Bioterrorism Preparedness and Response in Poland: Prevention, Surveillance, and Mitigation Planning

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BRIEF REPORT

Bioterrorism Preparedness and Response in Poland: Prevention, Surveillance, and Mitigation Planning

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ABSTRACT

Objectives: Biological weapons are one of the oldest weapons of mass destruction used by man. Their use has not only determined the outcome of battles, but also influenced the fate of entire civilizations. Although the use of biological weapons agents in a terrorist attack is currently unlikely, all services responsible for the surveillance and removal of epidemiological threats must have clear guidelines and emergency response plans.

Methods: In the face of the numerous threats appearing in the world, it has become necessary to put the main emphasis on modernizing, securing, and maintaining structures in the field of medicine which are prepared for unforeseen crises and situations related to the use of biological agents.

Results: This article presents Poland's current preparation to take action in the event of a bioterrorist threat. The study presents both the military aspect and procedures for dealing with contamination.

Conclusions: In Poland, as in other European Union countries fighting terrorism, preparations should be made to defend against biological attacks, improve the flow of information on the European security system, strengthen research centers, train staff, create observation units and vaccination centers, as well as prepare hospitals for the hospitalization of patients—potential victims of bioterrorist attacks.

Key Words: biological threats detection, biological weapon, bioterrorism

Biological weapons are 1 of the oldest weapons of mass destruction (WMD) used by man. The first details of their use can be found in historical records from the 5th century BC. This relates to the poisoning of the water with ergot or hellebore by the Assyrians.[1] In the years that followed, biological weapons were often used. Their use has not only determined the outcome of battles, but also influenced the fate of entire civilizations. Documents related to war strategy show that, by the end of the 16th century, there were methods of attacking opponents by triggering diseases (eg, smallpox) within their ranks.

The 17th century brought the first findings concerning the existence of microorganisms, first discovered by Antoni van Leeuwenhoek using the first self-made microscope. This discovery initiated the development of bacteriology. In the 19th century, Louis Pasteur and Robert Koch proved that some microorganisms can cause disease.[2-4] Researchers began to identify, classify, and systematize microorganisms. There were many discoveries in the field of bacteriology, including the attribution of disease to microorganisms.[5,6]

At the turn of the 21st, the use of biological agents was being planned, and in some cases, were used in terrorist attacks. For example, in 2001, anthrax bacteria were planted in the offices of the US administration. This situation put the entire health-care system on alert, not only in the United States, but also in many European countries, including Poland. It was the beginning of the modification of defense systems against WMD for many countries and armies of the world.[7-10]

Historical experiences, in particular those originating from armed conflicts, have caused the problem of biosecurity to be a point of interest to both the scientific world and governmental agencies. It was considered important to create a center that would gather knowledge concerning diseases, their spread, pathogenicity, and the prevention of their effects. Since 1946, the Centers for Disease Control and Prevention (CDC) in Atlanta in the United States has performed this role, with a European branch in Switzerland, the European Centre for Disease Prevention and Control (ECDC).[3-5] In the proceeding years, the CDC has become the most important center in the world of epidemiology and the prevention and control of infectious diseases. It brings together specialists from various fields of public health, and is a meeting and training site for medical staff from around the world. It also deals with the use of pathogens in biological weapons. It creates procedures to be followed in the event of an incident involving biological weapons, as well as databases, genomic libraries, treatment procedures, and many other elements related to the actual potential threat.

Although the use of biological weapons agents in a terrorist attack is currently unlikely, all services responsible for the surveillance and removal of epidemiological threats must have clear guidelines and emergency response plans. "*This outbreak demonstrates the importance of preparedness for the unexpected. State health departments have been actively involved in planning and preparing for the possibility of a bioterrorist event…*" .[6,7]

RESPONDING TO BIOTERRORISM IN POLAND

In the face of the numerous threats appearing in the world during the 21st century, including the possibility of terrorist attacks, it has become necessary to prepare for such an eventuality. In the Armed Forces of the Republic of Poland (AFRP), the main emphasis has been put on modernizing, securing, and maintaining structures in the field of medicine which are prepared for unforeseen crises and situations related to the use of biological agents.[11]

