

A Review of Instruments Assessing Public Health Preparedness

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SYNOPSIS

Objectives. The purpose of this study was to review instruments that assess the level of preparedness of state and local public health departments to respond to health threats such as bioterrorism.

Methods. The authors examined 27 published population-based instruments for planning or evaluating preparedness that were mostly unavailable in the peer-reviewed literature. Using the Essential Public Health Services framework, the instruments were evaluated for (1) clarity of measurement parameters, (2) balance between structural and process measures, (3) evidence of effectiveness, and (4) specification of an accountable entity.

Results. There was a great deal of overlap but little consistency in what constitutes “preparedness” or how it should be measured. Most instruments relied excessively on subjective or structural measures, lacked scientific evidence for measures assessed, and failed to clearly define what entity was accountable for accomplishing the task or function.

Conclusion. Strategies for improvement include measure standardization, better interagency communication, and investment in public health practice research to develop the underlying evidence base required for developing quality measures and assessments.

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Public Health has been recognized increasingly in recent years because of the visible role that it has played in responding to the worldwide HIV/AIDS epidemic, nationwide West Nile Virus outbreaks, and emerging infectious diseases, including Severe Acute Respiratory Syndrome (SARS). Concerns regarding these and other emerging/re-emerging diseases, coupled with the new risk of bioterrorism, have led to modest investment increases for the nation's public health infrastructure after decades of neglect. The federal government, for instance, has provided the states with over \$2 billion in fiscal years 2003 and 2004 to improve "public health preparedness."^{1,2} Coming at a time when states are strapped for resources and following decades of underinvestment in infrastructure for population-based public health, this new funding creates tensions among three important missions of public health agencies: fighting communicable diseases (including bioterrorism and emerging infections); population-based approaches to promoting health and preventing disease, including chronic diseases and injuries; and in some locations providing medical services/personal health services for those who cannot pay for care.³

Bioterrorism and emerging infections require a "population health" perspective, as do many of the health problems facing the United States in the 21st century. This means taking a more macro approach by focusing on the health of communities, rather than individuals. To be effective, population-based health management requires measures of health outcomes and evidence that links public health practices to these outcomes.⁴ Yet, because so many diverse social and economic as well as biological factors and entities can influence health, a community's health is increasingly recognized as a responsibility shared between governmental public health agencies and an array of public and private entities working in partnership.^{5,6} Local public health agencies are charged with managing this complex shared community responsibility in an era that increasingly demands accountability of both the public and private sectors.^{7,8,9} The recent investment in public health preparedness highlights the need to measure preparedness and to demonstrate what has been accomplished with this new federal investment.¹⁰

Personal health care service providers have increasingly embraced performance, or more specifically, quality measurement as a means to improve service delivery. Governmental agencies, private quasi-regulatory bodies and professional associations have all promulgated measures. Examples include the Center for Medicare and Medicaid Services (CMS),¹¹ the Joint Commission on Accreditation of Healthcare Organizations (JCAHO),¹² the National Committee for Quality Assurance (NCQA),¹³ the Veteran's Administration (VA),¹⁴ and physician professional groups¹⁵ that have developed a variety of measures for hospitals, individual providers, health plans, and managed care organizations.¹⁶ These measures tap into the relatively large body of scientific literature on effective medical practice. Though public health quality measurement has a long history,¹⁷ it is less well developed and not as widely used in health care settings,^{7,18} and has just begun in earnest in the area of preparedness for public health emergencies.

Developing measures for public health preparedness—the readiness of agencies to respond to emergent acute

threats to the public health—presents at least three challenges. First, in contrast to many personal health care services, the evidence base is frequently insufficient to determine either the specific capacity or process measures that are linked to desirable outcomes or the levels of those measures that would be regarded as adequate. Consider, for instance, public health surveillance. Notifiable disease reporting obviously should be as complete and timely as possible, but what level of completeness and timeliness is necessary? How are completeness and timeliness even measured? No studies tell policy makers the answers to these questions. Second, process and outcomes cannot be readily assessed by direct observation as in other areas, because bioterrorist attacks, nuclear blasts, and emerging disease outbreaks are, thankfully, not common. Lastly, the distribution of accountability is diffused by the shared responsibility of the various public and private entities involved.

