Chapter 5

MEDICAL MANAGEMENT OF POTENTIAL BIOLOGICAL CASUALTIES: A STEPWISE APPROACH

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INTRODUCTION

Response to a biological attack is relatively straightforward when the etiologic agent employed is known. A larger problem arises, however, in the context of diagnostic uncertainty. In some cases, an attack may be threatened or suspected, but whether such an attack has, in fact, occurred can remain unclear. Moreover, it may be uncertain whether casualties in certain situations arise from exposure to a biological agent, a chemical or radiological agent, a naturally occurring infectious disease process, or toxic industrial exposure, or may simply reflect a heightened awareness of background disease within a community or population. Experience with West Nile virus,[1] severe acute respiratory syndrome,[2] pneumonic tularemia,[3,4] and monkeypox[5] highlight this dilemma. In each of these cases, the possibility of bioterrorism was properly raised, although each outbreak ultimately proved to have a natural origin. In some instances, proof of such an origin may be difficult or impossible to attain, providing "plausible deniability," precisely the reason some belligerents may opt to employ biological agents. This chapter provides a structured framework for dealing with outbreaks of unknown origin and etiology on the battlefield, as well as in a potential bioterrorism scenario involving military support installations or the civilian populace.

In responding to the unknown, it is helpful in many situations to employ a standardized, stepwise approach. This is especially true in the setting of a medical mass casualty event (MASCAL), where the use of such an approach (as advocated by the Advanced Trauma Life Support [ATLS] model sponsored by the American College of Surgeons[6]) is already well accepted and practiced. It is also especially true under austere or battlefield conditions. Although major theater-level and continental United States-based military medical centers (and research institutions, such as the US Army Medical Research Institute of Infectious Diseases [USAMRIID] and US Army Medical Research Institute of Chemical Defense) may possess sophisticated diagnostic and response capabilities, providers on the battlefield and at lower-role medical treatment facilities are typically required to make rapid therapeutic decisions based on incomplete information and with little immediate support. Civilian clinicians, first responders, and public health personnel practicing in rural or remote areas during a terrorist attack would face similar decision-making challenges. In the setting of a biological (or chemical or radiological) attack, similar to the setting of a MASCAL trauma event, such decisions may have life-and-death implications. In such situations, a stepwise or algorithmic approach becomes invaluable.

USAMRIID has developed a 10-step approach to managing casualties that might result from biological warfare or terrorism. Many facets of this approach may be helpful in dealing with potential chemical or radiological casualties as well. In today's complex world, it is no longer adequate for most clinicians and medical personnel to simply understand disease processes. Rather, these personnel, whether military or civilian, must have tactical, operational, and strategic knowledge of threat response—and, in fact, of disaster response in general—as it applies to weapons of mass destruction. Tactical response concerns those elements of diagnosis and treatment of specific diseases that traditionally have been the realm of the individual practitioner. Operational response can be thought of as involving the mechanisms by which the provider interacts with his or her institution (hospital, clinic, medical unit) to provide mass care during a disaster. Strategic response involves system-wide disaster preparedness and response. In a civilian setting, this includes mechanisms by which state and federal disaster response elements might become involved. Medical personnel today need to have at least a basic understanding of operational and strategic response in addition to a firm grounding in tactical medical and public health intervention. The first 7 steps of this 10-step approach deal predominately with tactical issues (ie, at the level of the individual provider). Steps 8 and 9 transition into operational and strategic response (ie, at the level of the institution and of the system, as a whole). The derivation of the 10-step approach is reported elsewhere,[7–10] and a condensed version appears in recent editions of USAMRIID's *Blue Book*.[11] It is expanded upon here.

10-STEP APPROACH TO CASUALTY MANAGEMENT

Step 1: Maintain a Healthy Index of Suspicion

In the case of chemical warfare or terrorism, the intentional nature of an attack is often evident. In this case, victims would likely be tightly clustered in time and space; they would succumb in close proximity (both temporally and geographically) to a dispersal device. Complicating the discovery of the intentional nature of a biological attack, however, is the fact that biological agents possess inherent incubation periods, while conventional, chemical, and nuclear weapons do not. These incubation periods, typically of several days

(but up to several weeks in the case of agents such as *Coxiella burnetii* and the *Brucellae*), allow for the wide dispersion of victims in time and space. Additionally, they make it likely that the first responder to a biological attack would not be the firefighter, police officer, paramedic, or other traditional first responder, but rather primary care providers, hospital emergency departments, and public health officials. In such circumstances, maintaining a healthy index of suspicion is imperative.

In some instances, maintaining an index of suspicion might be simplified by the fact that diseases caused by biological agents may present with specific characteristic clinical findings, which allow for a very limited differential diagnosis. The hallmark of inhalational anthrax is a widened mediastinum, a clinical finding seen in few naturally occurring conditions. With botulism, the hallmark presentation is that of a descending, symmetric, flaccid paralysis. Whereas an individual patient with flaccid paralysis might prompt consideration of disorders such as Guillain-Barré syndrome, Eaton-Lambert syndrome, poliomyelitis, and myasthenia gravis, the near-simultaneous presentation of multiple patients with flaccid paralysis should quickly lead one to a diagnosis of botulism. Similarly, patients with plague and melioidosis may exhibit hemoptysis in the later stages of illness. Such a finding is uncommon among previously healthy individuals, but can be caused by tuberculosis, staphylococcal and *Klebsiella* pneumonia, carcinoma, and trauma. Multiple patients with hemoptysis, however, should prompt consideration of a plague or melioidosis diagnosis. Smallpox is characterized by a very unique exanthem, perhaps evocative of *Varicella* or syphilis in its earliest stages, but readily distinguishable from these entities as it progresses.

Yet, by the time each of these characteristic findings develops, treatment is less likely to be effective. Therapy is thus best instituted during the incubation or prodromal phases of these diseases if it is to be beneficial. Unfortunately, during their prodromes, these diseases are likely to appear as undifferentiated febrile illnesses, difficult, if not impossible, to distinguish from myriad other common infectious diseases. Similarly, many other diseases potentially arising from a biological attack (such as tularemia, brucellosis, melioidosis, Q fever, and Venezuelan equine encephalitis) may appear simply as undifferentiated febrile illnesses throughout their course. Prompt diagnosis and targeted therapy is thus possible only with a very high index of suspicion.

Epidemiological clues can lead a clinician to suspect that a disease outbreak may have been intentional (Exhibit 5-1).[12] Large numbers of victims tightly clustered in time and space, or limited to a discrete population, should raise suspicion. Similarly, unexpected deaths and cases of unexpectedly severe illness merit concern. An outbreak of a disease not typically seen in a specific geographic location, in a given age group, or during a certain season, likewise warrants further investigation. Simultaneous outbreaks of a disease in noncontiguous areas should prompt one to consider an intentional release, as should simultaneous or sequential outbreaks of different diseases in the same locale. Even a single case of rare disorders, such as anthrax or certain viral hemorrhagic fevers (Ebola, Marburg, Lassa, and many others) would be suspicious, and a single case of smallpox, because it no longer occurs naturally, would almost certainly represent an intentional release. The presence of dying animals (or the simultaneous occurrence of zoonotic disease outbreaks among humans and animals) might provide evidence of an unnatural aerosol release. Evidence of a disparate attack rate between those known to be indoors and outdoors at a given time should also be sought and evaluated.

