TECHNICAL
REPORT

Learning from Experience: The Public Health Response to West Nile Virus, SARS, Monkeypox, and Hepatitis A Outbreaks in the United States

MICHAEL A. STOTO, DAVID J. DAUSEY, LOIS DAVIS, KRISTIN LEUSCHNER, NICOLE LURIE, SARAH MYERS, STUART S. OLMSTED, KAREN RICCI, SUSAN RIDGELY, ELIZABETH SLOSS, JEFFREY WASSERMAN

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1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

1200 South Hayes Street, Arlington, VA 22202-5050

201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516

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PREFACE

Over the past three years, the U.S. Department of Health and Human Services (HHS) has made significant investments in state and local public health in an effort to enhance public health emergency preparedness. The RAND Corporation was contracted to work with the HHS Office of the Assistant Secretary for Public Health Emergency Preparedness (OASPHEP) to develop resources and to prepare analyses to help describe and enhance key aspects of state and local public health emergency preparedness. As part of this contract, RAND was asked to study the response of state and local health departments to recent disease outbreaks—specifically, Severe Acute Respiratory Syndrome (SARS), monkeypox, and West Nile virus—to address the following questions:

1. How did the public health system in the United States respond to each of these disease outbreaks? What were the roles of federal, state, and local health departments, health care providers, community organizations, and other groups, and how did they interact?
2. In what ways did recent federal investment contribute to public health preparedness?
3. What lessons does the public health response to these outbreaks have for future preparedness, particularly to address the threat of bioterrorism? What improvements are needed to public health infrastructure in the United States and in functional capabilities to address a public health emergency?
4. Was the CDC guidance helpful in building capacity for health departments to respond to the outbreaks studied? Are there areas in which guidance is still needed?

This work was carried out during the period beginning in October 2003 through March 2005.

This report was prepared specifically for the Office of the Assistant Secretary for Public Health Emergency Preparedness, but it should be of interest to individuals working in public health preparedness at the federal, state, and local levels. Comments or inquiries should be sent to the RAND principal investigators, Nicole Lurie (Nicole_Lurie@rand.org) and Jeffrey Wasserman (Jeffrey_Wasserman@rand.org) or addressed to the first author of this report, Michael Stoto (mstoto@rand.org).

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SUMMARY

State and local public health systems play a critical role in responding to emergencies and are central to the nation's efforts to improve its preparedness for bioterrorism. But public health departments have faced some significant challenges over the years. During the last half of the 20th century, the capacity of state and local public health systems in the United States seriously declined. Problems in the systems—such as weaknesses in laboratory capacity and poor communications with the public and health care professionals—were vividly displayed during the anthrax attack in 2001.

In the aftermath of these events, Congress and the Department of Health and Human Services (HHS) accelerated efforts to strengthen the public health infrastructure. In the spring of 2002, approximately $1.1 billion was distributed through the Office of Public Health Emergency Preparedness, the Centers for Disease Control and Prevention (CDC), and the Health Resources and Services Administration (HRSA) as part of cooperative agreements to strengthen state and local public health as well as hospital preparedness, with an additional $2.9 billion provided to the states in 2003 and 2004 (Schuler, 2004). After three years of major federal investment, it is appropriate to take stock of the current state of preparedness in local and state public health departments.

Four recent disease outbreaks from 1999 to 2003 provide a rare opportunity to assess the quality of the public health response and to gain insights into overall preparedness for a bioterrorist attack. These outbreaks include Severe Acute Respiratory Syndrome (SARS), monkeypox, and hepatitis A in 2003, and West Nile virus. Taken together, the four outbreaks tested a wide range of public health capabilities.

THE PUBLIC HEALTH RESPONSE TO THE FOUR OUTBREAKS WAS ROBUST, BUT CHALLENGES REMAIN

This report provides a focused assessment of public health's response to the four disease outbreaks in our case studies. It should be noted at the outset that, very fortunately, none of the outbreaks involved large numbers of human cases and deaths, substantial person-to-person transmission, or major social disruption. The outbreaks, however, did present three challenges that might also be presented by a bioterrorist attack. First, initial identification of the agent took considerable time in three of the four outbreaks because the organisms causing them had not

previously been seen in the United States. Second, in part because of the novelty of the biological agents, there was little information available about the clinical and epidemiological aspects of the diseases and about appropriate treatment and control strategies. Finally, due to limited resources and staffing, health departments found it difficult to both respond to the outbreak and perform their day-to-day operations. These challenges, therefore, provide us with a glimpse of how the public health system in the United States might respond to a major public health crisis such as one involving a bioterrorist attack or influenza pandemic.

In responding to these outbreaks, state and local public health agencies demonstrated their ability to implement all the major components of response to a public health emergency. Compared with what might have happened and to outbreaks in the past, the public health response to these outbreaks seems to have been fairly robust. The public health response was not without problems, however. We highlight here some of the key lessons learned from our evaluation of functional capabilities and capacity-building activities (explained more fully under "The Public Health Response").

THE NATURE OF PUBLIC HEALTH EMERGENCIES CALLS FOR CORE CAPABILITIES IN KEY AREAS

Taken as a whole, our case studies illustrate several key characteristics of public health emergencies involving infectious diseases that should to be emphasized in preparing for future emergencies.

- **Public health emergencies develop over time.** Unlike a natural disaster such as a hurricane or explosion, the outbreaks studied all played out over a period of months, or in the case of West Nile virus, years, and were characterized by substantial scientific uncertainty and confusion as the epidemiologic "facts" of the outbreak emerged. Public health departments must expect and plan for such similar emergencies in the future.
- **The required public health response is not necessarily proportional to the number of people actually exposed, infected or ill, or the number of deaths.** This is true in part because, as in the outbreaks we studied, necessary efforts to identify additional cases—active surveillance—are likely to result in many potential cases coming to the health department's attention, including individuals who do not have the disease in question but are worried that they do. Extensive population-based prevention efforts, such as education campaigns, are necessary to prevent transmission to others and reduce

the health consequences. These demands stress the capacity of public health systems even when the actual number of cases is small.

- **Public health agencies, unlike some other emergency responders, do not have command and control authority over important resources—hospitals and health care providers—as well as other government agencies that are needed for an optimal public health response. Moreover, jurisdictional arrangements in public health can be complicated.** Public health departments must rely on a host of other individuals and organizations, including health care providers and emergency responders as well as colleagues in other public health agencies, to mount an effective response. While most of the needed resources would likely be willing to help in the course of a crisis, they need direction in how to communicate and coordinate effectively. Moreover, while state health departments have most of the necessary authority to deal with a public health emergency, these functions are carried out through a mix of state, regional, county, and city entities, each of which operates in relation to different political leadership structures and local governmental and community organizations. Matters are further complicated by the lack of respect that pathogens show for state and local geography—with outbreaks quickly spreading throughout states and across state lines.
- **State and local public health departments may be overly optimistic about the help that they can realistically receive from the CDC during a public health emergency.** During an emergency, CDC is also often looked to for scientific advice and other kinds of help, and in many instances this support is both essential to state and local health departments and effective. On the other hand, state and local health departments may not be realistic about the kind of support they can expect from CDC or the timeframe in which such support will be available.

Specific approaches for addressing these issues will vary depending on the particulars of the disease outbreak. However, certain core capabilities are clearly needed. These include well-developed surveillance systems, epidemiologic and laboratory investigations, and the ability to develop policies and procedures to implement population-based prevention and clinical treatment. These must be supported by effective communication and coordination among all key players involved in public health response, information technology to support these communications, appropriate workforce training and assurance of sustained competence, participation in exercises and similar activities, and long-term planning to facilitate the development of partnerships and the clarification of lines of authority. CDC, together with state and local health departments, can learn from experience with such disease outbreaks as the ones we are studying to determine how it can best support state and local public health agencies, and then set and communicate realistic expectations.

THE PUBLIC HEALTH RESPONSE

We examined the public health response to these outbreaks in terms of the "capacity-building activities" and "functional capabilities" shown in Figure S.1. Capacity-building activities refer to actions taken to prepare for and enable an effective response to a public health emergency, while functional capabilities refer to those actions taken during the emergency itself. Both kinds of activities support the major objectives of early outbreak detection, effective response, and recovery and return to normal function, as well as the overarching goal of mitigating mortality, morbidity, stress, and social consequences of a terrorist attack or other public health emergency.

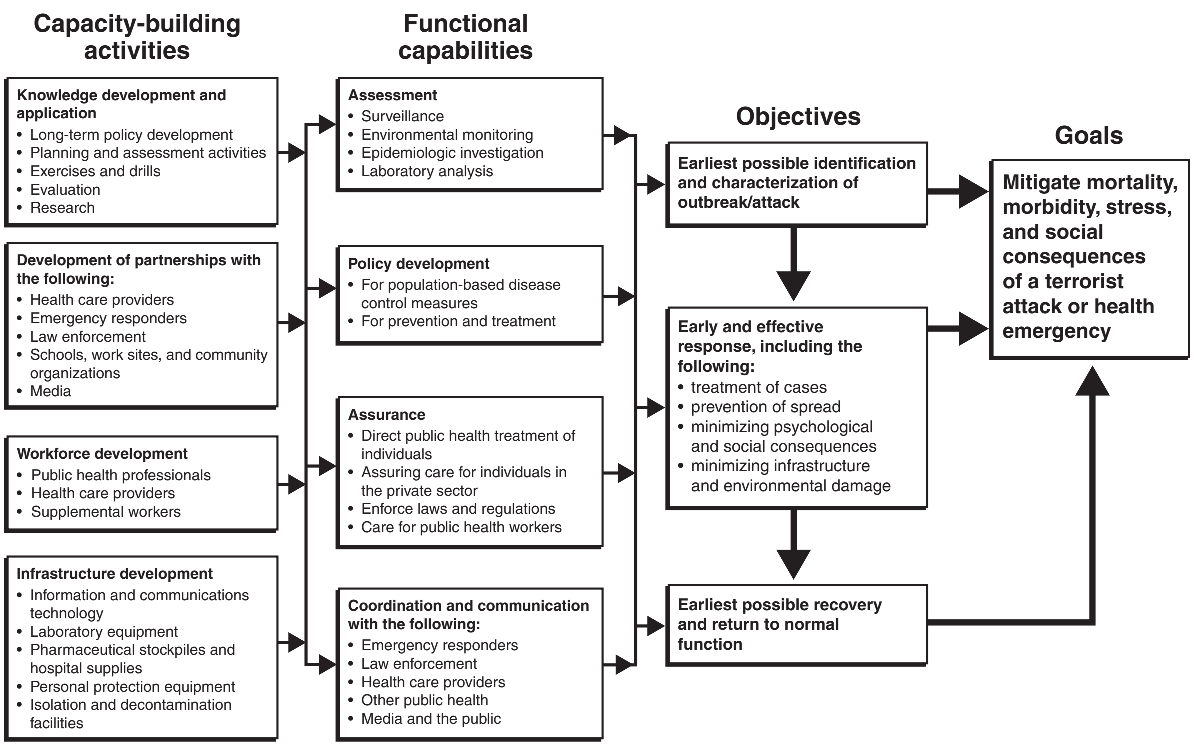

Figure S.1. A Logic Model for Public Health Preparedness Functional Capabilities

Public Health Assessment

The case studies suggest that state and local health departments are able to use existing surveillance systems, or create new ones as needed, to detect and manage the outbreaks of the sort we studied. Health departments were able to detect and characterize West Nile virus and monkeypox, both of which were new to the United States. Public health agencies also effectively monitored West Nile virus as it spread across the country, SARS after it emerged in Asia, and hepatitis A, a relatively common food-borne disease. Our case studies show, however, that identifying and characterizing an outbreak is inherently difficult and slow when the number of cases is small (but has the potential to grow). The outbreaks highlight the importance of routine reporting of all suspect cases of a disease as well as the need for effective partnerships among public health departments and with health care providers, veterinarians, and others who can assist in the process of identifying and addressing a disease outbreak.

It was also clear that the public health system was severely stressed and sometimes overloaded by the response. For some outbreaks, such as West Nile virus and monkeypox, identifying the pathogen took weeks. Although public health departments demonstrated a basic ability to carry out epidemiological investigations, this process was often uncoordinated, with multiple investigations going on simultaneously. Such problems highlight the need to trace confirmed and potential cases as well as possible contacts. The development, in advance of any future outbreaks, of generic databases that can be adapted to the specifics of a given outbreak would likely improve the public health response in the future. Further, regional epidemiology offices within states would help to avoid the multiple simultaneous but uncoordinated epidemiologic investigations that occurred in the outbreaks we studied. In addition, overlap across state lines and with CDC, the Food and Drug Administration (FDA), or other federal investigations should also be addressed. Finally, state and local public health laboratories should build capacity and develop methods to handle the surge of samples they receive during outbreaks such as these, without compromising their ability to perform routine testing in a timely manner.

Just-in-Time Policy Development

The SARS and monkeypox outbreaks raised awareness throughout the United States about the issues involved with implementing isolation and quarantine policies, but because the number of cases was relatively small they did not test these policies on a large scale. Significant problems did arise, however, regarding enforcement, reimbursing health care workers for lost work time, when orders should be lifted, and so on. It seems likely that if many more individuals had needed to be quarantined or isolated, the public health system would not have been able to perform as required.

Each outbreak also tested the ability of health departments to develop, disseminate, and update evolving clinical policies in real time. While health departments were usually able to get the word out, there was often confusion about recommended policies for hospital infection control, clinical testing, and vaccination. During the West Nile outbreak in Louisiana, for instance, there was confusion about interpretation of clinical tests, and screening tests were considered confirmatory.

Some states had not reviewed and updated laws governing isolation and quarantine for almost a century, and some health officials were not sure what authority they had. Moreover, even in states where laws had been updated and clarified, little attention has been paid to implementation details including coordinating in advance with police and determining who would be called upon to enforce these policies; as a result, health officials could not be sure that their authority would be enforced. Such policies can help to clarify lines of authority for enforcing policies, eliminating ambiguities in policies, and other problems.

In general, health departments were able to develop policies for mosquito spraying and other control strategies with the help of experts from other government agencies, universities, and the private sector. However, public health had not dealt with such an intervention in years. These decisions were further complicated by the need to consider the health risks and environmental consequences of spraying, and varying public attitudes about these matters.

Communication with the Public

The West Nile virus, SARS, monkeypox, and hepatitis A outbreaks provided an opportunity to review and revise public health departments' policies for communicating with the public and the media about public health risks. Improved communications with the public and the media yielded significant benefits to public health departments, as, for example, several public health officials indicated that their department's visibility increased during the West Nile virus outbreak and that the public and the media developed a better understanding of public health and its role in emergencies.

Public health was challenged in some cases when the need to raise awareness about one risk (e.g., the role of mosquitoes in spreading West Nile virus) led to concerns about another risk (e.g., potential harm from the use of insecticides to control the mosquito population). Furthermore, public health officials recognized that motivating behavior change among the public can be difficult even with a well-designed communications campaign.

Public health stressed the need for consistent communications, and also made efforts to target some communications to persons at heightened risk and to minorities and vulnerable populations. During the SARS outbreak, for instance, one local health department in New York worked with universities and high tech companies to reach their Asian employees and others who traveled frequently to Asia. In California, a mosquito control district developed special pamphlets, posters, magnets and other items in multiple languages that were specifically targeted to the large migrant worker community at risk for West Nile virus. In other cases, public health departments attempted to identify institutions that might have access to and credibility with minorities, migrant workers, rural and poor populations and other such groups.

Challenges remained. During the West Nile virus outbreak in Louisiana, for instance, public health agencies had difficulty communicating with and educating the African-American community because of the false impression that West Nile virus was “a white man’s disease.” In California, language and cultural barriers resulted in poor communication between the public health department and the Asian population about SARS. The outbreaks also underscored the need for “surge capacity” to meet the needs of hard-to-reach populations and to address high demand for information from the public.

Working with the media was an ongoing challenge. Health officials emphasized the need for public health to “speak with one voice” and to designate spokespersons and provide training to key staff to prepare them for working with the media. Establishing relationships with the media in advance, and working to anticipate their needs and to provide information that works within their constraints, is important to using the press as a tool to reach the public at large.

Coordination and Communication Within Public Health and With Its Community Partners

Our case studies identified the need for strong communication and coordination between public health and other governmental agencies involved in emergency response. They also identified the need for public health to communicate and coordinate their activities with health care providers and other professionals, such as veterinarians, to detect and characterize outbreaks, as well as to effectively treat patients and prevent further infections. Ensuring communication and coordination with all of the relevant parties is complicated for several reasons.

First, public health agencies, unlike some other emergency responders, do not have command and control authority over important resources—hospitals and health care providers—as well as other government agencies that are needed for an optimal public health response. While most of the needed resources would likely be willing to help in the course of a crisis, they must know how to communicate and coordinate effectively. Moreover, health care providers are needed to help with disease surveillance even before an outbreak comes to light; indeed, the information they provide is a key part of outbreak identification. Communication with health care providers is especially important when the “facts” of a disease outbreak are changing quickly.

Second, as the case studies illustrate, jurisdictional and legal arrangements in public health are frequently complex. State health departments have most of the necessary authority to deal with a public health emergency, but these functions are carried out through a mix of state, regional, county, and city entities, each of which operates in relation to different political leadership structures and local governmental and community organizations. In addition, many look to CDC for scientific advice and other kinds of help. Matters are further complicated by the lack of respect that pathogens show for state and local geography—with outbreaks quickly spreading throughout states and across state lines. As a result, there is likely to be uncertainty over which agency is responsible for what actions, both within and across state lines and with CDC. Appropriate roles can to some extent be worked out in advance through careful regional and state planning, but even so there will always be additional matters that need to be resolved during an emergency.

CAPACITY-BUILDING ACTIVITIES

Knowledge Development: Organizational Learning

State and local health departments in the United States have implemented a variety of activities aimed at enhancing knowledge within their agencies, as well as in the broader community public health system, about public health preparedness. The most common activities appear to be reviewing public health legal authorities, conducting exercises and drills, and implementing other educational opportunities for public health professionals. The process of meeting with first responders and other partners to refine plans seems to have aided communication and to have enhanced knowledge of each community partner's role in emergency preparedness.

Exercises and drills are relatively new additions to the public health knowledge development toolbox. Many health departments are now using them to assess gaps in preparedness plans, enhance capacities, and strengthen relationships with community partners. Although health officials generally voiced wholehearted enthusiasm for the usefulness of these exercises, efforts to evaluate outcomes and cost-effectiveness are in their infancy. Other challenges remain. Most important, key members of the public health response community, including community representatives and laboratory employees, were often not included in exercises.

State and local health departments appear to understand the value of learning from experience as a means of enhancing preparedness for responding to future events. Many public health departments considered their experience in responding to different disease outbreaks and other emergencies as an opportunity for ongoing learning. A number of the states that we visited issued planning or guidance reports that incorporate state and local health departments' experience with West Nile virus, and these proved useful to other states as the outbreak moved westward across the country. A few departments also summarized their experience for publication in the professional literature. However, given the workload of public health departments on a typical day—much less during an emergency situation—there is only limited time for reflection, synthesis, and application of lessons learned for plans for future events, and few models exist for doing so. In addition, we saw very few examples of health departments' use of a formal continuous quality improvement approach or formal after-action reports, which can add consistency and thoroughness to the process of understanding and responding to lessons learned.

Workforce Development

Federal funding has helped to increase the number of disease response staff, laboratory personnel, and communications staff in several states and it also helped to fund training in all of these areas. Clearly, the increase in staff and training helped health departments to conduct investigations, collect data, coordinate prevention and control measures, and respond to the media and the public during the West Nile virus, SARS, monkeypox, and hepatitis A outbreaks.

Despite this infusion of resources, the supply of many types of public health professionals—especially epidemiologists and public health laboratorians—is currently inadequate. Although some state and local health departments have been able to hire additional staff using federal funds, others reported that they are still understaffed and that a crisis would stretch them to the limit. Relatively low government salaries tend to make it challenging to attract and retain well-trained public health professionals. Personnel ceilings and hiring limits at the state and local levels (related to the financial crisis in state and local governments around the country) have made it difficult in some locations to hire new staff, even with new federal funds. In addition, a number of sites have hesitated to hire staff with federal funds—or have done so cautiously—because of concerns about supporting the position when CDC funding runs out.

Although federal funding has allowed for enhanced preparedness activities, it does not yet seem to have filled the vacuum related to general public health training for both public health professionals and public health partners. Indeed, interviewees in one local health department stated that they would like to see additional training opportunities in public health resources and responsibilities more generally.

Infrastructure Development: Laboratory Capacity and Information Technology

Every state we visited has made and is continuing to make substantial improvements in laboratory capacity, increasing both the types and numbers of tests that can be performed. Most immediately, improved laboratory capacity has allowed many states to more efficiently perform tests for West Nile virus, as well as increase the number of labs capable of performing these tests.

Similarly, each state has upgraded its information technology infrastructure. The upgrades have ranged from purchasing cell phones to developing statewide electronic surveillance and notification systems. The simplest activity, supplying cell phones and pagers to public health employees, seems to have increased access to these personnel during outbreak situations. And while some electronic disease reporting and surveillance systems were still in development and thus their role was limited, others were used effectively during the outbreaks we studied. State and local Health Alert Networks have increased communications to state and local health departments, and to a lesser degree to providers, but limitations in the timeliness of the information and penetration into the health care provider community still limit their usefulness. Nonetheless, these were considered positive enhancements by the local public health officials. CDC's electronic, web-based communications tool, Epi-X, also seemed to have helped public health officials who used it keep abreast on events going on around the nation during outbreaks.

Recognizing the limitations of case studies to evaluate the impact of such interventions, we found many examples in which surveillance systems, increased laboratory capacity, information technology, telephone hotlines and other systems have been developed and used in a way that appears to have enhanced the public health response to the outbreaks studied. It should be remembered, however, that investments in systems of this sort are useful only to the extent that well-trained staff are available to use them effectively.

PUBLIC HEALTH DEPARTMENTS HAVE BENEFITED FROM FEDERAL FUNDING AND GUIDANCE

In the years since 9/11, and to a more limited extent before then, the federal government has invested substantial resources in public health preparedness at the state and local level. While the impact of this funding is difficult to measure, the case studies provide many examples in which surveillance systems, increased laboratory capacity, information technology, telephone hotlines, and other systems have been developed and used in a way that appears to have enhanced the public health response to the outbreaks studied. Similarly, state and local health departments report on the positive impact during these outbreaks of additional staff who have been hired, regional epidemiological teams that have been deployed, and so on. The case studies suggest that the required planning and assessment activities have generally also made a positive difference.

Two alternative approaches to evaluating preparedness that might be considered are based on observing a state's public health system's performance (a) during actual public health emergencies similar to those reported here, and (b) in simulated situations such as tabletop exercises. In either case, an after-action report that summarizes observed strengths and weaknesses would have to be prepared. Perhaps more importantly, look-back and tabletop exercises should be imbedded in a quality improvement (QI) process that includes a mechanism to translate what is learned into organizational change.

Beyond this, the case studies also shed some light on the guidance associated with the CDC cooperative agreements, particularly the Focus Areas and Critical Capacities (CC). These measures were developed in part to measure progress that the states were making toward preparedness goals and to ensure accountability for federal funds. Table S.1 presents a summary of our assessment in these terms, highlighting areas in which selected Critical Capacities seemed to provide reasonably reliable measures of public health capacity as evidenced in the four disease outbreaks. Critical Benchmarks are addressed within the body of the report. Focus Area D (Laboratory Capacity—Chemical Agents) was not included in the CDC cooperative agreements since 9/11 and is not addressed here.

Table S.1. Overview of CDC Focus Areas and Critical Capacities

Relevant Focus Area	Comments
Focus Area A: Preparedness Planning and Readiness Assessment	• Case studies reinforce need for "strategic leadership, direction, coordination, and assessment of activities" to ensure preparedness and interagency collaboration (CC #1) and "integrated assessments of public health systems capabilities" (CC #2). They also provide indirect evidence that these capabilities have made a difference in the outbreaks studied. • States were able to respond to public health emergencies (CC #3) with some degree of efficacy.
Focus Area B: Surveillance and Epidemiology Capacity	• Significant progress has been made toward development of real-time electronic disease reporting systems (CC #5), though it is unclear whether adequate training has been offered to ensure that providers know how to use these systems. In addition, veterinarians and other health professionals are generally not included in such systems. • Substantial progress has been made toward development of comprehensive epidemiology response systems (CC #6). This included hiring and training public health staff, setting up regional epidemiology offices, but generally not developing lists of private sector health care providers as suggested by the critical capacities and benchmarks. • We are also aware of only a few formal after-action analyses of natural disease outbreaks, despite the call for them in CC #7.

Focus Area C: Laboratory Capacity—Biologic Agents	• A continuing need exists for better coordination of lab services, the focus of CC #8. • Relevant to CC #9, the case studies demonstrate the importance of "adequate and secure laboratory facilities, reagents, and equipment to rapidly detect and correctly identify biological agents" for natural pathogens.
Focus Area E: Health Alert Network/ Communications and Information Technology	• Health Alert Networks (CC#11) have been developed extensively at the state level and to a lesser extent at the local level. Coverage of private health care providers in these systems, however, is still very limited in many places. • CC #12 through 14 relate to IT connectivity, which was not directly assessed, although our site visits suggested that progress is being made in this area.
Focus Area F: Risk Communication and Health Information Dissemination/Public Information and Communication	• Relevant to CC#15, our case studies identified various weaknesses in risk communication, including some that have been remedied, in part, with CDC funding. We also saw a considerable amount of learning from natural disease outbreaks. • The outbreaks emphasized the need for efforts to communicate effectively with special populations (Enhanced Capacity #11), and case studies indicate some progress in this area, but much more needs to be done.
Focus Area G: Education and Training	• Progress has been made toward ensuring the delivery of appropriate education and training to public health professionals and partners (CC#16), although the depth and breadth varies.

Our assessment also identified areas that seemed important to public health preparedness that are not dealt with, at least directly, in the Critical Benchmarks and Critical Capacities. These include the following:

- **Quality improvement activities**. The importance of preparing formal after-action reports following major disease outbreaks, other public health emergencies, and exercises is recognized in Critical Capacity #7, but the value of this practice goes beyond surveillance and epidemiology (Focus Area B). As we discuss in Chapter 7, encouraging such reports could go a long way toward making state and local health departments into learning organizations that capitalize on experience to improve their capabilities.
- **Leadership**. *Leadership* and the *ability to respond to public health emergencies* are mentioned in Critical Capacities #1 and #3, and our case studies confirm the importance of these capacities (see especially Chapters 5 and 9). The related Critical Benchmarks are narrowly focused, however, and do not seem to be adequate measures of these concepts.

- **Communication and coordination**. As Chapter 5 illustrates, the ability of public agencies to communicate among themselves and with their partners, and to coordinate their activities, is critical during a public health emergency. Communication is covered in Critical Capacities #11 through #14, but these are primarily focused on information technology rather than on the human connections and already formed partnerships that are vital to effective coordination. Similarly, Critical Capacity #3 addresses coordination in the form of planning activities, but whether the resulting plans translate into effective coordination during an emergency is not addressed.
- **Technology and effective public health systems**. Many of the Critical Capacities and Benchmarks focus on information technology, laboratory capacity, and related items without regard to whether public health systems can use this technology effectively in a public health emergency. As discussed in Chapters 7 and 8, some of the health departments we visited invested their federal funds in training existing and hiring new staff for key positions, whereas in others the ability to hire staff has been limited. Compounded with an aging public health workforce, technology alone will not guarantee the ability of health departments to respond to public health emergencies in the future.

CONCLUSIONS

Taken together, four recent, relatively large-scale disease outbreaks in the United States—SARS, monkeypox, hepatitis A, and West Nile virus—tested a wide range of public health capabilities, providing a rare opportunity to assess the quality of the state and local public health response and to gain insights into the nation's overall preparedness for public health emergencies, including a bioterrorist attack. Compared to outbreaks in the past, the public health response seems to have been fairly robust. Public health agencies demonstrated their ability to implement the major components of response to a public health emergency: assessment activities such as outbreak identification, epidemiological and laboratory investigation; population-based disease control activities such as vector control, vaccination and mass prophylaxis, and isolation and quarantine; providing advice to health care providers; communicating within public health, and with health care providers and other government agencies; and communicating with the public directly and through the media.

The public health response, however, was not without problems. Perhaps the most pervasive were communication difficulties within public health agencies and with public health partners, which impeded the public health response to each of the outbreaks. Some problems seem inevitable when dealing with a major/novel disease outbreak, and are likely to be worse for a bioterrorist attack. For newly emerging pathogens, for instance, the "facts" of the outbreak are not clear at the outset, so additional time is needed to understand the epidemiological risk factors and develop effective control strategies. Many of these challenges would likely be more severe in a terrorist incident, and the implications of problems like those seen would be more severe. For other problems, the case studies provide examples of public health agencies learning and adapting during the outbreaks themselves. We saw relatively few instances, however, of more formal approaches to institutional learning. Failure to learn from actual emergencies, which are relatively rare, is a missed opportunity. One strategy that public health agencies can use to capitalize on these opportunities is to make it a practice to prepare after-action reports after major public health events.

On the whole, the case studies demonstrate how critically dependent success is on flawless performance of routine public health functions. In many parts of the country, however, these very capacities have declined, following a disinvestment in public health in the late 20th century. The case studies also demonstrate the need for strong communication and coordination between public health and other governmental agencies involved in emergency response, as well as effective leadership. The case studies also show the special need for communication and coordination with health care providers and other professionals, such as veterinarians, to detect and characterize outbreaks as well as to effectively treat patients and prevent further infections.

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1. INTRODUCTION

State and local public health systems play a critical role in responding to emergencies and are central to the nation's efforts to improve its preparedness for bioterrorism. Public health departments have faced some significant challenges over the years, and while there have been some successes the system as a whole has not always fared well. During the last half of the 20th century, the capacity of state and local public health systems in the United States seriously declined (IOM, 1988, 2003). Problems in the system were graphically displayed during the anthrax terrorist attack in 2001, which revealed weaknesses in laboratory capacity and poor communications with the public and health care professionals.

In the aftermath of these events, Congress and the Department of Health and Human Services (HHS) accelerated efforts to strengthen the public health infrastructure. In the spring of 2002, approximately $1.1 billion was distributed through the Office of Public Health Preparedness, the Centers for Disease Control and Prevention (CDC), and the Health Resources and Services Administration (HRSA) as part of cooperative agreements to strengthen state and local public health.[1] In 2003 and 2004, an additional $2.9 billion was provided to the states for this purpose (Schuler, 2004). These cooperative agreements are based upon an "all hazards approach," i.e., the monies are intended to prepare the country to address biological, nuclear, radiological, chemical or explosive threats, whether these events are caused by terrorism, accident, or natural disaster. These cooperative agreements require that states report back to HHS in terms of their progress toward achieving certain Critical Capacities, using given Critical Benchmarks. These measures, organized according to Focus Areas as described below, also provide guidance to the states about the effective use of the funds.

After three years of major federal investment, it is appropriate to take stock of the current state of preparedness in local and state public health departments and to ask how the federal investment has contributed to improved preparedness. Gauging the impact of this federal investment is challenging. Bioterrorist events and other public health emergencies (thankfully) do not occur often enough to allow reliable measurement of the impact of preparedness activities, or even to develop an evidence base that allows us to know which structures and

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[1] "Cooperative Agreement on Public Health Preparedness and Response for Bioterrorism," Program Announcement Number 99051.

processes are most effective in enhancing preparedness. However, four recent disease outbreaks from 1999 to 2003 provide a rare opportunity to assess the quality of the public health response and to gain insights into overall preparedness. These outbreaks include Severe Acute Respiratory Syndrome (SARS), monkeypox, and hepatitis A, all of which occurred in 2003. We also studied the West Nile virus outbreak, which began in 1999 (before the post–9/11 increase in federal funding levels), and provides an opportunity to observe changes resulting from that funding as well as the impact of West Nile virus–specific and the limited bioterrorism funding available to the states before 9/11.

The response to each of these outbreaks has lessons for different aspects of public health preparedness, as described below. Taken together, however, the four outbreaks test a wide range of public health recognition, response and recovery capabilities. The rationale for the choice of sites is given in Appendix A.

West Nile Virus emerged in the Western Hemisphere in 1999. Because it was new to American public health agencies, outbreak detection and epidemiological investigation were critical and challenging. Mosquitoes and birds are both involved in the virus' transmission cycle, so relationships with veterinarians and entomologists, as well as non–public health agencies such as mosquito control and environmental programs, were important in disease surveillance and control. Communication with the public about personal protective strategies, and with health care providers regarding diagnosis and treatment of a previously unseen condition were critical. West Nile Virus moved across the United States from New York City in 1999 to California in 2004, giving state and local health departments the opportunity to learn from others (Petersen, Roehrig, Hughes, 2002; CDC, 2004).

The global SARS outbreak of 2003 simultaneously affected 29 countries. Unlike West Nile virus, SARS is spread through person-to-person transmission, raising such complicated public health issues as isolation and quarantine. While there were only eight confirmed cases in the United States, 175 reported probable and suspected cases required follow-up and evaluation. Because of the efforts of the World Health Organization (WHO) and CDC, state and local public health agencies in the United States were aware of the outbreak before it affected Americans. In addition, WHO, CDC, and medical researchers around the world worked together to provide up-to-date information that guided prevention and control activities and medical care in the United States (IOM, 2004).

Monkeypox was introduced into the United States in 2003 by prairie dogs that were exposed to the virus during importation and subsequently spread it to humans. There were relatively few human cases, and only a small fraction were caused by person-to-person transmission. Unlike the SARS and West Nile virus outbreaks, Monkeypox was limited mostly to two Midwestern states and was stopped in a matter of weeks, although the fact that monkeypox had never been seen in the United States made outbreak detection challenging. However, the outbreak occurred at the end of the SARS outbreak and shortly after public health agencies throughout the country had prepared for an attack of smallpox, to which monkeypox bears some similarity, so health departments were presumably at a heightened state of alert (CDC, 2003a).

The hepatitis A outbreak in the fall of 2003 was caused by a contaminated food item at one restaurant and was limited to one region in western Pennsylvania. It is more typical of the disease outbreaks that health departments throughout the United States deal with on a routine basis. More people were affected, however, than is typically the case with a food-borne outbreak (or by SARS or monkeypox in the United States), and a more extensive public health response was required (CDC, 2003b).

A LOGIC MODEL FOR PUBLIC HEALTH PREPAREDNESS

Our ability to learn from these outbreaks requires us to address another challenge inherent to the development of valid measures of public health preparedness. The specific preparedness of public health departments during emergencies has been difficult to isolate given that accountability for performance in responding to an emergency is typically spread across a number of public and private entities. Moreover, the evidence base in public health is generally insufficient to determine which specific capacities or processes are linked to desirable outcomes or the levels of those capacities.

To address these challenges, this study uses a logic model. In evaluation research, a logic model describes the sequence of events for accomplishing a goal by synthesizing the main program elements into a picture of how the program is supposed to work. This model is typically displayed in a flow chart to portray the sequence of steps leading to program results. An effective logic model can aid in the development of valid measures of public health preparedness in at least four ways:

- It clarifies common understandings and existing evidence about why a particular activity is expected to lead to greater public health preparedness.
- It clarifies how the activities of individual entities in the community contribute to preparedness.
- It connects activities to outcomes to help estimate and compare the impact of various preparedness activities.
- It clarifies which assumptions and relationships are supported by evidence, and which require further research.

As shown in Figure 1.1, our model for public health preparedness differentiates between "functional capabilities" and "capacity-building activities." Reading from left to right, we see that public health departments engage in a number of activities to enable an effective response to an emergency; these include knowledge development and application activities and the development of partnerships, workforce, and infrastructure. These capacity-building activities contribute to public health's functional capabilities, which are used during the public health emergency. The model presents these capabilities in four categories: assessment, policy development, assurance, and coordination and communication. Both the capacity-building activities and the functional capabilities support the objectives of early outbreak detection, early and effective response, and early recovery and return to normal function. These objectives, in turn, support the broad goal of mitigating mortality, morbidity, stress, and social consequences of a terrorist attack or other public health emergency. Other frameworks commonly used to study public health preparedness, including the "Essential Public Health Services" (EPHS) framework (Public Health Functions Steering Committee, 1994) and the Focus Areas, Critical Capacities, and Critical Benchmarks associated with the CDC Cooperative Agreements, do not distinguish between "functional capabilities" and "capacity-building activities," and thus were less useful for organizing this report.

Although the logic model shows the flow of activity in one direction, public health preparedness should be viewed as a continuous, iterative process. After public health's functional capacities are exercised during an emergency, capacity-building activities begin again, particularly to address problems or gaps identified during the event. Indeed, capacity-building activities and functional capabilities can take place simultaneously. In this report, our evaluation begins with a discussion of functional capabilities and then turns to capacity-building activities, many of which were initiated in response to one or more of the outbreaks.

STUDY FOCUS

This report addresses the following questions:

1. How did the public health system in the United States respond to each of these disease outbreaks? What were the roles of local, state, and federal public health departments, and how did they interact? In what ways did health care providers, community organizations, and other groups participate in the public health response?
2. In what ways did recent federal investment contribute to public health preparedness?
3. What lessons does the public health response to these outbreaks have for future preparedness, particularly to address the threat of bioterrorism? What improvements are needed to public health infrastructure and in functional capabilities to effectively respond to a public health emergency?
4. Was the guidance associated with the CDC cooperative agreements (including the Critical Capacities and Critical Benchmarks) helpful in building capacity for health departments to respond to the outbreaks studied? Are there areas in which guidance is still needed?

We also use this assessment to provide input on the Critical Capacities and Critical Benchmarks associated with the CDC public health preparedness cooperative agreement. As we describe in individual chapters on the different functional capabilities and capacity-building activities, we refer to corresponding capacities and benchmarks, indicating what we learned about public health's capabilities in each area.

Limitations

The study has several limitations. All of the outbreaks involved fairly small numbers of cases and almost no person-to-person transmission, so some of the more challenging aspects of preparedness and response were not tested. While the outbreak response goes beyond the typical day-to-day experience of health departments and related agencies, it may not be indicative of what might happen in a larger public health crisis, such as a major bioterrorist attack or influenza pandemic. The health departments we visited are not, nor were they intended to be, a representative sample of health departments in the United States. In part, we chose states on the basis of their experience with SARS, West Nile Virus, monkeypox, and/or hepatitis A. The local areas we visited within those states were chosen with input from the state health department. As a result, the state and local health departments we visited had experienced the four disease outbreaks to a greater degree than others, and were probably more likely to have adopted "best practices" in a number of areas. On the other hand, the state and local areas were also chosen to reflect different types of health departments and a variety of geographic areas and populations, so that common results could be extrapolated from the jurisdictions studied. As the results indicate, there were a number of common themes across states and the various disease outbreaks.

The case study methodology also has limitations. Many of the observations described in the following chapters are based on interviews with people who may have an interest in presenting their agencies' activities in the best possible light. Moreover, we spoke mostly with health department officials and, to a lesser extent, officials from other agencies (such as mosquito control) and health care providers who were invited to participate by the health departments. We attempted to minimize these limitations by looking for consistency in reports from different sources, by looking for patterns in a variety of state and local areas, and by comparing what we heard in the site visits with published and other written material.

Although we draw some broad conclusions based on available evidence about the impact of federal funding, we did not attempt to analyze state or local budgets for bioterrorism-related or other public health activities, or to directly assess the impact of individual investments made with federal bioterrorism funding.

Finally, we should note that the scope of this research did not allow us to examine some issues in as much depth, or with as much rigor, as might be possible with a more focused case study. Leadership, for instance, is not covered as fully as might be desirable. Recognizing this and the other limitations listed above, we did not attempt to understand the motivation for every action reported, to assess the impact of decisions or prior investments, or to analyze what might have happened if other choices had been made. Rather, our goal was to identify more general trends and conclusions common to more than one state and local area, and issues cutting across the disease outbreaks studied.

Our objective in this report is to summarize the broad outline of the public health response to these outbreaks and analyze it in functional terms. We do not attempt to relate every detail in each state visited. Indeed, much has been published about the epidemiological response and other areas in publications such as CDC's *Morbidity and Mortality Weekly Report*.

