Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

CHAPTER 12

Biosecurity Programs and Assets

We refuse to remain idle when modern technology might be turned against us. We will rally the great promise of American science and innovation to confront the greatest danger of our time.
President George W. Bush, at the signing of the Project BioShield Act, July 21, 2004

Objectives

The study of this chapter will enable you to:

1. Relate recent initiatives in biosecurity to the four phases of emergency management.
2. Discuss the goals and objectives of the BioShield project.
3. Define the phrase *dual-use research of concern* and discuss the role of the National Scientific Advisory Board for Biosecurity.
4. Discuss how mass prophylaxis caches affect a nation's preparedness and ability to respond to a major disease outbreak.
5. Discuss the Cities Readiness Initiative.
6. Discuss the goals and objectives of the BioWatch program and how it provides early warning and detection capabilities for biothreat pathogens.
7. Discuss the goals and objectives of the BioSense program.
8. Discuss the role of the Laboratory Response Network and the function of its three tiers.
9. Describe the mission of the Federal Bureau of Investigations Hazardous Materials Response Unit.
10. Describe the mission of the National Guard's Weapons of Mass Destruction Civil Support Teams.

INTRODUCTION

The aim of this chapter is to make the reader aware of biosecurity programs and assets that exist mostly in the United States. The construction of this chapter follows the four phases of comprehensive emergency management (**preparedness, mitigation, response,** and **recovery**). Biosecurity programs and assets have been developed over the last 10 years to enable the nation to establish policy, provide early warning and detection, improve readiness, and provide specialized response and recovery capabilities.

A specialist in disaster mitigation, Dennis Mileti (1999), said that we "always seem to be preparing for the last disaster." Certainly, much could be said the same for facing the threat of biological terrorism. Since the anthrax attacks of 2001, the nation has been preparing to respond to two forms of bioterrorism: covert and overt attacks. Covert

Biosecurity and Bioterrorism
ISBN 978-0-12-802029-6
http://dx.doi.org/10.1016/B978-0-12-802029-6.00012-8

Table 12.1 Characteristics of outbreaks indicative of possible bioterrorism

1.	Many cases appearing at the same time, particularly in a discrete population.
2.	Many cases of a rare disease or those that fall within Department of Health and Human Services Category A or B.
3.	More severe cases than typical for a given disease.
4.	A disease related to an unusual route of exposure (anthrax and inhalation).
5.	A disease that is unusual in a given place or out of season.
6.	Multiple simultaneous outbreaks of the same disease or different diseases.
7.	Unusual disease strains or uncommon antibiotic resistance to an organism.

attacks would normally be characterized as silent releases of a biological agent into a population, which later would correspond to many patients presenting to clinics and hospital emergency departments with a similar clinical syndrome. In this setting, syndromic surveillance is of paramount importance. Indeed, there may be several indicators for a covert act of bioterrorism. Table 12.1 lists some of the indications and characteristics of an outbreak due to bioterrorism.

An **overt** biological attack would be characterized by the release of a biological agent with corresponding notification of the release by the perpetrator. Local fire, law enforcement, and emergency management would typically arrive on the scene within a few minutes to manage the incident. If this were an isolated incident, then federal and state agencies would join local authorities within a few hours to take charge of the scene because this falls into the realm of the use of weapons of mass destruction (WMDs).

Officials from all levels of government are charged with preparing their communities for the worst possible disaster. The biological challenge, whether overt or covert, poses one of the most difficult set of circumstances for response organizations to tackle. Local community government officials know that they have limited ability to respond to the release of a biological agent, be it overt or covert. Frankly, it would be prohibitively expensive for all communities, especially small ones, to build the critical mass needed for them to effectively recognize the problem, respond, contain the outbreak, and treat the casualties. Most state governments have built a capacity for dealing with the biological challenge, but they lack the resources needed to contain widespread outbreaks. For this reason the federal government has accepted the responsibility of building critical infrastructure to recognize the threat and effectively deal with it.

Critical Thinking

The 2001 Amerithrax incident was both covert and overt. Covertly, anthrax spores were sent to the AMI building in Boca Raton, Florida, without obvious notification that the act had taken place. The incident led to two cases of inhalation anthrax. The letters sent to government officials and media moguls contained a note that informed the victims that they had been attacked with "anthrax." Why did the perpetrator act first covertly and then overtly about a week later?

MITIGATION: ESTABLISHING POLICY AND OVERSIGHT

Hazard mitigation addresses the causes of a disaster, reducing the likelihood that it will occur or limiting its impact. The focus of mitigation is to stop disasters before they happen (Lindell et al., 2007). How could you stop a biological disaster before it happens? Indeed, how could you prevent a terrorist or group of belligerents from using biological agents? Laws with stiff penalties for breaking them may be a deterrent to some amateur terrorist or prankster; however, to others determined to advance their agenda, laws are of no consequence. Those concerned about the proliferation of bioweapons might enact policies for limited exchange or trade of questionable substances. Governments concerned about scientific advancements or sensitive information ending up in the public domain might assemble a group to provide guidelines and oversight. Finally, developments in disease prevention and new treatments might be fostered so that the threat from certain biological agents might dissipate, especially if you could protect a nation from such a threat.

Covered under the umbrella of mitigation are three examples of government attempts to mitigate disaster due to potential use of biological weapons: the Australia Group, the BioShield project, and the National Science Advisory Board for Biosecurity (NSABB). The Australia Group represents one of the few international efforts aimed at providing oversight for the Biological and Toxin Weapons Convention (BWC). Project BioShield was initiated shortly after the terrorist attacks of September 11, 2001. The $5.6 billion initially appropriated for this project was supposed to give the United States new countermeasures to mitigate a biological attack against the American people. Finally, the NSABB is a panel of experts assembled by the Department of Health and Human Services (HHS) to develop policy and establish guidelines to deal with scientific advances that might be exploited by would-be terrorists or adversaries of the United States.

The Australia Group

At the international level, the **Australia Group** was formed in 1985 by the government of Australia as an informal body aimed at reducing the proliferation of chemical and biological weapons. More relevant, the Australia Group has strived to support the objectives of the BWC, which has been in force since 1975. The group's main objective has been to enhance the effectiveness of national export licensing measures for specific chemical and biological agents. After its first meeting in Brussels, it quickly established export controls, which have been modified over the years to address emerging threats and challenges. The number of countries participating in the Australia Group has grown from 15 in 1985 to more than 40 (see Fig. 12.1). All of the participants in the Australia Group are parties to the BWC.

Evidence of the diversion of dual-use materials (discussed later) to biological weapons programs in the early 1990s led to the participants' adoption of export controls on

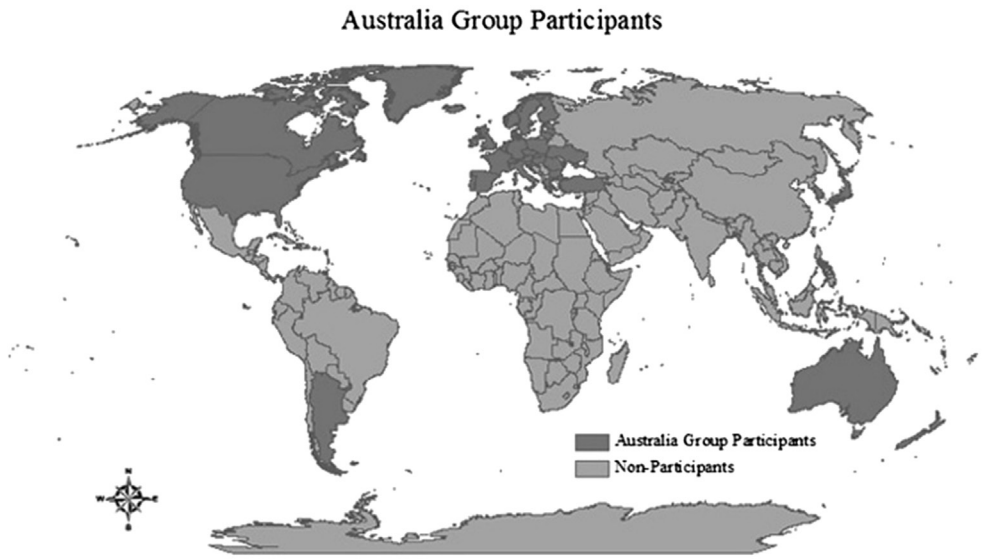

Figure 12.1 World map showing the 42 countries that are participants in the Australia Group as of 2015. *Courtesy of the Australia Group.*

specific biological agents. The agent control lists developed by the group have been expanded over the years to include technologies and equipment that can be used in the manufacturing or disposal of biological weapons. This comprehensive listing was subsequently used by the HHS to construct Category A, B, and C lists.

Project BioShield

On July 21, 2004 President George W. Bush signed a bill to provide funding for Project **BioShield**, an effort jointly directed by the Department of Homeland Security (DHS) and the HHS (see Fig. 12.2). BioShield is intended to provide medical countermeasures to protect the American public from chemical, biological, radiological, or nuclear (CBRN) attacks. Project BioShield legislation was the result of a bipartisan effort in response to the catastrophic events of September 11, 2001, and the anthrax and ricin attacks directed against members of Congress and other Americans. The BioShield project has three primary goals. First, the project authorized funds to purchase and stockpile vaccines aimed at countering specific biothreat agents. Second, the project authorized funding for increased research and development of new pharmaceuticals for the diseases caused by specific biothreat pathogens. Third, the project proposed sweeping changes in government authorization regarding medical response to a bioterror crisis and the approval processes for new drugs and vaccines (Marek, 2007).

Project BioShield Summary

Project BioShield institutes a secure funding source for the purchase of critical medical countermeasures, such as vaccines, therapeutics, and diagnostics. Project BioShield authorizes $5.6 billion in funding over 10 years for the advanced development and purchase of high-priority medical countermeasures. This "special reserve fund" was provided in the fiscal year (FY) 2004 DHS Appropriations Act and becomes available to the Secretary of HHS for procurements after interagency and White House approval. The Office of Public Health Emergency Countermeasures has authority for all procurement activities for Project BioShield. Acquisitions under Project BioShield are restricted to products in development that are potentially licensable within 8 years from the time of contract award (Russell, 2007).