EXHIBIT 5-1

EPIDEMIOLOGICAL CLUES TO A BIOTERRORIST ATTACK

- Presence of an unusually large epidemic
- High infection rate
- Disease limited to a discrete population
- Unexpected severity of disease
- Evidence of an unusual route of exposure
- Disease in an atypical geographic locale
- Disease occurring outside normal transmission seasons
- Disease occurring in the absence of usual vector
- Simultaneous outbreaks of multiple diseases
- Simultaneous occurrence of human and zoonotic disease
- Unusual organism strains
- Unusual antimicrobial sensitivity patterns
- Disparity in attack rates among persons indoors and outdoors
- Terrorist claims
- Intelligence reports
- Discovery of unusual munitions

Data source: Pavlin JA. Epidemiology of bioterrorism. *Emerg Infect Dis*. 1999;5:528–30.

Finally, intelligence reports, terrorist claims, and the discovery of aerosol spray devices would obviously lend credence to the theory that a disease outbreak was of sinister origin.

On the modern battlefield, an array of developing technology is available to assist clinicians, preventive medicine and chemical corps personnel, operators, and commanders in maintaining their index of suspicion through early "stand-off" detection of biological threats. The Portal Shield is the Department of Defense's (DoD's) first automated biological detection system, and was designed to provide fixed-site protection to air and port facilities. Portal Shield is equipped with modular sensors capable of simultaneously assaying for eight different agents and providing presumptive identification within about 25 minutes. The Biological Integrated Detection System, a system mounted on a high-mobility multipurpose wheeled vehicle, is equipped with samplers, an aerodynamic particle sizer, a flow cytometer, and a chemical biological mass spectrometer. The Joint Biological Point Detection System integrates into the M31A2 Biological Integrated Detection System platform (Figure 5-1) to permit rapid, real-time detection of 10 separate biological threat agents on the battlefield; the system is capable of definitively identifying biowarfare threat agents within 18 minutes. The Joint Biological Agent Identification and Diagnostic Systems (JBAIDS) is a reusable, portable, and modifiable biological agent identification and diagnostic system capable of rapid, reliable, and simultaneous identification of multiple biological agents and other pathogens of operational concern. The JBAIDS anthrax, tularemia, plague, and Q fever detection systems are cleared by the Food and Drug Administration (FDA) for diagnostic use. Until these technologies are refined, validated, and made widely available, though, those tasked with responding to an attack must rely on clinical, epidemiological, and intelligence clues to maintain their index of suspicion.

Figure 5-1. The Biological Integrated Detection System (BIDS) is a semi-automated biological agent detection/identification suite mounted on a dedicated heavy high mobility multipurpose wheeled vehicle. The system uses multicomplimentary bio-detection technologies.

Step 2: Protect Yourself

Providers who themselves become casualties are of little use to their patients. Before approaching casualties of biological or chemical warfare or victims of a potential terrorist attack, clinicians should be familiar with basic means of self-protection. Such protective measures generally fall into one of three categories: (1) physical protection, (2) chemical protection, and (3) immunologic protection. Under a given set of circumstances, clinicians and laboratory personnel might appropriately avail themselves of one or more of these forms of protection.

Physical Protection

Since the beginning of modern gas warfare on the battlefields near Ypres, Belgium, in 1915, physical protection during military operations has involved gas masks and, more recently, charcoal-impregnated chemical protective overgarments. Although military-style protective clothing and masks were designed with chemical agent protection in mind, they are capable of offering protection against biological agents as well. Although some countries have advocated the issuance of military-style protective masks and ensembles to civilians (eg, the Israeli government has issued masks to its general populace), such items, even if offered, would likely be unavailable to civilians at the precise moment of agent release; the unannounced release of odorless and colorless biological agents by belligerents or terrorists would afford no opportunity to don protective gear, even if it were available. Furthermore, misuse of protective equipment in the past has led to fatalities, including cases of infants and adults suffocating in protective ensembles.[13,14] Although military masks such as the M40/42, M45, and M50 series provide ample protection against inhalation hazards posed by chemical and biological weapons as well as against radioactive dust particles, they add heat stress and are potentially mission-degrading. Moreover, a simple surgical mask will usually afford adequate protection against inhalation of infectious aerosols of virtually any of the biological agents typically mentioned in a terrorism context. An important exception might be smallpox, in which case a high-efficiency

particulate air (HEPA) filter mask would be ideal. With the exception of smallpox, pneumonic plague, and certain viral hemorrhagic fevers, the agents in the Centers for Disease Control and Prevention's (CDC's) categories A and B (Exhibit 5-2) are not contagious via the respiratory route. Respiratory protection is thus necessary when operating in an area of primary release, but would not be required in most patient-care settings (see step 7).

Chemical Protection

During Operations Desert Shield and Desert Storm, tens of thousands of US troops were given pyridostigmine under an emergency-use authorization, and in early 2003, the FDA gave its final approval for the use of pyridostigmine bromide as preexposure prophylaxis against intoxication with soman, an organophosphate-based chemical nerve agent. It is conceivable, given credible and specific intelligence, that similar strategies might be employed against biological weapons. For example, if a specific terrorist group possessing a specific weaponized agent were known to be operating in a given locale, public health authorities might conceivably contemplate the widespread distribution of an appropriate prophylactic antibiotic. Obviously, the opportunities to employ such a strategy are likely to remain few and far between, and the logistics of doing so would be exceedingly difficult in a civilian setting.

Immunologic Protection

For the near future, active vaccination is likely to provide one of the most practical methods for administering preexposure prophylaxis against biological attack. In the military, decisions regarding vaccination policy are typically made through the office of the Assistant Secretary of Defense for Health Affairs, with input from high-level military medical, public health, and intelligence sources. The decision to offer a specific vaccine in a specific circumstance is a complex one that must take into account a careful risk-benefit calculation. During Operations Desert Shield and Desert Storm, some 150,000 service members received at least one dose of anthrax vaccine, while about 8,000 received a botulinum toxoid vaccine. Since 1998, the US military has intermittently employed force-wide anthrax vaccination, and since 2003 has administered smallpox vaccine to deploying troops and certain medical response teams.

In a civilian counter-terrorism context, the decision to employ a specific vaccine is even more difficult and complex. Factors that would influence a decision by public health officials to recommend vaccination include intelligence (eg, how likely or plausible is an attack? How imminent is the threat? How specific is the threat?), vaccine safety, vaccine

EXHIBIT 5-2

CRITICAL AGENTS FOR HEALTH PREPAREDNESS

Category A*	Category B†	Category C‡
• Variola virus • *Bacillus anthracis* • *Yersinia pestis* • Botulinum toxin • *Francisella tularensis* • Filoviruses and arenaviruses	• *Coxiella burnetii* • *Brucellae* • *Burkholderia mallei* • *Burkholderia pseudomallei* • Alphaviruses • Certain toxins (ricin, staphylococcal enterotoxin B, trichothecenes) • Food safety threat agents (Salmonellae, *Escherichia coli* O157:H7) • Water safety threat agents (*Vibrio cholerae*, etc)	Other biological agents that may emerge as future threats to public health, such as: • Nipah virus • Hantaviruses • Yellow fever virus • Drug-resistant tuberculosis • Tick-borne encephalitis

*Agents with high public health impact requiring intensive public health preparedness and intervention.
†Agents with a somewhat lesser need for public health preparedness.
‡Other biological agents that may emerge as future threats to public health.
Data source: Centers for Disease Control and Prevention. Biological and chemical terrorism: strategic plan for preparedness and response. *MMWR*. 2000;49(RR-04):1–14.

availability, disease consequences (ie, is the threat from a lethal agent or from an incapacitant?), and the availability of postexposure prophylaxis or therapy. Recently, civilian public health and policy planners have given extensive consideration to the widespread distribution of anthrax and smallpox vaccines.