Defense against WMD, that is chemical, radiological, but mainly biological, is treated with the utmost attention. This is why, in the past 2 decades, not only civil, but also military, diagnostic, Biological Safety Level (BSL) -1 and BSL-2 microbiological laboratories have been established. These are both stationary and mobile diagnostic centers assigned to medical military units that are supported by military scientific research institutes.[12]

One of the most important military units for the identification and diagnosis of biological agents is the Epidemiological Response Centre of the AFRP in Warsaw. It has in its extensive structures: BSL-1, BLS-2, and mobile microbiological laboratories. They are located in containers on specially designed trucks and are able to travel long distances (eg, near contamination zones). Moreover, the Epidemiological Response Centre of the AFRP has an Epidemiological Crisis Team, which collects data on diseases occurring in soldiers both in the country and on foreign missions. They are well-equipped Decontamination Teams, designed for the decontamination of people within a contamination zone yet remain part of the field hospital comprising an infectious disease ward and isolation department, together with qualified medical staff trained in bioterrorist events. An additional advantage of the stationary Epidemiological Response Centre of the AFRP laboratory is the close cooperation with the Central Contamination Analysis Centre of the Armed Forces of the Republic of Poland, which deals with the identification and diagnosis of chemical and radiological contamination in samples obtained from contaminated areas and of unknown origin.[11,12]

Another military research center equipped with a BSL-3 laboratory is the Biological Threat Identification and Countermeasure Centre of the Military Institute of Hygiene and Epidemiology in Puławy. Currently, the Center's priority research focuses on the detection and neutralization of pathogens and toxins that can be used as biological weapons. Furthermore, the center creates detailed diagnostic procedures for the AFRP for identifying biological agents.[13]

There is also a Military Health Inspectorate in the medical structures of the AFRP. It includes, among others, Military Centres of Preventive Medicine located in the following cities: Modlin, Kraków, Gdynia, Wrocław, and Bydgoszcz, as well as mobile Biological Recognition Teams. In the Military Centres of Preventive Medicine, there are stationary BSL-2 laboratories. Military Centres of Preventive Medicine carry out, among other activities, tasks related to anti-epidemic protection, health and hygienic protection, anti-epizootic protection, epidemiological response, and detection of biological risk factors for the Ministry of Defence in regions under their responsibility. The task of the Biological Recognition Teams is to travel to areas where the suspected use of potential biological weapons has been reported, and safely retrieving samples from the contaminated area for further diagnosis.[14,15]

Diagnostic and microbiological laboratories operating within the structures of the Polish Military have a qualified staff of specialists in the field of microbiology and analytics, who in their work use the diagnostic methods available on Polish and foreign markets, facilitating the rapid and effective identification of pathogens, while observing international standards on procedures and proper selection of test methods and reagents.[16]

The basis for setting the policies for medical support of the AFRP is the document issued by the Ministry of Defence on 22 February 2013 entitled "Priority Research Policy in the Ministry of Defence for 2013-2022." It lists several sub-areas of significant importance to defense in the sphere of Defence against Weapons of Mass Destruction. These include: (1) rapid identification of CBR (chemical, biological and radiological) contamination, with an emphasis on biological contamination and infection, and development of procedures applicable to existing contaminations, in addition to early detection of infections; (2) risk assessment, especially regarding the spread and detection of the most dangerous pathogens and toxins; (3) identification of threats and recognition of the current epizootic state (zoonotic threats, threats related to food safety) in areas where military units are deployed and in the area of warfare operations; (4) continuous updating of rapid techniques for diagnosing and warning of CBR contamination; (5) development of preventive procedures and modification of therapeutic procedures in the field of battlefield medicine, which in the future may affect the achievement of operational capabilities in this area; and

(6) medical protection in the field of hygiene and epidemiology aimed at reducing the number of cases of soldiers suffering from zoonoses during military operations in current military operations and missions, Polish Military Contingents.[17,18]

