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CDC Proposal: Effects of Accreditation on Local Public Health Preparedness

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Available at: https://works.bepress.com/glen_mays/110/
PROJECT SUMMARY (See instructions):
Local public health agencies occupy pivotal positions within the nation’s emergency preparedness and response systems because of their statutory authority to perform essential public health functions and because of their ability to organize and coordinate the public health actions of many other organizations at the community level. Accreditation of public health agencies has received considerable policy attention because of its potential to promote consistency and interoperability in public health practice, and its ability to encourage participation in other beneficial initiatives such as guideline adoption and quality improvement. This investigation will use a prospective, quasi-experimental research design to evaluate the impact of one of the nation’s first state-based public health agency accreditation programs on local emergency preparedness and response capabilities. The specific aims of the study are to: (1) compare the preparedness and response capabilities of communities served by accredited and non-accredited health agencies; (2) determine how preparedness capabilities change in response to agency participation in an accreditation process; (3) assess the ability of accreditation standards and measures to detect meaningful differences in preparedness among participating agencies; (4) identify the structural and organizational attributes of local public health systems that influence their preparedness capabilities and their accreditation outcomes; and (5) identify and test strategies for enhancing the impact of accreditation programs on preparedness and response capabilities. To address these aims, local public health agencies in North Carolina will be observed both before and after their participation in that state’s accreditation program, and will be compared with a propensity-score matched comparison group of local public health agencies located in states without accreditation programs. Data obtained from after-action reports of drills and exercises, a self-administered preparedness survey, a national census survey of local health agencies, and administrative data from the accreditation program will be used in the investigation. Strategies for enhancing the effects of accreditation on preparedness will be disseminated to both state and national stakeholders.

RELEVANCE (See instructions):
Findings will inform the design and implementation of both state-based accreditation programs and the developing national public health accreditation program so that they can achieve their intended effects of strengthening the nation’s response to both routine and emergent public health threats.

PROJECT/PERFORMANCE SITE(S) (if additional space is needed, use Project/Performance Site Format Page)

Project/Performance Site Primary Location
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Project/Performance Site Congressional Districts: 2

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Project/Performance Site Congressional Districts:
2. SPECIFIC AIMS

Local governmental public health agencies occupy pivotal positions within the nation’s emergency preparedness and response systems because of their statutory authority to perform essential public health functions—such as those involving community health assessment, epidemiological investigation, and enforcement of health laws and regulations—and because of their ability to organize and coordinate the public health actions of many other organizations at the community level. Although it is widely recognized that strong and effective local public health agencies are essential for preparing for and responding to health threats on a population-wide basis, studies from the past two decades have found evidence of substantial gaps and wide variation in the performance of essential public health services at local levels. In response, a number of initiatives have been launched in recent years to stimulate improvements in the quality of public health agency activities, including those involving dissemination of practice guidelines, the measurement and reporting of agency performance, training in quality improvement methods, and the development of accreditation programs for public health agencies. Accreditation has received special attention because of its potential to promote consistency and interoperability in public health practice, and its ability to encourage participation in other beneficial initiatives such as guideline adoption and quality improvement. At least four states have implemented accreditation programs for local public health agencies over the past several years, and a national accreditation program for local and state public health agencies has been launched with the support of federal and nongovernmental sources.

Accreditation programs have the potential to strengthen not only routine public health capabilities but also the ability to prepare for and respond to emergencies. As the Institute of Medicine recently noted in its letter report on preparedness research priorities, systems of preparedness “should be accountable for achieving performance expectations,” and accreditation programs have become a widely used approach for performance monitoring and accountability in the health and human services arena. Consequently, the Institute of Medicine has called for practice-based research that examines, “to what extent, if any, will accreditation standards for state and local health departments contribute to an agency’s preparedness as it relates to capacity and performance?”

As one of the first states to implement public health agency accreditation, North Carolina provides a compelling opportunity to examine the effects of accreditation on a community’s preparedness and response capabilities, and to identify ways of improving the design and implementation of accreditation programs so as to strengthen community preparedness and resilience. Findings from this type of investigation will have broad implications for other state-based accreditation programs and for the developing national accreditation program. To this end, this proposed study will accomplish the five aims described below.

