Bioterrorism in 2001 – How ready are we?

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On January 30, 2001, the federal Immigration Department's headquarters in Ottawa were evacuated and shut down following a bioterrorism scare, which turned out to be a hoax. The building reopened 48 h later, after it was determined that the substance found was not anthrax (1). In the same week, a similar hoax forced the evacuation of an Ontario provincial government building in Toronto (1).

In the past several years, there has been renewed concern about bioterrorism, either as a hoax or a real threat, and about our ability to deal with it. In the United States, the Department of Health and Human Services has committed hundreds of millions of dollars to bioterrorism preparedness (2). Both the Centers for Disease Control and Prevention (CDC) and the Association for Professionals in Infection Control and Epidemiology (APIC) have published documents outlining strategies for dealing with a threat related to a specific organism (3,4). The Infectious Diseases Society of America's Emerging Infections Committee is developing a strategic plan to assist physicians in becoming involved in local bioterrorism preparedness planning (5). In recognition of concerns about *Bacillus anthracis* being used as an agent of bioterrorism, an infectious disease note devoted to anthrax was published in *The Canadian Journal of Infectious Diseases* in 1998 (6). Two years ago, an editorial (7) in the journal addressed the general issues and current knowledge relevant to bioterrorism, and offered suggestions on how infectious diseases physicians can prepare for such an event: education (of doctors, other health care providers and the population as a whole) on how to recognize the clinical presentations consistent with these syndromes and how to confirm a diagnosis promptly; support of governments and public health systems to ensure that we are prepared to respond to a biological catastrophe; and support of research to develop effective vaccines and other preventive strategies. Despite interest and good intentions, it is unlikely that the academic or public health communities have begun, in any organized way, to prepare for the threat of biological terrorism. A recent article in *The Globe and Mail* stated that while Health Canada, the Solicitor-General's office, and the provincial and municipal governments have begun discussions, and the Royal Canadian Mounted Police and Canadian Forces have specially trained response units, there is no comprehensive interagency plan or procedures for dealing with bioterrorism (8).

DEFINITION

Bioterrorism is the use of biological agents to intentionally produce disease or intoxication in susceptible populations to meet the aims of terrorists. In addition to the potential medical sequelae is the likelihood of human panic – a worthwhile goal in itself for the terrorist group. One only has to look at the public and health care worker response to a meningococcal outbreak or a single potential case of an exotic disease to gain a sense of the likely reaction to a bioterrorist threat. The potential spectrum of bioterrorism incidents ranges from hoaxes to state-sponsored terrorism that employs classic biological warfare agents and can produce mass casualties (9). It is recognized that three critical elements are needed to produce a bioterrorism event: perpetrators, biological agents and a means of dispersal. Five of seven countries listed by the United States in 1996 as spon-

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TABLE 1
Agents of bioterrorism

Category A – High priority agents
- can be easily disseminated or transmitted person-to-person
- cause high mortality with potential for major public health impact
- may cause public panic and social disruption
- require special action for public health preparedness

Examples:

variola major	*Francisella tularensis*
Bacillus anthracis	filoviruses
Yersinia pestis	arenaviruses
Clostridium botulinum toxin	

Category B
- are moderately easy to disseminate
- cause moderate morbidity and low mortality
- require specific enhancements of the Centers for Disease Control and Prevention's diagnostic capacity and enhanced disease surveillance

Examples:

Coxiella burnetti	*Salmonella* species
Brucella species	*Shigella dysenteriae*
Burkholderia mallei	*Escherichia coli* 0157:H7
Alphaviruses	*Vibrio cholera*
Ricin toxin	*Cryptosporidium parvum*
Epsilon toxin	*Staphylococcus* enterotoxin B

Category C
- could be engineered for mass dissemination

Examples:

Nipah virus	tickborne hemorrhagic fever viruses
hantaviruses	tickborne encephalitis viruses
yellow fever	multidrug-resistant tuberculosis

Data from reference 3

soring international terrorism were suspected to have biological warfare programs (10). In terms of biological agents, there are many potential pathogens. A North Atlantic Treaty Organization handbook dealing with biological warfare defence lists 39 agents that could be used as biological weapons (10). The CDC (Table 1) has identified three categories of potential biological agents based on the risk posed and public health preparedness (3). Of this long list of potential pathogens, only a handful are reasonably easy to prepare and disperse, inflicting sufficiently severe disease to paralyze a city (11). The agents of greatest concern are variola major, *B anthracis*, *Yersinia pestis* and *Clostridium botulinum* toxin, none of which have been effectively deployed as a biological weapon in modern times. The *World Directory of Collections of Cultures and Microorganisms* lists 453 repositories in 67 nations that will supply biological agents; 54 will provide *B anthracis* and 18 will provide *Y pestis* without requiring evidence of professional or academic research need (12). While finding an effective means of disseminating the pathogen is a considerable challenge, it has been attempted. Aerosolizing devices can be purchased in commercial electronics stores, and instructions on creating devices that can effectively disseminate biological agents in large buildings or communities are available on the Internet (11,12). The occurrence of large outbreaks of food and waterborne illnesses gives a sense of how effective those routes of dissemination could be in producing widespread illness.

