Chapter 9: Bioterrorism

Anthony G. Macintyre; Joseph A. Barbera

INTRODUCTION AND EPIDEMIOLOGY

An adequate response to a bioterrorist event of any magnitude requires early recognition and effective coordination of many disparate health and medical entities beyond the ED. Although the emergency physician plays a critical role in these types of events, many other essential functions must be addressed by individuals and organizations representing public health, mental health, law enforcement, emergency management, and others.

A bioterrorist incident is the release, or the threat of a release, of a biologic agent among a civilian population for the purpose of creating fear, illness, and death. Such an occurrence is a low-probability, high-impact incident. For example, in the U.S. anthrax dissemination incident, the U.S. Postal Service was used to deliver letters containing spores of *Bacillus anthracis*. Although the environmental contamination was widespread, only 22 diagnosed cases of anthrax infection occurred: 11 cases of inhalational and 11 cases of cutaneous anthrax. Five patients died as a direct result of the anthrax exposure. Communities on the Eastern Seaboard of the United States were severely affected, with thousands of people receiving prophylaxis for anthrax. Fear then spread across the nation, as concern increased for a wider delivery of anthrax. Much of this national anxiety may have been exacerbated by the perception of an inadequate public health response capability, with the deficiencies demonstrating a critical need to integrate acute care medicine and the public health response.

Biologic agents are classified into two groups: biologically produced toxins and infectious organisms. Biologic toxins usually act as chemical agents in their human impact. The recognition and response requirements for these are very similar to those for chemical incidents. Infectious agents are subdivided into two categories: contagious (propagating person to person) and noncontagious. Contagious agents have additional ramifications, both for protection of the healthcare workforce as well as propagation of the disease beyond the initially exposed population. The contagious agents of greatest concern, such as smallpox, plague (pneumonic), and certain viral hemorrhagic fevers, are person-to-person infectious through airborne or droplet transmission. Suspected biologic agents causing illness should be treated as contagious until demonstrated otherwise.

AGENTS OF CONCERN
Certain characteristics make individual organisms particularly attractive as weapons for generating widespread fear, illness, and death among civilian populations. The Centers for Disease Control and Prevention identified select organisms and the diseases they cause as the priority for focused preparation.\(^3\) Infectious agent selection was based on four general criteria:

1. Potential for public health impact
2. Delivery potential (an estimation of the ease for development and dissemination, including the potential for person-to-person transmission of infection)
3. Public perception (fear) of the agent
4. Special requirements for public health preparedness (diagnostic, logistic, etc.)