Some of the findings from this analysis will not be new to seasoned public health professionals, but we expect that the results will help to illustrate a broad range of issues in public health preparedness for readers who are new to the field or only familiar with some aspects of it.

ORGANIZATION OF THE REPORT

This report is organized as follows. Chapter 2 summarizes the basic epidemiological facts and dimensions of U.S. public health response for four disease outbreaks: West Nile virus, SARS, monkeypox, and hepatitis A. Chapters 3 through 6 analyze functional capabilities as they were deployed during the disease outbreaks. They cover public health assessment (Chapter 3), policy development and assuring necessary health care (Chapter 4), coordination and communication within public health and with its community partners (Chapter 5), and communication with the media and the public (Chapter 6). Chapters 7 and 8 analyze the capacity-building activities enabled or enhanced by federal and other support: knowledge development and application as well as workforce development (Chapter 7), and other infrastructure development activities including information technology and laboratory capacity (Chapter 8). Chapter 9 presents conclusions and cross-cutting themes. Appendix A describes the study's methodology in detail, including the rationale for the choice of study sites. Appendices B to E provide additional information about the response in each state and local area visited. We used the logic model described above to structure our data gathering activities and analyses but found that many issues could have been discussed in terms of capabilities, communication and coordination regarding those capabilities, or in terms of capacity building activities. This structure represents a balance between the logic model and a readable report.

Although the CDC "Focus Areas," "Critical Benchmarks," and "Critical Capacities" have been used to structure federal programs, as we analyzed the data from our site visits we decided that our logic model was a more compelling organizational structure. The CDC measures, for instance, do not distinguish capabilities that are needed during an emergency from activities that health department undertake now so that they will have those capabilities when the time comes. In order to keep the discussion of each Focus Area near the relevant substantive findings, we have placed them in the following chapters.

Table 1.1. Guide to CDC Focus Areas

Focus Area	Discussed in Chapter(s)
A: Preparedness Planning and Readiness Assessment	7 (Organizational learning and workforce development)
B: Surveillance and Epidemiology Capacity	3 (Public health assessment)
C: Laboratory Capacity—Biologic Agents	3 (Public health assessment) and 8 (Infrastructure development)
D: Laboratory Capacity—Chemical Agents	Not discussed[2]
E: Health Alert Network/Communications and Information Technology	8 (Infrastructure development)
F: Risk Communication and Health Information Dissemination (Public Information and Communication)	6 (Communication with the public)
G: Education and Training	7 (Organizational learning and workforce development)

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[2] Focus area D has not been included in recent CDC cooperative agreements.

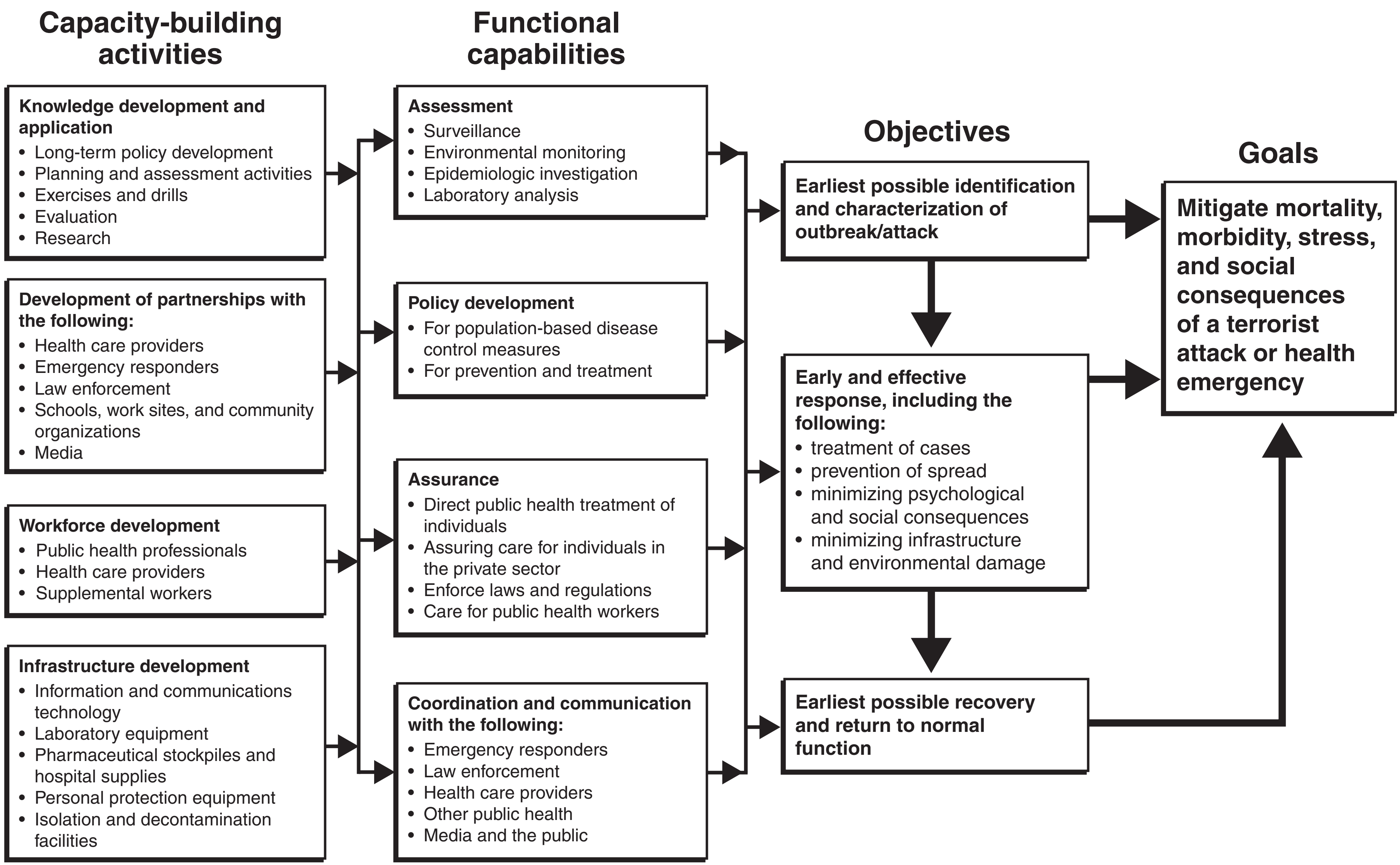

Figure 1.1. Public Health Preparedness Logic Model

2. SUMMARY OF DISEASE OUTBREAKS

In this chapter, we provide some background on the four disease outbreaks covered in this report. Our goal is to lay out basic clinical and epidemiologic information and to provide an overview of the timeline for each outbreak in the United States.

We do not attempt to describe the public health response to these outbreaks, since that will be discussed in subsequent chapters. We do, however, discuss some critical milestones regarding each outbreak, particularly to provide a sense of how each disease developed over time. Additional information about the response in each state and local area visited can be found in Appendices B to E.

The rest of the chapter is organized as follows. We first describe the clinical characteristics of the diseases studied. We then provide an overview of the disease outbreaks, including a discussion of the timing of the outbreak in the United States.

CLINICAL AND EPIDEMIOLOGIC CHARACTERISTICS OF THE FOUR DISEASES

In this section, we describe the basic clinical characteristics of the four diseases studied in this report. Key characteristics such as mode of transmission and treatment methods underlie the public health response for each disease.

West Nile Virus

West Nile virus (WNV) is a mosquito-borne zoonotic infection that is asymptomatic in the majority of humans. In those who develop symptoms, West Nile virus causes a usually mild febrile illness, but can result in meningitis and encephalitis. Severe cases can result in death. West Nile virus is transmitted to humans by Culex species mosquitoes that have bitten an infected animal (birds and horses are particularly susceptible), not by person-to-person contact or directly from infected birds.[3] Thus, public health prevention and control strategies are aimed at reducing the contact between humans and potentially infected mosquitoes. These strategies

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[3] West Nile virus is primarily transmitted to humans through the bite of infected mosquitoes; however, transmission is possible through blood transfusions or transplanted organs from infected donors; transmission from mother to child through breastmilk or prenatally through transplacental transmission has also been recorded. In addition, a few cases of occupational exposure in laboratory workers have been documented.

involve surveillance of humans, birds and other animals, and mosquitoes, mosquito control, personal protective measures, and information campaigns. Eradication of the virus from North America is unlikely, so prevention and control activities are critically important. There is no vaccine for humans, although an equine vaccine has been developed.

SARS

SARS (Severe Acute Respiratory Syndrome) is a febrile respiratory illness that is caused by a coronavirus known as SARS-CoV. The most common symptoms are fever, nonproductive cough, myalgia, shortness of breath, and headache, and in serious cases pneumonia and respiratory distress syndrome. Although it appears to be a zoonotic disease in Asia, in the United States SARS is spread from person to person through respiratory droplets and can be highly contagious. SARS can produce mild illness or can result in severe respiratory distress and death. The disease was brought under control in Asia and elsewhere by traditional public health methods such as isolation and quarantine as well as stringent infection control procedures in hospitals and health care facilities.

Monkeypox

Monkeypox is a zoonotic disease that is primarily spread to humans through contact with infected animals. Clinical presentation of the illness in humans is similar to smallpox, but symptoms are usually less severe, although it can be fatal. Because monkeypox is related to smallpox, the smallpox vaccine can be used as a protective measure preceding or following exposure to an animal or human infected with the monkeypox virus. More importantly, because of the similarities in the disease and the required public health response, the monkeypox outbreak sheds some light on the public health response to a smallpox attack.

Hepatitis A

Hepatitis A is an acute form of viral hepatitis that causes inflammation of the liver. It can be transmitted person-to-person by fecal-oral transmission or through contaminated food and water. Most individuals infected with the disease fully recover. The disease can be fatal to those with compromised immune systems or preexisting liver problems. There is a vaccine for hepatitis A. Supportive treatment is typically given, including immune globulin.

Table 2.1 summarizes the major clinical characteristics of the four case study diseases.

Table 2.1. Clinical Characteristics of Case Study Diseases

	WNV[1]	SARS[b]	Monkeypox[c]	Hepatitis A[d]
Transmission	Primarily vector-borne mosquitoes)	Respiratory droplets (person-to-person)	Zoonotic (close contact with infected animals); Person-to-person through close contact	Contaminated food or water; Person-to-person by fecal-oral route
Incubation	2-14 days	2-7 days; up to 14 days	7-17 days	15-50 days
Presentation	WN Fever: fever, headache, fatigue; occasionally skin rash, eye pain, swollen lymph glands WN Neuroinvasive Disease: *Meningitis*: fever, headache, stiff neck *Encephalitis*: fever, headache, altered mental status ranging from confusion to coma; other neurological symptoms such as weakness or paralysis, cranial nerve palsies, sensory deficits, abnormal reflexes, convulsions	Fever, nonproductive cough, muscle aches, shortness of breath, and headache; chills, diarrhea, nausea, sore throat; pneumonia; respiratory distress syndrome	Fever, headache, other flu-like symptoms, swollen lymph nodes, vesicular rash similar to smallpox	Low-grade fever, malaise, anorexia, nausea, vomiting, diarrhea, abdominal pain, jaundice, dark-colored urine, and light-colored stools; liver inflammation
Treatment	Supportive	Respiratory support; treatment of pneumonia	Supportive; smallpox vaccination within 4 days but may be given up to 14 days after exposure	Supportive; immune globulin
Seriousness of Illness	80% infected are asymptomatic; 1 in 150 have neuroinvasive disease; Greater risk of neuroinvasive diseases with increased age; Unknown risk of poliomyelitis	Highly variable ranging from mild illness to death[e]	Most recover; milder than smallpox, but can be fatal	Most recover; can be fatal in older people and those with liver dysfunction

[a] http://www.cdc.gov/ncidod/dvbid/westnile/clinicians/
[b] http://www.cdc.gov/ncidod/sars/
[c] http://www.cdc.gov/ncidod/monkeypox/index.htm
[d] http://www.cdc.gov/ncidod/diseases/hepatitis/a/fiore_ha_transmitted_by_food.pdf
[e] http://www.phppo.cdc.gov/HAN/ArchiveSys/ViewMsgV.asp?AlertNum=00125

OVERVIEW OF DISEASE OUTBREAKS

We now present a brief overview of the disease outbreaks in the United States, with an emphasis on the sites visited. Included in this discussion are timelines indicating major milestones in each outbreak's progression. These timelines also show the timing of disease outbreak milestones in relation to federal funding.

A summary table providing an overview of the four disease outbreaks appears at the end of this chapter (Table 2.2).

West Nile Virus in the United States

The scope of West Nile virus in the United States has been broad. The disease first emerged in 1999, and by fall 2004 the disease was seen in all but four states. Over a six-year period, 16,637 cases and 653 deaths were recorded. The scope of the disease thus required a significant and prolonged public health response. However, because the disease outbreak occurred in stages, some states had a relatively long time to prepare for a local outbreak and, as we shall see in subsequent chapters, were able to learn from the experience of other states that had incurred the outbreak sooner.

The first documented appearance of West Nile virus in the Western Hemisphere occurred in August 1999 in New York City. Sixty-two cases were observed and seven deaths resulted. The number of confirmed human cases in New York State dropped in 2000 and again in 2001, and then went up in 2002 and 2003.

Beginning in 1999, the virus spread rapidly throughout the United States and established itself as enzootic among birds, with horses and humans as incidental hosts. By the summer of 2000, West Nile virus had been detected in 12 northeastern and mid-Atlantic states. By summer of 2001, it had been detected in 27 states and the District of Columbia; this number had increased to 39 states by summer 2002, and to 45 states by summer 2003. By fall 2004, West Nile virus had been detected in every state except Alaska, Hawaii, Maine, and Washington.

In Louisiana, the virus was first detected in horses and sentinel chickens in May and June 2002, with the first human cases showing up in hospital emergency departments in July. The Louisiana outbreak lasted until the first week in November, peaking in the second week of August when 47 suspected cases received laboratory confirmation. By the end of 2002, there were 329 confirmed cases of West Nile virus in Louisiana and 24 deaths associated with the disease. The outbreak spread quickly across the state; human cases were eventually reported in 41 out of the state's 64 parishes, with the highest rates of infection in the southwestern part of the state where the outbreak originated.

Although West Nile virus first appeared in Eastern Colorado in 2002, a major outbreak occurred throughout the state in 2003, with birds testing positive as early as mid-June throughout the state. The first human case was reported on July 22, and ultimately Colorado reported a total of 2,947 human cases of West Nile virus infection in 2003.

In contrast with the other states in our study, California had a relatively long time to prepare for a major West Nile virus outbreak. The first human case was reported in 2002 in Los

Angeles County. In August 2003, a case was found in a woman who apparently had been infected while in Colorado, and the 2003 outbreak in California eventually consisted of 3 human cases. The three human cases and a number of animal cases were mostly confined to southern California. In 2004, however, there were 737 reported human cases.

SARS in the United States

Although the SARS outbreak of 2003 had its greatest impact outside of the United States, it nevertheless tested the federal, state, and local public health systems. While there were only eight confirmed cases and no deaths in the United States, 175 probable and suspected cases required follow-up and evaluation. SARS represented a truly global outbreak. Worldwide, 8,098 cases were reported, and as of 2003, 774 deaths had been confirmed. Worldwide publicity surrounding the SARS outbreak in Asia, which began in China in 2002 but was not made public until early 2003, meant that public health departments across the United States began simultaneously to take steps to prevent the disease's spread.

SARS emerged in Guangdong Province, China, in November 2002. The specific identity of the disease was not immediately known. In February 2003, China notified the World Health Organization (WHO) of 305 cases of acute respiratory syndrome of unknown etiology. On March 12, WHO issued a global alert concerning SARS and recommended worldwide surveillance for the disease. Three days later, CDC issued a preliminary case definition and recommended enhanced surveillance in the United States. CDC advised passengers arriving from Hong Kong, Guangdong Province, or Hanoi (locations with large active SARS outbreaks) to seek medical attention for febrile respiratory illness and advised the public health community to conduct heightened surveillance among arriving passengers. On March 24, CDC announced that a previously unknown coronavirus (SARS-CoV) had been found in SARS patients. As of March 26, 1,323 suspected and/or probable SARS cases had been reported in 14 locations worldwide.

Because the New York City and State health departments had been alerted about the illness of travelers who turned out to have SARS, these departments were aware of SARS early. SARS was made a reportable disease in New York on April 21, 2003, as the result of an emergency designation process, which had been put into place after anthrax, to allow the state health commissioner to designate reportable conditions subject to retroactive review and approval by the state health board.

Other states also began early surveillance. On March 17, 2003, the Milwaukee Wisconsin health department developed a screening form for patients with SARS-like symptoms, and distributed it to local emergency departments. SARS presented difficult infection control issues, and many states developed and disseminated coordinated strategies despite the fact that they had few or no suspected SARS cases. Knowledge about the global outbreak developed and changed on a daily basis, making it difficult for some health departments to keep up. In response to warnings of the outbreak in Asia, the California state health department created a SARS response team comprised of a clinical group to follow up on individual cases, an infection control group, an epidemiology group, and a laboratory group.

On April 4, 2003, President Bush signed an executive order adding SARS to the list of notifiable communicable diseases. By the end of that month, 289 cases of suspected SARS had been reported to CDC from 38 states. The last of these cases was reported on April 11, 2003. Sixty cases were tested for SARS-CoV; of these, eight were positive for the virus.

Monkeypox in the United States

The monkeypox outbreak lasted only two months, from May to June 2003. The first human case of monkeypox in the United States came to light in central Wisconsin in May 2003. A trace-back investigation identified prairie dogs as the source of the outbreak, and helped to uncover human cases associated with a pet distributor in Illinois who had shipped the animal that infected the first Wisconsin cases. In June 2003, CDC announced that a monkeypox-like orthopox virus was the etiologic agent responsible for the disease. A total of 72 cases were reported over a two-month period, with no deaths. The final case was seen on June 20, 2003.

Hepatitis A in Pennsylvania

The hepatitis A outbreak had a similarly brief time span. The first case was found in Western Pennsylvania; its origins were traced to contaminated green onions, imported from Mexico, that had been used in a salsa served in a Beaver County restaurant. A total of 660 cases were reported, resulting in 3 deaths.

Table 2.2 summarizes the major characteristics of the four disease outbreaks discussed in this chapter.

Table 2.2. Overview of Disease Outbreaks

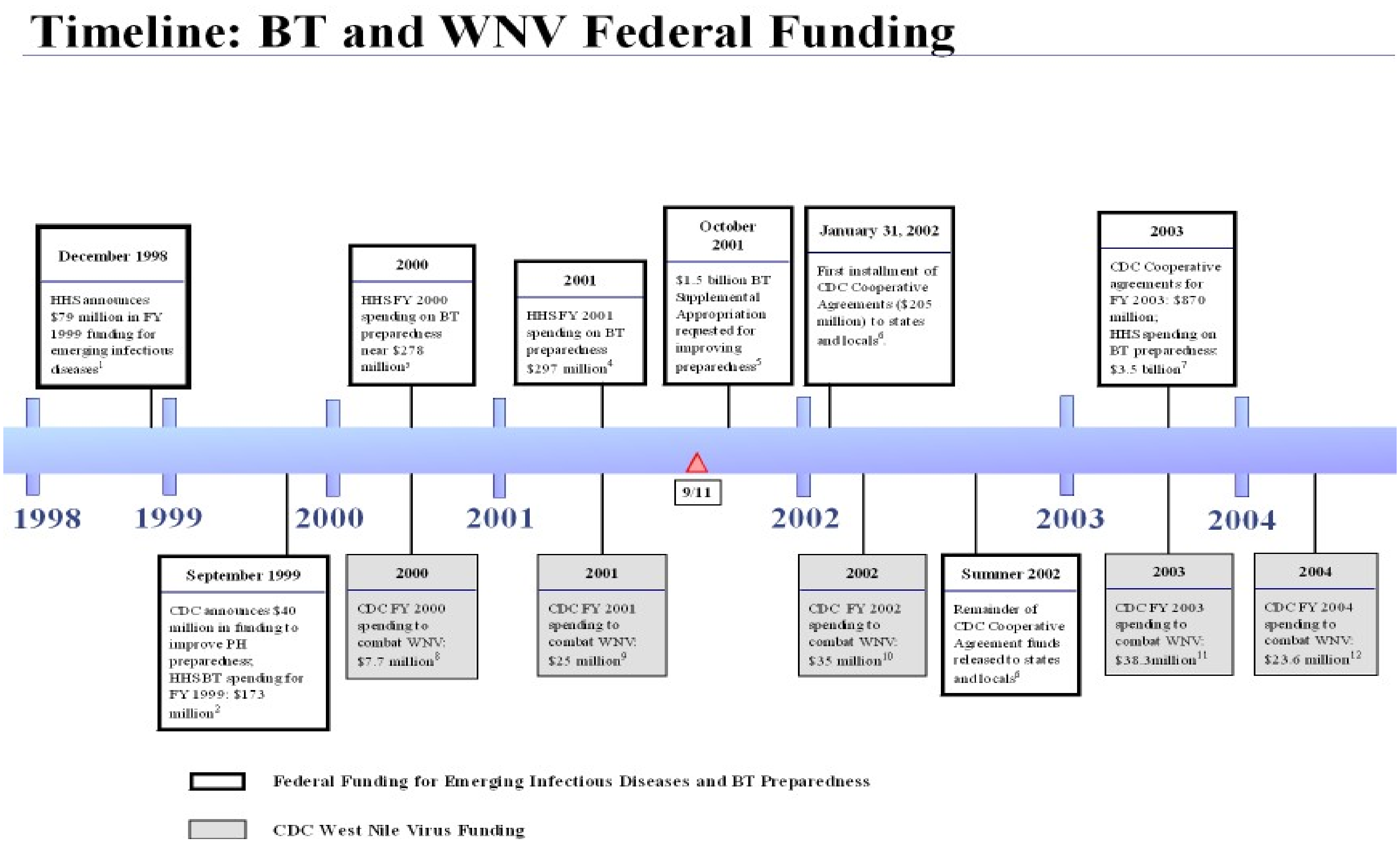
	WNV[a]	SARS[b]	Monkeypox[c]	Hepatitis A[d]
Scope	National over 6 years	Global	Six Midwestern states	County in PA
Timing	1999-2004	February – May 2003 (in US)	May – June 2003	October-November 2003
Origin/Source	Eastern hemisphere	Guangdong Province of China	Prairie dogs infected by rodents imported from Africa	Contaminated green onions imported from Mexico
Transmission	Vector-borne (mosquitoes)	Respiratory droplets (person-to-person)	Zoonotic (close contact with infected animals); Person-to-person through close contact	Contaminated food or water; Person-to-person by fecal-oral route
Incubation	2-14 days	2-7 days; up to 14 days	7-17 days	15-50 days
Pathogen	Arbovirus	Novel coronavirus (SARS-CoV)	Orthopox virus	Hepatitis A virus (HAV) (picornavirus)
Case Fatality Ratio	3-15% among those with serious illness; Highest among the elderly	Overall 9.6%; Reports as high as 50% in people 65 and over	1-10% reported in medically underserved areas of Africa; 0% in US cases	0.3%; As high as 1.8% in persons 50 and older
Number of Cases	16,637 cases and 653 deaths in 6 years[e]	US: 29 probable; 8 confirmed; 0 deaths; Worldwide: 8,098 cases; 774 deaths in 2003	72 cases and 0 deaths	660 cases and 3 deaths
Prevention	Public campaign re: personal protective measures	Respiratory etiquette; Masks for all presenting to emergency departments with fever/cough	Smallpox vaccine for exposed; Embargo and prohibition on the importation, interstate transportation, sale, and release into the environment of certain rodents and prairie dogs	Hepatitis A vaccine and immune globulin within 2 weeks of contact
Control	Mosquito larviciding and adulticiding; Draining public sources of standing water	Identify potential cases; Isolation of suspected cases; Contact tracing (critical to containment)	Isolation of cases; Isolation/euthanasia of suspected infected animals	Hand washing and food safety interventions

[a] http://www.cdc.gov/ncidod/dvbid/westnile/clinicians/
[b] http://www.cdc.gov/ncidod/sars/
[c] http://www.cdc.gov/ncidod/monkeypox/index.htm
[d] http://www.cdc.gov/ncidod/diseases/hepatitis/a/fiore_ha_transmitted_by_food.pdf
[e] Total cases and deaths derived from the following sources:
http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount04_detailed.htm
http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount03_detailed.htm
http://www.cdc.gov/washington/testimony/In1062004207.htm

http://www.cdc.gov/od/oc/media/pressrel/r030708.htm
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5123a1.htm
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4946a2.htm
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4841a3.htm

Figure 2.1 provides a timeline of federal funding for improving public health preparedness and for combating West Nile virus over a period of seven years (1998-2004). The timeline offers a preliminary view of the availability of federal funding to improve public health preparedness and to fight West Nile virus. The outbreak emerged in 1999, more than two years before significant new federal funding for bioterrorism in response to 9/11. However, states affected in the first three years received special funding to help fight the disease. For example, in 2002, CDC provided $35 million to assist states; Louisiana alone received $1.3 million, much of which was used to develop mosquito control programs. In 2004, CDC provided over $23 million targeted to support mosquito control efforts, help enhance surveillance, supplement testing, and support public education campaigns.

Figure 2.1. Timeline for BT and WNV Federal Funding



NOTE: BT = Bioterrorism.

3. PUBLIC HEALTH ASSESSMENT

In this chapter we examine the public health assessment process used during the four outbreaks. Assessment is one of the three core functions of public health, and it includes efforts to collect, assemble, analyze, and make available information on the health of the community, and on community health needs (IOM, 1988). This chapter focuses on four key components of assessment in the context of public health preparedness: surveillance, epidemiological investigation, environmental monitoring, and laboratory analysis. Our goal is to understand which public health assessment activities were undertaken during the West Nile virus, SARS, monkeypox, and hepatitis A outbreaks and how these activities contributed to the public health response. We also seek to identify how public health capabilities changed as a result of these outbreaks and to assess the impact of CDC bioterrorism and other funding programs on these capabilities. The chapter identifies broader lessons learned from the public health assessment activities undertaken in response to these outbreaks.

This chapter addresses two of the CDC Focus Areas and Benchmarks: Focus Area B, Public Health Surveillance and Epidemiology Capacity, and Focus Area C, Laboratory Capacity for Biological Agents.

The rest of the chapter is organized as follows. We begin with a discussion of relevant public health assessment activities undertaken during the course of the outbreaks under study, with a focus on the four key components listed above. We then summarize lessons learned and discuss the impact of federal funding. We conclude with a discussion of the relevant CDC Focus Areas.

PUBLIC HEALTH ASSESSMENT ACTIVITIES

Surveillance

Public health surveillance is the systematic collection, analysis, interpretation, and dissemination of health data on an ongoing basis. Surveillance activities are undertaken to gain knowledge of a pattern of disease occurrence and potential in a community and ultimately to control and prevent the disease in the community. For two of our case studies (West Nile virus and monkeypox), the public health system served to detect and characterize the first cases of new and unusual pathogens. In the case of hepatitis A, the system was called upon to identify a new outbreak of a disease that was already well known. In relation to SARS, the U.S. public health system did not need to identify the outbreak, which began in Asia; surveillance activities instead focused on understanding patterns of the disease's occurrence in the United States.

In this subsection, we discuss activities relating to four components of surveillance: outbreak identification, disease reporting, development of special surveillance systems, and syndromic surveillance.

Outbreak Identification. Several of the case studies illustrate the important role played by an astute physician or other health professional in identifying a disease outbreak. West Nile virus first came to light in August 1999 when an infectious disease physician at a small hospital in Queens called the New York City health department about two otherwise healthy elderly patients with severe muscle weakness that the physician thought could be botulism. A health department epidemiologist went to the hospital to investigate, and soon three additional cases in the same hospital were found. At this point, the health department initiated active surveillance[4] by contacting area hospitals by phone or fax, and by initiating collection of cerebrospinal fluid (CSF), which had been drawn for other purposes from nearby hospitals. These initial surveillance activities led to the timely initiation of the epidemiologic analysis, which resulted in the identification of the disease outbreak and initiation of disease control activities approximately one week after the initial phone call (the latter steps in this process will be discussed later in this chapter).

The identification of the monkeypox outbreak unfolded more slowly. In May 2003, a veterinarian treated a sick prairie dog that had bitten a child in Marathon, Wisconsin. The child subsequently became ill. The veterinarian noticed that the prairie dog had an enlarged lymph node, and sent samples to the Marshfield Clinic laboratory for analysis. A gram-negative bacterium was isolated from the prairie dog's lymph node, suggesting plague or tularemia, both of which can infect prairie dogs. (It was later determined that the bacterium isolated was a contaminant in the culture, and was not the infectious agent that was causing illness in either the prairie dog or humans.) Because both plague and tularemia are reportable diseases, the local health department was notified. However, neither the physicians treating the original patient nor lab personnel and health department officials were alarmed, since all suspected a bacterial rather than a viral illness (CDC, 2003; Reed et al., 2004). Moreover, despite heightened awareness of the possibility of a terrorist attack using smallpox, this disease was not a concern here since it is not transmittable from animals to humans, and it was clear that the boy's illness followed exposure to the sick animal.

The outbreak was identified about two weeks later after the original patient's mother became ill and further laboratory tests were done at the Marshfield clinic, while another patient, a meat inspector and distributor of exotic pets, presented at a hospital emergency department in the Milwaukee area with a febrile vesicular illness and was reported. A state epidemiologist connected the three cases, and soon afterwards the diagnosis of monkeypox became clear.

An astute physician also played a role in the identification of the hepatitis A outbreak in Beaver County, Pennsylvania. An emergency department physician, who had recently completed a bioterrorism course, noticed a cluster of cases of patients with flu-like illness, plus jaundice and abdominal pain. The jaundice and abdominal pain suggested hepatitis, and laboratory testing confirmed that the hepatitis A virus was responsible. Hepatitis A is a reportable disease, so the physician notified the Pennsylvania Department of Health. Although the cases would likely have been seen in laboratory surveillance some days later, the physician's report led to earlier detection and response (Hersh, 2004; Bell, 2004).

Disease Reporting. The cases of SARS and West Nile virus illustrate public health's ability to assess the severity of an infectious disease outbreak. Critical to this role is the notification of other health departments about the outbreak.

The first SARS cases came to light in Asia, affording time for the WHO and CDC to alert state and local health departments before the first cases appeared in the United States. Similarly, after 1999, health departments beyond New York City were alerted to the possibility of West Nile virus in their jurisdictions before they occurred. To spread the word on SARS and West Nile virus, state and local health departments throughout the nation relied on health alert networks, electronic disease reporting systems, and blast fax systems, as well as personal contacts with the health care community forged through bioterrorism preparedness work.

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[4] Active surveillance includes efforts by the health department, beyond passive receipt of disease reports, to reach out to health care providers to identify individuals who may have the condition in question.

Federal bioterrorism and other funding in recent years facilitated much of this communication, as will be discussed in Chapter 8.

The New York City and State health departments first became aware of SARS when a Chinese physician who had recently visited New York City became ill and required medical attention in Germany on his way back to China. German health officials reported this case to CDC, which notified New York, and city health officials followed up on his status by telephone. The state health department used its e-mail/blast fax system to alert local health departments and hospitals throughout the state about the cases, diagnostic criteria, and reporting procedures. SARS was also designated a reportable disease in New York before it became so nationally. This was possible because of an emergency designation process, put into place after the anthrax attacks, which allows the state health commissioner to designate reportable conditions subject to retroactive review and approval by the state health board.

The Milwaukee, Wisconsin, health department developed a screening form that the emergency departments could use for patients with SARS-like symptoms, and distributed it to regional emergency departments using a preexisting electronic communication system. In addition, information from the forms was transmitted back to the health department daily through the same system (Foldy et al. 2004).

After the first human West Nile virus case was diagnosed in Illinois, one county health department requested that hospitals accelerate their normal reporting procedures for encephalitis cases from within 7 days to 24 hours, and to fax rather than phone their reports. This was intended to enable the health department to create GIS maps to track the outbreak in real time and guide mosquito control and public information interventions. Although the cooperation of hospitals made the 24-hour reporting requirement possible, the department quickly became overwhelmed with the sheer volume of faxes. In addition, case report forms were coming in with incomplete information as a result of the reduced reporting time.

Overall, standard notifiable disease reporting systems, augmented by special efforts to inform physicians and other health care providers, worked reasonably well to identify SARS and West Nile virus cases. By the time that SARS struck, new information technology systems to support disease reporting were in place in many parts of the country. One county in California, for instance, modified a preexisting syndromic surveillance system to include respiratory signs and symptoms as well as travel history consistent with the SARS case definitions. Between this and a preexisting 24-7 notifiable disease reporting system, the health department received 85 case reports by the end of the outbreak, 15 of which were reported as suspect cases. The successful functioning of these systems depends on good relationships between public health and health care providers, a topic that is discussed further in Chapter 5.

Even with notification, identification of cases of a new disease can be difficult. For example, the first human case of West Nile virus in Louisiana in 2001 was misdiagnosed even though two years had passed since the disease first emerged in New York, and despite a heightened state of alert because bird and equine cases had already been seen in Louisiana. This patient, who subsequently died of the disease, may have been missed because she was comatose on arrival at the emergency department and it was initially assumed that she had had a stroke. Moreover, her symptoms were not typical of West Nile fever or encephalitis. The first correctly identified case in Louisiana, on the other hand, had typical symptoms of meningitis or encephalitis as well as a personal history that put him at risk for West Nile virus: he was homeless and lived outdoors next to a horse stable. He was tested for Eastern Equine Encephalitis, and reported to the regional health department since meningitis and encephalitis are reportable conditions in Louisiana.

Development of Special Surveillance Systems. Surveillance for West Nile virus relied on a number of special surveillance systems that were either in place or were set up quickly once the outbreak was known. For instance, the New York City health department was able to actively screen cerebrospinal fluid (CSF) that was collected in nearby hospitals for other reasons. The City health department, with support from CDC, was also able to implement community-based seroprevalence surveys in 1999 and 2000 (Mostashari et al., 1999). CDC also supported a seroprevalence study at Slidell Memorial Hospital in Louisiana in 2002.

In west central New York, the Finger Lakes Office of Surveillance and Epidemiology (FLOSE) operated a regional CSF surveillance program before the West Nile outbreak, and in 2000 started active surveillance for encephalitis and meningitis in anticipation of the outbreak reaching that part of the state. FLOSE is a regional surveillance program based at the University of Rochester, but it has offices in the Monroe County health department's building and covers eight neighboring counties. Funded through the CDC Emerging Infections Program, FLOSE predates the post-September 11 public health preparedness cooperative agreements (University of Rochester Medical Center, undated).

Illinois has a surveillance system for central nervous system illnesses that dates back to a 1975 outbreak of mosquito-borne St. Louis encephalitis. During arboviral season (May 15 through October 31 or the first killing frost) CSF specimens are requested from all patients who present with clinical or laboratory symptoms of nonbacterial central nervous system infections or with acute flaccid paralysis. These specimens are tested for the presence of antibodies to the arboviruses; if the results are positive, the appropriate local health department is informed and initiates epidemiologic and clinical investigations. Surveillance case data are forwarded to the state health department, which in turn forwards the information to the CDC (Cook County Department of Public Health 2003).

Syndromic Surveillance Systems. Syndromic surveillance systems[5] were implemented in a variety of ways in the states that we visited. New York City, for instance, monitors the chief complaint of emergency department admissions and Emergency Medical Services (EMS) runs through an automated data system (Heffernan, et al., 2004). During the SARS outbreak, health officials in one New York county made daily calls to hospitals in the county to get the number of total and influenza-like illness visits. After the outbreak, this county started a project to look at every patient admitted to hospital with pneumonia to make a more detailed diagnosis, and this is expected to be able to detect a reemergence of SARS or similar illnesses in the future. Local health departments in California and elsewhere also described syndromic surveillance systems that had been developed with federal bioterrorism funding.

Most syndromic surveillance systems are designed for rapid detection of large-scale bioterrorist attacks or natural disease outbreaks rather than the case identification and follow-up that were needed to control SARS. However, while the number of actual or even possible SARS cases was not sufficient to trigger these alert systems, the lack of a signal reassured health officials that large numbers of cases were not going undiagnosed.

Environmental Monitoring

Environmental monitoring was an important component of the public health assessment for those diseases spread through contact with animals or insects. Many of the examples seen in our cases studies related to West Nile virus. State and local health departments throughout the country implemented a great variety of dead bird, sentinel chicken, equine, and mosquito

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[5] Syndromic surveillance is the statistical analysis of data on individuals seeking care in emergency rooms or other health care settings with pre-identified sets of symptoms thought to be related to the precursors of diseases caused by bioterrorist attacks and emerging infections of interest. By

pool/trap surveillance systems. For instance, the Louisiana Office of Public Health began surveillance for West Nile virus in the spring of 2000, less than a year after it was first seen in New York. These efforts included identifying 16 hospital emergency rooms as sentinel surveillance sites; establishing and maintaining sentinel chicken flocks; trapping and testing mosquitoes; and testing horses, birds, and humans that exhibited symptoms. Sentinel chicken surveillance involves setting caged chickens out into the environment to be monitored for West Nile virus.

Although it did not see substantial West Nile virus activity until 2004, California began planning for an outbreak of WNV in 1999. A comprehensive mosquito-borne disease surveillance program has monitored mosquito abundance and activity since 1969, and immediately following the 1999 New York City outbreak, the state reviewed its surveillance activities and developed an enhanced Mosquito-Borne Virus Surveillance and Response plan to be used by local health departments and vector control agencies. The Mosquito and Vector Control Association of California and the University of California at Davis and Berkeley both contributed to the development of this plan, which provides a semi-quantitative measure of virus transmission risk based on six to eight surveillance factors such as environmental conditions, mosquito activity, and dead birds (California Department of Health Services, 2004). The state health department also strengthened its relationship with the University of California Davis Center for Vectorborne Diseases, which engages in trapping and testing of various mosquito species for a number of arboviruses.

In 2002, Chicago implemented a city-government-wide plan in which the Streets and Sanitation Department picked up dead crows and blue jays, and the health department arranged for them to be tested at local laboratories. 3-1-1 calls (the city's nonemergency reporting line) about dead birds were diverted to Streets and Sanitation, which then picked up the birds and forwarded the information to the Chicago Department of Public Health (Chicago Department of Public Health, 2003).

Although such systems were used to target mosquito control activities, opinions varied across and within the states we visited about how such systems should be set up and operated, as well as their relative value for public health. Some states, for instance, considered sentinel chicken surveillance to be essential; others did not see its value. State and local health

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focusing on symptoms rather than confirmed diagnoses, syndromic surveillance aims to detect bioevents departments also differed in the way they implemented dead bird surveillance. Some tested all dead birds that were reported, while others only tested a fraction or all until a positive bird was found, and stopped testing others from that area. One state tested all birds from a county near the state laboratory, but only a small fraction from other areas. Other states do not test any birds for the virus, but carefully monitor the number and location of all dead birds (Eidson et al. 2001).

Epidemiological Investigation

An urgent case report or an apparent increase in cases in a surveillance system does not necessarily require a public health response. To determine whether such signals represent an outbreak requiring intervention, a local or state health department would carry out an epidemiologic investigation (Reingold, 1998). The experiences of SARS, West Nile virus, monkeypox and hepatitis A indicate that public health departments in the United States can mount effective investigations, at least at the relatively small scale necessary for these outbreaks. Doing so, however, stressed the public health system, and the problems that were encountered suggest that responding to larger outbreaks would be more problematic. In this subsection, we discuss the initiation of such investigations in our case studies, as well as the responsibilities for conducting and managing the investigation.

Initiation of Epidemiological Investigations. Shortly after the original cases of West Nile virus were reported in New York City in 1999, epidemiologic analysis of the results of active surveillance showed that the cases were clustered in a small area in northern Queens and that mainly older people were affected. These facts, together with clinical and laboratory results on the reported cases, suggested that an arbovirus was responsible. Since this implicated mosquitoes in the chain of transmission, New York City began mosquito control activities about a week after the original call (Fine and Layton, 2001; GAO, 2000).

The outbreak was originally thought to be St. Louis encephalitis (SLE). However, about a month after the first call, officials identified West Nile virus as the responsible agent. The turning point was the detection of West Nile virus in birds at the Bronx Zoo. Although the health department was aware of reports earlier that summer of unusual numbers of dead birds at the zoo and throughout the city (a fact that would rule out SLE, which does not kill its avian

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earlier than would be possible with traditional surveillance systems.

host), health officials did not originally "connect the dots" and understand the implications for public health.