CONTAMINATION DETECTION SYSTEM IN THE AFRP

The Crisis Management System of the Republic of Poland includes the Contamination Detection System of the AFRP and subsystems for the prevention and elimination of chemical, biological, radiological, and nuclear contamination, commonly known as CBRN (chemical, biological, radiological, nuclear).[19] Chemical weapons include toxic warfare agents (including asphyxiating, blistering, choking, nerve, and hallucinogenic agents) as well as auxiliary warfare agents (including tear gas, defoliants, and inflammatory agents). Examples include mustard gas, tabun, sarin, VX, chlorine, phosgene, isocyanate derivatives, and amine and amide derivatives.[20,21] Biological agents include, for example, bacteria (eg, *Bacillus anthracis*, *Yersinia pestis*, *Francisella tularensis*), their toxins (eg, produced by Clostridium botulinum), viruses (eg, Ebola, Marburg, Denga), as well as fungi, protozoa, and exotoxins.[22,23] Radiation and nuclear agents are mainly: alpha, beta, and neutron (n) radiation; electromagnetic radiation; ionizing radiation: gamma, X-ray (X), cosmic, electromagnetic; nonionizing radiation: static electric and magnetic fields, electromagnetic fields, and micro and radio frequencies.[24,25]

The Contamination Detection System was established under Regulation by the Council of Ministers concerning the systems of detection and notification of the occurrence of contamination and the jurisdiction of public administrations with responsibility in these matters. It is an organized system of governmental elements that are connected by common organizational and technical relations, designed to acquire, collect, process, and analyze information concerning: the use of chemical, biological, or nuclear weapons; events other than WMD attacks; and the potential sources of these threats.[26]

The leading coordinator in situations requiring the initiation and launch of procedures contained in the National Contamination Detection and Alert System is the Minister of Defence. The Ministry has command over the entire process subsumed by the Dispatch Centre, the Central Contamination Analysis Centre of the AFRP. The Central Contamination Analysis Centre of the AFRP is the day-to-day central point of the Contamination Detection System in Polish Armed Forces. The Contamination Detection System remains in force at each level of command during peacetime, crises and war, and it includes: contamination analysis centers, analytical laboratories and information sources. Under this system, the Early Warning Subsystem operates under constant operational readiness.[27,28]

LABORATORY DIAGNOSTICS IN THE FIELD

Diagnosis of biological agents on the battlefield or at contaminated sites are performed by soldiers from medical military units specifically designated for this purpose. It requires specialized equipment and tests suitable for application in difficult conditions, showing within a short space of time (several minutes maximum), initial test results. The equipment should indicate whether there is a biological agent in the environment and what that pathogen is. An example is immunochromatographic tests in the form of pregnancy tests, where instillation of a reconstituted environmental sample (air, soil, or organic substance) allows you to read the result in a short space of time, and where 2 lines indicate a biological agent present in the contaminated area. Another example of rapid detection in a contaminated zone is the BIODES biological agent detector, the work of the Institute of Optoelectronics of the Military University of Technology, which is based on Laser Induced Fluorescence technology and provides real-time detection of suspected biological substances in the air.

These portable devices are currently used by the military and enable identification based on the above-mentioned methods. They are adapted to work in field conditions and provide fast data analysis, which is critical for proper triage. At the same time, they are equipped with an alarm system that signals when critical levels of contamination have been exceeded, and a system for transmitting the acquired data to command points coordinated by the National Contamination Detection and Alert System. One of the components of this system is the contamination detection subsystem of the AFRP. Data regarding contamination are supplied by the Mobile Laboratory for Defence against Weapons of Mass Destruction. Its task is, among other activities, to sample contaminated materials (biologically, chemically, and radioactively) and conduct field laboratory analyses of the samples taken of contaminated materials. The data obtained support the command process with regard to the assessment of the level of actual contamination and its impact on the implementation of military actions of the AFRP. They also provide support to civil authorities.

