Chapter 19

CONSEQUENCE MANAGEMENT: THE NATIONAL AND LOCAL RESPONSE

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INTRODUCTION

Response to an intentional biological attack is likely to overwhelm local and regional healthcare facilities and resources, requiring the use of national assets to treat the infected and contain the disease. As stated in the biological incident annex of the National Response Plan (NRP), "No single entity possesses the authority, expertise, and resources to act unilaterally on the many complex issues that may arise in response to a disease outbreak and loss of containment affecting a multi-jurisdictional area."[1] There must be coordination among healthcare facilities, local authorities, public health officials, state agencies, and federal agencies for an effective and efficient response to terrorism events. Biological response plans must be integrated at all levels, and cooperative efforts to leverage assets from nonaffected areas must be planned and exercised before the event. Critical tasks for healthcare facilities responding to an outbreak include treating the ill and preventing nosocomial spread of disease; however, facilities must also be prepared to expand surge capacity and personnel, deal with large numbers of infectious remains, and provide risk communication to the public and the media. Additionally, healthcare facilities and personnel may be involved in epidemiological investigations, contact tracing, and distribution of mass antibiotic prophylaxis and vaccinations to the community. This chapter reviews some of the legislation and authorizing acts relevant to the response to a biological event, the NRP, the role of the Department of Defense (DoD) in support of civil authorities, and key features of the local response, including disease containment, mass patient care, mass prophylaxis, and mass fatality management.

DoD healthcare providers and planners must be familiar with these concepts because they may be required to provide the medical response on military reservations or in the deployed setting, or they may need to augment the medical response in civilian communities after a natural or artificial biological incident. For example, the military may be called on to "effect a quarantine," possibly using National Guard troops under federal control in response to an avian influenza outbreak.[2]

Military medical treatment facilities should maintain an emergency management plan outlining their response to disasters and mass-casualty incidents using an all-hazards approach. These plans should include specific annexes that detail the response to an intentional release of a biological agent and outbreaks of emerging or reemerging infectious diseases.

THE NATIONAL RESPONSE

Legislation

National policy and legislation concerning biological warfare and terrorism provide the foundation for key aspects of the federal response to a biological event. An overview of the pertinent legislation is provided below.

The Stafford Act

The Robert T Stafford Disaster Relief and Emergency Assistance Act[3] is the cornerstone legislation for providing federal assistance to states and territories during disasters and emergencies. This act outlines the federal programs available and procedures for disaster preparedness, including mitigation assistance, major disaster and emergency assistance administration, major disaster assistance programs, emergency assistance programs, and emergency preparedness. The Stafford Act provides an orderly and continuing means of assistance by the federal government to state and local governments in carrying out their responsibilities to "alleviate the suffering and damage resulting from disasters" and establishes procedures for states to request disaster assistance from the federal government. Under this act, a state governor may request that the president declare a major disaster or emergency and direct federal assistance to the state, as long as the disaster is of such severity and magnitude that effective response is beyond the capability of the state.

Defense Against Weapons of Mass Destruction Act

In 1997 Congress enacted the Defense Against Weapons of Mass Destruction Act,[4] referred to as the Nunn-Lugar-Domenici Act. This act contains initiatives to improve the overall national preparedness for large-scale terrorist attacks of a chemical, biological, radiological, nuclear, or high-yield explosive (CBRNE) nature. Among its provisions is the Domestic Preparedness Program, which provides training, expertise, and equipment grants to the 120 largest US cities. Originally assigned to the DoD and administered by the Soldier's Biological and Chemical Command (now the Research, Development, and Engineering Command), the Domestic Preparedness Program has provided data on modeling of biological incidents as well as templates and guidelines to assist communities in improving

preparedness for such events (some of these products will be discussed in more detail in the section on local response). The Domestic Preparedness Program was transferred to the Department of Justice, under the Office of Domestic Preparedness, in 2002,[5] and later to the Department of Homeland Security (DHS).

Emergencies Involving Chemical or Biological Weapons Act

This act allows the attorney general to request DoD assistance directly in response to an emergency involving biological or chemical weapons of mass destruction that exceeds the capability of civilian authorities. This DoD assistance may consist of identifying, monitoring, containing, disabling, or disposing of the weapon, but not direct law enforcement actions.[6]

The Homeland Security Act of 2002

This act established the DHS to prevent terrorist attacks within the United States, reduce the country's vulnerability to terrorism, minimize the damage of and assist in the recovery from terrorist attacks, and act as the focal point for natural and manmade crisis and emergency planning.[7] The DHS is charged with the following:

- coordinating federal-level preparedness and working with state, local, tribal, parish, and private-sector emergency response providers to combat terrorism;
- consolidating previously existing federal emergency response plans into a single, coordinated NRP;
- ensuring adequate planning, training, and exercise activities;
- conducting risk and vulnerability assessments of critical infrastructure;
- identifying priorities for protection; and
- securing the borders, territorial waters, ports, terminals, waterways, and air, land, and sea transportation systems of the United States.

The National Response Plan

Released in December 2004, the NRP provides a framework for the response to incidents of national significance when the following situations occur (see chapter 20):

- a federal department or agency acting under its own authority requests the assistance of the secretary of Homeland Security;
- an event overwhelms the resources of state and local authorities, and those authorities request federal assistance;
- more than one federal department or agency is substantially involved in responding to an incident; or
- the president has directed the secretary of Homeland Security to assume responsibility for managing a domestic incident.[8]

The NRP integrated previously existing plans, including the initial NRP, the Federal Response Plan, the US Government Interagency Domestic Terrorism Concept of Operations Plan, and the Federal Radiological Emergency Response Plan, to establish a comprehensive, national, all-hazards approach to domestic incident management across a spectrum of activities, including prevention, preparedness, response, and recovery.

The NRP established the National Incident Management System (NIMS) as a standardized approach for managing all major incidents, regardless of etiology, that unifies federal, state, and local lines of government for incident response using the Incident Command System. The Incident Command System standardizes the organization of incident management response by creating five sections: (1) command, (2) operations, (3) planning, (4) logistics, and (5) finance/administration.[9] NIMS incorporates a unified command structure to ensure coordination and joint decisions on objectives, strategies, plans, priorities, and public communications among different jurisdictions and multiple agencies. A key component of the NRP, NIMS allows several different agencies and organizations to work together with similar command, control, and coordination elements.

The National Response Plan Base Plan and Emergency Support Functions

The NRP is designed to handle incidents at the lowest jurisdictional level possible. The secretary of Homeland Security executes the overall coordination of federal incident management activities, and other federal departments and agencies carry out their incident management and emergency response responsibilities within the NRP's overarching framework.

There are 15 separate emergency support functions (ESFs) that make up the response components of the NRP (listed in Table 19-1). Each ESF has a primary lead agency responsible for implementation and oversight for that aspect of the response, and additional federal agencies provide support to the primary agency. For example, in ESF #10 (Oil and Hazardous

TABLE 19-1

EMERGENCY SUPPORT FUNCTIONS OF THE NATIONAL RESPONSE PLAN

ESF #	ESF Title	ESF Coordinator
1	Transportation Annex	Department of Transportation
2	Communications Annex	Department of Homeland Security/Information Analysis and Infrastructure Protection/National Communications System
3	Public Works and Engineering Annex	Department of Defense/US Army Corps of Engineers
4	Firefighting Annex	Department of Agriculture/Forest Service
5	Emergency Management Annex	Department of Homeland Security/Emergency Preparedness and Response/Federal Emergency Management Agency
6	Mass Care, Housing, and Human Services Annex	Department of Homeland Security/Emergency Preparedness and Response/Federal Emergency Management Agency
7	Resource Support Annex	General Services Administration
8	Public Health and Medical Services Annex	Department of Health and Human Services
9	Urban Search and Rescue Annex	Department of Homeland Security/Emergency Preparedness and Response/Federal Emergency Management Agency
10	Oil and Hazardous Response Annex	Environmental Protection Agency
11	Agriculture and Natural Resources Annex	Department of Agriculture
12	Energy Annex	Department of Energy
13	Public Safety and Security Annex	Department of Homeland Security/ Department of Justice
14	Long-Term Community Recovery and Mitigation Annex	Department of Homeland Security/Emergency Preparedness and Response/Federal Emergency Management Agency
15	External Affairs Annex	Department of Homeland Security

ESF: emergency support function

Material Response Annex), the ESF lead agency and coordinator is the Environmental Protection Agency (EPA), and the US Coast Guard (part of DHS) is a supporting agency. Agencies that provide support for this ESF include the Department of Agriculture, Department of Commerce, DoD, Department of Energy, Department of Health and Human Services (DHHS), DHS, Department of the Interior, Department of Justice, Department of Labor, Department of State, Department of Transportation, General Services Administration, and the Nuclear Regulatory Commission.[1] The ESF modular structure allows mobilization of the precise components that can best address the requirements of the incident. Localized events may be resolved with the activation of a select number of ESFs, whereas some large-scale disasters may require activation of all ESFs.

The federal-level medical response begins with the activation of ESF #8 (Public Health and Medical Services Annex). ESF #8 is coordinated by the secretary of the DHHS principally through the assistant secretary for public health emergency preparedness. Activation of ESF #8 includes the following core functional areas: (*a*) assessment of public health/medical needs (including behavioral health), (*b*) public health surveillance, (*c*) provision of medical care personnel, and (*d*) provision of medical equipment and supplies.[1] As lead agency, DHHS coordinates all ESF #8 response actions with its internal departmental policies and procedures.[10] Each support agency is responsible for managing its respective response assets after receiving coordinating instructions from DHHS. ESF #8 response is coordinated through the DHHS secretary's operations center, which maintains frequent communications with the Homeland Security Operations Center.

The National Response Plan Concept of Operations

The secretary of Homeland Security utilizes multiagency structures at the headquarters, regional, and field levels to coordinate efforts and provide appropri-

ate support to the incident command structure. At the federal headquarters level, incident information sharing, operational planning, and deployment of federal resources are coordinated by the Homeland Security Operations Center, and its component element, the National Response Coordination Center.

Joint Field Office. The multiagency joint field office (JFO), established locally during incidents of national significance, provides a central location for coordination of federal, state, local, tribal, nongovernmental, and private-sector organizations. The JFO's scalable organizational structure (Figure 19-1) uses the NIMS Incident Command System for managing both preincident and postincident activities. The JFO does not manage on-scene operations; rather, it provides support to on-scene efforts while also conducting broader support operations that may extend beyond the incident site.

The JFO's coordinating officials include the principal federal official, the federal coordinating officer, the state coordinating officer (appointed by the governor), and other senior federal officials. The federal coordinating officer, who works in partnership with the state coordinating officer and the governor's authorized representative, conducts an initial appraisal of the assistance most urgently needed and coordinates the timely delivery of federal assistance to affected state, local, and tribal governments and disaster victims. The JFO coordination staff includes the chief of staff, external affairs personnel, Office of the Inspector General personnel, the defense coordinating officer (DCO), the safety coordinator, and liaison officers.