RECENT HISTORY OF BIOTERRORISM

The Monterey Institute of International Studies in California collects American and international data on terrorist activities using biological, chemical, radiological and nuclear materials (13). Incidents involving biological agents were quite rare between 1960 and 1999 (66 criminal and 55 terrorist incidents). Since 1995, however, the number of incidents has risen sharply; however, 80% have been hoaxes. Only one terrorist attack with biological agents has resulted in casualties (no deaths): the Rajneeshee cult contamination of restaurant salad bars with *Salmonella typhimurium*. Aum Shinrikyo, the religious cult responsible for the sarin attack in the Tokyo subway in 1995 also had plans for biological terrorism – in its arsenal were large quantities of media, botulinum toxin, anthrax cultures and drone equipment with spray tanks (11). More than 200 anthrax threats have been made in the United States since 1998; none produced a health threat and almost half were linked to abortion-related protests (8). Individual responses to American incidents have cost as much as $890,000 (8).

STRATEGIC PLAN TO DEAL WITH BIOTERRORISM

The elements of a strategic plan for bioterrorism preparedness and response are very similar to those of preparing for a natural disaster, with one major difference: the criminal aspects of bioterrorism events. The CDC has outlined five focus areas in their strategic plan (3). The first is preparedness and prevention through the support of local and state public health agencies, because they develop coordinated plans and protocols.

The second is detection and surveillance. This is where infectious disease and emergency room physicians will especially play a role, because they are the 'first responders'. It is crucial that 'first responders' be aware of the clinical syndromes associated with these potential agents (14). Physicians will also have to be on the alert for clusters of illnesses, which may be the first clue that an act of bioterrorism has taken place. Unlike other acts of terrorism whose effects are usually immediate and obvious, bioterrorism attacks are more apt to be covert. Thus, bioterrorist events will not likely be recognized until after a number of illnesses have occurred (15). Features pointing to the possibility of a bioterrorism-related outbreak include: a rapidly increasing disease incidence in a normally healthy population; an epidemic curve that rises and falls during a short period of time; an endemic disease seen at an unusual time or with an unusual pattern of illness; clusters of patients arising from a single geographic area; large numbers of rapid deaths; or a single patient presenting with an uncommon disease that has bioterrorism potential (4,16).

The third aspect is diagnosis and characterization of biological and chemical agents. Laboratories must be prepared

to provide prompt diagnosis of potential pathogens. In cases where laboratories do not have the capability to work safely with the agent, a procedure must be in place to refer specimens to the appropriate biocontainment facility. The response component includes epidemiological investigation, medical treatment and prophylaxis for infected persons, and the initiation of disease prevention or environmental decontamination measures (3). For hospitals, specific response issues are the need for large scale patient isolation (including rooms with special ventilation); laboratory work with potentially very hazardous organisms; critical care availability; increased demand for personal protective equipment; determining exposure risks; identifying sources for vaccines, antibiotics, immunoglobulin and antitoxin; protection of health care workers, other patients, the visiting public and the hospital environment; and assuring staff availability (15). Plans for the evaluation and discharge of patients need rapid implementation, including written discharge instructions.

Finally, effective communication systems are crucial. Up-to-the-minute clear and correct communication between health care and public health personnel is essential for the early detection of a possible or real event, the dissemination of diagnostic results and emergency health information, the understanding of roles and responsibilities, and the coordination of activities. Effective public communication is essential to limit the terrorists' ability to induce panic and disrupt daily life (3).

INDIVIDUAL PREPAREDNESS FOR THE PHYSICIAN

Reference has been made to education concerning the clinical manifestations of the most likely serious agents: *B anthracis*, *Y pestis*, *C botulinum* toxin and the smallpox agent. A plan can be formulated for initial response to an incident, either perceived or real. This plan should incorporate instructions for the initial response to exposure (including telephone numbers for facility emergency response personnel, infection control, hospital administration and public affairs, the local emergency measures organization, law enforcement agencies and public health officials), how to manage exposed and/or ill individuals, and how to prevent further spread of contamination and exposure.

The Bioterrorism Readiness Plan: A Template for Healthcare Facilities (4), jointly prepared by APIC and CDC, contains disease-specific information on anthrax, botulism, plague and smallpox. Awareness and application of this information will, it is hoped, eliminate the overreaction that has characterized many anthrax threats (8). In each situation, consideration is given to: procedures for patient management; postexposure management including decontamination, prophylaxis and postexposure immunization; and triage management of large scale exposures or potential exposures (4). Decontamination of individuals should only be done where there has been gross contamination, to minimize the transmission risk from cutaneous or gastrointestinal routes. It preferably should be done before arrival at the health care facility to avoid contaminating other patients and health care workers (4,17). Bathing patients with disinfectants is not necessary and should be avoided.