Anthrax. Anthrax Vaccine, Adsorbed (AVA, BioThrax; Emergent BioSolutions, Lansing MI) is a fully licensed product, approved by the FDA in 1970. The vaccine consists of a purified preparation of protective antigen, a potent immunogen necessary for entry of key anthrax toxin components (lethal and edema factors) into mammalian cells. Administered alone, protective antigen is nontoxic. In a large controlled trial, AVA was effective in preventing cutaneous anthrax among textile workers.[15] Based on an increasing amount of animal data, there is every reason to believe that this vaccine is quite effective at preventing inhalational anthrax as well.[16] Moreover, well over 20 clinical studies, surveys, and reports now attest to the safety of AVA,[17,18] and the FDA has reaffirmed the vaccine as being safe and effective in light of those studies.[19] Nonetheless, although widespread use of AVA has occurred within the US military (as of January 2014, more than 12.1 million doses of AVA had been given to more than 2.4 million service members), logistical and other considerations make large-scale civilian vaccination impractical at present. The vaccine is licensed as a five-dose series, given at 0 and 4 weeks, and at 6, 12, and 18 months. Yearly boosters are recommended for those at ongoing risk of exposure. Further complicating any potential civilian anthrax vaccination strategy is the fact that AVA is approved by the FDA only for individuals 18 to 65 years old. Although a large-scale preexposure offering of AVA to the general public might thus be problematic, some have recommended that a three-dose series of AVA (given at time zero and at 2 and 4 weeks after the initial dose), combined with 60 days of antibiotics under an investigational new drug (IND) protocol or emergency use authorization, might be an acceptable alternative to longer (60–100 days) antibiotic courses alone for postexposure prophylaxis against inhalational anthrax.[20] This recommendation was based on nonhuman primate challenge studies; no human studies currently exist to support such a strategy, and AVA is not licensed by the FDA for postexposure prophylaxis or therapy.

Smallpox. Widespread vaccination against smallpox is equally controversial and problematic. Nonetheless, in 2002, President George W. Bush announced a plan to vaccinate selected American healthcare workers and military personnel. Within the DoD, service members deploying to locations thought at risk for biological attack and members of designated smallpox epidemiological and clinical response teams were selected for vaccination. The program includes prevaccination screening to exclude members with vaccine contraindications or household contacts at risk, instruction on vaccine site care and potential complications, and mandatory follow-up. As of January 10, 2014, over 2.4 million military response team members, hospital workers, and operational forces had been vaccinated, with one death occurring due to a lupus-like illness. Although the emergence of myopericarditis (there were 161 confirmed, suspected, or probable cases among 1.4 million vaccinees as of January 2008) as a complication of vaccination[21] led to a revision of prevaccine screening (candidates with multiple cardiac risk factors are now excluded), rates of other adverse reactions were low. Cases of autoinoculation or transmission to household and other contacts have been rare.[22–24] One case of progressive vaccinia occurred in a primary vaccine recipient,[25] and three cases of eczema vaccinatum occurred among contacts of vaccinees.[26,27] No cases of fetal vaccinia have been reported. Vaccinia immune globulin was required on only seven occasions, to treat ocular vaccinia,[28] progressive vaccinia,[26] eczema vaccinatum,[27,28] and as prophylaxis for a vaccinated patient who sustained large burn wounds. The success of this smallpox immunization program suggests that mass vaccination can be accomplished with greater safety than previously thought possible.[29]

Although universal civilian vaccination was not recommended under President Bush's plan, the possibility of a future strategy calling for such recommendations was allowed for, and provisions were made to provide smallpox vaccine to those members of the general public who specifically requested it. The wisdom of widespread civilian vaccination is difficult to assess. Most medical decisions involve a risk-benefit analysis on the part of the responsible clinician. In the case of smallpox vaccination, the risks are well known, and they are significant.[30,31] The benefits, however, are far less certain; although the global eradication of smallpox surely ranks among the greatest public health accomplishments of recent history and the wisdom of vaccination with live vaccines went unquestioned during the era of endemic smallpox, the likelihood of contracting smallpox today via a terrorist attack is unknown and likely miniscule for the average civilian. In this regard, the risk-benefit calculation is not based on medical considerations, but rather on intelligence estimates to which few are privy.

Despite these concerns, a prerelease mass vaccination program for the general population may be the most effective countermeasure to the terror threat

posed by smallpox. By inducing individual and herd immunity and by obviating the extreme difficulty of conducting postrelease vaccine and quarantine efforts, a program involving the resumption of universal smallpox vaccination possesses distinct advantages over other response plans. However, such an approach is hampered not only by the unknown risk of a smallpox release, but also by safety and logistics issues.[32,33]

A large number of persons are at risk for severe vaccine reactions today compared to the previous era of routine civilian smallpox vaccination, which ended in 1972. This increase in risk is due to the presence in the population of a large number of persons with compromised immunity associated with human immunodeficiency virus and with advances in immunosuppressive therapy and bone marrow and solid organ transplantation. This phenomenon raises concern about the safety and risk-benefit ratio of any preexposure vaccination program.[34] Similarly, the occurrence of rare but severe smallpox vaccine complications in otherwise healthy recipients could result in morbidity and mortality that would be unacceptable in times of low risk. Risk analysis favors prerelease mass vaccination of the general population only if the probability of a large-scale attack is high. Prerelease mass vaccination of healthcare workers might again be contemplated in the future, owing to the risk of exposure while caring for patients, and the value of keeping healthcare workers healthy and functioning in the setting of an epidemic.[35]

The smallpox vaccine currently employed in the United States is ACAM2000 (Acambis Inc, Cambridge, MA), which uses modern cell-culture-based production of vaccinia, an orthopoxvirus closely related to variola. ACAM2000 was licensed by the FDA in 2007, and replaced Dryvax (Wyeth Laboratories, Marietta, PA), a preparation derived from the harvested lymph of inoculated calves, in 2008. It is unlikely that this will significantly diminish the risk of adverse reactions, however, as the new vaccine employs the same live strain of vaccinia virus. The vast majority of adverse reactions to current vaccinia-containing vaccines derive from the live nature of the virus rather than the method of preparation.

The CDC controls release of civilian ACAM2000 stocks and conditions for release have been established.[36] The current CDC smallpox response strategy is based on preexposure vaccination of carefully screened first responders and members of epidemiological and clinical response teams. CDC plans also provide for a program to treat certain severe complications of vaccination using vaccinia immune globulin under an IND protocol, as well as for compensation of persons experiencing such complications, through the establishment of a smallpox vaccine injury compensation program.[37]

The CDC's response plan calls for "ring vaccination" after a smallpox release: identification and isolation of cases, with vaccination and active surveillance of contacts. Mass vaccination would be reserved for those instances when the number or location of cases renders the ring strategy inefficient, or when the risk of additional virus release is high.[38] Although ring vaccination was successful historically (in the setting of herd immunity), mathematical models predict that this strategy may be problematic when applied to large or multifocal epidemics today.[39] Furthermore, there is controversy among experts regarding the predicted benefit of postrelease mass vaccination due to lack of herd immunity, a highly mobile population, a relatively long incubation period, and the difficulties associated with prompt implementation of quarantine and mass vaccination.[40,41] Finally, it should be kept in mind that vaccination is but one component of a multifaceted response, which should also include farsighted planning and logistical preparation, risk communication, surveillance, treatment, isolation, and quarantine.