Although the first monkeypox case in Wisconsin was not originally recognized as such, the local health department was notified since both plague and tularemia were suspected, and a local investigation was initiated on the basis of those tentative diagnoses. A statewide epidemiological investigation began when another human case was identified in another part of the state. Since the first case had involved a child bitten by a prairie dog that had been sold at a pet "swap meet" (large, unregulated, weekend events to buy and sell pets), the outbreak investigation involved searching for other prairie dogs sold at the same swap meet, and this search soon expanded to other states. In addition to the state and local health departments, the Wisconsin and U.S. Department of Agriculture were also involved because of their jurisdiction over animals. Investigators contacted people who had been exposed and also traced prairie dogs sold at pet swap meets, where there are often no paper trails for sales and where large numbers of people potentially have multiple exposures.

The investigation eventually found that five human cases in Wisconsin were exposed to prairie dogs from a pet distributor in Illinois. The Wisconsin Department of Public Health subsequently notified its counterpart in Illinois, which began its own investigation. Tracking the possibly exposed prairie dogs through the swap meet was more difficult than anticipated. The owner of the Illinois pet distributor had a relative who also owned pet shops, and health officials were concerned that some of the animals were being moved to the other pet shops despite an order to keep them in place. In addition, people were not forthcoming about having purchased these animals, a number were unwilling to give up their pets, and several denied investigators access to their homes.

Regional Epidemiology Offices. The epidemiological investigations for the hepatitis A outbreak in Pennsylvania was handled by the state health department through the South West Regional Office because the outbreak occurred in a part of the state that is not served by a local health department. Because hepatitis A is a food-borne disease, the Pennsylvania Department of Agriculture and the U.S. Food and Drug Administration were also involved in the investigation (Bell, 2004; Hersh, 2004).

A regional epidemiology office also played a key role in the investigation of a possible SARS cluster in New York. The first case involved a one-year-old girl, who had been adopted from China and was showing respiratory symptoms. The girl was brought to an outpatient clinic at a county medical center, where she was evaluated and later discharged to her home in a neighboring county. Five days later, another child from the same adoptee group developed respiratory symptoms in another county and was reported to the state health department. The state initiated active surveillance of the entire adoptee group and their families, including some who were out of state, and as a result alerted the health department in the first county about the first case. Working with the state regional epidemiology office, four symptomatic people in the area we visited were identified and investigated. The local county public health departments, with support from the regional epidemiology office, handled contact tracing. None of these people were ultimately confirmed as having SARS.

Overlapping Investigations. Disease outbreaks do not follow health department jurisdictional lines. Consequently, epidemiological investigations often overlap. During the monkeypox outbreak, for instance, local health departments in Wisconsin led the epidemiologic investigation with support from the state health department. In central Wisconsin, two counties coordinated to investigate the cases in their region, while in southeastern Wisconsin, the investigation was led by the Milwaukee Health Department. The Illinois Department of Agriculture set up an investigation that was separate from that of the local health departments.

The California Division of Communicable Disease Control created a state-level SARS response team comprised of a clinical group to follow up on individual cases, an epidemiology group for tracking the number of cases and managing the database, an infection control group, and a laboratory group. Each "group" consisted of one or two individuals. Together, these groups essentially served as a virtual emergency operations center at the state level. Information flowed between these groups and the local health departments. Weekly conference calls were held, which both state and local health officials reported were very helpful in responding to the SARS outbreak. Local health departments raised questions that the state might not have anticipated and state officials provided valuable information, guidance and support to local health departments. These calls identified the lack of an adequate database for tracking cases. Excel spreadsheets were used, but were found to be cumbersome and laborious to complete.

Overlapping investigations (discussed further in Chapter 5) sometimes created problems and confusion. For instance, some individuals interviewed as part of the epidemiological investigation were confused about why they had been contacted twice. Overloaded investigators, in some cases, had to enter the information in different formats into two separate databases. Moreover, overlapping investigations sometimes used different numbers on their line lists[6] to identify patients, confusing communication between the parties involved in the investigations.

Caseload Management. The epidemiological capacity of many local health departments was taxed in a number of instances involving our case studies, especially when active surveillance and public notices led to an excess of reported cases, including individuals with other illnesses, or simply the "worried well." For example, in the case of West Nile virus, health alert notices and frequent news releases from the Colorado Department of Public Health and Environment (CDPHE) put physicians, hospitals, laboratories and the public on the alert. During the 2003 outbreak, CDPHE required local health departments to conduct epidemiological investigations on all cases with a positive laboratory test result. The state health department received information on cases in various ways: from local health department and hospital labs through the Colorado Electronic Disease Reporting System (CEDRS); by phone and by fax from individual health care providers, hospitals not connected to CEDRS, private laboratories; and from patients themselves. The large volume of cases in a short period of time required public health officials to adjust their operations to meet the increased demand. One large, multi-county health department, for instance, has a centralized system of disease control response. Two people are dedicated to epidemiological investigations and a disease control team is available for surge capacity. In addition, nursing field staff can be brought in to assist with investigations. At the peak of the West Nile virus infection in 2003, that department was receiving approximately 20 case reports per day. During that time, seven people were conducting interviews. In the middle of the West Nile virus outbreak, the same department also investigated three different food-borne illness outbreaks and two shigellosis outbreaks, which further stretched their epidemiological resources.

A smaller, rural county in Colorado also instituted a centralized management system for handling West Nile virus case investigations. As positive cases came in, they were funneled through the Disease Control Program Director or Assistant Director, who would assign the case to an Emergency Response Team (ERT) member to conduct the investigation. Health department staff worked closely with the local hospital infection control coordinator so that all

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6 A line list is a numbered list of cases under investigation; each listing includes data for each case such as name, phone number, other pertinent contact information and key exposure and demographic characteristics

cases diagnosed in the hospital were reported directly to the Disease Control Program Director or Assistant Director.

In a third Colorado county health department, the nurses in the communicable disease division of the health department normally investigate cases during an outbreak. However, in July 2003 the number of cases of West Nile virus infection increased dramatically in less than two weeks, requiring other staff to assist with the investigations. Four nurses were the primary investigators, but as the number of cases increased, duties were shifted. Everyone, including the director of the health department, made time to conduct interviews. They often found it difficult to reach people during the daytime hours, so they instituted flex hours with some of the nurses working into the evening. Staff worked long hours but felt that they were successful in maintaining the department's normal functions. However, they felt that this was partially due to the fact that they were dealing only with West Nile virus and were fortunate that no other disease outbreaks occurred at the same time.

Laboratory Analysis

Public health laboratories had varied responses and roles in the outbreaks studied. In general, the laboratories had the technical capabilities to perform required tests, although they were often overwhelmed with the volume of samples, especially with West Nile virus, and in some cases were understaffed. Additionally, communication problems between public health labs and physicians and the CDC caused some problems. Laboratory infrastructure capacity is discussed in Chapter 8.

For West Nile virus, many state and local public health laboratories did their own human and animal (dead birds, sentinel chickens, mosquitoes, etc.) testing, but in some cases contracted with other labs to perform some of the testing. Most states, however, reported problems with the amount of work required due to the volume of samples delivered to the labs, especially the number of dead birds collected for testing. States developed different ways to handle the increased workload. In Wisconsin, for instance, bird testing was stopped once a county had five confirmed positive birds or two birds in subsequent years. In Colorado, once the outbreak started affecting humans, public health labs stopped testing birds and sentinel chickens and focused only on human samples and mosquitoes. In Louisiana, other routine lab functions such as sexually transmitted diseases, HIV and hepatitis testing were all delayed as a result of the large surge in West Nile virus cases. New York limited the number of birds that local health departments could send to the state lab for testing, but one county close to the state lab tested almost one thousand birds in one year. As a result, that county showed up with an extremely high positive bird count.

For West Nile virus, problems arose in some states concerning testing humans and reporting the results. In Louisiana, for instance, confusion arose because physicians sent samples from suspected West Nile virus patients to private labs, which did not have the ability to perform confirmatory testing. Because of the high false positive rates of the tests, numerous patients were wrongly informed they had West Nile virus when in fact they were not infected. In some instances in Colorado, communication between physicians and the public health lab was poor, and some patients received their test results directly from the lab instead of from their physicians, who were not informed of the results. Finally, access to the West Nile virus test was sometimes blocked. In Colorado, for instance, the cost of the test was passed from the state laboratory to the physician and, in turn, to the patients and their insurance companies. Because the federal Migrant Health Program would not pay for the West Nile virus test, many suspected symptomatic cases in the migrant worker population in Colorado were never confirmed with a laboratory test.

Laboratory testing for monkeypox occurred at federal, state, and private laboratories, including some veterinary-based laboratories. The initial monkeypox diagnosis was made at the Marshfield Clinic, a private lab in central Wisconsin associated with the hospital at which the patient was being treated. Scientists there performed highly technical, nonstandard tests, including electron microscopy of tissue samples, to identify the infectious agent. After the initial diagnosis, public health labs in Wisconsin and Illinois processed suspected human samples using PCR testing using supplies from the CDC. In Illinois, animal samples were sent to another state lab or a federal lab, which were slow in reporting results. Although there were no confirmed cases, the New York state lab rapidly developed its own PCR test for monkeypox, and used it to investigate possible cases.

New York State's well-developed laboratory system played a major role in the SARS outbreak. By the time of the outbreak, Federal support had enabled the state's laboratories to hire a very strong team of scientists to build a bioterrorism lab, enabling the health department to quickly validate assays and write protocols for SARS related testing.

Because there were few SARS cases in the United States, state and local public health laboratories were not stressed by the outbreak. However, in at least one state with possible cases, final results from the state public health lab were delayed up to six months and preliminary reports were often internally inconsistent.

The CDC provided lab support of various kinds for state and local health departments in all of the outbreaks we studied. There were concerns, however, about poor communications between public health departments and laboratories and the CDC laboratories, including problems with getting test results back from the CDC, inconsistent identification of samples, and inability to obtain more supplies from the CDC.

One county health department in California, for instance, reported that the lab received "zero guidance from CDC" during the outbreak. County officials reported that no mechanism for triaging specimens was established, nor was a protocol set up for sending specimens for testing. Moreover, the types of specimens that were to be gathered changed "on a daily basis." The county lab had to rely on the state, which was not always consistent with the changing CDC guidelines. Local health officials and lab staff, with consultation from the state, ended up developing their own methods and protocols for specimen collection, packaging, and transportation. Specimens were received, packaged, and sent to the state lab for tests, but results were frequently late in coming back. Overall, the situation was described as "somewhat chaotic."

Some state labs—New York and California—conducted their own SARS testing, but others relied on the CDC laboratories. CDC also helped many states with overflow testing for West Nile virus. In one instance, the CDC set up a laboratory in a local hospital to help handle the increased volume of West Nile virus samples. In the same state, however, the public health lab had difficulty contacting the CDC to replenish supplies needed to test for WNV, and CDC could not immediately replenish the reagents when requested.

For monkeypox, the CDC supplied the test protocol and supplies and performed some confirmatory testing, but communications problems were evident. In one instance, a state public health lab obtained different results on monkeypox tests from those of the CDC lab using the same test, but the differences turned out to be due to changes made by the CDC in how to interpret the test results, which had not been passed along to the state laboratory. Problems were also noted for CDC test results, which were sometimes late in arriving, and sometimes did not match any patient samples that had been sent by the state lab to the CDC. Finally, personnel in the state commented that CDC officials did not trust the initial monkeypox diagnosis made by scientists at the Marshfield Clinic until they actually saw the electron micrograph images.

Issues relevant to communications between CDC and public health departments are discussed further in Chapter 5.

LESSONS LEARNED

The experience in the seven states we studied suggests that state and local health departments were able to use existing surveillance systems, or create new ones as needed, to detect and manage the West Nile virus, SARS, monkeypox, and hepatitis A outbreaks. These activities involved detecting and characterizing three disease pathogens that were new to the United States—West Nile virus, SARS, and monkeypox—as well as hepatitis A, a relatively common disease. Information from surveillance systems was used to guide further surveillance activities and epidemiological investigations to identify infected cases and prevent further spread, and, in the case of West Nile virus, to target control programs. These successes, however, were not without problems and in some cases severely stressed the epidemiologic and laboratory capacity of state and local health departments, thus providing opportunities for institutional learning and improvement.

Limits to the Early Detection of Biological Events

For public safety and other emergency preparedness professionals, the existence and the basic nature of an emergency that requires a response is usually clear: a bomb has exploded, a chemical has been released, or a hurricane has struck. Identifying and characterizing a disease outbreak, on the other hand, is more difficult, especially when the number of cases is small (but has the potential to grow) and when the pathogen has not been previously identified in the area. For most of the outbreaks we studied, the first person was exposed to the pathogen weeks before public health agencies knew there was a problem, and even after the first cases were detected, more time (a week or more) was required to characterize the nature of the problem.

Similarly, for West Nile virus and monkeypox, it was a matter of weeks before the responsible agent was correctly identified, and one might ask whether this performance could be improved. In the case of West Nile virus, the delay was due in part to public health officials not recognizing the relevance of the massive bird die-offs even though they were aware of them. For monkeypox, the delay was due in part to laboratory contamination. While these particular problems might be avoided in the future, other problems might arise, and public health would need to get essentially everything right to make a quicker diagnosis.

Policymakers and the public must have realistic expectations about what public health can do. Complacency, of course, is not acceptable. Public health agencies must learn from events like this to raise the bar and improve their performance in the future. Another lesson from these experiences is that epidemiologic investigations need not be complete before taking action. As discussed in Chapter 4, public health officials were able to take effective disease control actions such as mosquito spraying and instituting infection control practices even before the pathogens were fully characterized.

The Importance of Routine Disease Reporting

The outbreaks illustrate the importance of partnerships between public health and health care providers. West Nile virus, monkeypox, and hepatitis A each came to public health's attention because a physician noticed and reported one or more unusual cases. The benefits of these discoveries would have been lost if the physicians did not know that it was important to report these cases and how to do so.

The outbreaks also highlight the importance of routine reporting of all suspect cases, not just confirmed ones. In the examples discussed, one physician needed to see more than one potential case before the health department was called, or in the case of monkeypox, before the health department began a full investigation. Unusual symptoms are common in medicine, and are typically not regarded as potential public health issues until a pattern begins to emerge in a large city. A substantial number of people could be ill, but if each patient saw a different physician in a different facility, the public health implications would not be immediately noticed and the initial patients would not be properly diagnosed. Efforts to improve the completeness of notifiable disease reporting can help address such issues.

The cases also illustrate the challenges of traditional disease reporting systems that rely on "astute physicians" to report unusual cases to their local health department. The hepatitis A outbreak was easier to detect because only one hospital serves the affected area in Western Pennsylvania, so every patient sought care at the same emergency department. This approach was effective in these cases in part because physicians knew whom to call, suggesting preexisting relationships between public health and health care providers. Local physicians see the New York City health department as able to offer help with difficult cases, and this is an incentive for physicians to call (Fine and Layton, 2001). The physician who reported the hepatitis A cases in Pennsylvania had recently been to a bioterrorism training course, and this may have raised his awareness.

Mandatory reporting of notifiable diseases is in place throughout the country and increasingly is being supported by electronic reporting systems. The completeness and timeliness of this reporting, however, is unknown, and many suspect that important cases may be reported late or not at all. Perhaps the most important thing that needs to be done is to ensure that health care providers, veterinarians, and others understand the importance of their role in public health surveillance, know when and how to report, and have incentives to do so. Such incentives could include providing clinical advice on unusual cases, as in New York City when West Nile virus first appeared.

These examples also illustrate the importance of communicating with veterinarians and entomologists about animal outbreaks in order to alert public health to a human outbreak and help to characterize the pathogen. Veterinarians were heavily involved in detecting and investigating monkeypox, and a closer involvement would have speeded up the recognition of West Nile virus.

Although we observed a number of instances in which the relationship between public health and health care providers "worked," there is still room for improvement. Many of the individuals we spoke with felt that the development of health alert networks, blast fax capacities, and so on, mostly supported with federal bioterrorism funds, made a difference, but that technology of this sort complements but is not a substitute for developing working relationships. As mentioned above in the discussion of West Nile virus in New York City, for example, public health officials believe that incentives, such as help with difficult cases, encourage physicians to communicate.

The outbreaks that we studied also indicate that, to be effective partners in public health surveillance and epidemiological investigation activities, health care providers need up-to-date information about case definitions, testing procedures, and so on, and it is the local health department's responsibility to provide it. Keeping up to date is both difficult and important when the epidemiological facts and clinical understandings themselves are quickly changing, as they were in the examples we studied. Health care providers also need to know where to send specimens for testing and should receive timely results to report to their patients. This issue is discussed further in Chapter 5.

The Need for Surge Capacity and Workload Management in Public Health

The case studies illustrate that, for public health emergencies, the required response is not directly proportional to the number of people actually exposed, infected or ill, or the number of deaths. With SARS, for instance, state and local areas that had few to no cases, in the end, still needed enhanced surveillance simply because of the potential for an outbreak. This is true in part because, as in the outbreaks we studied, necessary efforts to identify additional cases—active surveillance—are likely to result in many potential cases coming to the health department's attention. Some of these will be individuals who do not have the disease in question (but display similar symptoms or are simply the "worried well"). All such potential cases must be investigated though, which puts stress on health care facilities as well as outbreak response teams and laboratory capacity. Conducting such investigations sometimes requires that resources be transferred from other programs. Some of the jurisdictions that we visited have been able to hire new staff to assist with such investigations using bioterrorism funds, but others have not been able to because of state level restrictions. State and local public health laboratories need to determine appropriate methods to handle the surge of samples they receive during outbreaks such as these, without compromising their ability to perform routine testing in a timely manner.

Health departments and other agencies must find ways to avoid the multiple simultaneous but uncoordinated epidemiologic investigations that occurred in the outbreaks we studied. Better coordination of separate investigations, or even better, finding a way to organize joint investigations, would help. Each of the examples we studied involved investigating cases in more than one local jurisdiction. In some instances, this resulted in confusion and extra work when different local, state, and federal agencies set up independent investigations. In other instances, however, the regional epidemiological offices that have been created using bioterrorism funds in some states have facilitated and simplified the investigation of disease outbreaks. In addition, overlap across state lines, and with CDC, FDA, or other federal investigations should also be addressed.

State and local health departments should develop standard databases in advance that can be adapted to the specifics of a given outbreak. There is often not enough time to do this effectively during an outbreak, and the lack of such a database leads to confusion and excess workload. In a number of instances in our case studies, public health officials had to create databases to manage epidemiological investigations essentially "on the fly" and this sometimes led to confusion regarding case identifiers among different lists being used. In others, the pre-development of databases seems to have helped. This suggests that efforts to develop generic databases and consistent identification systems that can be adapted as needed in a new outbreak would be beneficial. Some of the health departments we visited have used federal bioterrorism funds to strengthen their information technology infrastructure to facilitate this, as discussed further in Chapter 8.

The Importance of Laboratory Diagnostic and Surge Capacity

These case studies also highlight the need for highly functional public health laboratories. Outbreaks are likely to increase the volume of samples received by the public health laboratories, and systems need to be in place to handle the excess, ideally without causing delays in completing routine testing. In addition, these examples highlight the importance of well-equipped laboratories, including the adequate provision of supplies and reagents, and highly trained personnel. While the monkeypox diagnosis was delayed due to a bacterial contamination, the research level capabilities of the private lab allowed it to make the diagnosis of a pathogen previously unseen in the western hemisphere. Additionally, the New York state lab used research techniques to develop their own PCR test for monkeypox as well as make contributions to the diagnosis of SARS and West Nile virus.

Public health departments and laboratories also need to be connected with private and veterinary laboratories. For monkeypox, the initial diagnosis was made at a private lab, which coordinated and communicated with the public health department. The monkeypox and West Nile virus outbreaks also highlighted issues of animal testing, and some state health departments—Wisconsin and Louisiana were the examples among the states we visited—have developed strong working relationships with private and university-based veterinary labs to assist with this testing. However, at least one state, Illinois, identified its capacity for animal testing as deficient and recognized the need to develop those capabilities or develop relationships with other labs to perform those duties.

IMPACT OF FEDERAL FUNDING

The case studies include many instances in which state and local health officials cited federal funding as important to meeting critical capabilities. These include the development of health alert systems, blast fax tools for reaching physicians, web-based case reporting systems, and other information technology tools. Federal funding has been used throughout the country to enhance surveillance activities, including active CSF surveillance for encephalitis and meningitis, which could be the result of West Nile virus or other infectious diseases, as well as animal and mosquito surveillance. The development, with federal funding, of regional epidemiology offices in several states seems to have aided in the investigation of all of the outbreaks we studied. Federal funding, or at least meeting the requirements of the CDC cooperative agreements, also had more subtle effects. A number of health departments reported, for instance, that relationships that were built with health care providers, other health departments in their region, and others were important in responding to SARS, monkeypox, and West Nile virus. Laboratory capabilities have also been improved due to increases in federal funding. States reported upgrading their laboratories to Bio-Safety Level 3 facilities and purchasing equipment that allows them to more rapidly perform required tests. However, these outbreaks also highlighted the reliance that many state and local public health laboratories have on CDC expertise and capabilities. These issues are discussed further in Chapter 8.

The states we visited varied in the extent to which they have been able to hire staff to support surveillance, epidemiologic investigation, and laboratory work. Where this has been possible, state and local health departments report important contributions made by these personnel, especially in responding to all of the outbreaks we studied. In other states, statewide hiring ceilings and an unwillingness to hire permanent staff with funding that is not guaranteed into the future have limited health departments' ability to use funds to meet staffing needs. These issues are discussed more fully in Chapter 7.

It is important to note that not all of the federal funding came through the CDC public health preparedness cooperative agreement. Funding targeted to West Nile virus, and bioterrorism funding before 9/11 were also important in some cases, highlighting the role of progressive and incremental improvement. Although public health officials made a convincing case about the impact of investments with federal funding, it is difficult to know what would have happened during the outbreaks if the investments had not been made.

CRITICAL CAPACITIES AND BENCHMARKS

The Critical Capacities and Benchmarks that have been set up to guide the federal cooperative agreements, particularly those in Focus Areas B and C, provide one way to summarize the strengths and weaknesses of current public health systems for surveillance, epidemiologic investigation, and laboratory assessment. Applying these measures to the case studies that we report also serves to assess how well the Capacities and Benchmarks describe public health preparedness.

Issues, Critical Capacities, and Critical Benchmarks relevant to Focus Area B, Surveillance and Epidemiology Capacity, and Focus Area C, Laboratory Capacity–Biological Agents, are shown in Table 3.1.

Table 3.1. Critical Capacities and Benchmarks Related to Public Health Assessment

FOCUS AREA B: SURVEILLANCE AND EPIDEMIOLOGY CAPACITY
I. PUBLIC HEALTH SURVEILLANCE AND DETECTION CAPACITIES
Critical Capacity #5: To rapidly detect a terrorist event through a highly functioning, mandatory reportable disease surveillance system, as evidenced by ongoing timely and complete reporting by providers and laboratories in a jurisdiction, especially of illnesses and conditions possibly resulting from bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies.
***Critical Benchmark #7*:** Complete development and maintain a system to receive and evaluate urgent disease reports and to communicate with and respond to the clinical or laboratory reporter regarding the report from all parts of your state and local public health jurisdictions on a 24-hour-per-day, 7-day-per-week basis.
II. PUBLIC HEALTH EPIDEMIOLOGIC INVESTIGATION AND RESPONSE CAPACITIES
Critical Capacity #6: To rapidly and effectively investigate and respond to a potential terrorist event as evidenced by a comprehensive and exercised epidemiologic response plan that addresses surge capacity, delivery of mass prophylaxis and immunizations, and pre-event development of specific epidemiologic investigation and response needs.
***Critical Benchmark #8*:** With local public health agencies, identify and maintain a current list of physicians and other providers with experience and/or skills in the diagnosis and treatment of infectious, chemical, or radiological diseases or conditions (including psychological and behavioral) possibly resulting from a terrorism-associated event (for example, those who have seen and treated smallpox) who may serve as consultants during a public health emergency.
***Critical Benchmark #9*:** Establish a secure, Web-based reporting and notification system that provides for rapid and accurate receipt of reports of disease outbreaks and other acute health events that might suggest bioterrorism. Include provision for multiple channels for routine communications (e.g., Web, e-mail) and alert capacity for emergency notification (e.g., phone, pager) of key staff.
Critical Capacity #7: To rapidly and effectively investigate and respond to a potential terrorist event, as

evidenced by ongoing effective state and local response to naturally occurring individual cases of urgent public health importance, outbreaks of disease, and emergency public health interventions such as emergency chemoprophylaxis or immunization activities.

***Critical Benchmark #10*:** At least annually, assess through exercises or after-action reports to actual events, the 24/7 capacity for response to reports of urgent cases, outbreaks, or other public health emergencies, including any events that suggest intentional release of a biologic, chemical, or radiological agent.

***Critical Benchmark #11*:** At least annually, assess adequacy of state and local public health response to catastrophic infectious disease such as pandemic influenza, other outbreaks of disease and other public health emergencies.

FOCUS AREA C: LABORATORY CAPACITY—BIOLOGIC AGENTS

Critical Capacity #8: To develop and implement a jurisdiction-wide program to provide rapid and effective laboratory services in support of the response to bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies.

Critical Benchmark #12: Complete and implement an integrated response plan that directs how public health, hospital-based, food testing, veterinary, and environmental testing laboratories will respond to a bioterrorism incident, to include: (a) roles and responsibilities; (b) inter- and intrajurisdictional surge capacity; (c) how the plan integrates with other department-wide emergency response efforts; (d) protocols for safe transport of specimens by air and ground; and (e) how lab results will be reported and shared with local public health and law enforcement agencies, ideally through electronic means.

Critical Capacity #9: As a member of the Laboratory Response Network (LRN), to ensure adequate and secure laboratory facilities, reagents, and equipment to rapidly detect and correctly identify biological agents likely to be used in a bioterrorist incident.

***Critical Benchmark #13*:** Ensure capacity exists for LRN validated testing for all Category A agents and other Level B/ C protocols as they are approved.

***Critical Benchmark #14*:** Conduct at least one simulation exercise per year, involving at least one threat agent in Category A, that specifically tests laboratory readiness and capability to perform from specimen threat assessment, intake prioritization, testing, confirmation, and results reporting using the LRN website.

Source: CDC, Continuation Guidance—Budget Year Five, June 14, 2004.

All of the states that we visited have taken steps to develop the kind of system called for in Critical Capacity #5, and although none of these systems is fully operational, they have played a role in the detection of the West Nile virus, monkeypox, SARS, and hepatitis A outbreaks. Our case studies show, however, that simply having such systems may not guarantee "rapid" detection:

- First, providers need to know about the systems and have incentives to use them. As discussed above, this requires building relationships that go beyond communication systems.
- Second, our case studies show that the involvement of veterinarians, entomologists, and perhaps others, depending on the disease outbreak, is also important.
- Finally, even complete and timely reporting does not guarantee that the outbreak can be characterized as quickly as one might hope, as the West Nile virus and monkeypox examples illustrate. A novel bioterrorist agent, if used covertly, is likely to be harder to detect than the outbreaks that we explored.

The case studies discussed here represent one way to address Critical Capacities #6 and #7, corresponding especially to the method suggested by Critical Benchmark #11. We are aware of some efforts by the states themselves to review their experience with these outbreaks, but such reviews were not universal and, when performed, were often informal. Although state and local public health officials reported that they did learn from experience, they often were too busy responding to the next crisis to carefully study the last one and make improvements to their protocols and systems.

Our own analyses suggest that the state and local health departments we visited did have the ability to "rapidly and effectively investigate… a potential terrorist event" or a natural disease outbreak, at least if it did not exceed the scale of the outbreaks we studied. As discussed above, outbreak investigations were reasonably timely and successful, but heavily stressed the existing resources. In general, capabilities to support the "surge capacity" described in Critical Capacity #6 need to be further developed. The health departments we studied, to the extent they planned for surge capacity at all, drew on personnel from other health department programs. In order to staff a major investigation over a significant period of time, those programs would suffer.

The Critical Capacities and Benchmarks do not clearly reflect some things that we found to be important in our case studies. For example, the importance of establishing a preexisting database that can be adapted and used to manage an epidemiologic investigation should be reflected in the Critical Capacities and Benchmarks. The confusion and extra workload that results from multiple simultaneous epidemiologic investigations, and the potential contributions of regional epidemiology offices, should also be reflected.

We now turn to Focus Area B, Laboratory Capacity. The West Nile virus and monkeypox experiences highlight the difficulties of providing rapid laboratory services of the sort described in Critical Capacity #8 and performing Laboratory Response Network (LRN) functions addressed in Critical Capacity #9. In both cases, identification of the pathogen was delayed. These outbreaks provide many examples of how having a detailed laboratory response plan in advance, including provisions for resupply of necessary reagents, would have helped the response. Roles and responsibilities regarding animal samples, for instance, could have been better laid out for some states. Surge capacity was a problem in all of the states visited. Reporting of lab results was a problem for all of the diseases studied in different ways. In two states we heard that private labs tended to have more false positive results than public health labs. In addition, in one state there seemed to have been confusion about the need for confirmatory testing, and some physicians misinterpreted preliminary tests from private laboratories as confirmatory. This led to some extra confusion and anxiety among the public, and potentially, more people going to the emergency department than was necessary.

The case studies did not address specifically Critical Benchmarks #13 and #14, both of which address specific bioterrorism pathogens. However, it should be noted that these Critical Benchmarks do not address the problem, highlighted in our case studies, that public health and other labs have in identifying previously unknown pathogens such as monkeypox, West Nile virus and the SARS coronavirus. Focusing on existing pathogens does not encourage the laboratories to develop the ability to identify novel pathogens.

4. JUST-IN-TIME POLICY DEVELOPMENT AND ASSURANCE

This chapter focuses on two functional capacities: policy development and assurance. As one of the three core functions of public health, policy development includes developing recommendations to prevent further infections in health care and community settings and even enforcing quarantine laws (IOM, 1988). Assurance, another core function of public health, includes ensuring that individuals receive needed preventive care and disease treatment, whether it is directly provided by the health department or in private settings.

Regarding policy development, we focus here on the development of policies and procedures needed in the short term to control disease outbreaks during a public health emergency. No matter how much long-term planning goes into public health preparedness, this short-term or "just-in-time" policy development is essential; the unique characteristics of the situation require real-time adjustments to existing policies. Long-term policy development or organizational learning, including the identification of lessons learned from one outbreak and actions taken to improve future responses, is discussed as a capacity-building activity in Chapter 7. Public information campaigns, which are critical to just-in-time policy development, are described separately in Chapter 6.

Our discussion of assurance is necessarily brief, given that the limited impact of the outbreaks studied was such that the provision of health care was not a major problem. Just-in-time policy development and assurance are discussed together in this chapter because these activities are often linked (e.g., assurance policies are usually developed in real-time during public health emergencies based on the unique characteristics of the public health emergency being addressed).

This chapter does not include a discussion of any of the CDC Focus Areas. Although policy development is part of CDC Focus Area A, the activities covered emphasize long-term issues and therefore are discussed in Chapter 7.

The remainder of this chapter is organized as follows. We first discuss population-based disease control strategies—in particular, isolation and quarantine and mosquito abatement. We then discuss the development of clinical policies such as triage of patients, hospital infection control policies. Next we describe assurance policies (e.g., direct care by health department for affected individuals, health department involvement in assuring private sector care for affected individuals). Finally, we summarize lessons learned.

JUST-IN-TIME POLICY DEVELOPMENT FOR POPULATION-BASED DISEASE CONTROL

The SARS, West Nile virus, monkeypox, and hepatitis A outbreaks required health departments to focus on different disease control strategies, as summarized in Table 4.1.

Table 4.1. Modes of Transmission and Major Disease Control Strategies for Case Study Diseases

Disease	Primary Mode of Transmission	Disease Control Strategies
SARS	Person-to-person	Isolation and quarantine of humans, respiratory disease precautions
West Nile virus	Vector-borne (mosquitoes)	Mosquito abatement, personal protective measures
Monkeypox	Human contact with animals, Person-to-person	Isolation and quarantine of both humans and animals, vaccination of exposed humans
Hepatitis A	Contaminated food	Food safety strategies

Two incidents in particular provide insight into the types of complex situations that developed and the impact on the responding health departments. These examples also illustrate the issues and concerns that arise when limited information is known about a suspected deadly infectious disease.

- On April 1, 2003, an American Airlines passenger jet arriving at San Jose International Airport in Santa Clara County from Tokyo was quarantined on the tarmac after five people on the plane complained during the flight of symptoms similar to those of SARS. It was believed that four of the five had transferred to Tokyo from Hong Kong. American Airlines requested assistance from the airport after the pilot reported that he had been informed of a passenger requiring medical assistance. The local health department simultaneously dispatched an investigator and activated its department emergency operations center (DEOC). People who were symptomatic were escorted off the plane by paramedics; two patients were immediately ruled out for SARS.[7] The other

[7] http://www.cbsnews.com/stories/2003/04/01/health/main547271.shtml; CBS News.com, San Jose, CA., April 1, 2003: “Plane Quarantined In San Jose For SARS”.

three were transported to a local hospital and placed in isolation. The remaining passengers were educated regarding symptoms, asked to take temperatures regularly and were instructed to report to their physicians if symptoms developed. Later that day, the three hospitalized patients were ruled out as SARS cases and were discharged.[8] Local, national, and international media inquiries began to flood the health department—an estimated 100 distinct phone calls and pages were logged during the first hour alone and over 200 distinct media organizations had contacted the department by the end of the first day. While the incident proved to be a false alarm, the volume of inquiries from the media, schools, businesses, community organizations, and governmental agencies required the DEOC remain active for an additional two weeks to coordinate departmental responses and produce and distribute educational materials.

- Also on April 1, the University of California Chancellor, in anticipation of an influx of potentially infected students to the UC Berkeley summer semester (with its large Asian population), called for a task force to explore options. The task force was composed of UC Berkeley officials, local health department officials, law enforcement, and hospital representation. Following a month of planning and guided in part by a stochastic model predicting the size of a potential SARS outbreak and necessary resources, UC Berkeley announced it would not allow visiting students from mainland China, Taiwan, Singapore, and Hong Kong to enroll in summer classes. The move sparked both local and national controversy that, according to one local health official, was never anticipated. No other California schools followed suit. By mid July 2003, UC Berkeley lifted all travel and enrollment restrictions related to SARS.[9] In August 2003, UC Berkeley released a new SARS prevention and response plan that did not mention any possibility of a future ban on enrollment. Instead, "the plan calls on university and city officials to act immediately to prevent contagion of this infectious disease by investigating and isolating any potential cases before SARS could spread."[10]

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8 http://www.sccphd.org/scc/assets/docs/238853SARS%20Press%20Release%20040103%20AM.pdf and http://www.sccphd.org/scc/assets/docs/238850SARS%20Press%20Release%20040103%20PM.pdf; County of Santa Clara, Public Health Department: Press Releases; April 1, 2003.

9 http://www.dailycal.org/article.php?id=12182; "UC Berkeley Lifts SARS Ban", The Daily OnLine Californian; July 18, 2003.

10 http://www.dailycal.org/article.php?id=12399; "UC Berkeley Releases New SARS Plan, No Enrollment Bans Mentioned," The Daily OnLine Californian; August 22, 2003.

Isolation and Quarantine

Isolation and quarantine are two related but distinct public health tools for stopping infectious disease outbreaks by physically separating people who are infectious from those who are susceptible. Isolation applies to individuals who are ill and undergoing treatment, and includes both physical barriers and policies to keep susceptible individuals away from those who are ill. Because the subjects are under treatment, isolation is often enforced in clinical settings. Quarantine, on the other hand, applies to individuals who may have been exposed to an infected person, and are thus potentially infected, but who have not yet developed disease symptoms. Potentially infected individuals are frequently quarantined in their homes—essentially told to stay home and monitor their symptoms. Health departments may ask the local police department to help enforce either isolation or quarantine, although enforcement of quarantine is usually voluntary.

Implementation of Isolation and Quarantine Policies. Because SARS is spread from person to person, health department officials had to consider population-based disease control strategies such as isolation and quarantine to prevent spread of the disease. Many health departments ran into problems, however, because of outmoded state laws for isolation and quarantine, or due to uncertainty about the limits of their authority or how much cooperation they would receive from local law enforcement agencies.

In Colorado, for instance, prior to the state's SARS outbreak, the governor had established an expert epidemiology committee to review and update existing policies that establish the authority of health directors to order isolation and/or quarantine (as required by federal bioterrorism funding requirements). This committee determined that the current state laws were unclear about enforcement, but these issues were not resolved before the state had to deal with SARS.

Under California law, county health officers have the authority to isolate and quarantine individuals when a health emergency has been declared, but only county boards of supervisors and the county executive have the ability to declare a health emergency. As a result, county health officers are powerless to enforce isolation and quarantine until the board of supervisors declares a health emergency. In addition, one county we visited in California reported that it needed assistance from its local police department to enforce isolation and quarantine orders, yet there were few preestablished communication links between the health department and local law enforcement agencies. The department also reported having very limited plans and policies regarding isolation and quarantine even if the relationships with law enforcement did exist. It is no surprise, therefore, that in California no quarantine orders were issued during the SARS outbreak

In Wisconsin, the state health department's statutory authority to isolate or quarantine individuals was updated shortly before the SARS outbreak and was thought to be very clear. The SARS outbreak, however, challenged these statutes because the recommendations for the length of quarantine and isolation changed over the outbreak and there were no clear guidelines for release from quarantine. As a result, quarantine and isolation were used primarily on a voluntary basis in Wisconsin during the SARS outbreak.

In New York, one county health department reported having worked proactively to coordinate with the sheriff's department and emergency medical services in the event they needed to enforce quarantine. In response to the state's mandate, this county had developed a protocol for the local implementation of mandatory isolation and quarantine. This plan, which the state health department suggested as a template for other counties, incorporates a specific implementation protocol and stresses the education of judicial and law enforcement personnel about these issues before a crisis. This protocol was used for one particularly recalcitrant tuberculosis (TB) patient in 2003, and the judge supported the health department.

Another local health department in New York faced the problem of individuals from out of town who met the case definition for SARS and therefore had to be isolated for 10 days. Although these individuals were actually sick for only the first few days, they could not return to their homes. The Commissioner issued orders that these people were to be isolated where they were, and police were stationed outside their hospital rooms. The hospitals were willing to keep them but required reimbursement for their costs, to which CDC eventually agreed. Although this was manageable for a small number of people, health officials realized that it would require a large, dedicated facility if the need were greater. After the isolation period, some were given free tickets to a professional basketball game as compensation for the inconvenience.

Voluntary Isolation and Quarantine. The use of voluntary isolation and quarantine was an issue with monkeypox. In Illinois, for example, families exposed to monkeypox were initially cooperative with the voluntary restraints, but this soon changed. Those who had the disease were supposed to stay in their rooms at home until their lesions scabbed over, and contacts were supposed to take their temperature twice a day, but were not quarantined at home unless they developed a fever. Some family members, however, checked their temperature twice a day for the first few days and then stopped. Patients also stopped returning phone calls from the health department and became impatient with attempts to contact them. Some found that they could appear to be at home simply by giving the health department a cell phone number for follow-up.

It quickly became apparent that voluntary quarantine would not work. During the monkeypox outbreak, Illinois health officials found that some residents had broken their quarantine surreptitiously. Teenagers were most likely to break quarantine, and health officials found that parents were not helpful in enforcing compliance. As a result, the number of cases that the health department had to track grew astronomically as quarantined teens went to parties and came in contact with others. In another instance, one probable case of monkeypox involved a young boy whose mother insisted on sending him to football camp. The only argument that eventually dissuaded her from doing so was that she could be held liable for others becoming infected.

Mosquito Abatement and Control

West Nile virus required health departments to consider population disease control strategies that involved the control and abatement of mosquitoes.

Roles and Responsibilities. Most health departments in New York had not been involved in mosquito control for many years prior to their 1999 West Nile virus outbreak and therefore had to recruit experts from other agencies and the private sector. The state health department hired a full-time entomologist to assist with planning. One county created two new positions in its health department and began mosquito surveillance in 2000. The two successful candidates received training at Cornell University on control strategies, as well as mosquito surveillance and species identification.