Aim 1. Determine the extent and nature of differences between accredited and non-accredited public health agencies in the preparedness and response capabilities of the local communities they serve.

To obtain an initial view of the relationship between accreditation and preparedness, we will assess the preparedness and response capacities of public health agencies that have sought and attained accreditation through the North Carolina Local Health Department Accreditation Program, and compare these with the capacities of public health agencies that have not attained accreditation. As of May 2008, 36 of North Carolina’s 85 local public health agencies had achieved accreditation, and another 6 agencies were in the process of pursuing accreditation. Cross-sectional comparisons of the preparedness and response capacities of accredited vs. non-accredited agencies will provide important information about the types of agencies that undergo accreditation and about the nature and magnitude of differences in their capabilities. Two levels of
comparison will be examined as part of this investigation. First, a single-state comparison will focus exclusively on accredited and non-accredited public health agencies in North Carolina, using detailed measures of preparedness and response capacities obtained through primary data collection. Second, a multi-state comparison will examine accredited and non-accredited public health agencies in all four states that have implemented accreditation programs to date (NC, IL, MI, MO), using secondary data collected through the 2008 national survey of local health departments conducted by the National Association of County and City Health Officials (NACCHO).

Four primary hypotheses will be tested under Aim 1 of the study:

H1.1: Public health agencies that pursue and attain accreditation have greater financial and organizational resources (funding per capita, staff per capita, density of inter-organizational relationships, and scope of services offered) compared to non-accredited agencies. This hypothesis will be tested using both the single-state and multi-state comparisons.

H1.2: Accredited public health agencies exhibit higher levels of performance on structural and process measures of emergency preparedness, compared to non-accredited agencies. This hypothesis will be tested using both the single-state and multi-state comparisons.

H1.3: Accredited public health agencies exhibit higher levels of performance on public health emergency response exercises and drills, compared to non-accredited agencies. This hypothesis will be tested only in the single-state comparison involving North Carolina agencies.

H1.4: Public health agencies that achieve higher levels of performance on structural and process measures of preparedness also achieve higher levels of performance on emergency response exercises and drills. This hypothesis will be tested only in the single-state comparison involving North Carolina agencies.

Importantly, all of the analyses to be conducted under Aim 1 will use measures of emergency preparedness and response obtained at the system (or community) level.

Aim 2. Determine how the preparedness and response capabilities of local public health systems change in response to public health agencies’ efforts to achieve and maintain accreditation.

To assess changes in public health system preparedness attributable to accreditation, we will conduct a prospective, longitudinal analysis of local preparedness and response capacities using a cohort of local public health agencies that are followed over a four-year period of time, both before and after their efforts to seek accreditation. In addressing this aim, we will examine the extent to which accreditation-seeking agencies are more likely than their non-accredited counterparts to achieve improvements in emergency preparedness and response capabilities over time. North Carolina local public health agencies that seek accreditation over the three-year period will be compared with (1) their counterparts across the state that choose not to seek accreditation, and (2) a matched comparison group of local public health agencies from states that have not implemented accreditation programs. The two levels of comparison will allow us to test and control for selection bias regarding the types of agencies that elect to pursue accreditation during the study period, while also examining the possibility of a state-wide accreditation effect (i.e. a beneficial form of contamination) that influences the preparedness capacities of both accredited and non-accredited agencies within North Carolina. The following hypotheses will be examined under Aim 2 of the study:
**H2.1:** Public health agencies experience improvements in structural and process measures of emergency preparedness after participating in the North Carolina accreditation process.

**H2.2:** Public health agencies that participate in accreditation experience larger improvements in performance on structural and process measures of emergency preparedness, compared to non-participating agencies. This hypothesis will be tested using both the single-state and the comparison-state analysis.

**H2.3:** Public health agencies achieve improvements in performance on public health emergency response exercises and drills after participating in the North Carolina accreditation process.