Other Agents. Few authorities, either military or civilian, have advocated widespread vaccination against potential agents of bioterrorism other than anthrax and smallpox, and the implementation of any such strategy would currently be problematic. A vaccine against plague, previously licensed in the United States, is currently out of production. It required a three-dose primary series followed by annual boosters. Moreover, it was licensed only for persons 18 to 61 years old. Finally, although reasonably effective against bubonic plague and widely employed by the DoD to protect against endemic disease, it probably afforded little protection against pneumonic plague, the form of disease likely to be associated with warfare or terrorism. A vaccine against one specific viral hemorrhagic fever, namely yellow fever, is widely available, although its causative virus is not regarded as a significant weaponization threat by most policymakers and health officials. Again, while the US military has administered yellow fever vaccine to large numbers of troops, it does so to guard against endemic disease, rather than a bioweapon threat. Additionally, a vaccine against Q fever (Q Vax, CSL Ltd, Victoria, Australia) is licensed in Australia. Although this vaccine might conceivably prove a useful addition to the military biodefense armamentarium, the self-limited nature of Q fever makes it unlikely that widespread use of this vaccine would be contemplated for the general public. Numerous research efforts are aimed at developing improved next-generation vaccines against anthrax, smallpox, and plague. Similarly, vaccines effective against tularemia,

brucellosis, botulism, the equine encephalitides, staphylococcal enterotoxins, ricin, and several viral hemorrhagic fevers, as well as other potential agents of bioterrorism, are in various stages of development.[42] Investigational vaccines against tularemia, botulism, the equine encephalitides (especially Venezuelan equine encephalitis), staphylococcal enterotoxin B, Q fever, and other agents, have been used under IND protocols to protect scientists studying these agents.

Step 3: Save the Patient's Life (Primary Assessment)

Once self-protective measures are implemented, the clinician can approach the MASCAL scenario and begin assessing patients (the "primary survey," in keeping with ATLS guidelines[6]). This initial assessment is intended to be brief and its purpose limited to the discovery and treatment of those conditions presenting an immediate threat to life or limb. Biological (or chemical) warfare victims may also have conventional injuries; attention should thus be focused at this point on maintaining a patent airway and providing for adequate breathing and circulation. The need for decontamination and administration of antidotes for rapid-acting chemical agents (nerve agents and cyanide) should be determined at this time. An "ABCDE" algorithm aids the clinician in recalling the specifics of the primary assessment. "A" stands for airway, which should be evaluated for the presence of conventional injury, but should also be examined because exposure to certain chemical agents (such as mustard, lewisite, or phosgene) can damage the airway. "B" denotes breathing; many agents of biological (and chemical) terrorism may cause the patient to experience respiratory difficulty. Examples include anthrax, plague, tularemia, botulism, Q fever, the staphylococcal enterotoxins, and ricin, as well as cyanide, nerve agents, and phosgene. "C" denotes circulation, which may be compromised due to conventional or traumatic injuries sustained during a MASCAL event, but may also be involved in the septic shock associated with plague and in the circulatory collapse associated with the viral hemorrhagic fevers. "D" refers to disability, specifically, neuromuscular disability. Note that botulism and nerve agent exposures are likely to present with a preponderance of neuromuscular symptomatology. Finally, "E" refers to exposure. In a MASCAL setting, this serves as a reminder to remove the victim's clothing to perform a more thorough secondary assessment. It is here that one considers the need for decontamination and disinfection.

Step 4: Disinfect or Decontaminate as Appropriate

Once patients have been stabilized, decontamination can be accomplished, where appropriate. On the battlefield, considerable mature military doctrine drives decontamination efforts, which are carried out by unit personnel, guided or assisted by specific, highly trained Chemical Corps decontamination units. It should be pointed out, however, that decontamination, in the classical sense, may not be necessary after a biological attack (the same cannot always be said after a chemical attack). This is due, again, to the inherent incubation periods of biological agents. Because victims will not typically become symptomatic until several days after exposure to such agents, they are likely to have bathed and changed clothing several times before presenting for medical care, thus effectively accomplishing self-decontamination. Exceptions might include personnel directly exposed to an observed attack or persons encountering a substance in a threatening letter, where common sense might dictate topical disinfection. Even in these situations, bathing with soap and water and conventional laundry measures would likely be adequate. Moreover, it should be kept in mind that situations such as the case of the threatening letter represent crime scenes. Any medical interest in disinfection must be weighed against law enforcement concerns regarding preservation of vital evidence, which can be destroyed through hasty and ill-considered attempts at decontamination. Furthermore, significant psychological stress has been caused by unnecessary, costly, and resource-intensive attempts at decontamination in the past.[43] Some of these attempts have involved forced disrobing and showering in public streets; to avoid such problems, the following measured responses should be considered.[44]

The Announced Threat (or Presumed Hoax). The need to preserve evidence, and maintain a chain-of-custody when handling that evidence, is an important consideration at any crime scene. Although human and environmental health protection concerns take precedence over law enforcement procedures, threat and hoax scenarios nonetheless require the early involvement of law enforcement personnel and a respect for the need to maintain an uncompromised crime scene. Decontamination or disinfection is not typically necessary.

The Telephoned Threat or the "Empty Letter." In the majority of cases involving a telephoned threat, no delivery device or package is located. If a device is found or a threat is subsequently deemed credible, public health authorities should contact potentially exposed individuals, obtain appropriate information, and consider instituting prophylaxis or therapy. An envelope containing nothing other than a written threat poses little risk and should be handled in the same manner as a telephoned threat. Because the

envelope constitutes evidence in a crime, however, further handling should be left to law enforcement professionals. In these cases, no decontamination is typically necessary, pending results of the legal and public health investigation.

The Suspicious Package. When a package is discovered and found to contain powder, liquid, or other physical material, response should be individualized. In most cases, the package should not be disturbed further, the room should be vacated, additional untrained persons should be prohibited from approaching the scene and from handling the package or its contents, and law enforcement and public health officials should again be promptly notified. Persons who have come in contact with contents should remove clothing as soon as practical and seal it in a plastic bag. Victims should then wash with soap and water[45] and, in most cases, may be sent home after adequate instructions for follow-up are provided and contact information obtained. In general, antibiotic prophylaxis would not be necessary before the preliminary identification of package contents by a competent laboratory, although decisions to provide or withhold postexposure prophylaxis are best made after consultation with public health authorities. Floors, walls, and furniture would not require decontamination before laboratory analysis is completed. Nonporous contaminated personal items, such as eyeglasses and jewelry, may be washed with soap and water or immersed in 0.5% hypochlorite (household bleach diluted tenfold) if a foreign substance has contacted the items.

The Delivery Device. If an aerosol delivery device or other evidence of a credible aerosol threat is discovered, the room (and potentially the building) should be evacuated. Law enforcement and public health personnel should be notified immediately and further handling of the device left to personnel with highly specialized training, such as the Army's 22nd and 110th Chemical Battalions (Technical Escort Units), the Marine Corps Chemical-Biological Incident Response Force (CBIRF), or the Federal Bureau of Investigation's Hazardous Materials Response Unit. Contact information should be obtained from potential victims and detailed instructions provided. Clothing removal, soap and water showering, and decontamination of personal effects should be accomplished as above (the CBIRF brings with it extensive decontamination capabilities). Decisions regarding institution of empiric postexposure prophylaxis pending determination of the nature of the threat and identification of the involved biological agents should again be left to local and state public health authorities. In providing a reasoned and measured response to each situation, public health and law enforcement personnel can assist in minimizing the disruption and cost associated with large-scale decontamination, costly hazardous materials unit involvement, and broad institution of therapeutic interventions, and can help avoid widespread public panic.