The Defense Coordinating Officer. As the DoD's single point of contact at the JFO, the DCO coordinates and processes requests for defense support for civil

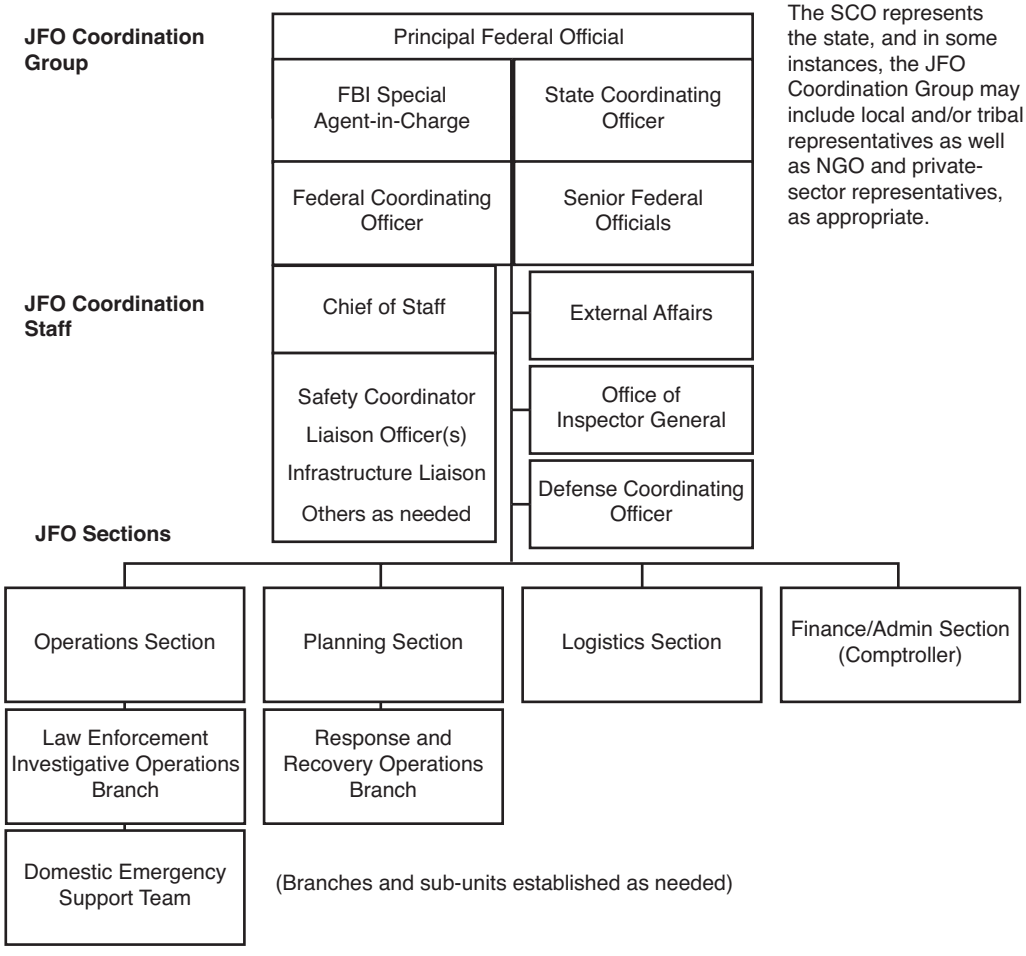


Fig. 19-1. Organizational Structure of the Joint Field Office
FBI: Federal Bureau of Investigation
JFO: Joint Field Office
NGO: nongovernmental organization
SCO: state coordinating officer

authorities originating at the JFO. The DCO's specific responsibilities include processing requirements for military support, forwarding mission assignments to the appropriate military organizations through DoD-designated channels, and assigning military liaisons, as appropriate, to activated ESFs.

Defense Support to Civilian Authorities

DoD provides defense support for civil authorities in response to requests for assistance during domestic incidents, including terrorist attacks, major disasters, and other emergencies on a reimbursable basis. The initial requests for assistance, usually from the lead or primary agency, are made to the Office of the Secretary of Defense, Executive Secretariat. If the secretary of defense approves the request, DoD designates a supported combatant commander to lead the response. The commander determines the appropriate level of command and control, usually deploying a senior military officer to the incident site. Under most circumstances, the senior military officer at the site is the DCO. The commander may also use a joint task force to consolidate and manage supporting military activities. The joint task force commander exercises operational control of all allocated DoD resources (however, neither the joint task force commander nor the DCO handle US Army Corps of Engineers resources, National Guard forces operating in state active duty or Title 32 status, or, in some circumstances, DoD forces in support of the Federal Bureau of Investigation).

Defense Department Medical Response Support

DHHS, the lead agency for the federal medical response, may request assistance from the DoD (operating under ESF #1, Transportation, and ESF #8). This assistance may include the following:

- activating the DoD National Disaster Medical System (NDMS) patient reception plans, which manage medical evacuation of seriously ill or injured patients from a collection point in or near the incident site to locations where hospital care or outpatient services are available (such as nearby NDMS nonfederal hospitals, Veterans Administration hospitals, and DoD military treatment facilities);
- deploying military medical personnel (including reserve and National Guard medical units) to provide triage, medical treatment, and mental health support, as well as public health protection (such as assistance with food, water, wastewater, solid waste disposal, vectors, hygiene, and other environmental conditions);
- providing available DoD medical supplies, including blood products, for distribution to medical care locations;
- providing services such as evaluations, risk management appraisals, and confirmatory laboratory testing support; and
- assisting in the management of human remains, including victim identification and mortuary affairs.

Other Defense Department Support

Support for law enforcement and domestic counterterrorism activities may be provided in limited circumstances consistent with applicable laws and, in some circumstances, independent of the DCO. Imminently serious conditions resulting from any civil emergency may require immediate action to save lives, prevent human suffering, or mitigate property damage. When time does not permit approval from headquarters in such situations, local military commanders and responsible DoD officials are authorized by DoD directive[11] and preapproval by the secretary of defense, subject to any supplemental direction from their DoD component, to respond to requests from civil authorities consistent with the Posse Comitatus Act, referred to as "immediate response."

In addition to direct support for incident response, DoD possesses specialized capabilities that may be requested (in addition to the medical services described above), including use of test and evaluation facilities and capabilities; education and exercise expertise; explosive detection; technical escort; and the transfer of applicable technologies, including those developed through DoD science and technology programs. The DoD Homeland Defense Coordination Office, established at DHS headquarters, facilitates interdepartmental cooperation and transfer of these capabilities to the emergency responder community.

The Biological Incident Annex

The all-hazards approach is a consistent theme throughout the NRP; however, response to an intentional biological agent release may entail additional consequence management actions. A coordinated response of several federal agencies is the key to successful consequence management. Over 40 federal departments and agencies have some role in combating terrorism, and over 20 departments and agencies participate in preparations for or responses to the public

health and medical consequences of a bioterrorist attack.[12] The NRP Biological Incident Annex identifies the actions and coordination needed in response to the intentional release of a biological agent.

DHHS is the primary federal agency for the public health and medical preparation for and response to a biological terrorism attack, as well as a naturally occurring outbreak from a known or novel pathogen, including an emerging infectious disease. Per the NRP, state and local governments are primarily responsible for detecting and responding to disease outbreaks and implementing measures to minimize an outbreak's health, social, and economic consequences. Whereas DHHS coordinates the overall federal public health and medical emergency response efforts, DHS coordinates the overall nonmedical federal support and response actions.

The NRP Biological Incident Annex identifies the following key elements of an effective biological response:

- rapid detection of the outbreak;
- swift agent identification and confirmation;
- identification of the population at risk;
- determination of how the agent is transmitted, including an assessment of the efficiency of transmission;
- determination of susceptibility of the pathogen to treatment;
- definition of the public health, medical, and mental health implications;
- control and containment of the epidemic;
- decontamination of individuals, if necessary;
- identification of the law enforcement implications of the threat;
- augmentation of local health and medical resources;
- protection of the population through appropriate public health and medical actions;
- dissemination of information to enlist public support;
- assessment of environmental contamination and cleanup or decontamination of biological agents that persist in the environment; and
- tracking and preventing secondary or additional disease outbreak.[1]

Once notified of a threat or disease outbreak that may require significant federal public health or medical assistance, DHHS convenes a meeting of all organizations involved in ESF #8. The immediate tasks are to identify the population affected, the population at risk, and the geographic scope of the incident. The initial public health and medical response includes some or all of the following actions:

- targeted epidemiological investigation;
- intensified surveillance in healthcare settings for patients with certain clinical signs and symptoms;
- intensified collection and review of potentially related information; and
- organization of federal public health and medical response assets including personnel, medical supplies, and materiel.

The public health system, starting at the local level, is required to initiate appropriate protective and responsive measures for the affected population, including deploying first responders and other workers engaged in incident-related activities. These measures may include mass vaccination or prophylaxis for populations at risk, including those who might be exposed from secondary transmission or the environment. The overarching goal is to develop a prioritized list of treatment recommendations based on epidemiological risk assessment, the biology of the disease or agent in question, and the deployment of the strategic national stockpile (SNS) as soon as possible (see below for a discussion of the SNS).

DHHS and partner organizations evaluate the incident and make recommendations to the appropriate public health and medical authorities on the need for quarantine, shelter-in-place, or isolation to prevent the spread of disease. DHHS works closely with DHS when recommending the use of NDMS or the US Public Health Service Commissioned Corps. The governors of affected states implement isolation or social-distancing requirements using state and local legal authority, and DHHS may take federal action to prevent the interstate spread of disease. State and local authorities also assist with the implementation and enforcement of isolation and quarantine actions. The scope and nature of the outbreak may require mass isolation or quarantine of affected or potentially affected persons, as well as food, animals, and other agricultural products.

Defense Department Bioterrorism Response Assets

In addition to providing medical care, logistics, and evacuation, the DoD maintains several specialized organizations, equipment, and capabilities to respond quickly to an intentional biological agent release. For example, the US Army Medical Research Institute of Infectious Diseases (USAMRIID) performed approximately 19,000 anthrax assays within a short period immediately after the anthrax mailings in 2001.[13] The following is an overview of some of these organizations and their interactions.

US Northern Command

The US Northern Command (NORTHCOM) was established in 2002 to plan, organize, and execute homeland defense and civil support missions. Several joint task forces have been assigned to NORTHCOM, including Joint Task Force North, Joint Force Headquarters National Capital Region, Joint Task Force Alaska, and Joint Task Force Civil Support. NORTHCOM's civil support capabilities include domestic disaster relief operations for fires, hurricanes, floods, and earthquakes; counter-drug operations; and consequence management assistance for events such as a terrorist's use of a weapon of mass destruction.[14]

Joint Task Force Civil Support is headquartered at Fort Monroe in Hampton, Virginia, and consists of active-duty, National Guard, and reserve military members of all service branches, as well as civilian personnel commanded by a federalized National Guard general officer. When approved by the secretary of defense and directed by the NORTHCOM commander, Joint Task Force Civil Support deploys to a CBRNE incident site in the United States and its territories and possessions. At the site, the task force executes command and control of designated DoD forces and provides support to the civil and federal authorities managing the incident to save lives, prevent injury, and provide temporary critical life support.[15]

20th Support Command

Whereas NORTHCOM operates within the United States, the 20th Support Command works outside the country, serving as a command and control element and provider of US CBRNE operational response teams and technical augmentation cells worldwide. Also called the CBRNE Command, it is subordinate to the US Army Forces Command. The 20th Support Command brings command and control of the Army's specialized weapons of mass destruction operational response assets together to provide a single point of contact when a coordinated response to the threat or use of weapons of mass destruction is needed anywhere in the world. Its mission is to command and control organic and allocated Army technical assets to support full-spectrum CBRNE technical operations that detect, identify, assess, render safe, dismantle, transfer, and dispose of CBRNE incident devices and materiel, including unexploded ordnance and improvised explosive devices.

