM

Chemical terrorism uses toxic chemicals to harm human health, damage property, or inflict psychological distress. Chemical terrorists might use military chemical weapons, as in the 1995 use of sarin in Tokyo; however, the use of toxic industrial chemicals may be more likely. Military chemical weapons can be expensive and difficult to synthesize in large quantities, while toxic chemicals used as industrial precursors or products are widespread and easily obtained.[1] The "first responders" to an act of chemical terrorism are likely to be the usual responders to chemical incidents: firefighters, police, and designated hazardous materials (HazMat) teams.

If a terrorist act involves a deliberate release of an industrial chemical, in some regards the response is much like other HazMat events. In any toxic chemical release, responders must detect and identify the chemical agent and quantify exposure levels. The appropriate response procedures, including selection of personal protective equipment, response procedures, and decontamination can be found in existing HazMat protocols. In the US, regulations and guidelines are provided by the Occupational Safety and Health Administration, the Environmental Protection Agency, and others.[2,3,4] These regulations suggest that when in some circumstances where the nature of the exposure hazard is not known, workers should wear totally encapsulating chemical protective suits with positive-pressure self-contained or supplied air respirators ("Level A" protection) until the hazardous exposure is identified. Responders can then step down to lower levels of protective equipment as appropriate.[5]

In some ways, however, the response to an act of chemical terrorism may differ from a conventional HazMat response. A conventional HazMat incident often occurs in an industrial park or along railroad lines or highways. These frequently are located away from densely populated areas (although chemical spills and other situations can occur in urban areas). Because there are fewer people in the affected area, there will be fewer victims to extricate and responders can limit their exposure time in the "hot zone." In addition, these events frequently occur in the open air where wind dispersion can reduce the concentration. The effectiveness of personal protective equipment and the health effects of exposure depend on the concentration of the exposure hazard and the duration of exposure, so the outdoor and remote location of an unintentional HazMat incident will help limit the responders' exposure risk.

Both concentration and time may differ in a terrorism response. An act of terrorism, carried out with intent to harm as many as possible, will likely be in a populated area. This will result in a larger number of victims requiring extrication, requiring more responder time in the hot zone. Such an act might take place in a downtown urban environment where buildings will interfere with wind dispersion or indoors in areas with limited ventilation, resulting in higher hazard concentrations. If these factors are present, the increased exposure time and concentration will contribute to the responders' exposure risk.

A terrorism response differs from a traditional HazMat event in one additional regard. A terrorist intent on harming first responders may employ a so-called "secondary device." This is typically an explosive, timed to detonate during the response to the first event and therefore to injure as many responders as possible.[6] Responders to hazardous chemical events are frequently not ordinance disposal experts. The response to an event of chemical terrorism, therefore, may require participation from teams trained to identify and recover explosive devices.

BIOLOGICAL TERRORISM

Biological terrorism produces very different challenges, which may be quite unfamiliar to responders well versed in chemical disaster response. Responders may confront either an announced purported release of a biological agent or an outbreak resulting from successful unannounced use of a biological weapon. The appropriate response will vary depending upon the particular scenario. In all these events, the optimal response involves coordination with public health and law enforcement officials.

The most common scenario currently confronting emergency responders to date is the discovery of an envelope, package, or other container with some indication (such as a label or accompanying letter) suggesting the contents are an infectious hazard. Often the label or letter states that the contents are anthrax spores.[7] Responders face several decisions: whether the contents truly are infectious; how to handle the package; and whether to detain, decontaminate, or administer prophylactic medications to civilians who may have been exposed to the contents.

In the US, usually law enforcement officials coordinate the collection of evidence (e.g., letters, packages, or air-handling system samples) and deliver materials to a qualified laboratoryfor testing. The goal is to provide test results that confirm or refute that the contents were an infection hazard. In general, public health officials, working with law enforcement and first response personnel, should determine the need for decontamination and postexposure prophylaxis. However, in most of the recent hoaxes purporting anthrax exposure, immediate postexposure decontamination and prophylaxis were not indicated because the threat was not credible. Instead, current recommendations suggest that officials collect contact information for potentially exposed persons for notification of laboratory results or other follow-up. Potentially exposed persons also should be given information about the signs and symptoms of illnesses associated with the biologic agent and about whom to contact and where to go should they develop illness.[7]

Perhaps the most likely act by a terrorist determined to use a biological weapon to cause harm will be the unannounced dissemination of an infectious agent. This assumption is supported by two instances of biological terrorism. One occurred in 1984, when members of a religious commune in Oregon intentionally contaminated salad bars to cause an outbreak of salmonellosis.[8] The other occurred in Japan, where prior to their use of sarin, the Aum Shinrikyo cult made several unannounced and (fortunately) unsuccessful attempts to release anthrax and botulinum toxin.[9] A successful event involving the unannounced release an of infectious agent, as occurred in Oregon, will not be recognized until the subsequent

appearance of cases of resulting illness. There will be no identified "hot zone" or emergency response to the exposure, and the "first responders" will be the providers of medical care (physicians in primary care offices and emergency departments) who first recognize and report the cases, the medical staff who care for the victims, and the public health authorities who initiate the community response to control the outbreak.[10]

In a bioterrorism-related disease outbreak, therefore, the response strategies for traditional first responders will differ from those of a chemical event. Responders will not control an exposure source or rescue exposed civilians. Instead, they primarily will be involved in transporting patients to medical care facilities, as they do in naturally occurring outbreaks of diseases such as influenza. Response procedures and personal protective equipment should be selected based upon principles of infection control rather than hazardous materials operations. The goal is to protect the worker from the patient's infection during care and transport. As such, recommendations for infection control in hospitals during bioterrorism outbreaks provide useful guidelines.[11] Personal protective equipment need not involve elaborate measures appropriate to chemical protection such as "Level A" suits. Instead, the appropriate protection entails so-called "standard precautions"to protect the worker from percutaneous or mucous membrane exposure to blood or body fluids and secretions.[12] Protective garments include impermeable gloves (latex or synthetic), gowns, and eye protection. The importance of eye protection in some diseases cannot be overstated; in the 2000 Ebola outbreak in Uganda, several fatal occupational infections among health care workers may have resulted from eye exposure from splashes or inadvertently rubbing one's eye with a contaminated finger.[13]

"Standard precautions" for diseases, which are not transmitted through the air, such as pulmonary anthrax, require only a surgical mask to prevent mucous membrane exposure when aerosols or spatter may be produced. Higher levels of respiratory protection may be needed depending upon the particular disease and how it is transmitted. Pneumococcal pneumonia may be transmitted by large droplets coughed by the patient, but these droplets are large enough that a surgical mask will protect the worker.[11]

Some diseases, however, are transmitted by fine aerosols; these includes smallpox, one of the potential agents of bioterrorism. Workers caring for smallpox patients will need a higher level of respiratory protection, at least that provided by a disposable respirator providing the equivalent of high-efficiency particulate filtration such as those meeting NIOSH class N95.[11] It is important that users be fit tested to ensure that a given type of respirator provides an adequate seal to the user's face. Workers using respirators without fit testing frequently have so much leakage of unfiltered air that the respirator provides little or no protection - in one study, 95% of such workers had more than 33% leakage.[14] Fit testing should be done as part of the organization's routine preparations - a crisis is too late to begin testing and searching for effective respirators.

However, respiratory protection is not a complete solution for some biological hazards due to the small exposure required to cause disease. The infectious dose for smallpox infection, for example, is unknown but may be as low as just a few virus particles.[15] Depending upon the exposure concentration, even a respirator offering 95% reduction in exposure may not suffice, although it will reduce the exposure challenge. For this reason, responders transporting or caring for ill patients also may need immunization or antibiotic prophylaxis. Some diseases, such as pneumonic plague, warrant antibiotic postexposure prophylaxis.[16] During a smallpox outbreak responders will be candidates for smallpox vaccination. However, the scarcity of the vaccine and the risk of adverse effects dictate that it be administered only to responders who, in fact, will have contact with infectious patients. Response plans should include strategies to deliver these treatments to responders, and to

provide alternatives to individual responders who are allergic to a particular drug. Antibiotics and vaccines are not needed when caring for patients with diseases not transmitted from person to person, such as botulism or anthrax.

OTHER NEEDS

Responders and health care workers also have nonspecific needs, applicable to both chemical and biological responses. One vital component of a response plan is to reach out to essential partners. In many communities first responders have little or no interaction with the local health department and thereby miss an important two-way partnership. Responders can help health department identify that an occult act has created an outbreak by monitoring the numbers of patients they transport for different types of symptoms and signs. The health department, in turn, can advise responders of what the outbreak is which are appropriate infection control precautions, and how to implement plans for providing antibiotics or immunizations to staff.

Hospital partnerships, too, should be included in responder plans for terrorism. Responders should work with hospitals to ensure plans for patient transport to facilities that will be equipped to meet the situation. During a biological event, responders must know if the community will designate a specific hospital for highly contagious diseases such as smallpox.[15] Planning for a chemical event must include awareness of which hospital has adequate decontamination facilities, or whether the hospital will need the fire department's assistance with decontamination.[17]

Unanswered questions requiring further research remain, as well. One is the critical topic of respiratory protection. In the US, we currently lack certification standards for civilian respirators to be used against weapons of terrorism, presenting two challenges. The first is an issue of worker safety, to ensure that the respirators emergency responders use offer adequate protection against the exposures they are likely to encounter. The other is an administrative challenge: in that US regulations state that an employer can provide workers only with respirators that have been certified by the National Institute for Occupational Safety and Health, which has not previously certified respiratory protection against weapons of terrorism. Programs to develop appropriate certification standards are now being implemented.[18]

A second research need is to develop improved detector technology. First responders need real-time instrumentation that is rugged, portable, and can reliably identify the type and concentration of hazardous exposures, including both military and industrial chemical weapons. Again, extensive work is currently underway in this area. Finally, response agencies must recognize that responders are subjected to unique and potentially disabling stress during a disaster, so-called "critical incident stress." The knowledge base about responder critical incident stress after acts of terrorism is limited. However, experience gained from other disasters strongly indicates that response agencies must anticipate the need to protect terrorism responders from the effects of critical incident stress.[19]

CONCLUSION

An act of chemical or biological terrorism will require appropriate measures to protect first responders from exposure to hazardous substances or infection by biological agents. Some of the safety challenges are common to more conventional disasters such as industrial chemical spills or natural disease outbreaks, although terrorism response pose some unique challenges as well. These challenges can be met, but require advance planning to ensure that the necessary equipment, procedures, and collaborative relationships are available in the time of crisis.

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KEYWORDS
Terrorism; responders; occupational safety and health; firefighters; respirators; public health

88. PSYCHOLOGICAL EFFECTS OF CHEMICAL AND BIOLOGICAL (CB) TERRORISM: LESSONS FROM THE PAST

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ABSTRACT

The psychological effects of CB terrorism derive from two sources; the action of the agents on the body and the brain, and the effects and implications of the terrorist act itself on the human psyche. The physical and mental effects of agent exposure are reasonably, but not completely, described in the technical literature. The psychological effects of terrorist acts in general are also reasonably well described, but only limited information is available on the specific impact of CB terrorism. Emergency response and public health systems must be prepared to handle the range of effects that can result from a terrorist incident involving a chemical or biological weapon. This paper attempts to draw from the lessons of the past to outline the types and extent of psychological effects which can be expected as a result of CB terrorism.

INTRODUCTION

The psychological effects of CB terrorism stem from two sources; the action of the agents on the body and the brain, and the effects and implications of the terrorist act itself on the human psyche. The physical and mental effects of agent exposure are reasonably, but not completely, described in the technical literature. The acute psychological effects of hypoxia resulting from exposure to the pulmonary agents, feelings of anxiety and agitation from the cyanides, the central nervous system effects of the nerve agents (forgetfulness, inability to concentrate, irritability, insomnia and depression), and the mental effects of some toxins and some biological agents are well documented. This paper focuses on the effects and implications of the terrorist act itself.

METHODS

A review of published studies, documents and interviews was conducted. Sources included reports prepared following the Tokyo incident, symposia proceedings, journal articles, reference books, news articles, and internet web sites.

RESULTS

The psychological effects of the terrorist act can range from relatively short-term effects such as panic, disorientation, sleep disturbances, over reaction to noise and stress, to appearance of psychosomatic symptoms and Acute Stress Disorder (ASD), to longer-term reactions including Post Traumatic Stress Disorder (PTSD).

Although most people will have only mild, short-term symptoms, some individuals will develop psychiatric illness. Factors which increase psychological consequences include lack of warning, and lack of understanding of the risk. Fear of the unknown always seems to add to the impact of such an event. The presence of life threatening danger, gruesome situations, toxic material, and extended exposure to the specific danger increases the potential for psychological trauma. Extreme fatigue and intense emotional demands, such as might be experienced by emergency personnel having to make difficult rescue or triage decisions, are other indicators of high psychological potential. Symptoms of post traumatic stress range from mild to severe. At the low end of the scale are recurring anxiety, nightmares and insomnia. Extreme behaviors, such as avoiding use of the subway after the Tokyo attack or

reacting to loud sounds after witnessing a bomb explosion, can also occur and persist for long periods. Depression is often a common result among survivors, families of victims, and rescuers. These initial effects sometimes progress to more severe and debilitating symptoms, such as self-imposed isolation, substance abuse, domestic violence and suicide.

Table 1 lists two levels of psychological disorder that may occur as a reaction to trauma. Generally, the symptoms are the same. The major difference lies in the timing and duration following the trauma. Acute Stress Disorder (ASD) is a relatively short-term condition, lasting days to weeks, occurring within one month post incident. The more severe Post Traumatic Stress Disorder (PTSD) can occur any time post incident with the symptoms lasting for longer periods, possibly years. In the Tokyo Sarin incident, we can recognize these symptoms from the statements of the victims themselves. A 37-year old female who was a passenger on the Tokyo subway on 20 March 1995 was still experiencing effects in 1999. She stated in an interview, " At night, there were so may times that I would be awakened by nightmares. All of a sudden, I wouldn't be able to breathe and couldn't sleep. Now, 4½ years after the attack, I suppose I'm pretty close to being able to lead a normal life...Until AUM (ed. note: AUM Shinrikyo, the sect which carried out the terrorist act) changes, substantially, and admits its guilt, I think that I could be a victim at any time."

Toshiaki Toyota, 52, who was a station attendant on the Chiyoda line of the subway, had two friends die in the incident. He actually responded to the emergency call and picked up a Sarin-soaked newspaper. He experienced the classic symptoms of nerve agent poisoning, ultimately collapsing and remaining unconscious for 27 hours. He states, " I have no physical symptoms, but psychologically, there's this burden. I've got to get rid of it somehow." A 37-year old man who is the brother of a woman who was reduced to a nearly vegetative state by the exposure to Sarin states, " According to a nurse, she was in a "sleeping state"...Her face, to be crude, looked more dead than asleep. I could hardly bear to look at her... Since then she's had therapy and has progressed to the point where she can move her right hand. It's still not easy for her to speak...most of her memory has disappeared. They took what little joy we had." [(5)]

Kenji Ohashi, 47, a car dealer, was on one of the subway cars that was attacked. He experienced dimness of vision, runny nose, twitching, and shortness of breath. Hospitalized for 12 days, he continues to experience vicious headaches. He has been diagnosed with PTSD. "I feel very isolated...I've contemplated suicide. I almost think I'd be better off dead." [(6)] Reading the above quotes we can detect most of the symptoms of stress disorder. In 1999, the Japanese National Police Agency sent questionnaires to over 5000 victims of the Tokyo incident., of whom 1,247 responded. More than half declared that they were still suffering from physical or mental effects. Over 72% habitually use sleeping pills or alcohol to soothe their nerves. Fifty-seven percent (57%) report psychological complaints, such as fear of repeat attack flashbacks and bad dreams. In another survey of 610 victims seen at St Luke's Hospital, taken 6 months after the incident, 32% of the victims reported fear, 29% insomnia, 16% depression, 16% irritation, and 16% reported continuing nightmares (most commonly big monsters, or huge rocks falling on victims). Another 10% reported fear of using the subway system again.