Despite these challenges, governmental agencies, private quasi-regulatory bodies, and professional associations have begun to develop measures for population-based public health preparedness that parallel those in the personal health care services arena. Many of the documents reflecting these efforts are not available in the peer-reviewed literature, yet they are being used to assist the networks of public and private providers in preparing for their shared responsibilities in defending against emerging threats to the public's health. As a prelude to examining California's local public health infrastructure from a preparedness perspective, we reviewed existing population-based instruments for planning, assessing, or evaluating the preparedness of public health agencies and the communities they serve. We assessed the measures based on their scope as defined by the widely accepted Ten Essential Public Health Services. We also assessed the level of evidence supporting their use, and how accountability is distributed. The issues identified in this review should guide both public health agencies struggling to improve their preparedness in our uncertain age as well as future instrument construction.

METHODS

Overview

We identified 27 evaluation instruments through a literature search of the Medline database maintained by the National Library of Medicine and by canvassing experts. Project staff classified components of the evaluation instruments by essential public health services to determine the degree of overlap and to identify gaps. We then assessed each evaluation instrument for strengths and weaknesses.

Terminology

The medical and public health literature's use of terms related to quality measurement varies markedly, and was similarly varied within the instruments we reviewed. For the sake of consistency, we have used terms modified from a widely accepted framework.¹⁹ We have chosen to use the term *measure* inclusively as a statement about the existence or performance of a public health capacity, service, or function that is deemed to contribute to public health preparedness. Similarly, an *instrument* is a published collection of measures.

Measures can sometimes be distinguished by whether there is evidence that the presence of the capacity or successful performance of the service or function leads to the desired health outcome, but given the state of the literature, we have not required such evidence for the measure to be included in our analysis. Measures are sometimes accompanied by *benchmarks* regarding the desired level of capacity or performance of the service or function, but the lack of available evidence precluded the ability to require such benchmarks for a measure to be included in our inventory.

Identification of evaluation instruments

We performed Medline literature searches for peer-reviewed articles published in the past 10 years using the terms *public health, preparedness, bioterrorism, performance measures, quality indicators, assessment, validation, effectiveness, function, evidence-based, measurement, science-based, improvement, criterion validity, strategies, and instruments*. We identified further studies from references in those initially identified. In addition, we canvassed nationally known experts in public health preparedness to identify evaluation instruments that might not be found in the peer-reviewed literature. One reviewer (MM) evaluated each article to determine if it contained an evaluation instrument.

To be included, evaluation instruments had to: (1) address multiple aspects of preparedness for public health emergencies, and (2) contain recommended measures or plans for assessing capacity or process in responding to such emergencies. Only two of the 27 identified evaluation instruments are available in the peer-reviewed literature, and these were generic instruments with a primary focus other than preparedness.

Classification of evaluation instruments

Two independent reviewers (MM, SA) classified each identified evaluation instrument by whether preparedness was the primary or secondary focus, the type of issuing agency, and the targeted entity to be measured (e.g., local health department). These reviewers then abstracted the measures contained in the evaluation instruments and assigned each measure into one of ten essential public health services (EPHS), drawn from the Public Health Functions Working Group Steering Committee (see Figure 1).²⁰

Within each EPHS, reviewers empirically identified subdomains relevant to public health preparedness. For example, within EPHS 1 (Monitor health), reviewers identified disease reporting, syndromic surveillance, capacity to receive/analyze data, and facility hazard evaluation as subdomains. Differences in classification were resolved by mutual discussion. The purpose of this classification was to allow documentation of measurement domains and comparisons of the scope of the instruments. We had no a priori hypothesis that all 10 EPHS or particular subdomains should be addressed by an ideal instrument.

Assessment of evaluation instruments

All of the authors participated in a qualitative critique of the identified evaluation instruments. We used the classification system outlined above to describe areas of overlap and differences between evaluation instruments. We used a previ-

Figure 1. Essential Public Health Services

- 1 Monitor health status to identify and solve community health needs (Monitor health)
- 2 Diagnose and investigate health problems and health hazards in the community (Diagnose problems)
- 3 Inform, educate, and empower people about health issues (Educate people)
- 4 Mobilize community partnerships and action to solve health problems (Mobilize communities)
- 5 Develop policies and plans that support individual and community health efforts (Develop policies)
- 6 Enforce laws and regulations that protect health and assure safety (Enforce laws)
- 7 Link people to needed personal health services and assure provision of health care when otherwise unavailable (Assure services)
- 8 Assure a competent workforce—public health and personal health care (Assure workforce)
- 9 Evaluate effectiveness, accessibility, and quality of personal and population-based health services (Evaluate services)
- 10 Research for new insights and innovative solutions to health problems (Research solutions)

ously published framework for evaluating quality measurement systems in public health^{8,21} in developing a priori criteria for assessing evaluation instruments. The four criteria and their definitions were:

- *Clarity of measurement parameters and normative standards*, which we defined as the extent to which the methods for measurement of the indicators, actions, or structures were explicitly stated in the instrument.
- *Balance between structural and process measures*, defined as the extent to which the instruments spanned these two categories of indicators.
- *Evidence for effectiveness*, defined as the extent to which the observational or experimental evidence was clearly provided for the indicated actions or capacities.
- *Specification of an accountable entity*, defined as the extent to which the instruments identified a portion of the evaluated institution as responsible for completion of each component indicator.

Project staff conducted a series of conference calls to evaluate instruments against these criteria. A panel of national public health experts reviewed our conclusions for face validity.

RESULTS

Classification

Fourteen of the evaluation instruments focused on preparedness specific to public health emergencies, while the remaining 13 addressed preparedness more generally. Several of the documents were conceived as preparation guides as

much as preparedness evaluations, but nonetheless contained evaluative measures. Fourteen of the evaluation instruments were issued before September 2001, and the remaining 13 were issued after. Of the 27 identified evaluation instruments, four were issued by state governments,^{22–25} ten by federal agencies,^{26–35} one by a private certifying organization,³⁶ four by professional associations,^{37–40} and six by umbrella groups covering more than one of these categories.^{41–46} Three of the federal evaluation instruments issued by the Centers for Disease Control and Prevention (CDC)^{32,33,35} were different versions of the same parent evaluation instrument prepared for different entities—local and state public health systems. Local and state public health systems were the targets of most of the evaluation instruments, although four primarily targeted national efforts^{26,27,29,47} and four targeted health care facilities.^{24,31,36,37}

Figure 2 depicts how each evaluation instrument defined preparedness in terms of the EPHS domain and subdomains. In all, abstractors identified 48 subdomains within the 10 EPHSs. All EPHS domains were addressed by at least one evaluation instrument. Most evaluation instruments addressed most EPHSs. EPHS 10 (Research solutions) was an exception; only nine evaluation instruments had provisions for guiding research into public health preparedness. Several evaluation instruments^{37,42,44,48,49} did not propose measures in EPHS 9 (Evaluate services) and two did not propose measures in EPHS 2 (Diagnose problems).^{36,50} The most focused evaluation instrument we reviewed was the Epidemiologic Capacity Assessment Guide issued in 1998,⁴² which concentrated on five of the 10 EPHSs and addressed 13 of the subdomains. The most comprehensive evaluation instrument was the Public Health Preparedness and Response Capacity Inventory for localities issued in 2002 by the CDC, which addressed 46 of 48 subdomains.³²

Most of the measures in EPHS 1 (Monitor health) revolved around evaluation of the effectiveness of disease reporting and the capacity to receive and analyze such reports. Syndromic surveillance also received quite a bit of emphasis, though many of the measures here were rudimentary, often asking only if a syndromic surveillance system existed without specifying any of its attributes. Many measures in EPHS 2 (Diagnose problems) addressed epidemiologic manpower and laboratory capacity. For example, one evaluation instrument specified that each Metropolitan Statistical Area with a population of greater than 500,000 have at least one epidemiologist (CDC). In EPHS 3 (Educate people), many of the measures were similarly structural and concentrated on communication functions, asking if local health systems or hospitals had a designated public information officer and protocols for communication of risk in case of public health threats.

Virtually all of the evaluation instruments underlined the importance of mobilizing partnerships (EPHS 4). Common measures in this area asked if formal protocols were in place to engage other key governmental agencies (e.g., law enforcement) through secure communication systems, or to engage community organizations to provide volunteers in case of emergencies. EPHS 5 (Develop policies) measures often asked if a senior official had been designated to develop and administer emergency response plans and whether

organizations had participated in planning exercises with other involved organizations. Measures of capacity to enforce relevant laws (EPHS 6) commonly addressed timelines for staff review of statutes authorizing emergency public health actions and access to legal counsel.