The 20th Support Command also provides CBRNE technical advice and expertise within the United States, to help mitigate incidents involving the nation's chemical warfare stockpile, manage recovery and disposal of legacy chemical and biological munitions and materials from formerly used defense sites, and conduct technical escort of chemical surety materiel in support of the management of chemical stockpile and chemical defense research and development. This unit has the technical expertise to conduct sensitive site exploitation, disablement, disposition, demilitarization, and consequence management operations. It also augments and reinforces installation support teams after a CBRNE incident at any US Army facility, and supports other CBRNE response missions as directed by the commander of the US Army Forces Command.[16]

Weapons of Mass Destruction Civil Support Teams

The Weapons of Mass Destruction Civil Support Teams were established to provide rapidly deployed federal assistance to local authorities at incident sites. They are composed of 22 full-time National Guard members (either Army or Air National Guard), who are federally resourced, trained, and exercised. If the teams are federalized, they fall under Joint Task Force Civil Support operational command and control. Teams are designed to be ready to deploy within 4 hours to anywhere within their area of responsibility, with their own detection and decontamination equipment, medical supplies, and protective gear. Each team has two large pieces of equipment: (1) a mobile analytical laboratory for field analysis of chemical or biological agents and (2) a uniform command suite to provide interoperability of communications to all responders. The teams provide assistance by identifying agents and substances, assessing current and projected consequences, advising on response measures, and assisting with requests for additional military support. Their role can include entering a contaminated area to gather air, soil, and other samples for on-site evaluation.[17,18]

Chemical and Biological Incident Response Force

Located 26 miles from Washington, DC, the Chemical and Biological Incident Response Force was formed in 1996 and consists of marines and sailors who can forward-deploy or respond to a credible threat of a CBRNE incident. The force assists local, state, or federal agencies and unified combat commanders in consequence management operations by providing capabilities for agent detection and identification; casualty search, rescue, and personnel decontamination; and emergency medical care and stabilization of contaminated personnel. In addition to several exercises, the force has demonstrated its capabilities in the 2001 anthrax and 2004 ricin decontamination operations of the US Senate office buildings.[19]

US Army Medical Research Institute of Infectious Diseases' Patient Containment Care Suite

Maximum biological containment consists of four principal features: (1) a physical protective barrier, (2) an air pressure barrier, (3) a filtered inflow and outflow air supply, and (4) waste disinfection.[20] In the United Kingdom, containment care is provided by a negative-pressure, polyvinylchloride envelope isolator, similar to the reverse-barrier isolators used historically to protect patients with profound immunodeficiency disorders. USAMRIID has a two-bed containment care unit specifically engineered to provide these features.

The Centers for Disease Control and Prevention (CDC) categorizes the laboratory safety requirements of potentially pathological agents into one of four categories based on pathogenicity, potential for aerosol transmission, and whether an effective vaccine or therapy exists. A laboratory's biosafety level (BSL) is determined by its available safety controls relating to practices, techniques, and containment fixtures and facilities. Agents that require BSL-4 laboratory procedures include filoviruses, arboviruses, arenaviruses, hantaviruses, the severe acute respiratory syndrome (SARS) virus, new influenza strains, and other viruses with a high or unknown risk of aerosol transmission. The BSL terminology can also be applied to hospitals, which, in addition to handling specimens in their clinical laboratories, care for infectious patients.

USAMRIID's patient-containment care suite has conditions analogous to a BSL-4 laboratory. During operation, the doors to the unit are sealed with duct tape and the interior pressure is brought to 0.5 inches of water negative pressure, corresponding to 18 air exchanges per hour. Air entering the suite passes through a high-efficiency particulate air (HEPA) filter and exhausted air passes through double HEPA filtration.

Individuals working in the unit wear protective Chemturion encapsulation suits (ILC Dover, Frederica, Del), which connect to hoses providing overpressure and a clean air supply (Figure 19-2). Air entering the suits through these hoses has passed through both charcoal and HEPA filters. Personnel enter and exit through an anteroom, where they don the protective suits, and then pass through a decontamination shower with double-sealed closure doors. The chemical disinfectant shower consists of a 1-minute water rinse, followed by 2.5-minute chemical shower with a 5% solution of Micro-Chem Plus (National Chemical Laboratories, Inc, Philadelphia, Pa) ammonium compound, followed by another 1-minute water rinse.

Materials can pass in and out of the unit through one of four pathways. Sewage passes though dedicated lines to a steam treatment plant where all of the sewage waste is sterilized. Solid waste is passed through a pass-through autoclave. Food and medications are passed though an ultraviolet light box, and clinical specimens are sealed in plastic bags and passed through a chemical dunk tank.

The two patient rooms have standard intensive care monitoring equipment comparable to any medical center intensive care unit. They are staffed by a team of intensive care medical personnel from Walter Reed Army Medical Center, consisting of doctors, nurses, and ancillary support personnel. The team trains in the facility on a quarterly basis to provide the full range of hospital services that a medical intensive care unit patient may need.[21]

Since its construction in 1972, 17 patients have been admitted to the unit, all of whom were research scientists with occupational exposure to BSL-3 or BSL-4 agents. If a patient admitted to the unit were exposed to an agent with a high or unknown risk of aerosol transmission, particularly a highly lethal agent, consideration must be given to postexposure isolation prior to onset of illness. Although none of the admissions resulted in active disease, the most recently admitted patient, a scientist exposed to the Zaire strain of the Ebola virus in March 2004, was kept in isolation in the unit for 3 weeks while being tested daily for infection.

The major limitation of USAMRIID's containment care unit is the lack of continuous on-site medical-center–level support for patients who become critically ill. Laboratory services, other than specific agent-related testing performed by USAMRIID's diagnostic systems division, require outside support for all but a few basic procedures. Studies performed in uncre-

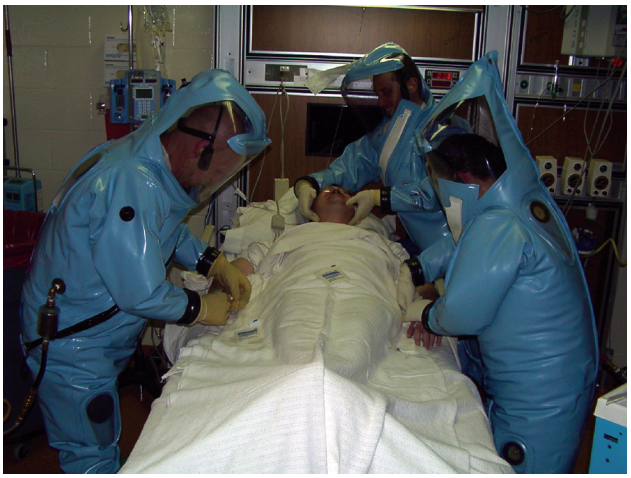


Fig. 19-2. Provision of medical care under biosafety level 4 conditions in the US Army Medical Research Institute of Infectious Diseases' patient containment care suite.

dentialed laboratories for human clinical use require the review of a clinical pathologist before they can be used to make treatment decisions. Simple radiographs can be performed in the USAMRIID unit, but they require evaluation from outside organizations. The unit's greatest limitation, however, involves training personnel to provide care under the constraints of high-level containment.

THE LOCAL RESPONSE

Initial Response to a Biological Event

Biological agents may be attractive weapons for terrorists for several reasons: (*a*) some agents have a high case-fatality rate; (*b*) some agents are contagious and may propagate secondary infections throughout the community; (*c*) the psychological impacts of a bioterrorism event can cause a far greater effect than the agent alone; and (*d*) because casualties from a covert release of a biological agent will not likely be identified until patients develop symptoms after the disease incubation period, the perpetrator has time to leave the scene.[22] An intentional biological event may not be detected until several days or weeks after the incident, and the first clues will likely be an increase in emergency department and clinic evaluations for nonspecific influenza-like symptoms. As patients develop more specific symptoms, astute clinicians may make the presumptive diagnosis of an intentional agent exposure.

Healthcare facilities, clinical laboratories, public health officials, law enforcement, and civil authorities need to work together to create plans for responding to bioterrorism events. Military healthcare facilities need to work closely with the local civilian community to set up mutual aid agreements and memoranda of understanding in the event a bioterrorism event occurs either on or off the military installation. Figure 19-3 depicts a sample response to an intentional biological agent event.

Containment

Active containment of disease is a pillar of outbreak management. Epidemiological evaluations and active disease surveillance will help identify people who have been exposed to the initial biological agent release, the active cases of disease, and in the case of communicable diseases, contacts of those with active disease. Biological events may be overt or covert and, unlike chemical, nuclear, and high-explosive events, biological agent aerosols are odorless, colorless, and may not cause obvious symptoms for several days or longer, depending on the incubation period of the organism.

Overt biological attacks may be recognized if the attack is announced before the release, the attack is witnessed, or responsibility is claimed immediately after an initially unrecognized agent release. Educating the public, first responders, and healthcare providers is necessary to increase awareness and recognition of overt attacks. Several organizations will be involved with an on-scene response to an overt biological attack, including the fire department, hazardous materials teams, emergency medical services (EMS), and police. On-scene tasks include the need to secure the scene; identify those who have been exposed; decontaminate patients, equipment, and the environment; and initiate both criminal and epidemiological investigations. Those who have been exposed or are likely to be exposed should be evaluated for prophylaxis, depending on the biological agent suspected. Demographic data should be collected on everyone at the scene so that adequate follow-up and evaluation can be performed. People with gross contamination need to be decontaminated. On-scene response procedures, training, personal protective equipment (PPE), and medical surveillance are governed by the Occupational Safety and Health Administration regulation, "Hazardous Waste and Operations and Emergency Response."[23]