Figure 12.2 President George W. Bush signs the BioShield bill on July 21, 2004. This important program was instrumental in giving us better medical countermeasures (vaccines and treatments) for specific biothreat pathogens. The program comes under the auspices of the Biomedical Advanced Research and Development Authority and the National Institutes of Health. *Courtesy of Lawrence Livermore National Laboratories.*

Consider the preexisting state of affairs in which a private company considers the research and development costs of producing a new drug or vaccine for a disease that is rare or not normally known to occur in the United States. After spending tens to hundreds of millions of dollars up front, what would be the likelihood that the product would sell in sufficient quantity to enable the company to show a profit? There is virtually no way for new drug makers to see a potential profit in any of these ventures unless they were able to predict when, where, and what agent would be used in the next act of bioterrorism, if any.

The Project BioShield bill gave authority to the Food and Drug Administration (FDA) to use unapproved drugs in national (public health) emergencies. The Project BioShield bill also authorizes federal officials to contract with private enterprises to purchase these medications while they are still under development. However, the final approval for purchase is contingent on clinical trials and tests that indicate the treatments are safe and efficacious. Project BioShield was intended to remove some of the uncertainties that companies face in producing these drugs. Perhaps one of the most important aspects of this is the preemergence of a buyer (the federal government) for a product that will take tens of millions of dollars to research and produce. In this way the speculative nature of any new venture is, to a degree, reduced.

Although the federal government has guaranteed funding, biotechnology companies are still charged with the task of creating a safe and efficacious product. Therefore failure to effectively produce a viable medication would be economically devastating to that company after many years of investment. This is probably why so few companies are actively engaged in BioShield and working toward these goals.

There are other concerns about BioShield from the biotechnology sector. Biotech executives complain that language in BioShield does not offer sufficient protection from product liability should a newly developed pharmaceutical have adverse effects on patients or fail to protect them against a specific pathogen.

Perhaps because of the initial shortfalls of the BioShield bill, President Bush signed into law the formation of a new regulatory division, the Biomedical Advanced Research and Development Authority (BARDA). The BARDA provides another $1 billion in funding for continuation of research and development initiatives addressed under Project BioShield. The government will now assist with the cost of establishing domestic manufacturing facilities. It will also provide liability coverage to those companies whose products, not yet licensed with the FDA, will be used during biological attacks. Under these new guidelines, clear evidence of intentional misconduct must be present for a company manufacturing one of these pharmaceuticals to be sued. BARDA also provides funding for the development of experimental animal models to be used in clinical trials for testing of drugs and vaccines against diseases that are too dangerous for human subjects (ie, viral hemorrhagic fever, smallpox, pneumonic plague).

The original primary goal of Project BioShield has been to increase the development, purchase, and immediate availability of medical countermeasures to bioterror agents. Project BioShield was originally focused on Category A bioterror agents smallpox, botulinum, and anthrax. However, it was quickly realized that other agents, such as radiological agents, nuclear agents, and nerve agents, should also be encompassed within Project BioShield. At the conclusion of 2011, Project BioShield had paid for the delivery of 28.75 million doses of BioThrax, which is the only FDA-approved anthrax vaccine, and 107,560 doses of an antitoxin for botulism (Scheidmiller, 2012). Although the number of doses of the botulism antitoxin are well below the 200,000 originally ordered in 2006, the HHS decided that

Table 12.2 Recent funding amount breakdowns by type of threat for the Project BioShield program

Countermeasure area/product	Funding amount	Explanation
Anthrax	$1,456,130,000	Antitoxins and vaccines
Botulism	$476,000,000	Antitoxins
Smallpox	$1,085,000,000	Vaccines
Radionuclear	$234,500,000	Radiation sickness
Nerve agents	$60,800,000	Midazolam for seizures

From Department of Health and Human Services Project BioShield Annual Report: January–December 2013.

the 107,560 doses received were sufficient (Roos, 2012). However, HHS has continued to receive additional deliveries of botulism antitoxins through 2013 (US DHHS, 2014). Refer to Table 12.2 for a summary of funds spent on primary WMD concerns.

One of the major success of the Project BioShield program is in the increased development of countermeasures to potential bioterror agents. The market for developing medical countermeasures is typically a high-cost, high-risk market (Russell, 2007). This is particularly true when the major purchasers of your product are governments. "The federal government is frequently perceived by pharmaceutical and vaccine manufacturers as an uncertain and low-profit market" (Russell, 2007). The annual appropriations process further complicates these factors as long-term fund availability becomes questionable, at best. Project BioShield provided a long-term financial incentive to manufacturers to develop the products needed for defense against CBRN threats (Russell, 2007). To date, 12 new products have been added to the Strategic National Stockpile (SNS) to address anthrax, botulism, smallpox, and other CBRN threats (US DHHS, 2014). This includes 4.8 million doses of potassium iodide and 437,710 doses of intravenous calcium/zinc diethylenetriamine pentaacetate for radionuclear threats; 920,000 ST-246 vaccines and 20,864,000 Imvamune MVA smallpox vaccines; 138,749 doses of botulinum antitoxin; 28,750,000 doses of BioThrax (anthrax vaccine absorbed); 10,000 doses of anthrax immune globulin; and 65,000 doses of monoclonal antibody (Raxibacumab, formerly Abthrax) for anthrax (US DHHS, 2014).

The second goal of Project BioShield, which is to increase the flexibility and authority of the National Institutes of Health to expedite research and development of potential countermeasures, has been mostly successful when considered alongside the primary goal. The financial incentive provided to pharmaceutical companies has led to increased development and research for medical countermeasures for potential bioterror agents. With a funding source firmly in place from the federal government, pharmaceutical companies are more likely to spend their money on the research and development of potential countermeasures. Project BioShield continues to encourage development by promising to purchase countermeasures up to 8 years before it is reasonably expected to be delivered. This allows appropriate time for the research and development of productive countermeasures and for the protracted FDA approval processes.

The final goal of Project BioShield involves the allowance for an EUA from the FDA for bioterror countermeasures that are in the final stages of the approval process. This authorization would only be used in an emergency, but it also encourages the continued development of medical countermeasures. An EUA can be issued by the Secretary of HHS and expires "when the HHS Secretary determines the underlying emergency circumstances no longer exist" (Gottron, 2014). There are currently EUAs issued for Ebola virus disease (EVD), H7N9 influenza (avian influenza), Middle East respiratory syndrome, and the mass dispensing of doxycycline for "post-exposure prophylaxis (PEP) or inhalation anthrax" (Food and Drug Administration, 2015).

The FDA's first issuance of an EUA occurred in 2005 to "enable the use of Anthrax Vaccine Adsorbed (AVA) in military personnel deemed by DoD (Department of Defense) to be at heightened risk of exposure" (US DHHS, 2014). Previously, only a military emergency or domestic emergency allowed for the Secretary of HHS to issue an EUA. Because of changes in authority as part of the Pandemic and All-Hazards Preparedness Reauthorization Act (PAHPRA), the HHS Secretary can now issue an EUA when they determine there is a significant potential for a public health emergency (US DHHS, 2014). This flexibility has been crucial in the recent EVD threat. Without the ability to issue an EUA for a potential public health emergency, one likely would not have been issued for EVD.

The initial funding for Project BioShield occurred with the original passage of the Project BioShield Act of 2004, which allocated $5.6 billion to the initiative over a 10-year time frame. These funds were part of the FY2004 DHS Appropriations Act (US DHHS, 2013). Many of these funds have been allocated through a Special Reserve Fund managed by the BARDA (US DHHS, 2013). "BARDA has awarded nine contracts for development and acquisition of CBRN (Chemical, Biological, Radiological, and Nuclear) medical countermeasures valued at over $2 billion, and has successfully stockpiled seven medical countermeasure products against six CBRN threats" (US DHHS, 2013).

All funding for Project BioShield is procured through the BARDA and the Assistant Secretary for Preparedness and Response of HHS (US DHHS, 2013). Contracts are awarded to pharmaceutical companies to research, develop, and deliver medical countermeasures for bioterror agents. Contracts are generally awarded as fixed price contracts (US DHHS, 2013).

Although the funding for Project BioShield was originally scheduled to only run from FY2004 to FY2013, Project BioShield continues to be provided with funding appropriations. For example, the 2016 budget will, according to the Obama administration, provide billions of dollars for infectious disease programs, including $646 million for BioShield for "continuing efforts to develop new medical countermeasures" (Roos, 2015). This funding is an increase to the $2.8 billion over 10 years that was allocated for Project BioShield in the PAHPRA of 2013 (Genomeweb, 2013).

Although Project BioShield appears to be receiving a continued boost in funding, this has not always been the case in recent years. In 2010, the House of Representatives unsuccessfully attempted to shift $2 billion from BioShield to pay for other government projects (Global Security Newswire, 2012). The White House's proposed FY2013 budget diverted funds from BioShield to BARDA (Global Security Newswire, 2012). The sudden arrival of EVD to the United States in 2014 quickly thrust the fear of biological agents back into the spotlight, likely leading to increased budgetary considerations in the immediate future.

BioShield successfully created a guaranteed market. It did not, however, eliminate the technical development risks, the lack of requisite technical expertise in the company, or the need for sufficient development funding to license a product.

Robert Kadlec (2013)

Although the implementation of BioShield's initiatives has been a necessarily slow process, there have certainly been marked successes in the increase of the available biological agent antitoxins and vaccines available in the SNS and the increased development of medical countermeasures. The expansion of the application of EUAs has also been a successful aspect of Project BioShield. The addition of public health emergencies to the list of available avenues to issue an EUA has allowed for EUAs to be activated for H7N9 and EVD threats. These activations have been two of the most expansive EUA issuances to date.

National Science Advisory Board for Biosecurity

The NSABB was established in 2005. The NSABB is a critical component of a set of federal initiatives to promote biosecurity in life science research. The HHS created this advisory board to provide advice, guidance, and leadership regarding biological research that has the potential for misuse and could pose a biologic threat to public health or national security (refer to Fig. 12.3). This is often referred to as **dual-use** research of concern. That is, research that can be reasonably anticipated to "provide knowledge, products, or technologies that could be directly misapplied by others to pose a threat to public health, agriculture, plants, animals, the environment, or materiel." The NSABB has proposed a series of experimental outcomes that should be given special consideration for their dual-use potential.

