Strengthening The Nation's Public Health Infrastructure: Historic Challenge, Unprecedented Opportunity

It takes a system that is competent to handle routine public health situations to handle the emergencies.

by Edward L. Baker Jr. and Jeffrey P. Koplan

ABSTRACT: The nation's attention has been focused on the vital need for a strong public health infrastructure to protect community health. In this paper we provide an overview of progress during the past decade and point to immediate challenges and opportunities that resulted from recent events. Further, we highlight the need for continued vigilance and broad partnership development if we are to maintain public support for public health. Finally, we point to the need for better language, compelling case reports, and quantitative capacity assessment to guide policymakers and program leaders and to ensure long-term support.

NEVER BEFORE HAS THE UNITED STATES focused such attention on the critical importance of strengthening our nation's public health infrastructure. As a result of the events of September 11 and the anthrax attacks, the public now has a heightened awareness of what the field of public health does and, beyond this awareness, values the services that public health provides, particularly those that protect community health from threats such as bioterrorism. By building the core capacity to deliver the essential public health services, we can use this unprecedented opportunity to strengthen public health.

We must also demonstrate that bioterrorism preparedness is but one piece of the big picture of public health. For example, the public understands the value of vaccines and the need for a strong, systematic approach to vaccine delivery. But the average citizen is challenged to provide compelling and clear examples of what public health does and its value.[1] The enhanced awareness of the importance of a strong public health infrastructure is associated with a concern that we are not adequately prepared to respond to future terrorist threats.

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In a recent Research!America survey, 45 percent of those surveyed said that the nation is either slightly or not at all prepared to respond to a terrorist event.[2] Another 45 percent believe that we are somewhat prepared; and only 10 percent believe that we are well prepared. These findings are consistent with data from a recent survey of local public health jurisdictions conducted by the Centers for Disease Control and Prevention (CDC) in collaboration with the U.S. Department of Justice, which demonstrated that only 25 percent of 1,898 local public health jurisdictions reported being able to deliver 60 percent or more of the essential public health services needed to protect community health in a terrorist event.[3]

Following the events of September 11 and the anthrax attacks, public health professionals have been examining what went well during those challenging times and which areas need improvement. As a result, local, state, and federal agencies are identifying infrastructure weaknesses and developing plans for action. The public will expect these plans to be implemented. This expectation will be heightened by the availability of substantial increases in federal funding to strengthen the public health infrastructure. As a result of the confluence of these forces, an opportunity exists to strengthen our nation's public health infrastructure and leave a legacy for generations to come. In this paper we discuss the concept of and review research on the public health infrastructure. We describe recent efforts to enhance infrastructure and indicate ways in which these efforts were put to use after September 11. We then identify near-term opportunities and challenges and, finally, provide a long-term vision for the future.

The Concept Of Public Health Infrastructure

■ **Definitions.** In a cogent discussion of the concept, Bernard Turnock points out that the public health infrastructure can be described by what it is and what it does.[4] He defines it as the nerve center of the public health system, representing the capacity necessary to carry out public health's core functions. In describing what it does, he refers to the landmark 1988 Institute of Medicine (IOM) study, *The Future of Public Health*, which defines the core functions of public health as assessment of population health, policy development, and assurance that high-quality public health services are available.[5] While these terms may be understandable to public health professionals, they fail to communicate well to the public and may even distance the world of public health practitioners from the public they serve.

To address this gap, these core functions were elaborated upon through the development of the *Public Health in America* statement, which includes a set of ten essential public health services: (1) Monitor health status to identify and solve community health problems; (2) diagnose and investigate health problems and hazards in the community; (3) inform, educate, and empower people about health issues; (4) mobilize community partnerships and action to solve health problems; (5) develop policies and plans that support individual and community health efforts; (6) enforce laws and regulations that protect health and ensure safety; (7)

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link people to needed personal health services and ensure the provision of health care when otherwise unavailable; (8) ensure a competent workforce—public health and personal care; (9) evaluate effectiveness, accessibility, and quality of personal and population-based health services; and (10) research for new insights and innovative solutions to health problems.[6]