The incident site will likely be sectioned into different zones by the incident commander to decrease the spread of contamination, control the number of personnel authorized in the high-risk areas, and delineate required levels of personal protection to be worn. Traditionally, incident scenes will have at least three zones: (1) hot zone (contaminated area); (2) warm zone (the area where decontamination of personnel and equipment occurs); and (3) the cold zone (the uncontaminated area where workers should not be exposed to hazardous conditions). Despite debate over the role of medical personnel entering the "hot" or "warm" zone, emergency medical personnel need to be trained in scene safety, PPE, and standard operating procedures for on-site response. EMS responders should use PPE as specified by the incident commander. Minimal PPE that should be carried or immediately available to EMS workers includes eye protection; a single-use barrier garment, such as Tyvek (DuPont, Wilmington, Del); hooded chemical-resistant clothing; nitrile gloves; chemical-resistant footwear covers; properly fit-tested N100 or N95 masks; and an escape hood to allow workers to remove themselves from contaminated areas.[24] A full-face piece respirator with a P100

filter or powered air-purifying respirator with HEPA filters may be used when it can be determined that an aerosol-generating device was not used to create high airborne concentrations or when dissemination was by a letter or package that was easily bagged.[25] If medical personnel are to provide medical treatment including triage during decontamination, a minimum of level C PPE should be worn, including a hooded, powered, air-purifying respirator with a protection factor of at least 1,000, with an appropriate filter, and chemical-resistant gloves, boots, and suits to match or exceed the level of respiratory protection worn.[26] Recommendations for PPE in the hot zone include the use of pressure-demand, self-contained breathing apparatus approved by the National Institute for Occupational Safety and Health (NIOSH), in conjunction with either level B or level A protective suits. Level B suits should be worn if the suspected biological aerosol is no longer being generated or a splash hazard may be present. Level A suits should be worn when responding to a suspected biological incident in which the type of airborne agent is unknown, the dissemination method is unknown, dissemination via an aerosol-generating device is still occurring, or dissemination via an aerosol-generating device has stopped, but no information is available on the duration of dissemination or concentration of exposure.[25]

The need to decontaminate people exposed at the incident site varies based on the agent released (if known), the method of dissemination, and the individual's potential for exposure. Agents that are released completely as aerosols behave as a gas and leave little

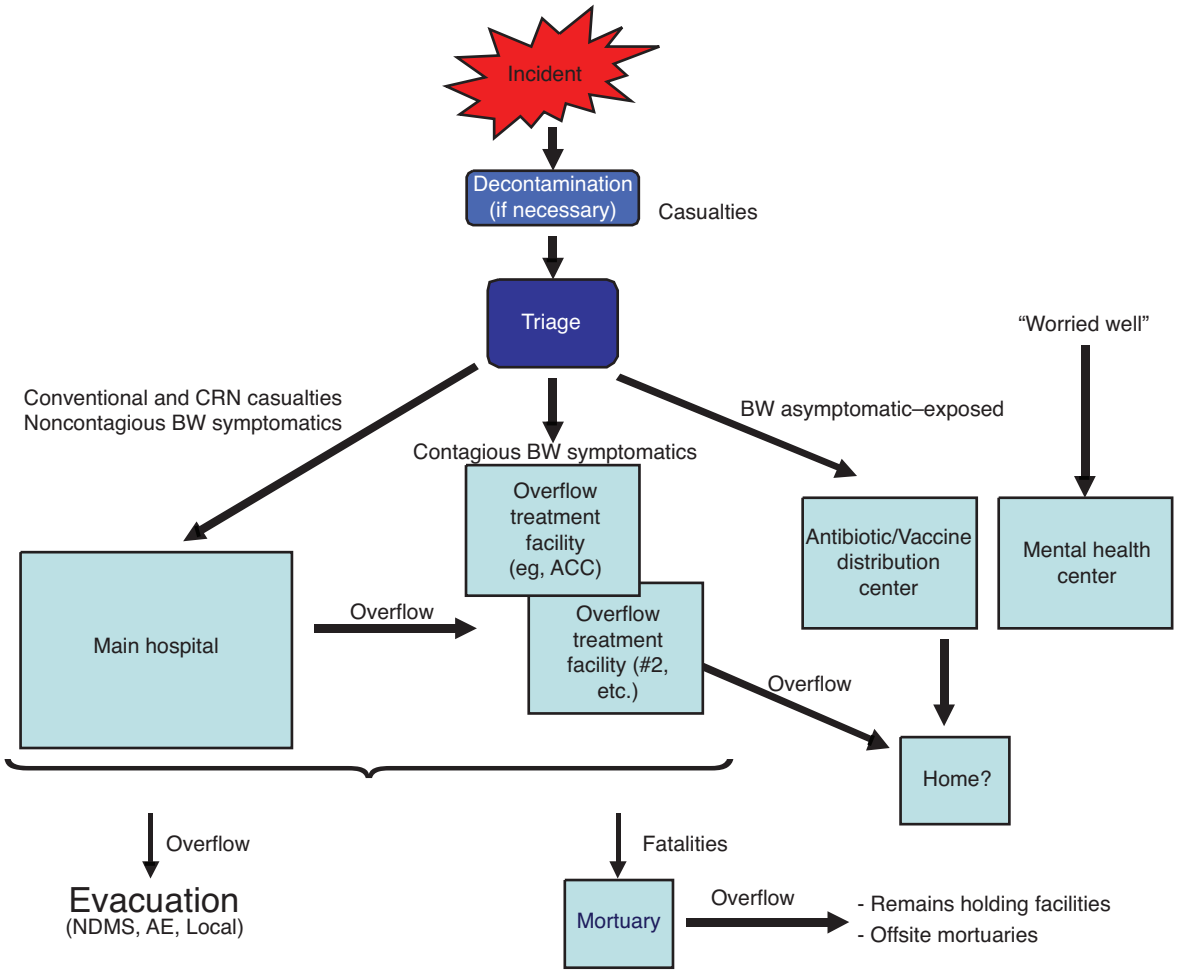


Fig. 19-3. Response to an intentional biological agent flow diagram
ACC: acute care center
BW: biowarfare
CRN: chemical, radiological, nuclear
NDMS: National Disaster Medical System

to no residual environmental contamination. Any gross contamination from dry powders or liquid agents requires decontamination. Personnel decontamination should be accomplished with high-volume, low-pressure water at a minimum of 60 pounds per square inch with a decontamination solution including soap, water, and hypochlorite, or a variety of commercially available dry, gelled, or powdered absorbents.[21] For most biological agents, showering with soap and water is the only necessary decontamination.

For certain types of biological incidents, especially anthrax spores, it may be necessary to assess the extent of contamination and to decontaminate victims, responders, animals, equipment, buildings, critical infrastructure, and large outdoor areas. Additionally, powdered agents may lend themselves to secondary aerosolization (created by kinetic energy near the settled powder). One study has shown that a person actively performing exercise for 3 hours on an area of ground contaminated with $2 \times 10^7/m^2$ of *Bacillus subtilis* spores would inhale between 1,000 and 15,000 spores.[27] Secondary aerosolization may pose a significant problem when dry agent is released in an enclosed environment. Before decontamination of the Hart Senate office building, agar plates were placed in an office and normal activity was simulated. Sixteen of 17 agar plates subsequently grew *B anthracis* colonies.[28]

Under the Federal Insecticide, Fungicide, and Rodenticide Act,[29] decontamination solutions must be registered with the EPA. No decontamination chemicals for use against biological agents have been approved by the EPA, although a review of current technologies from more than 75 different vendors is being conducted.[30] Responders to an incident site must request an emergency exemption from the EPA for each specific event before chemicals can be used for biological decontamination. The emergency exemption allows the sale, distribution, and use of an unregistered pesticide for a limited time. The three broad categories of decontamination technologies are (1) liquid-based topical agents, such as hypochlorite; (2) foams and gels; and (3) gaseous and vapor technologies (fumigants), including chlorine dioxide gas, vapor-phase hydrogen peroxide, paraformaldehyde, and methyl bromide. No single technology is applicable in all situations. In general, liquids are effective cleaners of nonporous surfaces, but they can cause surface corrosion or degradation. Foams and gels have shown some promising results, but they present postdecontamination cleanup problems. Gases and vapors are effective in destroying biological contamination under controlled conditions (eg, in sterilization chambers) and, in some cases, in field remediation, but they warrant further evaluation for use in large buildings.[31] Chemicals that have been granted crisis exemptions by the EPA for biological agent decontamination include chlorine dioxide, ethylene oxide, hydrogen peroxide, hypochlorite, and paraformaldehyde.[32]

A large covert release of a biological agent represents a public health catastrophe that could involve tens of thousands of victims and rapidly overwhelm local resources. For example, a 1970 report from the World Health Organization predicted the number of casualties and fatalities from various agents delivered as aerosols from an aircraft over a 2-kilometer line near a population center of 500,000. Released anthrax would disseminate over 20 kilometers, causing 125,000 casualties and 95,000 deaths.[33] Patients may not develop symptoms for several days (depending on the incubation period of the agent), may be dispersed over a large geographic area, and may unwittingly infect others if a contagious agent has been released. Recognition of the attack occurs when sick patients present to medical clinics and emergency departments. In this situation, the healthcare facility is the frontline of the response, rather than the response teams typically at the scene of a catastrophic event.

Covert attacks may be recognized through surveillance if the number of symptomatic casualties is large. A significant aerosol attack will likely cause a dramatic increase in patients presenting with nonspecific constitutional symptoms, which may be noted anecdotally by clinicians, or by public health officials and epidemiologists conducting active surveillance. Laboratories or pharmacies may also note an unusual pattern of findings. Attacks with agents that are not contagious or infect only a handful of patients would probably not be detected by surveillance. This type of attack might be recognized by astute clinicians[34]; however, healthcare providers may fail to include biological warfare or terrorist agents in the differential diagnosis of casualties. The 2003 report of the Gilmore panel, a government-funded advisory group assessing terrorism response capabilities, concluded that the level of expertise in recognizing and dealing with a terrorist attack involving a biological or chemical agent is problematic in many hospitals.[35] Well-trained, astute clinicians familiar with biological terrorism agents and their manifestations would provide the earliest possible detection of a covert biological attack; however, such training must be significantly increased.[36]

A large biological agent attack will likely extend beyond the boundaries of a single community, with contagion spread by commuters and other travelers. An event at a military facility will affect the public health of the surrounding community, and airports in

an affected area could facilitate the spread of disease to other parts of the United States and the world. The nature of a covert attack with biological organisms is likely to produce widespread fear that may present unique challenges to responders, government officials, and the public.[37]

Isolation and Quarantine

The initial response in most biological terrorism drills is to restrict movement, cordon off the area, and enforce quarantine of the population. Although the terms "isolation" and "quarantine" are used somewhat interchangeably, there are distinct differences between the two. Isolation is the separation and confinement of ill individuals known to be or suspected of being infected with a contagious disease to prevent them from infecting others. Quarantine is the compulsory physical separation, including restriction of movement, of populations or groups of healthy individuals who have potentially been exposed to a contagious disease. Quarantine may be voluntary or mandated, and state laws determine the specific mechanisms of instituting the quarantine, its duration, and its enforcement.[38]

The authority for isolation and quarantine comes from the Public Health Service Act,[39] which gives the secretary of DHHS the responsibility to prevent introduction, transmission, and spread of communicable diseases. The diseases covered under this act must be specified by executive order of the president, on recommendation of DHHS. The federal government is concerned with preventing introduction of communicable diseases into the country. States have been given the authority to declare and enforce quarantine within their borders. The state health director may have this authority, or it may be delegated to the local health director. In addition to the legal considerations of authority and enforcement of quarantine, several other factors may influence quarantine adherence. During the SARS outbreak in 2003, several Asian countries instituted quarantine of large numbers of people: approximately 130,000 people in Taiwan; 23,000 to 30,000 people in Toronto, Canada[40]; and roughly 7,800 people in Singapore were placed in quarantine either at home or in a designated facility.[41] The decision to impose quarantine includes the following considerations: (*a*) Do the public health and medical analyses of the situation warrant the imposition of quarantine? (*b*) Are the implementation and maintenance of a large-scale quarantine feasible? (*c*) Do the benefits of a large-scale quarantine outweigh the possible adverse consequences (economic impact, perceptions of ethnic bias, government mistrust, and potential for increased risk of disease transmission in those quarantined together)?[42]

DoD medical treatment facilities must be aware of the quarantine laws in their respective states. Although commanders have authority over their soldiers, sailors, airmen, and marines, a significant number of dependents may reside outside the military reservation and fall under the state's quarantine laws.