The NSABB is charged specifically with guiding the development of a system of institutional and federal research review that allows for fulfillment of important research objectives while addressing national security concerns. The NSABB also developed guidelines for the identification and conduct of research that may require special

Figure 12.3 The National Science Advisory Board for Biosecurity (NSABB) provides advice, guidance, and leadership regarding biological research that has the potential for misuse and could pose a biologic threat to public health or national security (ie, dual-use research of concern). *Courtesy of the NSABB (*www.biosecurityboard.gov*).*

attention and security surveillance. The NSABB developed professional codes of conduct for scientists and laboratory workers that can be adopted by professional organizations and institutions engaged in life science research and materials and resources to educate the research community about effective biosecurity.

The NSABB is made up of 25 voting members that have a broad range of expertise in molecular biology, microbiology, infectious diseases, biosafety, public health, veterinary medicine, plant health, national security, biodefense, law enforcement, and scientific publishing. The NSABB also includes nonvoting ex officio members from 15 federal agencies and departments. These include the following:

- Executive Office of the President,
- Department of Health and Human Services,
- Department of Energy,
- Department of Homeland Security,
- Department of Veterans Affairs,
- Department of Defense,
- Department of the Interior,
- Environmental Protection Agency,

- Department of Agriculture,
- National Science Foundation,
- Department of Justice,
- Department of State,
- Department of Commerce,
- Intelligence community, and
- National Aeronautics and Space Administration.

The principal aim of the NSABB is to enhance biosecurity in life sciences research. In this light, *biosecurity* refers to "processes and procedures that are designed to minimize the likelihood that biological research will be misused for the production or enhancement of biological weapons" (NSABB website, 2015). This initiative includes implementation of the Public Health Security and Bioterrorism Preparedness and Response Act through the Select Agent Program, which were previously covered in chapter Legal Aspects of Biosecurity. It supports the following actions, with the guidance of the NSABB:

- Developing guidelines for oversight of dual-use research and ongoing evaluation and modification of these guidelines as needed;
- Working with the scientific community, including journal editors, to ensure the development of guidelines for the publication, public presentation, and public communication of potentially sensitive research and encouraging the adoption of these guidelines by international organizations;
- Providing guidance on the development of a code of conduct for scientists and laboratory workers; and
- Developing mandatory programs for education and training in biosecurity issues for all scientists and laboratory workers at federal and federally funded institutions.

The NSABB advises all federal departments and agencies that conduct or support life science research. The board recommends specific strategies for the efficient and effective oversight of dual-use biological research, including the development of guidelines for the case-by-case review and approval by institutional biosafety committees. The NSABB takes into consideration national security concerns and the needs of the research community. This includes strategies for fostering continued rapid progress in public health research (eg, new diagnostics, treatments, vaccines and other prophylactic measures, and detection methods) as well as in food and agriculture research while being mindful of national security concerns.

PREPAREDNESS

Preparedness protects lives and property and facilitates rapid recovery (Lindell et al., 2007). Preparedness for bioterrorism consists of the plans, procedures, and resources that must be defined in advance. The components of preparedness are designed to support a

timely and effective emergency response and recovery process. The threat of bioterrorism and concerns about pandemic influenza in the United States brought increased attention to the need for state and local public health authorities to provide their communities with rapid, reliable access to prophylactic medications. In fact, the federal government recently called on all states to devise comprehensive mass prophylaxis plans to ensure that civilian populations have timely access to necessary antibiotics and vaccines in the event of future outbreaks (Hupert et al., 2004).

Prophylaxis is defined as the medical care or measures provided to individuals to prevent or protect them from disease. This medical care or protective measure may be performed on entire populations or large sectors considered to be at risk. When this becomes the objective, the campaign or program may be referred to as **mass prophylaxis**. These measures traditionally include dispensing medications or implementing vaccination. Effective public health response to a large-scale outbreak hinges on the ability to recognize the outbreak, to mobilize supplies of needed materials to affected populations in a timely manner, and to provide ongoing medical care for affected individuals (Hupert et al., 2004).

Accordingly, there has been a major expansion of federal assets to assist local public health providers to plan and implement mass prophylaxis campaigns for bioterrorism and disease outbreak response. This expansion includes mass prophylaxis caches, the BioWatch program, the BioSense program, and the Cities Readiness Initiative (CRI). Each of these components will be considered in this section of the chapter.

Mass Prophylaxis Caches

The Centers for Disease Control (CDC) maintains the SNS of prophylactic agents and provides technical assistance on dispensing operations to local public health and emergency management planners throughout the United States. However, the SNS and its support staff do not constitute a stand-alone, first response operation. Likewise, the National Disaster Medical System was established by HHS to provide rapid response capability for medical disasters throughout the United States, but this system is not designed to supplant comprehensive local planning and operations for mass prophylaxis campaigns either (Hupert et al., 2004).

The ready availability of drugs and vaccines may limit the response capacity to a serious outbreak. The federal government created the SNS, which is composed of a number of ready-to-deploy push packs containing medical supplies to treat thousands of patients affected by CDC Category A agents and other WMD concerns (eg, nerve agent exposure). In addition, predesignated pharmaceutical supply caches and production arrangements and/or vendor-managed inventory may be used for large-scale ongoing prophylaxis or vaccination campaigns. States, some large municipalities, and a few medical facilities across the United States have developed smaller stockpiles and secure supply chains for critical antibiotics and medical material for use in an outbreak (Hupert et al., 2004).

Figure 12.4 A Strategic National Stockpile (SNS) package arriving at a receive, store, and stage warehouse in Washington, DC. Arrival of the shipment, "Eagle Pack", kicked off the largest regional mass dispensing exercise ever conducted in the national capital region. Escorted by US Marshals, Maryland State Police, Metropolitan Police Department (DC), and other local law enforcement professionals, the shipment of simulated medical countermeasures represents the rapid deployment of SNS medications in response to a public health emergency. *Courtesy of the Centers for Disease Control and Prevention.*

Federal mass prophylaxis assets and resources are intended to build on the local and regional first-response infrastructure for carrying out mass prophylaxis. Every public health jurisdiction in the country has the responsibility to develop and maintain the capability to carry out first response and federally assisted mass drug dispensing and vaccination campaigns tailored to its local population. At least four reasons underlie this rule:

1. Local mass prophylaxis activities need to be under way before the arrival of any federal assets.
2. Federal or state assistance will not include sufficient personnel to fully command or staff community-wide mass prophylaxis dispensing operations.
3. Mass prophylaxis operations are likely to remain under local control even after federal or state assets are delivered.
4. Dispensing and follow-up operations are likely to continue after the departure of federal or state assets (HHS and AHRQ 17–19).

Once requested, assets from the SNS are likely to arrive in less time than it takes to set up a network of fully functional dispensing or vaccination centers. Each center must have a well-defined supply route linking it to the receive, store, and stage site for these SNS materials, as well as to any local stockpiles (see Fig. 12.4). Most local stockpiles are predesignated for use by local first responders, hospitals, and emergency management personnel to ensure that they are ready to work with the public as soon as or before federal assets arrive.

Onsite stockpile management requires the ability to ensure proper storage (eg, coolers), inventory management, and security of supplies. If the center is dispensing drugs or vaccines under investigational new drug protocols, local staff may have to track the patients to whom those supplies are distributed. However, recent legislative proposals call for the creation of emergency use authorizations (EUAs) to facilitate rapid dispensing of off-label or investigational medicines and vaccines in the setting of mass prophylaxis (Hupert et al., 2004).

BioWatch: Early Warning and Detection

President George W. Bush announced the BioWatch program to the American public in his 2003 State of the Union Address. BioWatch is an early warning system (detect-to-warn) for aerosolized biological agents. The program now falls under the Health Threats Resilience Division of the DHS. With early detection and medical treatment, people exposed to a biological agent have a much greater chance of recovery and the consequences of such an attack can be mitigated (Crawford, 2006).

Using a network of cabinets or stations, BioWatch Generation 2 collectors gather samples of airborne particles into a filter system (see Fig. 12.5). Each day, filters are collected manually by a technician and taken to a CDC Laboratory Response Network (LRN) facility for processing. The sensor filters are tested for five specific organisms: *Bacillus anthracis* (anthrax), *Burkholderia mallei* (glanders), *Burkholderia pseudomallei* (melioidosis), *Yersinia pestis* (plague), *Variola major* (smallpox virus), and *Francisella tularensis* (tularemia). A positive result from definitive testing is referred to as a BioWatch Actionable Result. The time of air sample collection, transport, and sample processing

Figure 12.5 Actual BioWatch collector units. From the left to right are units at a Washington, DC subway station, the next on a street in Salt Lake City (near an Olympics venue), and the last outside of a New York Police Department police station. *Courtesy of the Department of Homeland Security.*

introduces at least a 36-h turnaround time from the moment when a sample is collected until the moment local officials could be notified to make appropriate responses.

BioWatch Summary

BioWatch provides early warning of a biological attack by sampling the air of high-risk cities, continuously and expeditiously identifying six biothreat pathogens. The mission of BioWatch is to deploy, sustain, and maintain a continuous operational ability to detect, mitigate, respond to, and recover from a bioterrorist event. Goals of the BioWatch program are to provide early warning of a biological attack, determine the extent and type of the attack, assist in the identification of the attackers, and determine the scope of the contamination as it is related to the infected population and area (DHS, Office of the Inspector General, 2007).

Reportedly, in 30 jurisdictions across the United States, the exact location of the sampling monitors and the cities where they are deployed has not been made public for obvious security reasons (Shea and Lister, 2003). BioWatch is a component of the National Biosurveillance Integration System, which combines human health data from the CDC, agricultural diseases data from the US Department of Agriculture (USDA), food safety data from the USDA and HHS, and environmental monitoring from BioWatch to improve detection and response (Brodsky, 2007).

BioWatch is a joint program involving several federal agencies. The DHS is overly responsible for BioWatch. The CDC and Environmental Protection Agency (EPA) conduct the daily activities that make it function. The EPA is responsible for monitor deployment, site security, and accessing monitor technology (Pike, 2006). The CDC processes the samples. In addition, Los Alamos National Laboratory and Lawrence Livermore National Laboratory cooperate with the EPA and the CDC on the more technical aspects of the program.