Others have discussed the public health infrastructure in a similar way. In a 2001 report to the U.S. Senate, the CDC delineated the three major components of infrastructure as workforce capacity and competency, information and data systems, and organizational capacity.[7] Turnock adds a fourth component—financial resources—in describing these essential elements.[8] And in the *Healthy People 2010* objectives for the nation, a special chapter on infrastructure lists specific objectives under the headings of data and information systems, skilled workforce, effective public health organizations, resources, and prevention research.[9]

■ **Public health system.** In a related vein, the concept of the public health system deserves attention. As discussed in greater detail elsewhere, this system consists of the broad range of organizations and partnerships needed to carry out the essential public health services, such as hospitals, voluntary health organizations, other nongovernmental organizations, and the business community.[10] A final approach links the term *public health infrastructure* to the local health agency.[11] Explaining infrastructure in this way acknowledges that the local public health agency represents the foundation of the public health enterprise, delivering services to protect community health.

Evaluation Of The Public Health Infrastructure

Following the development of these concepts, researchers set out to evaluate the public health infrastructure using specific indicators to assess the performance of essential public health services by local or state health systems.[12] Using this approach, a recent study shows that the nation's largest health departments deliver only 64 percent of the activities related to the essential public health services.[13]

■ **Workforce evaluation.** Since the public health workforce represents an essential element of the public health infrastructure, evaluation of workforce composition and competency is vitally important.[14] Public health workforce evaluation to date has been limited by methodological challenges.[15] These challenges include the definition of *public health worker,* the availability of data sources that provide a consistent categorization of the workforce, and support for researchers to conduct a systematic, nationwide (or statewide) assessment of the workforce. Much progress has been made in recent years in developing methods and in conducting direct assessments of workforce composition and competency.[16] In 1989 the Health Resources

and Services Administration (HRSA) established that only 44 percent of the 500,000 public health workers had received formal academic training in public health.[17] A study of public health administrators revealed that 78 percent lacked formal public health training.[18] Virginia Kennedy's study of Texas public health workers provides an excellent framework for considering workforce composition and a useful description of the areas of workforce expertise.[19] At the core of this workforce framework are official public health agencies; they are surrounded by a variety of other workforce settings, including private nonprofit associations, educational institutions, the personal health services industry, private industry, community-based organizations, and other public-sector settings. Also, Kristine Gebbie has extensively studied both composition and competency of the workforce as a whole and has recently developed a set of core competencies needed to address the threat of bioterrorism, such as understanding the incident command system and demonstrating readiness to apply professional skills to emergency situations.[20]

■ **Health information systems.** Information and communications systems are vital to effective public health practice as tools to share information across jurisdictions, provide access to practice guidelines and protocols, support distance learning, facilitate disease surveillance, and alert practitioners to public health threats and emergencies. Unfortunately, the state of the public health information infrastructure has been shown to be weak. A 1992 survey of local health departments found that only 45 percent had the capacity to send fax alerts to their community.[21] Also in 1997, a test of e-mail effectiveness revealed that only 35 percent of local agencies successfully received a test message.[22] More recently, a CDC study showed that as of October 2001, only 68.3 percent of county health agencies had Internet connectivity.[23]

In the aggregate, these and other research findings indicate major weaknesses in the nation's public health infrastructure. Much of the work done to date has consisted of evaluation surveys designed to improve programs, and these have proved useful. As we move into the future, a more rigorous approach to public health systems research using validated methodologies and employing a prospective study design will be needed to provide the science basis for improving the system. In certain respects, the need for public health systems and services research parallels the need, noted decades ago, that led to the creation of the field of health services research focusing on clinical health care effectiveness.[24]

Infrastructure Improvement Initiatives

For more than a decade, initiatives to improve national and regional infrastructures have been organized to address needs identified in research or in national policy reports. In this regard, the CDC has played a national leadership role, in partnership with national organizations, by identifying public health infrastructure development as a national priority, by supporting programs and activities needed to improve certain aspects of infrastructure as noted below, and by supporting research and research-methods development on the public health system.