Step 5: Establish a Diagnosis (Secondary Assessment)

Once decontamination has been considered, and accomplished as warranted, the clinician may perform a more thorough and targeted assessment aimed at establishing a diagnosis (the ATLS "secondary survey"). The thoroughness and accuracy with which one establishes this diagnosis will vary depending upon the circumstances the clinician finds him- or herself in. At robust roles of care (Role 4), the clinician may well have access to infectious disease and microbiology professionals, as well as to sophisticated diagnostic assays. Under such circumstances, it may be possible to arrive at a definitive microbiologic diagnosis fairly promptly. On the other hand, it is equally conceivable that the primary care provider, practicing at lower roles of care (Roles 1 to 3) or in more austere circumstances, may need to intervene promptly based on limited information and without immediate access to subspecialty consultation. Even in such cases, however, reasonable care can be instituted based simply on a syndromic diagnosis. An "AMPLE" (A: allergies, arthropod exposures; M: medications [as well as military occupational specialty and mission-oriented protective posture status]; P: past illnesses and vaccinations; L: last meal; E: environment) history may aid in establishing this diagnosis. A brief but focused physical examination, even one performed by inexperienced practitioners, can, at a minimum, reveal whether a victim of a biological or chemical attack exhibits primarily respiratory, neuromuscular, or dermatologic signs, or suffers simply from an undifferentiated febrile illness. By placing patients into one of these broad syndromic categories, empiric therapy can be initiated (see step 6); such empiric therapy can be refined and tailored once more information becomes available.[46,47]

When the situation permits, laboratory studies should be obtained to aid in later definitive diagnosis (Exhibit 5-3). On the battlefield, samples obtained at lower echelons would normally be submitted to the local clinical laboratory and, from there, through clinical laboratory channels to the 1st Area Medical Laboratory (AML). The AML is a theater-level tactical laboratory with very robust scientific capabilities, including the ability to rapidly identify biological, chemical, and radiological threat agents, as well as endemic, occupational, and environmental health hazards. The AML also has "reach-back" ability and works closely

EXHIBIT 5-3

SAMPLES TO CONSIDER OBTAINING FROM POTENTIAL BIOWARFARE OR BIOTERRORISM VICTIMS*

- Complete blood count
- Arterial blood gas
- Nasal swabs for culture and PCR
- Blood for bacterial culture and PCR
- Serum for serologic studies
- Sputum for bacterial culture
- Blood and urine for toxin assay
- Throat swab for viral culture, PCR, and ELISA
- Environmental samples

*This list is not all-inclusive, nor is it meant to imply that every sample should be obtained from every patient. In general, laboratory sampling should be guided by clinical judgment and the specifics of the situation. This is a list of samples to consider obtaining in situations where the nature of an incident is unclear and empiric therapy must be started before definitive diagnosis.
ELISA: enzyme-linked immunosorbent assay
PCR: polymerase chain reaction

with national laboratories at USAMRIID and the US Army Medical Research Institute of Chemical Defense in Maryland.

Step 6: Provide Prompt Therapy

Once a diagnosis (whether definitive or syndromic) is established, prompt therapy must be provided. In the cases of anthrax and plague, in particular, survival is directly linked to the speed with which appropriate therapy is instituted. A delay of more than 24 hours in the treatment of either disease leads to a uniformly grim prognosis. When the identity of a bioterrorist agent is known, the provision of proper therapy is straightforward (Table 5-1). When a clinician is faced with multiple victims and the nature of the illness is not known, however, empiric therapy must be instituted. Guidelines for providing empiric therapy in such situations have been published, and an algorithmic approach to syndromic diagnosis and empiric therapy has been developed (Figure 5-2). Doxycycline, ciprofloxacin, or levofloxacin should be administered empirically to patients with significant respiratory symptoms when exposure to a biological attack is considered a possibility.

Step 7: Institute Proper Infection Control Measures

The clinician must practice proper infection control procedures to ensure that contagious diseases are not propagated among patients. The majority of biological threat agents are not contagious. Among these are the causative agents of anthrax, tularemia, brucellosis, Q fever, the alphaviral equine encephalitides, glanders, melioidosis, and many others, including all of the toxins. Standard precautions alone suffice, in most cases, when caring for victims of such diseases.[48] More stringent transmission-based precautions should be applied in certain circumstances. Three subcategories of transmission-based precautions exist. Droplet precautions are required to manage victims of pneumonic plague. Ordinary surgical masks are a component of proper droplet precautions and constitute adequate protection against acquisition of plague bacilli by the aerosol route. Contact precautions should be employed when managing certain viral hemorrhagic fever patients. In theory, these would be adequate for managing even Ebola victims given the transmission of this disease through infected blood and body fluids. Recent experience with Ebola in West Africa, however, illustrates the ease with which such precautions might be compromised. Given the prodigious amounts of body fluids (emesis and diarrhea) produced by these patients, the very low infectious inoculum of Ebola, and the propensity for hemorrhagic sputum to be aerosolized during coughing, the CDC now recommends that both contact and droplet precautions be employed when managing Ebola victims. Airborne precautions, ideally including an N-95 HEPA-filter mask, should be used when caring for smallpox victims. A summary of hospital infection control precautions as they apply to victims of biological terrorism is presented in Exhibit 5-4.

Step 8: Alert the Proper Authorities

As soon as it is suspected that a case of disease might be the result of exposure to biological or chemical agents, the proper authorities must be alerted so that appropriate warnings may be issued and outbreak-control measures implemented. On the battlefield and in other military settings, the command must be notified immediately. It is similarly important to notify preventive medicine officials, as well as chemical corps and laboratory personnel. Early involvement of preventive medicine personnel ensures that an epidemiological investigation is begun promptly (see step 9) and that potential victims (beyond the index cases) are identified and treated early, when such treatment is most likely to be beneficial. Similarly, early notification of Army chemical corps personnel allows for battlefield surveillance, detection, and

TABLE 5-1

RECOMMENDED THERAPY OF AND PROPHYLAXIS AGAINST DISEASES CAUSED BY CATEGORY A BIOTHREAT AGENTS

Condition	Adults	Children
Anthrax, inhalational, therapy* (patients who are clinically stable after 14 days can be switched to a single oral agent [ciprofloxacin or doxycycline] to complete a 60-day course†)	Ciprofloxacin 400 mg IV q12h **OR** Levofloxacin 500 mg IV q24h **OR** Doxycycline 100 mg IV q12h **AND** Clindamycin‡ 900 mg IV q8h **AND** Penicillin G§ 4 mil U IV q4h **AND CONSIDER** Raxibacumab 40 mg/kg IV	Ciprofloxacin 10–15 mg/kg IV q12h **OR** Levofloxacin 8 mg/kg IV q12h **OR** Doxycycline 2.2 mg/kg IV q12h **AND** Clindamycin‡ 10–15 mg/kg IV q8h **AND** Penicillin G§ 400–600 k U/kg/d IV × q4h **AND CONSIDER** Raxibacumab IV (> 50 kg: 40 mg/kg; 15–50 kg: 60 mg/kg; < 15 kg: 80 mg/kg)
Anthrax, inhalational, postexposure prophylaxis (60-day course†)	Ciprofloxacin 500 mg PO q12h **OR** Levofloxacin 500 mg PO q24h **OR** Doxycycline 100 mg PO q12h	Ciprofloxacin 10–15 mg/kg PO q12h **OR** Levofloxacin 8 mg/kg PO q12h **OR** Doxycycline 2.2 mg/kg PO q12h
Anthrax, cutaneous in setting of terrorism, therapy¥	Ciprofloxacin 500 mg PO q12h **OR** Levofloxacin 500 mg PO q24h **OR** Doxycycline 100 mg PO q12h	Ciprofloxacin 10–15 mg/kg PO q12h **OR** Levofloxacin 8 mg/kg PO q12h **OR** Doxycycline 2.2 mg/kg PO q12h
Plague, therapy	Gentamicin 5 mg/kg IV qd **OR** Doxycycline 100 mg IV q12h **OR** Ciprofloxacin 400 mg IV q12h **OR** Levofloxacin 500 mg IV q24h	Gentamicin 2.5 mg/kg IV q8h **OR** Doxycycline 2.2 mg/kg IV q12h **OR** Ciprofloxacin 15 mg/kg IV q12h **OR** Levofloxacin 8 mg/kg IV q12h
Plague, prophylaxis	Doxycycline 100 mg PO q12h **OR** Ciprofloxacin 500 mg PO q12h **OR** Levofloxacin 500 mg PO q24h	Doxycycline 2.2 mg/kg PO q12h **OR** Ciprofloxacin 20 mg/kg PO q12h **OR** Levofloxacin 8 mg/kg PO q12h
Tularemia, therapy	Gentamicin 5 mg/kg IV qd **OR** Doxycycline 100 mg IV q12h **OR** Ciprofloxacin 400 mg IV q12h	Gentamicin 2.5 mg/kg IV q8h **OR** Doxycycline 2.2 mg/kg IV q12h **OR** Ciprofloxacin 15 mg/kg IV q12h
Tularemia, prophylaxis	Doxycycline 100 mg PO q12h **OR** Ciprofloxacin 500 mg PO q12h	Doxycycline 2.2 mg/kg PO q12h **OR** Ciprofloxacin 20 mg/kg PO q12h
Smallpox, therapy	Supportive care	Supportive care
Smallpox, prophylaxis	Vaccination may be effective if given within the first several days after exposure.	Vaccination may be effective if given within the first several days after exposure.
Botulism, therapy	Supportive care; antitoxin may halt the progression of symptoms but is unlikely to reverse them.	Supportive care; antitoxin may halt the progression of symptoms but is unlikely to reverse them.
Viral hemorrhagic fevers, therapy	Supportive care; ribavirin may be beneficial in select cases.	Supportive care; ribavirin may be beneficial in select cases.