The selected agents were then ranked in three categories, based on their overall potential for adverse public health impact (Table 9-1; Figures 9-1, 9-2 and 9-3). Class A agents have the most severe potential and include viruses and bacteria such as variola major (smallpox), \(B.\ \text{anthracis}\) (anthrax), and \(Yersinia\ \text{pestis}\) (plague). Class B agents are considered to have less potential for causing widespread illness and death, and Class C agents are those that, as technology improves, could emerge as future threats. More common pathogens could be used to cause intentional injury and death, and the intentional etiology of the infections may be apparent only through epidemiologic cohort evaluation. This chapter focuses on Class A agents, but applies also to a range of additional bacteria and viruses that, although not on the Centers for Disease Control and Prevention list, could have a similar human impact if used in a nefarious manner (e.g., hanta virus).
<table>
<thead>
<tr>
<th>Biologic Agent</th>
<th>Disease Caused</th>
<th>Incubation Period</th>
<th>Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Class A agents</strong></td>
<td></td>
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</tr>
<tr>
<td>Variola major</td>
<td>Smallpox <em>(Figure 9-1)</em></td>
<td>7–14 d</td>
<td>Initially fever, severe myalgias, prostration; followed within 2 d by papular rash on the face spreading to extremities (affecting palms and soles) and then to trunk (lesser extent than chickenpox); lesions progress at same rate, becoming vesicular and then pustular with subsequent scab formation</td>
</tr>
<tr>
<td><em>Bacillus anthracis</em></td>
<td>Cutaneous anthrax <em>(Figure 9-2)</em></td>
<td>Usually 1 d, up to 2 wk reported</td>
<td>Macule or papule enlarging into eschar with surrounding vesicles and edema; sepsis possible, less common</td>
</tr>
<tr>
<td></td>
<td>GI anthrax</td>
<td>Usually 1–7 d</td>
<td>Abdominal pain, vomiting, GI bleeding progressing to sepsis; mesenteric adenopathy on CT</td>
</tr>
<tr>
<td></td>
<td>Oropharyngeal anthrax</td>
<td>Usually 1–7 d</td>
<td>Sore throat, ulcers on base of tongue, marked unilateral neck swelling</td>
</tr>
<tr>
<td></td>
<td>Inhalational anthrax <em>(Figure 9-3)</em></td>
<td>Usually &lt;1 wk, 43 d reported at Sverdlovsk</td>
<td>First stage is nonspecific (fever, dyspnea, cough, headache, vomiting, abdominal pain, chest pain); second stage (dyspnea, diaphoresis, shock); hemorrhagic mediastinitis with widened mediastinum on x-ray</td>
</tr>
<tr>
<td><em>Yersinia pestis</em></td>
<td>Bubonic plague</td>
<td>2–8 d</td>
<td>Initially fever, chills, painful swollen lymph node(s); node progresses to bubo (sometimes suppurative)</td>
</tr>
<tr>
<td></td>
<td>Pneumonic plague</td>
<td>2–3 d</td>
<td>Fever, chills, cough, dyspnea, nausea, vomiting, abdominal pain; clinical condition consistent with gram-negative sepsis</td>
</tr>
<tr>
<td>Biologic Agent</td>
<td>Disease Caused</td>
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<td>Signs and Symptoms</td>
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<tr>
<td></td>
<td>Primary septicemic plague</td>
<td>2–8 d</td>
<td>The clinical condition is consistent with gram-negative sepsis, disseminated intravascular coagulation (secondary septicemic plague may occur after bubo formation)</td>
</tr>
<tr>
<td><em>Clostridium botulinum</em></td>
<td>Foodborne botulism</td>
<td>1–5 d</td>
<td>GI symptoms followed by symmetric cranial neuropathies, blurred vision, progressing to descending paralysis</td>
</tr>
<tr>
<td></td>
<td>Inhalational botulism*</td>
<td>12–72 h</td>
<td>Symmetric cranial nerve palsies followed by descending paralysis</td>
</tr>
<tr>
<td><em>Francisella tularensis</em></td>
<td>Tularemia</td>
<td>1–21 d</td>
<td>Depends on route of exposure: all usually involve abrupt nonspecific febrile illness; inhalation exposure progressing to pleuropneumonitis; cutaneous exposure developing glandular or ulceroglandular lesions; ingestion developing oropharyngeal lesions/tonsillitis</td>
</tr>
<tr>
<td>Filoviruses and arenaviruses (Ebola virus)</td>
<td>Viral hemorrhagic fevers</td>
<td>2 d–3 wk, depending on virus</td>
<td>Initial nonspecific febrile illness, sometimes with rash; progresses to bloody vomiting, diarrhea, shock</td>
</tr>
</tbody>
</table>

**Class B agents**

<table>
<thead>
<tr>
<th>Biologic Agent</th>
<th>Disease Caused</th>
<th>Incubation Period</th>
<th>Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Coxiella burnetii</em></td>
<td>Q fever</td>
<td>2–3 wk</td>
<td>Fever, myalgias, headache, 30% develop pneumonia, rarely lethal (2%)</td>
</tr>
<tr>
<td><em>Brucella</em> spp.</td>
<td>Brucellosis</td>
<td>2–4 wk</td>
<td>Fever, myalgias, back pain; CNS infections and endocarditis possible</td>
</tr>
<tr>
<td><em>Burkholderia mallei</em></td>
<td>Glanders</td>
<td>10–14 d</td>
<td>Local infection: ulcers, suppurative; pneumonia, pulmonic abscesses, sepsis possible</td>
</tr>
<tr>
<td><em>Burkholderia pseudomallei</em></td>
<td>Melioidosis</td>
<td>2 d to years reported</td>
<td>Local infection: nodule; pneumonia, pulmonic abscesses, sepsis</td>
</tr>
</tbody>
</table>
Inhalational botulism may not be preceded by GI symptoms. Inhalational and foodborne botulisms are caused by botulinum toxin, not the bacteria itself.