■ **Workforce development initiatives.** *Public Health Leadership Institutes.* The IOM report of 1988 contained a specific recommendation that the development of public health leaders is too important to be left to chance.[25] In response to this need, the Public Health Leadership Institute, a national program designed to provide a developmental experience for a select cadre of top-level public health professionals, was launched. Since 1992 this yearlong learning experience has benefited more than 600 professionals from the United States and abroad. In addition, the institute experience has spawned thirteen regional leadership institutes that serve more than forty states, reaching an additional 500 public health professionals annually.

Public Health Training Network. To address the public health workforce's need for access to high-quality, practice-relevant training, the CDC led the development of a national distance-learning system, the Public Health Training Network (PHTN) in 1993.[26] Over subsequent years the network has grown to become the nation's primary health distance-learning resource, providing training to millions of public health workers.

Following the terrorist attacks of September 11, the PHTN initiated a series of nationwide teleconferences entitled "CDC Responds," which reached more than 1.4 million public health and medical professionals with up-to-date information on a range of threats, including anthrax and smallpox. These broadcasts provided an unprecedented opportunity to disseminate and discuss new diagnostic criteria for pulmonary anthrax and to provide newly developed anthrax treatment guidelines within days of their development. At no time in the past has the CDC, working with its partners, been able to mobilize such a massive and timely communications effort, in the midst of responding to a major public health crisis.

The PHTN infrastructure has supported an innovative series of sessions in partnership with the University of North Carolina at Chapel Hill entitled Public Health Grand Rounds. The topics include obesity, immunization, breast cancer, public health performance standards, genetics and public health, and HIV prevention. Finally, the PHTN has embarked upon initiatives to link distance-learning systems in the United States with those in China and in Eastern Europe, ultimately leading to a global public health distance-learning system.

National Laboratory Training Network. In 1988 the CDC, in partnership with the Association of Public Health Laboratories (APHL), created the National Laboratory Training Network (NLTN). Since then the NLTN has trained thousands of laboratorians, providing access to critical training information needed to increase their competency and improve their knowledge.[27] The NLTN was particularly valuable in providing training to more than 6,000 laboratorians, following the anthrax attacks, on laboratory analysis and management needed to support the nation's bioterrorism response. The network serves as a vital laboratory training infrastructure to ensure high-quality public health laboratory services throughout the nation. In fact, the laboratorian who diagnosed anthrax in Florida had received training in anthrax diagnostic techniques through the NLTN.

Centers for Public Health Preparedness. In the 1988 IOM report, the study committee described a serious disjunction between academic public health and public health agencies.[28] As a result, limited training and educational opportunities have been provided by academic institutions, which have had direct practical value for public health practitioners. In 1999 a national network of Centers for Public Health Preparedness (CPHPs) was created through schools of public health around the nation.[29] Since then the network has expanded to include fifteen institutions in academic centers and specialty centers throughout the country. These CPHPs are linked to three local health agency exemplar sites to facilitate transfer of information and development of model practices. The centers were called upon following the events of fall 2001 to provide training to front-line public health workers and to develop a range of education and training resources needed to increase the preparedness of the public health workforce.

■ **Information and communication systems initiatives.** *Information Network for Public Health Officials.* In 1992 the Information Network for Public Health Officials (INPHO) initiative was begun to encourage innovative uses of infrastructure technology, to connect public health officials electronically, to provide online information access, and to facilitate data exchange.[30] The INPHO initiative demonstrated the usefulness of information systems—specifically, electronic mail, Web sites, and the electronic exchange of data—for public health practice.

EpiX. In 1998 the CDC led the creation of a Web-based system for the exchange of information by epidemiologists, EpiX. This system has grown to reach more than 800 public health professionals, providing updates on outbreaks of infectious disease and other public health threats and emergencies. During the fall of 2001 EpiX was used extensively as a tool to assist communication among public health professionals on the anthrax attacks.

National Electronic Disease Surveillance System. Public health surveillance is a cornerstone of the practice of public health.[31] Unfortunately, for decades the nation's system of public health surveillance programs has developed in a fragmented and poorly coordinated way. In response to the need for a modern and uniform approach, the CDC launched the National Electronic Disease Surveillance System initiative to improve the quality, timeliness, and security of surveillance information.[32] This landmark initiative has developed standards, achieved cohesion in the public health community around a shared vision, and implemented demonstration projects that will lead to the creation of a national system. As the initiative proceeds, it will reshape the way public health is practiced by providing practitioners with unprecedented access to high-quality and timely surveillance data.