Mass Patient Care

Healthcare needs during a large-scale bioterrorism event can quickly overwhelm medical facilities. Mitigation strategies include streamlining the facility logistical system, creating facility and local stockpiles of anticipated medications, and establishing plans for reception and distribution of the SNS. Communities must be able to expand both prehospital and hospital capacity. Hospital and community plans to resource patient care on a grand scale need to be realistic, known, and practiced.

Prehospital Transport

During a large-scale bioterrorism event, infected casualties and the "worried well" who seek aid will likely overwhelm emergency medical services and hospitals.[43] In an overt attack, casualties from conventional injuries (eg, blast or orthopedic injuries from explosions) or those with exacerbations of preexisting chronic diseases (eg, asthma) may need transport to a healthcare facility by EMS. Personnel at the incident site who have been exposed may become infected, but are not contagious, and should not develop symptoms until completion of an incubation period that varies depending on the specific agent involved.

During the sarin nerve agent attack in Tokyo, approximately 5,000 to 6,000 persons were exposed. Of those exposed, 3,227 sought medical care, and 493 were admitted to 41 hospitals.[44] Many of these patients arrived by commercial transportation or privately owned conveyance rather than by EMS. It can be estimated that approximately half of the patients from a large-scale terrorism event will arrive by EMS within 1 to 2 hours.[24] Therefore, local and regional medical resources must be available within the first few hours. Hospitals must be prepared to evaluate patients for exposure and gross contamination before allowing them into the facility. Plans for both prehospital and hospital "surge capacity" should be in place and exercised before an incident occurs.

After a covert event, the EMS may be quickly overwhelmed with transport of sick patients. Although the event may not be suspected at the time, supervisors may see an increase in transports for nonspecific or unusual complaints that coincides with the incubation

period of the agent released. In New York, the onset of the annual influenza season is recognized by monitoring EMS transports.[45] In the event of a large-scale aerosol release of a biological agent, potentially infected individuals will likely not be grossly contaminated because they will have changed clothes and showered since the event. Depending on the agent released, these patients may be contagious. Standard precautions should be used for all patients, including the use of surgical masks for those with pulmonary involvement. EMS personnel are at risk of contracting contagious diseases from transporting ill patients and need to protect themselves accordingly. Infection of EMS personnel can devastate the prehospital system. During the SARS outbreak, Toronto's 850 paramedics had 1,166 potential SARS exposures, requiring 436 of them to be placed in 10-day home quarantine (staying isolated from other persons within the home, continuously wearing an N95 respirator, and taking their temperatures twice a day). SARS-like illnesses developed in 62 of the paramedics, and suspected or probable SARS required the hospitalization of four others. When the outbreak's second phase began, more than 200 paramedics had contact with patients with SARS and were quarantined.[46]

Hospital Triage

Traditional triage systems seek to establish a small number of categories among victims that indicate the urgency with which they should be treated. The adequacy of the triage system used in large-scale events depends on many variables, including the nature of the event, the population affected, and the competence of the triage physician. Triage during outbreaks of easily transmitted diseases needs to be based on epidemiology as well as the patient's clinical condition. Epidemiological approaches to triage, considered more appropriate for biological events, sort infected patients into three categories: (1) susceptible individuals, (2) infected individuals, and (3) removed individuals (by successful vaccination, recovery, or death).[47] An expansion of this system into five categories has been suggested: (1) susceptible individuals (including those with incomplete or unsuccessful vaccination); (2) exposed individuals (those who are infected but are in the incubation period and are noncontagious); (3) infectious individuals (who are symptomatic and contagious); (4) removed individuals (those who have survived and are no longer contagious); and (5) successfully vaccinated individuals (with a confirmed clinical "take" or completed vaccination series).[48]

The goals of triage in this situation are to distinguish individuals who are contagious from those who are not, and to protect healthcare personnel, other patients, and the community from spread of the disease. The triage center must be able to identify those requiring decontamination immediately after an overt event, including self-referrals. Occupational Safety and Health Administration guidance for first receivers ("healthcare workers at a hospital receiving contaminated victims for treatment") states that minimal PPE for employees in the hospital decontamination zone when the agent is unknown includes the use of a NIOSH-approved, powered air-purifying respirator that provides a protection factor of 1,000; combination NIOSH-approved 99.97% HEPA/organic vapor/acid gas respirator cartridges; double-layer protective gloves; a chemical-resistant suit with openings sealed by tape, a head covering, and eye/face protection (if not part of the respirator); and chemical-protective boots.[49]

Response to a covert event with a contagious agent may require moving the triage site away from the patient-care facility to prevent nosocomial spread of the disease. Occupational Safety and Health Administration first-receiver guidance for employees outside the hospital decontamination zone includes normal work clothes and PPE as appropriate for infection-control purposes. Respiratory precautions should be instituted at the triage center for diseases transmissible by the respiratory route. All persons with signs and symptoms of a respiratory infection, regardless of presumed cause, should be instructed to (*a*) cover the nose and mouth when coughing or sneezing, (*b*) use tissues to contain respiratory secretions, (*c*) dispose of tissues in the nearest waste receptacle after use, and (*d*) use hand hygiene after contact with respiratory secretions and contaminated objects. In addition to tissues and receptacles for disposal, healthcare facilities should provide conveniently located dispensers of alcohol-based hand rubs as well as soap and disposable towels where sinks are available. Procedure masks (ie, with ear loops) or surgical masks (ie, with ties) may be used to contain respiratory secretions. People who are coughing should sit at least 3 feet away from others in common waiting areas.[50] These recommendations should be instituted during normal daily triage procedures to assist in decreasing nosocomial transmission of any respiratory disease and to increase staff familiarity with the recommendations before an emergency situation.

Hospital Infection Control

Standard precautions include hand washing, gloves, masks, eye protection, face shields, and gowns when there is a potential for exposure to blood; all body fluids, secretions, and excretions other than sweat, regardless

of whether they contain visible blood; nonintact skin; or mucous membranes. Additional precautions may be needed based on the mechanism of disease transmission. Transmission-based precautions (airborne precautions, droplet precautions, and contact precautions) are designed for patients documented or suspected to be infected with certain highly transmissible or epidemiologically important pathogens. Patients with smallpox require the addition of airborne and contact precautions, patients with pneumonic plague require the addition of droplet precautions, and patients with viral hemorrhagic fevers require the addition of contact and airborne precautions. Casualties from an intentional release of inhalational anthrax, brucellosis, tularemia, equine encephalitis, and toxins (eg, botulinum toxins, ricin, staphylococcal enterotoxin B, and tricothecene mycotoxins) are not contagious and pose no threat of nosocomial spread.

In small-scale events, routine patient placement and infection-control practices should be followed in the facility. However, when the number of patients presenting to a healthcare facility is too large to allow routine triage and isolation strategies, a practical alternative is cohorting patients who present with similar syndromes (ie, grouping affected patients in a designated area).[51]

Expanding Surge Capacity

Healthcare systems must have the ability to expand both inpatient and outpatient capabilities during an outbreak or large-scale attack. The amount of surge capacity needed depends on the agent released, the method of dissemination, the number of people exposed, and assessment of the population at risk for both primary and secondary infections. In addition to cohorting, strategies to increase capacity of healthcare systems include the transfer of noncontagious inpatients to other facilities, the transfer of contagious casualties that exceed the healthcare system's capacity to other facilities, and the expansion of the system to include nonhealthcare facilities that may be amenable to patient care. The DHHS Health Resources and Services Administration benchmarks for hospitals in the National Bioterrorism Hospital Preparedness Program include (*a*) developing adequate portable or fixed decontamination systems for 500 patients per million persons in the population; (*b*) developing systems that, at a minimum, can provide triage, treatment, and initial stabilization for 500 patients (per million persons in the population) with symptoms of acute infectious disease (especially smallpox, anthrax, plague, tularemia, and influenza) above the current daily staffed bed capacity within 3 hours of a terrorism incident; (*c*) having the capacity to maintain at least one suspected case of a highly infectious disease in negative-pressure isolation; and (*d*) identifying at least one healthcare facility in each region that is able to support the initial evaluation and treatment of at least 10 adult and pediatric patients in negative-pressure isolation within 3 hours postevent.[52]

Although the actual capacity needed for a biological attack is unknown, it is advantageous for healthcare organizations, local communities, and regional emergency operations planners to identify which assets are available, which assets can be leveraged through mutual aid agreements and memoranda of understanding, and which assets can establish a trigger to request assistance from the state and federal government. Planning for surge capacity allows a structured response to epidemics and pandemics of emergency or reemerging diseases that may overwhelm the healthcare infrastructure, such as the 1918–1919 influenza pandemic, which sickened approximately half of the world's population (1 billion people) and killed 21 million to 40 million people.[53]

Patient transfers. Mutual aid agreements may include options to transfer patients between facilities, either moving contagious patients between facilities or noncontagious patients out of the affected hospital to make room for contagious patients. Receiving facilities may include local civilian hospitals, military treatment facilities if memoranda of agreement are in place, or NDMS hospitals if the NRP is activated.

Transporting contagious casualties is safe provided appropriate standard and agent-specific transmission precautions are maintained. During the SARS outbreak in Ontario, Canada, a medically based command, control, and tracking center for all interfacility (including acute and long-term care) patient transfers was implemented. The center successfully handled more than 500 transfer requests per day within 36 hours of operation, and more than 1,100 requests per day within 2 weeks. There was no reported spread of SARS resulting from the transfers, and anecdotal evidence demonstrated that the program identified up to 13 new SARS cases.[54]

Isolation wards and cohorting. Additional patient-care space can be obtained by the creation of isolation wards to allow cohorting of patients with the same disease, which may be useful if all negative-pressure isolation rooms are used during a contagious disease outbreak. Designated cohort sites should be chosen in advance in consultation with facility engineering staff, based on patterns of airflow and ventilation, availability of adequate plumbing and waste disposal, and capacity to safely hold large numbers of patients. The cohort site should have controlled entry to minimize

the possibility of transmission to other patients and staff members; however, reasonable access to vital diagnostic services such as a radiology department should be maintained. Critical evaluation of the heating, ventilating, and air conditioning system is needed to limit the possibility of agents spread by aerosol.

Cohorting was used in Canada during the SARS outbreak to isolate 70 exposed patients in three open-plan wards. Elective isolation was carried out immediately when symptoms and signs suspicious of SARS manifested clinically, strict infection control was practiced, and no secondary transmission of the SARS virus within the cohort was observed. This technique may ease the logistical constraints imposed by demands for large numbers of isolation facilities in the face of a massive outbreak.[55]

Ancillary care centers. The expansion of the healthcare system into additional community facilities can increase capacity for both inpatient and outpatient care, allowing hospital resources to be redirected to care for the most seriously ill. In 1998 the DoD's Biological Weapons Improved Response Program conducted a series of multiagency workshops on improved management of bioterrorism consequences, resulting in the Modular Emergency Medical System (Figure 19-4). The system is based on the rapid organization of a community's medical assets into two types of expandable patient-care modules: (1) the acute care center (ACC) and (2) the neighborhood emergency help center.