*Note:* Incubation periods should be interpreted with some caution. Data in some instances are limited and in others may be based on natural outbreaks. Intentional releases or engineered organisms could cause variations in expected

<table>
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<tbody>
<tr>
<td>Alpha viruses (Venezuelan equine encephalitis, Eastern equine encephalitis, Western equine encephalitis)</td>
<td>Encephalitis</td>
<td>Variable</td>
<td>Fever, headache, aseptic meningitis, encephalitis, focal paralysis, seizures</td>
</tr>
<tr>
<td>Rickettsia prowazekii</td>
<td>Typhus fever</td>
<td>7–14 d</td>
<td>Fever, headache, rash</td>
</tr>
<tr>
<td>Toxins (ricin, <em>Staphylococcus</em>, enterotoxin B)</td>
<td>Toxic syndromes</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Chlamydia psittaci</td>
<td>Psittacosis</td>
<td>6–19 d</td>
<td>Fever, headache, dry cough, pneumonia, endocarditis</td>
</tr>
<tr>
<td>Food safety threats (<em>Salmonella</em> spp., <em>Escherichia coli</em> O157:H7)</td>
<td>—</td>
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</tr>
<tr>
<td>Water safety threats (<em>Vibrio cholera</em>, <em>Cryptosporidium parvum</em>)</td>
<td>—</td>
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<tr>
<td><strong>Class C threats</strong></td>
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<td><strong>—</strong></td>
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<tr>
<td>Emerging threat agents (Nipah virus, hantavirus)</td>
<td>—</td>
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</tbody>
</table>
disease parameters.

FIGURE 9-1.
Smallpox.

Source: J.E. Tintinalli, J.S. Stapczynski, O.J. Ma, D.M. Yealy, G.D. Meckler, D.M. Cline:
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FIGURE 9-2.
Ulcer and eschar of cutaneous anthrax.

Source: J.E. Tintinalli, J.S. Stapczynski, O.J. Ma, D.M. Yealy, G.D. Meckler, D.M. Cline:
www.accessmedicine.com
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FIGURE 9-3.
Chest radiograph with widened mediastinum characteristic of inhalational anthrax.
CLINICAL FEATURES: RECOGNITION OF A BIOTERRORISM INCIDENT

Unless the release of an agent is openly announced or the terrorist is caught in the process of delivering the agent, initial indications of attack may be subtle. Early symptoms of most agents of concern are not readily distinguished from more common, less threatening illnesses. Fever, myalgias, and malaise could be the initial presenting symptoms of a victim of bioterrorism (anthrax and others) or of influenza, parainfluenza, or many common illnesses. This is more than a theoretical risk, as demonstrated when some agents of concern have been documented to occur in the nonbioterrorism setting. During the anthrax dissemination incident in 2001, several anthrax-infected postal workers were evaluated by physicians early in their illness. Their relatively nonspecific symptoms were attributed to other causes, and they were discharged home without antibiotic therapy. Two postal workers in this cohort died from inhalational anthrax. The similarity in early symptoms also creates another response issue: once an attack becomes public, patients with any of those common symptoms or concerns about exposure may seek rapid evaluation in EDs, clinics, or private offices. Extreme patient volume and diagnostic challenge should be anticipated.

The recognition of a biologic attack could occur through several pathways:

1. A patient presents with signs, symptoms, or real-time diagnostic results that obviously indicate a suspect disease process.

2. A patient presents with protean symptoms, but an astute clinician establishes enough criteria (e.g., suspicious historical information, signs, symptoms, short-turnaround laboratory results, public health corroborative information) to designate the patient as a presumptive case until diagnostic confirmation can be accomplished.
3. Patient is evaluated and admitted or released but not suspected as being a victim of bioterrorism. That patient’s course then unexpectedly worsens, or diagnostic test results (e.g., blood cultures, immunoassays), even postmortem, subsequently establish a diagnosis.

4. Multiple patients present over a defined period with similar symptoms or historical characteristics, with the cohort pattern raising practitioner suspicions that prompt a report to public health. Further investigation, through environmental and diagnostic testing and/or public health investigation of the cohort, establishes the cause.

5. Public health surveillance systems establish unusual patterns of signs, symptoms, or disease in the community and investigate further to establish the etiology.