Depending on the nature of military structures, skills, and capabilities for the diagnosis of biological agents in field conditions in the AFRP, among others, the following are essential from the outset to ensure proper order in any population-based triage system[29]:

- HHA (Hand-Held Assay) for preliminary diagnosis.[30] Examples include commercial, single or multiagent tests designed to detect and identify in a sample 1 (eg, Alexeter Technologies) or several biological weapon agents (eg, Advent Biotechnologies, ANP Technologies) such as: *Bacillus anthracis*, *Yersinia pestis*, *Francisella tularensis*, botulinum, enterotoxin B, as well as ricin[31,32];
- Immunochromatographic tests (eg, JPS, or Joint Portal Shields) to obtain a result within 10-20 min. Detection is carried out using monoclonal or polyclonal antibodies marked

with colloidal gold, and the result is evaluated visually. The appearance of 2 colored bands on the test in zones T and C (as in a pregnancy test) indicates a positive result. This type of test has a high sensitivity of 103-104 CFU/ml (CFU, or Colony-Forming Units per milliliter)[33,34];
- The LRBSDS (Long Range Biological Standoff Detection System) detects biological hazards in an aerosol cloud within a 30-km radius. This device is equipped with an infrared laser transmitter, a receiving telescope, and a detector.[35] Its Polish equivalent, created by Polish scientists from the Military University of Technology in Warsaw, is LIDAR (Light Detection and Ranging).[36] Another aerosol cloud monitoring device with a simultaneous differentiation between biological and nonbiological clouds is the JBSDS (The Joint Biological Standoff Detection System)[37];
- The automated R.A.P.I.D. system (Ruggedized Advanced Pathogen Identification Device), based on polymerase chain reaction (PCR) techniques, is a breakthrough in the detection of biological contamination in field conditions. Its solid construction, reliability, and accuracy has meant it has become standard equipment for armies around the world, as well as in mobile laboratories and field hospitals.[38,39].

Burkle emphasizes that, although these terrorist bioevents have similarities with other disasters, there also are major differences, especially in the approach to triage management of surge capacity resources. Conventional mass-casualty events use uniform methods for triage on the basis of severity of presentation and do not consider exposure, duration, or infectiousness, thereby impeding control of transmission and delaying recognition of victims requiring immediate care. Bioevent triage management must be population based, with the goal of preventing secondary transmission, beginning at the point of contact, to control the epidemic outbreak. Whatever triage system is used, "*must first recognize the requirements of those Susceptible but not exposed, those Exposed but not yet infectious, those Infectious, those Removed by death or recovery, and those protected by Vaccination or prophylactic medication (SEIRV methodology)*." Everyone in the population exposed falls into 1 of these 5 categories.[40]

All triage systems and training are challenged by the rapid advances in biological detection, which may indeed represent the most complicated of system wide triage challenges within CBRN family of crises. Biological triage will occur at multiple sites along the continuum of care characteristic of all biological events. The European Union (EU) was the first to establish a multidisciplinary approach to improve the capacity of these multiple sites to counter intentional releases of pathogens. Called *AniBioThreat*, it spans "awareness, prevention, and response" targeting the health of animals, food, and consumers. Their tools use a "generic risk ranking system that allows biological agents to be classified by their probability to be used in a bioterrorism incident" ensuring the earliest identification of the pathogens and its rapid execution of necessary measures.[41,42] The US-based Global Health Security Agenda (GHSA) and One Health Security have incorporated EU's *AniBioThreat* project, made up of a community of users who coordinate responses to CBRN crises across Europe and includes the integration of professionals with expertise in security, law enforcement, and intelligence to join the veterinary, agricultural, environmental, and human health experts essential to prevent, detect, and eliminate the offending disease.

Additionally, *TOXI-Triage*, a Loughborough University project funded by the EUs Horizon 2010 research and innovation program, incorporates 18 teams comprising the emergency and health services, defense, industry, and university academics using advanced methods to integrate the assessment of the hot zones, provide diagnostics, vital communications, track and tag triage victims, determine the level of casualty exposure, monitor and map the environmental impact, and decontamination, all designed to optimize the emergency response.[43]

LIMITATIONS

The consequences of a terrorist attack using pathogens are difficult to imagine. Since September 11, 2001, the necessity of an international fight against bioterrorism has come to the fore. The priority has been on developing crisis prevention plans (particularly against bioterrorist attacks) and procedures for dealing with specific situations: eg, rules for notification and cooperation in the event of a threat of a dangerous infectious disease or bioterrorism, procedures for handling suspicious shipments, and diagnostic procedures in the event of biological agents being used. These procedures assume the use of standardized diagnostic methods in both BSL-1 and BSL-2 laboratories and in mobile military microbiological laboratories.