Public health officials in many states noted that mosquito control efforts ideally should be integrated across counties. However, in Colorado as in other states, mosquito control is funded primarily through local taxes and is managed at the local level. Consequently, decisions about mosquito control programs are driven by local economics and public opinion. Since 1986 there has been only one mosquito control contractor in the state, a private company that specializes in integrated mosquito management programs and employs entomology, biology, and public health technicians. The contractor provides services to over 80 county, municipal, commercial and residential clients throughout Colorado, and this has helped to standardize mosquito control activities. One county mosquito control program, for instance, includes 21 municipalities that contract with the company for mosquito control. Each municipality pays for control within their own area, but the county pays for spraying a one-mile buffer around each participating community. Counties typically used surveillance data to determine where to focus their abatement efforts. Consequently, programs vary throughout the state and often within a county.

Control Strategies. Typically surveillance data is used to determine where to focus mosquito control efforts. Abatement activities include reducing mosquito-breeding areas by eliminating standing water where possible and eradicating mosquito larvae (larviciding) by directly applying chemicals to areas of standing water that cannot be drained. Adulticiding—killing adult mosquitoes—is achieved through spraying, usually by truck.

The response to the identification and diagnosis of the first cases of West Nile virus in Queens in September 1999 was a spraying program aimed at adult mosquitoes. Until the nature and extent of the outbreak was better known, health officials decided to spray widely. But although city health officials believed this was necessary given the public health threat, some residents of the sprayed areas were concerned about the potential health effects of the insecticide. Thus, the 1999 spraying campaign was accompanied by a communications strategy focused on the benefits of spraying and information on where spraying would take place (Mullin, 2003).

As time passed and the outbreak spread throughout the state, control strategies evolved and vary from place to place. Some counties focus on spraying in the areas where confirmed human cases reside, with larviciding in advance of an outbreak. In order to spray only where most needed, some counties have used geographic information systems (GIS) and census data to target areas with a large elderly population. Others have focused on areas where bird or mosquito surveillance data suggests a high risk of human infection.

Adulticiding has been controversial because of potential health and environmental risks of the insecticides. New York City prepared a formal environmental impact statement, which although not completed until 2001, guided its activities starting in 2000. Local health departments tried to follow CDC spraying guidelines, which originally called for spraying within a two-mile radius of all known human cases. They were bombarded by calls on both sides of the spraying debate. There was also sometimes confusion about why some areas were sprayed, while other nearby areas, often in other jurisdictions, were not (Mullin, 2003).

General Clinical and Infection Control Policies and Guidance

During a disease outbreak, public health departments are often expected to develop, revise, and implement policies intended to control the spread of disease in clinical settings, and to advise health care providers about the diagnosis and treatment of novel or uncommon diseases. During the outbreaks we studied, state and local health departments tended to serve as conduits of information between CDC and WHO and health care providers. The SARS outbreak in particular was characterized by rapidly changing information about the clinical and epidemiologic characteristics, case definitions, and appropriate clinical policies. As a result, health departments had to communicate this information to health care providers in a timely and accurate way. SARS also presented difficult infection control issues. Outbreaks in Asia and later Toronto suggested that containing the virus in health care settings was integral to the safety of surrounding communities. The importance of early recognition of cases and appropriate personal protective equipment also became clear.

Roles and Responsibilities. During the 2003 SARS outbreak, state and local health departments in New York played a significant role in helping providers keep up with current knowledge. One county health department, for instance, promoted uniform signage about infection control practices at all hospitals to convey a consistent message and protect health care workers. The county's bioterrorism task force, set up before the SARS outbreak, provided a forum through which practitioners could review the current literature and recent developments on SARS. One New York county found that relationships formed with local hospitals and health care providers during the smallpox vaccination program proved helpful in that people knew whom to call with questions and concerns about SARS. More generally, state and local health departments played an important role in transmitting and translating information from WHO and CDC to local health care providers. The case definition and clinical criteria for SARS were constantly changing throughout the outbreak, and health departments helped providers keep up with current knowledge.

During the SARS outbreak in California, much of the information given to health care providers initially came from CDC, was adapted by the state health department, and then distributed by local health departments to health care providers via e-mail and blast fax. Similarly, local health departments were in close communication with their respective providers regarding diagnosis and consistency in the ever-changing SARS case definition. The state health department felt that getting this material out to all facilities would reduce the number of repeat questions from different individuals. To meet these challenges, the state health department developed and disseminated an infection control strategy, drawing on familiar infection control principles wherever possible.

Up until the time of the outbreak, the state health department did not consider local in-hospital infection control as within its purview. Hospitals in the state would typically contact the CDC directly for guidance on infection control procedures or, if they did contact the state health department, the health department would immediately put them in touch with the CDC. The limitations of this practice were revealed during the SARS outbreak, when the state did not always agree with CDC recommendations. Immediately following the alerts by the WHO and CDC, the California state health department drafted a bulletin and distributed it to both local health departments and acute care hospitals via e-mail and blast fax systems. The bulletin operationalized the CDC guidelines and included screening and reporting forms. As the outbreak developed, the state health department took an increasingly active role and acted as consultants to both health departments and hospitals on all reported possible cases. For example, the department ensured the symptom descriptions were consistent with the most current case definitions, suggested appropriate infection control practices, and, in particular, guided the handling of those cases that did not exactly fit the case definition. Notably, the department created the 72-hour "step down" home isolation protocol for individuals who met some but not all of the signs and symptoms. This "watch and wait" procedure was eventually adopted by the CDC.

As the West Nile virus outbreak unfolded, the Colorado health department also disseminated guidelines to health care providers to assist them in recognizing and diagnosing West Nile virus infection. Those guidelines suggested that providers "consider if there is any clinical value in testing patients with mild fevers of unknown origin in the absence of neurological signs."[11] There was some concern that this might spark controversy with physicians, but public health officials reported that complaints came instead from citizens whose physician refused to test them for West Nile virus.

Resolving Ambiguous Policies. In some cases confusion arose about appropriate policies. In Louisiana during the West Nile virus outbreak, regional health departments played a critical role in establishing and maintaining communications with local health care providers.

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[11] West Nile virus Guidelines for Emergency Departments and Health Care Providers;

The regional health director in St. Tammany Parish was in regular communication with the staff at both hospitals that experienced the largest number of cases (St. Tammany Parish Hospital and Slidell Memorial Hospital). Despite this regular communication, there were some clinical policies that were ambiguous in the beginning of the 2002 outbreak but were later clarified by regional health department staff. For example, in both hospitals there was uncertainty about whether or not blood or cerebrospinal fluid specimens were supposed to be taken. In the end, a rule was set that only hospitalized patients were to have specimens tested.

During the monkeypox outbreak, there was substantial confusion about the use of smallpox vaccine for people who might have been exposed to the virus. In early 2003, at a time when they were dealing with SARS, West Nile virus, and monkeypox, states were directed by CDC to develop and exercise detailed plans for smallpox vaccination. Initially, this had positive spinoffs in dealing with monkeypox. For instance, the Wisconsin state health department was able to use the smallpox coordinators at each local health department and hospital to maintain communications during the monkeypox outbreak. In addition, health care and public health workers were offered smallpox vaccine to prevent monkeypox infection.

However, there was subsequent confusion about how widespread the use of the smallpox vaccine should be. In Illinois, one local health official commented that during the monkeypox outbreak CDC recommended that all contacts, including health workers and agricultural workers, be given smallpox vaccine. The local hospitals in this county—only one of which dealt with monkeypox cases—decided not to offer the vaccine to their health care workers due to liability issues. Although one physician wanted to be vaccinated, all of the family members of patients refused. By the time the hospital made a decision regarding whether or not to offer the vaccine, the critical period for the vaccine to be effective had passed. In the end, no one in the county received the vaccine. In another county, a local health official commented that it was difficult to readily identify those within their department who either had received the smallpox vaccine already or were willing to take it in order to be able to respond to the monkeypox outbreak. This official noted that there was a general reluctance among the staff to be vaccinated and that health departments need to form a realistic advance assessment of the response personnel (including those vaccinated) they are likely to have in place in the event of such an outbreak.

Updated May 3, 2004; http://www.cdphe.state.co.us/dc/zoonosis/wnv/Provider.guidelines.WNV04.pdf.

Part of the confusion about smallpox vaccination, it should be noted, may be due to differences in the official recommendations for "pre-event" vaccination of health care workers (the focus of a national effort in the months before the monkeypox outbreak) and the "post-event" recommendations, which presumably applied after actual (monkeypox) cases were reported. Adverse effects of smallpox vaccine, to both vaccinees and their families, including some deaths, were also the subject of media reports at around the same time.

ASSURANCE

We now briefly turn to a discussion of assurance policies. Assurance policies during an outbreak can be thought of in three different dimensions:

- Direct care by a health department for affected individuals during an outbreak
- Health department involvement in assuring private sector care for affected individuals
- Special care for public health or other health care workers.

The outbreaks that we studied generally did not require direct provision of patient care by health departments. The number of cases generally remained within what the private health care system could handle. Indeed, the state and local health departments we spoke with typically reported that they rarely provide direct clinical care to individuals affected by an outbreak. There was also no need for special care for health workers.

Health departments were, in a limited way, involved in assuring care for affected individuals. The state health department in California did however report that it created an Excel database to track suspect, probable, and confirmed SARS cases and allow for the coordination of necessary follow-up. While the database was less than ideal—especially if the outbreak had been significantly larger—it was functional.

LESSONS LEARNED

The case studies provide several lessons for just-in-time policy development and assurance in public health.

The Need to Update Isolation and Quarantine Authority, Policies, and Procedures

In all of the states we visited, SARS and monkeypox demonstrated the need for carefully developed and clearly understood isolation and quarantine authority and policies as well as the procedures to enforce them. Because the number of cases requiring quarantine was relatively small, they did not severely strain public health agencies. Significant problems did arise, nonetheless, and it seems likely that if many more individuals had needed to be quarantined or isolated, the public health system would not have been able to perform as required.

Numerous problems with existing policies and procedures were demonstrated. During the 2003 SARS outbreak, for instance, California used an existing tuberculosis policy as a template for isolation, but found that it was not appropriate for quarantine. State and local health departments also learned about having to develop specific isolation and quarantine policies during an outbreak in response to the pathogen's epidemiologic and clinical characteristics. Isolation/quarantine policy needs to be disease specific but flexible.

Some states that we visited had not reviewed and updated laws governing isolation and quarantine for almost a century. Moreover, even in states where laws had been updated and clarified, little attention has been paid to implementation issues, including coordinating in advance with police, who would be called upon to enforce these policies. In one state, for instance, county health officers have the authority to issue isolation and quarantine orders, but not to declare public health emergencies, which must precede those orders. In another state, public health laws had been revised before the monkeypox outbreak and were thought to be clear, but the lack of guidelines about when someone should be released from quarantine caused problems. Other unanticipated issues involved isolating individuals who lived out of state and could not be sent home, and quarantined individuals giving cell phone numbers to the health department as a way to avoid staying at home. Clearly, an assessment of existing authorities, policies, and procedures—and changes if necessary—is called for.

The Importance of Coordinating with Environmental and Entomological Experts

The West Nile virus outbreak made state and local health officials realize the importance of building connections with entomologists and environmental health specialists, and in some instances bringing them onto health department staffs. During the outbreak, state and local health departments became involved in determining policies for mosquito spraying and other control strategies, a public health intervention that most departments had not dealt with in years. These decisions were complicated by the need to consider the health risks and environmental consequences of spraying, and varying public attitudes about these matters. In general, health departments were able to develop policies in these areas with the help of experts from other government agencies, universities, and the private sector. However, in some cases health departments needed to quickly identify and establish relationships with relevant experts.

The Need to Clarify Public Health's Role in Emergencies

The case studies also demonstrate the need to clarify in advance the role of public health agencies with regard to clinical infection control policies and guidance. The West Nile virus, SARS, monkeypox and hepatitis A outbreaks each tested the ability of health departments to develop and disseminate clinical policies during an outbreak—in some cases as the facts of the outbreak were rapidly changing. While health departments were usually able to develop appropriate policies and get the word out, there was often confusion about policies for hospital infection control, clinical testing, and vaccination. The need to clarify ambiguous policies as soon as possible is dealt with in the following chapter.

These outbreaks revealed differences in how health departments and health care providers view the role of public health in these matters. In New York City, for instance, a sense that the health department could help physicians deal with difficult cases led the first cases to be reported. During the SARS outbreak, on the other hand, at least one state health department initially questioned its role in providing clinical advice. One common difficulty was poor communication within public health and with health care providers, which will be discussed further in Chapter 6. In some cases, state and local health departments seemed to hesitate to act until they got advice from CDC, a topic taken up in Chapter 9.

5. COORDINATION AND COMMUNICATION IN PUBLIC HEALTH

Effective coordination and communication are important aspects of public health preparedness. Local public health departments stand at the nexus of a complex communications web linking those departments with health care providers (including hospitals, clinics, and physicians), other state and local governmental agencies, the media, government officials, and the public. Moreover, as the result of the history of federalism and the home-rule movement in the United States, public health authorities and resources are very diffuse. As a Constitutional matter, for instance, public health is primarily a state rather than a federal matter. In addition, many states grant substantial authorities to county, city, town or other local health departments, as well as position most of the resources needed to deal with a public health emergency at the local level (IOM, 2003). If a disease outbreak crosses jurisdictional boundaries (as was the case with West Nile virus, monkeypox, and SARS), or help from CDC is needed, coordination and communication become both essential and challenging.

To be effective, coordination and communication within public health[12] must be both horizontal (e.g., among local health departments in a region, across state lines) and vertical (e.g., between local public health departments and CDC, health care providers, other agencies and groups). Although the precise communications role any given public health agency plays will vary depending upon the organization of the public health system as well as the roles and responsibilities of other government agencies, it is fair to say that all public health agencies face significant challenges in ensuring that accurate and timely information is conveyed to their constituents. Similarly, the precise role public health departments play in the coordination of response to public health emergencies depends on the roles and responsibilities allocated to various agencies by local, state and federal mandate as well as the extent to which these agencies have collaborated in the past, either through formal or informal mechanisms. A common theme that emerged from our site visits is that the outbreaks helped health departments to identify—and fill—gaps in communications and coordination within their own departments, as well as between local health departments and other agencies and organizations, including CDC and a variety of governmental and nongovernmental agencies. In general, response to these outbreaks helped to

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[12] Although CDC is a public health agency that operates at the federal level, in this chapter "public health" primarily refers to state and local public health agencies.

forge new relationships and new systems within public health departments for communicating and coordinating efforts more seamlessly. However, challenges remain, as this chapter documents.

The remainder of this chapter is organized as follows. We first discuss horizontal communications between local health departments within a region and between local and state public health. We then look at vertical communications between state and local public health agencies and the CDC, local health care providers, emergency providers, other governmental agencies, and veterinarians, entomologists and other groups. Finally, we present lessons learned and discuss the impact of federal funding. CDC Focus Areas are not discussed in this chapter.

HORIZONTAL COMMUNICATIONS

Coordination/Communication Among Local Health Departments in a Region

Many local public health officials we interviewed reported that public health is a "tight-knit community" in which peer-to-peer interactions and communications are common. For example, in California, each health department division at the state and local level (e.g., public health laboratories, communicable disease) has its own meetings and lines of communication.

However, we found numerous communications problems at the regional level. For example, local health departments in Illinois found they faced difficulties when the West Nile virus and monkeypox outbreaks crossed jurisdictional boundaries. In one county, coordination issues arose when it became time to determine who would be doing the investigation when an individual who resided in one municipal jurisdiction was hospitalized in another. In this county, relations had previously been strained between various municipalities and the county health department (which serves the unincorporated parts of the county). However, as the outbreaks of West Nile virus and monkeypox intensified, the municipal health departments began participating in monthly and then weekly meetings. This was the first time that they had engaged in such extensive regional coordination. However, the county health department felt it had to defer to the municipalities on West Nile virus and communication continued to be difficult between the municipal and county departments, with each responding separately to the media.

Communication Between State and Local Public Health Departments

In general, local health departments reported mixed experiences in coordinating with state health departments. In Illinois, the state health department provided technical assistance to local health departments, disseminated CDC information, and updated local departments on the progress of the outbreak (in this case, West Nile virus). The state was also responsible for laboratory testing of dead birds and specimens. The state health department, like its local counterparts, often had to divert staff from other key endeavors (e.g., lead, mold and moisture, environmental toxicology) to respond to the West Nile virus outbreak.

While local health department officials in Illinois generally spoke positively of the financial, informational, and coordination support they received from the state, they stressed the need for independence when it came to forming policies and dealing with their own constituencies. They also noted that some local hospitals had encountered problems when state laboratories reported test results directly to individuals rather than to the local hospitals or physicians that had arranged for the specimens.

Many state health departments communicate with local health departments and some with other constituencies through the use of Health Alert Networks (HANs). For example, Colorado uses both a state-level HAN and an electronic newsletter to disseminate communicable disease information to local health departments. Local health departments, in turn, send messages through their own HAN systems to clinical providers and hospitals within their jurisdictions. Health officials with whom we spoke were very positive about HANs and felt that they were one of the most effective products that emerged from federal bioterrorism funding. On the other hand, some also expressed concern that information is not updated as regularly as it should be and that coverage of health care providers in many locations is far from complete. In some instances local health departments do not know which physicians already have access to the state HAN so that they can target their communications to those who do not.

Other public health departments report the use of a variety of electronic platforms for receiving case reports and managing epidemiologic investigations. For example, some local health departments in Wisconsin reported using Survnet, EMSystem®, and Epi-X to communicate with other health departments, hospitals and physicians. These systems are discussed in more detail in Chapter 8.

Local health departments sometimes find e-mail and other “unofficial” routes of communication more efficient because of delays in updating information on the HAN. Some state health departments initiated weekly conference calls or web-casts during an outbreak, which the local health departments found helpful. Most also appreciated their state health department's role as a conduit of information from CDC, but some felt that timeliness continued to be an issue.

VERTICAL COMMUNICATIONS

Communication Between State and Local Public Health Departments and the CDC

For the most part, state and local health officials with whom we spoke reported that the CDC provided valuable assistance to state health departments during the outbreaks, although some aspects of communication and coordination with local health departments could have been improved. For example, one local health department in Illinois reported that it was not notified in advance that a CDC team would be in their county to investigate the monkeypox outbreak. The CDC had been asked to participate as a consultant to the state health department, but the local health department did not find out the CDC team was there until the team was "already on the ground." The local health department did not even receive a call from the CDC team after it had begun operations. The CDC was contacting pet distributors, and the local media was querying the local health department about what was going on. Regular communication with the CDC was established only after the local health department insisted that they be included in conference calls between the state health department and the CDC.

One state health department reported that it had routine direct communication with the CDC, but primarily through personal contacts rather than official channels. A local health department in Illinois noted that their state health department served as "go-between" with the CDC and local health departments—passing along information to local health departments via target mass faxing. However, at one point the state health department became overwhelmed with the amount of information and frequent corrections and updates coming from the CDC. It was difficult to assess what had changed from one memo to the next. State officials suggested that more targeted releases, clearly indicating what information had changed since the previous release, would have made the task simpler.

Other health officials criticized the CDC as slow to respond or unable to provide needed resources. A health official in Louisiana reported that when the state laboratory called the CDC to request more reagents it could not get through—"we only got answering machines." We were unable to ascertain whether the delayed responses on the part of CDC were due to difficulties in responding to simultaneous outbreaks in multiple jurisdictions or the need to have messages cleared by the Department of Health and Human Services and/or the White House or both. Moving forward, it is clear that CDC must work to manage state and local health officials' expectations regarding the type and timing of information that those officials will receive from CDC during infectious disease outbreaks.

Communication Between Public Health Departments and Health Care Providers

Local health departments emphasized the importance of maintaining good relationships between public health and health care providers. To the extent that local health departments reported that their public health systems "worked" in being able to effectively respond to the outbreaks of infectious disease, they often attributed their success to their long-term efforts to develop and maintain relationships with hospitals and the physician community. For example, one health department in New York suggested that the department's willingness to help physicians with diagnosis of difficult and unusual cases resulted in more physicians routinely reporting unusual cases to the health department, improving the department's ability to initiate active surveillance when necessary in the community (Fine and Layton, 2001).

Our case studies identified a number of specific examples of health department collaboration with physicians and hospitals that were critical to addressing the outbreaks of disease in local communities. For example, after an astute physician in Pennsylvania noticed a cluster of cases with symptoms consistent with hepatitis A, the physician telephoned the state health department and reported the cluster.[13] Within hours, the health department began to mount a rigorous epidemiologic investigation of all of the cases reported by the physician.

To be effective, health departments must communicate information to health care providers in a timely and accurate way. The SARS outbreak was characterized by rapidly changing information about the clinical and epidemiologic characteristics, case definitions, and appropriate clinical policies. Health departments throughout the country found a variety of ways of both keeping up to date themselves (sometimes by going outside the "official" channels to get information), and communicating with health care providers. One New York county that has an international airport with daily flights to and from Toronto hosted daily communications with hospitals and public health staff. Relationships that were formed with local hospitals and health care providers during the smallpox vaccination program proved helpful in that people knew whom to call with questions and concerns about SARS.

Lines of communication could become tangled. For example, in California during the SARS outbreak, state and national policies sometimes differed, leaving local hospitals with conflicting recommendations. A local health department in California utilized its blast fax system to keep local health care providers abreast of the changing case definitions and protocols (based on information created from CDC, WHO, Pro-Med, and the state health department). Its first SARS alert was issued on March 17, 2003 and reached more than 3,800 local physicians. The alert provided information on symptoms, instructions for specimen collection, and detailed guidelines on reporting. The first suspect SARS case was reported to the health department the following day (and ultimately was one of the two lab-confirmed cases in California and one of the eight in the country).

Local health departments used a variety of methods to communicate with hospitals and other health care providers. Technology was an important factor in linking health departments with hospitals. For example, Pennsylvania has developed its version of the National Electronic Disease Surveillance System (PA-NEDSS), which allows physicians and nurses to report diseases of public health importance to the state health department in real time. In addition, during an outbreak, the system can be easily modified to include applications that allow physicians and nurses to enter detailed information regarding potential cases to be followed up by health department staff.

Other methods used to disseminate information to providers included e-mail and blast fax systems, many of which were either purchased or improved with bioterrorism funds. In Louisiana, for instance, the state public health department used a blast fax system to contact its regional medical directors and hospital administrators across the state to inform them of the first West Nile virus case and to activate active surveillance. Several local health departments in Colorado discovered (by developing close working relationships with local hospitals) that fax was preferred over e-mail. They also learned that timing the fax messages was critical since the fax machines in physician's offices were only operational at certain times of day. Other

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[13] Most Pennsylvania counties, including the one in which the cluster appeared, have no local health department, so reports are made directly to the state health department, which responds.

physicians preferred written communications (memos placed in their hospital mailbox) to any form of electronic communication.

In addition to "active" communications, state and local health departments we visited also employed "passive" communications with the health care community. These included posting and updating the latest outbreak information on a web site and setting up emergency 24-hour hot lines. These are considered passive because health care personnel must either initiate the call or access the website.

Some local health departments also use face-to-face communications to enhance coordination with health providers. During outbreaks, one local health department in Colorado supplemented electronic and written communications to discuss the management of West Nile virus and SARS with regular face-to-face meetings with infectious disease physicians and hospital infection control staff. Another local health department in New York reported that its staff members participate in hospital infection control committees. Another emphasized its efforts to develop relationships with laboratory staff in the hospitals. Members of still another local health department visited each of its area emergency departments to educate physicians and staff.

Local health departments also provided disease-specific materials to assist physicians in identifying rare disease. For example, one local health department in California had delivered so-called "zebra packets" to local health care providers before the SARS outbreak, educating them on rare disease with nonspecific signs and symptoms. During the outbreak, this same health department also used a blast fax system to keep local health care providers abreast of changing case definitions and protocols. Messages were concise summaries of information created by CDC, WHO, and the state health department on symptoms, instructions for specimen collection, and detailed guidelines on reporting. Local health officials reported that, because of the packets, local providers were "savvy" and responded quickly and efficiently in identifying and reporting suspected SARS cases.

In addition to communicating with health care providers, some local health departments provided assistance to physicians and hospitals in their care of patients by providing brochures and pamphlets for distribution to patients. For example, in Colorado, as the epidemiological investigation of West Nile virus progressed, nurses conducting interviews reported that some patients diagnosed with West Nile fever were being sent home without instructions to note symptom changes. Some of these patients went on to develop neurological symptoms but didn't understand the importance of reporting this change to their physician. Following up on this, the health department distributed to providers a handout for patients that advised them about symptoms that may develop and should be reported to their health care provider.

Some local health departments emphasized the importance of developing personal relationships with health care providers at times other than during a crisis. One public health official noted that it was easy to communicate during an outbreak because the relevant people knew one another from conferences and had worked together on outbreaks in the past. These kinds of personal contacts helped to facilitate setting up surveillance and control programs that were important in subsequent outbreaks. In addition to attending conferences on a regular basis, other health departments conducted a series of panel discussions and informative sessions aimed at providing “up-to-the-minute” information to clinical staff in the community. Sessions were also broadcast to hospitals across Louisiana and Mississippi using a “telehealth” network. Another local health department emphasized the importance of developing relationships with the local medical society. Because an ongoing relationship had fostered openness and communication, there was a basis for trust between the local health department and local physicians during the early part of the monkeypox outbreak. Some local health departments have used medical society websites as an additional dissemination tool. Another public health department began to distribute a bimonthly newsletter on current public health topics as a way to maintain communications with the provider community.

Communication Between Public Health Departments and Emergency Responders

Although most local health departments recognized the need for well-established relationships with emergency responder organizations such as police and fire departments, few had actually established such relationships, and the relationships that existed were typically not tested in the outbreaks we studied. Most of the local health departments reported fledgling steps toward establishing partnerships.

For example, in Wisconsin, bioterrorism funding has been used to fund 12 public health preparedness consortia to build a regional infrastructure for local health departments to respond to bioterrorism as well as natural events. These consortia have begun to identify appropriate partners and build relationships with local emergency responders, law enforcement personnel and other agencies. While every county in the state has an emergency service chief, some chiefs report directly to the county executive and others to the police or fire chief. In many counties, the fire departments and Emergency Medical Technicians (EMTs) are all volunteers. Like other local health departments, these have encountered “turf” issues with fire departments and other agencies over command of emergency response events and control of bioterrorism funding coming from the federal level. One local health department noted that building partnerships is good, but that, to be useful, these partnerships need to be used or exercised regularly. Partnerships cannot ensure that communications will always flow smoothly during an emergency, however. For example, one health department noted that, even after performing a tabletop exercise with emergency responders, the health department was not notified during two subsequent bioterrorism hoax events.

Local health departments have tried a variety of means of making themselves more visible to emergency responder organizations, including participating in local emergency planning committees, making presentations to emergency responder organizations (this type of communication proved useful during the West Nile virus outbreaks in some communities), and arranging meetings with specific responder organizations to address respective roles and responsibilities in advance of an outbreak event. One local health department in Illinois reported that its community hoped to create a unified incident command system that would be activated for public health emergencies.

Perhaps of most concern to local health departments was the potential role that police and other law enforcement personnel (including district attorneys) would be required to play should isolation or quarantine be necessary during an outbreak of infectious disease. While some local health departments in California reported that they had statutory authority to issue orders for home quarantine, for example, they would need the police department to enforce those orders—and they therefore needed to “cultivate” that relationship. Other health departments noted that while they had authority to order quarantine or isolation in a public health emergency (such as SARS), the health department does not have the authority to declare a public health emergency, which is a necessary precursor.

One local health department reported that while the relationship between the health and law enforcement communities is “better than it was before 9/11,” it is still in need of cultivation, especially in determining the roles and responsibilities of stakeholders as the outbreak unfolds. In discussing reasons for this lack of coordination, some local health officials feel that law enforcement agencies neither know nor respect the role that public health departments play.

Some feel that emergency responder organizations see public health as a threat to their funds and responsibilities rather than a partner in their efforts.

Communication Between Public Health Departments and Other Governmental Agencies

Local health departments reported that outbreaks of West Nile virus, SARS and monkeypox forced them to coordinate their efforts with a host of other state and local governmental agencies, including many they had not worked with before. Health departments report varying degrees of success in working with non–health related state and local agencies.

To address West Nile virus, a county health department in Colorado established a real-time electronic network that allowed the health department real-time access to data regarding mosquito control activities in the county. In smaller counties in that same state, one-to-one communication between health departments and mosquito control has allowed the health department to share information on disease clusters with mosquito control. The mosquito abatement agency can use this information to help target mosquito control activities. On the other hand, other local health departments continue to have difficulty in their relationships with mosquito control districts. While some health departments have responsibility to control mosquitoes as vectors of disease, they have no authority to regulate abatement efforts. Some have tried to reach contractual agreements, including stipulations requiring larviciding if the districts are using public health funding to perform adulticiding.

The monkeypox outbreak required health departments to develop links with animal control agencies, such as the Department of Agriculture. Because these agencies were often used to dealing with larger animals, protocols for collaboration and responses regarding prairie dogs had to be created "on the fly." At times these agencies were not able to respond to the local health department's needs for immediate information. In addition, there were times when efforts were duplicated. For example, upon learning about the relationship between the monkeypox outbreak and a pet supplier in their county, one county health department in Illinois sent out an epidemiologist to contact the pet stores in the area. The county health department discovered that the Department of Agriculture had already contacted these businesses. However, because the county health department personnel felt they were getting insufficient information from the Department of Agriculture, they continued to contact local pet stores in the area. According to these health officials, the two departments "have a long way to go" to put coordination mechanisms in place.

In Wisconsin, the state emergency management department serves as the official connection between local health departments and other state and federal agencies to support disaster response and recovery efforts. Every county has an emergency management director, often in the sheriff's department, who reports to the state emergency management director. Although this arrangement is focused on hazardous materials and chemicals rather than public health, local health authorities report that they attend monthly meetings and work together in tabletop exercises and other activities, which provides a base through which public health has become recognized as an important partner in emergency management.

Communication With Veterinarians, Entomologists, and Related Groups

Veterinary practitioners are another stakeholder group that became important to health departments as a result of the monkeypox and West Nile virus outbreaks. While some states reported long-standing relationships with the veterinary community (including blast e-mail systems for members of the statewide veterinary medical association), others reported having to build these communications links in response to particular outbreaks. In response to the monkeypox outbreak, one county health department in Illinois decided to build a database of local veterinarians so that, in the future, they can draft messages and send them out quickly in the event of an incident involving infected animals. Louisiana is developing a web-based veterinarian reporting system supported by bioterrorism dollars, and other health departments added veterinarians to their staff (supported, in part, by bioterrorism dollars). One county in Colorado reports that some veterinarians are included in the HAN contact list. In one California county, the local humane society provides the health department with weekly counts of animal deaths, enabling the health department to monitor zoonoses.

Local health departments have also enhanced their communications with zoos, parks departments, and with the entomology community through relationships with university scientists and natural history museums. West Nile virus was the catalyst for the first real collaboration between Louisiana's state university agricultural school and the state health department, and has opened the doors for communication and collaboration with the agricultural community and with the Cooperative Extension, which represents another mechanism to reach the public. In California, West Nile virus was also the stimulus for strengthening the relationships with a university center for vector-borne disease, and SARS was the stimulus for improving relationships with university laboratories. In Pennsylvania, hepatitis A was a stimulus for strengthening relationships between the state health department and the state department of agriculture.

LESSONS LEARNED

Our case studies illustrate that while much progress has been made on the communications front since the advent of West Nile virus and the subsequent monkeypox, SARS, and hepatitis A outbreaks, there were a number of challenges to be addressed.

The Need to Improve Relationships Between State and Local Public Health, CDC, and Emergency Responders

In many but certainly not all instances, we were struck by the level of disappointment expressed by health officials regarding the performance of officials at higher levels of government. For example, local health department officials were often left to fend for themselves when facing novel communications challenges, rather than being able to count on help from state and federal officials. Similarly, as we have indicated previously, CDC's record of technical assistance to the states in this area has been, at best, mixed. Some of the less positive experiences may have come from a lack of "surge" capacity at the CDC, a problem that would be more severe in a large-scale national outbreak or bioterrorism attack. Even among those state officials actively handling communications, little to no additional staff help was provided, and "burn out" was common. Thus, communication surge capacity was an overlooked yet needed area of development.

In addition, we noted in a previous chapter that although the SARS outbreak served as a catalyst for public health and police departments to jointly confront legal issues surrounding isolation and quarantine, much work remains to be done. Improved communication, for instance, is required to ensure that police officers understand where the authority to issue isolation and quarantine orders is vested and who is responsible for enforcing such orders.

The Need for Partnerships Beyond Public Health

The response to infectious disease outbreaks such as West Nile virus, monkeypox, SARS, and hepatitis A required public health departments to coordinate their efforts at the federal, state, and local levels and to expand or to establish partnerships with organizations that they typically do not work with and over whom they do not have authority. Prior to these outbreaks, public health departments more typically than not had not identified contacts with stakeholders in sectors outside of public health (e.g., law enforcement, agriculture, veterinarian communities). During the course of the outbreaks studied, state and local health departments improvised to establish such relationships with limited resources and within tight time frames, and contributed to what is certainly an evolutionary process of uncovering communications weaknesses and developing creative solutions.

The Importance of Clarifying Roles and Responsibilities in Advance of an Emergency

Communication becomes critical when outbreaks occur, and lines of command need to be clearly delineated beforehand. Our case studies emphasized the need to develop relationships in advance of a crisis situation in order to come to a common agreement about the relative roles and responsibilities of different agencies during a crisis such as a disease outbreak or bioterrorism event. Standing in the way of such partnerships, at times and in some places, were a lack of mutual respect, concerns about “turf” and power, and issues of control over bioterrorism and other preparedness resources. In response to questions about coordination, some health officials discussed the lack of “control” over other agencies as if “coordination” and “control” were synonyms. Some states are developing a more permanent infrastructure for regional partnerships, but many states and communities continue to rely on ad hoc mechanisms such as task forces that exist only for the duration of an outbreak. Health officials recognized the need to “exercise” relationships to maintain them, but some did not have the resources to do so. Coordination across jurisdictional boundaries was reported to be especially difficult in some places.

A lesson from the monkeypox experience was the importance of tabletop exercises through which public health officials work out in advance who they need to talk to in the other sectors in order to mount an effective response. For example, one public health official with whom we spoke suggested that beyond tabletop exercises, his county should be doing a post-mortem with local hospitals on the monkeypox outbreak and on other infectious disease outbreaks to further clarify and solidify these relationships.

It is only since September 11, 2001, with funding and encouragement, that state and local health departments are actively reaching out to make contacts and to participate in training and exercises with nontraditional partners like emergency responders. And the evidence we gathered during the course of this study indicates, once again, that there is no substitute for practice, especially when the "practice" involves responding to actual threats and/or disease outbreaks.

Health officials noted that public health and health care communities traditionally have not been as close as they need to be in terms of their structure and functions (i.e., public health takes care of disease outbreaks whereas health care providers take care of sick people). If local public health officials do not have these relationships established in advance with the local hospitals, then coordination can become problematic. Additionally, communication channels between the CDC, state health departments, and local health departments are not adequate in all jurisdictions around the country. Even with technological assistance such as HANs, some local health departments are still reporting difficulties in getting accurate and timely information.

The Need to Improve the Effectiveness of Communication Within Public Health and With Health Care Providers

Some state and local health departments emphasized the need for quick and effective communication between levels of government (CDC to state health departments, state health departments to local health departments) and between health departments and health care providers. However, a number of health department personnel expressed frustration that even with electronic means (such as HANs), they still had barriers to overcome such as bureaucracy in approving HAN messages. Health officials also noted that some of the electronic platforms were reaching only a fraction of the physician community. Using CDC and HRSA bioterrorism grants and cooperative agreements, health departments were able to address many of these barriers. Community-wide health alert networks were developed along with e-mail and blast fax systems. Communities used bioterrorism funds to support training and exercises and, in some cases, to hire new employees (such as veterinarians).

IMPACT OF FEDERAL FUNDING

There can be no doubt that CDC cooperative agreement grants have had a significant impact on state and local preparedness activities, including communication. In most of the health jurisdictions we visited, for example, improved infrastructure for sharing information was often cited as a benefit of preparedness activities. CDC funding led to the establishment and further development of the Health Alert Network in many states, and these reportedly have been very well received by public health officials, hospitals, and health care providers. Pagers and cell phones purchased with bioterrorism funds also proved helpful to improve communications among health department staff in virtually all of the states and locales we visited. However, as one official was quick to point out, cell phones and other similar equipment are useless if there are inadequate numbers of personnel to use them.

Bioterrorism funding also helped to increase the number of communications staff across many of the states and locales included in the study, with dedicated health department public information officers rapidly becoming the norm. For example, bioterrorism money helped to pay for staff communication training. Clearly, the increase in staff and training helped health departments to develop and test communications plans for conducting prevention and control activities within public health departments and between public health departments and other agencies and for responding to the media and the public during the West Nile virus, monkeypox, and SARS outbreaks.

Finally, states used bioterrorism funding to fund regional structures to enhance communication and coordination. Wisconsin, for instance, established 12 public health preparedness consortia to build a regional infrastructure for local health departments to respond to acts of bioterrorism as well as natural disasters. These consortia have become the platform on which to build the critical collaborative relationships that link public health to emergency responders, local law enforcement and other governmental and nongovernmental agencies.

Infrastructure development is discussed further in Chapter 8.

6. COMMUNICATION WITH THE PUBLIC

Clear, accurate, and timely communication with the public—often conducted through the media—is an important public health function, and as these case studies illustrate, such communication becomes especially critical during public health emergencies. Communication is important for educating the public about steps that individuals can take to reduce the spread of infectious disease and to protect themselves. During an emergency, and especially in an emergency caused by a bioterrorist attack, appropriate communication can reduce public concerns and anxiety, increase trust in public health officials, and increase the effectiveness of the response.

To illustrate these issues, this chapter focuses on public information and education campaigns developed in response to the outbreaks studied. We give special emphasis to the campaigns developed for the West Nile virus and SARS outbreaks, since these were broad in scope. The public health communication efforts discussed include both those in which public health worked with the media to reach the public as well as those involving direct communication with the public through telephone hotlines and websites. This chapter addresses CDC Focus Area F, Risk Communication and Information Dissemination.

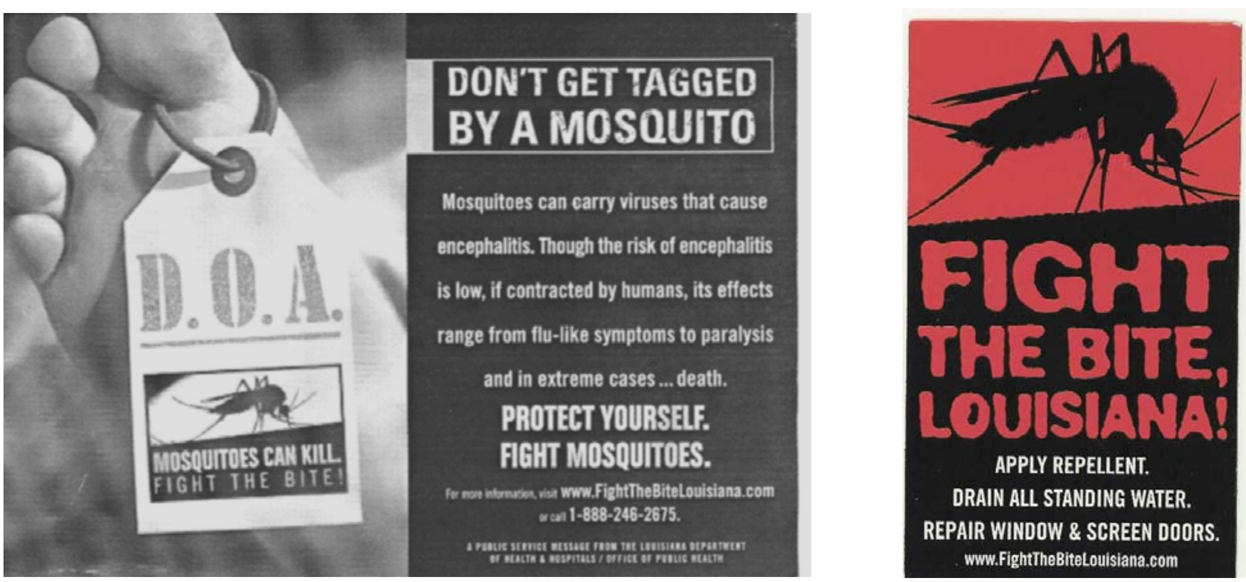
The organization of the chapter is as follows. We first describe the public information campaigns for the diseases. We then identify lessons learned and discuss the role of federal funding. The chapter concludes with a discussion of the relevant CDC Focus Area.