6. Sampling technologies (of which there are numerous types related to different jurisdictions and agencies) detect the release of an agent of concern in the community.

Based on the few historical cases, the first three scenarios may be the most likely ways in which a bioterrorist event would be detected. Scenario 3 is how the inhalational anthrax index case was initially diagnosed in Florida during the fall of 2001. The initial inhalational anthrax infection in a postal worker was recognized as in scenario 2. Thus, the emergency physician should have an operational knowledge of the biologic agents of concern or understand where to readily access this information. This knowledge should include basic pathologic principles for each agent, modes of dissemination and transmission, disease signs and symptoms, recommended diagnostic testing, recommended treatment (medications, immunizations, or prophylaxis), and infection control practices (Table 9-1 and Table 9-2).
<table>
<thead>
<tr>
<th>Biologic Agent</th>
<th>Vaccination</th>
<th>Prophylaxis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variola major</td>
<td>Vaccinia vaccination: currently not recommended for general public use because of its association with limited numbers of deaths and complications in immunocompromised individuals and those with eczema; useful in preventing disease if given within 4 d of exposure</td>
<td><strong>Vaccinia immune globulin</strong>: best given within 2–3 d of exposure; limited supplies are available; consider giving to those exposed who have contraindications to vaccine. Several antivirals are under investigation for postexposure prophylaxis.</td>
<td>Supportive.</td>
</tr>
<tr>
<td><em>Bacillus anthracis</em></td>
<td>Anthrax vaccination: five-part series vaccination at 0 and 4 wk and then at 6, 12, and 18 mo; annual boosters required; currently not available to the public (offers have been made to the first responder community); efficacy in preventing inhalational anthrax demonstrated in animal models</td>
<td><strong>Ciprofloxacin</strong> or <strong>doxycycline</strong> for 60 d is preferred, but alternatives exist. In addition, amoxicillin and penicillin V potassium for penicillin-susceptible strains; 60-d term established by using latency period for last infection occurring at Sverdlovsk⁴; consider concurrent 3-dose vaccination.* NOTE: 60-d regimen recommended whether vaccinated before event, receiving postexposure vaccination, or no vaccination.⁹</td>
<td>Three-drug IV regimen for presumed or proven meningitis concurrent with illness. Two-drug regimen for illness with meningitis ruled out (see Hendricks et al⁹ for specifics). Consider antitoxin administration for systemic anthrax infection (either raxibacumab or anthrax immune globulin).</td>
</tr>
<tr>
<td>Biologic Agent</td>
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<td>Treatment</td>
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</tr>
<tr>
<td><em>Yersinia pestis</em></td>
<td>Killed whole bacilli vaccine no longer available by producers; vaccine had efficacy in preventing bubonic disease but not the pneumonic form</td>
<td>Ciprofloxacin or doxycycline; alternative: chloramphenicol; prophylaxis for 10 d.</td>
<td>Streptomycin or gentamicin preferred choices; alternatives: doxycycline, ciprofloxacin, chloramphenicol.</td>
</tr>
<tr>
<td><em>Clostridium botulinum</em></td>
<td>Vaccine not available to the public: pentavalent toxoid of C. botulinum toxin types A–E; three-part series with yearly booster</td>
<td>Not applicable.</td>
<td>Antitoxin: requires procurement through local public health agency (state or the Centers for Disease Control and Prevention); antitoxin may preserve remaining neurologic function but does not reverse paralysis; may require prolonged, assisted mechanical ventilation and supportive care.</td>
</tr>
<tr>
<td><em>Francisella tularensis</em></td>
<td>Live attenuated vaccine was under investigation but now discontinued in United States</td>
<td>Ciprofloxacin or doxycycline for 14 d.</td>
<td>Streptomycin or gentamicin preferred choices; alternatives: doxycycline, ciprofloxacin, chloramphenicol.</td>
</tr>
<tr>
<td>Filoviruses (e.g., Ebola virus) and arenaviruses</td>
<td>Not applicable</td>
<td>Not applicable.</td>
<td>Supportive therapy; ribavirin may have applicability in arenaviruses.</td>
</tr>
</tbody>
</table>

*Not approved by the U.S. Food and Drug Administration but potentially available under Emergency Use Authorization.*
NOTE: Due to multiple ongoing efforts, some new or adjusted therapies may be available in the near future. Readers are encouraged to check peer-reviewed literature because this is a dynamic field. Specific recommendations exist for some agents and may entail use of therapies traditionally reserved for nonpregnant adults. In some cases, these entail use under Emergency Use Authorization, which is beyond the scope of this chapter.

