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Preparing for Expected Bioterrorism Attacks

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The threat of bioterrorism in the United States is increasing. Health professionals, especially "front-line" practitioners, must be able to recognize the potential for major impacts from a bioterrorism event. Although an effective attack could produce numbers of casualties equivalent to those resulting from a nuclear weapon, an unannounced attack would be unlikely to be recognized immediately. Health workers may be the first to recognize an attack. However, only limited assistance is available to aid local community medical organizations in planning for bioterrorism. Military medical personnel have had more experience in planning for terrorist activities than many of their civilian colleagues. Their experience may be invaluable to local civilian treatment facilities in developing practical plans to meet the unique aspects of bioterrorism. In addition to considering agent-specific medical problems and requirements, it is particularly important for plans to address command and control, communication, and coordination if the resultant response is to be effective.

Introduction

The potential for bioterrorism attacks in the United States is increasing.[1–4] Potential targets include military facilities, metropolitan areas, theme parks, government centers, events with large crowds, and any high-profile occasion or person. The expanded risk reflects the improved sophistication and financial resources of terrorist groups. Dispersal of life-threatening biological agents so that they retain their infectivity is not simple, but the developing capabilities of terrorists increases the possibilities of an effective assault. Additionally, the goals of some terrorist groups have apparently shifted from making political statements through violence to attacking larger, less defined targets that will produce maximum casualties.[5–7] Biological agents may be particularly appealing to such groups because the attack can be invisible, delays in onset may preclude identifying and treating exposed groups, death may follow rapidly after the onset of symptoms, and treatment is limited or essentially nonexistent for some agents. These factors add significantly to terror in the general public and may increase the attractiveness of a biological attack. Terrorists do not actually have to accomplish an attack to claim responsibility. A call to a radio station stating that those attending a sporting event had just been exposed to anthrax could result in mass panic. Reassurance may not be sufficient to prevent panic responses. Hoaxes may also be used as diversions for an actual attack. Whether an actual episode or a hoax, health professionals will play crucial roles in responding to such events. It is thus essential that health care workers have the well-developed response capabilities necessary to recognize the threat, detect an event, and respond effectively to an attack.

Recognizing the Threat

Bioterrorism Capabilities

More than 30 countries are thought to have sophisticated biological and chemical weapons of mass destruction. Intensive development efforts are under way by other groups.[1,8] Potential bioterrorism weapons include bacterial agents, viral agents, and toxins that can cause diseases such as anthrax, smallpox, viral hemorrhagic fevers, viral encephalitides, and plague. More than a dozen agents could be used by bioterrorists.[9,10] Most of these agents have the potential to produce large numbers of casualties. The thought of deliberately causing illness and death is abhorrent to health professionals. For many, even considering the possibility of a bioterrorism event is considering the "un-

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thinkable." The potential for genetic manipulation of potential biological agents, with or without the assistance of health professionals, further complicates attempts to recognize and respond to a biological event. Any suggestion that physicians and other health professionals could aid groups in developing bioterrorism agents is even more distasteful. Unfortunately, history provides compelling evidence that some members of a medical community have supported the activities of a nation or organization without regard to ethical concerns.[11,12]

Health professionals at all levels must recognize that the bioterrorism threat is very real. The threat falls into the category of "low probability, high cost."[6] In view of the fact that one successful attack could produce unacceptably high numbers of casualties, the threat cannot be ignored.

Potential Impacts from a Bioterrorism Attack

An effective biological attack could be devastating, producing literally millions of casualties. That impact equals, or exceeds, the casualty impact of a nuclear weapon. For example, release of 100 kg of anthrax spores upwind of Washington, DC, could produce between 130,000 and 3,000,000 deaths from inhalation of the agent.[9,13] Antibiotic therapy is available to treat anthrax, but it currently appears that treatment must be given before the onset of significant symptoms to be effective. Because the early symptoms resemble those of typical influenza, the true diagnosis may be recognized only when those infected die, with mortality approaching 90%. A large number of patients, all with the concurrent requirement for up to 60 days of treatment, could exhaust the available supplies of effective antibiotics.[4,13] An effective vaccine against anthrax is available, yet controversy exists regarding its use.[14] It is not anticipated that there will be any effort to vaccinate large portions of civilian populations in the forseeable future.