Figure 1 displays the frequency of these symptoms among the victims of the Tokyo incident. Data from other disasters and traumatic situations show that both victims and rescuers are affected. Figure 2 shows the percentage of those involved who exhibit traumatic stress for a variety of incidents. Note that in the general population, emergency response personnel are at higher risk for ASD and PTSD, at about the 20% level, over their lifetime. This makes intuitive sense, because they are more often exposed to stressful and life-threatening situations. Following the Oklahoma City bombing, which certainly qualifies as a

Weapons of Mass Destruction (WMD) incident, 41% of the survivors had "diagnosable mental health conditions." Also note that 20% of the responders are thought to similarly be affected. [9] This confirms the depth of trauma experienced by victims and rescuers in a situation in which there is large loss of life, gruesome results, and involvement of many children. Note also that the Tokyo incident appears to be much more traumatic to victims than other incidents. Perhaps this is due to the "fear of the unknown" aspects of such an event as compared to a more familiar and common form of disaster such as earthquake, explosions and even war.

Following exposure to traumatic situations, responders often report feelings of helplessness, of not doing enough, of being overwhelmed. They suffer from seeing others suffer, and they feel under extreme pressure to "make it better." Often, these feelings are increased when they are put in the spotlight as heroes, because in their psyche, they feel they could not or did not do enough, and thus should not be considered "heroes." How many times have we read of an individual who obviously risked his life to save another, state in all honesty and humility, "I just did my job, " or "I just did what anyone else would do in that situation." The end results of stress among the approximately 12,000 rescue workers in Oklahoma City have been an increased divorce rate, domestic violence, resignations and alcohol use. Among those involved in the rescue and prosecution, there have been 6 suicides. In addition, among local firefighters and their families, there have been 30 interventions that successfully prevented a threatened suicide. Interestingly, of the first 10 rescue dog handlers on scene (50 ultimately responded), 70% have resigned from the service.

CONCLUSIONS

Response planning for incidents of terrorism involving WMD will have to include more than just the initial rescue and treatment of personnel and the restoration of the site to normal operations. The immediate and longer-term effects of the trauma among victims, their families and rescue personnel must be expected and accounted for in the response plan. Initial interventions should focus on decreasing those factors that are known to increase the psychological consequences of an event. Making the situation safe as quickly as possible, providing rest and relief for responders and providing stress intervention debriefings will help. High-risk groups, especially those exposed to the most gruesome aspects of the disaster, need to be identified for help. Researchers have found that those exhibiting avoidance and numbing symptoms are most predictive of PTSD. Active outreach programs for victims and responders and their families should be established.

As action at the scene decreases, there will be time for the initiation of later interventions. Incident stress debriefings for high-risk groups should continue. The media can help resolve the "fear of the unknown" among the populace, victims and responders by publishing factual, non-exploitative information. This implies that the response community must be prepared to assist the media by providing accurate information and guidance in as timely a manner as possible. Arranging and conducting memorial services gives individuals the opportunity to grieve, to recognize the extent of community support available, to recognize that they are not alone in their feelings about the event, and to begin to bring closure to the tragedy. Government support, including mental health services, restitution for victims, and successful prosecution of the perpetrators all assist in decreasing the psychological trauma. Finally, provision must be made for long-term psychological treatment of the most difficult cases.

SUMMARY

CB terrorism has a high potential to cause psychological stress in victims and

responders, with both acute and chronic impact. Consideration of actions and integration of personnel to assist in mitigating and relieving this stress must be included in the response and recovery plan. Incident stress debriefings and other mental health interventions will be a critical aspect of the immediate and long-terms response to such incidents.

Table 1: Degrees of Reaction to Trauma

Symptom	Acute Stress Disorder	Post Traumatic Stress Disorder
Re-experiencing trauma	X	X
Avoidance of reminders	X	X
Hyperarousal	X	X
Dissociation	X	X
Significant distress or impairment	X	X
Onset of symptoms	Within 1 month of trauma	Anytime following trauma
Duration of symptoms	2 days to 4 weeks	> 1 month

From Diagnostic and Statistical Manual of Mental disorders, Fourth Edition (DSM-IV)

Figure 1: Frequency of Psychological Symptoms Following the Tokyo Incident

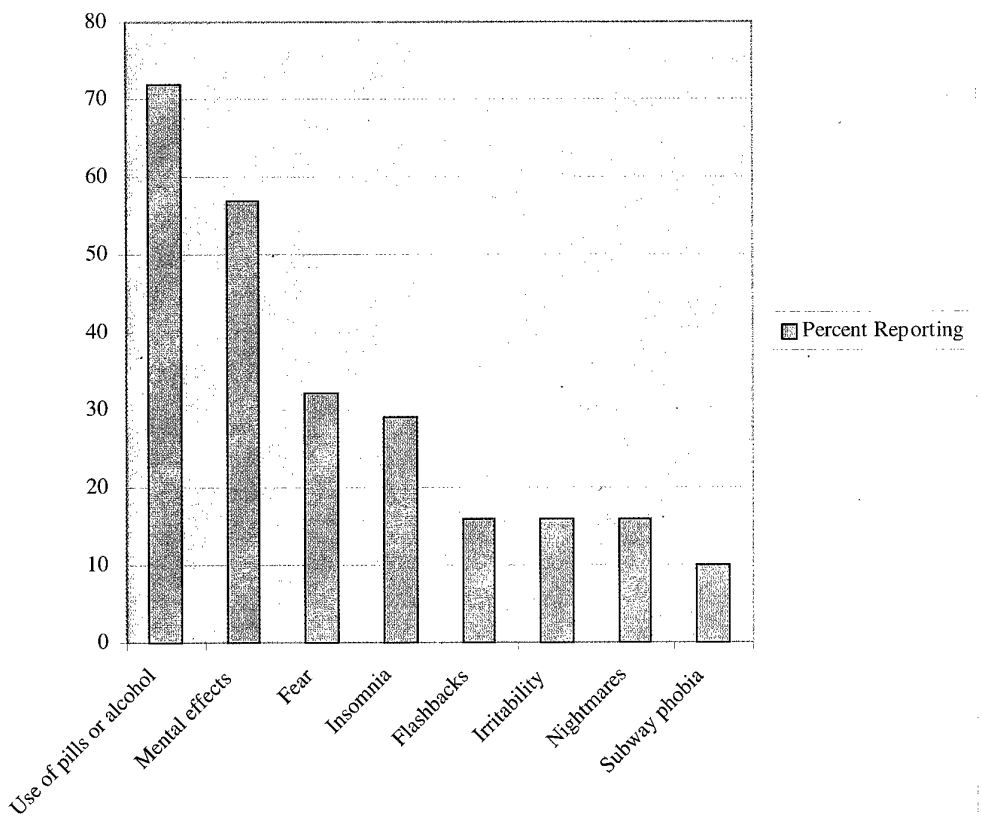
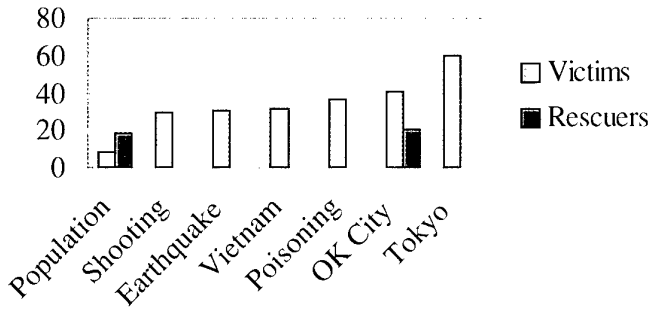


Figure 2: Traumatic Stress from a Variety of Incidents



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89. CONSEQUENCE MANAGEMENT: A DUAL APPROACH

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INTRODUCTION

The U.S. Agency for International Development /Bureau for Humanitarian Response/Office of Foreign Disaster Assistance (USAID/BHR/OFDA) is responsible for providing non-food, humanitarian assistance in response to international crises and disasters. The USAID Administrator is designated as the President's Special Coordinator for International Disaster Assistance, and OFDA has the responsibility to coordinate the USG's response to humanitarian emergencies and disasters abroad.

OFDA provides humanitarian assistance in response to a declaration of a foreign disaster made by the U.S. Ambassador or the U.S. Department of State. Once an event or situation is determined to require U.S. Government (USG) assistance, OFDA can immediately provide up to $25,000 to the U.S. Embassy or USAID Mission to purchase relief supplies locally or give a contribution to a relief organization in the affected country. OFDA can also send its own relief commodities, such as plastic sheeting, tents, and water purification units, from one of its four stockpiles located in Italy, Guam, Honduras, and the U.S. Increasingly, OFDA deploys short-or long-term field personnel to countries where disasters are occurring or threaten to occur, and in some cases, dispatches a Disaster Assistance Response Team (DART) to help manage the disaster or event for the U.S. Ambassador and Country Team.

The largest percentage of BHR/OFDA's assistance goes to relief and rehabilitation project grants managed by Private Voluntary Organizations (PVOs), Non-Governmental Organizations (NGOs) and International Organizations (IOs). Relief projects include airlifting relief supplies to affected populations in remote locations, managing primary health care and supplementary feeding centers, and providing shelter materials to disaster evacuees and displaced persons. A rehabilitation project might immunize dislocated populations against disease, provide seeds and tools to farmers who have been affected by disasters, or drill wells or rehabilitate water systems in drought-stricken countries. OFDA carefully monitors the organizations implementing these projects to ensure that resources are used wisely and to determine if the project needs to be adapted to changing conditions. The goal of each project is to meet the humanitarian needs of the affected population, with the aim of returning the population to self-sufficiency.

The "notwithstanding" clause of Section 491 of the Foreign Assistance Act of 1961 states that no statutory or regulatory requirements shall restrict OFDA's ability to respond to the needs of disaster victims in a timely fashion. OFDA follows the standard USAID procedures for routine procurements, but utilizes expedited or modified procedures when necessary to achieve its disaster response objectives. The first principle in disaster response accountability is to ensure that appropriate assistance gets to the neediest victims in time to minimize death and suffering. Procurement and accounting procedures may be expedited, but must include effective systems of internal control.

Not all of OFDA's assistance goes to providing aid in response to disasters. OFDA's mitigation staff oversees a portfolio of projects designed to reduce the impact of disasters on victims and economic assets in disaster-prone countries. During the last several years, BHR/OFDA has invested in a number of programs in partnership with the U.S. Geological

Survey (USGS), the Pan American Health Organization (PAHO), the Asian Disaster Preparedness Center, the World Environment Center, and other offices within USAID. These programs not only enhance a country's capacity to manage its own disasters and hazards, but also promote the transfer of technology, goods, and services between the U.S. and the host country. OFDA mitigation-related programs range from investing in drought early warning systems that can possibly head off a famine to training local relief workers to manage the response to a disaster more effectively. OFDA is increasingly investing in programs designed to prevent, mitigate, prepare, and plan for complex emergencies, which are more the result of human actions than of acts of nature.

The decade of the 1990's presented OFDA with new challenges to its mandate of saving lives, alleviating human suffering, and reducing the economic impact of disasters. 1998's unprecedented year of international humanitarian emergencies continued into FY 1999/2000 with the devastation of an earthquake in Turkey, the widespread destruction from Hurricane Mitch in Central America, the shelter crisis due to civil strife in Kosovo, the flooding disaster in Mozambique, and the drought and civil conflict in the Horn of Africa.

An increase in highly visible, conflict-related, complex emergencies such as those in Sudan, Ethiopia, Somalia, Rwanda, and the former Yugoslavia have consumed the bulk of international humanitarian resources over the past decade. In addition, vulnerability to natural disasters is greater than ever, due to factors such as population growth and environmental degradation. In response to these changes, OFDA has adopted new programming and response capabilities. Its mission represents a reshaped approach to humanitarian relief. The last few years of OFDA involvement illustrates that in any humanitarian disaster OFDA may find itself functioning as a donor, a coordinator, and even an implementer of disaster response.

A widowed IDP mother prepares food for her child in the village of Thiet, Lakes Region of southern Sudan. BHR/OFDA funded a WVUS program that provided non-food relief items to the IDPs, including the cooking pot (photo by Ted Maly, BHR/OFDA).

While OFDA has traditionally viewed itself as functioning with immediate and short-term response capability to humanitarian disasters and providing basic necessities to affected populations, the Office also recognizes the importance of incorporating mitigation techniques into its response activity whenever possible. Mitigation techniques are those designed to

reduce the number of lives lost and amount of property damaged from natural and complex disasters. The unique nature of OFDA's role in disaster provides the Office with an opportunity for strategic response planning in an effort to minimize the impact of future disasters. Throughout the year, BHR/OFDA uses its position as a key player in the international humanitarian relief community to make mitigation an integral part of emergency response.

'A DUAL APPROACH'

OFDA responds to humanitarian crisis, natural and/or technological disasters worldwide on a continuing basis and, as directed by Presidential Decision Directive 39/62, will similarly respond to the consequences of a terrorist event, in support of a host nation through the U.S. Ambassador. OFDA recognizes the imperative to prepare and plan for the consequences of a potential terrorist WMD attack, however infrequent, by drawing upon the past experience and expertise gained from years of humanitarian response operations.

OFDA has developed a *'dual approach'*, to assist an affected population victimized by terrorism or a technological emergency, such as a hazardous materials release as the result of a flood or earthquake. Through interagency relationships that give OFDA access to expertise from U.S. Public Health Service's Agency for Toxic Substance and Disease Registry (ATSDR) and the Center or Disease Control and Prevention (CDC), OFDA is developing a response capability for these unique events. This capability includes a training program, reference materials and consultation, and access to expert advice and/or assessment missions for any type of consequence management event, be it caused by human error or intentional malice.

OFDA understands that a catastrophic terrorist or technological event, like many humanitarian emergencies that will overwhelm a nation, will require the resources of many nations and organizations. OFDA hopes to draw upon the experience of natural disaster and humanitarian complex emergency response, fortified by consequence management plans and interagency preparedness measures, to be equally prepared for the unimaginable.

90. CHEMICAL WARFARE AGENT DISPOSAL PUBLIC HEALTH OVERSIGHT

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INTRODUCTION

In 1969 and 1970, Public Laws 91-121 and 91-441 were enacted. These laws required the Department of Defense (DOD) to take certain actions regarding the management of chemical and biological warfare agents. In the interest of public health protection, the Department of Health and Human Services (DHHS formerly Department of Health Education and Welfare) was charged with reviewing the plans to transport, test, or dispose of any lethal agents. DHHS was mandated to evaluate any hazards associated with these activities, and recommend precautionary measures as needed to protect the public health and safety. Subsequent cessation of open-air testing of lethal agents, limited DHHS oversight to agent transport and disposal activities.

Since these laws were enacted, a major thrust of DOD's activities has been planning for the destruction of obsolete lethal agents and munitions. In 1985, Public Law 99-145 specifically required the DOD to develop a comprehensive plan that would result in the disposal of the largest source of obsolete chemical agents and munitions that is the existing stockpile of these materials. The plan was to evaluate and select appropriate disposal technology, evaluate and select locations to carry out disposal activities (on- site, regional, or single national disposal site and establish a schedule for carrying out the entire stockpile disposal activity.

Various agent/munition disposal technologies were considered including chemical neutralization techniques, emerging chemical destruction methods and incineration. Incineration was selected as the preferred alternative because it was applicable to a wide range of chemicals, it resulted in relatively complete destruction, and it was a mature technology. It was further decided that the incineration should be conducted on -site where the agents and munitions are stored to minimize the potential risk to the public that would be associated with moving such materials through public transportation corridors. The original disposal plan called for the stockpile materials to be completely destroyed by 1994. Because of the many uncontrollable delays and difficulties encountered, that deadline has been pushed back to 2007. As of November 2000 6805 tons of the 31,496 tons of stockpiled munitions have been destroyed.