**H2.4:** Public health agencies that participate in accreditation experience larger improvements in performance on public health emergency response exercises and drills, compared to non-participating agencies. This hypothesis will be tested using both the single-state and the comparison-state analysis.

**Aim 3.** Determine the extent to which performance standards and measures used by the North Carolina accreditation program are able to detect meaningful differences in the preparedness and response capacities of local public health systems.

The ability of an accreditation program to drive improvements in local emergency preparedness and response capacities is likely to hinge in part on the program’s ability to detect meaningful differences in these capacities across local public health systems. To examine this issue, we will conduct a detailed analysis of the preparedness-related performance standards and performance measures that are used as part of the North Carolina public health agency accreditation program. We will assess the degree of concordance between these accreditation-related measures and an independent set of measures developed specifically to assess system performance in emergency preparedness and response. The independent set of measures to be used includes: (1) structural and process measures of emergency preparedness as reported by local public health officials; and (2) measures of system performance on public health emergency response exercises and drills. The following hypotheses will be examined under Aim 3 of the study:

**H3.1:** Public health agencies that score highly on accreditation measures related to emergency preparedness and response are more likely than their lower-scoring counterparts to score highly on an independent set of preparedness measures (reflecting preparedness structures, processes, and responses to exercises and drills) collected within 12 months of the accreditation site visit.

**H3.2:** Public health agencies that score highly on accreditation measures related to emergency preparedness and response are more likely than their lower-scoring counterparts to score highly on an independent set of preparedness measures collected more than one year after accreditation.

**H3.3:** Public health agencies that score highly on accreditation measures related to emergency preparedness and response are more likely than their lower-scoring counterparts to exhibit improvements in preparedness measures over time, based on an independent set of preparedness measures.
Aim 4. Identify the structural and organizational attributes of local public health systems that are associated with improved preparedness and response capabilities, and assess the influence of these attributes on accreditation outcomes.

Studies within the field of public health systems research have begun to elucidate the structural and organizational characteristics of local public health delivery systems that influence their ability to perform core services and activities. These characteristics include the system’s scale of operations, the breadth of organizations involved within the system, the frequency and nature of interaction among system participants, and degree to which effort is concentrated or diffused among organizations within the system. However, relatively little is known about the influence of these characteristics on the functioning of preparedness and response systems specifically. Similarly, the roles that these characteristics play in public health agency accreditation outcomes are not well understood. In Aim 4 of the proposed study, we will examine the extent to which these system characteristics are associated with the preparedness and response capabilities of public health systems, and with accreditation outcomes realized by public health agencies. As in Aim 1, two levels of analysis will be examined as part of this investigation. First, a single-state analysis will focus exclusively on public health agencies in North Carolina, using detailed measures of preparedness and response capacities obtained through primary data collection. Second, a multi-state analysis will examine all U.S. public health agencies using secondary data collected through the 2008, 2010, and 2012 waves of the NACCHO national survey of local health departments. In the multi-state analysis, accreditation outcomes will be examined in North Carolina and in the three other states that have implemented accreditation programs for local public health agencies (IL, MI, MO). The following hypotheses will be examined under Aim 4 of the study:

**H4.1:** Preparedness activities and accreditation outcomes exhibit positive returns to scale. Local public health systems having a larger scale of operations—measured by population size covered, agency expenditures per capita, agency staff per capita, and breadth of public health activities performed—will achieve higher levels of performance on measures of emergency preparedness and response, compared to systems with a smaller scale of operations. Moreover, public health agencies operating as part of large-scale systems will be more likely to achieve accreditation compared with their smaller counterparts.

**H4.2:** Preparedness activities and accreditation outcomes exhibit positive returns to integration. Local systems having greater organizational integration—characterized by a broader range of organizations involved in the delivery of public health services, and more frequent communication and interaction among these organizations—will achieve higher levels of performance on measures of emergency preparedness and response, compared to systems characterized by less organizational integration. Public health agencies operating in systems with high organizational integration will be more likely to achieve accreditation compared with their less-integrated counterparts.