Smallpox, another agent of particular bioterrorism concern, has a lower mortality rate (approximately 30%) but is highly infectious. Infection of a small number of individuals through a covert attack could spread rapidly, with each successive generation producing 10 to 20 times as many new patients.[15,16] Most practicing health professionals have never seen a case of smallpox, because it currently does not exist in the population. The incubation period is 2 weeks, and initial cases may be misdiagnosed as chickenpox. That situation limits the potential for early case recognition and vaccination. Vaccination within 4 days of exposure may prevent the disease or reduce fatal outcomes. An estimated 40 million doses could be required to control an epidemic during the first 4 to 8 weeks after an attack in the United States.[15] The current supply of vaccine in the United States could immunize only between 6 and 7 million persons. There is no capability at present to produce additional supplies.[15]

The potential impacts of these two historically recognized biological agents underscore the need for early recognition of an attack and design of methods to cope with such an event.

Recognizing an Attack

Unlike explosive or chemical attacks, days to weeks might pass before a biological attack is recognized. "Front-line" health professionals can be expected to play major roles in detecting and responding to a bioterrorism situation. Attacks may also be recognized through other means. Methods of confirmation include the following.

Recognition by Medical Treatment Personnel

Many military and civilian physicians, nurses and nurse practitioners, and physician assistants have epidemiological and clinical expertise that could facilitate recognition of a biological attack.[17] Information such as a sudden surge in patients with the same symptom complex, recognition of unusual clinical courses in patients, unusual seasonal or geographic presentations, obvious relationship to a particular event, and reports of large numbers of deaths in animals could be vital epidemiological and clinical clues. It has been demonstrated that techniques such as statistical process control will facilitate "real-time" recognition of disease outbreaks by depicting increases above normal variation.[18] A high index of suspicion must be maintained, even during prolonged periods of stability.[19] In the face of a sharp increase in "flu" patients, chest radiographs that demonstrate the widening of the mediastinum characteristic of inhalation anthrax may permit early lifesaving treatment of those exposed. Similarly, recognizing that skin lesions are smallpox rather than chickenpox may be sufficient to take steps to halt an epidemic. As with other medical conditions, thinking of a diagnosis facilitates making the diagnosis.[19] Training programs, including those offered through the Domestic Preparedness Program, as well as recent publications such as those listed in the references will assist in developing clinical expertise in recognizing a bioterrorism situation.[13,15,20-22]

Detection of an Attack Through Disease Surveillance

In 1999, the Centers for Disease Control and Prevention (CDC) provided major funding to certain states and metropolitan public health agencies as part of the government's response to the bioterrorism threat. This funding will be used to expand disease surveillance and other public health infrastructures. The surveillance will involve all sources of treatment, ranging from individual practitioners' offices to the largest hospitals. Eventually, this system will rapidly provide data needed to recognize that an attack has occurred. Initial patients may be treated at many different locations. Broad surveillance will help detect an overall, unexpected increase in patients otherwise not recognizable for hours or days. The system requires that all primary practitioners appreciate the need for prompt, accurate reporting of unusual disease patterns. Effective surveillance programs will not only aid in the early recognition of an attack but may also identify the asymptomatic exposed population.

The surveillance methodology for a bioterrorism event is identical to that used to detect new diseases (such as hantavirus a few years ago and Legionnaire's disease and Lyme disease a generation ago) and cases and outbreaks of rare diseases (such as malaria and cholera in the United States and vicious strains of *Escherichia coli* everywhere). Bioterrorism may result in unnatural primary cases, but that situation has little if any effect on the recognition and treatment of secondary cases. Consequently, the detection of initial bioterrorism patients through a surveillance orientation should be a "routine" capability for medical personnel who are providing direct patient care. With

such an orientation, an event can be rapidly recognized and reported so that appropriate treatment and prevention programs can be initiated.

To be effective in countering terrorism, a system must provide real-time information. Improved reporting and epidemiological communication capabilities at all health care and public health levels are essential in meeting this requirement.[23] As with early clinical recognition, rapid reporting, analysis, and confirmation of a terrorist event will facilitate a more prompt, more effective response.

