Bioterrorism: What? Why? and Who?

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INDEX TERMS: anthrax; biological agent; bioterrorism.

Clin Lab Sci 2002;15(1):5

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The world was definitely and dramatically changed on September 11, 2001. Terrorist acts became the dominate news in the press, TV, and Web sites. Since then we have faced the threat of anthrax with spores delivered using the United States postal system. We have been inundated with information on bioterrorism. For some individuals the idea of bioterrorism is a new and frightening concept.

Bioterrorism, however, is not unique to our century. Each millennium has had its share of events. In the 14th century during a siege of Kaffa, which is now the Ukraine, the Tartars catapulted bodies infected with the plague over the town walls. An outbreak of plague resulted soon after and was spread throughout the Mediterranean area by the escaping citizens. In the 1700s, the British and French gave blankets contaminated with smallpox as trade to the Native Americans who were unsympathetic or hostile to the government's plans to extend the western frontier.[1-4] Bioterrorist incidents have occurred in almost every century including the late 20th century. The Rajneeshee cult in 1984 contaminated a salad bar with *Salmonella* in order to win a local election in The Dalles, Oregon. The Japanese Aum Shinrikyo cult in 1995 tried on ten different occasions to deliver biological agents by aerosol. It was more successful, however, in its chemical attack in the Tokyo subway. In 1998, Larry Wayne Harris was arrested in Las Vegas after obtaining anthrax and plague vaccine strains and making threatening comments about their delivery by cropduster airplanes. Now in the 21st century, we have had several incidences of anthrax in New York, Florida, Washington DC, and New Jersey.

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WHAT IS BIOTERRORISM?

Klietmann and Ruoff define bioterrorism as "... the use of biological agents to inflict disease and/or death on humans, animals or plants."[2] A terrorist act can be aimed at the human population, or at symbols of the nation, in order to destroy or demoralize it; or at the animals and crops in order to destroy the nation's economy. There are two general types of terrorism:

1. Overt, usually using a chemical agent or an explosive device. We know from the two World Trade Tower incidences that the threats may be from outside forces, or from within as in the Oklahoma City bombing. The first responders are usually firefighters and/or the police.
2. Covert, usually the incident is unannounced and can go undetected for a length of time. The perpetrators are able to escape and the infected persons are able to disperse, spreading the agent. In this type of terrorism, the first responders are usually health professionals.

The Chemical and Biological Weapons Nonproliferation Project at the Monterey Institute's Center for Nonproliferation Studies categorizes events as terrorist events, criminal events, and state-sponsored assassinations. A terrorist event uses violence for a political, religious, or ideologic purpose. A criminal event, on the other hand, uses murder or extortion for a nonpolitical purpose. In the period from 1960–99 there were 66 criminal events and 55 terrorists events. There was a sharp increase in events in the USA after 1985 and again in 1995.[5]

Who plans acts of bioterrorism and why does a person or nation engage in such activities?

The events can be planned by single issue groups, nationalist and separatist groups, or by apocalyptic cults. The motivations for the perpetration of terrorist acts have changed over time. From 1975–89 the main motive was to protect government policies. Since 1990, the shift is toward nationalist or separatist objectives and for revenge. Religious fundamentalism is the strongest motivation in biological incidences. The targets also have changed over time from strategic military targets to civilian and symbolic buildings.[5,6]

During the last century, several nations developed biological warfare programs. Prior to World War II, Japan had actively produced biological weapons in Mongolia during its occupation of that area.[1] It is believed that the program may have served as the nucleus for the program developed later in North Korea. After World War II, many nations including the Unites States started developing biological weapons. The research and testing programs at Fort Detrick lasted until 1969 when President Nixon passed the Biological

Weapons Disarmament Declaration. With the Biological and Toxins Weapons Convention of 1972, Western governments agreed to stop the development of biological weapons and to withdraw the workers and the funding for the projects. Iraq and the former Soviet Union, however, continued their extensive clandestine programs. During this time, the U.S. became complacent about the threat of biological warfare until our wake-up call in 1979 with the anthrax release in Sverdlovsk. It was obvious then that the USSR had continued active production of biological agents.