Polish military units specializing in the identification and diagnosis of biological agents in a contaminated zone have worked for many years to cope with the problems mentioned above. This has been through the constant development of knowledge and skills, and the acquiring of experience in biological weapon emergency situations. Military units and their representatives participate in international exercises, training and conferences on WMD topics. An example of training in biosecurity is the annual workshop entitled: "Decision-Making Tools for Crisis Management in WMD Incidents". Medical military units, which subordinate to the Department of Military Health Service, such as the Epidemiological Response Centre of the AFRP and the Defence Against Weapons of Mass Destruction National Defence Academy Training Centre (currently the War Studies University) participate in these workshops in cooperation with the DTRA (US Defense Threat Reduction Agency). Other examples are the BIOSAFE Workshops on national and international cooperation in crisis situations related to the release of biological agents.

These have been attended by soldiers of the Epidemiological Response Centre of the Polish Armed Forces of the Republic of Poland, Military Preventive Medicine Centres, the Special Department of Military Police, the Military Medical Training

Centre in Łódź, employees of the Institute of Optoelectronics of the Military University of Technology, representatives of the Anti-Terrorist Operations Bureau of the General Police Headquarters, as well as 773rd Civil Support Team, 7th Civil Support Command, The United States National Guard Search and Rescue Team, officers of the Federal Bureau of Investigation, representatives of the Rapid Deployable Outbreak Investigation Team, and observers from the Hungarian Military Health Service.

It is necessary to constantly analyze whether individual initiatives affect the propensity to take preventive and adaptive measures in the event of specific threats.

A key issue in ensuring an adequate level of biosecurity is the adequate equipment of both stationary and mobile microbiological laboratories. For these units, the problem is the extended time needed to acquire equipment and reagents due to the Public Procurement Law in force in the AFRP.

At the same time, the authors are aware that not all aspects have been discussed in sufficient detail; this is due to the fact that some information is restricted to the relevant entities and cannot be publicly disclosed due to national security issues and applicable laws.

CONCLUSIONS AND POTENTIAL FOR THE FUTURE

In Poland, the State Health Inspectorate has developed plans to counteract crisis situations, in particular bioterrorist attacks, and procedures to deal with specific situations: eg, rules for notification and cooperation in the event of a threat of a dangerous infectious disease or bioterrorism, a scheme for dealing with suspicious shipments, and procedures for dealing with cases of smallpox, anthrax, and botulism.[44] Twenty-five hospitals have also been appointed to care for patients with particularly dangerous infectious diseases, as well as transport units for the evacuation of these patients, and 10 laboratories of provincial health and epidemiological stations, which have been proposed for inclusion in the NATO network of reference laboratories.[45-47] Smallpox vaccines have been purchased with funds budgeted for the Minister of Health and lists of persons from particular risk groups to be vaccinated in the event of an emergency have been prepared. A 24-h communication system has also been introduced between the Chief Health Inspectorate and voivodship state health inspectors, as well as, at the voivodship level, between organizational units of the State Health Inspectorate.[33,34]

An increase in expenditure on informational and educational activities to increase public awareness is needed, both in the area of threats related to the occurrence of bioterrorist threats, as well as possible actions to reduce risk. An urgent and important task is to develop a risk management plan at the national level, which will not only provide a diagnosis of the disaster risk, but also determine current administrative and organizational capabilities, as well as the available technical and financial resources. As part of the National Risk Management Plan, priorities should be selected concerning risk management together with key tasks and indicators for achieving the objectives, including changes in triage management as the advances in detection become operationalized. The current operational plans are not strategic and are quickly outdated.

In Poland, as in other EU countries fighting terrorism, preparations should be made to defend against biological attacks, improve the flow of information on the European security system, strengthen research centers, train staff, create observation units and vaccination centers, as well as prepare hospitals for the hospitalization of patients, potential victims of bioterrorist attacks.

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Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

K.G. conceived and designed the article; K.G. and B.O. collected data; K.G., B.O., W.P., R.C. analyzed the data; K.G., B.O., M.G. wrote the study; K.G., D.L., M.G., and F.B. reviewed and edited the study.

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