ACC facilities, as well as associated medical personnel and supplies, will be most efficient if they are used for victims of bioterrorism-related illness only, because most patients will require similar treatment, and cohorting patients limits the exposure of noninfected persons. Patients who require acute or critical medical treatment of urgent conditions such as heart attacks, traumatic injuries, or severe exacerbations of chronic conditions should receive care at an existing medical facility with more diverse resources, regardless of their exposure status.

ACC planning should include several considerations: (*a*) the use of either temporary or fixed facilities; (*b*) location of the facilities; (*c*) availability of parking and ease of access; and (*d*) building conditions such as total space, layout, size of doorways and corridors, electrical supply, heating and air conditioning, lighting, floor coverings, hand-washing facilities, and refrigeration capabilities. Buildings suitable for use as an ACC include National Guard armories, gymnasiums, schools, hotel conference rooms, health clubs, and community centers, which usually contain separate rooms with large floor space for patient care. These buildings are

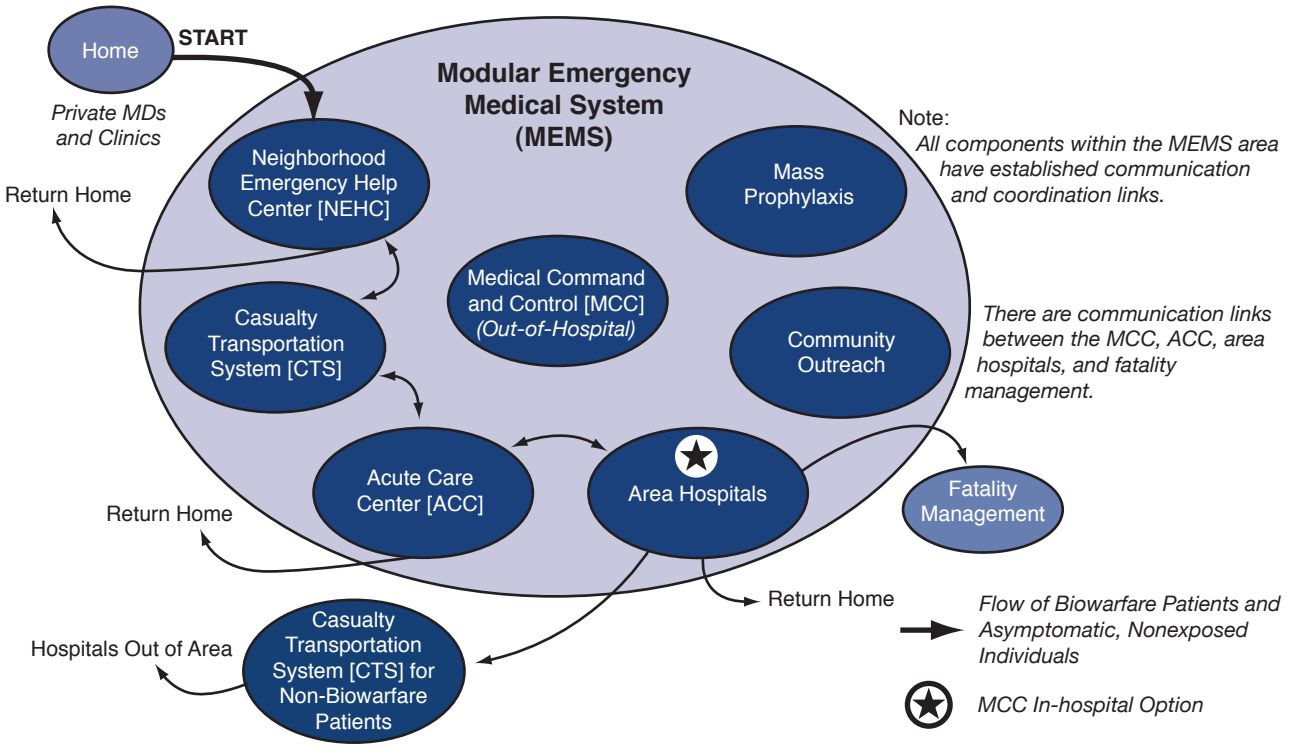


Fig. 19-4. Operational flow diagram of casualty evaluation and management using the Modular Emergency Medical System. Reproduced from: Acute Care Center: A Mass Casualty Care Strategy for Biological Terrorism Incidents. Aberdeen Proving Ground, Md: US Army Soldier and Biological Chemical Command; 2001.

likely to have bathrooms, kitchens, and laundry facilities with electrical and communication links, as well as adequate parking, loading ramps, and backup electrical generators. Schools and National Guard armories are generally publicly owned, which may make it easier for emergency officials to make use of them. Emergency planning officials should designate appropriate facilities in advance and begin to negotiate agreements for their use in mass casualty incidents.[56]

All patients who receive treatment in an ACC facility should be accompanied by a functional medical record throughout their stay. Basic admission packages should consist of preprinted admission orders, medical history and physical checklists, multidisciplinary progress notes, and nursing flowsheets. Nursing documentation should be scaled down as much as possible, and charting by exception is highly recommended. To facilitate the transfer and management of patient information, ACCs should adopt the inpatient record system of the supporting hospital in the most simplified form possible.

ACC patients infected with contagious agents such as pneumonic plague or smallpox should not be discharged until they are deemed noninfectious. However, home-care instructions should be developed in case more people are exposed than can be admitted. Home-care instructions should provide information on the remaining treatment regime and any follow-up care that may be required. Patients should be discharged from the ACC when they can care for themselves (use the toilet and feed and dress themselves) or can stay with someone who can provide care.

An ACC site will only be successful if staffed by necessary medical and ancillary personnel. The suggested minimum staffing per 12-hour shift for a 50-bed nursing subunit is outlined in Exhibit 19-1. Staffing may be a problem because normally available personnel might not assist in a bioterrorism event, and if alternative sites are necessary, the normal healthcare system is running beyond capacity, stressing routine levels of staffing. The Rocky Mountain Regional Care Model for Bioterrorist Events has developed an alternative care site selection matrix tool[48] to help emergency medical planners judge the suitability of facilities, available at http://www.ahrq.gov/research/altsites/.

Mass Logistics

Local Stockpiles

The American Hospital Association's chemical and bioterrorism preparedness checklist recommends that each hospital have a 3-day supply of basic PPE (such as gloves, gowns, and shoe covers); a 3-day supply of specified pharmaceuticals; emergency power; a loudspeaker or other mechanism to communicate with a large group of converging casualties outside the hospital entrance; and an external decontamination facility capable of handling 50 victims per hour. These guidelines give hospitals criteria by which they can measure their preparedness and improve their internal emergency response operation plans.[57] Hospital, state, and local officials have reported, however, that many hospitals needed additional equipment and capital improvements—including medical stockpiles, PPE, decontamination facilities, quarantine and isolation facilities, and air-handling and air-filtering equipment—to enhance preparedness.[58]

Effective planning for a biological incident includes not only acquiring materials and pharmaceuticals based on the population and risk, but also determining what resources are available in the community. Counting resources available in the local community or region allows medical planners to leverage assets for a more comprehensive response. When the inventory is compared with the requirements determined by credible biological scenarios, logistical shortfalls can be identified and rectified. The Emergency Preparedness Resource Inventory, a software tool that assembles a regional resource inventory, has been pilot tested in an eight-county region of Pennsylvania. The inventory categorizes resources by type and location, including antibiotics, antidotes and antitoxins, beds, blood products, communications capability, communications, equipment, emergency response capability, emergency response equipment, EMS personnel, emer-

EXHIBIT 19-1

SUGGESTED MINIMUM STAFFING PER 12-HOUR SHIFT FOR A 50-BED NURSING SUBUNIT

- One physician
- One physician's assistant or nurse practitioner
- Six registered nurses or a mix of registered nurses and licensed practical nurses
- Four nursing assistants or nursing support technicians
- Two medical clerks (unit secretaries)
- One respiratory therapist
- One case manager
- One social worker
- Two housekeepers
- Two patient transporters

gency transportation equipment, facility size, facility and utility capabilities, intravenous fluids, licensed practical nurses, major medical equipment, medical supplies, medical therapists, nonmedical personnel, pharmacists, physicians, registered nurses, technicians, transportation, and vaccines.[59]

Healthcare organizations may decide to develop local caches of medical supplies, including medications, vaccines, and patient care equipment. The Rocky Mountain Regional Care Model for Bioterrorist Events has adapted comprehensive lists of equipment and consumables developed by the Soldier's Biological and Chemical Command into three levels of medical caches for local hospitals (see Exhibit 19-2).

The Strategic National Stockpile

Local and regional stockpiles of medical supplies, equipment, and medications will likely not be able to meet the demand during a large-scale biological event. The SNS, managed by the CDC, is a national stockpile of medications, medical equipment, and supplies for use in the event of a terrorism event with chemical, biological, or radiological weapons. The SNS was originally called the National Pharmaceutical Stockpile, which was created in 1999; it was renamed and moved to the DHS with the Homeland Security Act of 2002.

The SNS consists of massive stockpiles of pharmaceuticals, vaccines, medical supplies, equipment, and other items to augment local supplies of critical medical supplies. The program response is tiered; the initial shipment consists of over 100 cargo containers of 12-hour "push packages," which contain over 100 different product lines. Storage and staging facilities are located throughout the country, so that the push packages can reach the area of need within 12 hours. The shipment can arrive on a wide-body aircraft or seven tractor-trailers. Additional support can be provided through a vendor-managed inventory, which can be tailored to the size of the event and the agent involved. SNS resources are designed for mass patient care and prophylaxis; for example, the stockpile can provide 60-day prophylaxis against anthrax for 12 million people and treat more than 1.1 million symptomatic patients.[60]

Although the SNS program deploys a technical advisory response unit to provide expert consultation

EXHIBIT 19-2

MEDICAL CACHE LEVELS FOR LOCAL HOSPITALS

Level I: Hospital Augmentation Cache

This cache consists of supplies for an increased surge capacity of 50 patients, including only items that have an extended shelf life: cots, linens, masks, gowns, gloves, intravenous injection poles, etc. This cache does not include any pharmaceuticals. Material in this cache may be packed in a trailer for mobility. The cache could be used as additional stock for an existing hospital (eg, to set up a medical ward in a cafeteria) or could provide supplies for limited-level care at an alternative site. If 11 hospitals acquired a cache, the total could provide the basic supply for a surge capacity of 550 patients in a metropolitan area of 1,000,000 people. Estimated cost for this cache (including trailer) is approximately $20,000.

Level II: Regional Alternative Site Cache

This cache represents a more complete list of materials to supply a regional alternative care site for 500 patients. The materials in this cache could be packaged in a modular fashion, so that material to support multiples of 50 or 100 beds could be easily extracted. Approximate price for a single cache is currently less than $100,000. As with the level I cache, only items with a long shelf life are included, and pharmaceuticals are excluded (it is assumed that the Strategic National Stockpile would provide pharmaceuticals within 72 hours of an event to augment levels I and II caches).