■ **Organizational capacity development initiatives.** *Health Alert Network initiative.* In response to a U.S. Senate request and to national needs, the CDC developed a vision for a national network of strong local public health agencies serving as an early-warning system to protect communities from health threats and emergencies: the Health Alert Network initiative. The initiative is designed to address critical

gaps and needs at the local level and has four major focus areas: (1) improving information, communications, and training infrastructures in local and state health agencies through enhanced Internet connectivity, improved capability to broadcast information to communities, and expanded distance-learning capacity; (2) linking community partners—in particular, hospitals and first responders—to governmental public health agencies; (3) developing knowledge management systems serving front-line public health workers through increased availability of information resources, development of information tools, and online training and education; and (4) supporting exemplar sites for advanced public health practice, which are committed to innovation, partnering with peer communities, and developing best practices.

To date, the Health Alert Network initiative has focused primarily on strengthening the nation's public health information infrastructure and on developing exemplar sites in local communities. For example, investments in the Health Alert Network information infrastructure enhanced New York State's ability to respond to the West Nile virus outbreaks in 1999. Investments made one year before the outbreak allowed the New York team to develop five new secure statewide disease surveillance systems, a secure electronic collection system, and a secure system for rapid information in just two and a half months. Without the staff, tools, and secure electronic connectivity, these activities would have taken years. Following September 11, the alert function of the network was used to provide health alerts to as many as one million health professionals, to facilitate distribution of information through state-based Health Alert Networks, and to channel communications back to the CDC on urgent public health concerns.[33] Before the initiative appeared in 1998, only 21 percent of local health agencies had high-speed, continuous Internet access; by the end of 2002 more than 90 percent of the U.S. population will be served by local health agencies with high-speed, continuous Internet connectivity. Clearly, much progress has been made.

National Public Health Performance Standards. In contrast to other private and public organizations, public health agencies have not used performance standards to assess performance and performance improvement over time. In response to this need, the National Public Health Performance Standards Program (NPHPSP) was initiated in 1997.[34] Through a series of on-site research projects and extensive dialogue with public health professionals around the country, performance standards have been developed for state and local public health systems and governance of public health at the local level. These performance-standards instruments had been used in fifteen states and have recently been adapted for use in thirty-five other countries through collaboration with the Pan American Health Organization (PAHO). For example, in Mississippi the use of public health performance standards highlighted the variable level of public health services across the state. As a result of this work, public health agencies now have a comprehensive yardstick to measure performance and to engage local partners to improve understanding of the public health enterprise.

Turning Point. In 1996 the Robert Wood Johnson and W.K. Kellogg Foundations collaborated to create the Turning Point initiative to enhance the public health infrastructure through strengthening partnerships between local and state public health professionals.[35] This national program has increased capacity through the development of strategic partnerships and the creation of public health improvement plans in states and localities. The initiative has also focused attention on major national priorities, including information systems development, performance standards, leadership development, and media advocacy.

Public Health Law Program. Most public health laws were passed many decades ago; since then our society's concept of individual rights in relationship to legal concepts and regulations has changed, so that public health laws must be adapted to current social realities and perspectives. To improve the legal foundation for public health practice and particularly to examine the need for updating of public health statutes, the Public Health Law Program was created in 2000.[36] As part of the program's initial effort, a model Emergency Health Powers Act was developed, which has been used in thirty states across the nation by state attorneys general and public health professionals to address the need for comprehensive legislation to protect the health of the public in the face of terrorist threats and other emergencies. Lawrence Gostin addresses this model legislation in greater detail elsewhere in this volume.[37]

Public Health Threats and Emergencies Act of 2000. In 2000 Congress passed and President Bill Clinton signed into law landmark legislation, the Frist-Kennedy Public Health Threats and Emergencies Act of 2000.[38] Recognizing the need for improved focus on strengthening the nation's public health infrastructure, the act created a focus on identification and improvement of specific capacities needed to ensure a strong infrastructure. It authorized a new approach to government funding for which Congress subsequently appropriated funding in fiscal year 2001. The act requires development of periodic reporting on the state of the public health infrastructure to Congress by the Department of Health and Human Services (HHS). The legislation was amended in 2002; provisions for a formula grant were added, and the authorized funding level was increased.