The most frequent concern represented in EPHS 7 (Assure services) was that of surge capacity. Plans to receive and manage items from the Strategic National Stockpile, to administer mass vaccinations, and to mobilize hospital and mental health workers received attention. Workforce measures (EPHS 8) sometimes overlapped with surge capacity assessments, but also evaluated training programs in emergency response. There were far fewer measures in EPHS 9 (Evaluate services) and EPHS 10 (Research solutions). These tended to ask about internal evaluation activities for other EPHS functions such as emergency planning, workforce competency, and partnership building.

EVALUATION OF POTENTIAL DEFICIENCIES IN PREPAREDNESS MEASURES

Clarity of measurement parameters and normative standards

One of the characteristics of good measures is that they encode clear standards, with the required data elements explicitly detailed.⁹ Many of the measures in the identified evaluation instruments were somewhat subjective, in the form of checklists. For example, they would ask evaluators to determine if an adequate plan for administering mass vaccinations existed without specifying what constitutes an adequate plan or what specific vaccines should be covered. Similarly, measures of timely reporting of key diseases often failed to specify thresholds for timeliness and completeness, or whether those thresholds varied by the reportable conditions. These issues of clarity preclude a description of the validity of identified measures, which was also often lacking in the identified instruments (see Evidence of effectiveness section below).

Balance between structural and process measures

Ideal measurement systems span the Donabedian categories of structure (capacity), process, and outcomes.⁵¹ Outcomes in the area of preparedness are problematic, as public health emergencies are rare and the averted morbidity and mortality difficult to ascertain. Structural measures have the advantage of being most responsive to policy changes but perhaps least related to outcome. Process measures are most responsive to quality improvement efforts by the service providers and are more proximally related to outcomes. However, the preparedness documents reviewed rely nearly exclusively on structural measures over process. They ask if the workforce is trained, rather than how well the workforce is performing their preparedness duties.

Evidence of effectiveness

The basis for quality improvement is evidence that the action or capacity measured is effective in achieving a desired outcome. Thus, for measures to be accepted, it is crucial that a scientific basis of the measure exist and be clearly stated. Very few of the documents refer to any scientific

Figure 2. Evaluation instrument definitions of preparedness (EPHS domain and subdomains)

		Assessment ^a																											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
<i>Essential Public Health Service</i>																													
#1 Monitor health problems to identify and solve community health problems																													
Disease reporting: complete																													
Timely																													
Compliance																													
Syndromic surveillance																													
Capacity to receive/analyze data																													
Facility hazard assessment																													
#2 Diagnose and investigate health problems and health hazards in the community																													
Information system capacity:																													
Health alert network																													
24-hour/7-day capacity																													
Active surveillance																													
Epidemiologic capacity																													
Laboratory capacity																													
#3 Inform, educate, and empower people about health issues																													
Reports on community health																													
Information Officer																													
Contact list																													
Preprinted materials																													
Website																													
Risk communication protocol																													
#4 Mobilize community partnerships and action to identify and solve health problems																													
Partnerships:																													
With healthcare providers																													
With public safety/ EMS																													
With community organizations																													
With media																													

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Figure 2 (continued). Evaluation instrument definitions of preparedness (EPHS domain and subdomains)

		Assessment ^a																											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
<i>Essential Public Health Service</i>																													
#5 Develop policies and plans that support individual and community health efforts																													
Emergency response plan:																													
Testing of plan																													
Plan integrated regionally/state																													
#6 Enforce laws and regulations that protect health and ensure safety																													
Clear and relevant laws exist																													
Process to review/update laws																													
Law enforcement capability																													
Legal Counsel available																													
#7 Link people to needed personal health services and assure the provision of healthcare when otherwise available																													
Resource Assessment																													
Resource management																													
Plan for hospital surge capacity																													
Plan for medication, supplies and personnel from region/state																													
Treatment Facilities designated																													
Vulnerable group treatment plan																													
Mental health support plan																													
Mass immunization/prophylaxis plan																													
#8 Assure a competent public and personal healthcare workforce																													
Workforce written tests																													
Workforce drills																													
Workforce training																													
Workforce credentialing																													
#9 Evaluate effectiveness, accessibility, and quality of personal and population-based health services																													
Evaluate emergency plan																													
Evaluate partnership activities																													
Evaluate staff knowledge																													
Evaluate drills																													
Quality improvement process																													

continued on p. 538

Figure 2 (continued). Evaluation instrument definitions (EPHS domain and subdomains)