PUBLIC INFORMATION AND EDUCATION CAMPAIGNS

West Nile Virus

Many of the communications surrounding West Nile virus involved spraying programs to kill the mosquitoes that were harboring the virus. New York initiated a communications campaign in 1999. The campaign sought both to inform the public about where the spraying would take place and to describe the benefits of the spraying. Although the budget and preparation time were limited, free media coverage was extensive. The city announced the areas of the city that would be sprayed every evening, and every TV station ran this information. The communications campaign also included fact sheets about pesticides and e-mail to elected officials, community boards, and community organizations. The city health department also responded to more than 200 requests to speak to community groups. Extensive national media coverage created stress for the health department staff (Mullins, 2003).

In 2002, Louisiana State Office of Public Health (OPH) developed a public education campaign for West Nile virus. This mass media campaign, originally known as “Skeeter Beaters” but later called “Fight the Bite,” incorporated television and radio ads, billboards, bumper stickers, posters, and flyers. While the ads produced in the early days of the campaign were intended to ease tension and educate the public about how to prevent infection, they may have exaggerated the risks and increased the public’s concern and anxiety. For example, one now notorious poster pictured a corpse with a toe tag that said: “Mosquitoes Can Kill—Fight the Bite” (see Figure 6.1).



Source: http://www.oph.dhh.state.la.us/medialibrary/OPH_MSQ_Sprt.pdf.

Figure 6.1. Initial (left) and Revised (right) Fight the Bite Louisiana Educational Posters

After OPH received feedback about the public’s dissatisfaction with the early ads, it refined the education campaign to be less frightening, focus more on facts, and more effectively educate people about how to protect themselves and prevent mosquito breeding. A red and black logo was developed and included on all “Fight the Bite” ads. Posters, billboards, and ads all relayed consistent short useful messages such as “Apply repellent, drain all standing water, repair window and screen doors.”

OPH also mounted a coordinated media effort, working with both local and national news outlets to regularly update the public about the status of the outbreak and recent developments. A state epidemiologist and a Public Information Officer, both of whom were experienced in dealing with the media, coordinated a communication strategy with regional health directors, hospitals, the CDC, and others to send a unified, consistent message to the media. As a result, briefings to the media were regular and informative.

OPH and CDC also developed a West Nile virus toll-free hotline that was funded and staffed by the CDC. The hotline was designed to reduce the number of calls to the regional and state health departments. The hotline answered questions about West Nile virus, provided information to help callers learn how to protect themselves and prevent mosquito breeding, and allayed fears by providing correct information about the disease.

Colorado developed its own "Fight the Bite" education campaign during its West Nile virus outbreak in 2003. The public education campaign was developed by a Tri-County Health Department Public Information Officer in cooperation with leadership from the state and county health departments. The campaign was developed from scratch except for borrowing the catchy "Fight the Bite" name from Louisiana and personal protection tips focusing on the four "Ds":

- DRAIN standing water around the house weekly since it's where mosquitoes lay eggs, including: tires, cans, flowerpots, clogged rain gutters, rain barrels, toys and puddles.
- DUSK & DAWN are when mosquitoes that carry the virus are most active, so limit outdoor activities or take precautions to prevent mosquito bites.
- DEET is an effective ingredient to look for in insect repellents. Always follow label instructions carefully.
- DRESS in long sleeves and pants during dawn and dusk or in areas where mosquitoes are active.

The campaign was unveiled to the media at the state health department in April 2003. Although the event was very successful and resulted in good news coverage, it was too early in the season to have much effect. In late May, as the mosquito season approached, the health department proceeded with the campaign, but it was no longer newsworthy from the media's perspective.

"Fight the Bite Colorado" included posters, pamphlets, wallet information cards, and fact sheets printed in English on one side and Spanish on the other side. Colorado health officials felt that wallet cards were the most popular and were more likely to be kept and referred to than pamphlets. A coloring page for children and checklists for homeowners and gardeners were also developed. The state health department distributed printed materials to local health departments for distribution within their jurisdiction. Some health departments purchased materials as a contribution to the campaign, but otherwise there was no charge. In addition to the printed versions, all of the materials are available on the "Fight the Bite" website and can be downloaded for free. By the end of April 2004, approximately 600,000 hits to the Colorado "Fight the Bite" website had been recorded. There is a Spanish page as well as links to the CDC website for information in Chinese and Vietnamese.

One Colorado county health department gave frequent presentations to community groups and distributed posters and pamphlets to schools, community organizations and clinics. In addition, they targeted feedlots and canal companies, places where workers were at high risk of infection.

Representatives from several of the state and local health departments we visited were concerned about the need to identify and target ethnic minorities and "difficult to reach" populations with public information campaigns. During the outbreak in Louisiana, public health agencies had difficulty communicating with and educating the African-American community due to the false impression that West Nile virus was "a white man's disease," which occurred because the initial victims were all white and the outbreak occurred first in predominately white areas. Public health agencies also found it difficult to communicate with rural populations where literacy rates are generally poor. In addition, no substantial efforts were made to communicate with homeless populations and other groups who by their very nature may have been at greater risk for contracting West Nile virus. Indeed, the first case of West Nile virus in the state had been a homeless man who regularly slept next to or inside a horse barn.

One health department in Colorado, concerned about migrant workers, tried unsuccessfully to survey farmers and ranchers who employ migrant workers regarding the impacts of West Nile virus on the migrant population. Not surprisingly, the response rate to the survey was low (30%). In addition, the federal Migrant Health Program indicated that there was no money to test migrant workers who were symptomatic. The local health department was unable to find any data on the number of migrant workers in the county and was unable to obtain data on communicable diseases because migrant workers typically do not access medical care except in life-threatening emergencies. In California, a mosquito control district developed special pamphlets, posters, magnets and other items in multiple languages that were specifically targeted to the large migrant worker community in their county.

Some local health departments in Louisiana reported developing “informal” communications networks with local religious leaders, minority community leaders and directors of homeless shelters. Others reported little success in communicating with vulnerable populations such as homeless individuals, even though these individuals, along with migrant workers, might be highly vulnerable to West Nile virus because they lived or worked out in the open. Housing for migrant workers is often in disrepair—lacking or having torn screens on windows or doors. There was also concern that homeless individuals and migrant workers might not have access to mosquito repellants with DEET.

Public information campaigns could be very time-intensive for public health personnel. In one Colorado location, the county public information officer and health educator each spent at least 50 percent of their time during the outbreak on communications and public education regarding West Nile virus. Several thousand posters and 25,000 wallet cards were distributed across the county. The public information officer and leaders from various community organizations were asked to distribute “Fight the Bite” materials to their constituents; on some occasions community members went door-to-door delivering materials and special alerts in neighborhoods with high numbers of cases. According to feedback from these community organizations, this method of distributing educational material was well received.

Most health officials we spoke with felt that the majority of local media outlets represented the issues fairly well and were helpful in educating the public but they indicated that this was only as a result of substantial efforts of health department public information officers. National media were somewhat more problematic and tended to sensationalize and “keep the fear level pretty high.” Reflective of the better cooperation at the local level, some public health information officers even convinced the local TV and newspapers to post links on their websites to the health department’s public information websites. Health department officials also spent many hours on local talk radio. Health departments emphasized the importance of developing an e-mail list of media actively working on public health so that communications can be targeted, and developing an internal list of health department staff most capable of handling television and print media.

Health departments in Illinois noted that sometimes the messages surrounding West Nile virus were obscured by the media because some interventions (e.g., larvicide treatments) do not make as effective visuals as others do (e.g., spray trucks). In one community, even though public health and mosquito abatement agencies agreed that larvicide treatment of standing water—rather than spraying of neighborhoods—was the most effective and the one best able to achieve long-term results, it was a struggle to persuade the media to portray the appropriate intervention in their stories. As a result, the public was left to question whether public officials were responding at all to the crisis.

Some health departments used media events to anticipate and address some of the difficulties. Some health departments held daily press conferences at the same time every day; others prepared fact sheets specifically for the media. In one Colorado community, the media event included a testimonial by a West Nile virus patient. In this way, the health department could give the media exposure to a patient without violating confidentiality and, at the same time, could exert some influence over the message. Another local health department reported organizing a two-day media event at a chicken coop, which allowed local media to interview local officials and acquire film footage of mosquito trapping and speciation, household insecticide use, and application of mosquito repellent. As a result, there were few requests to film these activities at the height of the outbreak since most local media outlets had stock footage available from this event.

SARS

While communication efforts for West Nile virus focused on raising awareness of the disease and encouraging the public to take protective measures, some of the public health communications concerning SARS attempted to reduce levels of community concern, particularly because there were relatively few suspected SARS cases in the United States. Concern had been heightened due to extensive media coverage of the disease. Public health departments created educational materials and provided support resources such as hotlines offering information on the disease and sometimes counseling, and instructions for what people could do to help themselves, and brochures targeted to different populations (especially Asian groups).

During the SARS outbreak in 2003, the New York state health department set up a website with news releases and information summaries. It also called upon staff from throughout the department to form a SARS workgroup, which prepared fill-in-the-blank press releases, drop-in ads, and other materials for local health departments, hospitals, physicians, and others to use. The state health department distributed information on hand washing and respiratory precautions to colleges, community-based organizations, and travelers visiting at highway rest stops, especially those used by people returning from Canada. The common theme was to relate SARS to colds and the flu (e.g. “cold, flu, and even SARS” was a common phrase), and these efforts proved to be helpful during the 2003-4 flu seasons.

Although there were no laboratory-confirmed cases of SARS in Illinois, the state and local health departments had to deal with residents who were sick and had traveled to high-risk areas. In one county, for example, several residents had just returned from Guangdong Province in China, where the SARS outbreak started. Although these individuals met the case definition for suspected SARS, none of them was laboratory-confirmed. The state health department also fielded phone calls from the worried well (e.g., businesses and universities with personnel who had recently returned from overseas) and others who had reason to believe they may have been infected with SARS. Fielding these calls was time-consuming, requiring on average 20 minutes per call. Local health departments then followed up on suspect cases.

The need to target public health information campaigns to specific groups of people, in this case the Asian population, was also important during the SARS response. Public health officials in New York focused on universities and high tech companies and attempted to reach their Asian employees and others who traveled frequently to Asia through university and employer-based health programs, religious communities and schools.

The SARS outbreak illustrated California’s limited capacity to communicate effectively with the Asian population. During the outbreak, language and cultural barriers resulted in poor communication with San Francisco’s Chinatown and incidents of public behavior fueled by misinformation. For example, there were reports of boycotts of local food stores because the owner appeared “sick.” Some state officials emphasized the need for a centralized state-level translation agency. One Bay area health official noted, however, that the Chinese language media in San Francisco seemed to be doing a good job of communicating with the public without help from the state or local health department.

Hepatitis A

Two days after receiving the first case report, the Pennsylvania state health department issued a health alert that contained information about signs and symptoms and a telephone number to contact the health department with questions and inquiries. The alert was distributed through radio, television, and print ads. Shortly after the health alerts began, the health department became flooded with phone calls from concerned members of the public. The department tried to field every call with staff members who were knowledgeable about hepatitis A. In addition, the department received a large number of e-mails from individuals requesting advice or potential solutions to the outbreak.

The health department did not, however, establish a separate "information line" for people to call regarding the outbreak. Health department staff later reported that such an information line would have improved the efficiency of their response.

There was intense media interest in the outbreak both locally and nationally. The most common question among the media was "What's today's 'daily number'?" but they also typically asked "What's causing this?" and "Did an infected employee cause the spread?" To limit the number of inquires, the health department put the updated case count on their web page every day. Despite these efforts, the health department was unprepared for volume of press and media inquires. For example, health department staff conducted over 100 media interviews in the first four days of the outbreak. To help with the volume of inquires the health department assigned a spokesperson on site in the area of the outbreak.

One problem that the health department encountered in responding to the outbreak was that it did not have enough staff trained in risk communication to handle inquiries from the press. There was also confusion about how and when information should be released, how information to the press could be controlled, and how to better respond to calls from the public. As the outbreak continued, the health department identified spokespersons and began to collaborate with state and local leadership about messages to the public.

The media interest had a negative effect on the outbreak investigation by distracting key health department staff from their duties investigating the outbreak to answer press and media inquiries.

Monkeypox

Public information and education campaigns for monkeypox required coordination between state and local health departments and agriculture departments. In Illinois, for example, the state department of health was the lead agency in communicating with the public and the press about the human-related issues associated with the monkeypox outbreak, whereas the state department of agriculture was the lead agency in communicating with the public and the press about animal-related issues. Both of these departments established a joint monkeypox hotline for members of the public and press. In addition, the state health department posted information about the outbreak on its website and issued two press releases. These departments also held joint monthly teleconferences during the outbreak.

LESSONS LEARNED

The West Nile virus, SARS, monkeypox, and hepatitis A outbreaks provided an opportunity to review and revise public health departments' policies for communicating with the public and the media.

The Need to Identify and Address the Full Range of Public Concerns

The West Nile virus case illustrates how communications about one risk can raise concerns about others. One significant challenge for risk communication occurred due to the tradeoff between the risk of contracting West Nile virus and the risk of harm due to the use of insecticides to control its spread. Some public health officials pointed out that many people are more afraid of DEET than they are of West Nile virus, and that others believe that West Nile virus will not affect them, even though many young and otherwise healthy people became ill and were hospitalized. In New York City, concerns about the health effects of the insecticide rose as the spraying continued. The health department had carefully reviewed the literature and felt that science was on its side in terms of the need to control the mosquitoes and the low-level exposures experienced by city residents. However, public perceptions of the level of risk can be driven by a number of causes; therefore, it is important to ensure that risk communication campaigns adequately identify and address the source of concerns.

The Challenge of Motivating Behavior Change

While increased awareness is one goal of public health communication campaigns, motivating behavior change can be another critical goal and one that is difficult to achieve. For diseases such as West Nile virus, public health officials recognized that the public needed to feel susceptible enough to change their behavior but not so fearful that they would avoid outdoor activities, especially visiting national parks and public recreational facilities. Health officials also understood that any event, whether naturally occurring or man-made, that creates public fear has the potential to adversely affect the local and state tourist economies.

In the case of West Nile virus in Colorado, not many people seemed to have changed their behavior, despite the 2003 “Fight the Bite Colorado” public education campaign. As a result, changes were made in the 2004 campaign. In Colorado, the text in some of the materials for 2004 was revised to reflect how hard-hit Colorado was by West Nile virus and to indicate the potential seriousness of the disease.

Louisiana’s West Nile virus public education campaign was regarded as successful by health officials; nonetheless, it encountered several problems. Despite the education campaign, people still did not understand how to protect themselves from West Nile virus and prevent mosquito breeding. For example, despite ads warning residents to eliminate standing water from around their homes, health department officials reported going to many homes and finding standing water in planters, bird baths, and other locations. In 2004, communication campaigns in Louisiana have included testimonials from people who became seriously ill from West Nile virus, in the hope that making the message more personal would be more effective in changing behavior. However, some have been skeptical about such campaigns, feeling that testimonials, because of their anecdotal nature, might have the opposite effect. For example, when interviewed by the media, the individual who was the first reported case in the Louisiana stated that mosquitoes bit him when he was hunting in a wooded area. Some have speculated that this story actually reinforced the belief that protection is needed only in the woods.

The Importance of Coordinating Communications

In New York, for both the West Nile and SARS outbreaks, state and local health officials stressed the need for public health to speak “with one voice,” made strong efforts to reach minority and affected communities, and addressed the “worried well.” At the state and local levels, health officials worked to maintain relationships with the media that they could call on during an emergency. The public health community’s experiences with the 2001 anthrax attacks significantly influenced its approach to communicating with the public during these two epidemics.

Officials in Louisiana advocated having a coordinated regional communications strategy that was inclusive of all health stakeholders. This would enable health agencies to craft and communicate a unified, consistent message about the outbreak and the public health response. In Wisconsin, health officials emphasized that, at a minimum, the health department needed to have its own communications plan that outlines staff responsibilities, eliminates unnecessary "bureaucracy" in approving media releases in a timely fashion, and ensures that there is "surge" capacity for media relations during an outbreak. The plan should help to ensure that the media message is consistent and that the messages can be tailored appropriately for different minority media outlets.

The Need to Target Communications

Many of the health departments developed targeted communication campaigns. In New York, health officials distributed materials about SARS at colleges, organizations hosting large community events, and at highway rest stops on roads linking Canada to the United States. In California, an educational campaign for West Nile virus targeted "nontraditional" partners including landscapers and youth clubs (a Boy Scout merit badge was created for vector control). Another mosquito control district focused on developing a newsletter that targeted private owners of swimming pools and still another partnered with entertainment personalities to create public service announcements that were placed on closed circuit television systems by local homeowners associations. A number of states provided SARS information directly to the public through web pages, sometimes in several different languages. Some states provided 24-hour SARS hotlines for people to call with questions about SARS or to report a possible SARS case.

Nevertheless, many jurisdictions are still not adequately prepared to communicate critical information to the public in multiple languages and have not yet established relationships with leaders and groups that can reach ethnic minority and disadvantaged communities who may have a more guarded attitude toward government agencies (including public health). More effort is needed to develop tailored information campaigns that can reach these communities. Possibilities to explore include informal communication networks developed together with local religious leaders, directors of homeless shelters, unions or other community organizations that represent the interests of migrant workers, and minority community leaders. Some interviewees suggested that this need is urgent as "invisible" populations such as migrant workers (a very difficult population to reach) are potentially vulnerable targets for a bioterrorist attack.

The Need to Manage Communications Demands

In many cases, the volume of calls to health departments during the outbreaks was overwhelming. The need for surge capacity was particularly necessary in order to communicate with "hard-to-reach" populations, including some ethnic minorities, migrant workers, and homeless individuals. Some state and local health departments emphasized the need for quick communications between levels of government (CDC to state health departments, state health departments to local health departments) and between health departments and health care providers. However, a number expressed frustration that even with electronic means (such as HANs), they still had barriers to overcome such as bureaucracy in approving HAN messages. Health officials also noted that some of the electronic platforms were reaching only a fraction of the physician community.

To reduce the volume of calls concerning West Nile virus, the state health department in Colorado began to institute West Nile virus announcements that were posted on their website at 4 p.m. every day. Some counties followed the state's lead and also posted West Nile virus updates at regular times. This action reduced the volume of calls and also had the added benefit of standardizing the release of information. The reduction in calls also led to a reduction in the lag time in sending information from the state to the local health department and freed up local health department staff to notify local officials and community leaders in advance of public announcements.

The Challenge of Working with the Media

Many health officials found that one of their most important challenges involved working with the media during an outbreak. While the Louisiana media tended to stick to the health department's message, the national media tended to sensationalize the outbreak, continually looking for an angle to sell the story to a nationwide audience, and local health departments were not prepared for this.

Health officials in Colorado noted that early in the West Nile virus outbreak press releases to the media were issued at both the state and local levels and the numbers rarely coincided, causing the media to distrust one or both sources of the information. Much of the problem came from the fact that some health departments were reporting the number of cases under investigation and others were reporting only confirmed cases. Some health departments were unable to resolve these issues but others adopted the practice of reporting only confirmed cases, which cut down on discrepancies. There was also a problem with the timing of releases. Sometimes the state health department would report a death before the local health department was aware of the case.

Health officials also emphasized the need for attention to the selection of spokespersons and training of public health staff to interact with the media. In Pennsylvania during the hepatitis A outbreak, a spokesperson was identified to remain on site at all times. Some local public health departments in Louisiana relied on public relations firms to help train their public information officers and other staff. It should not be assumed that any public health official with good credentials will be an effective media spokesperson. Interview skills can be learned (e.g., through practice on-screen interviews and feedback.) The credibility of the entire public health infrastructure is on the line when a spokesperson steps up to the microphone, so it is critical that the agency ensure that the person is prepared—not only armed with the appropriate information but also able to communicate it effectively.

The media's desire to interview disease victims posed another challenge. Confidentiality regulations prevented health departments from releasing any information other than an individual's sex, age and county of residence. Although the media pushed for more detail including the city or town in which the cases occurred, some health departments refused to release that information for fear that, in small towns, individuals could be identified. At the same time, health departments did not want to alienate members of the media because TV, radio and newspapers represent a significant free resource for public education. Focused attention on educating the media as well as the public seemed to help address such problems.

IMPACT OF FEDERAL FUNDING

Using bioterrorism grants, health officials were able to address many of the barriers to effective public communication. Community-wide health alert networks were developed, along with e-mail and blast fax systems. Communities used bioterrorism funds to support training and exercises and, in some cases, to hire new employees (such as veterinarians). States and local communities also used bioterrorism funds to develop large-scale public information campaigns, such as "Fight the Bite," that enabled them to reach large numbers of people with timely and useful preventive information. Some even used these funds to target campaigns on nontraditional partners and to develop "informal" communications networks (with religious leaders, community organizations and advocacy groups) to reach the "hard-to-reach."

CRITICAL BENCHMARKS AND CAPACITIES

Critical benchmarks and capacities relating to Focus Area F, Risk Communication and Health Information Dissemination, are shown in Table 6.1.

Table 6.1. Critical Capacities and Benchmarks Relating to Public Information

FOCUS AREA F. RISK COMMUNICATION AND HEALTH INFORMATION DISSEMINATION (PUBLIC INFORMATION AND COMMUNICATION) **Critical Capacity #15**: To provide needed health/risk information to the public and key partners during a terrorism event by establishing critical baseline information about the current communication needs and barriers within individual communities, and identifying effective channels of communication for reaching the general public and special populations during public health threats and emergencies. ***Critical Benchmark #23*:** Complete a plan for crisis and emergency risk communication (CERC) and information dissemination to educate the media, public, partners and stakeholders regarding risks associated with the real or apparent threat and an effective public response. ***Critical Benchmark #24*:** Conduct trainings, drills, and exercises involving communication systems to ensure channels of communication to inform the public, partners, and stakeholders about recommendations during public health emergencies work in a timely and effective manner. **Enhanced Capacity #11**: To identify, develop and improve crisis and emergency-risk communication planning with respect to the needs of special populations, cultural and psychological aspects of crisis communication, and communication barriers to effective public health response during public health emergencies including terrorism, infectious disease outbreak and other public health emergencies. Source: CDC, Continuation Guidance—Budget Year Five, June 14, 2004.

Our analysis indicates that states' experiences with West Nile virus, SARS, monkeypox, and hepatitis A provided enormous opportunities to address these capacities and benchmarks. For example, in every state and locale visited, the health department experienced a real-life "test" of its ability to provide critical health/risk information to the public and to key partners (Critical Capacity # 15). These tests revealed various strengths and weaknesses, which were often remedied, at least in part, with funds received under the CDC's bioterrorism grants program. Moreover, as we have noted, there was collective learning as these disease outbreaks, or suspected outbreaks, spread from one area of the country to another. California, for instance, was much better positioned to deal with West Nile virus because the state had several years to prepare for its arrival and to assimilate lessons learned from other states as the disease spread westward.

Although we did not attempt to quantify the degree to which the sites visited made progress in achieving Critical Benchmarks #23 (crisis and emergency risk communication plan) and #24 (trainings, drills, and exercises), our general impression is that significant progress has been made on both these fronts. We also believe that those states that were forced to confront one or more of the disease outbreaks we have studied have a “leg up” on their counterparts in other states who did not have their communications and coordination systems stressed in this regard.

Similarly, our results suggest that the study states also made progress with respect to Enhanced Capacity #11. At a minimum, states’ experiences with West Nile virus, SARS, and monkeypox highlighted various areas for improvement and led key health department officials to acknowledge that considerable work needs to be completed in this area before they are adequately prepared to meet the next infectious disease outbreak or a bioterrorist attack.

7. ORGANIZATIONAL LEARNING AND WORKFORCE DEVELOPMENT

In the previous chapters we have focused on several functional capabilities used by public health to respond to disease outbreaks. We now turn, in this and the next chapter, to a discussion of capacity-building activities, i.e., activities undertaken outside of the disease outbreaks in order to enable a more effective response. In this report, we have distinguished between policymaking that was done in the course of an outbreak (as discussed in Chapter 4) and long-term policy development. In this chapter, we discuss relevant activities that took place before some or all of the disease outbreaks under discussion, as well as others that took place after the disease outbreaks were under way.

Capacity-building includes activities to enhance organizational learning, to develop the workforce, and to build infrastructure. We discuss the first two of these in this chapter. Knowledge development and application activities include long-term policy development, planning and assessment activities, exercises and drills, and other opportunities to "practice" for emergencies, evaluation, and research. Also critical are activities to develop partnerships (with health care providers, emergency responders, and others). Workforce development is a different, but related, issue. Activities aimed at enhancing the public health workforce include hiring of new staff, reorganization or reassignment of existing staff, use of supplemental workforce, and training and other educational opportunities.

Many of the activities undertaken by state and local health departments using CDC cooperative agreement funds are aimed at filling readily apparent deficiencies related to preparedness—hiring additional staff, developing improved surveillance systems, and obtaining enhanced laboratory equipment, for example. A number of less visible activities are also suggested by CDC's guidance and undertaken with the goal of enhancing and applying knowledge at the community, local public health agency and/or individual public health professional levels. These are activities that contribute to institutional learning that can be applied and built upon over time, if done well.

The rest of this chapter is organized as follows. We first look at activities related to organizational learning and then to workforce development. We then present lessons learned in these two areas and discuss the role of federal funding in supporting these activities. The chapter concludes with a discussion of relevant activities in the CDC cooperative agreement: Focus Areas A, Preparedness Planning and Readiness Assessment, and G, Education and Training.

ORGANIZATIONAL LEARNING

In this section we discuss knowledge development and application activities in five areas: long-term policy development, planning and assessment activities, exercises and drills, evaluation and learning from experience, and research. Within the discussion of these issues, we also refer to related activities to develop partnerships with health care providers, emergency responders, and others.

Prior to our site visits, the requirements of CDC bioterrorism funding had prompted general reviews of public health authorities at the state and local levels. For example, as a result of federally funded bioterrorism activities and required smallpox planning, New York State had completed a comprehensive review of disease reporting and emergency response statutes and regulations prior to the SARS outbreak. Federal bioterrorism funding supported the hiring of a full-time attorney to work on these issues. One result was to amend the regulations for designating reportable conditions, and the new procedure was used for both SARS and monkeypox, as described in Chapter 3.

Others have developed structures for ensuring that planning is an ongoing process. For example, in one California county a "gang of five" comprising the health officer, sheriff, fire chief, police chief, and an office of emergency services representative was established to make recommendations about the optimal local use of federal funds. Similarly, another county health department in the same state formed a local influenza coalition, composed of both public and private sector representatives (including insurance and pharmaceutical and biotech companies), and has a working plan to guide the responses to a future outbreak, with a particular focus on "hard-to-reach" populations.

Long-Term Policy Assessment and Planning Activities

The West Nile virus and SARS outbreaks provide especially useful cases of the role of long-term policy development and planning.

West Nile Virus. In response to the West Nile outbreak in 1999, a number of states began to develop plans to guide public health activities if the disease reappeared or appeared for the first time in a new state. Much of this planning was in conjunction and with the support of

CDC, which has held annual meetings for public health practitioners and provided financial support to affected states. For example, the New York State Department of Health prepared a West Nile Virus Response Plan in early 2000 (NYS DOH, 2000). Based on experience with the original outbreak and building on CDC guidance (CDC, 2000), this plan was intended to prepare state and local health departments for an expected return of the virus in 2000. The plan was developed in collaboration with New York State agencies, the New York City and county health departments throughout the state, and representatives from community, environmental, and other nongovernmental organizations. The plan describes

- prevention, response and control systems that will be implemented
- surveillance systems to identify the virus in mosquitoes
- surveillance systems to identify the virus in birds and mammals
- active and passive surveillance systems for human West Nile virus cases
- improved systems for electronic data collection and sharing among public health agencies
- a campaign to heighten public awareness about reduction of Culex pipiens breeding sites and personal mosquito protection.

After the 2000 outbreak, the state health department reconvened the group that prepared the first plan and in May 2001 issued an updated response plan (NYS DOH, 2001). This "guidance document" is not intended to "direct local health units to take particular actions. Rather, it describes those steps that … are considered to be most effective in protecting public health and the environment."

In Louisiana, the state health department used CDC West Nile virus funding to create the "LA Mosquito Abatement Program" (LAmap) in 2002 to help parishes establish mosquito abatement programs (Louisiana Office of Public Health, undated). Parishes were given a blueprint of what they would need to do and how much it would cost for a program in their area. State officials report that Louisiana's earlier experience with West Nile virus in 2001 and 2002, left it better prepared to guide disease control policies in general.

The City of Chicago Health Department developed a comprehensive West Nile virus prevention plan that addresses risk communication and public education/community outreach, bird and mosquito surveillance, human case surveillance, mosquito control and source reduction, and communications with hospitals and physicians. This plan resulted in the 2003 implementation of an aggressive public education campaign to get the message out to residents to eliminate standing water and to take preventive measures to avoid mosquito bites (Chicago Department of Public Health, 2003). Similarly, in 2003, the Cook County health department developed its first West Nile virus response plan that addresses public education and community preparedness, responder staffing, GIS mapping, incident management, sentinel bird and horse surveillance, mosquito surveillance and control, surveillance for human cases, phased response for West Nile virus risk reduction, and expansion of communication capabilities (Cook County Department of Public Health, 2003).

Immediately following the 1999 New York City West Nile virus outbreak, the California Department of Health Services initiated a review and enhancement of existing guidelines to ensure the appropriateness of its current surveillance, prevention, and containment activities. This effort culminated in the development in 2000 of a West Nile Virus Task Force that serves as a loose-knit committee of key state and local agencies that meets three times per year. Additionally, the California Department of Health Services developed the Mosquito-Borne Virus Surveillance and Response Plan to be used by local agencies (California Department of Health Services, 2004).

SARS. The enormous attention surrounding the outbreak of SARS meant that public health departments needed to develop effective policies and plans for controlling the disease, despite the limited number of actual cases in the United States. SARS presented difficult infection control issues, and many states developed and disseminated coordinated strategies despite the fact that they had few or no suspected SARS cases. For example, New York health departments implemented strategies that would have been essential if there had been more cases. For instance, one local health department set up a computer database to track potential cases and contacts. This was possible only because preparatory work had been done after that department experienced both West Nile virus and anthrax.

In particular, SARS forced public health officials to consider how to implement quarantine and isolation. As part of New York state's review of its public health statutes and authorities, for instance, one New York county worked out a detailed "Protocol for Isolation and Quarantine of Communicable Diseases." This included information on the legal codes that give local health departments their authority in these situations, detailed plans on how to work with the sheriff's department and the courts, and forms to help implement the plan. This protocol was subsequently distributed to other counties by the state health department as a model.

In December 2003, New York prepared a guide for the possible reemergence of SARS, which included information on surveillance, nonhospital isolation, and quarantine, as well as clinical guidance (New York State Department of Health, 2003). The purpose of the guide is to assist public health officials and health care providers in preparing for and responding rapidly and decisively to the recurrence of SARS in the local community or a health care facility. The document provides detailed state implementation strategies, consistent with the national guidance from CDC in five areas: surveillance, clinical guidance, nonhospital isolation and quarantine, laboratory diagnosis, and public communication. New York State specific procedures, reporting forms, and legal guidance are provided. This guide was distributed to local health departments, the state health information network and on the department's website. A similar approach is also being used as a model for pandemic influenza planning in New York.

In the wake of SARS, the California Department of Human Services started work toward strengthening the link between law enforcement and legal communities and public health with regards to isolation and quarantine. One county health department in the state, for example, began discussions following the SARS outbreak with law enforcement communities in their jurisdiction—namely, police and district attorneys—in the hopes of creating protocols delineating the roles, responsibilities, and authority each stakeholder has in the event of a serious outbreak.

Building upon activities aimed at longer-term policy development, a number of sites reported implementing more-concrete planning and assessment activities. Most straightforward and common among these activities is the development of plans for responding to specific events or to public health emergencies more broadly. For instance, a California local health department added a "SARS annex" to an existing bioterrorism response plan. Both departments plan to add smallpox and influenza annexes in the future.

Exercises and Drills

Over the past several years, exercises and drills have become more common in the public health community as tools for training, gap assessment, and planning. Indeed, we heard about participation in these activities in each of the states that we visited. One Louisiana health department official tied the ability to do exercises directly to bioterrorism funding, noting that "It has allowed us to do a lot of trainings that we wouldn't have been able to do."

In Colorado, several public health officials reported that exercises helped them become better prepared for the West Nile virus and SARS outbreaks. For example, smallpox planning presented an opportunity to test local health departments' ability to conduct rapid training using web-cast technology and also allowed them to test some of their emergency response systems such as the Health Alert Network. Others reported that exercises and drills reportedly taught people how to send specimens to the appropriate laboratory and allowed them to practice putting on personal protective equipment. County public information officers and others who had not had much involvement in exercises prior to the increased preparedness efforts are now fully involved. In small health departments, experience with exercises has sparked cross-disciplinary training efforts. However, one of the most significant benefits associated with emergency preparedness drills and exercises was reportedly that people who had not met before got to know one another, thus providing opportunities for building partnerships.

Each of the local health departments we visited in New York had participated in a variety of exercises and drills, including tabletop exercises, mass immunization clinic and point of distribution drills, and hazardous materials exercises. Some have been doing so for many years; health department personnel in one New York county, for instance, have long participated in the required emergency management drills associated with a nuclear power plant in an adjacent county.

Evaluation and Learning from Experience

Although public health officials generally understand the importance of evaluation, we heard few examples of formal evaluations of processes and programs. Following a negative experience with voluntary quarantine and isolation during the monkeypox outbreak in Illinois, for instance, the state health department sent out a survey to those who were involved asking them to specify what conditions would need to be met in order for it to be possible or likely that they would comply. More commonly, the press of events during a serious disease outbreak and the lack of staff for anything other than urgent matters tends to preclude formal evaluations. It should be noted, however, that the West Nile virus and SARS planning documents discussed above—generally based on the previous year's experience—represent an important opportunity to learn from experience as an organization.

One exception to this pattern is an analysis of lessons learned from responding to the monkeypox outbreak prepared by the Wisconsin Division of Public Health (Davis, 2003) for a two-day meeting about the outbreak convened by the CDC in September 2003. The detailed analysis reviews what worked well and what did not work well during the outbreak with respect to surveillance, epidemiology and contact tracing, and laboratory practices; regulations and policies including quarantine and isolation; smallpox vaccination clinics; and media, public education and communication. With respect to surveillance and epidemiology, for instance, Wisconsin officials found that previously designated smallpox coordinators at each local health department and hospital, supported by preexisting forms and protocols that could be modified for the specific outbreak, helped the department respond to the outbreak. Coordination with CDC about laboratory testing and interpretation of test results, however, was seen as an area where improvement was needed. The review determined that legal powers for isolation and quarantine were sufficient, but attention was needed to workers' compensation insurance, which did not originally cover individuals who had to be quarantined but were later determined not to have the disease.

Another exception comes from New York (particularly at the state level and in New York City), where public health officials have taken the time to write up and publish papers in the professional and scientific literature based on their experience. Fine and Layton (2001), for instance, have written about the implications of the West Nile virus outbreak for bioterrorism surveillance. Gotham et al. (2001) used the West Nile virus experience as a case study of New York state IT infrastructure, and (2003) wrote about New York City's experience with West Nile virus and SARS as a case study in public health communication.

In many of the sites we visited, real-life events were seen as having done more than drills could have to prepare public health agencies. In one upstate New York county, for instance, interviewees noted that the anthrax experience prepared them for dealing with West Nile virus. Health department officials in this county had been faced with determining how to treat county workers who had been involved with the clean-up in New York City. These decisions needed to be made at a time when the county health director was out of town. The department's experience in determining "who is in charge," as well as dealing with exposed workers who did not speak English, helped prepare the health department for SARS. Experience with the West Nile virus also proved valuable in addressing SARS. The New York City health department was able to build a database on the fly to track possible SARS cases. This need had been identified during the early West Nile experience, and the health department used federal surveillance funding to build the framework of a tracking system in advance of the SARS outbreak.

In Louisiana, one parish's early experience with West Nile virus resulted in application of new knowledge in other parishes later on. Responses to West Nile virus in Baton Rouge and other areas that had later West Nile outbreaks were informed by the first parish's "lessons learned," which were communicated anecdotally in telephone conversations among regional medical directors. Specific lessons learned included

- a better understanding of laboratory issues (where to send samples, how to interpret the results)
- a more refined, less alarming public education campaign
- the need for involvement and assistance from the CDC
- advance warning that the virus was spreading much faster and with greater intensity than the state had originally anticipated.

In Illinois, the SARS outbreak led the health department to formalize some of its practices. For example, an Illinois state health department official found that the key to an effective SARS response was having an infectious disease physician on call. While this had been informal practice prior to SARS, the outbreak led the department to implement it as a standard practice. Additionally, the department's prior experience in talking to and advising individuals who were panicked about a particular disease or exposure helped the department respond to public concerns about SARS.

Although not well established in the public health arena, continuous quality improvement (CQI) holds promise for improving processes and outcomes. CQI refers to the implementation of formal approaches for learning from experience and creating change. Some of the states we visited have begun to implement CQI efforts, although these are not always seen by the participants as CQI per se. The following examples are all based on the West Nile outbreak in Colorado, but other states and outbreaks provide similar examples.

One local health department in Colorado responded to an upswing in the volume of West Nile virus cases that were reported from various sources in a short period of time by adjusting operations to meet the increased demand. While two people were generally available for disease report follow-up, up to seven were engaged in conducting interviews at the peak of the West Nile virus outbreak. This flexible response to the unfolding circumstances became even more important when, in the middle of the West Nile virus outbreak, the department had to investigate three different food-borne illness outbreaks and two shigellosis outbreaks.

Similarly, the local health departments we visited in Colorado reported learning about their surge capacity—how many cases could be handled without sacrificing all other public health activities and how long they could maintain such a high level of response. Some learned that there must be efforts to reduce the stress on staff who are working long hours over many weeks. One county instituted stress management measures for nurses conducting the investigations. For example, the health department held regular staff meetings so nurses could share their experiences, and each nurse was allowed to take two or three days off from conducting investigations.

Faced with burgeoning numbers of West Nile virus case reports, one Colorado county responded by instituting a centralized management system for handling West Nile virus case investigations. As positive cases came in, the director or assistant director of the disease control program would assign an Emergency Response Team (ERT) member to the case to conduct the investigation. Health department staff worked closely with the local hospital infection control coordinator so that all cases diagnosed in the hospital were reported directly to the disease control program director or assistant director.

Additionally, with some assistance from CDC regarding techniques for collecting mosquito data, the Colorado state health department was better able to integrate their mosquito surveillance data in 2003 than it had been the previous year. As a result, the department improved its ability to help local health departments decide what mosquito control action was necessary. This is an example of learning from challenges faced during a previous outbreak.

This learning approach was applied to laboratory issues as well. All human testing for West Nile virus was performed at the state lab in Denver in 2002. During the winter of 2002–2003, in anticipation of the need for increased capacity to perform human testing for West Nile virus across the state, a county laboratory began the process to become certified to perform human testing, and by July 2003 was ready to accept human samples and had worked out a plan with the state lab to share the workload. As the number of human cases increased, the number of human samples being sent to the county for testing increased as well. To accommodate the increased workload associated with testing human samples and to address widespread virus activity, the county stopped testing sentinel chicken flocks as well as dead birds and instead focused their nonhuman surveillance efforts on mosquitoes.

In light of the difficulty of sustaining an extremely high level of activity in 2003, many health departments in Colorado shifted activities in anticipation of the 2004 West Nile virus season. For example, in some health departments, routine environmental health inspections were scheduled for the cold weather months to allow for more available staff time during the summer; and reports that are usually completed in the summer were completed in the spring instead.