Near-Term Opportunities And Challenges

As mentioned at the outset, recent events have focused extraordinary public attention on the importance of a stronger public health infrastructure. To address this urgent need, the CDC and HRSA are providing more than $1 billion in FY 2002 to state and local public health agencies to increase capacity and improve preparedness.[39] In its announcement of the availability of funds, the CDC targeted six specific aspects of public health infrastructure needing improvement: preparedness planning and readiness assessment; surveillance and epidemiology capacity; laboratory capacity; Health Alert Network/information and communications systems; communicating health risks and disseminating health information;

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and education and training.

Further, the CDC specified certain critical capacities to be developed, along with priority benchmarks needing immediate attention, yielding a framework of accountability for the assessment of this major initiative's impact. This new program is unique not just in the amount of funding being made available (the largest in the CDC's history) but also with respect to its structure.[40] It represents the first grant program to use a broad-based capacity-building approach to enhancing the public health infrastructure. Also, through regular assessment of the capacity of state and local health systems, infrastructure improvement will be monitored.

To facilitate this assessment, the CDC is developing a capacity inventory for use at the local and state levels. Further, technical assistance will be made available to improve the efficiency and effectiveness of capacity-building activities throughout the country. Training will be an essential element of the initiative to ensure that the competencies of the public health workforce are improved. This major national initiative will address deficiencies identified and inadequately remedied for many decades.

Long-Term Perspectives

As revenues grow short and memories of 2001 more distant, the needs and requests for education, highways, prisons, basic research, and indigent care (all of which are important) may push long-term support for repairing long-neglected public health needs off the priority list. The dual-purpose nature of our public health system needs to be emphasized—that is, the elements that will prevent and control West Nile virus infections are largely the same ones that will deal with an influenza epidemic, a food-borne disease outbreak, or a bioterrorist attack.

■ **Need for a new language.** To increase the public's understanding of the public health enterprise, we need a new language, drawing on the verbs and nouns that arose in the fall of 2001 to shape a clear and compelling message of what public health is and what it does. This need is more urgent now than before: We have gained the attention of the public, but this attention is narrowly focused and potentially fleeting. For example, as we discuss "infrastructure," let us talk about the county and state health departments that investigated the first and subsequent cases of anthrax. As we discuss "case detection and confirmation," let us describe how an alert and well-trained physician can observe what seems to be a commonplace clinical presentation and include a rare cause in his or her differential diagnosis and then report it promptly to the right people to determine whether the rare cause is the real one. In talking about "connectivity," we can describe how the information on anthrax presentation that differs from the textbook definition learned in

south Florida can be shared with other affected areas and indeed every jurisdiction that is a potential target nationwide. As we talk about the value of training, let us describe the laboratorian in the Florida Health Department who was trained in state-of-the-art anthrax diagnostic techniques by the National Laboratory Training Network and given the reagents for testing and thus was able to make an accurate diagnosis without delay. As we describe "workforce needs," let us describe what the epidemiologists, lab workers, public affairs staff, and environmental specialists did twenty-four hours a day for many weeks in investigating, containing, and cleaning up after the terrorist attacks. Then, when this new language is used, the brief puzzled expression that usually accompanies references to the "public health infrastructure" will be replaced by a nodding recognition of the public health response to biologic threat explained in clear and colorful recent examples.

■ **Greater accountability.** Over the coming decade, public pressure for accountability will require that public health enter into an era of greater documentation of its competency. Programs to formally credential and certify the competencies of public health workers, although controversial, will continue to receive attention, and programs to formally assess and document the capacity and performance of governmental public health agencies will proliferate. Corporate executives are now being asked to sign off on the financial audits of their business performance. Should not public health leaders make it clear that they will not sign off on the public health preparedness of their area of responsibility without the resources and programs in place to justify such confidence?