Federal funding of the BioWatch Program for FY2003 was $40 million. This represented 12% of the total budgeted money for biological countermeasures that year (Shea and Lister, 2003). In FY2005, President Bush requested that BioWatch funding be increased to $118 million to expand the program and increase research and the development efforts for improved biosensors. In 2007 Congress cut BioWatch funding by $13 million, which was originally allocated for the purchase of new sensors. In a brief issued by the Nuclear Threat Initiative, the annual estimated cost of maintenance and collection per city is $1 million, with a final program budget estimated at $85 million (Brodsky, 2007). BioWatch is not a stand-alone, autonomous detection system. It requires many hands to pull the pieces together. As previously mentioned, someone has to collect the filter, transport it to a laboratory, extract the sample, process the material, and run the test. All of this labor represents approximately 75% of the operational cost of the program (Cohen, 2007).

The fundamental challenge of the BioWatch system is to detect a biological attack when there is no information about where the event might take place or what meteorological conditions may exist during the event (Shea and Lister, 2003). A critical step in

designing the BioWatch monitoring system was deciding where to site the air-sampling collectors. With a limited number of collectors to deploy and a multitude of potential sites, the goal was to maximize the probability that the network will detect the release of a biological agent while also maximizing the protection provided to the people of a given city. To reach this goal, the efficacy of each collector site and its contribution to the entire collector network had to be objectively evaluated using a standard set of metrics. To address this challenging problem, Los Alamos National Laboratory developed a geospatial application to provide analysts with a quantitative, decision-making tool for choosing collector sites. The BioWatch regional sensor siting tool (BioWatch tool) was developed within a commercial, off-the-shelf geographic information system (Linger, 2005).

Critical Thinking: Tularemia, BioWatch, and the US Capitol

On September 25, 2005, low levels of *F. tularensis* (tularemia) were detected on BioWatch filters in and around the Washington, DC area. These positive results came 1 day after a war protest took place on the Capitol Mall. DHS officials first suspected a problem when six sensors used in the BioWatch biological agent surveillance system collected air samples that indicated tularemia might have been present on the Mall. Subsequent testing at the CDC confirmed that there were low levels of tularemia bacteria on the Mall. However, those results were not considered entirely definitive under BioWatch standards; therefore DHS officials did not inform local public health officials in Washington for several days to avoid a public panic. In fact, it was not until September 30 that local health officials and the public were told to watch out for symptoms of the disease, which include chills, fever, headache, muscle aches, and pneumonia. DHS officials announced nearly a week later that the bacteria was naturally occurring and posed no health threat (Francis, 2006).

Two questions come to mind when reading this brief. First, why did it take federal government officials so long to notify local government agencies of a potential public health threat? After all, BioWatch is a system that stands for early warning and detection. Second, whenever we look for a problem, we will eventually find it, but we are looking for things that occur naturally. So how do we sort out background levels of these natural pathogenic agents from something that truly poses a threat? The technologies being used to detect these agents merely tell us of their existence; they do not necessarily tell us that they are viable. Diagnostic methods based on an organism's genetic structure do not yield results equivocal to that sample's ability to infect a host.

Since its inception, BioWatch has not been without its critics. Major issues were detailed in a 2007 DHS report. These included a lack of cooperation in regard to the reporting requirements and the lack of follow-through when after-action reports were received (DHS, Office of the Inspector General, 2007). One of the biggest issues with BioWatch has always been the cost of the program. As the program moves into advanced developmental phases, it has the potential to become what it was originally intended to be, an autonomous sampling and detection system. In fact, that has been the goal of the BioWatch Generation 3 (Gen-3) program. An autonomous, stand-alone detector was

being sought by DHS—one that would replace the labor-intensive sample collectors that currently exist. Unfortunately, the BioWatch Gen-3 program was canceled (GAO Report, 2014). BioWatch critics in Congress have managed to slow the program and derail advanced development efforts for the time being. However, the technology and commercially available hardware now exists to make the BioWatch program what it was always intended to be—a real-time early warning system for the detection of the most serious biothreat agents that might be released in high-risk areas. Time will tell if BioWatch will become an even more expensive reality or a foregone relic of the past.

BioSense

BioSense is a web-based software application designed to collect nationwide public health data and disseminate that information to public health officials to increase situational awareness for a possible biological event (Caldwell, 2006). The BioSense system gathers real-time disease occurrence data from medical treatment facilities and compares the data to historical data to identify trends or peaks in disease occurrence. Aberrations of disease occurrence data may be the first indication of a potential biological terrorism incident (Loonsk, 2004). The CDC developed BioSense to enable early detection and localization of possible bioterror attacks or other significant outbreaks (Sokolow et al., 2004). The primary goals and objectives of BioSense are to provide the standards, infrastructure, and data acquisition for early detection; enable near real-time reporting, analytic evaluation, and implementation; and provide early event detection support for state and local public health officials (Bradley et al., 2005). Consider the multitude of diseases covered in this text that manifest initially with "flulike" symptoms. An episode or spike in influenza-like illnesses (a syndrome) during the summer may be indicative of a biological incident (pandemic influenza, plague). This is precisely what BioSense strives to identify.

The BioSense program has a vision and a mission. The vision of the program is to provide a picture of the health of the nation that is integrated with the health of its health-care system (CDC, 2009). The mission of the BioSense program is to monitor the health-care system in a collective manner, to collate and interpret data on the health threats to the public, and to support responses to these threats (CDC, 2009).

Historically speaking, Congress passed the Public Health Security and Bioterrorism Preparedness and Response Act in 2002. This act mandated the formation of BioSense (Riviere and Buckley, 2012). The BioSense program launched in 2003 with many goals in mind. Initially, the launch was to establish "an integrated national public health surveillance systems for early detection and rapid assessment of a potential bioterrorism related illness" (CDC, 2012). The core principles of BioSense go beyond the basic data collection and monitoring. The principles include communication and collaboration, transparency, and innovation (CDC, 2009).

Communication and collaboration of BioSense includes encouraging everyone to share their knowledge and encourage those in the community to participate. By doing

so, this strengthens the overall public health realm and capacity and capability are improved. Transparency of BioSense deals with improving system operations and ensuring that programs are appropriately operating. Transparency also means leveraging existing capabilities and solutions at all levels, including state, regional, and local (CDC, 2009).

There are several important components of the BioSense initiative. To fully comprehend these components, it is necessary to address each one individually. The BioSense initiative includes the following:

- Support the advancement of early detection,
- Data acquisition and infrastructure for near real-time reporting and analytics,
- Promote the use of national standards and develop requisite specifications,
- Increase the sharing of approaches and technology, and
- Ensure integration with other public health systems.

BioSense goes through a series of steps to determine any possible disease outbreaks or bioterrorism. The early detection is a result of the work of the "system of systems." In the early stages of development, the BioSense program accessed data from Department of Defense (DoD) medical clinics and Veterans Affairs health-care facilities (Dembek, 2007). Information was later taken from a commercial vendor, LabCorp®, which provides laboratory testing for many hospitals and health-care facilities across the United States. This allowed for tracking of disease patterns (syndromes) all across the nation. The BioSense program has since matured. Data are now collected from hospitals, state and local health departments, and DoD and Veterans Affairs medical facilities for this program (see Fig. 12.6). The type of data includes patient's symptoms, drug prescriptions (quantities and types), and the number of emergency visits (Levi, 2011). All of this information is linked together, and

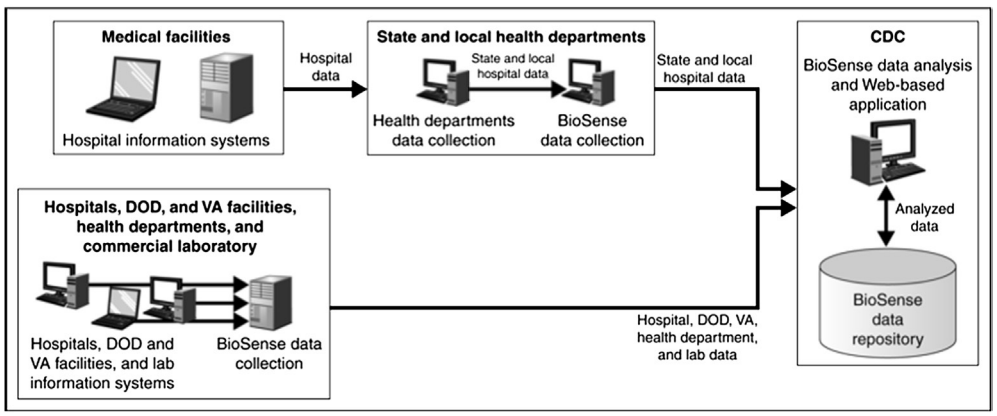

Figure 12.6 Graphic indicating the sources of information collected for the BioSense program platform. *CDC*, Centers for Disease Control and Prevention; *DOD*, Department of Defense; *VA*, Veterans Affairs. *Courtesy of the Centers for Disease Control and Prevention.*

the result is an overall national view. With the information, outbreaks may be detected early and even before any laboratory results are obtained. This is an essential component of the program. How the data are acquired and reported is also important.

BioSense is a part of the Public Health Information Network (PHIN). The PHIN provides national standards that "serve as the basis for developing and implementing information technology projects for various CDC-funded programs, including BioSense" (Rodrigues, 2009). BioSense has the capabilities for analysis to be done not only at the local level, but also at the state and national levels. Lombardo and Buckeridge (2012) note that data are sent to CDC every 15 min. Although these data are received in this time frame, they are not immediately visible. The process includes receiving the data, preprocessing, categorizing, storage in a data warehouse, and then visibility in the application (Lombardo and Buckeridge, 2012). This program has the ability to send out alerts when syndromic case numbers in a specific locale either exceed established thresholds or when patterns emerge that are aberrant from past experiences (Dembek, 2007). In addition, state and regional health departments may access information from BioSense in a web-based format.