Research

State and local public health officials have participated in preparing formal reports for CDC's *Morbidity and Mortality Weekly Report* about each of the outbreaks studied. They have also reported their efforts in the peer-reviewed medical literature, as exemplified by the articles in the *New England Journal of Medicine*, shortly after the West Nile virus (Nash et al. (1999)) and monkeypox outbreaks (Reed et al. (2004)). Other more specialized examples are Eidson et al. (2001) and Mostashari et al. (2003), who reported about surveillance for West Nile virus using dead bird reports, and Mostashari et al. (2001), who reported on the results of a household seroprevalence survey carried out during the 1999 West Nile virus outbreak.

Nationally, however, the federal government or academic institutions rather than state or local health departments tend to carry out public health research, and we saw relatively little evidence of public health research in our site visits. New York is an exception to this pattern.

The Wadsworth Center, New York State's public health laboratory, has been active in developing new methods to build capacity, communications, and preparedness generally. During the SARS outbreak in 2003, Wadsworth designated, outfitted, and trained staff for two separate BSL-3 laboratories to serve both research and clinical needs. The research lab designed conventional and real-time polymerase chain reaction (PCR) assays for SARS, and tested 180 samples from 42 New York State patients by culture and PCR. During the monkeypox outbreak, the Wadsworth lab was able to develop a recombinant PCR (rtPCR) test specific for monkeypox, as well as establish testing guidelines for animals and humans.

Louisiana has used money from the CDC, foundations, NIH, and others to conduct basic and applied research on West Nile virus—though not specifically the CDC bioterrorism funds. For example, Louisiana used funds from the CDC targeted for West Nile virus to pay for research assistants to help with West Nile virus research at the Louisiana State University School of Agriculture. LSU used these same funds to perform dead bird testing and mosquito testing for health departments. These tests also contributed to ongoing West Nile virus research at the university.

WORKFORCE DEVELOPMENT

In response to federal bioterrorism funding programs as well as experience with SARS, West Nile virus, monkeypox, and hepatitis A outbreaks, state and local health departments have undertaken a variety of approaches to workforce development. This has included hiring new staff, reassigning or reorganizing existing staff, the use of a supplemental workforce, and education and training.

Hiring Staff

The majority of the sites we visited were able to hire staff using bioterrorism funds. For example, prior to 9/11, Louisiana had no regional epidemiologists; there were just three state epidemiologists, who covered on average three public health regions each. Interviewees noted that if the West Nile virus outbreak had occurred before 9/11, the workload for people at the state would have been "unbearable." However, the bioterrorism funds allowed the state to hire additional staff, including disease coordination specialists, bioterrorism coordinators, and public health emergency coordinators in each public health region.

It is difficult to say how CDC bioterrorism funding affected workforce development in health departments across Colorado because the elimination of the state's per capita funding for local public health occurred around the same time that the cooperative agreement funding was received. Some local health departments were forced to eliminate positions as a result of the state's funding cut, and add bioterrorism-specific positions as a result of the bioterrorism funding. It also appears that some health departments interpreted the restrictions on bioterrorism-funded positions more stringently than others. Generally, the health officials with whom we spoke noted that there is a need for positions with few restrictions attached, especially in small health departments where staff must be capable of functioning in a number of different roles. On the other hand, several people reported that some positions made possible by bioterrorism funding significantly contributed to their ability as a health department to respond to the West Nile virus outbreak. For example, one county health department reported that it lost two full-time equivalent positions as a result of the state's funding cut; however, as a result of bioterrorism funding, an epidemiologist and an assistant were hired to cover their region of the state. Without this additional epidemiology staff, the county's capacity to respond to the West Nile virus outbreak would reportedly have been significantly decreased. In another health department, bioterrorism funding allowed the hiring of a public information officer who could handle the extensive number of calls from the media.

In Illinois, surge capacity was an ongoing concern at the local and state levels. A recently enacted statewide early retirement plan has created personnel shortages throughout the state public health department. In some units, almost 50 percent of the personnel had retired. As a result, during the monkeypox and SARS outbreaks, public health staff at the state level had difficulty keeping up with routine work in addition to responding to these particular incidents. However, the bioterrorism funding and hiring of bioterrorism coordinators and response personnel was viewed as helpful in terms of increasing state and local health departments' surge capacity. The department is using part of its bioterrorism funds to train public health personnel in various disciplines so that they can take on different roles if needed in the event of a public health emergency. In this way, bioterrorism-funded personnel can act as a "reserve" for responding to public health emergencies.

State and local health officials in Illinois feel that having a well-trained Epidemic Intelligence Service (EIS) officer[14] in place also was important in responding effectively to an infectious disease outbreak such as monkeypox. Indirectly, the bioterrorism funds enabled the Illinois state health department to obtain an EIS officer, which it had not had for some time.

Reorganizing Staff

We heard many examples of staff responsibilities being shuffled temporarily during outbreak response. In some cases, these shifts were institutionalized as part of established response plans. West Nile virus required many tradeoffs with health department personnel parishes across Louisiana. During the West Nile virus outbreak of 2002, for instance, the medical director and regional epidemiologist in one parish had to drop all of their other responsibilities and work exclusively on West Nile virus. It is perhaps inappropriate to classify this type of activity as "workforce development," given the other key functions that may have gone unfilled as a result, but it was a common way that the study sites filled workforce gaps during outbreaks that followed CDC bioterrorism funding.

Also in Louisiana, we learned that the health department did not hire more people as a result of bioterrorism funding, but instead "got more people dedicated to bioterrorism," eliminating other positions to create the bioterrorism positions. An interviewee noted that the opportunity cost of this shift is felt within the department and that “one of the two new people was a help during West Nile virus, but the other was just an extra body.”

The hepatitis A outbreak happened in a part of Pennsylvania that does not have a county health department and therefore staff from the regional epidemiology office (controlled by the state health department) had to be shifted to the county during the outbreak. This came at considerable expense to the state health department, which had to pay for the lodging and food of the displaced workers. In addition, the need for state staff to cover the outbreak caused a hardship for the workers, who had to be separated from their families for long periods of time.

In many cases, bioterrorism preparedness planning provided the impetus for health departments to develop a concrete strategy for responding to a surge in demand for services. For example, Colorado used bioterrorism funding to upgrade a county laboratory and as part of the upgrade developed a plan to shift staff away from noncritical tasks in case of a bioterrorism event. Consequently, staff were trained to perform different jobs within the laboratory. During the West Nile virus outbreak, this plan was implemented to meet the surge in human West Nile virus specimens. The household hazardous waste facility was scaled down and staff from that facility conducted water testing; staff who normally tested water shifted to performing STD testing; and staff who normally performed STD testing did human West Nile virus testing instead. Others told us that emergency preparedness planning helped them to structure their response: roles were clearly delineated and everyone knew their job and knew to whom they should report.

In one local health department in Colorado, monthly cross-training is conducted so that staff develop and maintain the skills required to perform different functions in an emergency situation. However, one staff member reportedly was not allowed to participate in this training because of restrictions associated with the federal grant that funds this position.

Use of Supplemental Workforce

At the health care delivery system level, the sites generally reported that private health care providers wanted to help with outbreak response but were limited by both the need to perform their regular professional functions and space capacity available for treating patients.

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[14] The Epidemic Intelligence Service is a CDC training program that sends officers to state and

For example, a Louisiana hospital official noted that staff are very willing to help in a crisis, but that they don't have "anywhere to put the patients" because there aren't enough stretchers or enough beds. They state that the goal is to hire more staff and train them more intensively on bioterrorism (a bioterrorism preparedness film is now shown to all new physicians), but it is not clear how this addresses capacity issues.

As part of its public health preparedness efforts, the Wisconsin state health department has developed an online system for registering volunteers for duty during a major public health emergency.[15] The Wisconsin Emergency Assistance Volunteer Registry (WEAVR), requests information about each volunteer that will allow public health officials to select and contact appropriate volunteers in the event of a public health emergency. Health professionals receive an invitation to register with their licensing renewal notices, and the same system will eventually incorporate an online credentialing system. WEAVR is located on the Health Alert Network and is funded through the CDC bioterrorism cooperative agreement. As of the date of our site visit, approximately 250 volunteers had registered.

Education and Training

Although training and educational activities were not a focus of our data gathering activities, the sites we visited have all used bioterrorism funds to provide these activities for their staff in addition to the exercises and drills described in the previous section. For example, in Wisconsin, training has included courses (offered either at local health departments or regionally) on forensics, Incident Command System (ICS), HAN, and post-exposure response team training. The ICS courses are taught by certified trainers and are evaluated using pre- and post-tests. Some personnel in the local health departments had received ICS training before the monkeypox outbreak with the support of bioterrorism funds. In general, the health officials we interviewed report that these training programs are useful.

In 2003 and 2004, the Wisconsin state health department sponsored annual meetings on Public Health and Hospital Emergency Preparedness aimed at local health officers, local preparedness staff, tribal health staff, local emergency management directors, hospital region representatives, state laboratory staff, Homeland Security staff, and Public Health Preparedness

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local health departments to aid in surveillance and outbreak response.

[15] "Wisconsin Emergency Assistance Volunteer Registry (WEAVR)." Available at http://dhfs.wisconsin.gov/health/Preparedness/WEAVR. Accessed on August 2, 2004.

staff. Session topics for the September 2004 meeting include Metropolitan Medical Response System/Strategic National Stockpile activities, cross-border coordination, science of anthrax, hospitals, and pandemic influenza, integrated communication, preparedness volunteer projects, fit testing personal protective equipment, tabletop exercises, roles for nonbioterrorism staff, the National Incident Management System, mental health, and legal issues and legislative updates.

LESSONS LEARNED

The sites that we visited have implemented a variety of activities aimed at enhancing knowledge within their agencies, as well as in the broader community public health system, about public health preparedness. The most common activities were reviewing public health legal authorities, conducting exercises and drills, and implementing other educational opportunities for public health professionals.

The Limited Impact of Exercises and Drills

Exercises and drills are a relatively new addition to the public health knowledge development toolbox. Long used by emergency responders and the military, exercises have slowly but surely become a major requirement of both CDC and other funders. Many health departments are now using them to assess gaps in preparedness plans, enhance capacities, and strengthen relationships with community partners. Although the interviewees with whom we discussed exercises generally voiced wholehearted enthusiasm for their usefulness, efforts to evaluate outcomes and cost-effectiveness are in their infancy.

Many of the individuals that we interviewed noted that the process of meeting with first responders and other partners to refine plans not only aided communication but also enhanced knowledge of each community partner’s role in emergency preparedness. And where it did not enhance knowledge, it at least enhanced understanding of the important questions that needed to be answered during the planning process. We heard from many that exercises were also helpful in facilitating communication, coordination, and planning.

However, despite strong enthusiasm for exercises and drills as knowledge-building tools, some remaining challenges to optimizing their effectiveness remain. Most important, the exercises did not always include key members of the public health response community, including community representatives, laboratory employees, and other emergency responders.

Moreover, although exercises and drills provide perhaps the best opportunity for testing preparedness plans, they will never replace the “real thing.” The monkeypox outbreak, in particular, made clear that despite all of the smallpox preparedness training health departments and health care providers have received, unresolved issues remained. Issues regarding exposure of health care workers, enforcing quarantine and isolation, and smallpox vaccination clearly need additional attention.

The Importance of Learning from Actual Experience

State and local health departments appear to have developed a solid understanding of the value of learning from experience as a means of enhancing preparedness for responding to future events. In many cases, public health aimed to enhance knowledge within state and local health departments in the broadest sense—not just knowledge among individual public health professionals, but knowledge across entire health department and community public health systems.

Many public health departments considered their experience in responding to different disease outbreaks and other emergencies as an opportunity for ongoing learning. Local health officials in New York, for instance, saw the West Nile virus, SARS, and monkeypox outbreaks and the response as part of a series of events going back to the 1990s, including a severe ice storm, raccoon rabies, a hepatitis A outbreak at the state fair (at the same time that West Nile virus first appeared), the September 11 attacks and subsequent anthrax attacks, smallpox preparations, and the annual flu season, especially its early appearance in 2003-4.

To cite another example, the response in the first parish of Louisiana affected by West Nile virus illuminated a number of challenges and opportunities for public health practice, which were reviewed by other health departments in the state to identify ways to improve their own responsiveness. The first region hit was caught off guard by the size of the outbreak and the number of deaths caused by the disease, but other parts of the state learned to expect and plan for a large outbreak. Areas that were hit later also saw fewer communication breakdowns, laboratory problems, and misdiagnosed cases, and were able to make use of a fully developed public information campaign.

While learning from experience seems to be an effective learning tool, it has limitations. Given the workload of public health departments on a typical day, much less during an emergency situation, there is only limited time for reflection, synthesis, and application of lessons learned to plans for future events, and few models exist for doing so. In addition, the informal nature of many of these activities means that they might not be carried out on a consistent basis, as might be required under a more formal lessons learned approach, such as after-action reviews and continuous quality improvement initiatives.

We are aware of only one formal “lessons learned” analysis, Wisconsin’s analysis of the monkeypox outbreak, which was prepared for a conference on smallpox preparedness and was not tied to any formal CQI process intended to make changes. Moreover, while continuous quality improvement has become a way of life in many parts of the private sector—and even in public agencies—it has not yet been fully embraced in the public health arena. However, a number of the states that we visited issued planning or guidance reports that incorporate state and local health departments’ experience with West Nile virus or SARS. And some state and local health departments have taken the time to summarize their experience for publication in the professional literature. Although such reports are different in format from after-action reports that are common in emergency response situations in other fields, they do provide an opportunity for health officials to reflect on, and learn from, experience.

Continuing Personnel Needs

There is currently an inadequate supply of many types of public health professionals—especially epidemiologists (CSTE, 2003) and public health laboratorians (APHL, 2003). This is the result of a minimal pipeline for trained professionals as well as the “aging out” of the current workforce. However, although a number of the sites we visited have been able to hire additional staff using bioterrorism funds, others reported that they are still understaffed and that a crisis would stretch them to the limit. Relatively low government salaries tend to make it challenging to attract and retain well-trained public health professionals. Personnel ceilings and hiring limits at the state and local levels (related to the financial crisis in state and local governments around the country) have made it difficult in some locations to hire new staff, even with new federal funds. In addition, a number of sites have hesitated to hire staff with bioterrorism funds—or have done so cautiously—because of concerns that the positions will disappear when CDC funding runs out.

The disease outbreaks often required personnel to be shifted from one position to another to meet critical needs. While many of the sites we visited had done this during past events, the mechanisms for shifting staff effectively during future events have generally not yet been formalized. Clearly, much remains to be learned about how to effectively shift staff with adequate expertise to fill critical roles during a public health emergency.

With respect to other training and educational opportunities, although bioterrorism funding has allowed for enhanced preparedness activities, this does not seem to have filled the vacuum related to general public health training for both public health professionals and public health partners. Indeed, interviewees in one local health department stated that they would like to see additional training opportunities in public health resources and responsibilities more generally.

THE IMPACT OF FEDERAL FUNDING

The site visits reveal the impact of federal bioterrorism funds on workforce development—both in terms of building a larger and better-prepared workforce and enhancing expertise within the existing workforce. Federal bioterrorism funding has helped to increase the number of disease response staff, laboratory personnel, and communications staff in several states; it also helped to fund training in all of these areas. Clearly, the increase in staff and training helped health departments to conduct investigations, collect data, coordinate prevention and control measures, and respond to the media and the public during the West Nile virus, SARS, monkeypox, and hepatitis A outbreaks.

In many cases, however, the activities described above could not be directly linked to CDC bioterrorism funds. Many of the sites had received funds as a part of other initiatives, such as West Nile virus response, and could not attribute specific activities to specific funding streams. In particular, a number of the activities described (especially exercises and planning activities) were carried out specifically for the purpose of meeting CDC requirements for smallpox preparedness.

This worked well in Pennsylvania, because public health officials were able to easily adapt their smallpox preparedness plan to help them vaccinate large numbers of people exposed to hepatitis A. On the other hand, some interviewees noted that smallpox-related activities took valuable time away from other activities and perceived that the focus on smallpox may have detracted from preparedness more broadly.

CRITICAL CAPACITIES AND BENCHMARKS

We now discuss relevant Critical Capacities and Benchmarks related to Focus Areas A: Preparedness Planning and Readiness Assessment (see Table 7.1) and G: Education and Training (Table 7.2).

Table 7.1. Critical Capacities and Benchmarks Related to Organizational Learning

FOCUS AREA A: PREPAREDNESS PLANNING AND READINESS ASSESSMENT

I. STRATEGIC DIRECTION, COORDINATION, AND ASSESSMENT
Critical Capacity #1: To establish a process for strategic leadership, direction, coordination, and assessment of activities to ensure state and local readiness, interagency collaboration, and preparedness for bioterrorism, other outbreaks of infectious disease and other public health threats and emergencies.
Critical Benchmark #1*:* Develop and maintain a financial accounting system capable of tracking expenditures by focus area, critical capacity, and funds provided to local health agencies.

Critical Capacity #2: To conduct integrated assessments of public health system capacities related to bioterrorism, other infectious disease outbreaks, and other public health treats and emergencies to aid and improve planning, coordination, and implementation.

II. PREPAREDNESS AND RESPONSE PLANNING
Critical Capacity #3: To respond to emergencies caused by bioterrorism, other infectious disease outbreaks, and other public health emergencies through the development, exercise, and evaluation of a comprehensive public health emergency preparedness plan.
Critical Benchmark #2**:** Develop or enhance scalable plans that support local, statewide, and regional response to incidents of bioterrorism, catastrophic infectious disease, such as pandemic influenza, other infectious disease outbreaks, and other public health threats and emergencies. Plans must include detailed preparations to rapidly administer vaccines and other pharmaceuticals, and to perform health care facility based triage and provide short-term acute psychosocial interventions as well as longer-term services to large populations. This should include the development of emergency mutual aid agreements and/or compacts, and inclusion of hospitals.
Critical Benchmark #3**:** Maintain a system for 24/7 notification or activation of the public health emergency response system.
Critical Benchmark #4**:** Exercise all plans on an annual basis to demonstrate proficiency in responding to bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies.
Critical Benchmark #5: (HRSA/CDC Cross-Cutting Activity) Review and comment on documents regarding the National Incident Management System (NIMS), develop and maintain a description of the roles and responsibilities of public health departments, hospitals, and other health care entities in the Statewide incident management system and, where applicable, in regional incident management systems.

III. STRATEGIC NATIONAL STOCKPILE
Critical Capacity #4: To effectively manage the CDC Strategic National Stockpile (SNS), should it be deployed—translating SNS plans into firm preparations, periodic testing of SNS preparedness, and periodic training for entities and individuals that are part of SNS preparedness.
Critical Benchmark #6: Develop or maintain, as appropriate, an SNS preparedness program within the recipient organization's overall terrorism preparedness component, including full-time personnel, that is dedicated to effective management and use of the SNS statewide. This SNS preparedness program should give priority to providing appropriate funding, human and other resources, and technical support to local and regional governments expected to respond should the SNS deploy there.

Source: CDC, Continuation Guidance—Budget Year Five, June 14, 2004.

Focus Area A, as outlined in the CDC grant guidance, includes critical capacities that relate directly to organizational learning and workforce development. Ideally, planning and assessment should not be one-time mechanisms for developing blueprints for action in the event of a public health emergency but should produce living documents that evolve as circumstances dictate and can be shaped to the needs of different users, in both the present and future. Although we were unable to directly measure the effectiveness of planning and assessment activities, we learned a good deal about how the sites are implementing these activities and what they hoped to gain from them. The activities described in this chapter are consistent with the stated need to establish processes for strategic leadership, direction, coordination, and assessment of response activities (Critical Capacity #1). However, our case study format does not permit us to assess a number of the specific benchmarks such as development of financial accounting systems, for example (Critical Benchmark #1).

Because we visited sites that had experienced actual public health emergencies in the form of West Nile virus, monkeypox, SARS, and hepatitis A, we were able to learn that the sites could respond to emergencies with some degree of effectiveness (Critical Capacity #3). We did not learn anything about sites' systems for 24/7 notification or activation of the public health emergency response system (Critical Benchmark #3) or review of NIMS (Critical Benchmark #5), nor do we have a basis for judging whether proficiency was demonstrated (Critical Benchmark #4) or whether sites had conducted SNS planning and assessment (Critical Capacity #4). However, we learned a good deal about the extent to which sites have exercised plans on an annual basis to demonstrate proficiency in responding to bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies.

Table 7.2 shows Critical Capacities and Benchmarks relevant to Focus Area G, Education and Training.

Table 7.2. Critical Capacities and Benchmarks Related to Workforce Development Issues

FOCUS AREA G: EDUCATION AND TRAINING **Critical Capacity #16:** To ensure the delivery of appropriate education and training to key public health professionals, infectious disease specialists, emergency department personnel, and other health care provides in preparedness for and response to bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies, either directly or through the use (where possible) of existing curricula and other sources, including Centers for Public Health Preparedness, other schools of public health, schools of medicine, other academic medical centers, CDC training networks, and other providers. ***Critical Benchmark #25*:** Develop and initiate a training plan (1 year), which ensures priority preparedness training is provided across all Focus Areas to the state and local public health workforce, health care professionals, and laboratorians. Source: CDC, Continuation Guidance—Budget Year Five, June 14, 2004.

With respect to Focus Area G, we learned that the sites had made strides toward "ensur[ing] the delivery of appropriate education and training to public health professionals and partners," (Critical Capacity #16), although the depth and breadth varied by site and we did not gather enough information to evaluate the comprehensiveness or success of the education and training programs. We did not specifically learn about sites' efforts to "Develop and initiate a training plan (one year), which ensures priority preparedness training is provided across all Focus Areas to the state and local public health workforce, health care professionals, and laboratorians" (Critical Benchmark #25).

8. INFRASTRUCTURE DEVELOPMENT

We now focus on capacity-building activities related to infrastructure development. These include equipment and capabilities for public health departments and laboratories, such as equipment for lab testing as well as that needed for collecting and disseminating information (e.g., information technology improvements for disease reporting and alert notifications). The material covered in this chapter addresses two CDC Focus Areas: Focus Area C, Laboratory Capacity, and Focus Area E, Health Alert Networks/Communications and Information Technology.

The chapter is organized as follows. We first describe improvements in laboratory infrastructure. Then we describe information technology systems, including health alert networks and electronic reporting systems. We then present lessons learned and identify areas in which federal funds facilitated infrastructure development. We conclude with a discussion of relevant CDC Focus Areas.

MAJOR ASPECTS OF PUBLIC HEALTH INFRASTRUCTURE DEVELOPMENT

Laboratory Infrastructure

The federal Laboratory Response Network (LRN) is a network of local, state and federal public health laboratories, private laboratories, veterinarian, and environmental laboratories that provide the capabilities to respond to acts of bioterrorism and other public health emergencies.[16] The LRN is organized in three levels (see Figure 8.1).

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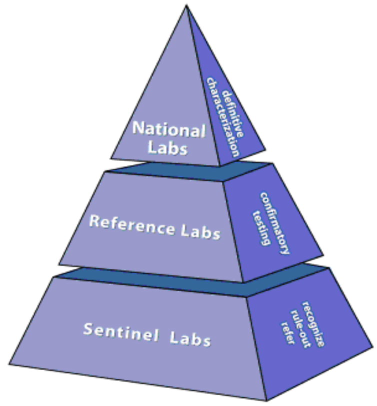
16 http://www.bt.cdc.gov/lrn/.



Source: http://www.bt.cdc.gov/lrn/.

Figure 8.1. Organization of Laboratory Response Network (LRN)

The highest level includes the national labs at CDC and the U.S. Army Research Institute of Infectious Diseases (USAMRIID). These labs, equipped at the Biosafety Level 4, are able to handle extremely infectious agents, definitively characterize pathogens, and act in support of the reference labs to identify bioterrorism and other emerging infectious agents.

The second level of the LRN, reference labs, includes over 100 state and local public health facilities, military and federal laboratories, and a few private laboratories. Reference labs (formerly called Level B and C labs) have the training and certification to analyze and identify some bioterrorism agents, as well as Biosafety Level 3 (BSL-3) capabilities.[17] BSL-3 laboratories are suitable for work with infectious agents that represent a potentially serious threat to health and safety of workers by the inhalation route. Biosafety cabinets are required; rooms are sealed and maintained at negative pressure, and exhaust air from the lab is HEPA filtered; special procedures are utilized for disposal of waste; and access to the laboratory is controlled and restricted.

The final level of the LRN includes BSL-1 and BSL-2 sentinel labs, primarily hospital and commercial labs, as well as some smaller public health labs, which provide routine diagnostic services to clinicians and hospitals. These labs are capable of recognizing highly infectious pathogens and ruling out bioterrorism agents. They are also able to determine if

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17 http://www.cdc.gov/od/ohs/symp5/jyrtext.htm.

samples need to be referred to the reference labs, and to prepare and ship samples using proper protocols.

Each of the states we visited described improvements to laboratory infrastructure as a direct result of federal funding, including improving some of their public health laboratories to join the reference lab category of the LRN. Most states specifically noted having upgraded between one or more laboratories to the BSL-3 level. In addition to upgrading a local public health lab to BSL-3, one state department of public health also supported a private, academic laboratory that had used private funding to upgrade its facilities to then join the LRN.

Along with these major improvements in BSL-3 capabilities, every state we visited noted significant improvements in diagnostic capabilities based on upgrading laboratory equipment in the state and local public health laboratories. These equipment upgrades included new PCR machines, flow cytometers, plate washers and readers, and improved computers. Public health officials commented that these equipment upgrades allowed the laboratories to increase both their capacity and efficiency in testing West Nile virus samples, as well as other routine testing.

Some state public health labs have formal and informal relationships with researchers and research laboratories. In some cases, the state public health lab is physically located on a university campus. In one case, a private lab has become a member of the federal public health LRN, and its research capabilities facilitated the Monkeypox diagnosis. Finally, the Wadsworth Center, New York's state public health laboratory, is a stand-alone public health lab that is also a research institution. Federal bioterrorism funding has allowed this state laboratory to improve equipment as well as hire personnel. As discussed in Chapter 3, the Wadsworth lab's expertise and state-of-the-art equipment have allowed it to develop new protocols and diagnostic tools for emerging diseases such as West Nile virus, SARS, and monkeypox, which were used during the outbreaks.

Health Alert Networks and Information Technology

Information technology upgrades improved the ability of public health departments to communicate with other departments and with hospitals and providers within the state, as well as with other state public health departments and federal agencies. In some cases, these systems distribute information in one direction—from state to local health departments, for example, or from local health departments to hospitals and physicians. In other cases, they provide two-way channels of communication.

In previous chapters we have discussed the use of state-level Health Alert Networks (HANs). Typically, these web, e-mail, and fax networks are used by state health departments to communicate with local health departments within the state. Some HAN systems also include local providers, especially infectious disease physicians and hospital infection control personnel, as well as emergency departments, local emergency responders, and laboratories. Local health officials, however, typically do not know how many of these groups actually access the HAN. Although the CDC created the HAN nationally before September 11, 2001, most of the states studied described developing or improving their HAN with increased federal public health preparedness funding. Health officials generally felt that HANs were useful, but expressed concerns that the systems were sometimes not updated as often as they should be. For this reason, and because they have not been fully developed at the local level, HANs were not the primary methods of communication during the outbreaks we studied.

Information technology has also been used to develop electronic disease reporting systems, although it should be noted that most of these systems are still not fully developed. These systems are designed to collect reportable disease information from local hospitals, private physician offices, and private laboratories, and are typically based on the CDC National Electronic Disease Surveillance System (NEDSS) standards.

Some newly developed systems also include capabilities to contact the hospitals, providers, and labs with web, e-mail and fax notices. For example, providers and labs in the Milwaukee area, which has 14 different local health departments, were often unsure about which department was supposed to receive a case report. A new electronic network called Survnet allows the labs and physicians to report to one central location, based at the City of Milwaukee Health Department, which then distributes the reports to the appropriate local public health jurisdiction based on where the patient lives (City of Milwaukee Health Department, undated). Survnet also allows the health departments to distribute information to hospitals, labs, and private physician offices. Survnet also has blast fax capabilities and an e-mail list serve for local hospitals (and a limited number of physicians) that was used to communicate alert messages, reporting guidelines, treatment information, case management information, and press releases. This system was used during the SARS and monkeypox outbreaks (see Chapter 5 for more detail).

Technology can be used to consolidate databases and eliminate duplication of effort. According to the Illinois state health department, for instance, the existence of multiple databases to track cases even within the state health department itself was also a major problem during the 2002 West Nile virus outbreak. As a result, staff unnecessarily spent time entering the same information into several different databases. Since then, the department created a single database, the Illinois National Electronic Data Surveillance System (I-NEDSS). The Illinois version of CDC's National Electronic Disease Surveillance System (NEDSS), I-NEDSS is a web-based system through which providers and laboratories input demographic, laboratory, and disease-specific data and update contact information. This system also enables the health department to keep providers updated with information from CDC, provide real-time feedback to those entering data (e.g. if the case they are entering does not meet case definition requirements), and provide access to other data nation-wide. Officials in a county that was a pilot site for the system found I-NEDSS to be useful after an initial adjustment period.

Combined electronic disease reporting, surveillance, and alerting systems are also being developed in California[18] and New York. The New York system, HERDS, for instance, is a statewide integrated, secure, web-based system that provides dynamic reporting, analysis and visualization of information between the health care, state/local public health and planning/response sectors. It was developed by the New York State Department of Health in collaboration with local health departments and the Greater New York Hospital Association, and received the Council of State Governments 2004 Northeast Region Innovation Award (Council of State Governments, 2004)

In addition to the HAN and electronic disease reporting systems, states have developed and improved their ability to contact local providers and hospitals. Most states have acquired systems that allow them to send blast fax correspondence to a subset of local providers, although the percentage of providers that they can contact is typically not known. The City of Milwaukee Health Department's EMSystem®, for instance, allows local health departments to communicate in real time with local emergency departments. EMSystem® is a secure, regional, emergency medicine Internet (REMI) software application, constantly on and monitored in area emergency departments. The system was designed in the Milwaukee area but is being used in 25 regions across the United States (Foldy, Barthell, et al. 2004; Foldy, Biedrzycki, et al. 2004). As described in Chapters 3 and 4, it was used to distribute a SARS screening tool to local emergency departments and facilitated syndromic surveillance for SARS.

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18 http://www.calphin.dhs.ca.gov/.

A problem with all of these systems is limited coverage. Wisconsin officials estimate that less then 5 percent of physicians can be contacted via Survnet and less then 1 percent via the EMSystem® while just under 50 percent of physicians can be contacted via blast fax. Some local health departments are concerned that they do not have adequate methods to reach physicians in private offices quickly. This is of special concern because physicians are the front line for surveillance, and have to be on the alert for unusual illness.

Some states described improved communication capabilities with other states and the CDC using the Epi-X system,[19] a secure, controlled-access, web-based communications tool for CDC officials, state and local health departments, poison control centers, and other public health professionals.

Finally, in many of the states we visited, state and local public health officials had received cell phones and pagers as a result of federal bioterrorism funding, in an effort to make them more accessible. A local health department director received the first case report of the monkeypox outbreak on a weekend on such a cell phone.

The majority of the infrastructure upgrades described, with the exception of those at private labs and hospitals, have been at least partially, if not fully, funded by federal bioterrorism dollars. Without these funds, public health laboratories would be less capable and information systems for communication and disease reporting would be significantly less widespread.

LESSONS LEARNED

The Need to Develop Laboratory Capacity

Every state we visited has made, and is continuing to make, substantial improvements in laboratory capacity, increasing both the types and numbers of tests that can be performed. Most immediately, improved laboratory capacity has allowed many states to more efficiently perform tests for West Nile virus, as well as increase the number of labs capable of performing these tests. Surprisingly, even with these lab improvements, at least one state had difficulty completing SARS testing in a timely manner.

Some of the laboratory infrastructure development we learned about is occurring at private health laboratories. In one instance, a private, academic lab used its own funds to

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19 http://www.cdc.gov/epix/.

upgrade its facility to BSL-3, and the state department of health supported it to become part of the LRN. The lab had to overcome many obstacles that limit nongovernmental laboratories from joining the LRN, including difficulty coordinating with the CDC and USDA.

However, even the most sophisticated laboratory facilities are useless if there are no trained personnel to operate them and there are critical shortages of laboratory supplies.

The Need to Improve the Public Health Information Technology Infrastructure

Every state we visited has upgraded its information technology infrastructure. The upgrades have ranged from purchasing cell phones to developing statewide electronic surveillance and notification systems. Use of some parts of the information technology infrastructure was limited, however. Moreover, while the investment in information technology, laboratory capacity, and other aspects of public health infrastructure has been extensive and apparently productive, investments of this sort are only useful to the extent that there are public health systems and well-trained staff to use them effectively. And, as the analysis in Chapter 5 shows, being able to communicate electronically does not mean that health departments and other entities can communicate effectively or coordinate their response to a public health crisis.

Health Alert Networks. A state Health Alert Network is only effective if it is updated regularly; the information is credible; and it reaches health care providers, local health department staff, and others who need to know its content. Use of Health Alert Networks has increased communications to state and local health departments, and to a lesser degree to providers, but their usefulness is limited due to the time required to get information out in this way and the lack of penetration into most local provider communities. These systems were, however, widely used in all of the disease outbreaks that we studied and, even with their limitations, were considered positive enhancements by the local public health officials.

Electronic Disease Reporting and Surveillance Systems. The usefulness of electronic disease reporting systems depends on physicians knowing about them and using them to report cases. Some of the electronic disease reporting and surveillance systems were still in development during the outbreaks we studied, and thus did not play large roles. Survnet and EMSystems, however, were used in the Milwaukee area during the monkeypox and SARS outbreaks, and were praised by public health officials and local physicians. In addition, at least two other states used their electronic disease reporting systems during the initial West Nile virus outbreaks. In one state, while a new electronic reporting and communications system is now operational, some counties have continued to use older IT systems that do not integrate with the new technology. Substantial reworking has been required to integrate the new system with local systems.

CDC's electronic, web-based communications tool, Epi-X, was praised by states that used it. When asked directly, public health officials commented that they could easily keep abreast on events going on around the nation. It was not commonly noted as having been helpful in the outbreaks studied.

IMPACT OF FEDERAL FUNDING

The case studies provide many examples in which surveillance systems, increased laboratory capacity, information technology, telephone hotlines and other systems have been developed and used in a way that appears to have enhanced the public health response to the outbreaks studied. Similarly, state and local health departments report on the positive impact during these outbreaks of additional staff that have been hired, regional epidemiological teams that have been deployed, and so on. Case studies do not provide information on what would have happened if these investments had not been made; nonetheless, logic suggests that these investments did make a positive difference.

CRITICAL CAPACITIES AND BENCHMARKS

Table 8.1 shows relevant Critical Capacities and Critical Benchmarks related to Focus Area C, Laboratory Capacity—Biologic Agents, and Focus Area E, Health Alert Network/Communications and Information Technology.

Table 8.1. Critical Capacities and Benchmarks Relevant to Laboratory Capacity

FOCUS AREA C: LABORATORY CAPACITY—BIOLOGIC AGENTS
Critical Capacity #8: To develop and implement a jurisdiction-wide program to provide rapid and effective laboratory services in support of the response to bioterrorism, other infectious disease outbreaks, and other public health threats and emergencies.

Critical Benchmark #12: Complete and implement an integrated response plan that directs how public health, hospital-based, food testing, veterinary, and environmental testing laboratories will respond to a bioterrorism incident, to include: (a) roles and responsibilities; (b) inter- and intrajurisdictional surge capacity; (c) how the plan integrates with other department-wide emergency response efforts; (d) protocols for safe transport of specimens by air and ground; and (e) how lab results will be reported and shared with local public health and law enforcement agencies, ideally through electronic means.

Critical Capacity #9: As a member of the Laboratory Response Network (LRN), to ensure adequate and secure laboratory facilities, reagents, and equipment to rapidly detect and correctly identify biological agents likely to be used in a bioterrorist incident.

Critical Benchmark #13: Ensure capacity exists for LRN validated testing for all Category A agents and other Level B/ C protocols as they are approved.

Critical Benchmark #14: Conduct at least one simulation exercise per year, involving at least one threat agent in Category A, that specifically tests laboratory readiness and capability to perform from specimen threat assessment, intake prioritization, testing, confirmation, and results reporting using the LRN website.

FOCUS AREA E. HEALTH ALERT NETWORK/COMMUNICATIONS AND INFORMATION TECHNOLOGY

Critical Capacity #11: To ensure effective **communications** connectivity among public health departments, health care organizations, law enforcement organizations, public officials, and others (e.g. hospitals, physicians, pharmacies, fire departments, 911 Centers).

Critical Benchmark #18**:** Implement a plan for connectivity of key stakeholders involved in a public health detection and response including a 24/7 flow of critical health information, such as clinical data, alerts, and critical event data, among hospital emergency departments, state and local public health officials, law enforcement, and other key participants (e.g. physicians, pharmacies, fire departments, 911 Centers).

Critical Benchmark #19: Ensure, by testing and documentation, at least 90 percent of the key stakeholders involved in a public health response can receive and send critical health information including alerts and critical event data.

Critical Capacity #12: To ensure a method of emergency communication for participants in public health emergency response that is fully redundant with standard Telecommunications (telephone, e-mail, Internet, etc.).

Critical Benchmark #20: Routinely assess the timeliness and completeness of the redundant method of alerting, as it exists to reach participants in public health response.

Critical Capacity #13: To ensure the ongoing protection of critical data and information systems and capabilities for continuity of operations.

Critical Capacity #14: To ensure secure electronic exchange of clinical, laboratory, environmental, and other public health information in standard formats between the computer systems of public health partners. Achieve this capacity according to the relevant IT Functions and Specifications.

Critical Benchmark #21: Ensure that the technical infrastructure exists to exchange a variety of data types, including possible cases, possible contacts, specimen information, environmental sample information, lab results, facilities, and possible threat information.

HRSA/CDC Cross-Cutting Activity Laboratory Data Standard

a. ***Critical Benchmark #22:*** Adopt and implement LOINC [Logical Observation Identifiers, Names and Codes] as the standard for electronic exchange of clinical laboratory results and associated clinical observations between and among public health department laboratories, hospital-based laboratories, and other entities, including collaborating academic health centers, that have a major role in responding to bioterrorism and other public health emergencies.

b. In connection with CDC-provided technical assistance, identify areas where refinement or extension of LOINC would enhance public health emergency preparedness.

Enhanced Capacity #9: To provide or participate in an emergency response management system to aid the deployment and support of response teams, the management of response resources, and the facilitation of inter-organizational communication and coordination.
Enhanced Capacity #10: To ensure full information technology support and services.

Source: CDC, Continuation Guidance—Budget Year Five, June 14, 2004.

Focus Area C, Critical Capacity #9, and Critical Benchmark #13 are directly related to infrastructure development. Although we did not directly measure the adequacy of laboratory facilities and their ability to test specific agents, the types of infrastructure investments and equipment purchases that were described to us are consistent with labs moving toward these goals. The other Focus Area C capacities and benchmarks are discussed in Chapter 3.

Focus Area E covers information and communications systems and other infrastructure developments. Critical Capacity #11 requires public health departments to "ensure effective communications connectivity" among various stakeholders and responders for bioterrorism events through Health Alert Networks. Our interviews indicate that public health officials are using the HANs, but that use could still be improved. The case studies did not directly address whether public health departments had a plan for connectivity or could reach 90 percent of the key stakeholders (Critical Benchmarks #18 and #19, respectively). However, the evidence suggests that most states are unable to reach 90 percent of the local providers, although not all providers may be considered "key stakeholders" in a public health response.

In terms of maintaining redundant communications methods with participants in a public health response (Critical Capacity #12, Critical Benchmark # 20), all of the states we visited have or are developing multiple ways (including phone, e-mail, blast fax, pagers, and web pages) for state and local health departments to send or receive information. However, our approach did not allow us to assess the timeliness and coverage of these capabilities. Critical Capacity #13, which deals with protecting critical data and information technology systems for continuity of operations, was not addressed in our case studies. All states have started developing systems for electronic disease reporting (Critical Capacity #14 and Benchmark #21), although these are not all complete and operational.