Announcement by the Terrorists at the Time of the Event

Terrorists may announce an attack to provide publicity and induce panic. Depending on the alleged agent, such an announcement may permit mobilization of defense capabilities and also target the responsible group for retaliation. There is a distinct possibility that the announcement would be a hoax rather than an actual dispersal. Responses to hoaxes have varied greatly. Occasionally, agencies have responded less than optimally because of communication problems, lack of prior planning, and lack of readily available information on proper response procedures.[23] Whether the event is actual or a hoax, local and other public health practitioners will be involved soon after the announcement. Clinical treatment facilities will become involved. Large numbers of individuals may request evaluation of possible exposures, urgent treatment, or interventions to prevent the disease. If the supposed agent was in a readily collectable form, such as a dust, it may require 24 or more hours to ascertain whether the supposed agent is infective or a harmless substance. If the alleged agent was reportedly an invisible aerosol, the impact on medical facilities could be significantly lengthened.

Confirmation of an Attack by Government Agencies

Surveillance of terrorist groups and individuals by law enforcement and intelligence agencies may permit warning or confirmation of a release of a biological agent. If a known release occurs, responses could be tailored to the agent. Public health surveillance programs could be increased and exposed populations could be identified to permit initial preventive treatment. Public health and clinical providers would be involved in the response.

Sensor Detection of an Agent

Military organizations and some organizations that handle hazardous materials (HAZMATs) have biological agent detectors and monitors. These devices require training, and they may provide false-positive and false-negative results. For example, all current HAZMAT chemical sensors are calibrated to produce more false-positives than false-negatives. It can be expected that biosensors will be similarly calibrated. However, mutations may produce false-negatives, and as a result, one cannot place absolute reliance on a "negative" reading from such detectors. Furthermore, currently available detectors may require significant time to characterize the agent.[2] Efforts are under way to use polymerase chain reaction, enzyme-linked immunosorbent assay, and other techniques to develop portable field instruments that may confirm the identity of an agent within 15 minutes. These instruments would ideally be able to identify mutated forms of agents as well as naturally occurring forms. Unfortunately, such devices probably will not be available in the near future. A false-positive result could cause public responses similar to those described for hoaxes.

Confirmation of an Attack Through Laboratory Studies

It may be necessary to transport suspect material to specialized laboratories, such as at the CDC or the U.S. Army Research Institute for Infectious Disease, for confirmation.[13,23] Even if dedicated aircraft are available for transport, significant time will be required to get the agent to the laboratory. The time may be lengthened significantly by such factors as mechanical problems with the aircraft or severe weather. Delays in confirmation will allow time for panic to spread and lessen the opportunity to initiate treatment or prevention programs. Development of reliable, practical, portable detection and identification devices should remain a high priority.

Developing Effective Response Capabilities

Health care facilities (HCFs) must be able to respond to known or suspected biological attacks. The situation may range from preliminary recognition and reporting of an event involving a very few patients to coping with the abrupt arrival of hundreds of individuals who believe they may have been exposed. Regrettably, at present, there is no single national government agency or accrediting body that is responsible for ensuring that civilian HCFs are specifically prepared to respond to bioterrorism situations (A.S. Khan, CDC National Center for Infectious Disease, August 1, 1999). Consequently, it is essential that senior health professionals take the lead in helping their members structure effective methods to deal with an attack.

The potential number of casualties may lead to the conclusion that "there could be so many casualties that nothing can be done." Some may believe that "no disaster will follow a plan, so why plan?" Certainly, disaster situations are fluid. Response plans must be sufficiently flexible so that constantly changing requirements can be met. Experiences with actual and simulated disasters have repeatedly demonstrated that medical groups that have developed and practiced appropriate plans accomplish coordinated, effective responses to mass casualty and other disaster situations. In contrast, attempts to "play responses by ear" result in disorganized, ineffective responses that have harmed ill or injured patients and may even have contributed to additional casualties.

Two distinct scenarios should be considered in planning responses to a bioterrorism event. In a covert attack, the first result could be the arrival of first-generation patients at HCFs, scattered locally or worldwide. The situation might become apparent only as more and more of the initially exposed patients seek care. This situation may rapidly evolve into a mass casualty situation. However, if recognized early, some time may be available to organize community health care resources and implement a bioterrorism response plan.