*In a mass casualty setting, where resources are severely constrained, oral therapy may need to be substituted for the preferred parenteral option.
†Assuming the organism is sensitive, children may be switched to oral amoxicillin (80 mg/kg/d× q8h) to complete a 60-day course. We recommend that the first 14 days of therapy or postexposure prophylaxis, however, include ciprofloxacin, levofloxacin, or doxycycline regardless of age. A three-dose series of Anthrax Vaccine Adsorbed may permit shortening of the antibiotic course to 30 days.
‡Rifampin or clarithromycin may be acceptable alternatives to clindamycin as drugs that target bacterial protein synthesis. If ciprofloxacin or another quinolone is employed, doxycycline may be used as a second agent, as it also targets protein synthesis.
§Ampicillin, imipenem, meropenem, or chloramphenicol may be acceptable alternatives to penicillin as drugs with good central nervous system penetration.
¥10 days of therapy may be adequate for endemic cutaneous disease. A full 60-day course is recommended in the setting of terrorism, however, because of the possibility of a concomitant inhalational exposure.
IV: intravenous; PO: per os (by mouth)

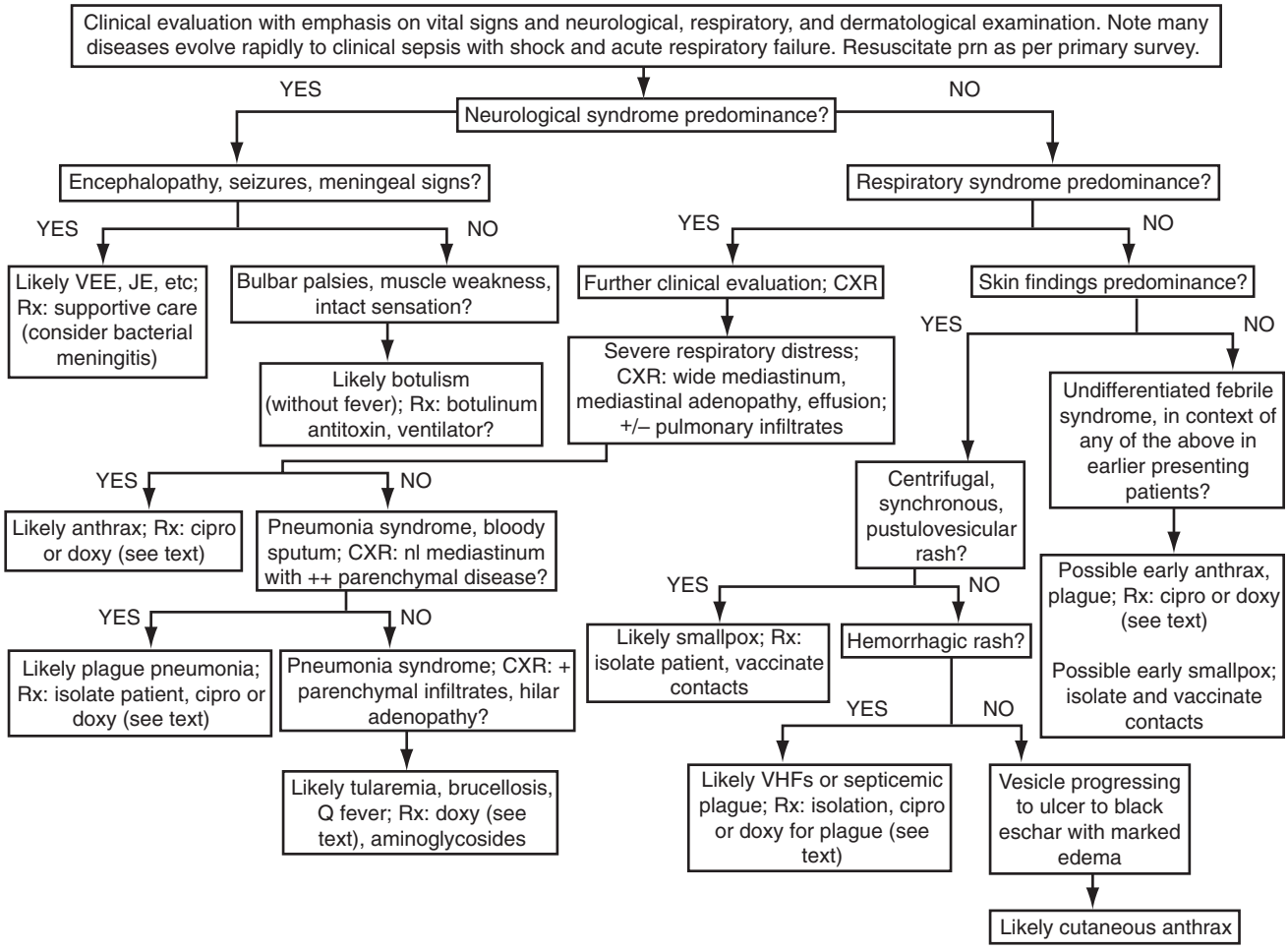

Figure 5-2. An empiric and algorithmic approach to the diagnosis and management of potential biological casualties.
cipro: ciprofloxacin; CXR: chest X-ray; doxy: doxycycline; JE: Japanese encephalitis; nl: normal limits; prn: as needed; Rx: prescription; VEE: Venezuelan equine encephalitis; VHF: viral hemorrhagic fever; +: positive finding; ++: strongly positive finding; +/–: with or without finding
Adapted with permission from Henretig FM, Cieslak TJ, Kortepeter MG, Fleisher GR. Medical management of the suspected victim of bioterrorism: an algorithmic approach to the undifferentiated patient. *Emerg Med Clin North Am.* 2002;20:351–364.

Figure 5-3. The M93 "Fox" nuclear, biological, and chemical reconnaissance vehicle.

delineation of the limits of contamination. Using M93 "Fox" or M1135 Stryker (Figure 5-3) nuclear, biological, chemical reconnaissance vehicles, these personnel can collect soil, water, and vegetation samples, mark areas of contamination, and transmit data to commanders in real time. Finally, notifying laboratory personnel not only permits them to focus their efforts at diagnosis, but also allows them to take necessary precautions.