Characteristics of Stockpiled Materials

Lethal chemical agents are often characterized by their mode of action, or impairment, on their intended victim. The chemicals in the U.S. chemical stockpile maintained by the

Army consist of "nerve agents" and "blister agents" or vesicants. Nerve agents are highly toxic chemicals that directly impair the central nervous system to the extent that death may occur unless there is quick and adequate medical intervention following human exposure to these agents. Blister agents cause inflammation, blisters, and tissue destruction on the skin surface where it is readily absorbed. Blister agents can act internally via exposure by inhalation or ingestion. Blister agents are intended to be incapacitating; nevertheless, exposure to these agents can result in delayed casualties. Table 1 lists the major lethal chemical agents in the stockpile.

Table 1 - Stockpiled Agents

Nerve Agents	Blister Agents
GB (Sarin)	H (Levinstein Mustard)
GA (Tabun)	HD (Sulfur Mustard)
VX	HN-1 (Nitrogen Mustard)
	HT
	L (Lewisite)

Under battlefield conditions, lethal chemicals were designed to reach their intended victims through air dispersion of droplets or vapors. Consequently, many of the stockpiled agents are contained in munitions that could effectively deliver and release the agents in the vicinity of enemy troops. Such munitions include rockets, projectiles, and land mines. Many of the munitions contain fuzes (detonation devices) and bursters (explosive charges) that were intended to fragment the casing and assist in dispersing agent in droplet or vapor form.

In addition to the stockpiled agent munitions, there is a considerable amount of agent stored in bulk form in "ton containers". Holding somewhat less than a ton of chemical agent, ton containers are the largest single items in the stockpile. The final item in the stockpile is dunnage. Dunnage consists of pallets, boxes, and cans used to store chemical munitions. It also contains agent-contaminated materials generated during disposal, such as protective clothing, charcoal filters, and other miscellaneous materials.

Disposal Considerations

As previously mentioned, incineration was selected as the preferred alternative for destroying the lethal chemical agents. Once the decision was made to use incineration, it was then necessary to decide how it would be implemented. That is, how many, and what types of incinerators would be needed, and where should they be located?

Any type of regional or single national incineration system would require that stockpiled agent and munitions be transported over considerable distances. Given the high hazard characteristics of these materials, and the possibility of a transportation mishap associated with such a large scale operation, the contingency planning was found to be untenable. Accordingly, it was agreed that it was in the best interest of public safety to conduct all stockpile materials incineration on-site where they are stored. This option not only limits material handling to a manageable task, but also assures that such handling occurs within the controlled confines of the installation where the agents are stored.

Once it was decided that on-site incineration would be used, it then remained to be decided just what kind of incinerators would be needed. This decision was based upon the physical and chemical characteristics of the overall stockpile waste mix.

Table 2 - Stockpile Locations	
Facility, State	**Agents Present**
Umatilla DA, Oregon	HD, GB, VX
Tooele AD, Utah	H, HD, HT, GB, VX, GA, L
Pueblo DA, Colorado	HD, HT
Pine Bluff Arsenal, Ark.	HD, HT, GB, VX
Newport AAP, Indiana	VX
Lexington BG AD, Kentucky	H, GB, VX
Aberdeen PG, Maryland	HD
Anniston AD, Alabama	HD, HT, GB, VX

There was pure liquid agent from the ton containers and drained from the rockets, projectiles and mines. This liquid had fairly high heat content and would behave as a fuel. There also would be drained metal parts from the rocket, and so forth, that would be contaminated with agent, but would contain very little fuel value. There would also be fuzes, bursters or other energetic and reactive materials that would need to be burned. Finally, there would be pallets, boxes, cans, filters, personal protective garb and other materials that could be lightly contaminated with agent, but would largely resemble industrial trash.

To address the variations in wastes to be incinerated, four different kinds of incinerators were called for. They include:

1. Liquid Waste Incinerator (LIC)
2. Deactivation Furnace System (DFS)
3. Metal Parts Furnace (MPF)
4. Dunnage Incineration (DUN)

Each incinerator is equipped with its own specialized materials handling system, control and monitoring system, and pollution abatement system.

Safety Considerations

When implementing the incineration program, both community and worker safety has been paramount to DHHS and the Army. Accordingly, implementation has been undertaken in a very conservative and deliberate manner. Table 3 contains an overview of some of the measures taken to help assure safe operations.

The safeguards outlined in Table 3 are broken into 3 categories: Procedural, Engineering, and Monitoring. Although the items are presented as discrete, in practical application they are often closely interrelated. For example, the continuous emissions monitoring is an integral part of the automatic waste feed shutoff (AWFSO) system. That is, if a monitored stack gas component goes above a predetermined acceptable limit, a signal will cause the AWFSO to activate. Furthermore, both of these particular provisions are required to operate a permitted hazardous waste incinerator, and therefore can be considered under the "regulatory compliance" activity.

Some of the items in Table 3 bear further explanation to illustrate how they can serve as safeguards to public health and safety. For example, the National Environmental Policy Act (NEPA) is an administrative requirement imposed on all major activities where federal monies are spent. For lethal agent incineration, NEPA requires that a detailed Environmental Impact Statement (EIS) be prepared for not only the concept of on -site agent incineration,

but also each site-specific incineration facility as well. An EIS requires careful analysis of all actual and potential impacts that an activity will have on the surrounding environment and community. Typically, there is considerable overlap in measures that are identified to be protective of both the environment and public health. NEPA forces a comprehensive and structured review of all such issues early in the planning cycle for major federal projects.

Table 3 - Lethal Agent Incineration Safeguards		
Procedural	**Engineering**	**Monitoring**
National Environmental Policy Act (NEPA)	Robotic material handling system	Operating parameters
Systemization	Specialized incineration systems.	Continuous emissions
Operational Verification Testing	Pollution Abatement System	Depot Area Ambient Air Monitoring Systems (DAAMS)
Preoperational Surveys and Inspections	Automatic Waste Feed Shutoff Systems	Automatic Continuous Air Monitoring Systems (ACAMS)
Extensive Training Personnel Protection	Controlled Air Handling	Visual Surveillance
Contingency Planning	Specialized Containment	Medical Monitoring
Test Burns (Stack Sampling)	Safety Interlocks	Quality Control Quality Assurance
Regulatory Compliance		

Systemization, operational verification testing, preoperational surveys, and test burns are all activities that are intended to assure that all incineration and support activities function as designed. For example, under systemization, furnaces may be operated on supplemental fuel only, while the performance of interlocks, emissions monitors and so forth are tested and fine tuned to perform up to specification. Preoperational surveys may be conducted before or during test burns as an outside audit to assure that standard operating procedures are in place and being followed, as well as, inspecting physical plant and support functions to assure that they are performing correctly.

Operational verification testing is designed to demonstrate an incinerator and materials handling systems readiness for various combinations of agent and munitions. Under all of these activities, it is typical that testing is first done with fuel only, followed by feeding a relatively safe agent simulant to the incinerator, and finally by feeding actual agent to the system. Concurrent with all of this is an intensive operator training program that allows operators to train under routine and contingency conditions in a full-scale prototype plant, complete with all robotic materials handling equipment.

A major safety tenet of the incineration of lethal agent is that agent must not be released to the air environment in an uncontrolled manner. For incineration, there are three ways that such releases can be anticipated to occur. The first is associated with the handling of agent and munitions to actually get them into the incinerator in the appropriate form. Munitions may require disassembly, or punching to be drained. Ton containers, likewise, have to be pumped of their contents. These processes have the potential for spills, leaks, or other uncontrolled releases of agent. Similarly, once the agent is in the incinerator combustion chambers, an overpressure condition can cause leaks or fugitive emissions of

agent and other airborne partial-breakdown products of combustion. Finally, if the combustion chambers are overloaded or not operated properly, agent could pass through the pollution abatement system and out the stack. All of these release-potential situations point up the need for effective engineering measures to assure that such releases will not present a health or safety problem.

The first two of the above agent-releases scenarios would be considered as "fugitive emissions" released at ground level. If left unchecked, such emissions could have significant effect on site personnel, and with a large release, agent could conceivably migrate off-site into a nearby community. Recognizing the need for tight control over potential fugitive emissions, it was decided to design and build the facility so that all activities where fugitive emissions are reasonably likely to occur be located in enclosed space where air movement could be carefully controlled. The result of this decision is a carefully designed air-handling system that directs all plant air through banks of charcoal filters maintained with ample redundancy. These filters are monitored for agent continuously at several locations between individual filters. This allows for an ample margin of safety to replace filters before agent breakthrough to the external environment could possibly occur. The entire building and its processes are maintained at a negative pressure with respect to outside ambient air pressure, thus assuring that air leakage is directed into the controlled air handling system.

The agent stack-release scenario is primarily controlled through the provision of proper combustion conditions within the incinerator. This is assured by a combination of good system design, careful system operation by well-trained operators, and automatic systems monitoring and interlocks designed to allow agent feed only when all operating parameters are functioning as designed. Additionally, the incinerator stacks are equipped with real time agent monitors (ACAMS) tied into alarms to signal the event of agent detection. ACAMS are placed throughout the facility where agent is handled in order to provide complete monitoring of plant air. The ACAMS are supplemented with time-weighted-average monitors (DAAMS) that provide verification of the ACAMS and quantify potential releases. Both the DAAMS and ACAMS are subject to a rigorous quality control and assurance program that has been strongly influenced and reviewed by DHHS.

Current Status of Agent Disposal Program

As mentioned previously, this program has proceeded with caution and deliberation. Much of the actual incineration experience to date has been achieved at two facilities. The first facility, known as the Chemical Agent Munitions Disposal System (CAMDS) is located at Tooele Army Depot, Tooele, Utah. This facility consists of somewhat-less- than-full scale incinerators for each of the four major waste categories previously described. Each incineration system is complete with specialized material handling systems for safely feeding the waste into the incinerators, plus a complete pollution abatement system to treat incinerator combustion products. Specialized air handling systems and area agent monitors are provided throughout. The CAMDS operates under a hazardous waste operating permit issued by the State of Utah.

The major purpose of CAMDS has been to develop actual large scale operating experience for various agent/munitions combinations and with all system safeguards in place. This experience has been gained using the procedural safeguards described previously. Also much of the experience gained has served to help optimize the further development of full-scale facilities for other stockpile locations.

The first operating full-scale incineration facility was the Johnston Atoll Chemical Agent Disposal System (JACADS) located on Johnston Island in the Pacific Ocean. This facility, operating under an EPA hazardous waste permit, has extended and complemented

the CAMDS experience in a four phase "operational verification testing" program. Again, all system safeguards and monitoring provisions are in place and fully functional during all tests of the various agent/munitions combinations.

The results of the testing at these facilities has been encouraging and instructive. They have afforded the Army the opportunity to refine materials handling systems, monitoring systems, incineration and pollution abatement hardware, and operating procedures under safe and controlled conditions. Accordingly, through the processing of thousands of pounds of lethal agent to date, there has not been a single uncontrolled agent release resulting in an exposure to the general public. Similarly, it has been demonstrated that the various agent/munitions combinations can be safely incinerated while meeting standards imposed by environmental regulatory agencies. The incineration facilities at the other agent stockpile locations are in various stages of planning, permitting, or construction.

Future Directions for DHHS Involvement

As required by law, DHHS has closely reviewed the incineration activities of the Army to date. It is anticipated that DHHS will continue to participate in such reviews, surveys, and inspections as the incinerator program moves forward at other stockpile facilities in the continental United States. It is also recognized that there may be technology improvements in any facet of the systems, ranging from materials handling, to new incineration technology, to new pollution control technology. There may even be advances in alternative technologies that would be preferable to incineration. For any such developments, DHHS will have to closely examine their potential for public health impact with the same level of scrutiny as has been exercised to date.

The focus of this paper has been on the incineration of stockpiled chemical warfare agents. It should be noted that within the last year, the Army has undertaken a major effort to address the issue of non-stockpiled lethal agent handling and disposal. These materials include items such as found agent-filled munitions used extensively in training and testing between World Wars I and II, old disposal sites for such materials, old equipment and vessels used in the production of such items, and other miscellaneous materials potentially contaminated with lethal chemical or biological agents. Although the Army is still scoping the magnitude of this program, it has been estimated that there may be as many as 90 sites in the United States that will have to be addressed. DHHS has already been involved in the early stages of this program in advising on the handling, storage, transportation and ultimate disposal of such materials. It is anticipated that this new program area will require considerable DHHS involvement.

CONCLUSIONS

The chemical agent destruction program has proceeded slowly and with due deliberation. The DHHS oversight mechanism envisioned by Congress has generally worked well. The Army has showed good cooperation in keeping DHHS informed and involved as needed. The Army has also been very responsive in addressing the issues raised by DHHS and incorporating changes as recommended. The result of this program has been the evolution of systems that are demonstrated to be safe to both workers and the public.

To maintain the level of effectiveness achieved will require a continued vigilance by the Army, DHHS, and regulatory agencies. New technology evolution and the emergence of new problems will continue to provide an exciting challenge for the foreseeable future.

91. RESPONDING TO A TERRORIST INITIATED TOXIC CHEMICAL RELEASE: PROTECTING HIGH VALUE FACILITIES AND VERY VULNERABLE POPULATIONS

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ABSTRACT

The release of a toxic chemical agent in a densely populated urban area, whether the direct result of a deliberate terrorist event or as an accident, poses a wide variety of serious challenges for crisis management authorities. The immediate concern is collecting information in a timely fashion so that first responders can take appropriate action to protect people and certain high value facilities such as emergency control centers, fire and police stations, military or national guard bases, and utility control centers from the toxic chemical agent. Timely and accurate information is critical to crisis managers who must decide whether to evacuate highly vulnerable populations, from locations such as hospitals, schools, retirement centers, and detention facilities. Specifically, first responders must know the direction, duration, and probable effects of toxic plumes in order to protect these populations.

This paper will discuss a solution offered by the Risk Management Planning (RMP) Chemical Plume Detection System. Originally developed by Dupont®, the RMP system is the result of a combined effort among industry scientists, academicians at the University of Wisconsin and the University of Mississippi, and is supported by remote satellite imagery provided by the National Aeronautics and Space Administration (NASA).

The RMP system is the world's only chemical plume detection and mapping system that uses real-time, on-site meteorological data and combines it with mathematical algorithms which describes and anticipates the ways that chemical gases "move" through the atmosphere. In addition, the RMP system is enhanced by the Cityscape® modeling feature that uses NASA satellite imagery to literally paint a picture of how gases move within an urban environment. The RMP system currently is being upgraded to add biological and radiological sensors to the meteorological towers and this new data will be imported into the overall model providing additional capabilities.

This paper will review how the RMP model is presently being employed and field tested by authorities in New Orleans, Louisiana.

BACKGROUND

Recent experience indicates that first responders and public health officials are ill-equipped to deal with the results of a terrorist inspired chemical gas attack. Experience gained from the 1995 Tokyo subway attack demonstrated that civil authorities had no readily available technology to detect the identity of the toxic plume in the subway or to predict how others in the vicinity could be impacted. Fortunately, the attack within the bowels of the Tokyo subway system, kept the chemical gas from widely dispersing throughout the city.
If the event had occurred above ground, local wind and weather conditions would have determined the direction of the plume and, consequently, the number of people at risk to death or injury.

The RMP system has been designed to provide command and control information to government authorities and crisis managers in response to such an event. The RMP system employs both mobile and fixed meteorological (MET) towers. The self-aligning unit

continuously transmits real-time data to an operations center. The data is logged every second and five minute average reports are generated to create plume maps of the affected area.