**H4.3:** Preparedness activities and accreditation outcomes are inversely related to concentration of effort within the system. Systems in which the local public health agency directly provides the majority of effort for performing public health activities will achieve lower levels of performance in emergency preparedness and response, compared to systems that distribute more of the effort among participating organizations. Public health agencies operating in highly concentrated systems will be less likely to achieve accreditation compared with their counterparts in more-distributed systems.

**H4.4** System integration and system concentration have interactive and offsetting effects on preparedness activities and accreditation outcomes, such that high levels of concentration offset the effects of low
levels of integration. Among systems having relatively low levels of organizational integration, those systems in which the local public health agency directly provides the majority of effort for performing public health activities will achieve higher levels of performance in emergency preparedness and response, compared to systems that distribute more of this effort among participating organizations.

Aim 5. Identify and test strategies for enhancing the impact of state and national accreditation programs on the preparedness and response capabilities of local public health systems.

Results from the analyses conducted under Aims 1 through 4 of the study will be used to identify opportunities for enhancing public health accreditation programs so as to achieve larger and more sustained effects on local preparedness and response capabilities. These enhancements will be tested for feasibility and effectiveness in North Carolina during the final two years of the project period. Although the full range of strategies to be tested will depend on findings from the proposed analyses, we anticipate that the following types of enhancements will be examined:

- Revising accreditation performance standards and measures to include more specific elements of emergency preparedness and response capacity, including the results of exercises, drills, and after-action reports of actual emergencies.

- Providing periodic, comparative feedback to local public health agencies in the form of a preparedness report that profiles each agency’s rating on structural and process measures of preparedness, along with each agency’s performance on preparedness exercises and drills, compared to peer agencies and norms across the state.

- Incorporating expectations and incentives for the use of quality improvement (QI) methods as part of emergency preparedness activities, such as through QI guidelines and training, multi-agency learning collaboratives, and accreditation performance standards tied explicitly to the use of QI.

Each enhancement will be implemented in conjunction with the North Carolina accreditation program and then assessed to determine how local public health agencies respond to the innovation and whether these responses are likely to lead to improvements in emergency preparedness and response capacities. Findings and recommendations based on these assessments will be disseminated broadly to state policy-makers as well as state and local public health officials in order to inform future changes in the state’s accreditation program. Because findings from this study will have application well beyond North Carolina’s accreditation program, we will synthesize all of the study’s single-state and multi-state findings in order to identify generalized implications for the design and implementation of public health accreditation programs in other states and, of particular importance, implications for the national public health accreditation program currently under development.

3. BACKGROUND AND SIGNIFICANCE

3.1 Public Health System Structure and Performance

A growing body of evidence indicates that the availability and effectiveness of core public health services varies widely and remains far from optimal in many communities, leading to concerns about the ability of the nation’s public health systems to respond effectively to both routine and emergent public health threats. Fifteen years ago, a study commission convened by the Institute of Medicine (IOM) found that an array of
factors—including stagnant public funding, new and resurgent health risks, and a large and growing indigent care burden—had left the nation’s public health system in disarray.² More recent reviews have documented progress in some areas of public health practice but persistent weaknesses in many other areas.⁹ Studies conducted during the 1990s found that only a half to two-thirds of the activities considered important elements of public health practice were performed in the average community.¹, ³, ⁴, ⁶, ⁸, ¹⁸, ¹⁹ These activities include processes for identifying health risks in the population, preventing and controlling communicable disease outbreaks, educating the public and health professionals about health risks and prevention practices, ensuring access to needed personal health services, and protecting the safety of water, food, air, and other environmental conditions necessary for health. Amid growing concerns about the public health threats of natural and man-made disasters, recent studies also have found evidence of substantial gaps and wide variation in system preparedness for public health emergencies.²⁰-²⁴