The CDC has provided several examples in which BioSense has been used for surveillance and situational awareness. In 2009 BioSense captured the outbreak of novel HIN1 swine flu, which later turned into a mild pandemic (see Fig. 12.7). The CDC used BioSense data and analyses to maintain situational awareness on the pandemic and aid in decision-making for their response division (Tokars et al., 2006). In 2010 BioSense was used to monitor health-care trends in the southeast United States in the wake of the Deepwater Horizon Gulf Coast oil spill.

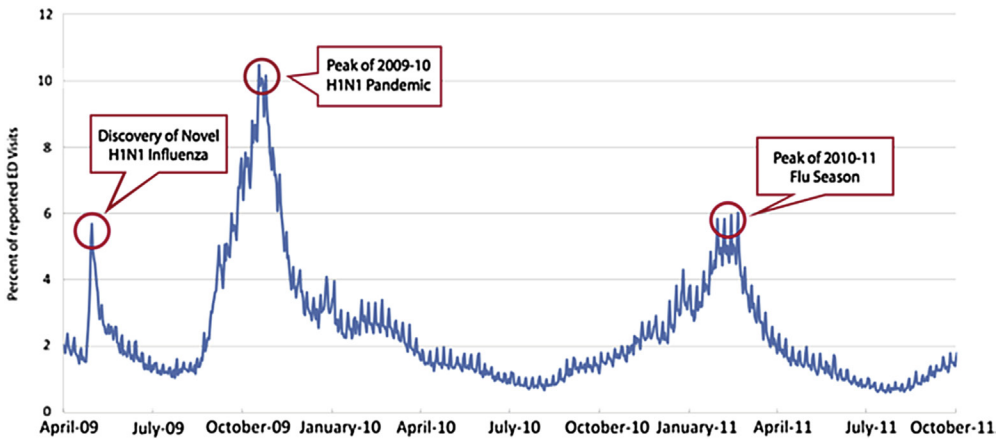

Figure 12.7 Graph of influenza-like illness of BioSense syndromic data for 2009–2011. It clearly shows the appearance of the novel H1N1 swine flu strain and the first and second peaks of this mild pandemic. *Courtesy of the Centers for Disease Control and Prevention.*

The BioSense program has many advantages, but it has also been criticized over the years for some of its limitations and concerns about its effectiveness. Biosurveillance systems such as BioSense are limited by their timeliness, false-positive rates, and overall sensitivity (Dembek, 2007; Gostin, 2008). BioSense is often thought of as an early detection or warning system, but some have opined that warning may come too late (Thoburn, et al., 2006). It is the opinion of this author that the system has its merit and has done well to overcome the objections of its early critics. The system should remain in place.

Cities Readiness Initiative

The CRI is a recently developed program created by the HHS under the CDC's Public Health Emergency Preparedness Project (Centers for Disease Control, 2004). The intent of the CRI is to develop an increased capacity to respond to biological outbreaks and radiological incidents (Centers for Disease Control, 2006) through the development of an SNS and a system of disseminating the SNS in the case of an emergency, which includes increased planning and cooperation among all levels of government. The CRI is designed to allow for dissemination of medications to the affected population within 24–48 h of the incident's onset.

The Cities Readiness Initiative (CRI) is a federally funded program designed to enhance preparedness in the nation's major metropolitan statistical areas (MSAs) where more than 57% of the U.S. population resides. Through CRI, state and large metropolitan public health departments have developed plans to quickly receive and distribute medicine and medical supplies from the Strategic National Stockpile (SNS) to local communities following a large-scale public health emergency. The initial CRI planning scenario was based on a response to a large-scale anthrax attack.

Cities Readiness Initiative website

The CRI sprang from an earlier emergency preparedness program that began in 1999 to enhance the SNS and its ability to rapidly dispense antibiotics and other pharmaceuticals. The initial program worked primarily with state governments; however, the CRI program was later expanded to deal with radiological and biological threats to large metropolitan areas (Centers for Disease Control, 2015b). In 2004, 21 pilot cities were included in the program. In 2005 an additional 15 cities were selected to participate. In 2006 another 36 cities were added, which brought the total to 72 cities inclusive of all 50 states and the District of Columbia (Centers for Disease Control, 2015a).

The funding for the CRI is through the CDC's Public Health Emergency Preparedness program (Centers for Disease Control, 2015b). Since 2001 the overall funding for the CDC's Public Health Emergency Preparedness project has decreased from approximately $900 million to $700 million (National Association of County and City Health Officials, 2007). The CDC's Public Health Emergency Preparedness project allows

funding to be used for preparedness across the depth of an entire metropolitan area. For instance, the CRI grant for Philadelphia also includes funding for Wilmington, Delaware and Camden, New Jersey (Centers for Disease Control, 2006). Although the program's funding comes from the CDC, only four metropolitan areas are directly funded: New York City, Los Angeles, Chicago, and Washington, DC. The other 68 cities receive their funds through the allocation of state funds from the CRI program. Each year states apply for and receive CRI grants, which now go out to all 50 states (Lindell et al., 2007).

There has been an interesting and creative component to the CRI program. Some CRI grant recipients have reached out to the US Postal Service (USPS) and negotiated a working relationship in which the USPS will be used in these cities to disseminate medications for mass prophylaxis campaigns (Centers for Disease Control, 2015b). The door-to-door delivery mechanism was arranged in 2005. To accomplish this, USPS employees must be trained on specific requirements for handling and storage of the pharmaceuticals (Centers for Disease Control, 2015b). The stated intent of this arrangement is to assist with a targeted response plan in reaction to the dissemination of aerosolized *B. anthracis* spores within a densely populated area in which such a release would rapidly affect a large percentage of the population (Centers for Disease Control, 2015b). Getting the antibiotics out in this way may be more efficacious than attempting mass prophylaxis by other means.

RESPONSE AND RECOVERY

Emergency response begins when the event occurs (Lindell et al., 2007). In some cases, early warning and detection systems may alert officials to the initiation of the event before the first index case becomes symptomatic. For the record, this early warning or occurrence has happened. During an overt attack the perpetrator's notification or display triggers officials to mount the response. Regardless of the nature of the attack or the lag time between dissemination of the agent and awareness of the incident, a rapid assessment of the contaminated area is needed. Emergency response has three goals: protect the public, limit the damage, and minimize the extent of secondary spread. Local emergency responders dominate the response period, which is characterized by uncertainty and urgency. Response leads us to recovery. Recovery from disaster is characterized as short term or long term. The goal of recovery efforts is to first establish normalcy and then strive to return the disaster area to what it was before the incident. This may or may not be achievable and depends highly on the nature of the incident.

Laboratory Response Network, Centers for Disease Control

In 1999 the CDC partnered with the Association of Public Health Laboratories and the Federal Bureau of Investigations (FBI) to form the LRN. The goal of this partnership was to bring together a collective body of knowledge and infrastructure needed to

facilitate cooperation in the event of an act of terrorism or other public health emergency and to enable rapid identification of a biological agent. The LRN currently has two major components: a well-developed network of public health laboratories dealing with biological agents (Bio-LRN) and a smaller network of public health laboratories dealing with chemical agents. The LRN is an international network of more than 150 laboratories. The network includes the following types of laboratories:

- **Federal**. These laboratories are at the CDC, the USDA, the FDA, the DoD, the EPA, and other facilities affiliated with federal agencies.
- **State and local public health**. These are laboratories affiliated with state and local departments of health. In addition to being able to test for Category A biological agents, a few LRN public health laboratories are able to measure human exposure to toxic chemicals through tests on clinical specimens.

The LRN is one network that encompasses both bioterrorism and chemical terrorism preparedness and response. LRN bioterrorism preparedness and response activities emphasize local laboratory response by performing the following tasks:

- Helping to increase the number of trained laboratory workers in state and local public health facilities,
- Distributing standardized test methods and reagents to local laboratories and promoting the acquisition of advanced technologies, and
- Supporting facility improvements.

The Bio-LRN is a network of approximately 153 laboratories in all 50 states that include local, state, and federal public health laboratories as well as international, veterinary diagnostic, military, and other specialized laboratories that test environmental samples, animals, and food (see Fig. 12.8 for LRN facility locations). Efficient detection and an effective response require the coordination of a network made up of three levels of laboratories that handle progressively more complex testing: sentinel, reference, and national. Each laboratory's support role and capacity within the LRN structure is detailed as follows.

Sentinel Laboratories

Sentinel laboratories play a key role in the early detection of biological agents. These include environmental, food, veterinary, agriculture, public health, and clinical laboratories. Because of their routine activities, these laboratories have the potential to handle materials that may contain agents that threaten the public's health. Routine assay of human specimens for the presence of microbial agents is an activity that places all clinical laboratories in a position to serve in a sentinel capacity within the LRN. By default, these laboratories are on the front line for detecting public health threats caused by agents of bioterrorism or newly emerging infectious disease. Sentinel laboratories:

- Are the most numerous in the LRN,
- Are made up of private and hospital laboratories that routinely process patient tests,
- May be the laboratories to first test or recognize a suspect organism,

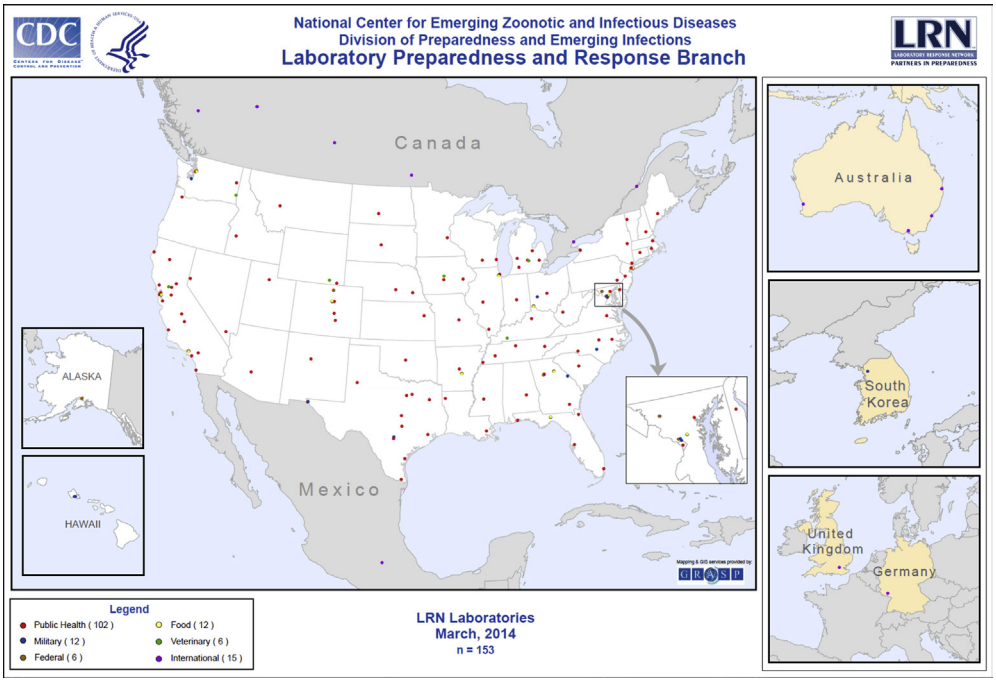

Figure 12.8 Locations of the 153 Laboratory Research Network (LRN) facilities in the United States, Canada, Mexico, Australia, South Korea, Germany, and the United Kingdom. *Courtesy of Centers for Disease Control and Prevention.*

- Conduct tests to rule out less harmful organisms, and
- Refer samples to a reference laboratory if they cannot rule out that the sample is a bioterror agent.