In a civilian terrorism response scenario, notification of a suspected biological, chemical, or radiological attack would typically be made through local or regional health department channels. In the United States, a few larger cities have their own health departments. In most areas, though, the county represents the lowest jurisdiction at which an independent health department exists. In some rural areas lacking county

EXHIBIT 5-4

CONVENTIONAL INFECTIOUS DISEASES AND DISEASES POTENTIALLY RESULTING FROM AN ACT OF BIOTERRORISM: REQUIRED HOSPITAL INFECTION CONTROL PRECAUTIONS[*]

Standard (handwashing)	Contact (gloves and gown[†])	Droplet (private room[‡] and surgical mask[§])	Airborne (private room,[‡] negative pressure room, HEPA filter mask)
All patients	MRSA, VRE	Meningococcal disease	Pulmonary TB
Anthrax	Enteric infections	Resistant pneumococci	Measles
Botulism	Skin infections	Pertussis	Varicella
Tularemia	Lice	Group A streptococci	Smallpox
Brucellosis	Scabies	Mycoplasma	
Q Fever	*Clostridium difficile* disease	Adenovirus	
Glanders	RSV, parainfluenza	Influenza	
Melioidosis	Certain VHFs	Pneumonic plague	
Ricin intoxication	• Ebola[¥]		
SEB intoxication	• Marburg[¥]		
T-2 intoxication	• Lassa Fever		
VEE, EEE, WEE	Smallpox		
	Melioidosis (with cutaneous lesions)		

[*]Thorough guidelines for hospital infection control can be found in: Cole LA. Bioterrorism threats: learning from inappropriate responses. *J Publ Hlth Manage Pract*. 2000;6:8–18.
[†]Gloves and/or gown should also be worn as a part of standard precautions (and other forms of precaution) when contact with blood, body fluids, and other contaminated substances is likely.
[‡]Mixing patients with the same disease is an acceptable alternative to a private room.
[§]Surgical masks should also be employed as a part of standard and contact precautions (along with eye protection and a face shield) if procedures are likely to generate splashes or sprays of infectious material.
[¥]While Ebola is transmitted primarily via infected blood and body fluids, the voluminous emesis and diarrhea produced by Ebola patients, the very low infectious inoculum of the virus, and the ease with which hemorrhagic respiratory secretions can be aerosolized during coughing, the CDC now recommends that both contact and droplet precautions be employed when managing Ebola victims; similar caution would likely apply to Marburg (and perhaps other VHF) patients as well.
EEE: eastern equine encephalomyelitis; HEPA: high-efficiency particulate air; MRSA: methicillin-resistant *Staphylococcus aureus*; RSV: respiratory syntactical virus; SEB: staphylococcal enterotoxin B; TB: tuberculosis; VEE: Venezuelan equine encephalitis; VHF: viral hemorrhagic fever; VRE: vancomycin-resistant enterococci; WEE: western equine encephalomyelitis

health departments, practitioners would access the state health department directly. Once alerted, local and regional health authorities know how to request additional support from health officials at higher jurisdictions. Each practitioner should have a point of contact with such agencies and should be familiar with mechanisms for contacting them before a crisis arises.

If an outbreak proves to be the result of terrorism, or if the scope of the outbreak overwhelms local resources, a regional or national response becomes imperative. Under such circumstances, an extensive panoply of supporting assets and capabilities may be summoned. The National Incident Management System and its component Incident Command System (ICS) provide a standardized approach to command and control at an incident scene.[49] Local officials use the ICS when responding to both natural and human-made disasters, and ICS would be equally applicable in responding to a biological attack. Under the ICS, a designated official, typically the fire chief or the chief of police, serves as local incident commander. The incident commander may be able to summon groups of volunteer medical personnel through the Metropolitan Medical Response System, which includes medical strike teams in 124 local jurisdictions. These teams, under contract with mayors of the 124 municipalities, are organized under the Department of Homeland Security's Office of Domestic Preparedness.

In any incident or disaster, whether natural or human-made, the local incident commander may request assistance from the state through the state coordinating officer if it appears that local resources or capabilities will be exceeded. The state coordinating officer works with the governor and other state of-

EXHIBIT 5-5

THE LABORATORY RESPONSE NETWORK

Sentinel laboratories. These laboratories, found in many hospitals and local public health facilities, have the ability to "rule-out" specific bioterrorism threat agents, to handle specimens safely, and to forward specimens on to higher echelon laboratories within the network.

Reference laboratories. These laboratories, typically found at state health departments, and at military, veterinary, agricultural, and water-testing facilities, can employ BSL-3 practices, and can often conduct nucleic acid amplification and molecular typing studies. The more than 100 reference laboratories can confirm ("rule-in") the presence of the various biological threat agents.

National laboratories. These laboratories, including those at the CDC and USAMRIID, can employ BSL-4 practices, and serve as the final authority in the work-up of bioterrorism specimens. These laboratories provide specialized reagents to lower level laboratories and have the ability to bank specimens, perform serotyping, and detect genetic recombinants and chimeras.

BSL: biosafety level
CDC: Centers for Disease Control and Prevention
USAMRIID: US Army Medical Research Institute of Infectious Disease

EXHIBIT 5-6

BIOSAFETY LEVELS

Biosafety Level 1: includes practices employed by a microbiology laboratory that deals only with well-characterized organisms that do not typically produce disease in humans. Work is conducted on open bench tops using standard microbiologic practices. Example: high school biology laboratory

Biosafety Level 2: includes practices employed by laboratories that deal with most human pathogens of moderate potential hazard. Laboratory coats and gloves are typically worn, access to the laboratory is restricted to trained personnel, and safety cabinets are often employed. Example: clinical hospital laboratory

Biosafety Level 3: Includes practices employed by laboratories that work with agents with the potential to cause serious and lethal disease by the inhalational route of exposure. Work is generally conducted in safety cabinets, workers are often vaccinated against the agents in question, and respiratory protection is worn. Clothing (such as scrub suits) is exchanged upon exiting the laboratory. Laboratories are negatively pressurized. Example: state health department laboratory

Biosafety Level 4: Also includes practices employed by laboratories working with highly hazardous human pathogens infectious via the inhalational route. BSL-4 organisms differ from those requiring BSL-3 precautions in that no vaccine or antibiotic therapy is available. Personnel may only enter the laboratory through a series of changing and shower rooms. Equipment and supplies enter via a double-door autoclave. Strict and sophisticated engineering controls are employed and personnel wear sealed positive-pressure space suits with supplied air. Laboratories are negatively pressurized. Examples: laboratories at the CDC, USAMRIID, the Canadian Science Center for Human and Animal Health, and a few other research facilities

BSL: biosafety level
CDC: Centers for Disease Control and Prevention
USAMRIID: US Army Medical Research Institute of Infectious Disease

ficials to make state-level assets (such as state health departments, state public health laboratories, and state police assets) available. Most state public health laboratories participate as "reference" laboratories in the Association of Public Health Laboratories and CDC's Laboratory Response Network. These facilities support hundreds of "sentinel" laboratories in local hospitals throughout the nation, and can provide sophisticated confirmatory diagnosis and typing of biological agents[50] (an overview of public health laboratory capa-

bilities is provided in Exhibit 5-5; the biosafety-level[51] precautions they employ are outlined in Exhibit 5-6). State police can provide law enforcement assistance and state police laboratories can assist with forensic analysis. Finally, governors can access military assets at the state level through National Guard units under their direct control. These units can provide law enforcement, public works assistance, mobile field hospital bed capacity, and other support. Every state governor now has, at his or her disposal, one of some 57 military Weapons of Mass Destruction–Civil Support Teams (WMD-CSTs). These 22-person advisory teams can offer expertise and provide liaison to additional military assets at the federal level.