This data includes wind speed and direction, temperature, barometric pressure, solar radiation and relative humidity. Since the data is real time and is continuously updated, crisis managers can remain flexible in deploying response assets in an environment where the weather is rapidly changing.

In theory, such meteorological data, collected in a flat terrain and open environment should provide a good predictive model of where and how fast the chemical plume will travel. However, in areas of complex terrain or densely built up urban areas, it becomes crucial to account for topographical features in modeling the dispersion and transport of a chemical release.

CREATING A VALID URBAN MODEL

How can a valid model of an urban area be created using this collection of meteorological data ? What elements must be incorporated into the design to insure that we are really modeling what we think we are ?

RPM first tested this system during a US Government anti-terrorism exercise carried out in New York City. Operation ICE simulated a sarin gas release in Manhattan and mapped the flow of the simulant in a densely populated, highly built up urban environment. The results of this test demonstrated that a plume can move up and down streets, turn corners, and generally behave in a fashion that might appear counterintuitive. That is, just because there is a brisk wind blowing out of the north, the plume may not necessarily move in a strict southerly direction.

In addition, the risk to residents of a particular building is a function of the air handling system. Air vents and subway ventilation pipes can draw the plume into a specific area. Facilities with centrally controlled air handling systems can regulate the amount of outside air brought into the building. Reducing the air intake can mitigate the amount of toxin introduced into a facility. In addition, tall buildings create micro-wind fields that create swirling patterns and large, massive buildings like a sports arena can generate changes in the ambient barometric pressure causing the plume to move towards an area of a lesser pressure. All of these structures affect how a chemical plume will behave.

New Orleans is an important test bed for the RMP system. First, most of the city of New Orleans is actually located below sea level. This is a different situation than, say Dubrovnik, because we test the behavior of a chemical plume that flows to lowest point in the area. In other words, the plume will "hug" the streets of the city as it moves to the coastline. Second, a large portion of all chemicals that are shipped in the US every year pass through New Orleans so the possibility of accident is quite high. Third, in cooperation with NASA, we have been able to create an accurate model of the city complete with all existing building's scaled to real size. Taken together, we have been able to identify specific buildings, housing vulnerable populations, which would be under extreme risk if a chemical gas incident were to occur in the New Orleans area.

HOW THE RMP SYSTEM WORKS

The RMP system offers crisis managers two options. First, it can be used as an area planning and crisis management tool. With strategically placed MET towers in an urban environment, the RMP system can provide real time data on the behavior of a plume in the city streets. Second, the RMP system can incorporate data from particular facilities, e.g., hospitals or schools, and be used to make decisions whether or not to evacuate. The analysis of a building permits authorities to identify spots were gas could leak into a building or where

it would be drawn in by the ventilation system. This information is included in a comprehensive emergency action-planning document. Additionally, three separate models are included in the overall analysis and this information is also added to the model.

INFILTRATION/EXFILTRATION MODEL

The key issue that faces emergency authorities when a chemical release occurs is what to do about specific populations in buildings that may be at risk from a toxic chemical plume. Should the building be sealed or evacuated? How much time would be needed to evacuate the site and where would the occupants be taken? How long before it is safe to return to the affected building? If the building is sealed, when can it be re-opened?

To answer these questions, the infiltration portion of the RMP model calculates the average indoor concentration and dosage within the building. This is carried out when there is an external release of an agent which will impact a particular building or a vulnerable population in a specific area. The calculations are based on the construction of the building and its primary air exchange rate coupled with an analysis of the outdoor chemical concentration levels and local meteorological conditions. This provides for a determination of the time that the indoor and outdoor concentrations reach a safe level so that the building can be reopened.

The system is also relevant in the event that a toxic chemical release occurs within a particular building, such as a major high rise housing government offices. The rate at which a chemical can subsequently be released into an outdoor environment will be calculated using an analysis of the building's vents and air flow exchanges and added to local meteorological conditions. This data will be imported into the overall RMP model so that the plume can be tracked after it is released from that structure. This portion of the model will be able to identify when it is safe to return into a particular building.

OTHER INFORMATION PROVIDED BY THE RMP MODEL

Additional information is required by emergency and response personnel. The RMP system provides plume graphics, downwind impact reports, toxicological reports, first aid reporting, population impacts and human response reports. The last two are extremely important in protecting vulnerable populations or high value buildings.

The Human Response Model predicts the toxic response of an individual, within an average population, by taking into account the specific chemical toxicity of the particular agent(s) in the release. This is calculated to determine injury and mortality impacts in a given area.

The Population Impact Model estimates the number of people who may be impacted from the release by taking a number of variables into account: the actual population distribution pattern for a given area, evacuation times, sheltering options, and the aforementioned building infiltration rates. The model then employs an infiltration algorithm to calculate impact reports identifying toxic loads, lethal exposure potentials, indoor dosages and concentration profiles as well as total numbers of individuals impacted by the release.

Taken together, these three models provide a complete picture of what impact a chemical release will have on a specific area, building or vulnerable population. This is critical to developing alternative methods to protecting life and property in areas that may be vulnerable to certain types of releases, i.e., urban business areas that are adjacent to a harbor facility where large quantities of chemicals may be transshipped. At the same time, the data from these models can be used to develop better coordination among emergency response and government agencies and allow them to model different scenarios for specific buildings which house sensitive facilities or are home to vulnerable populations.

MULTICOMPONENT RELEASES

It is often assumed that a toxic release would only involve a single chemical agent during an incident. However, a multicomponent release forces the model to simultaneously carry out a number of calculations since dispersion rates of each component and their toxicity levels must be calculated. At the same time, pool evaporation rates for each component must be derived and inputted into the model.

At the present time, the RMP model has analyzed multicomponent releases involving aqueous solutions of hydrochloric acid, ammonia, formaldehyde, fuming mixtures of chlorosulfonic acid, flourosulfonic acids and oleums. An event, such as a truck bomb or a train derailment, can cause the release of those chemicals in addition to those released initially. An explosion in or near a manufacturing facility that uses toxic chemicals in its production processes could trigger the release of those chemicals. Thus, it would not be prudent to assume that a gas plume from a toxic release would only contain a single agent. Moreover, because each chemical behaves in a different fashion, an accurate prediction of how the movement of a plume will impact a particular building must take the multicomponent issue into account. The RMP model incorporates these calculations into the overall analytical product.

THE NEW ORLEANS CASE STUDY

The RMP model will be tested in New Orleans to verify the components of the model. Vulnerable buildings have been identified and analyzed to develop an emergency response plan so that in the event of an incident, authorities located within the building have specific steps to take. For example, at Charity Hospital, an evacuation plan would move non-ambulatory patients into a loading dock area for transport on large, delivery type vehicles is in place. At the same time, procedures for shutting down ventilation systems and sealing the building are in place. Similar plans have been developed for a number of schools and emergency related government buildings located throughout downtown New Orleans. The detention center provides a difficult situation since it is located adjacent to the New Orleans waterfront and is in the lowest spot in the city. In the event of a chemical release, the plume would tend to flow towards a building holding thousands of prisoners in hundreds of locked cells. It would be impossible to evacuate this building in a short period of time.

Will these actions dictated by the RMP system completely safeguard the entire population within these buildings? Probably not. However, after adopting the RMP system, the odds for safe evacuations and minimal injuries and deaths will greatly increase. The very fact that we have walked the planners and responders through a detailed plan that can be used in the event of a chemical plume incident in and of itself dramatically improves the odds that the event can be managed in a more responsible fashion.

CONCLUSIONS

The RMP system is designed to save lives and minimize property damage in the event of a toxic chemical release, either one that is accidental or the deliberate results of a terrorist action. The system has been field tested and it has been proven to enhance cooperation and coordination among emergency response agencies. The installation of the system makes a powerful statement about a government's willingness to take a proactive stance in ensuring the safety of the community. In that regards, it is an important tool in the psychological battle between the civilized world and those extremists who wish to employ a weapon of mass destruction to advance their political objectives. Moreover, the deployment of the RMP system can be used as a strong deterrent and it will put terrorists on notice that their attempts

at disrupting an urban area with a chemical attack will be met with a corresponding action to minimize these actions.

Use of the RMP system will reduce training costs, reporting burdens, and planning time for emergency response agencies while serving to fully integrate real-time solutions into a comprehensive response plan.

KEY WORDS
Plume analysis, population impacts, vulnerability analysis, risk analysis

92. INDUSTRIAL CHEMICALS AS WEAPONS OF MASS DESTRUCTION

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ABSTRACT

Industrial chemicals are used more frequently as weapons of mass destruction by terrorists than military chemical warfare agents. A database of incidents involving intentional releases of industrial chemicals was developed to determine those that should be addressed in training programs for agencies in the USA that have domestic or international emergency response missions involving hazardous substances. The database was developed from a variety of sources, including United Nations disaster databases, news media reports, and chemical industry databases of high production volume chemicals. An analysis of the frequency of incidents and potential hazards indicated that flammable gases such as liquified petroleum and natural gases posed the greatest hazard, followed in order of descending frequency and hazard by flammable liquids (e.g., gasoline), poison industrial gases (e.g., ammonia and chlorine), solid and liquid poisonous substances (e.g., pesticides), and radiation. Training programs were developed and conducted for several US military, public health, and public safety agencies based on these results.

INTRODUCTION

A number of countries participating in the Chemical and Biological Medical Treatment Symposia (CBMTS) are preparing to address the emerging threat of chemical terrorism. Preparations to address this threat have increased substantially in the United States since 1996. During this process, several lessons have been learned that may be of interest to other countries participating in CBMTS. In the USA, we learned to broaden our threat analyses to include common industrial chemicals, rather than focusing solely on improvised military chemical agents. We then learned not to focus only on extremely toxic and rare industrial chemicals; but also to consider common chemicals of lesser toxicity but greater accessibility. We learned to focus on all four major industrial chemical hazards (ignitability, corrosivity, toxicity, and reactivity) rather than on toxicity alone. Finally, we learned to review previous history and local conditions as part of the threat assessment and preparation processes.

In the first CBMTS industry conference, the author presented a 10-step method for identifying, mitigating, and responding to incidents of industrial chemical terrorism.[1] At the CBMTS conference held in Spiez in 1999, the author presented a database structure for training first responders on a broad range of hazardous chemical incidents.[2] The purpose of this paper is to present preliminary results from that training database focused on industrial chemicals that pose the most plausible threats from deliberate releases, such as those that may occur during incidents of terrorism, conflicts, and sabotage. More details about the topic may be found in the presentations from the CBMTS-Industry II Pre-Conference Workshop on Industrial Chemicals as Weapons of Mass Destruction. Finally, this paper describes current efforts by an international task force to further refine the list of chemicals that may pose hazards as a result of deliberate or collateral damage releases, and to develop a searchable database of assessment and assistance information for those chemicals. We hope to able to present the results of the international task force efforts at future CBMTS conferences.

METHODS

The structure for the hazardous substances database consisted of identifying critical factors for common types of hazardous substances emergencies, and incorporating those factors into three key words: DISASTER, ASSISTANCE, and ASSESSMENT. Each common type of incident had a worksheet in the database, and each worksheet listed critical factors whose first letter was one of the letters in a key word. This teaching technique is called mnemonics, and it is used to assist students in remembering key factors for various types of analyses. For the key word DISASTER, the factors to be considered for each type of incident were Dangerous times when the incident may occur, the type of Incident (e.g., bombing), Sites where incidents may occur, Acids and bases involved, Smoke and fire hazards, Toxic substances, Explosion hazards, and Reactivity hazards. For the key word ASSESSMENT, the factors were Amounts released, Sources of chemicals, Signs of a release, Environmental media or delivery methods involved, Sensitive populations, Syndromes, Morbidity and mortality in past incidents, Equipment currently available, Needs (population support needs, first responder needs, risk communication needs, etc.), and the Training level of the current responders. For the key word ASSISTANCE, the factors were Acute care, Sequellae and care, Supplies, Information, Safety and security issues, Training assistance available, Analyses (with emphasis on rapid field methods for identifying chemicals), Necessities for population support (e.g., food, water, and shelter), Communications resources (telephone hotlines, fact sheets to assist in risk communication), and appropriate Equipment assistance.

After developing the database structure, a two-phased approach was initiated to incorporate information into the database on industrial chemicals likely to be present in recurring types of incidents, such as accidents, natural disasters, conflicts, sabotage, and terrorism. In the first phase, which is the focus of this paper, historical information about major emergencies and disasters involving hazardous chemicals was incorporated into the database. The second phase will involve a more extensive analysis of dangerous high production volume chemicals around the world.

Historical information about disasters and other emergency incidents involving industrial chemicals was obtained from media reports, conferences (such as CBMTS-Industry I), existing databases (e.g., the United Nations Awareness and Preparedness for Emergencies at the Local Level, or APELL, chemical accident database)[3], chemical references, and published papers.

For the second phase, information about high production volume chemicals has been obtained from lists developed by the Organization for Economic Co-Operation and Development (OECD) in 1997[4] and the International Council of Chemical Associations in 2001[5]. These lists will be cross-referenced with U.S. National Fire Protection Association hazard markings to select those that are moderately to highly hazardous, and further cross-referenced with lists of producers in the Directory of World Chemical Producers, to select those chemicals that are potentially dangerous, produced in high volumes, and are produced in many locations. Worksheets will then be developed for those chemicals in the database.

RESULTS

One of the references used to develop the first phase of the database was a report prepared by the United Kingdom's Institute of Terrestrial Ecology, in which a number of international chemical accident databases were evaluated[6]. The Institute's report indicated that about 55% of the accidents occurred at fixed facilities, about 40% occurred as the result of chemical transportation (pipeline, rail, ship, and truck), and about 5% occurred during the transfer of chemicals from storage facilities to transporters, or vice versa. Only 3% of the

total number of accidents reviewed by the Institute were the result of deliberate releases (e.g., conflicts, sabotage, and terrorism). Most were the result of accidents, dumping, or defective containers.

The APELL database contains information for about 300 major chemical accidents that occurred between 1970 and 1998. About 15% of the accidents occurred with fuel gases (e.g., liquefied natural and petroleum gases, natural gas, and propane); about 8% respectively involved petrochemicals and liquid fuels (e.g., gasoline), and about 7% involved oil. Therefore, roughly the 38% of the accidents occurred with hydrocarbons (fuel gases, fuel liquids, oil, or refined petroleum products such as aromatic hydrocarbons).

About 15% of the accidents in the APELL database involved explosive industrial chemicals (e.g., black or smokeless powders, ammonium nitrate fertilizers, or dusts).

About 8% of the APELL database accidents involved chlorine, about 6% involved ammonia, and another 6% involved industrial acids and bases. Taken together, these corrosive substances account for 20% of the accidents listed.

Pesticides and chemical intermediates accounted for 3% of the accidents respectively.

The remaining 21% included polychlorinated biphenyls (PCBs, 2%), radiation sources (1%), unspecified chemicals (5%), and other types of chemicals (13%).

Recent news media reports and published chronologies of terrorist attacks indicate that industrial chemicals most frequently used or targeted by terrorists are the same groups of chemical described above; that is, they are the same groups of chemicals most frequently released as a result of all causes in the UN APELL database. This indicates that the industrial chemical database developed for training first responders on a broad range of emergencies may be used to conduct training on industrial chemical terrorism.