Level III: Comprehensive Alternative Care Site Cache

This cache, designed for a completely supplied 50-bed alternative care site, consists of items with both long and short shelf lives, including equipment, consumables related to patient care, administrative consumables, and oxygen and respiratory equipment. Material has been categorized, when possible, into use for quarantine and for caring for infectious and noninfectious patients.

Data source: Rocky Mountain Regional Care Model for Bioterrorist Events. Available at http://www.ahrq.gov/research/altsites/alttool2.htm. Accessed March 2, 2007.

on storage, repackaging, and distribution of supplies, state and local authorities are responsible for receipt, storage, and distribution. A coordinated plan for these logistics is the key to successful use of the SNS. Such a plan would include identifying the location to receive the stockpile (airfields with runways that can accept wide-bodied commercial jets) and ensuring that appropriate equipment is available to off-load the push packages. Supplies should be stored in a secured site with controlled temperature and humidity and access to highways and other transportation means.[60] Additionally, certain items may need to be broken down and repackaged before distribution.

Mass Prophylaxis

Whereas medications, medical supplies, and medical equipment required by hospitals may be transported directly to a healthcare facility, prophylactic medications or vaccinations may need to be distributed in large numbers to the community. In response to the anthrax mailings in 2001, representatives from the CDC, the US Public Health Service, and five disaster medical assistance teams were assembled within 18 hours. This group screened and offered postexposure prophylaxis to 7,076 postal workers over a 68-hour period.[61] Aerosol dissemination of a biological agent would significantly increase the population at risk and the number of persons requiring prophylaxis or treatment, demanding significant coordination and personnel.

Uncommon antibiotics, antivirals, immunoglobulins, or vaccines may be necessary in certain situations. Hospitals, especially emergency departments, will be critical in administering prophylaxis to victims, staff, and members of the public, and must have ready access to large quantities of pharmaceuticals and supplies.[62] Public fears may lead to a high demand for antibiotic prophylaxis during bioterrorism events; for example, during the 2001 anthrax mailings, a majority of emergency physicians encountered patients who requested anthrax prophylaxis. Strategies should be pursued to control inappropriate antibiotic allocation during bioterrorism events and ease the burden on front-line clinicians.[63]

Every public health jurisdiction in the country is responsible for developing and maintaining the capability to respond to bioterrorism events, dispense antibiotics, and carry out vaccination campaigns tailored to its local population. Local response is necessary because mass prophylaxis activities must be operational before the arrival of state or federal resources; federal or state responders will likely require assistance from the community; a mass prophylaxis operation may remain under local control even after state and federal assets arrive; and follow-up operations may continue after their departure.[64]

Prophylaxis can be distributed to the community through a "push" or a "pull" system. In a push system, pharmaceuticals are brought to the individual; for example, the US Postal Service could deliver prepackaged medications to households. However, in this system, doses could not be modified based on weight, age, and comorbid conditions, nor could contraindications be evaluated. A pull system requires community members to come to a designated center to be evaluated and receive prophylaxis. The principal operating unit of this system is the point of distribution (POD).

Establishment of a POD requires detailed planning and preevent exercises incorporating local healthcare organizations, public health officials, law enforcement, the media, and emergency management planners. The plan needs to outline how the POD will function, how it will be staffed, what its operational protocols and procedures will be, and how it will be supplied. POD locations should have adequate storage capacity, ease of access, a communications system, and security; and POD activation plans should include triggers at the local, regional, and federal level.

Common POD operational concepts are depicted in Figures 19-5 and 19-6. Features include an initial greeting to direct the flow of patients at the entrance, distribution of demographic forms, and triage to identify those who are symptomatic, those who have definitely been exposed, those who may have been exposed, and those who have definitely not been exposed. The greeter identifies those who are not feeling well or believe they have been exposed to the biological agent or a contagious person. Those who are significantly ill are transported to a medical care facility. Those who are contacts or have been exposed may be moved to an isolation or quarantine facility, especially if they decline available prophylaxis or vaccination. A screening medical evaluation should be performed as well as a mental health evaluation if needed. A briefing on the agent released, the signs and symptoms of disease, the capacity to transmit the disease within the community, and the recommended treatment should be given. Finally, an evaluation for prophylactic medications or vaccination should be made, the medication or vaccination should be administered, and all forms should be collected.

The Bioterrorism and Epidemic Response Model, created by researchers at Weill Medical College of Cornell University in 2003 under contract to DHHS, is available to help determine requirements for community prophylaxis. Inputs into the model include the scale of the event; the size of the population; the extent

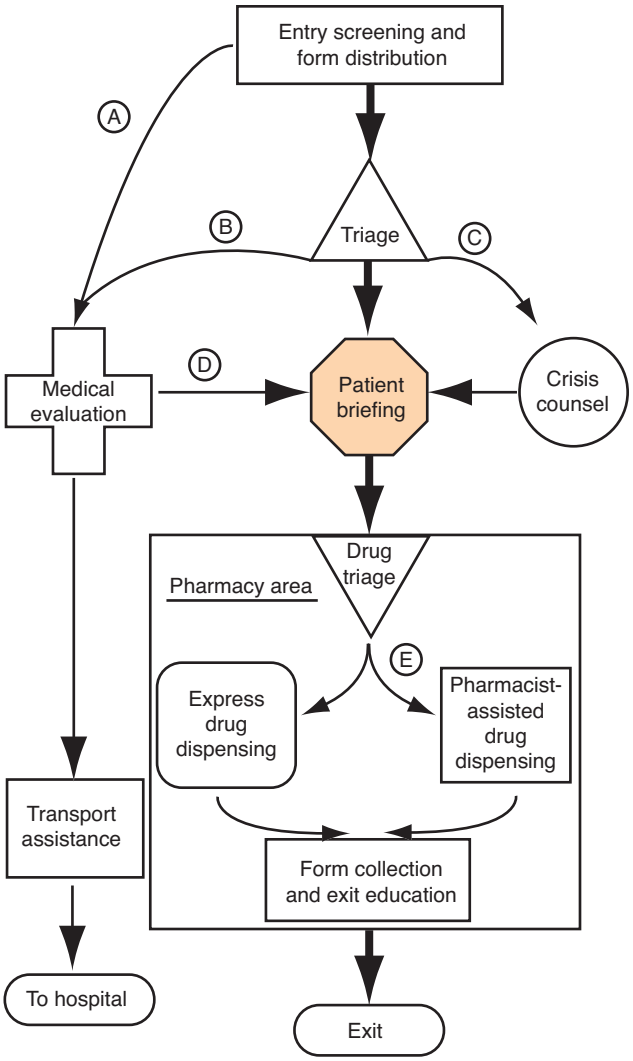
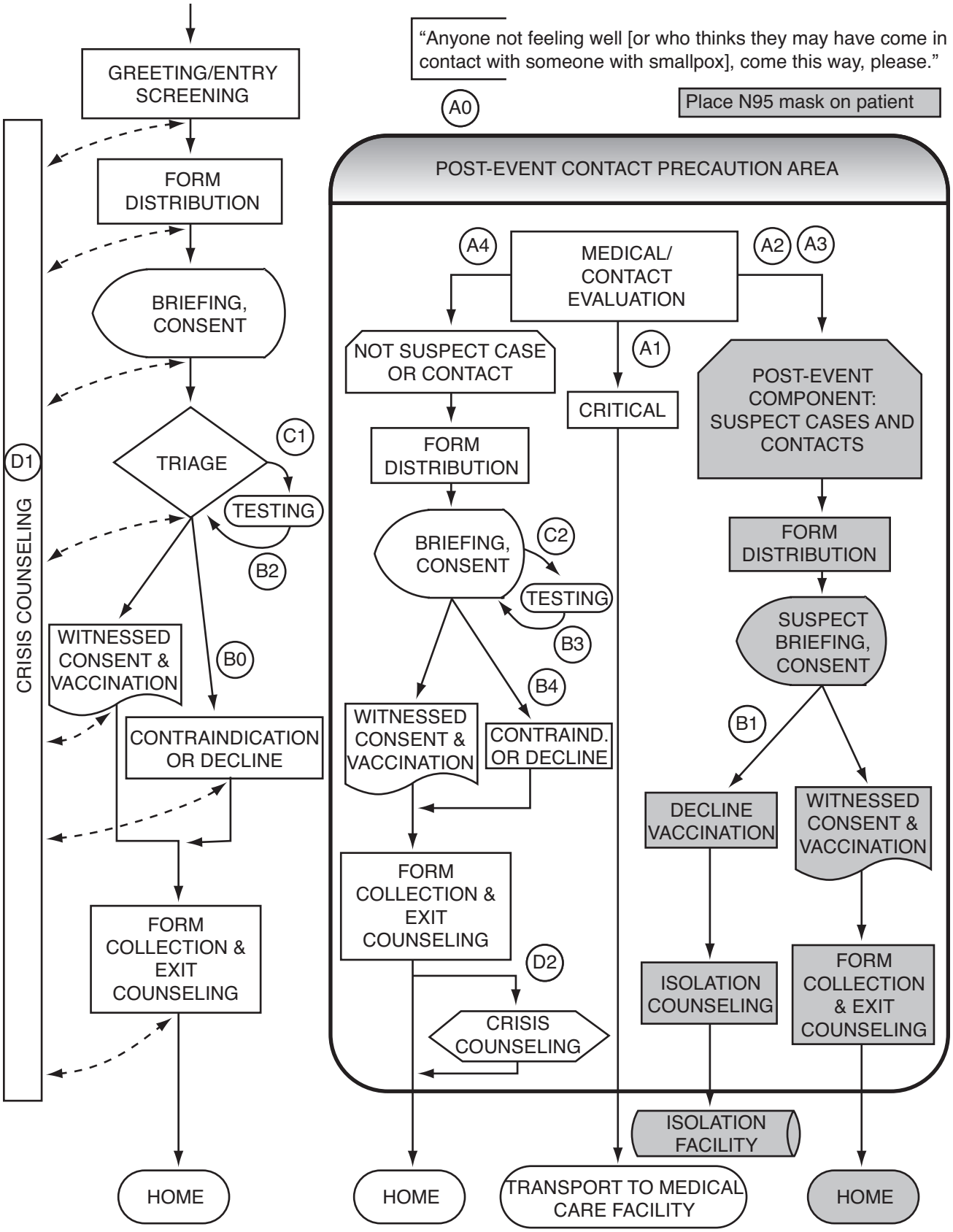


Fig. 19-5. Prophylaxis distribution center flow diagram. This process would be used in response to a mass exposure to anthrax or another noncommunicable agent, requiring the distribution of antibiotics. Patients arrive and are screened for visible signs of illness; those who are ill are sent to medical evaluation (**a**). The remaining patients are given any necessary forms and undergo triage, at which time they are sent to medical evaluation (**b**), mental health/crisis counseling (**c**), or patient briefings (**d**). A certain portion of patients who undergo medical evaluation come back through the briefings as well. Patients who are seriously ill are transported to hospitals or other medical care facilities. Those who finish briefings are sent to the drug triage area (**e**), where appropriate decisions are made regarding dispensing antibiotics or vaccination. Those with uncomplicated cases may go to express drug dispensing tables, whereas those with complicated cases may require assistance from pharmacists or other health professionals. Before patients leave, all forms and paperwork are collected in designated areas.