Reference Laboratories

Reference laboratories are responsible for investigation or referral of specimens. These include more than 100 state and local public health, military, international, veterinary, agriculture, food, and water testing laboratories. In addition to laboratories located in the United States, facilities located in Australia, Canada, and the United Kingdom serve as reference laboratories abroad. Reference laboratories:

- Have specialized equipment and trained personnel;
- Perform tests to detect and confirm the presence of a bioterror agent;
- Are capable of producing conclusive, confirmatory results; and
- Include local, state, and federal laboratories.

National Laboratories

The LRN for biological agents includes national laboratories operated by the CDC, US Army Medical Research Institute for Infectious Diseases, and the Naval Medical Research Center. These laboratories are responsible for specialized strain characterizations,

Anthrax attacks of 2001

In 2001, the LRN played a pivotal role in the Amerithrax investigation. It confirmed the first case in Boca Raton, FL and subsequent cases. Furthermore, the LRN accurately tested more than 125,000 environmental samples, which amounted to more than 1 million separate bioanalytical tests.

Avian Influenza

In 2005, the LRN and its partners worked quickly to establish a high-confidence, low-cost H5N1 assay and reagent kit to be used by public health labs. LRN labs helped validate test results and the FDA facilitated a speedy approval of the assay and reagents as an *in vitro* diagnostic test.

Severe Acute Respiratory Syndrome

In 2003, CDC laboratories sequenced the genome for the coronavirus believed to be responsible for the global epidemic of severe acute respiratory syndrome. The genome sequencing paved the way for LRN-developed PCR assays aimed at identifying the virus. The LRN has also developed reagents to support the SARS PCR.

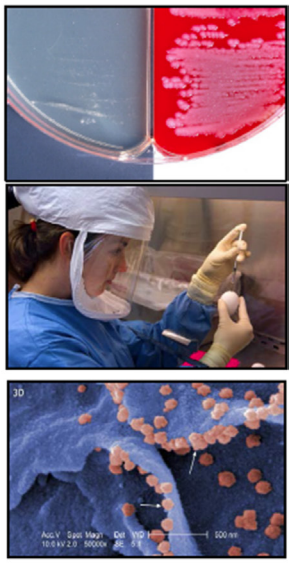

Figure 12.9 Examples of the Laboratory Research Network (LRN) in action. *Courtesy of the Centers for Disease Control and Prevention Laboratory Research Network website,* www.bt.cdc.gov/lrn.

bioforensics, select agent activity, and handling highly infectious biological agents. These national laboratories:

- Include the CDC, the US Army Medical Research Institute for Infectious Diseases in Maryland, and the Naval Medical Research Center, also in Maryland;
- Perform highly specialized testing to identify specific disease strains and other characteristics of an investigated agent; and
- Test certain highly infectious agents that require special handling.

The Bio-LRN has been involved in several major testing operations since it was established in 1999. In the 2001 anthrax attacks, Bio-LRN laboratories tested more than 125,000 samples by the time the investigation was completed. Bio-LRN laboratories were involved in developing tests and materials to support the DNA sequencing of the severe acute respiratory syndrome virus, which was identified at the CDC (Centers for Disease Control, 2004). As previously mentioned, Bio-LRN laboratories process all samples from the BioWatch program. Fig. 12.9 shows some important examples of the LRN in action.

The LRN has developed exquisitely sensitive and specific diagnostic protocols to either rule in or rule out Category A, B, and C biological agents. Each of the LRN laboratory levels has a specified list of diagnostic tests and procedures to identify the biothreat agents. This list is based on the biosafety level classification of each agent and the capacity of each laboratory to meet the biosafety level guidelines specified by the CDC and the

National Institutes of Health for each organism. Specific biological markers related to virulence or pathogenicity have been incorporated into the agent-specific protocols. These protocols and procedures are sensitive and not in the public domain; therefore it is not possible to comment further on these assays.

Important Considerations for Responders

Before submitting a sample to an LRN facility, responders should contact the facility's bioterrorism coordinator to ensure that the sample is taken in accordance with local laboratory procedures. Specific circumstances surrounding the incident should be discussed with the bioterrorism coordinator to ensure that the collection procedures are appropriate. Biosampling techniques can be agent specific and matrix specific (Sanderson et al., 2002). This means that certain biological agents require a specific sampling methodology to best support the testing necessary to identify the analyte or biological marker used by the definitive assay. In addition, the matrix or environment from which the suspect substance is believed to be (eg, clean water, wastewater, air, soil) may dramatically influence the sampling method used.

As discussed in chapter Response at the State and Local Level, samples submitted to the LRN must be field safety screened. Field safety screening can be limited to ruling out explosive devices, radiological materials, corrosive materials, and volatile organic compounds. The prescreened samples should be immediately transported in law enforcement custody to the laboratory. All of this should be done in coordination with the local FBI WMD coordinator.

There are currently no definitive tests for identifying biological agents in the field. In fact, in 2002, the HHS issued an advisory against first responders using hand-held assays to assist in making conclusive determinations on the scene of a possible biological incident. Additional field testing can mislead response efforts by providing incorrect or incomplete results and destroy limited materials critical for definitive laboratory testing required to facilitate any appropriate public health and law enforcement response.

The Department of Health and Human Services Advisory

In July 2002, the HHS issued the following advisory:

The U.S. Department of Health and Human Services at this time recommends against use by first responders of hand-held assays to evaluate and respond to an incident involving unknown powders suspected to be anthrax or other biological agents.

That statement has not been retracted.

State LRN reference laboratories developed and prepared agent- or test-specific sample collection kits that must be used by responders to collect unknown samples. Samples are not normally accepted by an LRN facility if they were not collected using

the specific kit needed to ensure that protocols and procedures are consistent with sampling methodology. Working from the statement made in chapter Recognition of Biological Threat of this text, do not take bad samples to a good test. Sampling kits normally contain cotton swabs (for suspected biological samples) and nylon swabs (for suspected chemical samples), tubes, jars, pipettes, labels, wax wrap, marker pens, and a clean metal paint can for overpackaging the samples. All of these items are packaged in a box for storage on hazmat vehicles.

When responders request a sample collection kit, they must meet certain criteria, which include having certified hazardous materials technicians on the team, possessing the appropriate level of personal protective equipment (PPE), and having completed state-provided training on sample collection. The recommended level of PPE is Level A (fully encapsulated with self-contained breathing apparatus [SCBA]) for indoor collection and Level B (splash protection with SCBA) for outdoor collection. The LRN stipulates that the FBI's 12-point collection process be used to collect samples. Samples can be (and have been) collected by numerous types of agencies: local hazardous materials response teams, civil support teams, the FBI's Hazardous Materials Response Unit (HMRU), and local emergency management agencies. All samples must be tested for chemical, explosive, and radiological/nuclear hazards before being transported to the LRN facility. In addition, all samples must include a chain of custody form and be transported to the LRN laboratory under the custody of a law enforcement official. Once the samples have arrived at the LRN facility, they are tested again for radiological hazards before being accepted into the laboratory.

Hazardous Materials Response Unit

The FBI's HMRU responds to criminal acts and incidents involving the use of hazardous materials and develops the FBI's technical proficiency and readiness for crime scene and evidence-related operations in cases involving chemical, biological, and radiological materials and wastes. The FBI HMRU fulfills its mission through an integrated effort involving specialized response teams, a national training program, interagency liaison, technical assistance to FBI field and headquarters divisions, and the development of field response programs. The unit also trains, equips, and certifies FBI field office personnel for hazardous materials operations. The FBI HMRU responds to the scene of a credible act of bioterrorism to ensure that the crime scene is processed in accordance with established protocols for safety and evidence processing. This team has extensive experience from the Amerithrax incident and numerous other events that have taken place over the past few years. Formed in June 1996, the FBI HMRU is an example of a vision made reality in a very short time as the nation was preparing for the 1996 Olympics. The unit was envisioned by Dr. Randall Murch, chief of the Scientific Analysis Division of the FBI's Laboratory Division, and Dr. Drew Richardson, the HMRU director. At the time, the unit's philosophy was simple: at the site of a WMD incident, there might be scores of

dead people about, but if you could not prove who did it, the likelihood of more victims in future incidents increases. Despite the extreme emotion of the moment, evidence has to be collected (Seiple, 1997).

National Guard WMD Civil Support Teams

The Defense Against Weapons of Mass Destruction Act of 1996 stipulated that the DoD take on a new role with additional responsibility for supporting the domestic antiterrorism mission. Specifically, the DoD was mandated by Congress to share its expertise and capabilities for neutralizing, dismantling, and disposing of explosive ordnance as well as radiological, biological, and chemical materials. In addition, the DoD was asked to work toward the development and deployment of countermeasures against WMDs. In May 1998 Presidential Decision Directive 62, Protection Against Unconventional Threats to the Homeland and Americans Overseas, directed that the DoD assist other federal agencies, train first responders, and maintain specially trained military units to assist states with WMD response. Shortly thereafter, the National Guard formed 10 rapid assessment and initial detection units. These teams were designed to provide rapid response to a WMD incident and assist state and local responders. The 10 teams became what is now referred to as WMD Civil Support Teams (CSTs). Since that time, the National Guard has added more teams with the goal of having one for each state. Currently, specific locations for these teams are based on population concentrations and are intended to minimize the response times within particular geographic areas. They were also located to prevent overlapping team areas of responsibility.