DIAGNOSIS

Real-time diagnostic studies to reliably confirm or exclude the presence of potential agents of concern are not available for all Centers for Disease Control and Prevention–designated agents (this actually does not differ from most common infectious processes). In some cases, specialized confirmatory testing by state or federal laboratories may be required (e.g., through the Laboratory Response Network), and methodologies are rapidly evolving. Therefore, clinicians should command sufficient knowledge to initiate available and appropriate test ordering, medical interventions, and reporting when they are suspicious of a patient’s clinical presentation. The public health authorities with jurisdiction over the involved communities should be consulted early for current diagnostic recommendations and further testing (both patient and environmental).

Be prepared to appropriately respond to notification of a potential disease by another health or medical professional (public health authority, laboratory technician, radiologist, pathologist, or medical examiner). Carefully query the reporting source for pertinent specific information before considering further actions such as those delineated below. Questions to be asked include the methodology of the testing that produced the concern (specimen collection technique and the sensitivity and specificity of the test procedure) and the time until confirmatory test results become available.

Situations that are much more common and pose a great challenge to ED operations are those in which patients present after having been exposed to an unidentified substance (e.g., white powder), with circumstances that raise suspicion for terrorism (e.g., threatening letter, high-profile location, a "very important person"). The source substance may not have been properly evaluated or secured, and any recommended treatment necessarily will involve coordination with outside agencies, especially public health and law enforcement. If no environmental or agent testing was performed, one may attempt to obtain confirmatory studies through the local public health authorities if the substance remains available. Otherwise, the difficult task of stratifying patient exposure risk is necessary, using arguably nonspecific factors such as patient demographics and the specific characteristics of the incident (e.g., white powder found in a local business vs a high-level federal official’s office). The public health authorities with jurisdiction over the involved communities should be consulted early in the process, ideally by using a preplanned notification process and decision support tools. When testing has been performed by others, the emergency clinician should request specific information on the testing methodology and judge the reliability of the test procedure. For example, anthrax environmental testing may be performed with a wide range of procedures, including immune-based assays, assays based on polymerase chain reaction, and confirmatory culture testing. Older immune-based assays caused numerous instances of false-positive environmental
tests, which were subsequently reported in the media and created serious public concern during and after the 2001 anthrax incident. Clearer understanding of the sensitivity and specificity of these tests could have assisted in interpretation and representation of results.  

**Methods for potentially detecting a biologic event include the recognition of unusual epidemiologic phenomena such as a high incidence of nonspecific illness, clusters or large numbers of rapidly fatal cases, and steep infection curves identified through public health surveillance systems.**

Much effort in the United States has been focused on developing broad-based public health surveillance systems for detection of disease. The surveillance systems currently in use or under development are based on collecting and analyzing public health information and/or patient diagnostic information in specific communities. It is intuitive that this may be further enhanced by the widespread adoption of electronic medical records. Information is sought from many disparate sources, including hospitals, clinics, nursing homes, pharmacies, emergency medical service systems, independent laboratories, medical examiners, and general businesses (e.g., absenteeism rates). Information collected from EDs often is based on symptom complexes (syndromic surveillance). The City of New York Department of Health and Mental Hygiene has operated this type of surveillance system since the late 1990s, which has more recently capitalized on the use of electronic medical records.  

Air sampling systems to detect inhalation agents have been implemented in some communities and for specific agencies or facilities across the United States. The most well-known is the BioWatch program, which uses strategically placed sensors in specific communities. These sensors operate on the principle of drawing air samples across filters that are subsequently analyzed for some agents of concern.

**INITIAL RESPONSE TO A BIOTERRORISM INCIDENT**

Every receiving facility and ED should have standard operating procedures to manage a bioterrorism threat or actual incident. These should be incorporated into the all-hazards emergency operations plan, with bioterrorism-specific procedures in an attached incident-specific annex. The initial response to a suspected or confirmed bioterrorist event should involve many different hospital departments plus agencies outside the hospital. Initial actions taken by the emergency physician can be pivotal in the success of the hospital performance and the overall community response.