Our study did not address the LOINC standards (Critical Benchmark #22). However, we do know that most of the states' electronic disease reporting systems are based on the CDC NEDSS system, and therefore should conform to these standards.

9. CONCLUSIONS AND CROSS-CUTTING THEMES

Between 1999 and 2004, state and local health departments around the United States were challenged with the emergence of mosquito-borne West Nile virus, the worldwide SARS epidemic, an outbreak of monkeypox, and a major food-borne hepatitis A outbreak. As described in the preceding chapters, these outbreaks tested many of the critical capabilities that the U.S. public health systems would need to respond to a bioterrorist attack. They also provided an opportunity for public health agencies to learn how to respond to similar events in the future, and about current problems in public health systems and gaps in resources.

In addition, the outbreaks provided an opportunity to assess the impact of recent federal investments in state and local public health preparedness. Starting less than a year after September 11, 2001 and building on existing smaller programs, the U.S. Department of Health and Services initiated a cooperative agreement, administered through CDC, to improve the preparedness of state and local public health agencies. Almost $1 billion per year was distributed to the states in 2002, 2003, and 2004 through this program. Under other CDC funding, including public health preparedness cooperative agreements issued before 9/11 and West Nile virus funding, money had been had distributed even earlier. As a result, the federal government had made substantial investments in public health preparedness in time to help state and local agencies deal with the West Nile virus, SARS, monkeypox, and hepatitis A. Because of the timing of these agreements and the disease outbreaks, our case studies provided us with an opportunity to see how these new federal funds had been used to improve public health systems relevant to the disease outbreaks.

The goal of this chapter is to go beyond the specific functional capabilities and capacity-building activities discussed in the preceding chapters in order to address several overarching questions concerning what the public health response to these four disease outbreaks tells us about public health preparedness:

- What did the response to these disease outbreaks tell us about the system’s ability to address a public health emergency, including the possibility of a large-scale bioterrorist attack?
- In what ways are the needs of public health emergency response different from those required to address other kinds of emergencies?

- What has been the impact of federal bioterrorism and related spending on public health preparedness? What has been the influence of the Critical Capacities and Critical Benchmarks associated with the CDC public health preparedness cooperative agreements?
- Finally, are there areas in which the guidance can and should be strengthened?

THE STATE OF PUBLIC HEALTH PREPAREDNESS

It should be noted at the outset that, fortunately, none of the outbreaks mimicked the worst aspects of a large-scale bioterrorist attack. None of them involved large numbers of human cases and deaths, substantial person-to-person transmission, or major social disruption. The outbreaks, however, did present three challenges that might also be presented by a bioterrorist attack or influenza pandemic.

- First, initial identification of the agent took considerable time in three of the four outbreaks because the organisms causing them had not previously been seen in the United States.
- Second, in part because of the novelty of the biological agents, there was little information available about the clinical and epidemiological aspects of the diseases and about appropriate treatment and control strategies.
- Finally, due to limited resources and staffing, health departments found it difficult to both respond to the outbreak and perform their day-to-day operations.

These outbreaks, therefore, provide us with a glimpse of how the public health system in the United States might respond to a major public health crisis such as one involving a bioterrorist attack or pandemic influenza.

The Quality of the Public Health Response

During these outbreaks, state and local public health agencies were able to mount a robust public health response that tested a wide array of capabilities related to public health preparedness, including the following:

1. Public health assessment: surveillance, outbreak identification, epidemiological investigation, developing and testing hypotheses, and laboratory investigations to characterize the responsible pathogens

2. Just-in-time policy development and implementation: direct population-based disease control activities such as vector control (e.g., mosquitoes for West Nile virus), vaccination (for monkeypox), and mass prophylaxis (for hepatitis A), as well as clinical and infection control advice to private sector health care providers
3. Coordination and communication among public health stakeholders: health care providers, other health professionals, and other government agencies
4. Communication with the public directly and through the media.

This is not to say, of course, that the public health response to West Nile virus, SARS, monkeypox, and hepatitis A in the United States was without problems. As we have seen in the preceding chapters, West Nile virus was originally misidentified as another arbovirus, and the first monkeypox cases were misdiagnosed despite a heightened state of awareness to smallpox. Simultaneous overlapping epidemiological investigations of West Nile virus and also of monkeypox led to confusion and duplication of effort. Three years into the West Nile virus outbreak, there were uncertainties about who should be tested and how, which surveillance strategies were most effective, and how many laboratory supplies were needed. There were also problems in implementing isolation and quarantine, in communicating with the media and the public, and in communication and coordination within public health agencies and with other professionals and agencies, including CDC. Many of these challenges would likely be more severe in a terrorist incident, and the implications of problems like those seen would be more severe.

It must be recognized that, to some degree, problems of this sort are inevitable when dealing with a major and/or novel disease outbreak. Indeed, they are likely to be worse for a bioterrorist attack. Part of the problem is the reality of what has been called in other settings, the “fog of war.” It is always difficult in a quickly evolving emergency for any single individual or group to have a clear picture of what is happening. Moreover, even if the things that were identified in the preceding paragraph were all “fixed,” other unforeseen problems would appear in the next emergency. The issue, we believe, is not whether problems can be completely avoided, but how quickly and effectively public health can identify and resolve problems and learn from them for the next time.

On the whole, the case studies demonstrate how critically dependent success is on flawless performance of routine public health functions. In many parts of the country, however, these very capacities have declined, following a disinvestment in public health in the late 20th century.

Learning From Experience

The case studies provide many examples of public health agencies learning and adapting during public health emergencies. For instance, New York health officials described their experience in responding to multiple public health emergencies as a sort of continuum flowing from 9/11 to the anthrax attacks, smallpox preparation, West Nile virus, SARS, monkeypox, influenza, the 2003 blackout, an ice storm in the late 1990s, and other natural outbreaks and widespread disasters. The experience of responding to one event contributed to better performance in responding to the next. To cite another example, during the West Nile virus outbreak, Colorado health officials learned and responded by changing systems and policies, in a continuous quality improvement–like process. One California health official wryly observed that, as a learning experience, “SARS is the best thing that even happened to us,” both in terms of learning about the public health department’s capabilities and problems and in raising the profile of public health—all without massive loss of life in this country.

State and local health departments have also engaged in planning activities designed to use lessons learned from past disease outbreaks. For example, the New York State Department of Health prepared a West Nile virus Response Plan in May 2000 (NYS DOH, 2000), only months after the emergence of the pathogen in New York City. Developed in collaboration with a number of state agencies, the New York City and other local health departments and representatives from community, environmental, and other nongovernmental organizations, the plan builds on experience with the original outbreak and was intended to prepare state and local health departments for an expected return of the virus in 2000. Many state and local health departments, including those of Louisiana, Illinois, California, and the City of Chicago, developed such plans with CDC support, which were also useful to states that experienced the outbreak in later years.

A few public health departments have also published journal articles about their experience in responding to emergencies. In New York, public health officials have published papers in the professional and scientific literature based on their experiences with outbreaks. Fine and Layton (2001), for instance, wrote about the implications of the West Nile virus outbreak for bioterrorism surveillance. Gotham et al. (2001) used the West Nile virus experience as a case study of New York state IT infrastructure, and Mullin (2003) wrote about New York City's experience with West Nile virus and SARS as a case study in public health communications. Such publications go beyond the typical, clinically oriented outbreak investigation reports published in the *Morbidity and Mortality Weekly Report* (MMWR) and medical journals to include the pragmatic details of what happened during the outbreak investigation and analyses and recommendations about public health practice.

Nevertheless, public health departments generally have had little involvement in more-formal approaches to institutional learning, such as after-action reviews and subsequent tests of change to improve the functioning of the system. This capability is far less developed in public health than it is in the military and emergency response agencies. The Wisconsin Division of Public Health's detailed analysis of lessons learned from responding to the monkeypox outbreak, which reviewed what worked and what did not work well during the outbreak (Davis, 2003), is an exception. The public health community could benefit from additional formal efforts to analyze and learn from its experience. Bypassing the chance to learn from rare events—and to share learning with others—is an important missed opportunity. Public health agencies should make it a common practice to prepare after-action reports and put lessons learned into practice.

THE NATURE OF PUBLIC HEALTH EMERGENCIES AND IMPLICATIONS FOR PREPAREDNESS

Our case studies illustrate several key characteristics of public health emergencies involving infectious diseases that should to be emphasized in preparing for future emergencies. Certain needs arise with any kind of public emergency. For example, clear and effective communication is needed on many levels: within public health agencies, from public health to health care providers and other government agencies, and to the public, either directly or through the media. There are several ways, however, in which public health emergencies can be considered different from other kinds of emergencies, such as natural disasters. We highlight several such characteristics here and identify the particular needs associated with each.

Surveillance and Outbreak Investigation

Infectious disease outbreaks, bioterrorism, and similar public health emergencies are unique in the way they develop over time. Unlike a natural disaster such as a hurricane or explosion caused by a terrorist, the outbreaks that we studied all played out over a period of months or, in the case of West Nile virus, years. In most cases, the first individual was exposed to the pathogen weeks before public health agencies knew there was a problem, and even after the first cases were detected, a week or more was required to characterize the nature of the problem. For newly emerging pathogens such as West Nile virus and SARS, the "facts" of the outbreak are not clear at the outset, and develop over time. As a result, additional time is needed to understand the epidemiological risk factors and develop effective control strategies. In addition, as our case studies suggest, scientific uncertainty or even confusion is to be expected.

These characteristics of public health emergencies suggest that public health departments should expect and plan for public health emergencies characterized by uncertainty, both in time and circumstance. Moreover, in order to detect and characterize natural or intentional disease outbreaks as quickly as possible, and thus to enable an effective response, public health surveillance systems must operate continuously before there is any warning of a disease outbreak, and be ramped up when there is a heightened state of alert (based on cases elsewhere in the country or the world) and after an outbreak has been known to occur in order to characterize its nature and monitor its course.

Surge Capacity

Another relatively unique characteristic of public health emergencies is that the required public health response may not be directly proportional to the number of people initially known to be exposed, infected or ill, or the number of deaths. This is true in part because, as in the outbreaks we studied, necessary efforts to identify additional cases—active surveillance—are likely to result in many potential cases coming to the health department's attention. Some of these will be individuals who do not actually have the disease in question. All such potential cases must be investigated, though, which puts stress on health care facilities as well as outbreak response teams and laboratory capacity. In addition, the degree of public and public health concern may trigger disproportionate response. At times, this response could take the form of a strategic decision to act preemptively or disproportionately to better ensure limited disease transmission. Extensive population-based prevention efforts such as education campaigns are necessary to prevent transmission to others and reduce the health consequences. System stress can extend to hotlines and other resources for communicating with the public, as well as resources for dealing with the media, particularly if national media are involved. Such demands stress the capacity of public health system even when the number of actual cases is small. In already understaffed agencies, this can be particularly challenging.

To address these issues, state and local health departments should plan for and develop surge capacity plans for epidemiological investigations, communication with the public and media, and in other areas. This is distinct from surge capacity in the health care facilities, the more common use of the term.

Coordination and Communication

As with all types of emergencies, our case studies demonstrate the need for strong communication and coordination between public health and other governmental agencies involved in emergency response. The case studies also show the special need for public health agencies to communicate and coordinate their activities with health care providers and other professionals, such as veterinarians, to detect and characterize outbreaks, as well as to effectively treat patients and prevent further infections. Ensuring communication and coordination with all of the relevant parties is complicated for the following reasons.

First, public health agencies, unlike some other emergency responders, do not have command and control authority over important resources—hospitals and health care providers—as well as other government agencies that are needed for an optimal public health response. While most of the needed resources would likely be willing to help in the course of a crisis, they must know how to communicate and coordinate effectively. Moreover, health care providers are needed to help with disease surveillance even before an outbreak comes to light. Communication with health care providers is especially important when the "facts" of a disease outbreak are changing quickly.

Second, as the case studies illustrate, jurisdictional and legal arrangements in public health are frequently complex. State health departments have most of the necessary authority to deal with a public health emergency, but these functions are carried out through a mix of state, regional, county, and city entities, each of which operates in relation to different political leadership structures and local governmental and community organizations. In addition, CDC, a federal agency, is often looked to for scientific advice and other kinds of help. Matters are further complicated by the lack of respect that pathogens show for state and local geography—with outbreaks quickly spreading throughout states and across state lines. As a result, there is likely to be uncertainty over which agency is responsible for what actions, both within states and with CDC. Appropriate roles can to some extent be worked out in advance through careful regional and state planning, but even so there will always be additional matters that need to be resolved during an emergency.

The communication and coordination necessary in public health emergencies are facilitated by information technology, a focus of much attention, as discussed below. Just as critical though often less emphasized, however, is public health's involvement in developing personal relationships, participating in joint planning, clarifying lines of authority, and taking part in exercises and similar activities. Thus, state and local health departments should work in advance of any public health emergency to build relationships, plan, and exercise together with other health departments, health care providers, relevant government agencies, and other entities that would be involved in the response to a disease outbreak.

The Role of CDC During a Public Health Emergency

One of the themes that runs consistently through our case studies is that state and local public health departments may be overly optimistic about the help they can realistically receive from the CDC during a public health emergency. Clearly, there were many instances when CDC support was both essential and effective. CDC's guidance for the preparation of West Nile virus plans not only helped the states affected early in the outbreak but also provided a way to share technical knowledge with states that were affected later. And most state public health labs simply could not conduct some laboratory tests. however, state and local health departments in each of the outbreaks experienced frustration with the timeliness of CDC's efforts to develop and disseminate case definitions, clinical guidance regarding treatment and infection control, and laboratory testing procedures, and with frequent changes in CDC's recommendations in these areas. By the time that CDC recommended smallpox vaccine for monkeypox contacts, for instance, the window of time when the vaccine would have been effective had closed. Problems were also encountered with overlapping and uncoordinated epidemiological investigations, with shortages and delays in providing laboratory reagents and other supplies, and in the interpretation of laboratory results. Many state and local health officials view CDC as having a kind of mystique, and seem unwilling to act without it.

It must be recognized that our case study format emphasizes the point of view of the state and local health departments and not of CDC, which likely has a different story to tell. On the other hand, one imagines that problems of this sort would be far greater if CDC were trying to support many state and local health departments simultaneously, as would be the case for a major nationwide outbreak. The problem, we believe, is one of expectations. Either because of lack of capacity at the state and local level, a lack of understanding at the local level as to the role of the CDC when an outbreak occurs, or because CDC encourages it, expectations of CDC are in some cases higher than it can deliver. CDC, together with state and local health departments, should learn from past experience how it can best support state and local public health agencies, and then set and communicate realistic expectations. We recognize that this problem of expectations will demand greater leadership and independence of state and local health departments and that the capacity to do this in many areas needs further development. But we believe it is a necessary component of preparedness.

IMPACT OF FEDERAL FUNDING AND GUIDANCE

Our case studies also provide an opportunity to evaluate, in a limited way, the impact of federal investments in public health preparedness.

First, the case studies provide many examples in which surveillance systems, increased laboratory capacity, information technology, telephone hotlines, and other systems have been developed and used in a way that appears to have enhanced the public health response to the outbreaks studied. Similarly, state and local health departments report on the positive impact during these outbreaks of additional staff who have been hired, regional epidemiological teams that have been deployed, and so on. Case studies do not provide information on what would have happened if these investments had not been made, but logic suggests that these investments did make a positive difference.

Second, while the impact of planning and assessment activities required and funded by the federal cooperative agreements is harder to gauge, the case studies suggest that these activities did make a positive difference. Reviewing public health authorities led some states to authorize emergency designation of notifiable diseases, and this authority was used during the SARS outbreak. Such reviews also led, in some cases, to updating public health authorities regarding isolation and quarantine, which was useful in dealing with the SARS and monkeypox outbreaks. Planning activities under the cooperative agreements (including mandated smallpox planning) brought together public health officials, private sector health care providers, emergency responders, and others. At a minimum, these activities (along with the scale of the funding) served to raise the awareness of public health issues in decision makers throughout the country. We also saw examples of how the relationships built during this process were useful in dealing with SARS.

Third, there was notable variation in the way that states used and distributed the funds they received. States vary, for instance, in the degree to which they retained the resources at the state level to build capacity that serves local areas. We saw many examples, in which investments at the state level in planning and assessment, laboratory capacity, IT developments, and staff had positive impacts during the outbreaks and other examples where funds distributed to localities improved programs and response. While it is difficult to assess the impact of such decisions, is seems that neither approach is substantially more effective. A number of states, for example, have built laboratory and IT capacity and hired staff at the state and regional level, an approach that seems more effective than distributing all of the federal funds to local health departments. States also vary in the extent to which they used federal funding to support public health infrastructure generally, or bioterrorism preparedness specifically.

Finally, our site visits identified some limited or negative impacts of federal funding. In many cases, hiring freezes and personnel ceilings intended to solve severe fiscal problems in state and local government limited health departments' ability to hire personnel even with federal funds. Health officials also voiced concerns about hiring people into positions for which funding might disappear in a few years. And although this was not the focus of our case studies, the site visits made us aware of instances in which the additional resources and attention to bioterrorism and public health preparedness seemed to result in shifting the focus away from some ongoing public health programs.

CRITICAL BENCHMARKS AND CRITICAL CAPACITIES

Our case studies of the West Nile virus, SARS, monkeypox, and hepatitis A outbreaks shed some light on the impact of the guidance for the CDC cooperative agreements. The implications regarding the specific Critical Benchmarks and Critical Capacities are discussed in detail in Chapters 3 through 8. Beyond these specific comments, however, we note that on the whole our case studies suggest that the annual state reports required under the CDC cooperative agreements are not good indicators of public health preparedness. With their focus on critical capacities and critical benchmarks, these reports identify what states have done with cooperative agreement funds, not whether that has made them more prepared for public health emergencies.

The narratives in these reports were generally consistent with what we learned during our site visits, but responses such as activities being “x percent complete” provided far less information than the case studies did about the operational strengths and weaknesses of the state and local health departments that we visited under actual emergency conditions.

In particular, issues such as the relationships, partnerships, and common understandings that are a prerequisite to effective coordination and communication during a public health emergency were missing. Health departments’ flexibility, adaptability, and ability to adapt/develop policies and procedures during an outbreak are similarly important and not assessed by the critical capacities and critical benchmarks. Leadership development is covered in Focus Area A, but the critical capacities and critical benchmarks do not fully cover the issues. All of these are issues for which the case studies provided more information than the required annual reports.

Two alternative approaches to evaluating preparedness that might be considered are based on observing a state’s public health system’s performance (a) during actual public health emergencies similar to those discussed in this report, and (b) in simulated situations such as tabletop exercises. In either case, an after-action report that summarizes observed strengths and weaknesses would have to be prepared. Perhaps more importantly, look-back and tabletop exercises should be imbedded in a CQI process that includes a mechanism to translate what is learned into organizational change.

Beyond this, the case studies also shed some light on the guidance associated with the CDC cooperative agreement, particularly the Critical Benchmarks and Critical Capacities. These measures were developed in part to measure progress that the states were making toward preparedness goals and to ensure accountability for federal funds. Table 9.1 presents a summary of our assessment in these terms, highlighting areas in which the Critical Capacities seemed to provide reasonably reliable measures of public health capacity as evidenced in the four disease outbreaks.

Table 9.1. Overview of CDC Focus Areas and Critical Capacities

Relevant Focus Area	Comments
Focus Area A: Preparedness Planning and Readiness Assessment	• Case studies reinforce need for "strategic leadership, direction, coordination, and assessment of activities" to ensure preparedness and interagency collaboration (CC#1) and "integrated assessments of public health systems capabilities" (CC#2). They also provide indirect evidence that these capabilities have made a difference in the outbreaks studied. • States were able to respond to public health emergencies (CC#3) with some degree of efficacy.
Focus Area B: Surveillance and Epidemiology Capacity	• Significant progress has been made toward development of real-time electronic disease reporting systems (CC#5), though it is unclear whether adequate training has been offered to ensure that providers know how to use these systems. In addition, veterinarians and other health professionals are generally not included in such systems. • Substantial progress has been made toward development of comprehensive epidemiology response systems (CC#6). This included hiring and training public health staff, setting up regional epidemiology offices, but generally not developing lists of private sector health care providers as suggested by the critical capacities and benchmarks. • We are also aware of only a few formal after-action analyses of natural disease outbreaks, despite the call for them in CC#7.
Focus Area C: Laboratory Capacity—Biologic Agents	• A continuing need exists for better coordination of lab services, the focus of CC#8. • Relevant to CC#9, the case studies demonstrate the importance of "adequate and secure laboratory facilities, reagents, and equipment to rapidly detect and correctly identify biological agents" for natural pathogens.
Focus Area E: Health Alert Network/ Communications and Information Technology	• Health Alert Networks (CC#11) have been developed extensively at the state level and to a lesser extent at the local level. Coverage of private health care providers in these systems, however, is still very limited in many places. • CC #12 through 14 relate to IT connectivity, which was not directly assessed, although our site visits suggested that progress is being made in this area.
Focus Area F: Risk Communication and Health Information Dissemination/Public Information and Communication	• Relevant to CC #15, our case studies identified various weaknesses in risk communication, including some that have been remedied, in part, with CDC funding. We also saw a considerable amount of learning from natural disease outbreaks. • The outbreaks emphasized the need for efforts to communicate effectively with special populations (Enhanced Capacity #11), and case studies indicate some progress in this area, but much more needs to be done.
Focus Area G: Education and Training	• Progress has been made toward ensuring the delivery of appropriate education and training to public health professionals and partners, (Critical Capacity #16), although the depth and breadth varies.

Our assessment also identified areas that seemed important to public health preparedness that are not dealt with, at least directly, in the Critical Benchmarks and Critical Capacities. These include the following:

- **Quality improvement activities.** The importance of preparing formal after-action reports following major disease outbreaks, other public health emergencies, and exercises is in recognized in Critical Capacity #7, but the value of this practice goes beyond surveillance and epidemiology (Focus Area B). As we discuss in Chapter 7, encouraging such reports could go a long way toward making state and local health departments into learning organizations that capitalize on experience to improve their capabilities.
- **Leadership.** *Leadership* and the *ability to respond to public health emergencies* are mentioned in Critical Capacities #1 and #3, and our case studies confirm the importance of these capacities. The related Critical Benchmarks are narrowly focused, however, and do not seem to be adequate measures of these concepts.
- **Communication and coordination.** As Chapter 5 illustrates, the ability of public agencies to communicate among themselves and with their partners, and to coordinate their activities, is critical during a public health emergency. Communication is covered in Critical Capacities #11 through #14, but these are primarily focused on information technology rather than on the human connections and already formed partnerships that are vital to effective coordination. Similarly, Critical Capacity #3 addresses coordination in the form of planning activities, but whether the resulting plans translate into effective coordination during an emergency is not addressed.
- **Technology and effective public health systems.** Many of the Critical Capacities and Benchmarks focus on information technology, laboratory capacity, and related items without regard to whether public health systems can use this technology effectively in a public health emergency. Technology alone will not guarantee the ability of health departments to respond to public health emergencies in the future.

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APPENDIX A: METHODS

This appendix presents the criteria that were used to select state and local health departments for site visits, the results of the site selection process, and the methods used to conduct the site visits, including the standardized protocols used to guide data gathering.

CRITERIA FOR SELECTING STATE AND LOCAL HEALTH DEPARTMENTS

Our goal was to identify six states, and at least two local areas within each state, that illustrated the range of the public health responses to West Nile virus, SARS, and monkeypox. We also took advantage of an opportunity to study a hepatitis A outbreak in 2003 in Western Pennsylvania, but this was not part of the original site selection process.

We used the following criteria to identify study sites. The first two criteria were intended to ensure that there was a sufficient amount of disease and public health activity in each of the sites to permit a useful case study.

1. The number of cases and potential cases, in humans or animals as relevant, or other measures of the actual or potential extent of the three outbreaks. This criterion was applied differently, as the three diseases required:
   a. For SARS, we used the number of suspected, probable, and confirmed cases in humans.
   b. For monkeypox, we used the number of human and, if available, animal cases, plus information on shipments of possibly infected prairie dogs.
   c. For West Nile virus, we used the number of human cases and deaths, as well as information on birds, horses, and other animals as appropriate, plus information from testing of mosquito pools. We also considered the evolution of the outbreak over time by selecting sites responding to an early outbreak (1999-2001) and sites with more recent outbreaks (2002-2003).
2. The extent of the public health and health systems response. Useful data were obtained from state and local health departments that were especially innovative or effective in responding to the challenges of these outbreaks, as well as those with a less thorough response. Since the details of the public health and health systems response were learned only during the site visits, before the site visit we applied this criterion based on descriptions of public health and health systems response found in the scientific and professional literature, on the web, and in news media.

The remaining criteria were intended to ensure that a range of health departments was considered, so that the lessons learned from the exercise could be meaningfully extrapolated to jurisdictions beyond those directly studied. These criteria were also used to guide the final selection of local areas within the selected states.

3. Characteristics of the population served, including total numbers; urban/rural composition; and racial, ethnic, and socioeconomic diversity.
4. Geographical distribution throughout the United States, especially with respect to climate and, for West Nile virus, the climate's effect on the length of the mosquito season.
5. Characteristics of state and local health departments, including the relationship between local and state health departments in the state; essential public health services provided by state and local health departments; the importance of the health department as a safety net provider; the public health workforce composition, background, and experience; the availability of relevant emergency public health legal authorities; the size and sophistication of the health department (including scientific and technological capabilities and borrowed personnel from CDC); existing support from CDC; the level of federal and state funding; and other.

SELECTION OF SITE VISIT LOCATIONS

Based on these criteria, RAND chose six states for site visits: California, Colorado, Illinois, Louisiana, New York, and Wisconsin. In addition, Pennsylvania was included for the case study of hepatitis A.

California

California experienced the first occurrence of SARS in 2003 along with the largest number of suspected and probable cases, particularly in the San Francisco Bay Area with its diverse urban populations and frequency of Asian travel. The first case of West Nile virus in California did not occur until 2002, three years after the first case appeared in New York, giving California time to prepare. California did not experience any cases of monkeypox.

California's public health system is strongly focused on independent county health departments, which we visited in three counties: Santa Clara, an urban county with a diverse population in the San Francisco Bay area; Riverside, a largely rural county with significant Mexican population and cross-border travel; and Sacramento, a midsize urban county. We also visited the health department in the city of Berkeley, which is one of three municipal health departments in the state.

Colorado

In 2003, Colorado dealt with the largest outbreak of West Nile virus in the country to date. It also recorded 11 suspected cases of SARS that same year. Colorado did not experience any cases of monkeypox.

Colorado has a decentralized public health system that contains 15 organized local health departments statewide. These health departments receive some federal funding for programs from allocations funneled through the State Department of Public Health and Environment. We visited three county health departments (Tri-County, Weld County, and Otero County) as well as the State Department of Public Health and Environment. Tri-County was selected because of its high incidence of West Nile virus cases, and because the first case in the state was found there in 2002. It was also chosen because it is a large suburban area health department that covers three counties in the Denver metropolitan region (Adams, Arapahoe and Douglas) and has a unique organizational structure. Weld County serves a large geographic area east of Denver, which is comprised of a mix of urban and rural communities and which experienced the first human case in the state in 2003 as well as a high number of cases overall. Otero was selected because it has a small health department that covers a large rural area in the southern region of Colorado and provides assistance to other neighboring counties as well when requested.

Illinois

In 2002, Illinois experienced one of the nation's largest outbreaks of West Nile virus, which resulted in more than 800 cases and more than 60 deaths. The monkeypox outbreak in 2003 resulted in a total of nine confirmed, one probable case, and two suspect cases in Illinois. Although no cases of SARS occurred in Illinois, all of the counties and municipalities we visited tracked the SARS outbreak through information provided by the CDC and the media with some health departments having to deal with residents who had traveled to high-risk areas.

Illinois has a decentralized public health system in which counties have the primary responsibility for public health activities. We visited the Illinois Department of Public Health (IDPH) located in Chicago and Springfield; the Sangamon County Department of Public Health, which serves a rural region as well as Springfield (the state capital); and the City of Springfield

Department of Public Health. We also visited the Chicago Department of Public Health, which serves a large and diverse urban population with proximity to Canada, and also receives federal bioterrorism funding separate from Illinois and the Cook County Department of Public Health, which serves suburban areas of the county. We also conducted telephone interviews with the DuPage County Department of Public Health in the Chicago suburbs.

Louisiana

In 2002, Louisiana was the site of a major West Nile virus outbreak, which produced the first human case of the year and later resulted in a total of 329 confirmed cases and 24 deaths.

The public health system in the state is very centralized, controlled and managed by the state Office of Public Health (part of the Louisiana Department of Health and Hospitals). The state system is divided into nine public health regions, each with a regional health department, with each region encompassing 4 to 12 parishes (the analog of counties in other states). We visited the parishes of Baton Rouge/East Baton Rouge, a midsize urban area with the largest cumulative number of human West Nile virus cases; New Orleans/Orleans, a large urban area; and St. Tammany, a rural area also with a large cumulative number of human West Nile virus cases.

Pennsylvania

The 2003 hepatitis A outbreak in Western Pennsylvania was the largest single-source outbreak in U.S. history. The outbreak lasted approximately two months and eventually included 660 confirmed primary cases and resulted in three deaths. The outbreak originated in a restaurant in Beaver County in Southwestern Pennsylvania and was caused by contaminated green onions imported from Mexico, which were used in salsa dip that was consumed by the restaurant's customers.

Pennsylvania was not one of the states originally chosen for a site visit, nor was hepatitis A one of the outbreaks we had originally planned to examine. The decision to add a discussion of hepatitis A in Pennsylvania was based on several factors, including the proximity of the outbreak to one of RAND's offices, and a decision by the University of Pittsburgh School of Public Health to organize a symposium on this event, which provided an opportunity to augment the experience base of this report.

New York

New York State had the earliest experience with West Nile virus, which was first seen in New York City in 1999. In 2003, New York State reported 46 suspected and probable SARS cases (27 in New York City alone), some or which were related to international travel. Although New York had no confirmed monkeypox cases, there were a number of possible cases among animals that required a public health response.

New York has a decentralized public health system in which counties have the primary responsibility for public health activities. We visited the state health department in Albany, as well as the New York City Department of Health and Mental Hygiene, the Monroe county health department in Rochester, and the Albany county health department. New York City is in a large urban area with a diverse population and substantial international travel. Its health department and public health laws predate those of the state, and therefore the department is somewhat independent. New York's public health system allowed us to explore a number of intergovernmental issues, including the role of direct federal funding and the need for cooperation among health departments in the metropolitan area, some of which are in New Jersey and Connecticut. Albany and Monroe counties each contain one mid-size city, and anchor regional public health activities.

Wisconsin

In 2003, Wisconsin had the first documented human cases of monkeypox in the Western Hemisphere. The outbreak ultimately resulted in 38 monkeypox cases (18 confirmed, 9 probable, 11 suspect), which were clustered in two geographic areas (central Wisconsin and southeast Wisconsin around Milwaukee). The first human case of West Nile virus in Wisconsin occurred in 2002, when the state had 52 reported cases. There were 25 suspected cases of SARS investigated in Wisconsin, but none was confirmed.

The public health system in Wisconsin is decentralized and consists of a State Division of Public Health, which is part of the Department of Health and Family Services (DHFS), and 96 local health departments. We visited the state health department as well as several local health departments, including the Dane County Public Health Division and City of Madison Department of Public Health, the City of Milwaukee Health Department and the Waukesha County Dept of Health and Human Services, which serve a suburban area west of Milwaukee. We also visited the Marathon and Clark County Health Departments, serving rural areas, because the monkeypox outbreak came to light there and because these counties use a unique health department structure in which public health nurses tend to most of the issues. These visits were supplemented by a visit to the Froedtert Memorial Lutheran Hospital in Milwaukee and a telephone interview with the Marshfield Clinic Laboratory.

METHODS USED TO CONDUCT SITE VISITS

Site visits were conducted by two- or three-member teams of RAND scientists using a detailed discussion guide as described below. These teams collected much information through in-person interviews with senior officials of the selected health departments and others in the communities nominated by the health departments. These interviews were conducted individually or in groups, depending on the preferences of the state and local officials. Telephone interviews were scheduled with key informants who were not available during the visit. Before, during, and after the site visits, team members gathered information regarding the nature and extent of the public health departments' emergency response activities for as many of the outbreaks as were relevant, including information on the departments' interactions with HHS and other federal agencies and other public or private entities. The teams also gathered materials prepared by the health departments during the outbreaks (for both internal and external use), analyses extracted from relevant reports and publications, and other materials.

To ensure the privacy of interview participants, interviewees were assured that their participation was completely voluntary and that everything discussed would be held in strict confidence. They were told that their comments would not be quoted or cited and would not be shared beyond the project team in an identifiable form. On this basis, RAND Human Subjects Protection Committee approved this project. Facts and opinions that have been reported in the scientific or popular literature or on public Web sites or have otherwise been publicly disclosed, are included in this report with attribution.

Discussion Guide

We developed a detailed discussion guide, which was then tailored to each site, depending on the disease outbreaks that were experienced and characteristics of the state and local health departments. The discussion guide addressed the details of each outbreak, the public health response to the outbreak in terms of functional capabilities, and the impact of relevant capacity-building activities prior and subsequent to the outbreak. A summary of the topics covered can be found in Table A.1.

During our site visits, we also discussed, by way of background, the roles and responsibilities of the interviewees as well as the general policy environment and how it had changed in recent years. Interviewees were asked about current or recent initiatives to improve public health infrastructure, as well as the costs associated with responding to SARS, West Nile virus and monkeypox. As relevant, interviewees were asked:

- Can you describe salient events, public concerns, etc., that occurred in response to the real/suspected outbreak?
- Can you describe the types of things that you were able to do at the time of the real/suspected outbreak as a result of preparedness planning and investments?
- What would you do differently based on your experience with the real/suspected outbreak? What didn’t work that was supposed to?
- What types of things can you do ***now***, in terms of public health functions and services, that you weren’t able to do prior to the CDC cooperative agreements and other initiatives undertaken in the wake of 9/11?
- To what extent was the “dual use” nature of public health investments considered when expending funds originating from the CDC cooperative agreements?
- What is the nature of the health department’s relationship with public health entities at other levels of government, in particular, roles and responsibilities associated with the federal (CDC and other public health agencies), state, local, and regional agencies?
- Do you have any suggestions for improving the CDC cooperative agreement process?

Table A.1. Site Visit Discussion Topics

A. Outbreak and public health response.

Identification and characterization of the outbreak

- The extent (numbers of cases by demographic, geographic, disease severity, route of transmission, and other factors as appropriate) and timing of the outbreak
- How the outbreak come to light
- How the agent and nature of the outbreak were characterized

Public health response

- Actions taken with respect to
  - Treatment of cases
  - Prevention of further spread
  - Minimizing psychological and social consequences

B. Functional capacities. How the jurisdiction's ability to carry out the following functions contributed to the public health response.

Assessment

- Surveillance tools
- Environmental monitoring
- Epidemiological investigation
- Local and state laboratory capacity

Policy development

- Population-based disease control plans and policies
- Clinical policies

Assurance

- Direct care by health department for affected individuals
- Health department involvement in ensuring care in the private sector for affected individuals
- Enforcement of laws and regulations
- Special care needed for public health or other health care workers

Coordination and communication

- Barriers encountered, and steps taken, to coordinate and communicate with
  - Emergency responders
  - Law enforcement
  - Health care providers, including mental health care providers
  - Other public health departments (e.g. regionally, state, CDC)
  - The media and the public

Table A.1. Site visit discussion topics, continued

C. Capacity building activities. How the following activities contributed to the public health response.

Knowledge development and application

- Long-term policy development (e.g. review and updating of public health authorities)
- Planning and assessment activities
- Exercises and drills
- Evaluation
- Research

Development of partnerships to support emergency operations

- Health care providers (e.g. with respect to surveillance and disease reporting, surge capacity, mental health, communication of treatment guidelines, etc.)
- Emergency responders
- Law enforcement (especially with regard to public health authorities)
- Community organizations (especially those that can help to communicate with minority and disadvantaged populations)

Workforce development

- Public health professionals
- Health care providers, including mental health care providers
- Identify and train supplemental workforce

Infrastructure development

- Information/communications technology (for improved surveillance, transmitting practice guidelines to physicians, emergency coordination, etc.)
- Laboratory equipment and capabilities
- Pharmaceutical stockpiles and hospital supplies (including plans for managing the National Pharmaceutical Stockpile)
- Personal protection and decontamination equipment
- Isolation and decontamination facilities

APPENDIX B: WEST NILE VIRUS

This appendix provides background information on the clinical characteristics and transmission of West Nile virus infection, as well as the occurrence of West Nile virus infections in the United States. Outbreaks of West Nile virus in the six states are described in Chapter 2.

EPIDEMIOLOGY AND CLINICAL FEATURES OF WEST NILE VIRUS

Clinical Characteristics

West Nile virus is an arbovirus (arthropod-borne virus) that belongs to the family of *Flaviviridae* (genus *Flavivirus*). It is a single-stranded RNA virus, with an E-glycoprotein that triggers the production of most IgM antibodies (Petersen and Marfin, 2002). West Nile virus is antigenically related to the St. Louis, Japanese, Kunjin, and Murray Valley encephalitis viruses (CDC, 2003a).

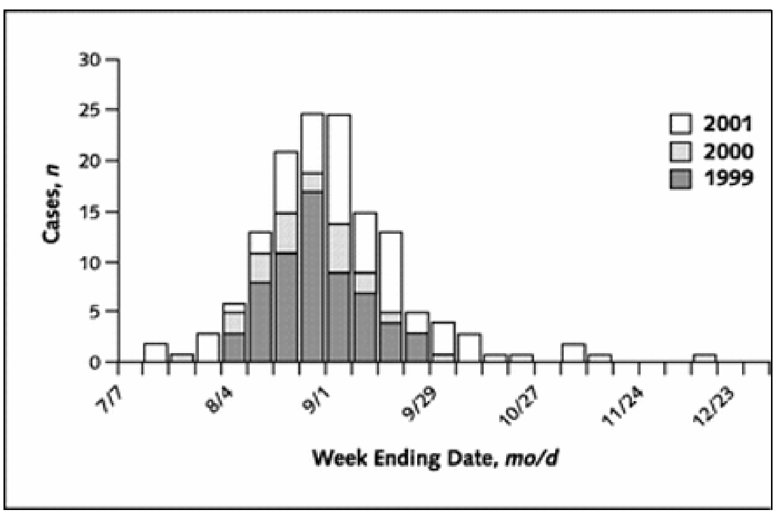
West Nile virus is a mosquito-borne infection that is asymptomatic in the majority of humans. In those who develop symptoms, West Nile virus causes a usually mild febrile illness, with a low rate of encephalitis and meningitis. West Nile encephalitis was classified as a nationally notifiable arboviral encephalitis in 2001 (CDC, 2001). A less severe manifestation of West Nile infection (i.e., symptomatic illness without encephalitis or meningitis), called West Nile fever, has not been classified as a notifiable illness, but CDC has issued a recommended case definition for West Nile fever (CDC, 2003a). The incubation period of West Nile virus is usually 2-6 days (range, 2-15 days) (CDC, 2003a).

The majority of cases do not display symptoms. In a survey of persons in New York City in 1999, only 20 percent of those testing positive for West Nile infection had experienced West Nile fever and only half of those had sought treatment (Mostashari et al., 2001). Serious neurologic disease is relatively uncommon among infected individuals, with an estimated rate of 1 in 150 infections resulting in meningitis or encephalitis (CDC, January 26, 2001; Mostashari et al., 2001). The case fatality rate among hospitalized patients was 12 percent in New York in 1999 (Nash et al., 2001). During the 1999 West Nile virus outbreak in New York City, the rate of clinical infection rose rapidly with increasing age, with the rate in persons 50 years and older about 20 times higher than those under 50 (Nash et al., 2001).

Diagnosis of West Nile virus infection is based on patient characteristics, location, timing of presentation, and laboratory results (Petersen and Marfin, 2002). CDC recommends evaluation for West Nile virus for patients with unexplained meningitis or encephalitis that occurs in the late summer or early fall in areas with West Nile enzootic activity. The most definitive method to confirm or rule out the West Nile virus diagnosis is testing for the IgM antibody to West Nile virus in serum or cerebrospinal fluid (CSF), which indicates central nervous system infection. Three of four patients with flavivirus infection have positive test results within the first four days following onset of symptoms, and almost all, by day seven or eight (Petersen et al., 2002).