The Soviet program, Biopreparat, was formed in 1973–74. It had 52 sites throughout the USSR with 50,000 people, many of whom were scientists, employed in its projects. The purpose was to hide the production of the agents behind civilian enterprises such as pharmaceutical and biotechnology/genetic engineering projects. They developed tularemia and Venezuelan equine encephalitis for use as primary tactical agents in the battlefield; anthrax and Marburg as agents in secondary rear guard actions; and smallpox and plague for use against enemy population centers.[7] When the USSR broke up in 1992, large quantities of the agents were stock-piled. The USA and Great Britain in 1992–93 challenged the new government about the status of the program but received no answers.[6-8] Iraq started its program in 1974 but did not achieve production of anthrax and botulinum toxin on an industrial scale until 1987–88. It added viruses to the list in 1990. After the Gulf War, it admitted to working with various agents of mass destruction. The United Nations in 1995 ordered the production centers, including the Al Kaham facility, and their stock piles destroyed. It is estimated that Iraq had grown a total of one-half million liters of biological agents with 8,000 liters of anthrax. When Iraq forced the expulsion of the United Nations Special Commission, the mission was not completed. It is believed that Iraq was able to preserve its biological weapons capability.[1]

What makes a "good" biological agent of mass destruction?

The agent must be one that the perpetrator can acquire, use to make a stable product, and effectively deliver to the target (Table 1). The delivery of the agent can be haphazard with only a few cases as long as it causes public fear and disruption of daily life.[1] For an agent to be effective the release should look like a naturally occurring outbreak so it can go undetected for a length of time. It should be highly infectious, moderately contagious, and can be aerosolized since the most common routes of attack are by food and/or water contamination or by airborne delivery. The CDC has a 'short list' of agents with anthrax and smallpox as the ones most likely to be released as aerosols (Table 2). Agents in liquid slurries or in dry powders are easier to aerosolize.[6] Some agents are not aimed at humans but rather to animals and plants which is a good way to destroy a nation's economy.

A biological weapon can be as destructive as a nuclear weapon and more destructive than either a chemical weapon or nerve gas.[9] It is said to be the "poor man's atom bomb".[1] In general, the biological weapons have the ease of production and lower cost compared to the other weapons of mass destruction. However, to mill high quality powders requires equipment and skilled personnel as well as the availability of treatment for the workers. The agents, the rapidly growing technical expertise, and people with the will and knowledge to use the agents are available, often to the highest bidder.[10]

Table 1. Qualities of an ideal biological agent

It must be:
- convenient: easy to obtain and easy to produce
- robust: fairly stable in the environment
- amenable to a simple delivery system: can be aerosolized and can disseminate

It must have:
- a population at risk or susceptible
- a high mortality/morbidity rate
- a means of person to person transmission
- a degree of difficulty in its identification

Modified from *Advance for Administrators of the Laboratory*, 1999: May 17; 7-10.

Table 2. CDCs agents of highest concern:

Bacillus anthracis
Yersinia pestis
Variola major
Clostridium botulinum toxin
Francisella tularemia
Ebola virus
Marburg virus
Lassa virus

Modified from *Morbidity and Mortality Weekly Report*, October 19, 2001.Vol.50.No.41

There have been many attempts over the years to control the production of biological warfare agents (Table 3). The League of Nations in 1925 in the Geneva Protocol renounced the use of chemical and biological weapons. The Biological Weapons Convention, signed by 118 countries in 1972, prohibited the development, production, and stock-piling of biological and chemical agents.[10,11] In the USA, we have known for at least the last six years that a bioterrorism act was a matter of when, not if. There has been deepening concern about the weakened public health infrastructure that has been eroding since the 1960s and 1970s as the USA became complacent about infectious diseases. The results have been decreased stockpiles of antimicrobial agents, fewer rapid identification methods, decreased communication systems, and a decrease in the training of health professionals.[12]

Table 3. Attempts at control

International

1925 League of Nations
1972 Biological and Toxins Weapons Convention

Domestic

1996 Biological Warfare Defense Program
1996 Defense Against Weapons of Mass Destruction Act
1996 Biological Weapons Improved Response Program
1999 Association of Profession in Infection Control and Epidemiology Bioterrorism Task Force and CDCs Hospital Infection Program Bioterrorism Working Group

*Modified from MLO 2000; Sept: 26-42.