When bioterrorism is confirmed or suspected, critical initial notifications and prompt emergency operations plan activation should include:

1. Activation of processes and procedures (including preplanned surge capacity configuration) as appropriate and as listed in incident-specific annexes to the emergency operations plan

2. Implementation of appropriate infection control procedures (which may extend to how patients are received in the ED), with provision of protective equipment for patients and healthcare workers
3. Notification of key departments, including hospital administration, infection control and infectious diseases, security, environmental services, and the hospital laboratory

4. Information flow to all hospital personnel regarding the suspected agent, its characteristics (including potential for person-to-person transmission), and actions to protect the staff

5. Coordination of hospital media messages to external entities (other hospitals, public health, emergency management) to avoid dissemination of conflicting information

6. Notification of the appropriate public health agency, with confirmation that law enforcement was notified by them

Initial information that should be conveyed to the public health department is listed in Table 9-3. Ideally, the hospital emergency operations plan fully integrates the hospital into the community response, which is critical for successful bioterrorist incident response.\(^\text{18}\)

**TABLE 9-3**

*Guidelines for Initial Public Health Reporting*

<table>
<thead>
<tr>
<th>Number</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diagnosed or suspected agent of concern</td>
</tr>
<tr>
<td>2</td>
<td>Whether it is a presumed or confirmed diagnosis (and method for &quot;confirmation&quot;)</td>
</tr>
<tr>
<td>3</td>
<td>Patient demographics (including occupation)</td>
</tr>
<tr>
<td>4</td>
<td>Recent history of travel or participation in special events by the patient(s) (mass gatherings, high-profile events, or at-risk activities)</td>
</tr>
<tr>
<td>5</td>
<td>Patient condition</td>
</tr>
<tr>
<td>6</td>
<td>Initial testing performed and further diagnostic testing being conducted</td>
</tr>
<tr>
<td>7</td>
<td>Treatment being provided</td>
</tr>
<tr>
<td>8</td>
<td>Public health assistance required (including environmental and additional patient testing)</td>
</tr>
<tr>
<td>9</td>
<td>Preferred method of contacting hospital or treating physicians for follow-up</td>
</tr>
</tbody>
</table>

The local department of health then has the responsibility to notify regional or state public health departments and the Centers for Disease Control and Prevention. With some agents and/or situations, the U.S. Department of Health and Human Services would notify the World Health Organization, because the potential impact could be global and this reporting is mandatory under International Health Regulations administrated by the World Health Organization (the United States is a signatory to International Health Regulations).\(^\text{19}\) Public health officials also have the responsibility for notifying local law enforcement and the Federal Bureau of Investigation.

**INTEGRATION WITH THE LOCAL HEALTH DEPARTMENT**
In any suspected or confirmed case of bioterrorism, the emergency physician can expect to interface with multiple diverse agencies in an ongoing fashion, the most critical of which is the local public health department. In most communities, public health epidemiologists are assigned the task of defining the size and scope of an incident, the at-risk population, and other incident parameters. This type of information becomes critical to acute care clinicians, other medical care providers, and hospitals in the evaluation and treatment of patients and in anticipating medical surge and continuity of operations requirements. Challenges, such as the evaluation of minimally symptomatic individuals or the evaluation of large volumes of patients, can be facilitated by receiving clear and concise information from public health. **The most important assistance public health can provide to all clinicians is in the development of a community-wide patient evaluation and treatment protocol.** Evaluation and treatment protocols provide criteria to stratify individual and population risk for exposure and guide steps for specific evaluation and treatment. The protocol also should include recommended testing, treatment, patient instructions, tracking of at-risk cohorts, and public education.

**A single evaluation and treatment protocol provides a uniform method across a community to evaluate patients presenting with possible exposure.** This is important not only for individual practitioners but also for the public. During the 2001 anthrax incident, the initial epidemiologic investigation in the Washington metropolitan area used nasal swabs in suspect exposures. This practice was misunderstood by some clinicians and the public as having individual diagnostic utility when, in fact, it was merely an epidemiologic surveillance tool. Anxiety and confusion resulted when individuals received nasal swabbing at some healthcare locations and were (correctly) told it was not useful for diagnosis at other medical facilities. Because no early standardized protocol was developed by the public health system, hospitals implemented their own individual protocols to limit variation between clinicians practicing within individual hospitals. The resultant variability between institutions, however, caused great consternation for patients and, subsequently, for providers.