Since mosquitoes are the primary vectors for transmission, the dates of onset for West Nile virus infections in humans usually extend from spring to late fall with highest incidence in late August and September (Figure B.1).

Figure B.1. Week of Symptom Onset for Persons Reported to Have West Nile Virus, 1999-2001

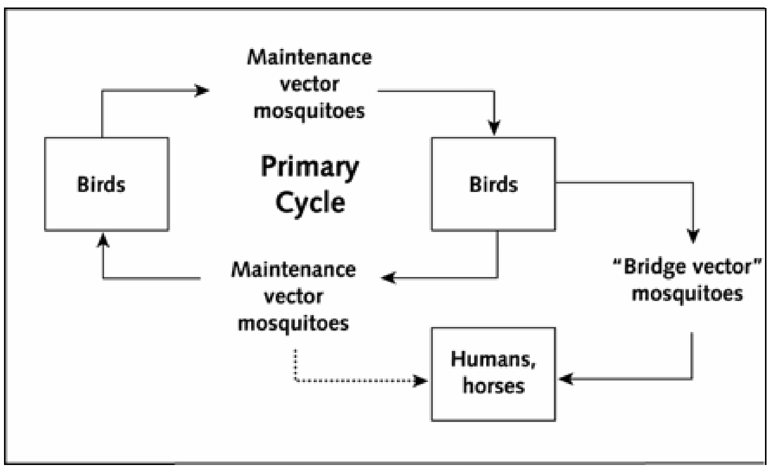


Source: Petersen and Marfin, 2002.

Transmission

As shown in Figure B.2, West Nile virus is perpetuated in an enzootic cycle primarily between *Culex* species mosquitoes and birds, with humans and horses as incidental hosts (Hubalek and Halouzka, 1999; Hayes, 2001). Mosquitoes mature through three aquatic stages (i.e., eggs, larva, and pupa) and emerge as adults in the spring in temperate regions. Mosquitoes are infected by biting infected birds that have high levels of West Nile virus in their blood. By late summer, sufficient numbers of "bridge vector" mosquitoes (i.e., mosquitoes that feed on both humans and birds) become infected and present an infection risk to humans. In tropical climates, transmission can occur throughout the entire year (Petersen and Marfin, 2002). There are a number of hypotheses as to how West Nile virus can overwinter under adverse climates, including vertical parent-progeny infection or reintroduction via chronically infected hosts. Supportive evidence is still lacking (Hubalek and Halouzka, 1999).

Figure B.2. Transmission Cycle of West Nile Virus



Source: Petersen and Marfin, 2002.

In Israel and the United States, West Nile virus has been observed with high mortality rates among avian species at the same time as, or shortly before, the occurrence of human cases of West Nile disease (Petersen and Roehrig, 2001; Swayne et al., 2001). Mortality rates are highest among American crows, other crow species, ravens, and jays (Eidson et al., 2001).

Although West Nile virus cannot be transmitted from person to person through casual exposure, it can be transmitted to humans by means other than being bitten by infected mosquitoes. West Nile virus infections have been documented in laboratory workers who had no known risk factors following accidental percutaneous inoculation while handling West Nile virus-infected animal specimens (CDC, December 20, 2002b). Other West Nile virus infections have occurred as a result of transfusion of blood products (red cells, platelets, or fresh-frozen plasma) and transplantation of organs from West Nile virus-infected donors (Pealer et al., 2003).

In addition, one case of probable mother-to-child transmission of West Nile virus was reported in 2002 as a result of breast milk ingestion (CDC, October 4, 2002). No one is known to have been infected from handling live or dead infected birds.

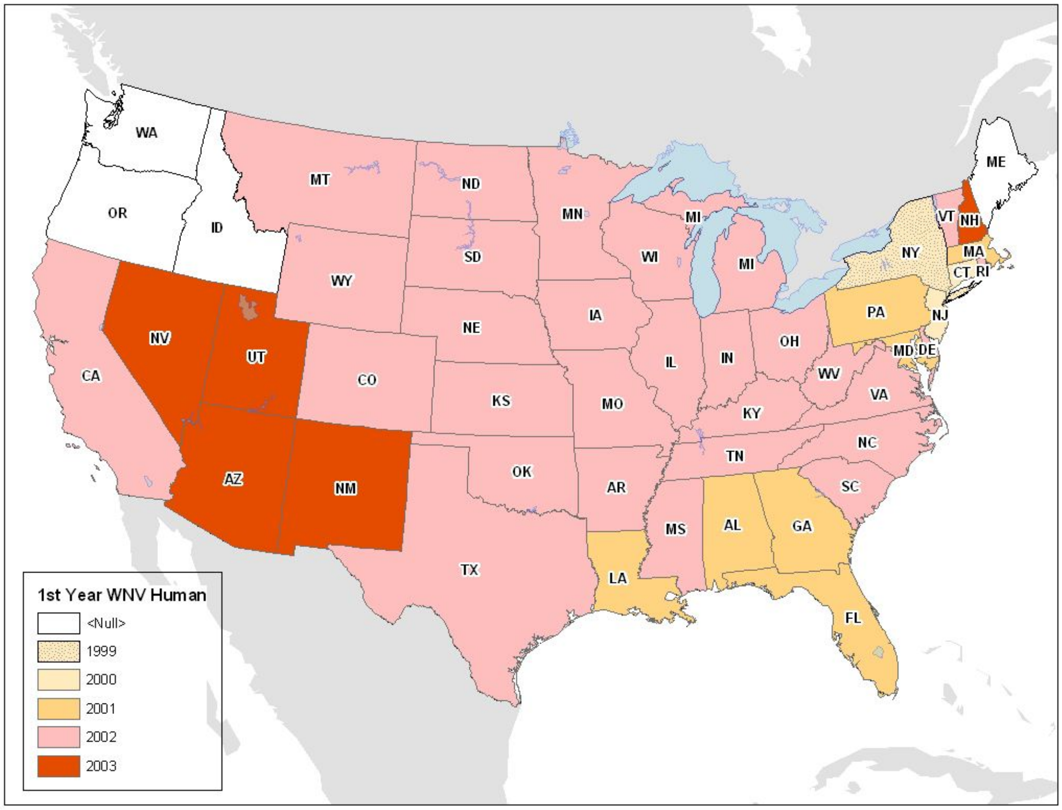
WEST NILE VIRUS INFECTIONS IN THE UNITED STATES

The first documented appearance of West Nile virus in the Western Hemisphere occurred in New York City in August 1999. Since then, the virus has spread rapidly throughout the United States and established itself as enzootic among birds, with horses and humans as incidental hosts. During 2004, 2,470 human cases of West Nile infection were documented in 40 states and the District of Columbia (CDC, 2005).

Since the first cases of domestically acquired West Nile encephalitis in the United States occurred in New York in 1999, West Nile virus activity has spread throughout most of the United States, as documented through surveillance of birds, mosquitoes, and horses. Human cases of West Nile virus infection had been identified in three states by the end of 2000, ten states by the end of 2001, 39 states and the District of Columbia by the end of 2002 and 45 states and the District of Columbia by the end of 2003 (Figure B.3). As of December 2004, only four states—Alaska, Hawaii, Maine, and Washington—had not experienced a human case of West Nile infection (CDC, 2005). Of these, Maine has documented West Nile virus activity in non-human species, while the other three states have not.

The number of reported human cases of West Nile virus increased dramatically from 1999 to 2003 and decreased in 2004 (CDC, 2005). During the 1999 outbreak, 62 cases of encephalitis were identified. The number of human West Nile virus cases increased steadily until 2003 when the number of reported cases peaked at 9,862. The incidence of human cases decreased substantially in 2004. As of January 11, 2005, there were only 2,470 human cases of West Nile virus reported in the United States in 2004. Of these, 900 (36 percent) have been confirmed to be neuroinvasive disease.

Figure B.3: Onset of Human West Nile Virus Activity in the United States, 1999-2003



Source: CDC: West Nile Virus, 2003.

Surveillance for West Nile Virus

West Nile virus surveillance was first conducted in New York State and then evolved in other states based on New York's experience and CDC recommendations. The recommended design of surveillance systems depends on geography, timing, the likelihood of arbovirus activity, and resource availability, and can include human, mosquito, equine, and avian surveillance, as detailed in Table B.1. The CDC recommends, at a minimum, laboratory-based surveillance for neurological disease in humans and equines. In Northeastern and Midwestern states, surveillance should begin in early spring and continue through fall with an emphasis on urban and suburban areas. In Southern states, surveillance should continue year-round. In Western states, surveillance should begin in early spring and continue until cold weather decreases mosquito activity (CDC, 2003a).

Table B.1. CDC Recommended West Nile Virus Surveillance Strategies

Avian
• Monitor avian morbidity/mortality (e.g., dead crow density)
  ➢ This is the most sensitive early detection system for West Nile virus activity
• Test serology of captive sentinels (e.g., chickens) or free-ranging birds (e.g., house sparrows)
  ➢ Seroconversion testing generally requires weeks for confirmation and extensive knowledge of transmission dynamics

Equine • Ensure equine neurological diseases are reportable • Investigate clusters of equine neurological diseases • Test suspect cases for West Nile virus • Contemplate use of equine West Nile virus vaccine   ➢ Vaccine has been available since 2001 but no published studies of efficacy have been done
Mosquito • Collect adult mosquitoes using gravid and/or light traps • Sample larval mosquitoes and map larval habitats • Implement laboratory support to identify mosquito species and test for West Nile virus   ➢ Focus initially on Culex mosquitoes • Track adult mosquito densities and infection rates over time and space

Human
• Focus on encephalitis
• Aseptic meningitis, Guillain-Barre syndrome, acute flaccid paralysis, and fever or rash illness are of lower priority
• Conduct enhanced passive surveillance of hospitalized cases of encephalitis or patients with IgM antibodies to either West Nile virus or SLE virus
  ➢ General alerts to key health care personnel can enhance reporting of possible cases
• Active surveillance is recommended for high-risk areas
  ➢ Contact health-care providers and hospitals on regular basis
  ➢ Implement lab-based surveillance of suspect cerebrospinal fluid (CSF) specimens
• Use special surveillance projects in high risk areas
  ➢ Use real-time syndromic surveillance systems

Source: CDC, 2003a.

Prevention and Control Activities

Eradication of the virus from North America is unlikely, so prevention and control activities aimed at reducing the contact between humans and potentially infected mosquitoes are critically important. These strategies involve mosquito control, personal protective measures, and information campaigns. In 2003, CDC published comprehensive guidelines for prevention and control that are targeted to state and local health departments (CDC, 2003a). Mosquito control methods are designed to eliminate the West Nile virus vector. Such programs rely primarily on (a) eliminating mosquito larval habitat breeding and (b) using larvicides and adulticides (pesticides intended to kill larvae and adult mosquitoes, respectively). The first can be accomplished through improved sanitation and water management strategies that minimize areas of standing water. The second might employ continued pesticide application and suppression of vectors or use of multiple pesticides with different modes of action. Larvicide must be used early in the season (e.g., May or June for the Northeast) to be effective.

Activities to Minimize Psychological and Social Consequences

Public information campaigns can be used to inform the public about West Nile virus (including signs and symptoms), promote the use of personal protective measures that reduce disease risk, and gain support for control measures (e.g., mosquito control measures involving pesticides). In general, according to CDC, public information campaigns should

- describe the overall West Nile virus prevention and control plan for the community and how it affects individuals
- stress the feasibility of lowering an individual's risk through serious, not fear-driven, messages
- communicate the safety profile of pesticides and the spraying schedule
- emphasize participation in community mobilization
- provide targeted information to specific groups such as seniors at increased risk for severe disease (CDC, 2003a).

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APPENDIX C: SEVERE ACUTE RESPIRATORY SYNDROME (SARS)

This appendix provides background information on the transmission and clinical characteristics of Severe Acute Respiratory Syndrome (SARS), as well as the occurrence of SARS infections in the United States. Outbreaks of SARS in the six states are described in Chapter 2.

EPIDEMIOLOGY AND CLINICAL FEATURES OF SARS

Clinical Characteristics

SARS is a febrile respiratory illness that is caused by a coronavirus known as SARS-CoV (Kuiken et al., 2003; Peiris et al., 2003). Coronaviruses are a group of viruses that cause approximately 30% of all common colds. The most common symptoms of SARS are fever, non-productive cough, myalgia, shortness of breath, and headache. Other less common symptoms are malaise, chills, diarrhea, nausea, and sore throat (Booth et al., 2003).

SARS has three phases: febrile prodrome, respiratory, and advanced. The febrile prodrome period is characterized by an incubation period (the time between exposure and the onset of symptoms) ranging from 2 to 10 days (median 4-5 days) in which there is little symptomology aside from a mild fever and chest X-rays are normal (WHO, 2003a).

The respiratory phase usually consists of a high fever, muscle aches and pains, and chills. It begins 3 to 7 days after the febrile prodrome stage begins and is marked by a dry nonproductive cough and shortness of breath (Booth et al., 2003). During this time, individuals may experience low blood oxygen levels, and a small number of cases may require intubation and mechanical ventilation to breath.

The advanced phase takes place 10-14 days after the febrile prodrome state begins and is typically the point at which infected persons are sickest. SARS is most likely to spread from person to person during this phase, but contagion can happen during the earlier stages. The SARS outbreak of 2003 was associated with a significant amount of mortality and morbidity. The Case Fatality Ratio (CFR), the proportion of total cases who died from the disease, was 15 percent, but differed greatly by age, ranging as high as 50 percent in individuals aged 65 and older (WHO, 2003a).

The CDC and the WHO classify reported SARS cases into three categories – suspected, probable, and confirmed – using clinical, epidemiological, and laboratory criteria (CDC, 2003a). Clinical criteria include a fever over 100.4 degrees Fahrenheit, a nonproductive cough, shortness of breath or difficulty breathing, and radiological evidence of pneumonia. Epidemiological criteria include a history of traveling to a SARS-infected area or exposure to someone who recently traveled to SARS-infected areas. Laboratory criteria include detection of antibodies to SARS-associated coronavirus (SARS-CoV) in a serum sample.

Suspected cases consist of individuals who appear to meet clinical and epidemiological criteria (exposure to other cases or travel to affected areas). Probable cases consist of individuals with positive initial diagnostic tests waiting for serological test results. Confirmed SARS cases are individuals with positive serological tests that identified them as having SARS (CDC, 2003b).

The criteria used to identify suspected cases were different in the United States from those used by the World Health Organization (WHO). WHO's definition requires radiographic evidence of infiltrates consistent with pneumonia or respiratory distress syndrome on chest radiograph. The CDC did not require such evidence for U.S. cases. Because SARS was not widespread in the United States, a more sensitive case definition was needed to identify as many potential cases as possible. A necessary result, however, was that many false positive cases – individuals with more common respiratory disease – were included among the suspected cases, making for a larger number of cases that required follow-up and epidemiological investigation.

These case definitions evolved over time as more epidemiologic information became available. In particular, there was no "gold standard" serological test for SARS during the outbreak, and the most appropriate serological test depended on the suspected stage of disease (Leung and Ooi, 2003). A fast and accurate test to identify SARS cases in the early stages of the disease does not exist. In addition, the reliability of existing serological tests is influenced by their cross-reaction with other human coronaviruses, including those causing the common cold (WHO, 2003b). Canadian health authorities had so many false positive tests during the second wave of their SARS outbreak that they began to require epidemiological evidence – evidence of contact with a SARS case or travel to an infected region – and a positive serological test for SARS for individuals to be considered a confirmed SARS case.

Because epidemiologic criteria were part of the SARS case definition, public health officials in Toronto found that health care providers needed up-to-date information on all of the known cases in order to determine whether someone with symptoms had been exposed. As a result, communication between health care providers and public health was of paramount importance.

Transmission

SARS is spread from person to person through close contact – living with, having face-to-face contact with, standing in an elevator next to, or having contact with the respiratory secretions of an infected person. The virus can be spread when an infected person coughs or sneezes, shedding the virus from the respiratory track (Bhaskar et al., 2003). Very small droplets of fluids contaminated with the SARS virus are respirated and settle onto nearby surfaces. The virus is capable of surviving outside of the body on such surfaces for several hours (Leung and Ooi, 2003). Transmission typically occurs when non-infected individuals come into contact with these droplets by touching an infected surface with their hands and then rubbing their eyes or touching their nose or mouth. Patients who are severely ill or experiencing rapid deterioration (typically during the second week of infection) are most likely to spread the infection to others (WHO, 2003b).

Some individuals with SARS – known as "superspreaders" – transmit the disease more readily than others. It is hypothesized that superspreaders have a high viral load and cough a lot, which may in part explain why they spread the disease at a greater rate than other infected individuals (Philipkoski, 2003).

One striking feature of SARS is the number of health care workers who became infected. For example, a Hong Kong resident fell ill shortly after visiting a friend at the Metropole hotel and was taken to the Prince of Wales Hospital, a nearby community hospital (Leung and Ooi, 2003). Since the hospital staff were unaware of SARS and took no precautions to prevent its spread, over 60 percent of the hospital staff became infected (Ho et al., 2003). Globally, 21 percent of probable cases occurred among in health care workers, and in Canada and Singapore the proportion was over 40 percent. In the United States, however, few health care workers were infected.

SARS WORLDWIDE AND IN THE UNITED STATES

The SARS outbreak of 2003 had its greatest impact outside of the United States, but nevertheless tested U.S. federal, state, and local public health systems. Because the SARS outbreak was global, affecting 29 countries at almost the same time, WHO and other multinational organizations had a large role to play. In particular, warnings and information from these agencies led U.S. public health agencies to prepare for the possibility of cases in this country in a way that would not have been possible had the first cases come to light here.

Origins and Global Spread

It is generally believed that SARS originated in the city of Foshan in the Guangzhou Province in the southern part of the People's Republic of China (Zhong et al., 2003). How SARS emerged there is still unclear (Enserink and Normile, 2003); however, exotic animals have been hypothesized as a possible causal agent (CDC, 2003c; Ng, 2003). In November 2002, doctors in Foshan and surrounding areas noticed an increase in the number of patients reporting flu-like symptoms; they began to suspect something other than influenza when the severity of many patients' symptoms became clear and the first fatalities appeared. Public health authorities outside of China were not aware of the problem at this time.

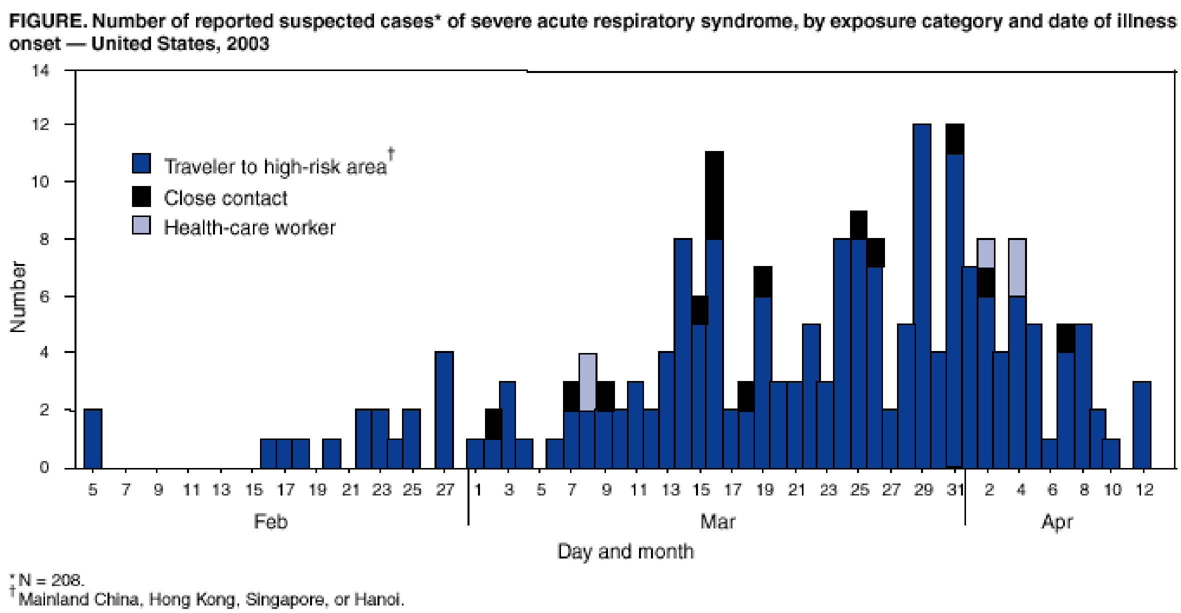
SARS apparently spread beyond China when a physician from Foshan visited Hong Kong in February 2003 and stayed at the Metropole Hotel. Ten other hotel guests became infected and carried the infection to Vietnam, Singapore, Canada, and the United States. SARS came to the world's attention when an American businessman from New York, who had stayed at the Metropole Hotel, traveled to Vietnam and became ill; the patient was seen by a WHO epidemiologist who recognized the uniqueness of the disease. WHO sent out the first notice of the outbreak on March 13, 2003.

By June 2003, SARS cases had been reported in 22 countries in 5 different continents across the globe (CDC, 2003d). By July 2003, WHO (2003e) reported SARS cases in 29 countries with the cumulative number of probable SARS cases rising to 8,098. China, the source of the SARS outbreak, had more probable cases than all other countries combined. The United States, on the other hand, had only 29 probable and 8 confirmed SARS cases. Canada, and particularly the Toronto area, had the only sizeable outbreak outside Asia, with 251 probable cases.

SARS in the United States

The presentation of SARS in the United States was not as extensive as in other parts of the world. However, although only 8 SARS cases were eventually confirmed, 175 suspected or probable SARS cases throughout the country required follow-up and evaluation, and the possibility of a more extensive outbreak evoked a public health response involving enhanced surveillance, various prevention and control strategies, and public communication. The first suspected case of SARS in the United States, a traveler to a high-risk area, experienced symptoms on February 5, 2003 (Figure C.1). The majority of infections occurred after March 13, when the first WHO notice was published. The last diagnosed case became ill on April 12.

Figure C.1. Number of Reported Suspected Cases* of SARS, by Exposure Category and Date of Illness Onset—United States, 2003



Source: CDC, 2003b.

Most of the probable and suspected cases of SARS in the United States were persons over the age of 18 who had recently traveled internationally. The number of cases in men and women was about even; cases were similarly divided among the sexes internationally. Over 90% of SARS cases were related to travel to high-risk areas. The disease disproportionately affected Asians, most likely because they were more frequent travelers to the countries with SARS outbreaks. Unlike other countries, which had large outbreaks in hospital settings among hospital employees, the United States had only a few cases of SARS in hospital employees. In addition, while nearly 20% of suspected SARS cases worldwide required the use of a mechanical ventilator, practically none in the United States needed one, presumably because most were not true SARS cases.

In response to the outbreak in the United States, public health activities at the state and local levels varied greatly among the states we visited, reflecting differences in the number of suspected SARS cases in each state, the perceived risk, and differences in the public health systems in these states. These activities ranged from targeted public information campaigns to changing state-level statutes regarding quarantine procedures.

Prevention and Control Strategies

The general strategy that public health agencies worldwide used to control the spread of SARS was to identify, isolate, and contain (Leung and Ooi, 2003). Identifying individuals with SARS as early as possible prevents further transmission. Singapore appears to have taken the most stringent measures, including putting patients in isolation rooms in hospitals, requiring staff to wear protective garments around all suspected SARS cases, quarantining suspected SARS cases, closing schools, and setting up checkpoints at airports to check the health of passengers from foreign countries.

Experience in Asia and Toronto suggests that isolation and quarantine were also important. Isolation is a medical intervention that involves the separation of known infected individuals from non-infected individuals during the period of disease communicability to prevent transmission of the disease. Isolation is typically used for individuals with disease symptoms, since infected but asymptomatic cases are not known to public health authorities. Quarantine is a legal action to limit the freedom of movement of individuals exposed to a disease for a period of time not longer than the usual incubation period (Last, 1988). In Toronto, officials coined the term "voluntary quarantine" because they lacked the legal authority to quarantine. Potentially exposed individuals were encouraged to restrict their movements voluntarily.

The CDC and WHO emphasize that it is crucial to identify every person with whom an infected individual has come into contact since being infected (Leung and Ooi, 2003). Cases must be questioned about where they have been, whom they saw, and so on. Everyone that the cases came into contact with since exposure must also be followed up and questioned.

Activities to Minimize Psychological and Social Consequences

SARS also highlighted the value of public information campaigns to contain outbreaks while mitigating public concerns and social disruption. These campaigns typically included one or more of the following types of information: (1) general SARS information, including its suspected origins and suspected transmission modes, (2) information about preventative measures the public should take to protect themselves and who to contact if they suspected they or someone they knew had come in contact with an individual infected with SARS, and (3) regular updates about cases and fatalities. Canada, for instance, had daily and sometimes hourly briefings with news agencies, whereas initially China had much more limited contact with news agencies.

A longitudinal study of public perceptions about SARS in Hong Kong from day 10 to day 62 of the outbreak found that timely dissemination of information regarding SARS by Hong Kong authorities helped Hong Kong residents to quickly adopt preventative measures, thus reducing the spread of the disease (Lau et al., 2003). Information campaigns, however, need to consider background perceptions of risk and the anxiety levels of the general public (Leung, et al., 2003). Information campaigns may also need to be tailored to certain groups. For example, because the elderly are most vulnerable to SARS, it may be necessary to tailor information campaigns to specifically address their concerns and needs (Tse et al., 2003).

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APPENDIX D: MONKEYPOX

This appendix provides background information on the transmission and clinical characteristics of monkeypox, as well as the occurrence of monkeypox infections in the United States. Outbreaks of monkeypox in the six states are described in Chapter 2.

EPIDEMIOLOGY AND CLINICAL FEATURES OF MONKEYPOX

Clinical Characteristics

Monkeypox is a zoonotic disease that is primarily spread to humans through contact with infected animals. Clinical presentation of patients with monkeypox is similar to smallpox, but symptoms, including fever, headache, other flu-like symptoms, swollen lymph nodes, and a vesicular rash, are less severe. However, in some cases monkeypox can be fatal. The illness usually lasts for two to four weeks (CDC, 2003g). CDC does not recommend specific treatment, but does recommend that all human cases be isolated. For patients with rash, isolation should be continued until all vesicles are scabbed. Patients without rash should be isolated for seven days following fever onset (CDC, 2003h). CDC also recommends that people exposed to monkeypox cases be observed for symptoms for three weeks. These recommendations were developed and issued during and after the U.S. outbreak.

Case definitions for suspect and probable cases of monkeypox are based on symptoms and epidemiologic criteria. Confirmed cases of monkeypox must meet one of the following laboratory criteria: (1) isolation of monkeypox virus in culture, (2) demonstration of monkeypox virus DNA by polymerase chain reaction (PCR) testing of a clinical specimen, (3) demonstration of virus morphologically consistent with an orthopox virus by electron microscopy in the absence of exposure to another orthopox virus, or (4) demonstration of presence of orthopox virus in tissue using immunohistochemical testing methods in the absence of exposure to another orthopox virus (CDC, 2003e).

The case fatality rate for monkeypox is lower than for smallpox; in Africa, between 1 and 10 percent of those infected with monkeypox die (CDC, 2003g). There were no deaths associated with the 71 known cases occurring during the 2003 US monkeypox outbreak.

Because monkeypox is related to smallpox, the smallpox vaccine can be used as a protective measure preceding or following exposure to an animal or human infected with the monkeypox virus. Data from past monkeypox outbreaks in Africa indicate that the smallpox vaccine is at least 85 percent effective in preventing a monkeypox infection (CDC, 2003c). CDC has published detailed guidance regarding use of smallpox vaccine, Cidofovir, and Vaccinia Immune Globulin (VIG) for prevention and treatment of monkeypox infections (CDC, 2003).

CDC recommends smallpox vaccination for those who are investigating or caring for monkeypox patients, and for those who come into close contact with an infected patient or in direct contact with an infected animal or laboratory specimens that might contain monkeypox (unless the potentially exposed person has been vaccinated within three years). For these individuals, CDC recommends vaccination within 4 days, but suggests that vaccination should be considered up to 14 days after exposure (CDC, 2003d).

Transmission

Monkeypox, along with smallpox and cowpox, is a member of the orthopox group of viruses. Besides monkeys, other animals are known to harbor the virus, including prairie dogs, squirrels, rats, mice, and rabbits. Monkeypox is spread to humans primarily by contact with an infected animal, especially by being bitten or touching the animal's blood, body fluids, or rash. Humans can also acquire a monkeypox infection from an infected person through large respiratory droplets during extended periods of face-to-face contact; or by touching body fluids of an infected person or contaminated objects such as bedding or clothing (CDC, June 12, 2003). Previous smallpox vaccination seems to be protective against monkeypox, but this might be true only of vaccinations administered within a few years of exposure (CDC, July 9, 2003).

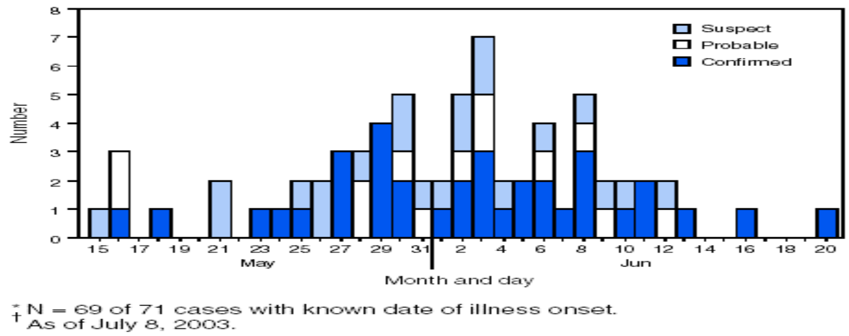
The first documented human monkeypox outbreak occurred in the Democratic Republic of the Congo (at that time, Zaire) in 1996-1997, resulting in 500 suspected cases of the disease (Voelker 1998). Person-to-person transmission occurred, leading to many generations of transmission, and the outbreak lasted for more than a year (WHO, 1997b). This large outbreak in Zaire led WHO to warn that monkeypox had the potential to become a serious health threat and merited closer attention (WHO, 1997c). There are two "genetically distinct" strains of monkeypox virus, West African and Congolese. Based on the PCR analysis, and the fact that the rodents carrying monkeypox were from Ghana, the strain responsible for the U.S. outbreak is considered to be closest to the West African strain (Reed et al., 2004).

MONKEYPOX IN THE UNITED STATES

The first human case of monkeypox in the United States came to light in central Wisconsin in May 2003. An epidemiologic investigation traced the initial onset of the illness of the first case to mid-May. The epidemic curve for the outbreak is shown in Figure D.1. CDC issued a preliminary case definition on June 17, with a revised version following on July 2. On July 30, 2003, a total of 72 confirmed, suspected, or probable cases had been reported in the United States, distributed by state as shown in Table D.1. Of these, 18 patients were hospitalized and there were no fatalities.

A traceback investigation by state and local health departments in Wisconsin as well as the CDC and other agencies identified prairie dogs as the source of the outbreak (Reed et al., 2004). The probable source was a shipment of African rodents (Gambian giant rats and dormice) from Ghana to Texas in April 2003. An animal distributor in Villa Park, Illinois, acquired some of these African rodents from a distributor in Iowa, and it appears that prairie dogs were exposed to the virus at this time. The Villa Park distributor sold prairie dogs to pet shops and other animal distributors, some of whom later exchanged them at a pet “swap meet” in central Wisconsin (Wisconsin Department of Health and Family Services, 2003). The eventual movement of the infected prairie dogs to a total of eight states and the related human monkeypox cases are illustrated in Figure D.2.

Figure D.1. Monkeypox Cases, by Date of Illness Onset, in Illinois, Indiana, Kansas, Missouri, Ohio, and Wisconsin



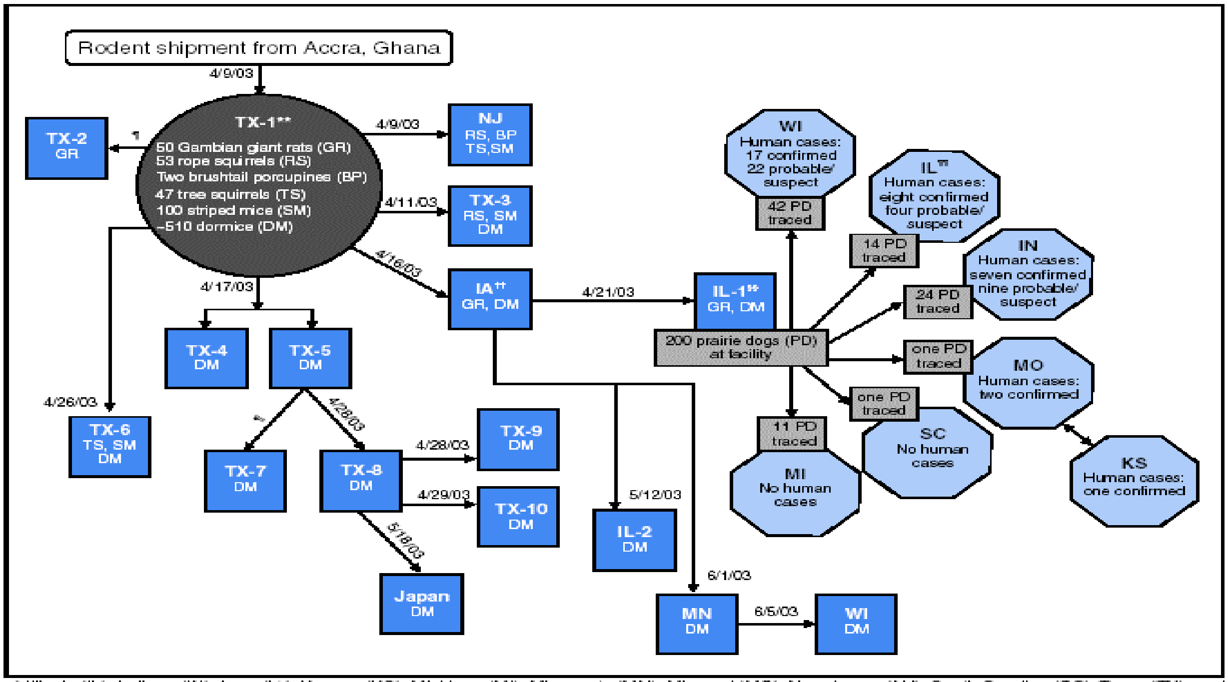
Source: Centers for Disease Control and Prevention, *MMWR*, July 11, 2003, 52(27): 642-646.

Table D.1. Reported Monkeypox Cases in the United States by State, 2003

	Number of Cases		
State	**Confirmed**	**Probable or Suspected**	**Total**
Wisconsin	18	21	39
Indiana	7	9	16
Illinois	9	4	13
Missouri	2	0	2
Kansas	1	0	1
Ohio	0	1	1
Total	37	35	72

Source: CDC, July 30, 2003.

Figure D.2. Movement of Imported African Rodents to Animal Distributors and Distribution of Prairie Dogs From an Animal Distributor Associated with Human Cases of Monkeypox—11 states, 2003



* Illinois (IL), Indiana (IN), Iowa (IA), Kansas (KS), Michigan (MI), Minnesota (MN), Missouri (MO), New Jersey (NJ), South Carolina (SC), Texas (TX), and Wisconsin (WI). Japan is included among sites having received shipment of rodents implicated in this outbreak.
† As of July 8, 2003.
§ Does not include one probable human case from Ohio; investigation is ongoing.
¶ Date of shipment unknown.
** Identified as distributor C in *MMWR* 2003;52:561–4.
†† Identified as distributor D in *MMWR* 2003;52:561–4.
§§ Identified as distributor B in *MMWR* 2003;52:561–4.
¶¶ Includes two persons who were employees at IL-1.

Source: Centers for Disease Control and Prevention (*MMWR*, July 11, 2003 / 52(27): 642-646.

Of the 71 cases reported through July 11, monkeypox virus was eventually confirmed through laboratory testing at CDC as the infectious agent in 35 (CDC, *MMWR*, July 11, 2003, 52(27): 642-646). About half of the 35 confirmed cases were females and 11 (31%) were aged 18 and under. Fourteen cases (40%) were thought to have been exposed through contact with an infected prairie dog, and another 14 (40%) through contact with either an infected prairie dog and/or human, although the exact source could not be determined. Seven cases (20%) lived in a house with a prairie dog and/or another human case of the illness. The most common symptoms experienced by the laboratory-confirmed cases were rash (97%), fever (85%), respiratory symptoms (77%), and lymphadenopathy (46%). Sixteen (46%) of the confirmed cases were hospitalized.

Prevention and Control Strategies

During the outbreak, the CDC and other agencies provided guidance to stop the spread of monkeypox throughout the animal population to animal handlers, veterinarians, and pet shop owners from the early days of the outbreak and updated it regularly during the ensuing weeks. CDC's response to the outbreak included the following activities (CDC, 2003g):

- activating its Emergency Operations Center
- deploying teams of medical officers, epidemiologists, and other experts to several states to assist with the investigation
- conducting extensive laboratory testing on specimens from humans and animals thought to have been exposed to monkeypox
- issuing interim U.S. case definitions for human monkeypox and for animal monkeypox
- issuing interim guidelines on infection control and exposure management for patients in the health care and community settings
- issuing an immediate embargo and prohibition on the importation, interstate transportation, sale, and release into the environment of certain rodents and prairie dogs
- providing ongoing assistance to state and local health departments in investigating possible cases of monkeypox in both humans and animals the United States
- working with state and federal agencies to trace the origin and distribution of potentially infected animals
- issuing an interim guidance on the use of smallpox vaccine, cidofovir, and vaccinia immune globulin in the setting of an outbreak of monkeypox
- issuing interim guidelines for veterinarians
- issuing interim guidance for persons who have frequent contact with animals, including pet owners, pet shop employees, animal handlers, and animal control officers.

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APPENDIX E: HEPATITIS A

This appendix provides background information on the transmission and clinical characteristics of hepatitis A, as well as the occurrence of HAV infections in the United States. Outbreaks of hepatitis A in the six states are described in Chapter 2.

EPIDEMIOLOGY AND CLINICAL FEATURES OF HEPATITIS A

Clinical Characteristics

Hepatitis A is an acute but generally benign form of viral hepatitis that causes inflammation of the liver. It can be transmitted person-to-person by fecal-oral transmission or through contaminated food and water. Most individuals infected with the disease recover fully; however, the disease can be fatal to those with compromised immune systems or pre-existing liver problems.

Hepatitis A is a liver disease caused by an RNA virus. The clinical characteristic of the disease varies with the age of the infected individual. Infected children rarely show signs and symptoms of infection, while nearly 70 percent of infected adults show signs and symptoms of infection (Arguedas and Fallon, 2004). The incubation period of hepatitis A ranges from 15 to 50 days with an average of 30 days (Bell, 2004).

Symptomatic hepatitis A is usually characterized by low-grade fever, malaise, anorexia, nausea, vomiting, abdominal pain, jaundice, coluria (dark urine), and acholia (light colored stools). Symptoms usually last two to four weeks. Most infected individuals fully recover without any long-term complications (Kemmer, 2000; Ryder 2001). Hepatitis is diagnosed through a blood test to detect anti-hepatitis A immunoglobulin (Ig) M antibodies, which are present in over 95 percent of all hepatitis A cases (Fiore, 2004).

Transmission

Hepatitis A is typically transmitted through the fecal-oral route, through either close personal contact or food or water contaminated by an infected individual that is ingested by a non-infected individual (Arguedas and Fallon, 2004). The period of communicability is approximately three weeks in length, from two weeks before the onset of jaundice to one week after the onset of jaundice. Hepatitis in organic material is stable in the environment for weeks (Bell, 2003).

HEPATITIS A IN THE UNITED STATES

The 2003 hepatitis A outbreak in Western Pennsylvania was the largest single-source outbreak in U.S. history (Lanard and Sandman, 2003). The outbreak lasted approximately two months and eventually included 660 confirmed primary cases, three of whom died. It originated in a restaurant in Beaver County, in Southwestern Pennsylvania, and was caused by contaminated green onions imported from Mexico used primarily in salsa dip that was consumed by the restaurant’s customers (Dato et al., 2003).

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