The mission of the WMD CST is to support local and state authorities at domestic WMD incident sites by identifying agents and substances, assessing current and projected consequences, advising on response measures, and assisting with requests for additional military support. CSTs maintain the capability to mitigate the consequences of a WMD event. They are considered to be experts in WMD effects and nuclear, biological, and chemical defense operations. This ambitious mission is accomplished by 22 personnel, highly trained in multiple disciplines covering 14 military occupational specialties. The team is divided into six functional areas or cells: command, operations, logistics/administration, communications, medical, and survey.

Local jurisdictions may request assistance from the CST through their state adjutant general's office for plans, operations, and military support. Direct request for CST assistance is also available through its operation and command sections. First responders are able to directly contact the CST for possible WMD assistance. Interagency training and cross-training for the CST and first responding agencies become a valuable tool to develop professional relationships (see Fig. 12.10). Furthermore, the CSTs are able to respond to all counties within the state or region, including distant island communities, by loading and flying vehicles on US Coast Guard or Air National Guard assets. Response time varies because of remoteness of locations; however, all team members are on

Figure 12.10 Members of the 93rd Weapons of Mass Destruction Civil Support Team (Hawaii) perform survey operations in a training exercise. *Courtesy of the Department of Defense.*

24-h alert at all times (Hurston et al., 2006). It is important to note that CSTs will not take command of the scene of the incident. They are there to augment the local and state assets that arrive on scene with them. They will integrate into the command structure through their own unit commander. Their capabilities, assets, and level of training are impressive.

Critical Thinking

Imagine that over a 24-h period 17 patients report to the emergency department of a small hospital in a rural community. Clinically, the patients' symptoms are fever, malaise, flushing, conjunctivitis, myalgia, abdominal pain, nausea, diarrhea, and a petechial rash. One of the patients is coughing up blood (hemoptysis) and another has seizures in the emergency department and falls into a coma. An infectious disease specialist is called in to determine the cause of this outbreak. The specialist collects blood and urine from most of the patients and orders a battery of tests. Samples are sent on to the hospital laboratory for routine blood and urine tests. A subset of the patient samples is forwarded to a commercial laboratory where more elaborate testing is available. On the basis of initial findings from the hospital laboratory, the specialist comes up with a differential diagnosis of viral hemorrhagic fever, bacterial sepsis, Rocky Mountain spotted fever or other rickettsial disease, leptospirosis, borreliosis, dengue hemorrhagic fever, septicemic plague, or hemorrhagic smallpox.

The specialist begins to piece together information gathered from the patients and family members. There appears to be one common event shared by all of the case patients: all attended a major sporting event, a championship college football game that occurred nearly 2 weeks earlier. The physician has a reasonable suspicion that the cases are all related to an intentional act or at least to some bizarre coincidence.

Critical Thinking—cont'd

At this point, isolates from case patients would be forwarded to a regional laboratory in the state's capitol city for further testing. If the isolate is found to test positive for one of the CDC bioterrorism agents (Category A, B, or C), an isolate would be sent to the national laboratory in Atlanta for definitive testing. The state bureau of investigation, the FBI, and a local joint terrorism task force would send agents to the community to work with epidemiologists to determine the source of the outbreak. The FBI's HMRU, along with the state's Army National Guard's WMD CST, might be requested to respond to collect and process evidence within the community. The evidence that these teams collect would be delivered to the laboratory via local, state, or federal law enforcement. Environmental and clinical samples would be gathered from numerous sites. The field collection effort would be enormous and likely to include thousands of samples.

Review the scenario to discuss implications for local emergency managers and response organizations from the jurisdictions that will be included in the response and investigation. Where does the National Incident Management System, Incident Command System, unified command, and the National Response Framework come into play here? What agency will be in charge of the response? What agency will be in charge of the investigation? Consider something like this occurring in your town.

CONCLUSION

Programs and assets have been assembled internationally, nationally, and regionally to safeguard populations from the threat of biological agents. The programs and assets can be viewed with the framework of comprehensive emergency management, which is made up of mitigation, preparedness, response, and recovery. Nations have come together and taken a stance individually to mitigate the threat. For the most part these programs produce policy and procedures that support the BWC of 1972. In addition, the best mitigation strategy may be to develop safe and effective vaccines that could prevent disease from some of the most serious biothreat pathogens. Perhaps Project BioShield will one day give us a few of these vaccines.

Nothing is easy about preparing for a biological disaster, especially on a large scale. The task is further complicated by the added dimension that the disaster you may be preparing for will be due to an intentional, covert act that is strategically used in the areas where you are weakest. Such is the insidious nature of bioterrorism and biowarfare. Regardless, we may all find ourselves rather "flat-footed" if and when that moment comes, especially if we are unable to recognize early on that the problem exists. This is all the more dangerous if the agent that emerges is highly transmissible from person to person, the incubation period short, and the case-fatality rate high. A few examples that come to mind are smallpox, pneumonic plague, and pandemic influenza. Our hope is that BioWatch provides us with early detection, which of course depends on where the

sensors are placed and what they monitor. Probably one of the best investments we have made along these lines is the establishment of the LRN. Having the ability to *quickly and definitively identify the problem* is a mainstay of the LRN's charter. This extensive and highly capable network stands to *recognize* the threat, which will enable us to focus response efforts and get onto the business of recovery.

Responding to a biological disaster will be frustrating, confusing, and dangerous for first responders, first receivers, and public health officials. Developed countries are far better trained and equipped to deal with the release of a formulated biological agent than they were 15 years ago. However, we have a long way to go before we are truly capable of responding with a standard set of rules and procedures that will enable us to minimize death and restore the community back to its predisaster state. Chapter Consequence Management and a Model Program explores consequence management, or what we will do when a positive result from biosensor indicates that we may have been attacked.

ESSENTIAL TERMINOLOGY

- **Australia Group**. An informal forum of countries that, through the harmonization of export controls, seeks to ensure that exports do not contribute to the development of chemical or biological weapons. Coordination of national export control measures assists Australia Group participants to fulfill their obligations under the Chemical Weapons Convention and the Biological and Toxin Weapons Convention to the fullest extent possible.
- **BioSense initiative**. A national program intended to improve the nation's capabilities for conducting near real-time biosurveillance, enabling health situational awareness through access to existing data from health-care organizations across the country.
- **BioShield project**. A comprehensive effort to develop and make available modern, effective drugs and vaccines to protect against attack by biological and chemical weapons or other dangerous pathogens.
- **BioWatch program**. An early warning system that can rapidly detect trace amounts of biological materials in the air, whether they are due to intentional release or minute quantities that may occur naturally in the environment. The system assists public health experts to determine the presence and geographic extent of a biological agent release, allowing federal, state, and local officials to more quickly determine emergency response, medical care, and consequently management needs.
- **Covert**. Secret or hidden, not openly practiced, engaged in, shown, or avowed.
- **Dual-use research of concern**. Research that, based on current understanding, can be reasonably anticipated to provide knowledge, products, or technologies that could be directly misapplied by others to pose a threat to public health and safety, agriculture, plants, animals, the environment, or material.

- **Hazardous Materials Response Unit (HMRU)**. A highly trained unit, belonging to the Federal Bureau of Investigations (FBI) laboratory services, that responds to criminal acts and incidents involving hazardous materials. The unit also develops technical proficiency and readiness for crime scene and evidence-related operations in cases involving chemical, biological, and radiological materials and wastes and trains US and international law enforcement in these skills. It also provides site safety oversight of FBI personnel operating in other high-hazard crime scenes, including collapsed structures and confined spaces.
- **Laboratory Response Network (LRN)**. A national network of local, state, and federal public health, food testing, veterinary diagnostic, and environmental testing laboratories that provide the laboratory infrastructure and capacity to respond to biological and chemical terrorism and other public health emergencies. The more than 150 laboratories that make up the LRN are affiliated with federal agencies, military installations, international partners, and state and local public health departments.
- **Mass prophylaxis**. Medical care or measures provided to a large percentage of a population to prevent or protect them from disease. The best example of this is the smallpox eradication campaign that rid the world of one of the worst human diseases in 1980. As a program, mass prophylaxis can be a mitigation measure, a preparedness initiative, or a postevent response function.
- **Mitigation**. Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and the environment.
- **Overt**. Open and observable, not secret or hidden.
- **Preparedness**. Actions that are undertaken to reduce the negative consequences of events in which there is insufficient human control to institute mitigation measures. Plans, training, exercises, stockpiles, warning systems, and capacity building for response commonly fall into the realm of preparedness.
- **Recovery**. The coordinated process of supporting emergency-affected communities in reconstruction of the physical infrastructure and restoration of emotional, social, economic, and physical well-being. When it comes to bioterrorism and major outbreaks, recovery is often an afterthought.
- **Response**. Activities and programs designed to address the immediate and short-term effects of the onset of an emergency or disaster.
- **SNS**. Large quantities of medicine and medical supplies to protect the American public if there is a public health emergency (eg, terrorist attack, flu outbreak, earthquake) severe enough to cause local supplies to run out. Once federal and local authorities agree that the SNS is needed, medicines will be delivered to any state in the United States within 12 h in something referred to as a push pack. Each state has plans to receive and distribute SNS medicine and medical supplies to local communities as quickly as possible.

- **WMD Civil Support Team (CST)**. US National Guard teams made up of 22 highly trained personnel with the mission to deploy rapidly to assist a local incident commander in determining the nature and extent of an attack or incident, provide expert technical advice on weapons of mass destruction (WMD) response operations, and help identify and support the arrival of follow-on state and federal military response assets. The WMD CST is a joint unit, which can consist of Army National Guard and Air National Guard personnel.