Hydrocarbons lead the list of industrial chemicals used as weapons by terrorists. Terrorists bombed oil pipelines in Colombia 73 times in 1998, 96 times in 1999, and 97 times in 2000[7-9]. Many of these attacks resulted in substantial casualties. In October 1998, 41 people were killed and 70 injured by a terrorist bombing attack on a Colombian pipeline. In December 1998, 73 people were killed when terrorists bombed British Petroleum's Ocensa oil pipeline, which set the village of Machuca on fire. The number of deaths in these incidents exceeded the number killed in the Aum Shinri Kyo nerve agent attack on the Tokyo subway system. The violence has spilled over into Ecuador, where a terrorist bombing attack on a pipeline in Sucumbios province killed 8 people in December 2000[10]. Oil exploration, production, and transportation is increasing in a number of locations around the world where terrorism is present, including Angola, the Caucusus, Chechnya, Gaza, Nigeria, and the Tri-border region of Argentina, Bolivia, and Paraguay. The U.S. Department of State reports that terrorist attacks on petroleum industry infrastructure in Nigeria are increasing[11]. INA petroleum production and distribution facilities in Croatia suffered damage as a result of deliberate attacks during the conflict with the Federal Republic of Yugoslavia[12]. Toxic substances in hydrocarbon smoke (in this case, carbon monoxide) caused ten injuries among firefighters responding to attacks on INA's Sisak refinery in October 1991. Therefore, analyses of industrial chemical terrorism must include hydrocarbon production, storage, transportation, and distribution facilities at the top of the list of potential targets.

The U.S. Department of State reports that, inspite of rhetoric by some terrorist groups advocating the use of military chemical agents, most terrorists continue to favor explosives, firearms, and abductions as their primary means of attack[11]. Industrial chemicals have been and will continue to be used as chemical intermediates by terrorists to fabricate explosives, as was the case in the World Trade Center, Oklahoma City, and Nairobi embassy bombings[13-15]. The explosive properties of industrial chemicals themselves may also be employed as weapons.

Attacks on chemical industries in Croatia during the conflict of 1991-1995 resulted in actual or potential releases of large amounts of ammonia, chlorine, inorganic acids, and organic acids in Zagreb, Kutina and Jovan[16,17]. Corrosive decomposition products in hydrocarbon smoke (nitric and sulfuric acids) were released during attacks on refineries such as Karlovac and Sisak. Therefore, corrosive industrial chemicals, and corrosive decomposition products in smoke from industrial chemical fires, must be considered in analyzing potential industrial chemical terrorism hazards.

Pesticides and chemical intermediates have also been targeted during deliberate release attempts. Attacks on Croatia's Herbos pesticide plant and Pliva's Pharmaceutical plant during the conflict of the 1990s had the potential to release large amounts of hazardous chemical intermediates into nearby populated areas in Sisak and Zagreb[17,18]. The release of methyl isocyanate at Bhopal in 1984 is now thought by some experts to have been the result of an act of industrial sabotage[19].

Other common chemicals that have been used in terrorist attacks include arsenic, cyanide compounds, mercury, phosgene, and thallium. With the exception of the Aum Shinri Kyo phosgene attack on a Yokohama rail sttaon, most of these attacks involved poisoning a limited number of individuals. One lesson to be learned form these attacks is that the inhalation and skin routes are not the only ones to consider when addressing industrial chemical terrorism: ingestion is an important pathway that has been used on several occasions.

Many of the attacks described above, particularly those targeting hydrocarbons plants and pipelines, were not motivated by attempts to release the industrial chemicals because they were highly toxic. Rather, the chemicals had strategic value during a conflict (in the case of Croatia, fuel production refineries), or they represented a political target (in the case of Colombia, the presence of foreign oil companies). Thus, chemical terrorism preparedness programs focused solely on assessing sources of extremely toxic chemicals may well miss the facilities and infrastructure most likely to be targeted by terrorists.

CONCLUSIONS

Industrial chemicals in the situations described above are not rare, extremely toxic substances. They are relatively common high production volume chemicals, present in most industrialized areas of the world. Therefore, they may be encountered in emergencies resulting from accidents as well as deliberate releases. First responders may use existing chemical safety references and databases to prepare for terrorism involving these chemicals. Many of these chemicals pose multiple hazards: ignitability, toxicity, corrosivity, and reactivity. All four hazards should be addressed when preparing assessments and identifying appropriate assistance measures to respond to deliberate releases. An in-depth analysis of hazards related to high production volume chemicals will be conducted as a second phase in the development of a hazardous substances database for first responders. The results of this second phase will be reported to participants in future CBMTS conferences.

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KEYWORDS

Terrorism, chemical, industries, oil, emergency response

93. CDC PUBLIC HEALTH OVERSIGHT OF CHEMICAL WEAPONS DISPOSAL

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ABSTRACT

The Department of Health and Human Services is mandated by Congress to protect the health and safety of the workers and surrounding communities during the transportation and disposal of chemical warfare weapons. This responsibility was delegated to the Chemical Demilitarization Branch of the Centers for Disease Control and Prevention (CDC). CDC performs this mission by assessing the disposal process, evaluating the chemical agent monitoring systems, setting chemical agent exposure limits, and preparing communities to respond to medical emergencies related to the chemical disposal program.

KEYWORDS

Chemical demil, chemical monitoring, chemical disposal program

94. THE CDC NATIONAL PHARMACEUTICAL STOCKPILE: CONTENTS AND IMPLEMENTATION

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The National Pharmaceutical Stockpile (NPS) consists of drugs and medical/surgical items provided to the U.S. population to reduce morbidity/mortality associated with bioterrorism.

The NPS contains antibiotics, nerve agent antidote, cardiac/respiratory support drugs, and IV fluids. A sufficient quantity of ancillary items to administer and dispense drugs are also provided, (e.g., IV catheters and administration sets, syringes, needles, dispensing bags. Airway management supplies provide portable intubations and ventilator capability for both chemical and biological events. Wound care products are available to care for trauma associated with any type of event. The NPS antibiotic formulary was selected to deter the effects of agents such as inhalational anthrax, plague, and tularemia. Currently, the NPS is stocked with both oral and parenteral versions of a fluoroquinolone, aminoglycoside, and tetracycline derivative. Chemical response consists of an oxime type antidote, anticholinergic, and benzodiazepine symptomatic treatments. Ancillary drugs for cardiac/respiratory support are potentially applicable for any type event. They include vasopressors, corticosteroid, and a beta agonist. Morphine injection is stocked for severe pain management associated with trauma. Lorazepam addresses the need for sedation and patient control during ventilator support.

The philosophy of including sufficient quantities of every ancillary item that may be needed for drug administration and dispensing removes the assumption that the local incident scene will have these items on hand. Under the guise of managed health care, it would be unsafe to assume that sufficient local inventories if med/surg items exist seamlessly throughout the U.S.

The NPS airway management supplies were selected to enable emergency providers to intubate, suction, and ventilate civilian populations. Manual ventilator devices can provide more immediate care, while mechanical equipment provides longer-term needs. The equipment was chosen in various sizes to provide care to infant, pediatric, and adult populations.

Likewise, CDC's NPS Program has attempted to address all ancillary needs to efficiently execute the oral drug dispensing process. Program staff are in the process of evaluating the utility of tablet counting machines for dispensing mass oral prophylaxis. These dispensing aids may act as a sole source or adjunct process to a local incident response plan.

Because the mission of CDC's NPS Program is to provide both treatment and prophylaxis, drugs are available in both oral and parenteral forms. Oral suspensions are included for children and those adults who cannot swallow tablets. The drugs are provided in forms allowing for dosage adjustment based on weight, age, or medical conditions. The chemical response drugs are provided in a military designed spring-loaded injector form, allowing rapid IM administration.

The quantities for each antibiotic were chosen based on the desired number of victims to treat and prophylax for each threat. The numbers of victims, or "N," are derived by technical expert "worst case scenario" threat analysis. The quantities are not static, and will be adjusted up or down as more research and intelligence community information is provided to NPS Program.

Interagency and non-governmental medical expert panels are also routinely convened to determine optimal drug regimens for the identified threats. CDC's preferred treatment for inhalational plague is aminoglycoside monotherapy. Alternatively, a tetracycline derivative is also approved and effective. If patient improvement allows, the treatment course may be completed with a cost-effective oral equivalent.

CDC recommends an oral tetracycline derivative for post-exposure plague prophylaxis. Asymptomatic persons having household, hospital, or otherwise close contact with confirmed untreated plague cases should receive a 7-day course and be monitored for fever and cough. Pediatric doses are adjusted based on age and weight.

Symptomatic inhalational tularemia also responds to aminoglycoside and tetracycline derivates. Additionally, an IV fluoroquinolone can be used. Given the variety of treatment options, the cost factor may come into play when considering treating a large population. In such cases, the aminoglycoside is least expensive, but burdens the health-provider system with a greater degree of therapeutic level and side effect monitoring. Both tetracycline derivative and fluoroquinolone are applicable for post-exposure prophylaxis against tularemia.

In vivo data supports the use of both fluoroquinolone and tetracycline derivative for treatment of inhalational anthrax. In the absence of definitive sensitivity tests, CDC recommends the use of a fluoroquinolone, as tetracycline and penicillin resistant strains of *B anthracis* are known to exist. The tetracycline derivative is, by comparison, much less expensive, emphasizing the need for timely sensitivity results when treating large populations. Because risk of recurrence remains high after IV treatment due to delayed germination of spores, it is recommended that therapy continue with an oral drug equivalent for a total of 60 days.

In the absence of definitive sensitivity tests, it is recommended that anthrax post-exposure oral prophylaxis also be initiated with a fluoroquinolone. The U.S. Food and Drug Administration (U.S. FDA) recently approved a fluoroquinolone as the first anthrax aerosol post-exposure antibiotic regimen. Like treatment, oral penicillin and tetracycline derivatives should be reserved until the strain is proven susceptible. Besides more cost effective, penicillin and its derivatives exhibit a safer side effect profile for children and pregnant women. Thus, conversion to these classes is desirable for these groups considering the long duration of therapy.

Compared to biological response, dosing guidelines for treating nerve agent exposure are based on multiple and sometimes subjective variables. Treatment for inhalational organophosphate is based on the amount of time that has elapsed since initial exposure and presenting symptoms. Minimal exposure (miosis, nausea, vomiting) that occurred more than 5 minutes ago may only require observation. Conversely, moderate exposure that includes dyspnea warrants a first dose of an oxime and anticholinergic agent, with subsequent observation for reversal of symptoms.

Over time, the nerve agent's binding affinity to cholinesterase becomes irreversible. The oxime drug is less effective at reactivating cholinesterase as the enzyme/organophosphate bond matures. Therefore, it is essential to administer the oxime as soon as possible after exposure. This clinical reality has direct implications for emergency response logistics. Where chemical antidotes are stockpiled and how they will be transported

to incident sites must be carefully planned out in advance. Treatment is more aggressive in direct relation to symptom severity. Some patients may require after care with IV maintenance infusions in a facility setting.

Ancillary drugs in the NPS are non-specific to chemical or biological events. They include the vasopressors dopamine and epinephrine and IV fluids for blood pressure maintenance. Corticosteroids and epinephrine are stocked for potential anaphylactic reactions. Bronchodilators have application for dyspnea secondary to both chemical and biological inhalational threats. In the case of an incident that includes an explosion, sever pain management with morphine injection may be necessary.

CDC must take into consideration all special civilian populations when choosing drugs and medical/surgical items for formulary inclusion in the NPS. For example, drug monitoring for renal compromised patients receiving an aminoglycoside should include dosage adjustment based on blood level monitoring. Several of the NPS antibiotics have significant precautions for use in children and pregnant women. Risk versus benefit issues must be taken into consideration.

Currently, one NPS 12-hour Push Package is designed to provide approximately 5-day empiric (pre susceptibility test) anthrax prophylaxis with oral fluoroquinolone to 48,000 persons. Depending on incident specific variables, the 60-day regimen may be completed with the same fluoroquinolone, or cost-effective alternatives. If the decision is made to maintain the same fluoroquinolone for the full regimen, prophylaxis capacity is reduced within a 12-hour Push Package, as the stock of tetracycline derivative will not be used. In such case, the Vendor Managed Inventory (VMI) portion of the NPS will be called upon to provide more of the same fluoroquinolone.

One 12-hour Push Package has the capacity to prophylax 180,00 and 200,000 persons against plague and tularemia. Overall, IV treatment capacity in the NPS is much less than that of oral prophylaxis. It is estimated that the majority of the population after exposure will present as asymptomatic (mostly because they are not infected) and therefore suitable for oral prophylaxis. Especially in the case of anthrax, the majority of victims that become symptomatic will not survive, in spite of initiating IV treatment. Therefore, CDC believes it can have greatest impact of reducing mortality by providing oral prophylaxis to asymptomatic persons at risk of having been exposed.

Because morphine and benzodiazepines have potential for abuse, they are classified as "controlled substance" in the U.S., and therefore subject to strict storage, transfer, and security regulations. This presents a potential burden for drugs that may be needed to respond to an emergency. Therefore, the CDC is working with the U.S. Drug Enforcement Agency (DEA) to determine policies/procedures for efficient handling these items under the guise of a bioterrorism scenario.

The NPS includes written and electronic drug information specific for patients and health care providers. The patient data includes side effect and proper use information available in multiple languages. Issues of patient consent and tracking for efficacy and side effect monitoring have also been addressed.

95. DEVELOPMENT AND IMPLEMENTATION OF CIVIL SUPPORT TEAMS FOR WEAPONS OF MASS DESTRUCTION

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ABSTRACT

Local fire, police, and emergency medical services are usually first on the scene of an intentional release of a biological, chemical, or radiological agent. These agencies frequently do not have specialized training and equipment to conduct secondary, detailed site assessments to confirm the presence of an agent, model potential transport of the agent in the environment, and communicate potential public health and safety hazards to decision makers, the news media, and the public. National Guard Civil Support Teams have been developed in the USA to provide such support to State and local agencies. These teams include a command and control element, agent survey and detection units, an advanced communications element, an operations section with advanced modeling capability, a medical section to provide occupational health and safety support and to identify health hazards posed by agents, and a logistics section to provide materiel support. These teams have been used to provide advanced training to local first responders, and to support actual responses involving intentional releases of chemicals into the environment. Team capabilities and equipment were discussed in detail during a workshop conducted prior to the World Congress on Chemical and Biological Terrorism.

KEYWORDS

Weapons of mass destruction, chemicals, biological, civil support, National Guard

96. AN ANALYSIS OF 404 NON-MILITARY INCIDENTS INVOLVING EITHER CHEMICAL OR BIOLOGICAL AGENTS

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INTRODUCTION

GOALS:

1. Facilitate our understanding of chemical and biological terrorism by profiling both the perpetrator and the incident.
2. Relate the broad choice of agent to other factors that characterize both the perpetrator and the incident.
3. Generate a set of tables useful for a variety of analytical tasks.

DATA SOURCES:

All data was acquired from open sources including newspapers, magazines, books, transcripts of radio and television broadcasts and reports prepared by various organizations.

ANALYTICAL METHODOLOGY:

1. Data describing 404 incidents of the non-military use or threatened use of CB agents were collected and then compiled in the CABO Database.
2. The data were coded for 18 factors that characterize both the perpetrator and the incident.
3. Tables were prepared using PSG's Incident Analysis Tool to facilitate analysis of the relationship between agent and the 18 characterization factors.

CHARACTERIZATION FACTORS:

Perpetrator Categories
Perpetrator Action
Cost
Dedication and Discipline
Dissemination Technique
Engineering Skills
Information Access
Load Carrying
Logistics
Motive
Number of Adversaries
Outcome
Planning Ability
Security and Tactical
Specialized Materials
Target
Technical Knowledge

SUMMARY OF FINDINGS REGARDING AGENTS

Type of CB material: Chemical or Biological?