The wide variation in public health practice and preparedness across communities stems in part from the heterogeneity in how public health systems are organized. State and local governmental public health agencies vary widely in their statutorily defined powers and duties.²⁵ Although governmental health agencies shoulder much of the responsibility for organizing and implementing essential public health services, the capacity of a public health system cannot be determined without examining the contributions made by many other governmental and private organizations.²⁶-²⁸ Medical care providers, community-based and faith-based organizations, health insurers, employers and businesses groups, public safety and homeland security agencies, educational institutions, foundations and philanthropies, and the media play critical roles in public health initiatives. Some organizations have altruistic, mission-driven reasons for contributing to these activities while others are motivated by business considerations and economic interests.²⁹-³² Within the governmental sphere, public health responsibilities are frequently carried out by agencies other than the designated health department, including agencies devoted to environmental management, social services, housing, transportation, public safety, agriculture, economic development, labor, and emergency management. One national study estimated that approximately one-third of the core public health services available in large metropolitan communities were performed by organizations other than the designated local health department.⁶

The complex inter-organizational structures within public health systems make issues of coordination, decision-making, and division of responsibility essential to system effectiveness in performing core services.²⁷ Indeed, studies of local public health systems have found higher levels of achievement in performing core public health services among those systems with strong governance and decision-making structures and relationships with a broad array of organizational contributors.²⁹, ³³ Studies also have found evidence of scale effects in the performance of core services, such that systems serving larger populations are more successful in providing a full range of public health services.⁷, ¹⁹

Unnecessary and harmful variation in public health performance results not only from heterogeneity in public health system structure, but also from professional uncertainty about the most effective public health practices and barriers to adoption of these practices. In some areas of public health practice, evidence-based or consensus-based guidelines do not yet exist, suggesting a need for more research to identify effective practices.³⁴, ³⁵ In other areas of practice, studies suggest that professionals may not be aware of existing guidelines or they may lack the financial resources, skilled staff, or legal authority necessary to adhere to guidelines.³⁶-³⁹ These problems suggest a need for stronger mechanisms to promote awareness of recommended public health practices, and to create incentives for adherence to these practices.
3.2 Public Health System Performance in Emergency Preparedness and Response

Emergency preparedness and response activities represent a special domain of public health system performance—one that has received heightened attention in the wake of the post-9/11 anthrax attacks, outbreaks of SARS and other emerging infections, and the 2005 Gulf hurricanes. To be sure, a system’s ability to prevent, detect, and respond to a large-scale public health crisis draws heavily upon performance of routine public health activities such as surveillance, epidemiological investigation, communications, planning, and policy enforcement. However, preparedness activities also involve specialized functions in incident command, countermeasures and mitigation, mass health care delivery, and management of essential health care supply chains. Moreover, effective emergency preparedness and response actions may require the performance of routine public health activities under unusual time pressure and resource constraints. Consequently, a public health system’s ability to perform routine public health activities under usual conditions may not perfectly predict its capacity for performing emergency preparedness and response functions.

The relatively few studies to assess public health preparedness and response suggest that wide variations exist in capacity and practice across communities—echoing studies of routine public health practice domains. One small study of local public health agencies, for example, found that only 2 of 19 agencies consistently met the recommended standard of receiving and responding to critical case reports on a 24/7 basis. The causes of variation and deficiency in public health preparedness are likely to parallel the causes of undesirable variation in routine public health system performance, but with some key differences. The evidence base concerning what constitutes effective public health preparedness is extremely thin, leading perhaps to greater professional uncertainty in this arena than in routine practice. Similarly, a number of different performance standards for preparedness have been developed by various agencies and organizations, leading to overlapping and sometimes inconsistent recommendations and program requirements. At the same time, heterogeneity in the composition and structure of public health systems is likely to be an important source of variation in preparedness as in other aspects of public health practice.