DISCUSSION QUESTIONS

- How does the comprehensive emergency management model relate to countering the threat of biothreat agents?
- Explain the process for getting samples to the Laboratory Response Network.
- What is wrong with performing rapid tests in the field for the detection of biothreat pathogens?
- An act of bioterrorism involving pneumonic plague occurs in your town. Imagine how the situation would unfold. How would it be recognized? What agencies in your local community would respond? What assets at the regional, state, and federal level could you call on to lend assistance? Who would be the incident commander?

WEBSITES

Australia Group. Available at: www.australiagroup.net/en/index.html.
BioSense initiative. Available at: http://www.cdc.gov/biosense/.
Cities Readiness Initiative. Available at: www.bt.cdc.gov/cri/.
The Truth About BioWatch. Available at: http://www.dhs.gov/blog/2012/07/12/truth-about-biowatch.
National Science Advisory Board for Biosecurity. Available at: http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/nsabb.
Laboratory Response Network. Available at: http://emergency.cdc.gov/lrn/.
Project BioShield home page, available at: http://georgewbush-whitehouse.archives.gov/infocus/bioshield/.
Strategic National Stockpile. Available at: http://www.cdc.gov/phpr/stockpile/stockpile.htm.

REFERENCES

Bradley, C.A., Rolka, H., Walker, D., Loonsk, J., 2005. BioSense: implementation of a national early event detection and situational awareness system [electronic version]. Morbidity and Mortality Weekly Report 54 (Suppl.), 11–19.
Brodsky, B., 2007. The Next Generation of Sensor Technology for the BioWatch Program. Available at: http://www.nti.org/analysis/articles/sensor-technology-biowatch/.

Caldwell, B., 2006. Connecting for Biosurveillance: Essential BioSense Implementation Concepts [electronic version]. Available at: https://www.amia.org/sites/amia.org/files/2006-Policy-Meeting-biosurveillance.pdf.
Centers for Disease Control, 2004. The Cities Readiness Initiative City-by-city Allocations Formula.
Centers for Disease Control, 2006. The Cities Readiness Initiative Guidance.
Centers for Disease Control, 2009. National Syndromic Surveillance Program. Retrieved from: http://www.cdc.gov/nssp/biosense/index.html.
Centers for Disease Control, 2012. BioSense Background. Retireved from: http://www.cdc.gov/nssp/biosense/background.html.
Centers for Disease Control, 2015a. BioSense. Available at: http://www.cdc.gov/nssp/biosense/index.html.
Centers for Disease Control, 2015b. The Cities Readiness Initiative. Available at: http://www.cdc.gov/phpr/stockpile/cri/.
Cohen, J.M., 2007. United States Department of Homeland Security Science and Technology: Six Years after the Attack: Are We Better Prepared to Respond to Bioterrorism? Hearing before the United States Senate Committee on Homeland Security Government Affairs on October 23.
Crawford, M., 2006. United States Department of Homeland Security Science and Technology Fact Sheet.
Dembek, Z., 2007. Medical Aspects of Biological Warfare. TMM Publications, Washington, DC.
Francis, D., 2006. U.S, Defends Tularemia Response. Global Security Newswire.
GenomeWeb, 2013. Congress passes pandemic act, extending funding for project bioshield and BARDA. GenomeWeb. Retrieved from: https://www.genomeweb.com/congress-passes-pandemic-act-extending-funding-project-bioshield-and-barda.
Global Security Newswire, February 16, 2012. Obama Budget Would Shift Funds from Bioshield. Retrieved from: http://www.nti.org/gsn/article/obama-budget-would-shift-more-funds-bioshield/.
Gostin, L., 2008. Public Health Law: Power, Duty, Restraint. University of California Press, Los Angeles, CA.
Gottron, F., June 18, 2014. The Project BioShield Act: Issues for the 113th Congress. Congressional Research Service. Retrieved from: http://fas.org/sgp/crs/terror/R43607.pdf.
Hupert, N., Cuomo, J., Callahan, M.A., Mushlin, A.I., Morse, S.S., 2004. Community-Based Mass Prophylaxis: A Planning Guide for Public Health Preparedness. Prepared by Weill Medical College of Cornell University, Department of Public Health under Contract No. 290-02-0013-3. AHRQ Pub No. 04-0044. Agency for Healthcare Research and Quality, Rockville, MD.
Hurston, E., Sato, A., Ryan, J., September–October 2006. National guard civil support teams: their organization and role in domestic preparedness. Journal of Emergency Management 4 (5), 20–27.
Kadlec, R., 2013. Renewing the Project BioShield Act. What Has It Brought and Wrought? Policy Brief. Center for a New American Security. Available at: http://www.cnas.org/files/documents/publications/CNAS_RenewingTheProjectBioShieldAct_Kadlec.pdf.
Levi, J., 2011. Ready or Not? Protecting the Public's Health from Diseases, Disasters, and Bioterrorism. Retrieved from: www.healthyamerican.org.
Lindell, M., Prater, C., Perry, R., 2007. Introduction to Emergency Management. John Wiley and Sons, Hoboken, NJ.
Linger, S., 2005. The BioWatch tool: GIS-enabled sensor siting. URISA 2005 annual conference, geographic information systems. In: Addressing Conference Proceedings, Public Participation GIS Conference Proceedings.
Lombardo, J., Buckeridge, D., 2012. Disease Surveillance: A Public Health Informatics Approach. John Wiley and Sons, Hoboken, NJ.
Loonsk, J.W., 2004. BioSense—a national initiative for early detection and quantification of public health emergencies [electronic version]. Morbidity and Mortality Weekly Report 53 (Suppl.), 53–55.
Marek, A., March 18, 2007. A Meager Yield from BioShield: A Federal Effort to Protect the Public from Bioterrorism Isn't Off to a Strong Start U.S. News and World Report.
Mileti, D., 1999. Disasters by Design: A Reassessment of Natural Hazards in the United States. Joseph Henry Press, Washington, DC.
National Association of County and City Health Officials, 2007. Federal Funding for Public Health Emergency Preparedness: Implications and Ongoing Issues for Local Health Departments.
National Science Advisory Board for Biosecurity, 2015. Biosecurity. Retireved from: http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/dual-use-research-concern.
Pike, J., 2006. BioWatch. Available at: www.globalsecurity.org/security/systems/biowatch.htm.

Riviere, J., Buckley, G., 2012. Ensuring Safe Foods and Medical Products Through Stronger Regulatory Systems Abroad. National Academies Press, Washington, DC.

Rodrigues, J., 2009. Health Information Systems: Concepts, Methodologies, Tools, and Applications. IGI Global, Hershey, PA.

Roos, R., September 17, 2012. BioShield Report Shows Growth in Biodefense Stockpile. Center for Infectious Disease Research and Policy. Retrieved from: http://www.cidrap.umn.edu/news-perspective/2012/09/bioshield-report-shows-growth-biodefense-stockpile.

Roos, R., 2015. Infectious-disease programs fare well in Obama's 2016 budget. Center for Infectious Disease Research and Policy. Retrieved from: http://www.cidrap.umn.edu/news-perspective/2015/02/infectious-disease-programs-fare-well-obamas-2016-budget.

Russell, P., 2007. Project BioShield: what it is, why it is needed, and its accomplishments so far. Clinical Infectious Diseases 45, S68–S72.

Sanderson, W., Hein, M., Taylor, L., Curwin, B., Kinnes, G., Seitz, T., Popovic, T., Holmes, H., Kellum, M., McAllister, S., Whaley, D., Tupin, E., Walker, T., Freed, J., Small, D., Klusaritz, B., Bridges, J., 2002. Surface sampling methods for *Bacillus anthracis* spore contamination. Emerging Infectious Disease 8, 1145–1151.

Schneidmiller, C., September 19, 2012. After 8 Years, HHS Countermeasure Program Still a Work in Progress. Global Security Newswire. Retrieved from: http://www.nti.org/gsn/article/hhs-countermeasure-program-still-work-progress/.

Seiple, C., Autumn 1997. Consequence management: domestic response to weapons of mass destruction. Parameters 119–134.

Shea, D., Lister, S., November 19, 2003. The BioWatch Program: Detection of Bioterrorism. Report No. RL 32152. Congressional Research Service, Washington, DC.

Sokolow, L.Z., Grady, N., Rolka, H., Walker, D., McMurray, P., English-Bullard, R., Loonsk, J.W., 2004. Practice and experience deciphering data anomalies in BioSense [electronic version]. Morbidity and Mortality Weekly Report 54 (Suppl.), 133–139.

Thoburn, K.K., Miller, J.R., Tokars, J.I., Bradley, C., Zomer, D., 2006. The New York state BioSense sentinel alert experience [electronic version]. Advances in Disease Surveillance 1, 68.

Tokars, J.I., Roselle, G.A., Brammer, L., Pavlin, J., English-Bullard, R., Kralovic, S.M., Gould, P., Postema, A., Marsden-Haug, N., 2006. Monitoring influenza activity using the BioSense system, 2003–2005 [electronic version]. Advances in Disease Surveillance 1, 70.

U.S. Department of Homeland Security, Office of the Inspector General, 2007. DHS Management of BioWatch Program. Publication OIG-07-022. Washington, DC, Available at: www.dhs.gov/xoig/assets/mgmtrpts/OIG_07-22_Jan07.pdf.

U.S. Government Accountability Office, 2014. Biosurveillance. Observations on the Cancellation of BioWatch Gen-3 and Future Considerations for the Program [electronic version]. Available at: http://www.gao.gov/assets/670/663998.pdf.

United States Department of Health and Human Services, 2014. Project Bioshield Annual Report: January 2013–December 2013. Retrieved from: https://www.medicalcountermeasures.gov/media/36766/pbs_report_2013_508.pdf.

United States Food and Drug Administration, 2015. Emergency Use Authorization. Retrieved from: http://www.fda.gov/EmergencyPreparedness/Counterterrorism/MedicalCountermeasures/MCMLegalRegulatoryandPolicyFramework/ucm182568.htm#doxy.

United States Department of Health and Human Services, 2013. Project Bioshield Acquisitions. Public Health Emergency. Retrieved from: http://www.phe.gov/about/amcg/Pages/projectbioshield.aspx.