1. 250 of 404 incidents involved a toxic chemical (62%)
   Specific chemical identified in 191 incidents
   Specific chemical not identified in 59 incidents
2. 101 of 404 incidents involved a biological pathogen or toxin (25%)
   Specific biological identified in 92 incidents
   Specific biological not identified in 9 incidents
3. Type of CB material was not identified in 53 incidents (13%)

Availability of CB materials

1. CB material was actually acquired in 264 incidents (64%)
2. CB material was actually or apparently used in 234 incidents (58%)

AGENTS INVOLVED IN 3 OR MORE INCIDENTS

Bacillus Anthracis
Butyric Acid
Mercury
Botulinum Toxin
Rat Poison (Warfarin)
Thallium Salts
Ricin
Arsenic
Potassium Cyanide
Sarin
Sodium Cyanide
LSD
Paraquat
Salmonella Species
Strychnine
Vibrio Cholera
Yersinia Pestis

SIGNIFICANT FINDINGS FROM THE COMPARISON TABLES

PERPETRATOR CATEGORIES

Perpetrators whose actions were based on religious or philosophical beliefs were the most common type of adversary (33%) and were most often associated with biological agents (53%).

PERPETRATOR ACTIONS

Actual use other than for extortion was the predominant type of action (51%). Threatened use without clear demands was the predominant type of action involving biological agents (51%).

COST

Approximately 75% of all incidents apparently cost less than $250.00.

DEDICATION AND DISCIPLINE

Most incidents required little or no dedication or discipline (69%).

A willingness to persevere was more often required in chemical incidents (33%) than in biological incidents (9%).

DISSEMINATION TECHNIQUE

The most common means (40%) of either actual or threatened dissemination was via contaminated consumables (food, water, medication, etc.).

ENGINEERING SKILLS

Approximately 80% of all incidents in which agent was used required little or no workshop or engineering skills to fabricate the dissemination device.

INFORMATION ACCESS

The majority of incidents involving biological agents required the lowest level of information access (63%).

LOAD CARRYING CAPABILITY

Dissemination devices would fit in the perpetrator's pocket in a majority of biological incidents (62%).

LOGISTICS

Approximately 64% of all incidents required no more than a personal vehicle and typical household kitchen equipment.

MOTIVE

deological considerations were the most common apparent motive (49%).

NUMBER OF ADVERSARIES

Most incidents (67%) apparently involved no more than three individuals.

OUTCOME

Approximately half of all incidents (49%) were successful.

Chemical incidents failed less often (3%) than did biological incidents (9%).

PLANNING ABILITY

Very few incidents displayed sophisticated planning (12%).

SECURITY AND TACTICAL

47% of the incidents required no security or tactical skills.

Incidents involving chemical agents more often (56%) required basic skills than did incidents involving biological agents (19%).

SPECIALIZED MATERIALS

The majority of incidents (75%) did not require access to specialized materials handling or processing equipment.

TARGET

Groups of individuals linked by a common characteristic were the most frequent target (55%).

TECHNICAL KNOWLEDGE

In 79% of the incidents the perpetrator needed no more technical knowledge than the ability to recognize toxic or infection material.

VENUE

Retail stores and reproductive rights clinics were the most common venues for both chemical and biological incidents.

CONCLUSIONS

Material that may be a CB agent is likely to be encountered in slightly less than two-thirds of all incidents.

Incidents involving chemical agents are more likely than those involving biological agents.

"Military" agents are less likely to be encountered than industrial materials.

Perpetrators whose actions are based on religious or philosophical beliefs represent the greatest threat.

97. WEAPONIZATION AND DELIVERY OF CHEMICAL AND BIOLOGICAL AGENTS: A TERRORISM PERSPECTIVE

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INTRODUCTION

An appreciation of the techniques that have been employed to disseminate chemical and biological agents in non-military incidents is relevant to a variety of policy and planning issues including the following:

- Prioritization of R&D funds earmarked for agent detection
- Exercise scenario development
- Development of symptom recognition guides
- Agent contamination and decontamination plans

GOALS OF THIS RESEARCH:

1. Facilitate our understanding of the dissemination and delivery of CB agents in non-military incidents.
2. Determine the relationship between dissemination technique and incident outcome.

DATA SOURCE

All data were acquired from open sources including newspapers, magazines, books, transcripts of radio and television broadcasts and reports prepared by various organizations.

ANALYTICAL METHODOLOGY:

1. Data describing 233 incidents of the actual or apparent use of CB agents in non-military incidents were analyzed to determine the means of dissemination and delivery used.
2. Cluster analysis was used to reduce the preliminary findings to a simplified topology of dissemination techniques.
3. Incident data were coded using the dissemination topology criteria and compiled in the CABO Database.
4. Tables were prepared using PSG's Incident Analysis Tool to facilitate analysis of the relationship between dissemination techniques, agent and incident outcome.

Table1: Determination of a dissemination typology by cluster analysis

Preliminary Findings Regarding Dissemination	→	Clustering by Route of Absorption	→	Simplified Typology
Animals Consumable Products Food and Drink Gases Non-Consumable Products Particle Clouds Projectiles Reservoirs Splash Spray Syringe Unknown		Inhalation Particle Clouds Sprays Gases Splash Ingestion Food & Drink Consumable Products Reservoirs Injection Projectiles Syringes Dermal Effects (or Transport) Non-Consumable Products Animal Bites Animal Unknown	↘ ↗ → → → →	Aerosols Vapors Contaminated Consumables Injection Contaminated Non-Consumables Vectors Unknown

Table 2: Findings on the relationship between dissemination technique and agent

DISSEMINATION TECHNIQUE	BIOLOGICAL	CHEMICAL	UNKNOWN	TOTAL
AEROSOL	8	13	1	22
VAPOR	-	64	0	64
CONTAMINATED CONSUMABLE	4	98	8	110
CONTAMINATED NON-CONSUMABLE	2	8	0	10
INJECTION	3	4	0	7
VECTOR	4	0	0	4
UNKNOWN	3	3	10	16
TOTALS	24	190	19	233

AEROSOLS:
Dissemination of the CB material via small droplets or particles suspended in the air.

VAPORS:
Dissemination of the CB material as a gas at prevailing weather conditions.

CONTAMINATED CONSUMABLES:
Dissemination of the CB agent by deliberately adding it to foods, water or other beverage or other consumable product, including medications.

CONTAMINATED NON-CONSUMABLES:
Dissemination of the CB agent by placing it on or within an item other than a consumable, e.g., clothing.

INJECTION:
Dissemination of the CB agent by direct injection into the target via a needle and syringe (or equivalent), or contaminated dart, ball or bullet.

VECTORS:
Dissemination of the CB agent by deliberate use of some animal carrier, including insect pests.

UNKNOWN:
Source material provided insufficient information to permit the determination or estimation of the dissemination technique.

Table 3: Findings on the relationship between dissemination technique and incident outcome

DISSEMINATION TECHNIQUE	FAILURE	PARTIAL SUCCESS	SUCCESS	UNKNOWN	TOTAL
AEROSOL	0	10	11	1	22
VAPOR	2	1	61	0	64
CONTAMINATED CONSUMABLE	1	56	53	0	110
CONTAMINATED NON-CONSUMABLE	0	5	5	0	10
INJECTION	0	1	6	0	7
VECTOR	1	1	2	0	4
UNKNOWN	0	0	14	2	16
TOTALS	4	74	152	3	233

SUCCESS:

Target was exposed to the CB agent and reacted to it.

PARTIAL SUCCESS:

CB agent was disseminated but the target either was not exposed or did not react.

FAILURE:

CB agent was not successfully disseminated.

UNKNOWN:

Source material provided insufficient information to permit the determination or estimation of the success.

CONCLUSIONS REGARDING DISSEMINATION TECHNIQUES

1. Contaminated consumables were the most frequently employed technique (47%).
2. Techniques that facilitated inhalation of the agent were used in 37% of the incidents.
3. Techniques that disseminated the agent as a vapor (27%) were attempted approximately three times as often as techniques that aerosolized (9%) the agent.
4. Biologicals (33%) were disseminated more often as aerosols than were chemicals (8%).
5. The threshold for apparent success was met in 65% of the incidents.
6. Only 2% of the incidents were apparent failures.
7. Incidents where the agent was released as a vapor were the most successful (95%).
8. Incidents involving vectors were the most likely to fail (25%).

98. STATISTICAL VIEWS ON LATE COMPLICATIONS OF CHEMICAL WEAPONS IN IRANIAN C.W.VICTIMS

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SUMMARY

During the 8 years Iran - Iraq war (1980 - 1988) chemical weapons had been frequently used by Iraqi army against Iranian military persons[1] and also against civilian people of some Iranian border towns and villages[2-10]. During these chemical attacks, several kinds of chemical agents (nerve agents, blistering agents, mixed agents) were used[11]. According to the recorded data from field emergency units, field hospitals of battle zones and the list of evacuated CW victims from the front, more then 100,000 military and civilian persons had received treatment for the acute effects of CW agents in those medical centers and in other hospitals and cities behind the front(both out patient and inpatient treatment). Today, more than 13 years after the end of the Iraq - Iran war, approximately 34,000 Iranian military and civilians are still suffering from the long term effects of chemical weapons deployed by Iraq (especially mustard gas), and they are receiving medical treatment services by the organization of veterans affair (Janbazan orgnization)[12]. The severity of these late complications in CW victims depends on the rate of exposure, type and dose of CW agents[13], so we have a method in the Janbazan organization for categorizing the severity of complications in the CW victims. According to this method (based on severity of late complications and the clinical status), there are three category of patients: patients with MILD, MODERATE and SEVERE complications. In this article the criteria used in this categorizing method and the statistical results of this categorizing are discussed.

INTRODUCTION

1) Definition of chemical weapon:

According to article II of the Chemical Weapons Convention (CWC); "Chemical weapon" means the following, together or separately: a) Toxic chemicals and their precursors, except where intended for purposes not prohibited under the CWC, as long as the types and quantities are consistent with such purposes. b) Munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemical specified in sub paragraph a, which would be released as a result of the employment of such munitions and devices. c) Any equipment specifically designed for use directly in connection with employment of munitions and devices specified in sub paragraph b (14).

2) A brief history of chemical warfare:

The use of poisons as weapons and efforts to ban them dates from ancient times. Despite the Hague convention (1899/1907) and Geneva protocol (1925), chemical weapons were used in World War (WW) 1, Iran-Iraq war, by Italy in Ethiopia, by Japan in China and various other conflicts, and, they remain a serious threat for civilian and military personnel. During WWII chemical weapons were not used (for several reasons) but during the Iran-Iraq war (1980-1988) there were various unconfirmed reports that Iraq had used chemical weapons, but the international community was slow to react at first. However, UN fact-finding teams confirmed that Iraq had indeed been using chemical weapons on a massive scale and that Iran had suffered thousands of military and civilian casualties as a result of these attacks [17].

The first mission came to Iran in March of 1984 and released its official report (No: S/16433). They returned to Iran in 1986 and released their second report (No: S/17911) and the third mission took place on 1987 and the third report released in May 1987(No: S/18852).

The conclusions, based on field inspection, clinical examinations of casualties and laboratory analyses of chemical ammunition, can be summarized as follows: chemical weapons, in the form of aerial bombs, had been used in the areas inspected in Iran by the official UN team, the main type of chemical agent used was bissulfide or mustard gas, on some occasions evidence was found for the use of the nerve agent ethyl N, N-dimethylphosphor amidio cyanidate, or tabun [19]. These reports renewed attention to the dangers of chemical weapons proliferation and to the horrors of chemical warfare [20].

THE CATEGORIZING METHOD

Today, more than 13 years after the end of the Iraq-Iran war, approximately 34,000 Iranian military and civilian people are still suffering from the long term effects of chemical weapons (especially sulfur mustard) used by Iraq, and they are receiving medical treatment by the organization of veterans affair (Janbazan Org). The severity of these late complications in those chemical warfare victims (CWV) depends on the rate of exposure to chemical agents, type and dose of agents, so we have a method for categorizing the severity of complications in these CWV. According to this method there are three categories of patients with chronic effects: mild, moderate and severe complications. The treatment and rehabilitation services and also the disability are based on the result of this categorizing method, so the criteria for this method for each category has been discussed in several professional and scientific committees and evaluated by the results of other researchers in this field. The method is compatible with scientific resources and textbooks and is principally based on physical examination, laboratory and paraclinic findings and the clinical status of patients. In order to avoid any misinterpretation in the paraclinic findings and discrepancies in evaluating physical examination findings, there is a standardized instruction, which is the basis of our clinics' performance.

Principles of the categorizing method

1. -Determining of severity in pulmonary system lesions:

- **Mild lesions** - spirometry: 65=<FEV1<80 or 65=<FVC<80 physical exam: abnormal lung sounds
- **Moderate lesions** -spirometry: 50=<FEV1<65 or 50=<FVC<65 physical exam: abnormal lung sounds
- **Severe lesions** - spirometry: 40=<FEV1<50 or 40=<FVC<50 physical exam: abnormal lung sounds probably with scianosis and intercostal retraction or tracheal stenosis in bronchoscopy

2. Determining of severity in skin lesions:

Mild lesions:

1) Itching or burning without clinical lesions
2) Dry skin .
3) Hypo or hyper pigmentation or both or depigmentation less than 18% of body surface or in covered area.
4) Alopecia areata totalis or universalis.
5) Generalized vitiligo.
6) Psoriasis (less than 20% of body surface).
7) Lichen simplex and limited prorigo.
8) Limited and mild eczema.
9) Limited scars in covered area .

10)Single keloid without limitation in rang of motion and in covered area.
11) Severe acne volgaris and nodulostic or suppurative hydradenitis.
12) Chronic hives or angioedema.
13) Vesicant lesions (localized).
14) Recurrent superficial fungal disease (chronic resistant dermatophitosis).

Moderate lesions:

1) Hypo or hyper pigmentation or both or depigmentation more than 18% of body surface or in uncovered area.
2) Severe and diffuse eczema.
3) Generalized prurigo.
4) Diffuse scare (or in uncovered area).
5) Keloid with limitation in rang of motion and in uncovered area.
6) Generalized recurrent vesicant lesions.
7) Generalized and chronic itching with clinical lesions
8) Psoriasis(more than 20% of body surface).
9) BCC

Severe lesions :

1) skin or mucosal cancer (except BCC)

3. Determining of severity in eye lesions:

1. **Mild lesions**:
   (Complains) photophobia- foreign body sensation- tearing- burning- itching - red eye - blurred vision - visual loss - pain - problem in reading (signs) conjunctival inflammation and hyperemia - sub conj. hemorrhage - vessels swelling - blepharitis - Meibomian glands dysfunction - papillary change
2. **Moderate lesions**:
   Above complications + mild corneal involvement: epithelial and sub epithelial opacity - anterior stroma in peripheral cornea - perilimbal hyper pigmentation - iron deposit in cornea - band keratopathy - pannus<2mm - no melting - BUT : 5-10 sec - Schirmer(with anesthesia) : 5-10 mm - red reflex : 9/10 - 10/10
3. **Severe lesions**:
   Above complications + severe corneal involvement: Thinning - melting - severe hyaline like deposit - corneal vascularization, BUT <5 sec - Schirmer (with anesthesia)<5 mm - red reflex: 1/10-4/10
4. **Very severe**:
   - above complication AND very severe corneal involvement: Diffuse corneal opacity - severe thinning - desmatocel - severe vascularization - red reflex<1/10 - retina is not visible

CONCLUSION

Chemical weapons, as a serious threat for world peace and security, have a broad spectrum of harmful damage on different human organs. According to the results of evaluations of the clinical status of Iranian CWVs, and the categorizing the severity of late complications in them (Table 1), the most common complications in these patients are the pulmonary complications (from mild lesions to severe lesions). In general about 42.5 percent of Iranian CWV population are suffering from pulmonary complications (37% mild lesions - 4.5% moderate lesions - 1% severe lesions) (graph 1). In other hand as the nature of pulmonary complications of mustard gas is progressive and some late complications appear many years after exposure so the number of patients with these complications will rise. Graphs 2 and 3 show the percent of complications to the eye and skin. Managing this large

number of patients with different complications (mostly with mixed complications) is impossible without a well-organized care system. So in our country there are now several special clinics and well equipped medical centers for observing these patients, as well as a standard medical care program for management of late complications in these patients (by the periodical visits and follow up of patients).