Critical information that the public health system should also provide includes a clear and concise case definition for the particular agent in question. **A case definition imparts definitive clinical and diagnostic criteria for an individual patient.** Within the case definition, criteria should be supplied that define "presumptive" or "suspect" cases for patients awaiting confirmatory testing. This kind of tool is simple and allows practitioners to officially designate victims as "confirmed" or "presumptive/suspected" for the target illness. Similarly delineated "exposure" categories are helpful in providing criteria for stratifying risk by designating "confirmed" or "presumptive" (suspected) exposure.

**INTEGRATION WITH OTHER RESPONSE ASSETS**

Requests for assistance or for resources not available within an individual hospital should be coordinated through the hospital administration to other hospitals (through mutual aid mechanisms), the local department of health, and/or the local emergency management agency. From there, requests may be transmitted to the regional, state, or federal levels.18
TREATMENT

General treatment principles for victims of bioterrorism should be understood by the practitioner. Specific therapies for individual Class A agents are listed in Table 9-2. From a population perspective, morbidity and mortality are primarily minimized by preventing exposure and providing prophylaxis and immunization as appropriate, and then by treating the infected, symptomatic patients. Treatment may involve specific pharmaceuticals or general supportive care. Depending on the agent involved, prophylaxis or immunization of the hospital staff may be warranted. Prophylaxis, immunization, or treatment may be indicated even without obvious signs of disease or definitive information about exposure. This makes the practitioner heavily reliant on the public health sector to stratify patient risk based on exposure and to provide evidence-based prophylaxis and treatment. With specific agents (e.g., anthrax), large community-based efforts have been developed with federal support related to the dispensing of postexposure prophylaxis (i.e., Medical Counter Measures).

MEDICAL SURGE

One of the critical issues in providing treatment to victims of bioterrorism is the development of adequate medical surge. This issue is complicated by current healthcare industry practices that minimize staff, maintain just-in-time inventory, and limit hospital bed capacity. Medical surge capacity is developed by first maximizing individual healthcare facility capacity and capabilities (through an effective emergency operations plan) and then by coordinating regional resources to address and match patient needs to available resources. The development of emergency healthcare coalitions is supported by federal funding through the national Hospital Preparedness Program, in part to achieve this surge requirement through information dissemination and effective mutual aid. State and federal assistance should also be included in planning but not relied upon for at least the first 48 hours.

Federal agencies distinguish medical surge capacity from surge capability, which similarly can pose challenges. Medical surge capability refers to the ability to manage patients requiring unusual or very specialized medical evaluation and care. It is intuitively obvious, for example, that even one patient presenting with signs and symptoms of smallpox would present highly unusual challenges affecting any hospital's continuity of operations.

DISEASE CONTAINMENT

Infection control guidelines for the diagnosed or suspected agent should be put into practice. This is essential to protect clinicians, hospital staff, visitors, and other patients. It is also critical in maintaining the ability of the hospital to continue its regular medical commitment to the community. The Association for Professionals in Infection Control and Epidemiology has published guidelines for hospital infection control in response to a bioterrorist event. Most agents of concern require only standard precautions (gloves, mucous membrane protection when potential for splashing exists, and a gown when the potential exists for soiling), but meticulous attention to detail is required. The more troubling agents are those that are contagious.
through airborne or droplet transmission. Disease containment for a case of pneumonic plague requires 
droplet protection and patient isolation. Smallpox requires airborne and contact precautions and, therefore, 
full patient isolation. If a contagious disease is spreading within the community, procedures must be 
instituted to screen everyone entering the healthcare facility (e.g., staff, patients, visitors, delivery personnel) 
for active disease. This screening should ideally take place in an appropriately established “facility” before 
entering or immediately upon entry into the hospital building.