When state capabilities are overwhelmed or insufficient, the state coordinating officer may alert the federal coordinating officer, who can, in turn, assist in activating the national response framework. The national response framework guides delivery of federal assets and provides for a coordinated multiagency federal response. Federal response and support to state and local jurisdictions, according to the framework, is organized into 15 emergency support functions (ESFs). ESF 8 provides for health and medical services. While a specific agency is assigned primary responsibility for each of the 15 ESFs, more than two dozen federal agencies, as well as the American Red Cross, can, under federal law, be tasked to provide assistance. Federal disaster medical support is primarily the responsibility of the Department of Health and Human Services which, through its Office of Emergency Response, oversees the National Disaster Medical System (NDMS).[52] A principal component of the NDMS is its network of disaster medical assistance teams, each of which consists of trained medical volunteers with the ability to arrive at a disaster site within 8 to 16 hours. Another important component of the NDMS is its excess hospital bed capacity, held at numerous Department of Veterans Affairs, military, and civilian hospitals throughout the nation.

Finally, several other federal agencies may play an important role in the response to disasters, including, in particular, those resulting from a biological attack. The CDC and USAMRIID provide national laboratories, which support the reference labs at the state level and are capable of dealing with virtually all potential biological threat agents.[53] Expert consultation and epidemiological investigative assistance is also available through the CDC, and bioweapons threat evaluation and medical consultation is likewise available through USAMRIID. Additionally, the military can provide expert advice and assistance to civilian authorities through Army National Guard's CBRNE Enhanced Response Force Package Teams, which can arrive at a disaster site within a few hours of notification, as well as through the aforementioned CBIRF, which is capable of providing reconnaissance, decontamination, and field treatment. Military support, when provided, would be subordinate to civilian authorities and would be provided and tailored by the Joint Task Force for Civil Support, a component of US Army Northern Command that provides a command-and-control element for all military assets involved in disaster response missions and other contingencies within the United States. Finally, the CDC has developed the Strategic National Stockpile, whereby critical drugs and vaccines necessary to combat a large disaster or terrorist attack are stockpiled at several locations throughout the country, available for rapid deployment to an affected area.[54] Release of stockpile components is currently controlled by the Department of Health and Human Services.

Step 9: Conduct an Epidemiological Investigation and Manage the Psychological Aftermath of a Biological Attack

Clinicians must be versed in the basic principles of epidemiology and be prepared to assist in the epidemiological investigation, which will be of paramount importance after a suspected terrorist attack. Although preventive medicine officers, environmental science officers, veterinarians, preventive medicine technicians (68S in US Army organizations), and field sanitation personnel may be invaluable in the course of such an investigation, the clinician should, nonetheless, have a working knowledge of the steps, known as the epidemiological sequence,[55] involved in the conduct of an epidemiological investigation

EXHIBIT 5-7

THE EPIDEMIOLOGICAL SEQUENCE

1. Make an observation
2. Count cases
3. Relate cases to population
4. Make comparisons
5. Develop the hypothesis
6. Test the hypothesis
7. Make scientific inferences
8. Conduct studies
9. Intervene and evaluate

Data source: Centers for Disease Control and Prevention. Investigating an outbreak. In: *Principles of Epidemiology: Self Study Course SS3030*. 2nd ed. Atlanta, GA: CDC; 1998: 347–424.

(Exhibit 5-7). Although the well-prepared clinician may positively impact the health and well-being of individual patients, it is only through the rapid conduct of a competent epidemiological investigation that large numbers of exposed persons are likely to be reached, and successful medical and psychological prophylaxis implemented, before the widespread outbreak of disease or panic.

In addition to the instigation of an epidemiological investigation and the institution of specific medical countermeasures against biological agent exposures, the clinician should be prepared to address the psychological effects of known, suspected, or feared exposure to threat agents.[56] An announced or threatened biological attack can provoke fear, uncertainty, and anxiety in the population, and can result in an overwhelming number of patients seeking evaluation and demanding therapy for feared exposure. Such a scenario might also follow the covert release of an agent once the resulting epidemic is characterized as being the consequence of a biological (or chemical or radiological) attack. Symptoms due to anxiety and autonomic arousal, as well as side effects from postexposure prophylactic drugs, may mimic prodromal disease due to biological agent exposure and pose dilemmas in differential diagnosis. Persons with symptoms arising from naturally occurring infectious diseases may likewise pose significant challenges to healthcare providers and public health officials.

Public panic and behavioral contagion are best prevented by timely, accurate, well-coordinated, and realistic risk communication from health and government authorities. Such communication should include an assessment of the risk of exposure, information regarding the resulting disease, and a recommended course of action for suspected exposure. As the epidemic subsides and public knowledge increases, public anxiety will decrease to realistic and manageable levels. This cycle of uncertainty, panic, response, and resolution occurred during the October 2001 anthrax bioterror event.[57] Readily accessible, biological, chemical, and radiological agent-specific information packages for local public health authorities and the general public are available through the CDC website, and can be of valuable assistance in risk communication.

Effective risk communication is possible only in the presence of well-conceived risk communication plans and tactics, worked out well in advance of an actual event. Similar advanced planning must take into account the need to rapidly establish local centers for the initial evaluation and administration of postexposure prophylaxis. Finally, the development of patient and contact tracing mechanisms and vaccine screening tools, the mechanisms for accession of stockpiled vaccines and medications, and the means by which to identify and prepare local facilities and healthcare teams for the care of mass casualties must be clearly elucidated in advance. The CDC's smallpox response plan[40] provides a useful template for such a coordinated, multifaceted approach, and the wisdom of farsighted planning and coordination was amply demonstrated by the efficient mass prophylaxis of over 10,000 individuals in New York City during the events surrounding the discovery of anthrax-contaminated mail in 2001.[58]

Step 10: Maintain a Level of Proficiency

Once response plans have been developed, they must be exercised. Military commanders and their units are typically well versed in planning and executing conventional field-training and command-post exercises. In the future, such exercises must account for the real possibility that military units may encounter biological weapons on the battlefield. Similarly, planning and exercises must account for the tandem threat posed by bioterrorist attacks against garrison activities. Local civilian exercises (which can often include military participants) are likewise a necessary component of disaster preparation. Such exercises should be designed so as to test incident command and control, communications, logistics, laboratory coordination, and clinical capabilities. These exercises may involve only the leadership of an organization and focus on planning and decision making (the command-post exercise), they may involve notional play around a tabletop exercise, or they may involve actual hands-on training and evaluation in a disaster drill or field-training exercise. In fact, the CDC expended considerable effort prior to the 2009 H1N1 influenza pandemic preparing for just such an event, conducting numerous tabletop and full-scale exercises involving CDC personnel as well as state public health participants. The Joint Commission requires hospitals to conduct a hazard vulnerability analysis, develop an emergency operations plan, and evaluate this plan twice yearly; one of these evaluations must include a community-wide drill.[59] Moreover, the Joint Commission specifically mandates that hospitals provide facilities (and training in the use of such facilities) for radioactive, biological, and chemical isolation and decontamination.

SUMMARY

Many resources, including this text, are now available to assist both military and civilian clinicians and public health professionals in planning for, and maintaining proficiency in, the management of real or threatened terror attacks. Finally, as discussed under step 8 above, numerous governmental, military, and civilian organizations have now been organized, trained, and equipped to provide assistance and consultation to clinicians, first responders, and public health officials faced with planning for and treating the victims of a potential terrorist attack. It is assistance that, if incorporated into thorough planning efforts, will hopefully never be needed for actual patient care purposes.

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