of the disease's transmission in the community; the duration of the campaign; the hours of POD operation and its downtime; the number of shifts worked in the POD; and whether crisis counseling and testing are to be offered in the POD. The model will then give the estimated patient flow rate of the POD, the number of PODs needed, the total number of staff required, the specific staffing requirements at each station, and the support staff required.[65] This tool is available at http://www.ahrq.gov/research/biomodel.htm. Additionally, the CDC offers free planning software for large-scale smallpox prophylaxis clinics that may be

Fig. 19-6. Flow diagram for a campaign responding to smallpox or other communicable agent. Patients are greeted at the front door of this clinic by screeners who ask if anyone is symptomatic or had contact with an infected individual. Those who are symptomatic or are suspected contacts are sent to a contact precaution area that is separate from the main area of activity in order to minimize the risk of contagion. Patients in the main (non contact precaution area) are given necessary forms and undergo briefings and triage. Clinics may offer testing including pregnancy and/or rapid HIV testing depending on the event, response, and availability of supplies and staff to perform tests. Written consents and vaccinations may need to be witnessed. Clinics may offer crisis/mental health counseling on site. Prior to exit, patients receive counseling on vaccination site care and follow-up and turn in forms. Patients in the contact precaution area are immediately taken to medical evaluation at which point they are classified as seriously ill requiring transfer to a hospital or other medical care facility, a suspect case or contact, or not a suspect case or contact. Patients in the latter two categories are then given necessary forms, briefings, triage, testing, vaccination, or other dispensing, and exit counseling much like patients outside the contact precaution area. One major difference is that suspected cases or contacts who refuse prophylactic medications or vaccination may be placed in isolation depending on the setting and applicable public health regulations. The diagram includes special isolation counseling for these individuals. Reproduced from: Hupert N, Cuomo J, Callahan MA, Mushlin AI, Morse SS. *Community-Based Mass Prophylaxis: A Planning Guide for Public Health Preparedness*. Rockville, Md: Agency for Healthcare Research and Quality; August 2004. AHRQ Pub 04-0044. Rockville, MD. Available at: http://www.ahrq.gov/research/cbmprophyl/cbmpro.htm. Accessed March 1, 2007.


"Anyone not feeling well [or who thinks they may have come in contact with someone with smallpox], come this way, please."
A0
Place N95 mask on patient
GREETING/ENTRY SCREENING
FORM DISTRIBUTION
BRIEFING, CONSENT
TRIAGE
C1
TESTING
B2
D1
CRISIS COUNSELING
WITNESSED CONSENT & VACCINATION
B0
CONTRAINDICATION OR DECLINE
FORM COLLECTION & EXIT COUNSELING
HOME
POST-EVENT CONTACT PRECAUTION AREA
A4
MEDICAL/ CONTACT EVALUATION
A2
A3
NOT SUSPECT CASE OR CONTACT
A1
CRITICAL
POST-EVENT COMPONENT: SUSPECT CASES AND CONTACTS
FORM DISTRIBUTION
BRIEFING, CONSENT
C2
TESTING
B3
B4
WITNESSED CONSENT & VACCINATION
CONTRAIND. OR DECLINE
FORM COLLECTION & EXIT COUNSELING
D2
CRISIS COUNSELING
FORM DISTRIBUTION
SUSPECT BRIEFING, CONSENT
B1
DECLINE VACCINATION
WITNESSED CONSENT & VACCINATION
ISOLATION COUNSELING
FORM COLLECTION & EXIT COUNSELING
ISOLATION FACILITY
HOME
HOME
TRANSPORT TO MEDICAL CARE FACILITY
HOME

downloaded at http://www.bt.cdc.gov/agent/smallpox/vaccination/maxi-vac/.

Because of limited local pharmaceutical supplies, plans should include mobilization of regional resources and the SNS.[66] PODs may be initiated and staffed by active-duty military, National Guard units, US Public Health Service members, disaster medical assistance teams, or local medical personnel. Several public health centers are using similar models for distributing annual influenza vaccinations as an exercise for possible outbreaks of biological agent attacks. Some health departments have even created "drive through" vaccine distribution centers.[67]

Mass Fatalities

Response to a biological event includes mortuary affairs and the disposition of infected remains. Healthcare organizations must have well-formed procedures for handling, storing, and managing large numbers of contaminated human remains, developed in coordination with local medical examiners and coroners based on available assets. Medical examiners and coroners must coordinate activities with several agencies including law enforcement, design a geographic strategy to manage mortuary affairs operations, mitigate the contamination from human remains and maintain biosafety considerations, and manage a personal effects depot.

Code of Federal Regulations 49[68] governs the transport of infectious substances and requires the substances to be labeled and packaged appropriately. Section 173.196 states that infected human remains are considered infectious substances that must be packaged to standard, including the use of one or more inner leak-proof packages and an outer package with material sufficient to absorb the entire contents of the inner package. The entire package must be strong and secured against movement, and it must not be reopened after arriving at its destination.

The capability of cemeteries to bury the number of remains from an event must be considered in planning. Additionally, many agencies have yet to confirm environmental hazards associated with burial of large numbers of contaminated remains, and cemetery owners may require authorities to provide indemnity from future citation.[69] Cremation is the disposition of choice for highly infectious remains, but may not always be practical. As a rule, cremation takes approximately 3 hours per body, which may be impractical if there are large numbers of fatalities. Additionally, crematoriums must have a retort system that captures and burns particles in the smoke before it is released into the atmosphere.

Current procedures for handling remains of patients who succumbed to infectious diseases are based on mode of transmission of the disease. For example, the recommendation for handling corpses with *Mycobacterium tuberculosis* includes using NIOSH-approved HEPA filters, temporarily placing a surgical mask or disposable cloth over the body's mouth and nose to prevent possible generation of any aerosols, placing the remains and disassociated portions in plastic burial pouches, and using negative-pressure rooms that provide at least 12 air exchanges per hour. Electric saws should be equipped with protective guards and vacuum attachments to capture and remove aerosolized contaminants.[70]

Recommendations for handling remains of anthrax victims include the use of standard precautions during general handling, with additional respiratory PPE when performing activities that generate aerosols. Autopsies should be performed with respiratory PPE, and under BSL-3 conditions during activities with a potential to create aerosols. During burial, contact with corpses should be limited to personnel wearing PPE, embalming should be avoided, and the body should be packaged in leak-proof containers and buried without reopening the casket.

The recommendations for remains of patients dying from plague are similar to those of anthrax fatalities. For smallpox-contaminated remains, the same general recommendations as for anthrax and plague apply; additionally, only personnel who have received the smallpox vaccine, or who will be subsequently placed on fever watch, should handle the remains, and autopsies should be performed only if absolutely needed. Corpses of patients who had viral hemorrhagic fevers should be autopsied only in BSL-4 conditions, with the use of additional respiratory PPE during handling.

LEGAL ISSUES

Legal counsel should be included in all steps of disaster preparedness and response planning to assist with ensuring adequate building and health codes, enforcing quarantine, and protecting medical workers and volunteers from liability. Occupational Safety and Health Administration regulations on PPE should be followed.

The standard of medical care may need to be altered in a large-scale response. Although the term "altered standards" has not been clearly defined, it is generally assumed to mean "a shift to providing care and allocating scarce equipment, supplies, and personnel in a way that saves the largest number of lives in con-

trast to the traditional focus on saving individuals." Examples of altered standards of care in response to a biological incident include changing infection control standards to permit group-isolation rather than single-person isolation units; creating alternate care sites in facilities not designed to provide medical care, such as schools, churches, or hotels; changing the personnel who provide various kinds of care; and temporarily changing privacy and confidentially protections. It is important to establish clear authority to activate the use of altered standards of health and medical care. Minimally accepted levels of care documentation provided to an individual may have to be established, both for patient care quality and as the basis for reimbursement from third-party payers.[71] Additionally, healthcare providers may be asked to perform above their training or credentialing. During the 1918–1919 influenza outbreak, states used dentists as physicians, graduated medical students early, and expedited medical board examinations to provide more physicians.[41]

Declaration of quarantine, not just for those who are ill but also for their contacts and contacts of contacts, can have legal implications, especially when dealing with those who refuse quarantine. Key factors in quarantine compliance in Canada during the SARS outbreak included fears of income loss, consistent information about the threat and measures to contain it, and adequate logistical and psychological support to those quarantined.[72] Each of these factors should be addressed in a quarantine plan.

Prohibiting direct military involvement in law enforcement is in keeping with long-standing US law and policy limiting the military's role in domestic affairs. The Posse Comitatus Act was enacted after the Civil War in response to the perceived misuse of federal troops who were charged with domestic law enforcement in the South.[73] It has come to symbolize the separation of civilian affairs from military influence. The act generally prohibits US military personnel from interdicting vehicles, vessels, and aircraft; conducting surveillance, searches, pursuit, and seizures; or making arrests on behalf of civilian law enforcement authorities. The act states:

> Whoever, except in cases and under circumstances expressly authorized by the Constitution or Act of Congress, willfully uses any part of the Army or Air Force as a posse comitatus or otherwise to execute the laws shall be fined under this title or imprisoned not more than two years, or both.[73]

DoD Directive 5525.5[74] extended the act's substantive prohibitions to the US Navy and Marine Corps. The act does not apply to the US Coast Guard in peacetime or to the National Guard when not in federal service. However, Congress has enacted exceptions to the law that allow the military to assist civilian law enforcement agencies in certain situations, most commonly in illegal drug enforcement. Other examples include the following:

- The Insurrection Act,[75] which allows the president to use military personnel at the request of the state legislature or governor to suppress insurrections. It also allows the president to use federal troops to enforce federal laws when rebellion against US authority makes it impracticable to use traditional law enforcement authorities.
- Title 18 United State Code Section 831[76] permits DoD personnel to assist the Justice Department in enforcing prohibitions regarding nuclear materials, when the attorney general and the secretary of defense jointly determine that an "emergency situation" exists that poses a serious threat to US interests and is beyond the capability of civilian law enforcement agencies.
- When the attorney general and the secretary of defense jointly determine that an "emergency situation" exists that poses a serious threat to US interests and is beyond the capability of civilian law enforcement agencies. DoD personnel may assist the Justice Department in enforcing prohibitions regarding biological or chemical weapons of mass destruction.[77]

SUMMARY

Response to a bioterrorism event or outbreak of emerging diseases can rapidly overwhelm the country's current medical infrastructure. To respond appropriately, officials must create response plans and provide the necessary resources to mitigate these events. The economic implications of preparedness are substantial. A 1997 model predicted that the economic impact of a bioterrorism attack could range from $477.7 million to $26.2 billion per 100,000 persons exposed, depending on the agent.[78] Planning, streamlined surge capacity, and initiation of early prophylaxis may drastically decrease these figures. Healthcare organizations must know their capabilities for patient care and logistics and have plans in place to leverage assets at the local, regional, state, and federal level to provide an adequate response. Military medical units must be prepared to respond to incidents at their locations as well as work with the civilian community.

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