Isolation of large numbers of infectious patients may be necessary. Current hospital configurations often 
prohibit large-scale containment of patients in official isolation rooms, but entire wings could be adapted 
(using fire doors and manipulation of ventilation/air pressure within hospital smoke compartments) to serve 
as isolation wards. Plans to provide adequate separation from other, noninfected patients, to designate and 
train specific staff to care for these patients, and to furnish proper personal protective equipment should be 
developed in the emergency operations plan annex.

Another important initial consideration for ED personnel is whether patient decontamination is indicated. 
Decontamination is a consideration only if a patient presents shortly after acute exposure to a substance 
suspected or confirmed as a biologic agent, in contrast to the presentation of the patient who has already 
developed symptoms of an infectious disease. If a realistic concern exists, simply disrobing the patient and 
showering with soap and warm water should be adequate decontamination, but this must be accomplished 
in a controlled environment before patient entry into the healthcare facility. Clothing and personal 
belongings should be secured to assist with the public health and law enforcement investigations. 
Decontamination agents, such as diluted bleach, should be avoided, due to their potential for harm and the 
lack of demonstrated clinical or protective efficacy.\textsuperscript{22,23}

SUPPLY MANAGEMENT

Just-in-time inventory practices may limit the amount of vaccine, antibiotics, and other pharmaceuticals and 
supplies available. Vendors for emergency back-up supplies and equipment are commonly shared by 
multiple institutions, each counting the vendor’s back-up cache as their own. Having a community-wide 
mutual aid system between all the hospitals promotes appropriate sharing of critical supplies, equipment, 
and staff during an emergency. If prescriptions are being written for antibiotics, the local pharmacies’ on-
hand supply should be considered (an issue during the anthrax incident in 2001). Writing short-course 
prescriptions with procedures to provide completion of the medication regimen may be indicated until 
adequate supplies are available, but this strategy should be implemented on a region-wide basis to not place 
an individual practitioner’s patients at increased risk. Integration of Strategic National Stockpile supplies into 
a medical community has specific requirements that are available for review through the Centers for Disease 
Control and Prevention and requires specific planning by the community emergency management and 
public health agencies.\textsuperscript{18}

PATIENT MANAGEMENT
In unusual and very threatening situations such as bioterrorism, addressing the requirements of each patient encountered and maximizing efficiency can markedly facilitate the overall processing of victims. For those patients who are potentially exposed but not physically ill, the patient interaction may require sophisticated explanations as to why the individual is or is not receiving a particular therapy. Preprinted instructions (indicating category of risk stratification and why the patient was placed in that category) can increase efficiency and be helpful for patients being treated and released. These instructions should clearly indicate how the disease is transmitted, measures that prevent spread, and early signs and symptoms of disease with appropriate steps if they should occur. Appropriate follow-up should be established (in a large-scale incident, this may not be with a primary care physician but through a public health venue). It is important to note any change in the epidemiology of the incident (e.g., a new site tests positive for the agent) or if new information becomes available on the etiologic agent itself (e.g., antibiotic resistance patterns). Patients may need to be rapidly re-contacted to change therapy. Proper record keeping and organization of charts based on assigned risk category can assist with this process. Entering all patients into a reliable long-term surveillance database should be a task for the public health agency, but hospitals and EDs could facilitate this process.

For agents of concern that have an available vaccine, such as anthrax and smallpox, in a preincident setting, recommendations are to withhold vaccination for the general public. Anthrax vaccination requires a series of five injections followed by yearly updates. A 2003 initiative to vaccinate healthcare workers and willing civilians against smallpox was discontinued after only a minority of the target cohort actually accepted vaccinations. The risk of potential life-threatening side effects, such as generalized vaccinia and potential cardiac sequelae, complicates the recommendations for smallpox vaccination in the absence of known disease.

Therapeutics recommended for some bioterrorism agents are normally not approved for children or for pregnant or lactating women. In many situations, these recommendations are relaxed (e.g., Emergency Use Authorization) when the risk of infection and its consequences exceeds the risks of the medication or vaccine. In addition, some unique treatments (e.g., ciprofloxacin for anthrax prophylaxis in children) have received U.S. Food and Drug Administration approval.

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USEFUL WEB RESOURCES

Association for Professionals in Infection Control and Epidemiology, infection control guidelines—http://www.apic.org


Centers for Disease Control and Prevention, Emerging Infectious Diseases—http://www.cdc.gov/ncidod/EID

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