3.2 Accreditation as an Intervention for System Improvement

A variety of initiatives have been launched in recent years to reduce undesirable variation in public health practice and stimulate improvements in performance, including the dissemination of practice guidelines, the measurement and reporting of agency performance, the promotion of quality improvement methods, and the development of accreditation programs for public health agencies. Accreditation has received special attention because of its potential to promote consistency and interoperability in public health practice across different communities and different types of public health systems. Accreditation is also appealing for its potential use in diffusing other beneficial innovations into public health practice, such as guideline adoption, performance reporting, and quality improvement. Although widely adopted in health care, social service, education, and public safety, accreditation programs have been slow to develop in the field of public health until recently. Four states have implemented accreditation programs for local public health agencies over the past several years, and a national accreditation program for local and state public health agencies has been launched with the support of federal and nongovernmental sources.
Public health accreditation programs are analogous in function to other types of organizational assessment and improvement interventions (Figure 1). These programs develop performance standards that define critical elements of practice and expected levels of achievement (i.e. quality, timeliness, efficiency) within each practice. These standards are based on the available evidence and/or professional consensus regarding practices that are most likely to lead to desirable public health outcomes. Accreditation programs use assessment processes and measures to determine the degree to which each standard is achieved by a participating agency. Measures often rely on data collected through self-assessments or surveys, which are then verified and augmented by a site visit team using direct observation, staff interviews, and reviews of documentary evidence. Measures are then combined into a score or set of scores that determine whether accreditation is granted to the participating agency. The required periodicity for re-accreditation may hinge on the accreditation score achieved. Information generated through an accreditation process is often used to demonstrate accountability and quality to external stakeholders, while also being used to motivate and inform internal quality improvement efforts. Many accreditation programs entail some degree of voluntary participation along with implicit or explicit incentives that accrue to those organizations receiving accreditation. In North Carolina, state legislation requires all local public health agencies to become accredited by 2014, but agencies are allowed flexibility in choosing when to pursue accreditation. Each year, the state offers grants for up to 10 public health agencies that volunteer to initiate accreditation activities during the year.

Evidence concerning the impact of accreditation programs in health and social service sectors is limited but suggestive of positive effects on quality and adherence to standards. Studies of accreditation programs for substance abuse facilities and for managed care organizations, for example, have found that these programs increased adherence to evidence-based clinical practices. However, assessing the impact and effectiveness of accreditation programs is complicated by the voluntary aspects of these programs. Voluntary programs may give rise to selection effects, wherein organizations elect to pursue and attain accreditation because they already achieve the relevant performance standards. Selection effects raise questions about the ability of accreditation programs to generate improvements among low-performing organizations. However, accreditation programs may also generate improvement effects, wherein organizations take steps to enhance their performance in order to achieve or maintain a positive accreditation rating and/or to remedy a negative accreditation finding. The question of whether selection effects or improvement effects predominate is particularly salient when considering the influence of accreditation on public health preparedness, given that wide variation in practice exists and that the evidence-base to inform practice is limited.

Source: Nelson, Lurie, Wasserman 2007
3.3 Conceptual Framework for Studying Accreditation and Preparedness

Identifying the potential effects of accreditation on public health preparedness requires a broad and interdisciplinary view of the determinants and drivers of public health system performance. Existing conceptual models of public health system performance, which are grounded in organizational sociology and industrial organization economics, stress the importance of structural characteristics of governmental public health agencies and their relationships with other organizations that act within the system (Figure 2).26, 47, 48 These structural characteristics determine the capacity of the system to respond to public health threats, including statutory authority, financial and human resources, governance structures, and inter-organizational relationships with both governmental and private organizations having relevant resources and expertise. Public health officials make strategic decisions about how to prepare for and respond to public health emergencies by matching the structural capacities of their agencies and systems with relevant population and environmental characteristics that determine public health needs, risks, and threats. Within this framework, accreditation exists as one of the possible decision supports that influence the actions public health officials choose to take regarding preparedness and response capacities.43 Accreditation informs these strategic decisions by raising awareness about recommended practices and performance standards in public health, building external political and public support for achieving these standards, and providing feedback about needed improvements in performance.

4. PRELIMINARY STUDIES

The proposed investigation is motivated and informed by a series of preliminary studies that explore the causes and consequences of variation in public health system performance and that investigate the role of accreditation and performance measurement in stimulating system improvement. These studies are beginning to identify pathways for strengthening public health system capacities for addressing both routine and emergent public health threats. Moreover, these studies demonstrate the feasibility and utility of applying a diverse set of constructs and methods from the disciplines of health services research, health economics, and organizational sociology to the study of public health systems and preparedness.