Our domestic efforts for preparedness began in 1995 with the Presidential Decision Directive 39, U.S. Policy on Counter-terrorism. It defined the federal agencies and their respective responsibilities. For example, the FBI was responsible for immediate crisis management and any resulting criminal investigation; FEMA was responsible for managing the aftermath assistance. The Biological Warfare Defense Program of 1996 encouraged partnerships with universities and other organizations to develop activities that would ensure our preparedness; research programs to develop detection devices; training programs for first responders; training for laboratory personnel; and the establishment of rapid response teams. Also in 1996, the Congress Defense Against Weapons of Mass Destruction Act created a program to increase the emergency response of state and local agencies.[12,13] The CDC started a comprehensive program called the Bioterrorism Preparedness and Response Program with included surveillance, rapid laboratory diagnosis, epidemiologic investigation, communication and preparedness planning, and readiness. The program recognizes the need for an infrastructure based on training and education.[2]

What does this mean for us as health professionals?

Since the bioterrorism act is usually covert, the health professional is the first responder. Timely recognition of the event relies on the alert health professional. It is important that all clinicians be familiar with the clinical signs and symptoms of the biological warfare agents. Kadlec gave the following as indicators of suspicion: an outbreak of a rare disease; an outbreak of a disease in an nonendemic area; or an occurrence of a seasonal disease at the wrong time of year; a known pathogen with an unusual antimicrobial pattern.[14,15] Good epidemiology and public health practices are crucial. Prompt reporting of cases is critical with a follow-up investigation. The best defense is the ability to detect the outbreak and to control the disease.[15,16]

In the case of a bioterrorism event, the laboratory response needs to include a prompt identification of the agent, a means to notify all health law enforcement agencies, and the means to support the healthcare providers. However, managed care has affected the laboratories greatly and has caused them to be stretched just to meet basic services. The microbiology laboratories are especially challenged. Outsourcing of tests, downsizing, and cross-training have resulted in a lack of personnel with the required expertise to do reliable identification of the possible bioterrorism agents. Many laboratories do not have the appropriate biological safety hoods and therefore don't do viral or toxin testing.[11]

To help address some of the challenges, the 1999 Laboratory Response Network created a partnership with non-public health clinical microbiology laboratories and the public health system. Laboratories are classified into four levels. Level A comprises most of the laboratories that are to perform tests to rule out agents and to refer suspected agents to a higher level. Level B classification is composed mostly of public health laboratories with biological safety level III facilities. They have the responsibility for performing rapid tests to presumptively identify agents of bioterrorism and to perform confirmatory and susceptibility testing. Included in Level C are public health and private laboratories with stain-typing capabilities that can do nucleic acid testing, molecular typing, and toxin testing. Level D are the BSL IV facilities or the 'hot labs' that do specialized testing and archiving.[2,10,16]

Summary

The former Secretary of the Department of Health and Human Services, Donna Shalala, indicated in an address in 1999 that complacency needs to be replaced with a sense of urgency in order for us to deal successfully with the threats of bioterrorism.[2] The attack on September 11, 2001 and the anthrax threats have made our vulnerability clear. We are now living in a new and frightening world. Our complacency is gone. The victims and the survivors shall remain forever in our minds. Dr. Jeffery Koplan, Director, Centers for Disease Control and Prevention in his broadcast, *Building Infrastructure to Protect the Public Health* said we must look at preparedness in a new way. We need to: build a solid public health infrastructure with grant monies; rapidly address the problem of inadequately trained staff; and address the capacity of a laboratory to produce timely and accurate results for the diagnosis of agents in the investigation of outbreaks.[17,18] We must take action to prepare the healthcare system to rapidly meet any challenge, overt or covert, that may emerge.

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