■ **Case reports and studies.** Sustained interest in and support for public health infrastructure during the coming decades will require, in our view, a combination of meaningful case reports and quantitative studies that address tangible needs in communities across the nation. We encourage public health professionals to document case reports of ways in which investments in public health infrastructure, particularly through funding directed at terrorism preparedness, have improved local responses to high-visibility public health emergencies, perhaps through a public health version of the "after action report" used by the military. Such documentation should demonstrate, if possible, benefits in terms of illness prevented and resources saved. In addition, concerted, science-based efforts should take place to assess the capacity and performance of local and state public health agencies, using tools such as the National Public Health Performance Standards Program. Further, national disease outbreaks will test agency capacity; methods must be developed to document the response capability and real-world performance of the public health system in the face of these emergencies.

Through such documentation, objective evidence and quantitative assessment can be developed to provide policymakers and public health leaders with a comprehensive, evidence-based assessment of the infrastructure. Such an assessment can be used to monitor system improvements in relationship to investigations and to identify gaps and needs. Combining case examples and quantitative system as-

sessments makes long-term accountability for investments in infrastructure more likely to occur. National organizations such as the Association of State and Territorial Health Officials (ASTHO) and the National Association of City and County Health Officials (NACCHO), in partnership with the CDC and others, could play a central role in developing these types of information for use by policymakers. Policymakers should encourage this development and see that policies exist to ensure periodic assessment of public health system capacity and performance.

■ **Expanded partnerships and improved systems.** Increasingly diverse populations will require increasingly sensitive and culturally relevant approaches to disease control and health promotion. As the scope of the public health enterprise increases, new partnerships must be forged to increase collaboration in communities and at the national and state levels. Practitioners will be called upon to engage with community partners through structured dialogue designed to reveal the fundamental values and needs of the community. By grounding programs in these values and needs, public health can ensure itself continued support and relevance. Further, the tools practitioners need to accomplish their goals will change; increasing reliance upon electronic data and information systems will require practitioners to become more facile in the use of technology. Knowledge management systems will be created to guide practitioners in daily decision making. Also, improved and increased communications within the public health system, both vertical (local, state, and federal) and horizontal (across state and local jurisdictions) will improve.

■ **Broader range of responsibility.** As opposed to the health departments of the early twentieth century, and even some today whose programs are exclusively focused on infectious diseases and maternal and child health, effective public health agencies of the twenty-first century must have a broader range of responsibilities, including chronic disease prevention, health promotion, environmental and occupational health, injury prevention, mental health, substance abuse prevention, and other population-based services. Development of these programs will present major challenges for health agencies.

■ **Consolidation.** We anticipate that consolidation will occur through regionalization of public health jurisdictions, so that the number of local public health jurisdictions could diminish from approximately 3,000 to an estimated 500–1,000 entities. As a result, each of these entities will provide the full range of essential public health services to its community through direct service delivery and through partnerships with others.[41] At the state level, we anticipate that further refinement of the role of state public health agencies through the use of public health performance standards and the capacity inventory mentioned above will focus attention of state agencies on the essential public health services.

Clearly, local and state public health agencies will continue to play a role in either ensuring or delivering personal health care services to those in need and will remain safety-net providers for those who require health services or access to a more limited set of clinical services. Increasingly, these governmental agencies

will form partnerships with organized systems of health care to ensure that personal health care services and population-based prevention are available to those served by both entities. As a result of the changes in the health care system, public health delivery systems will be reshaped and will take on different roles and responsibilities while ceasing to perform others. In some jurisdictions, the privatization of public health services will continue in ways that seek to improve efficiency of service delivery through private providers using contractual arrangements.

THESE IMPROVEMENTS TOWARD A RATIONAL, coordinated, comprehensive, and better-financed public health system will occur only if we expand the advocates of public health beyond the pool of those who practice it. We need to retain the elected officials, news media, health care workers, public security leadership, and other concerned community leaders who since 9/11 better understand the nature and value of public health. We need to do this through use of clear dramatic examples of the regular threats before us and the price each of us will pay professionally and personally if we ignore recent harbingers of future public health challenges.

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40. E. Salinsky, *Public Health Emergency Preparedness: Fundamentals of the System* (Washington: George Washington University National Health Policy Forum, April 2002).
41. G.P. Mays, C.A. Miller, and P.K. Halverson, *Local Public Health Practice: Trends and Models* (Washington: American Public Health Association, March 2000).