In the second scenario, an announced attack, large numbers of individuals may arrive at HCFs within a short time, all demanding immediate treatment. Response cannot be delayed until laboratory studies can confirm whether an actual attack occurred. Any delay could result in serious health and other consequences in a real

event. Decontamination, in addition to evaluation and treatment, may be required. The decision about what if any decontamination is required should be made in conjunction with appropriate local, state, or federal health agencies.[2,20]

Several sources of assistance are available to aid in planning for covert or overt bioterrorism events. A number of larger communities have received funding assistance to develop response programs through the Metropolitan Medical Response Systems program. The Nunn-Lugar-Domenici legislation has provided support for this domestic preparedness program. Partners in the program are the Department of Defense, Department of Energy, Environmental Protection Agency, Federal Bureau of Investigation, Federal Emergency Management Agency, and Public Health Service. The Department of Defense received support to provide training for emergency management, emergency responder, HAZMAT technician, and hospital provider individuals. Although health care provider training has been presented in more than 120 municipalities, significant training in HCF operations is not included in the program at present.[2] Current publications can be sources of assistance in planning, as suggested by their titles: *Weapons of Mass Destruction Events with Contaminated Casualties: Effective Planning for Health Care Facilities*; *Bioterrorism Readiness Plan: A Template for Healthcare Facilities*; and *Taking the Terror Out of Bioterrorism: Planning for a Bioterrorist Event from a Local Perspective*.[2,20,23]

Education programs and information can provide important planning information, but preparing an actual, specific plan to respond to bioterrorism events can pose significant challenges to HCF planners. The previously noted lack of a national agency to oversee the development and implementation of response plans in civilian HCFs is a significant handicap to appropriate planning. Until more definitive standards are established, local HCFs will frequently have to "reinvent the wheel," setting the stage for the possible omission of essential components of the response. It would be beneficial for national agencies or working groups to develop a standardized template that could be adapted to facilities of varying size. The template should incorporate information from recent and ongoing studies as well as evaluations of recent actual responses. Such assistance might significantly improve planning efficiency and effectiveness. In developing response plans, the experience of area military HCFs may be of significant value. Many military HCFs have developed plans and practiced responses to bioterrorism events, and they may provide assistance to nearby civilian HCFs in developing their own plans. An additional benefit of such interaction could be the opportunity to ascertain whether the HCF or other military agencies might be available to provide assistance during an event. Once a plan is developed, it is essential that the plan be practiced in conjunction with all other agencies that would be involved in a bioterrorism event.

Some Specific Planning Concerns

Past experiences with actual and simulated mass casualty and disaster situations have demonstrated the crucial importance of command, control, communication, and coordination in responding to such events.

Command and Control

As emphasized during one national panel discussion of a bioterrorism scenario, "Who is in charge. . . is one of the most important questions. . . because any large-scale relief effort would require good management. Complicating the answer, however, are various levels of government, each with its own responsibilities and perspectives on response."[24]

Difficulties arising from uncertainty about who is in charge were witnessed during two major exercises in 1999. Although all participants had been trained previously, there was still significant controversy during the exercises. Leaders of on-scene response groups did not agree when control would be passed to the Federal Bureau of Investigation. Currently, that agency is the domestic lead for responses to bioterrorism occurrences. Similar command concerns and conflicts existed between some state and local government agencies. In providing care, confusion existed about providing patient care as opposed to the need to protect criminal evidence. Repeated experiences in other actual and potential mass casualty situations indicate that these problems were not unique. Others have stressed the need for coordinated command and control.[2,23] Unfortunately, the question of authority at hospitals "is unresolved," and "who is coordinating activities at the hospital is still unclear."[24] Clear lines of authority and practice in conducting the response are critical if delays and potential harm to patients are to be avoided.

Communication

Disasters have repeatedly demonstrated problems in maintaining effective communication capabilities. Problems ranged from incompatible equipment among responders to inappropriate nonemergency use that precluded urgent transmissions. Planners may not consider the need for secure communication. Media and individuals who monitor the unsecured communications can induce panic. Reliance on cellular phones is not the answer.[23] Both limited battery life and circuit overload could inhibit the use of these devices during a terrorist event. Recall systems for some HCFs are not as functional as they might be. In some instances, the head of a department or section is expected to notify all members of the unit if a recall for a mass casualty situation is needed. There may be no alternative designated if the responsible individual cannot be contacted. A pyramid recall system is typically much more efficient than the cumbersome "one person calls all" approach. The system can be adapted to provide modular responses so that a total recall would be instituted only when necessary. Periodic practice of communication capabilities involving other responding agencies will help delineate difficulties and maintain the ability to use the system properly.