TABLE 2
Web sites relevant to bioterrorism

http://www.apic.org
http://www.cdc.gov/ncidod/diseases/bioterr.htm
http://www.hopkins-biodefense.org

Collecting diagnostic specimens should be completed in consultation with laboratory and public health specialists. In all cases of suspected bioterrorism, an acute serum sample should be collected for baseline comparison to a convalescent sample. It should be determined whether any of the diagnostic specimens are required for criminal investigation.

When dealing with potential anthrax exposure, ventilation systems should be shut down, doors should be closed and individuals in the immediate environment should be evacuated to a safe location that minimizes potential exposure. As much information as possible regarding the number of people exposed and the nature of the contamination should be given to the emergency responders to assist in their response (17). An assessment of the likelihood of exposure is made; this involves public health officials working with the first responders and law enforcement personnel. There is no reason for prolonged detention of individuals beyond the management phase, insuring that a record is kept of those potentially exposed for follow-up purposes. The risk of reaerosolization of spores is extremely low, but where gross contamination has occurred, cleansing of skin and fomites may reduce the risk for cutaneous and gastrointestinal forms of the disease (4). Decontamination of exposed patients may include the removal of contaminated clothing followed by a thorough shower with soap and water. Clothing should be stored in labelled plastic bags with minimal handling. Environmental surfaces can be decontaminated with a sporicidal and/or germicidal agent or a 0.5% concentration of hypochlorite. Routine infection control practices are sufficient for caring for patients with anthrax (18).

Depending on the likelihood that the threat represents a real exposure, a decision regarding prophylaxis will be made. Chemoprophylaxis with a fluoroquinolone or, as an alternative, doxycycline, preferably combined with vaccine, is recommended (14,19,20). For children, the need for prophylaxis must be balanced against the potential side effects of quinolones and doxycycline. Once it is confirmed that the *B anthracis* isolate is susceptible to penicillin, then penicillin may be used for prophylaxis in children (4,14). With botulism, person-to-person transmission does not occur, and routine practices for infection control suffice (18). Contamination with botulinum toxin does not place persons at risk for dermal exposure, and decontamination of patients is not required (4). Trivalent botulinum antitoxin may be considered for postexposure prophylaxis (4,14).

Unlike anthrax and botulism, patients with pneumonic plague are infectious until they have completed 72 h of antimicrobial therapy (14). Droplet precautions are, therefore, recommended (18). In situations where there may have been gross exposure to *Y pestis*, similar patient and environmental decontamination procedures such as are used for anthrax may be considered (4). Postexposure prophylaxis should be started for confirmed or suspected exposures, as well as health care workers and others who had unprotected face-to-face contact with symptomatic patients (4). The recommended prophylactic agents are doxycycline or ciprofloxacin (4,14).

Smallpox can be transmitted through the airborne route. Patients are infectious from the onset of the rash until scabs separate (approximately three weeks). Airborne precautions are required in addition to contact precautions (4,18). Patients suspected or confirmed to have smallpox are required to be placed in rooms that meet the ventilation and engineering requirements for airborne precautions (18). This may require their transfer to a facility with appropriate negative pressure isolation rooms. Patient or health care worker decontamination after exposure to smallpox is not indicated (4). Postexposure immunization with smallpox vaccine and passive immunization with vaccine-immune globulin are available (14). Vaccination alone is recommended if given within three days of exposure. Both vaccine and immune globulin are recommended if more than three days have elapsed after exposure (21).

While it may seem that preparedness for bioterrorism requires tremendous effort and costs for an event that may never happen, it is important to remember that some of the initiatives for managing bioterrorism should enhance our ability to deal with the natural infectious diseases challenges that are faced on a regular basis. A worldwide surveillance program to detect the incidence and prevalence of selected infectious diseases would be very useful in public health practice (22). At the same time, these efforts toward preparedness must be balanced with the many other health priorities that we face.

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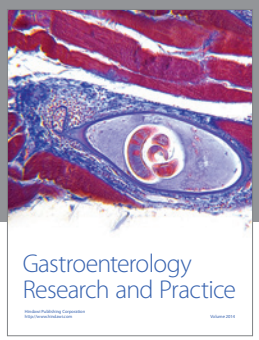

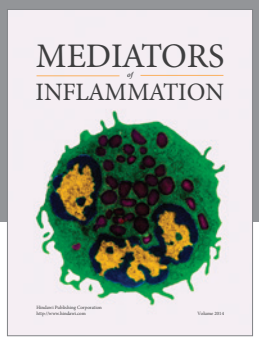

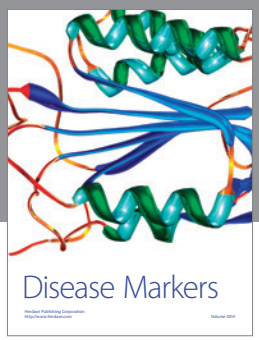

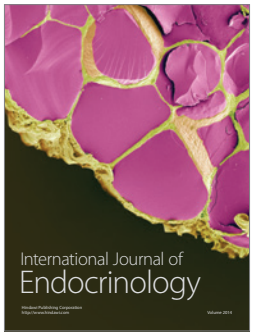

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