Essential Public Health Service	Assessment ^a																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
#10 Research for new insights and innovative solutions to health problems																												
Identify and apply research findings																												
EPHS = Essential Public Health Services																												
^a Assessment																												
1. Public Health Improvement Plan, Washington State, 1994																												
2. Assessment Protocol for Excellence in Public Health, APHA, ASTHO, CDC, NACCHO, and United States Conference of Local Health Officers (USCLHO), 8/96																												
3. Guide for All-Hazard Emergency Operations Planning (State and Local Guide), FEMA, 9/96																												
4. Epidemiologic Capacity Assessment Guide, Council of State and Territorial Epidemiologists (CSTE) and CDC, 1998																												
5. Emergency Support Function (ESF) #8, Health and Medical Services Annex, DHHS, 4/99																												
6. Bioterrorism Readiness Plan: A Template for Healthcare Facilities; Association for Professionals in Infection Control and Epidemiology (APIC), 4/13/99																												
7. 1999 Local Health Department Infrastructure Survey, NACCHO, 1999																												
8. Fiscal Year 1999 State Domestic Preparedness Support Program: Assessment and Strategy Development Tool Kit, CDC, NACCHO, ASTHO, CSTE, DOJ (Office for State and Local Domestic Preparedness Support), 1999																												
9. Healthy People 2010, DHHS, 6/1/00																												
10. Assessing Core Capacity for Infectious Disease Surveillance, DHHS, Office of the Assistant Secretary for Planning and Evaluation, 11/1/00																												
11. Checklist for Bioterrorism Preparedness: Environment of Care Standards, JCAHO, 1/01																												
12. The Public Health Response to Biological and Chemical Terrorism: Interim Planning Guide for State Public Health Officials, DHHS, CDC, 7/01																												
13. Bioterrorism Preparedness and Response Core Capacity Project 2001, CDC, 8/28/01																												
14. Public Health Assessment of California Local Health Departments, Health Officers Association of California (HOAC), 9/01																												
15. National Public Health Performance Standards Program: Local Public Health System Assessment Instrument, NACCHO/CDC; ASTHO, NALBOH, APHA, PHF, ASPH, 11/29/01																												
16. National Public Health Performance Standards Program: State Public Health System Assessment Instrument, ASTHO/CDC; NACCHO, NALBOH, PHF, APHA, 12/05/01																												
17. National Public Health Performance Standards Program: Local Public Health Governance Performance Assessment Instrument, CDC/NALBOH, APHA, ASTHO, NACCHO, NALBOH, PHF, ASPH, 1/28/02																												
18. State of California Bioterrorism Surveillance and Epidemiologic Response Plan, CDHS, 1/02																												
19. Bioterrorism Hospital Preparedness Program Cooperative Agreement Guidance, HRSA, 2/15/02																												
20. Public Health Preparedness and Response Capacity Inventory (LOCAL Version 1), CDC, 8/02																												
21. Public Health Preparedness and Response Capacity Inventory (STATE Version 1), CDC, 8/02																												
22. ASTHO's Bioterrorism Accountability Indicators Project (BTAIP), ASTHO, 9/02																												
23. Public Health in the Americas: Conceptual renewal, performance assessment, and basis for action, PAHO, CDC, Latin America Center for Research in Health Services, 2002																												
24. California Hospital Bioterrorism Response Planning Guide, CDHS, 2002																												
25. Michigan Local Public Health Accreditation Program Self-Assessment Report, State of Michigan, 2001																												
26. National Bioterrorism Hospital Preparedness Program, DHHS Health Resources and Services Administration Special Programs Bureau, 2004																												
27. Centers for Disease Control and Prevention (CDC). "Continuation Guidance for Cooperative Agreement on Public Health Preparedness and Response for Bioterrorism—Budget Year Five" (Atlanta: CDC, 2004)																												

studies supporting specific measures, though most refer to other expert bodies for support. Our own efforts to locate scientific support for common measures were mostly fruitless, with some exceptions. Syndromic surveillance was widely recommended in the evaluation instruments we identified, but evidence supporting its broad use is still quite limited and comes to conflicting conclusions.⁵²⁻⁵⁴ In other instances, while the efficacy of an intervention such as immunization is not in question, how well it is delivered to the population at risk in a timely way is.⁵⁵ More commonly, we were unable to find evaluations of the effects of widely recommended measures, such as the frequency and intensity of training drills or number of epidemiologists per population, even on intermediate outcomes like provider knowledge. The capacity for 24/7 reporting was often recommended, and while a reasonable goal, has not been subjected to an evaluation of the added benefit that such a capacity would (compared to availability only in normal business hours) engender. Furthermore, methods to assess this rather straightforward capacity have not been developed.