HCF communication capabilities must include ready access to sources of assistance and to required reporting agencies. Telephone numbers and bookmarked Internet sites for assistance must be readily available at all times, including nights and weekends.[20,23] Unfortunately, a recent survey revealed that many health departments had no access to the Internet, did not use electronic mail, and had little if any experience using on-line services and support from the CDC and other government agencies.[23,25]

Collecting and reporting of disease surveillance information is another communication concern. As mentioned previously, the emphasis must be on real-time reporting of unusual events if

the data are to be useful in early recognition of an attack.[23,26] During a recent hoax, the absence of a flexible surveillance system significantly impeded response.[23] Problems resulted from individuals not being trained in the use of computer surveillance programs, from attempts to collect epidemiological information using a paper-based system, and from failure to integrate local surveillance with state surveillance programs.

Coordination

At the national level, significant coordination of planning efforts by agencies concerned with bioterrorism has occurred. To varying degrees, states have also coordinated efforts. However, recent reports have documented the fact that public health systems in some states are unprepared because of a lack of coordination among medical, emergency management, and law enforcement agencies.[27] Coordinated planning has been even less extensive in many communities, even though the detection of an event and the initial response will be local.[23,24,26,28] Because of the large number of agencies that will become involved in any bioterrorist attack, lack of coordination may become a major impediment to an optimum response.

In some instances, HCFs may rely on existing HAZMAT plans. However, the unique challenges of a bioterrorism event are unlikely to "fit" the plans for nonbiological events.[2,27] Specific bioterrorism concerns, such as control of large crowds, will require coordination with agencies beyond those involved in other disaster situations.[2,19] For examples, during the Aum Shinrikyo 1995 sarin attack in the Tokyo subway system, 5,000 medical evaluations were accomplished.[2] Similar results can be expected with a bioterrorism event.

Appropriate coordination will assist not only in responding effectively to an event but also in obtaining support and assistance from other agencies. The National Disaster Medical System coordinates access to approximately 100,000 hospital beds throughout the United States.[5] Local and regional military HCFs may be able to provide support, depending in part on whether they are directly involved in the bioterrorism response. Prolonged 24-hour operations by fully staffed HCFs would soon produce staff exhaustion, especially if personal protective gear were required. Appropriate coordination will help establish and facilitate alternatives, if available. If alternatives involve aeromedical evacuation, advanced coordination is essential to assure the special requirements of such transport are met.[29]

Similarly, advance coordination will be of marked value in meeting the heavy logistical demands resulting from a bioterrorism event. Although logistics may not pose significant problems during the first few hours of response, the demands will greatly increase over time as resources are consumed much more rapidly than in normal operations. Problems may occur with pharmacy supplies (such as antibiotics, antitoxins, and oxygen), general supply items (such as beds, sheets, gowns, masks, gloves, and bleach for decontamination), and services (including food services, laundry, and similar units). Coordinating methods to meet these demands before the event will help ensure that the HCF can function effectively during the required prolonged response periods.

A major benefit of coordination, joint planning, and exercises to evaluate the effectiveness of coordination is that all involved become better acquainted with each other and with the capabilities of each other's agencies. Even if the original work is irrelevant to the real event, the interactions foster informal relationships that compensate for the inevitable gaps and omissions that occur in the formal planning phase. In view of the importance of interagency contacts, they should be strongly encouraged by all involved in developing and coordinating response plans. In essence, the unique challenges of a bioterrorism event underscore the importance of prior, and practiced, coordination within the HCF as well as with the numerous other agencies outside the HCF that will be involved in the response.

Practical approaches to command, control, communication, and coordination must be incorporated into bioterrorism response plans. These components are as critical to designing effective responses as are disease identification, decontamination, infection control, and treatment options.

Summary

A bioterrorism attack, with resultant large numbers of casualties, can be expected in the United States. Local clinical and public health professionals are likely to be directly involved in recognizing and responding to the event. Appropriate planning and preparation will enhance the response and help limit the impacts. It is essential to incorporate effective command and control, communication, and coordination in such plans. An attack could come in the near future, so there is an urgent need to develop effective response capabilities.

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