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KEY WORDS

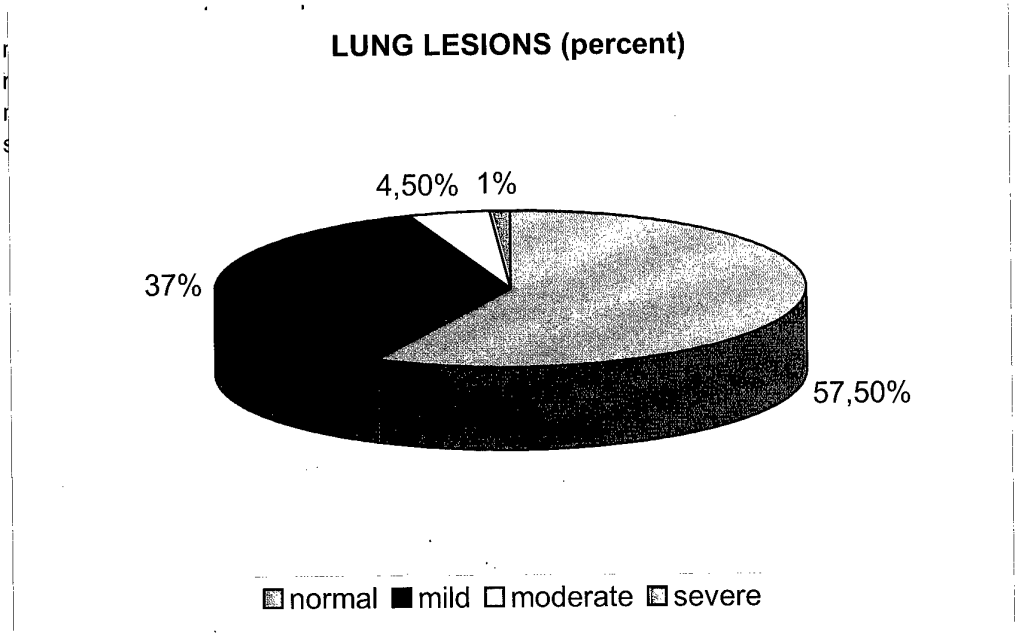
Late complications, mustard gas, categorization method, Iran, Janbazan, CW victims

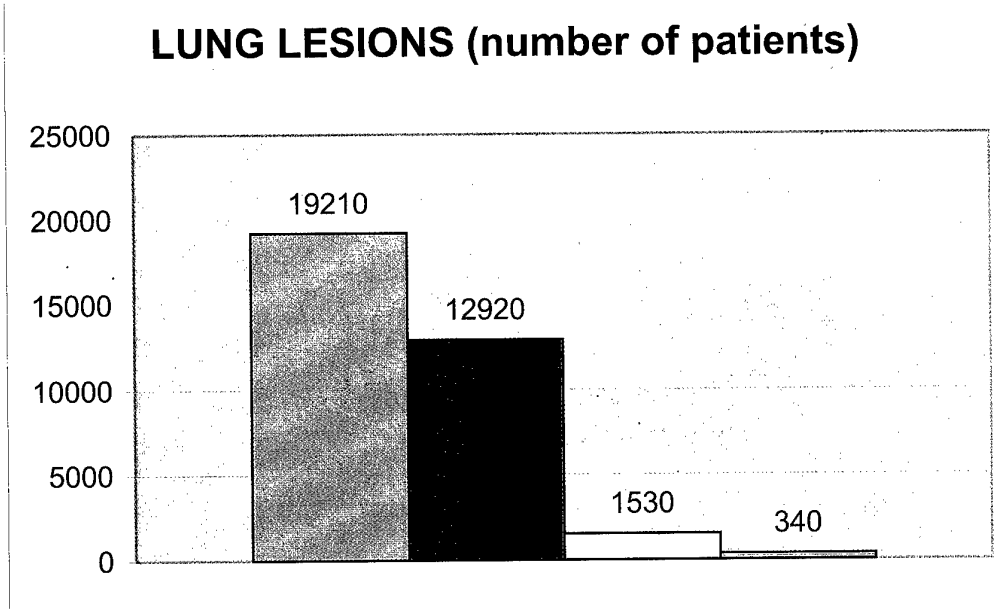
FIGURES AND TABLES

Table 1. The severity of lung, eye and skin complications in Iranian CW victims.

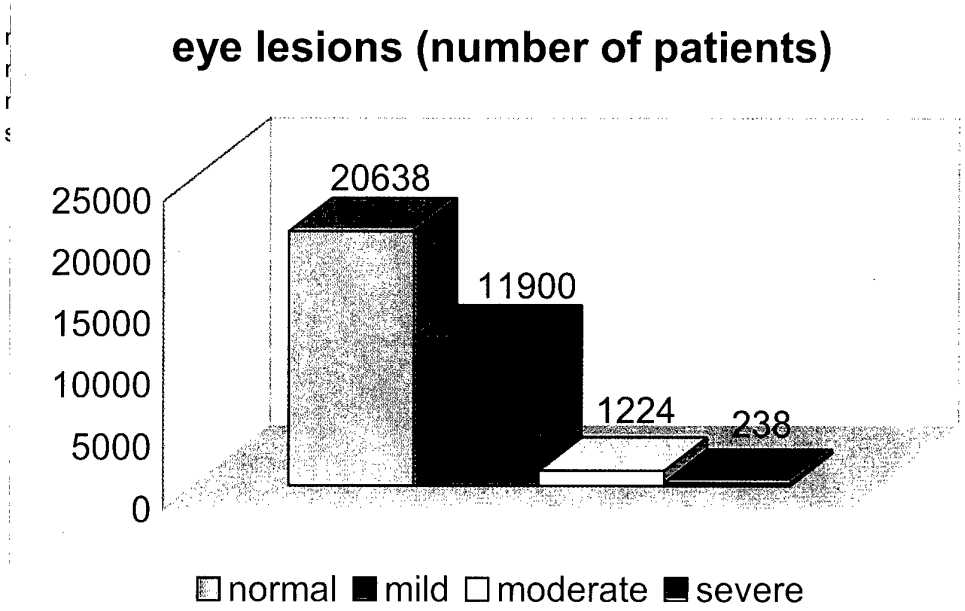
Klinical form	Lung	Eye	Skin
Normal	19550	20638	25670
	(57.50%)	(60.70%)	(75.50%)
Mild	12580	11900	7820
	(37%)	(35%)	(23%)
Moderate	1530	1224	510
	(4.50%)	(3.60%)	(1.50%)
Severe	340	238	8

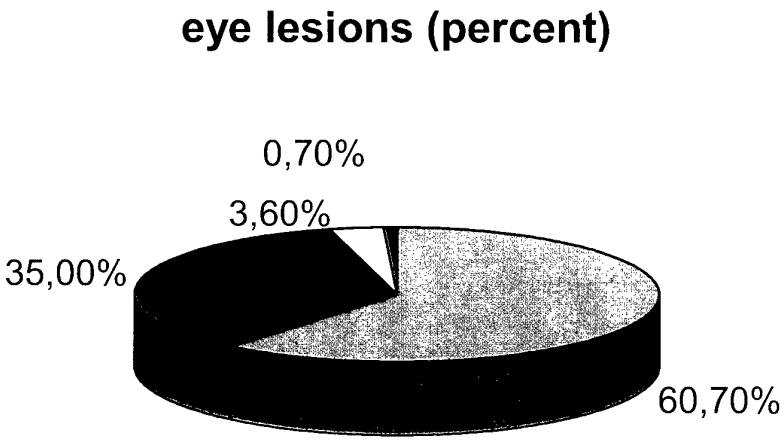
Graph 1: Lung lesions (percent of lesions and number of patients)



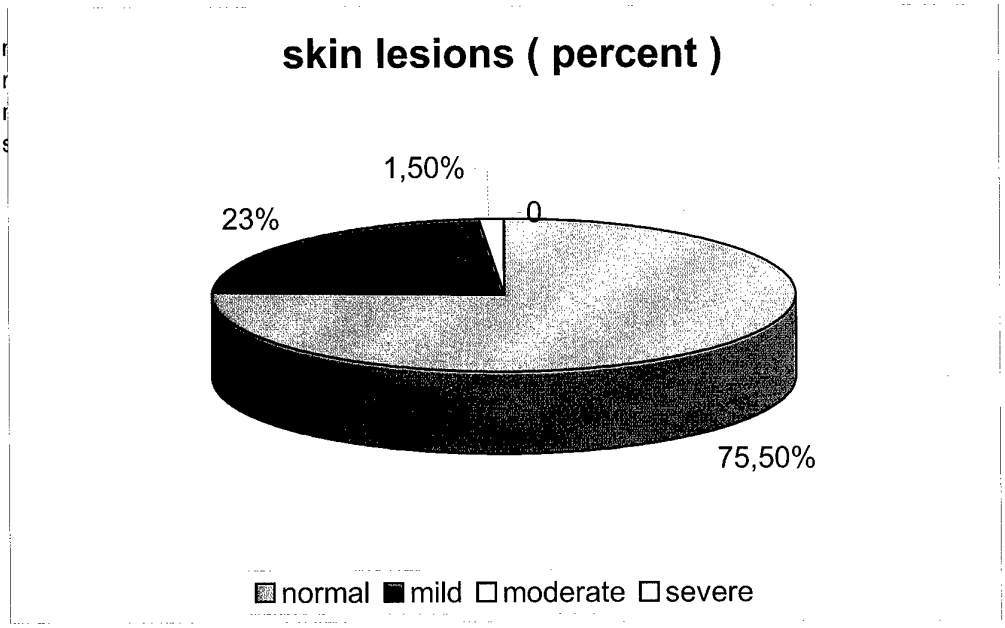


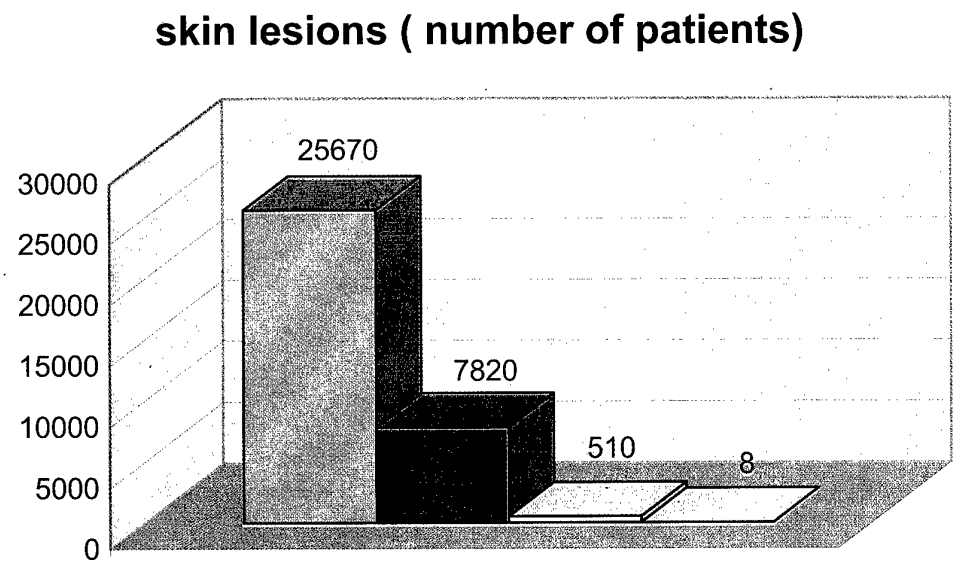
Graph 2: eye lesions





Graph 3: Skin lesions (percent of lesions and number of patients)





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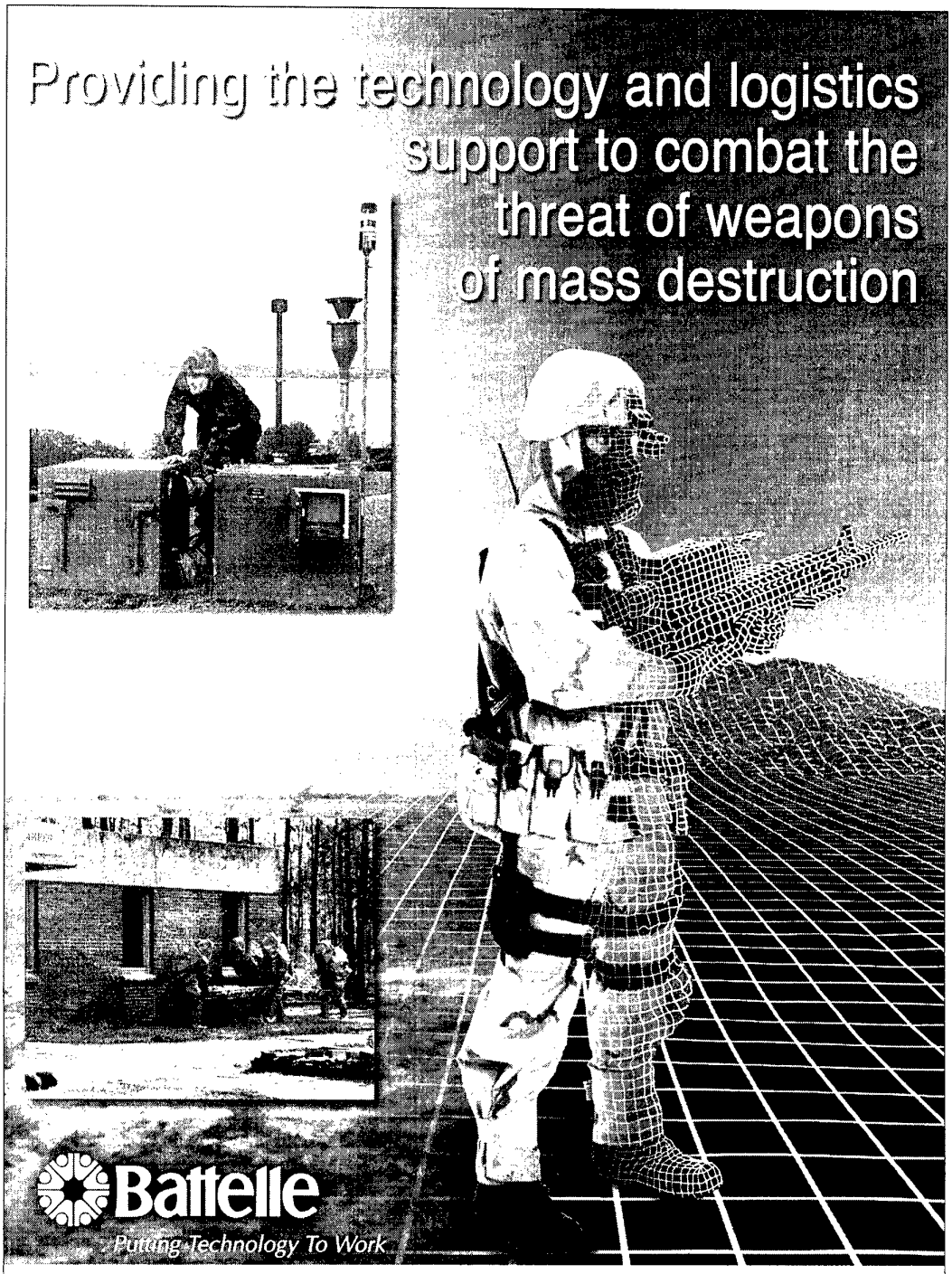
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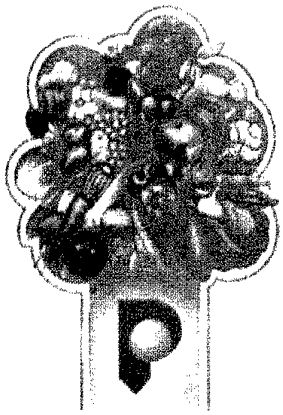