Specification of an accountable entity

Another desirable attribute of preparedness measures is that the entity accountable for the capacity or process be specified. For measures to be effective in changing behavior, it must be clear who is responsible for implementing the changes implied by the measure. While local flexibility in assigning responsibility may be desirable in optimizing preparedness,⁷ this flexibility does not obviate the need for a clear delineation of agency and departmental or community partner roles. The reviewed evaluation instruments were fairly general in their approach to accountability. For example, the CDC Bioterrorism Preparedness and Response Core Capacity Project holds the "state and local public health systems" accountable for performing risk assessment to identify the community's potential hazards and vulnerabilities rather than identifying specific categories of staff or departments within the public health agency tasked with doing so.^{9,56} Moreover, local instruments prepared by state agencies^{23-25,49} were rarely specific in designating accountability or even a process for assigning accountability. More broadly, the division of labor between local and state health departments, federal agencies, personal health care providers, and facilities with regard to recommended capacities and processes was absent from many evaluation instruments. The Federal Emergency Management Agency's Guide for All-Hazard Emergency Operations Planning is an exception, with well-delineated roles for public and private officials.²⁶

DISCUSSION

Policy makers and the public rightfully expect that the new investments in the public health infrastructure will lead to increased preparedness, but health officials are challenged to measure whether preparedness is actually improving absent an unfortunate event that will test the system.¹⁰ We have reviewed a set of instruments promulgated by government, private quasi-regulatory bodies (e.g., the JCAHO), and professional groups that relate to public health preparedness. As Figure 2 demonstrates, we found that although there are a multitude of instruments for measuring preparedness with

a great deal of overlap in domains, there is little agreement about what actually constitutes preparedness or how it should be measured.

We did not necessarily expect that an ideal instrument should cover all Essential Public Health Services domains. However, greater convergence in scope would indicate a growing consensus on what constitutes preparedness and how to measure it. Consensus would reduce confusion and inefficiencies in local public health departments and other institutions responsible for maintaining preparedness.

However, such a consensus will be slow to develop in the absence of evidence for efficacy of particular practices or capacities. While evidence for public health technologies such as immunization is common, we found that the absence of evidence that links information about capacities, practices, and processes to desired outcomes undermined the evaluated instruments. This explicit linkage of scientific evidence to the development of guidelines, so common in personal health care, has been slower to evolve for public health practice.

The roots of the disjunction between evidence and preparedness guidelines may lie in part in the greater difficulty of conducting efficacy and effectiveness studies of public health practice. The unit of analysis is often at the institution or community level rather than at the individual level, forcing difficult study design choices. Evaluated processes are often more complex and difficult to standardize than those in personal health. For example, defining syndromic surveillance and ensuring standard implementation in an effectiveness trial poses greater methodologic challenges than an effectiveness study of beta blockers after myocardial infarction. Moreover, the public health practices in question are generally more similar to "service policies," which address how resources are allocated to deliver services to a population or a group of people, than to "practice policies," which address the use of resources by practitioners.⁵⁷ Thus, new conceptual approaches such as those offered in research on complex systems may be required to improve public health system performance.⁵⁸

One possible explanation for the lack of evidence linking preparedness processes to outcomes is the thankfully rare nature of the catastrophic outcomes for which public health agencies must prepare a response. It is difficult to conduct statistically meaningful studies with such rare outcomes, and often simulations are the best possible design. Simulations have already been done for smallpox immunization study strategies,⁵⁶ and models based on other systems with rare but catastrophic outcomes such as aerospace and nuclear power may fill this gap. Another possible explanation is that resources available to support effectiveness evaluation of preparedness efforts have been lacking until recently. A final possible explanation is the absence of valid and widely accepted tools for risk adjustment, making it difficult to account for differences in communities that affect system performance.

In any case, the lack of evidence supporting the processes of public health practice in the area of preparedness has forced a reliance upon expert opinion or upon structural measures that have an unproven relationship to the desired outcomes.¹⁰ While expert opinion-based measures are most likely better than no measures, development of a better evidence base for public health preparedness practices is

clearly a priority for future public health services research. The U.S. Task Force on Community and Preventive Services has set an example of how to begin this process in public health practice,⁵⁹ although its work until now has not directly addressed preparedness.

The problem of accountability in public health is even more diffuse than it is in clinical medicine, and resources are often allocated on the basis of political considerations rather than on the basis of need or scientific merit. Recent recommendations to involve more community-based constituents in meeting public health objectives,^{60,61} while logical from a number of perspectives and embodied in almost all of the instruments we reviewed, reflect this diffusion of accountability and may increase the difficulty of measuring preparedness. This problem is further compounded by the fact that neither the federal government nor the states have clearly defined what their own accountability is in public health.

The accountability and abilities of local health systems may also vary by the size of the communities they serve, which may range from a few thousand to ten million people. With only a few exceptions, the measures that we reviewed do not distinguish health systems or the communities they serve by size. While every community may need access to a public health laboratory, for instance, larger communities might meet this need with their own facilities, while smaller communities may reasonably depend on a state lab. Within the public health community, however, there is an ongoing debate about the ability to provide public health services in small and remote communities, as well as the minimum size community that can support a fully functioning local public health agency. The Institute of Medicine notes the lack of evidence on such “critical mass” issues.⁶ Nonetheless, the public and policy makers rightfully expect to see clear evidence of the impact of the more than \$2 billion already expended to strengthen the public health infrastructure. Such evidence will be difficult, if not impossible, to assemble absent a shared understanding of how preparedness is measured and accountability is assessed.

These challenges converge on the current need to assure that our public health infrastructure is prepared to protect the public from new and emerging threats. While terrorism-related threats have been the main focus of attention, it is clear that we face important challenges from emerging infectious diseases such as SARS and West Nile Virus, from emerging epidemics of chronic disease such as diabetes and obesity, and from the increased effects of environmental degradation. These new challenges are not only worthy topics for quality measurement in themselves, but the experience of public health agencies in responding to them can most likely provide evidence about the level of effective bioterrorism preparedness in a community. If investments in preparedness are, in fact, intended to strengthen the general public health infrastructure, better measures will be required not just for emergency preparedness, but for much more of what public health is expected to address. Perhaps just as importantly, more comprehensive public health quality measures are needed to ensure that mandated spending on preparedness at the expense of other priorities does not adversely affect the public health in those other areas.^{62,63}

The lack of agreed upon preparedness measures poses challenges to the efficient strengthening of the public health infrastructure. Lack of agreement on a definition of preparedness and how to measure it results in multiple data requests to complete checklists or inventories—each with slightly different components. This may not only waste precious local public health resources, but it can result in other inefficiencies. If, in fact, the inventories are measuring elements that don’t ultimately lead to better preparedness, they can direct investments to the wrong areas. Further, without clear measures and goals, they may reinforce natural tendencies to rebuild a public health system that worked well in the past, but may not facilitate the types of redesign that could better meet current and future needs.

The evolving National Public Health Performance Standards (NPHPS)³³ could serve as the basis for addressing some of these issues, although it too is subject to many of the limitations we identified in our review. The NPHPS already addresses some components of preparedness, and as evidence accumulates and the technology of measurement specification improves, more could be added. The CDC and HRSA critical benchmarks⁶⁴ also set forth a challenge to state and local agencies and hospitals to plan for public health emergencies and could be further developed to incorporate more comprehensive preparedness measures.

Given the magnitude of the gaps in our current state of knowledge, what can we recommend? First, better communication across agencies—both between federal agencies, and federal-state-local agency communication—will facilitate an agreement on goals and lead toward a common set of domains to measure. Second, better delineation of accountability for specific preparedness functions in measurement instruments will make them more actionable. Third, a more explicit approach to describing the underlying evidence behind measures would increase legitimacy and utility.

However better communication and even better delineation of accountability and available evidence, while necessary, will not be sufficient to meet the goal of ensuring preparedness for public health emergencies. But as we continue to invest in preparedness, it is imperative that the investment be much more than a political tool for “spreading money around.” It is just as important to know whether we are making the right investments, in the right places, at the right time, and whether they lead to the desired outcomes. To accomplish this, public health systems research must develop the currently sparse evidence base to know how much of what kind of preparation is enough, and the measurement tools to know if we are indeed prepared for the new public health challenges that the post–September 11 world poses.

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