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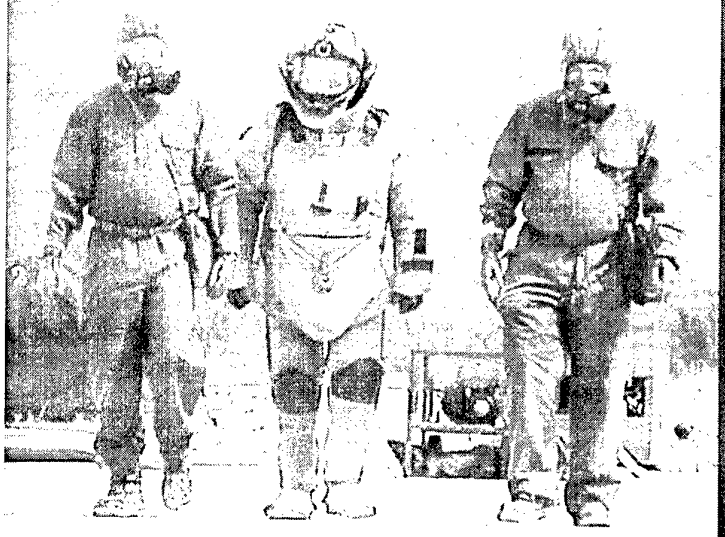

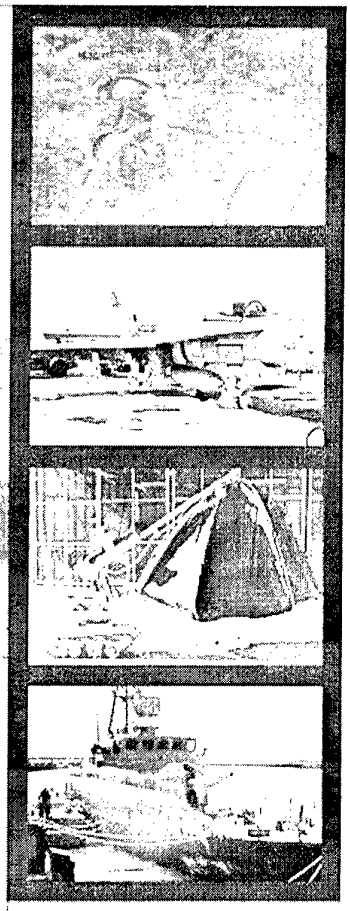

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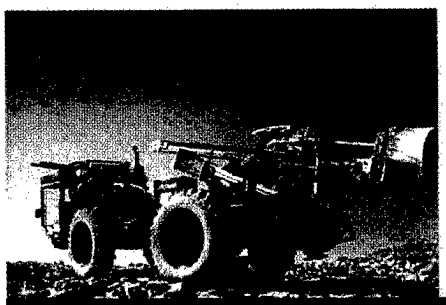

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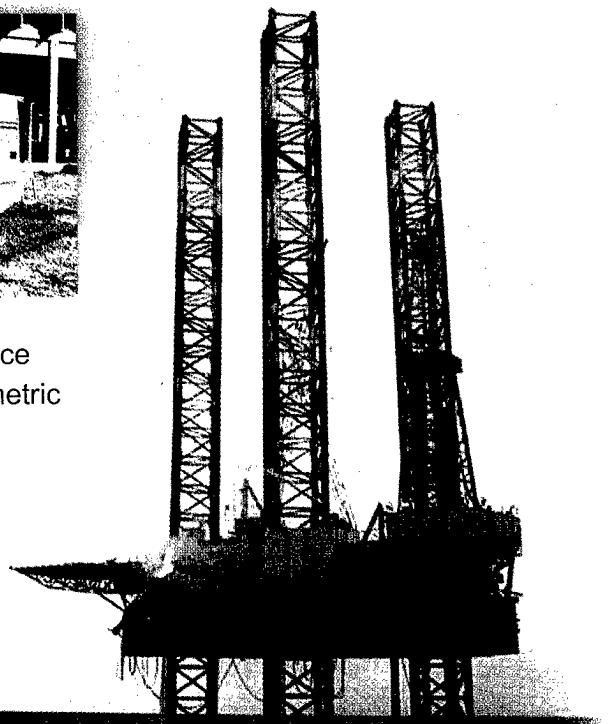

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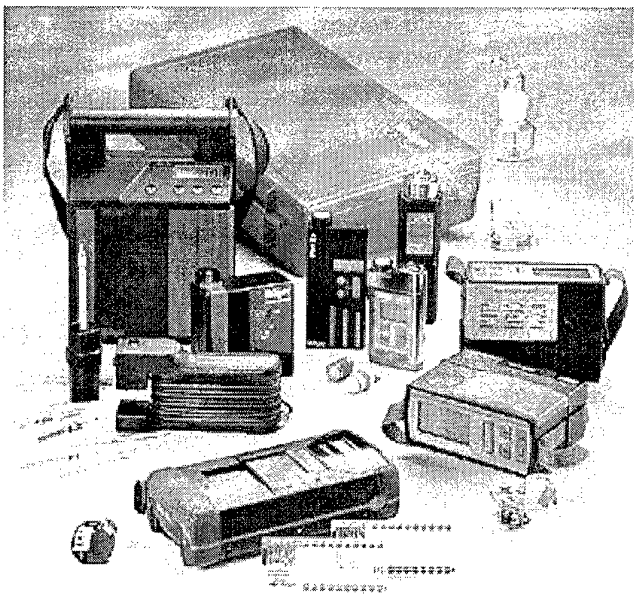

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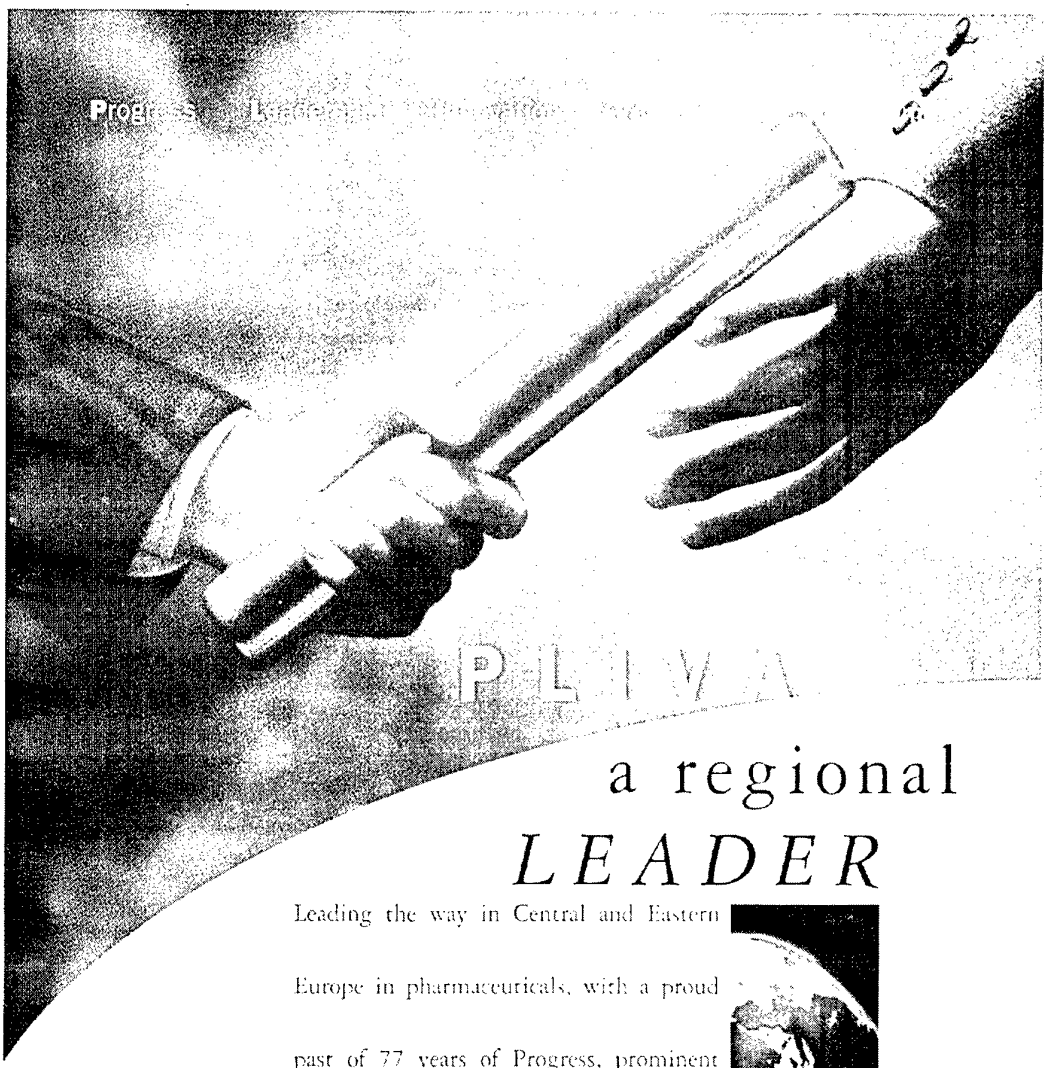

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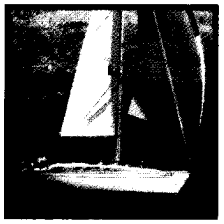

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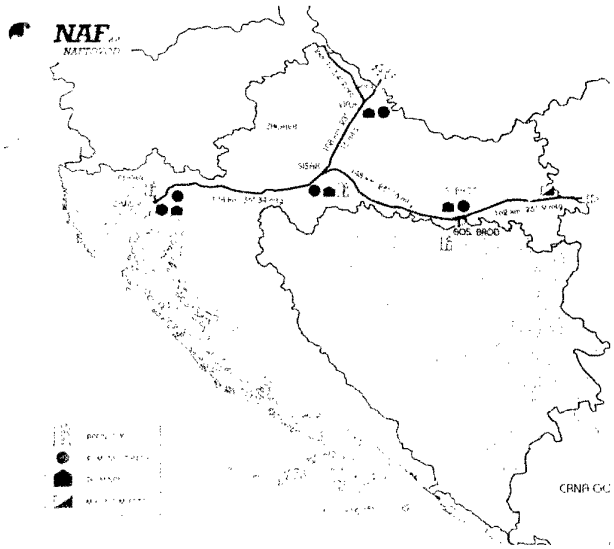

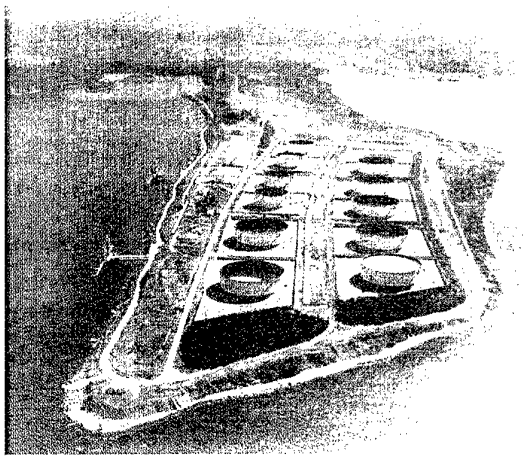

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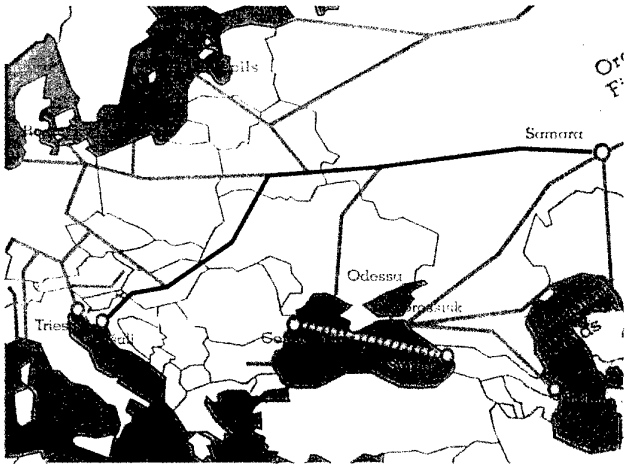
  - SEEL Project - *South Eastern European Line* (Constanza - Omišalj - Trieste)

(right)



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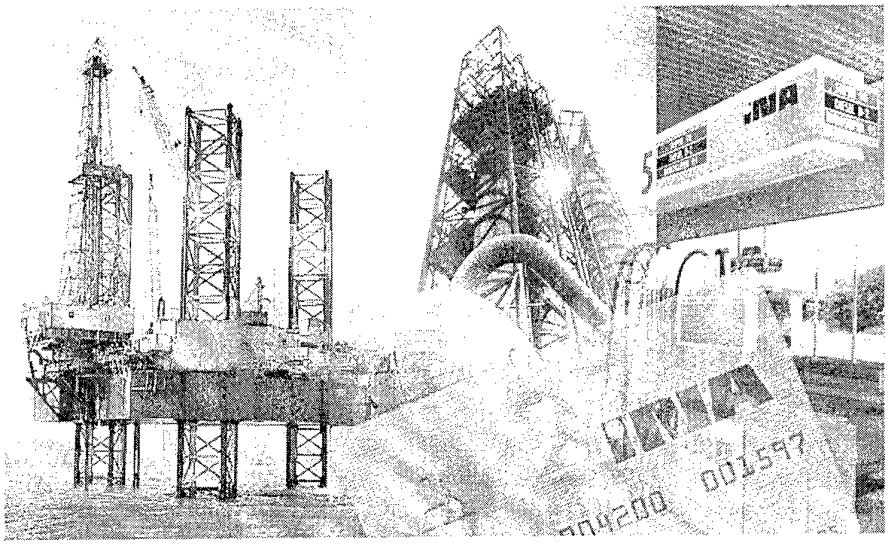

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CONTACT PERSON: Božidar Cikač
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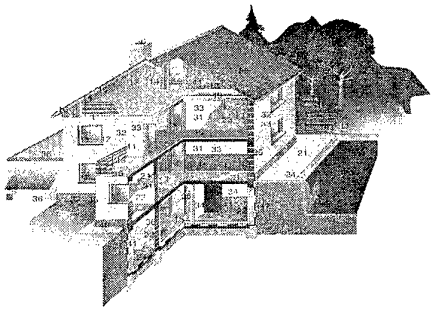
production of fruit juices
production of carbonated non-alcoholic beverages and mineral water
production of meat and meat products
production of bread and rolls
production of animal fodder

KVALITETA Vindija

MATERIALS FOR CONSTRUCTION INDUSTRY



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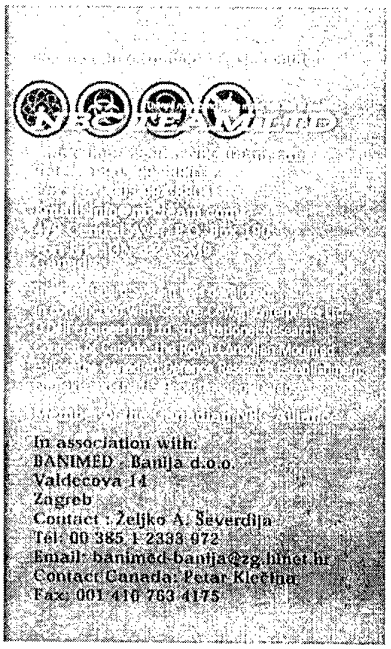
Special thanks to the Croatian Government and CBMIS II Organising Committee who did a superb job. Especially, Richard and Barbara Price, I Col Zvonko Orehovec, Slavko Bokan, the soldiers and officers of the Croatian Army/MOD, Rudi Portman and all the other support staff

It is with great sadness that we note that the leadership role shown by this congress in addressing the CB Terrorism Topic is even now more important with the results of the catastrophic events of September 11 unfolding. We at NBC Team join ASA in our condolances to all affected and our continued pledge to provide the best advice and systems to the forces of counter-terrorism world wide.