4.1 Public Health System Structure and Performance

Preliminary studies conducted by members of the proposed research team have documented large gaps and wide disparities in the ability of communities to deliver essential public health services, and have begun to identify some of the characteristics that contribute to high-performing and low-performing public health systems. The proposed principal investigator, Glen P. Mays, Ph.D., and colleagues conducted one of the first

FIGURE 2: Conceptual Model of Public Health System Preparedness
national studies of geographic variation in public health service delivery, finding that less than two-thirds of the activities considered to be essential elements of public health practice were performed in the communities where most Americans reside. The domains of activity with notable gaps in performance include areas relevant to emergency preparedness and response, including capacities for community health assessment, investigation of adverse health events, and dissemination of information to the public. Using advanced multivariate methods, this CDC-funded study identified characteristics of local public health delivery systems that account for much of the observed variation in performance, including the population size served by the system, the financial resources controlled by the local public health agency, the type of administrative relationship existing between the local and state public health agency (e.g. centralized vs. decentralized), and the presence of a local public health governing body with policy-making authority. An important product of this work was the development and validation of a set of multivariate, hierarchical models used to explain variation in system performance based on structural characteristics of the public health agency and system along with population characteristics and health resources of the communities served. These empirical models have wide applicability in observational and quasi-experimental studies designed to evaluate the effects of administrative, policy, and programmatic interventions on public health system performance.

Related studies by Dr. Mays and colleagues have examined the organizational structure and composition of public health systems and the effects of these characteristics on the availability of core public health activities. These studies, also funded by CDC, examined variation in the types of organizations that contribute to public health activities in local communities and the factors that facilitate and inhibit these contributions. Several analyses have focused on the contributions made by private health insurers and managed care plans to the delivery of public health services, and the organizational and market conditions that influence these contributions. Other studies have examined the roles played by medical care providers in performing core public health activities, including community hospitals, community health centers, and physician practices. Collectively, these studies provide insight into the scope and scale of nongovernmental contributions to public health activities, and suggest strategies for enhancing coordination and cooperation in service delivery.

Another line of research led by Mays and colleagues has examined the financial characteristics of public health systems and the effects of governmental spending patterns on the availability of core public health activities. An initial cross-sectional study funded by CDC documented wide variation in per capita public health spending levels across U.S. communities. This analysis suggested that local, state, and federal public health spending levels were independently associated with the availability of essential public health services at the community level, even after controlling for the effects of local health resources and socioeconomic conditions. A recently completed study funded by the Robert Wood Johnson Foundation has used a longitudinal, quasi-experimental design to estimate the effects of changes in local public health spending on mortality from preventable causes of death. Findings suggest sizeable reductions in mortality have occurred in communities that experienced spending growth between 1993 and 2005.

Most recently, Dr. Mays is leading a national study to more precisely characterize the organizational structure of local public health delivery systems and to examine cross-sectional and longitudinal variation in these structures. In this investigation, funded by the Robert Wood Johnson Foundation and conducted with colleagues at the University of Kentucky, researchers have classified public health systems along three basic dimensions commonly used in economic and organizational research to characterize heterogeneous service delivery systems: the scope of public health activities performed (differentiation); the range of organizations that participate in performing these activities (integration); and the distribution of effort across participating organizations (concentration). Using advanced multivariate methods, the investigators have identified an
empirical typology of public health system structure comprised of seven different “types” of systems that collectively explain most of the observed variation in organizational structure across communities. Using nationally representative survey data collected in both 1998 and 2006 along with in-depth qualitative data, the researchers have documented the longitudinal consistency of this typology and demonstrated its sensitivity to both cross-sectional variation and longitudinal changes in structure. The resulting Public Health System Typology provides a framework for classifying and comparing homogenous groupings of systems based on their organizational structure, thereby enabling “apples to apples” comparisons of system performance, preparedness, and response.

4.2 Performance Measurement and Accreditation

The proposed research is also guided by studies of performance measurement approaches and accreditation programs in public health that have been conducted by members of the research team. Collectively, these preliminary studies suggest that performance measurement and accreditation may be effective strategies for strengthening the capacity of communities to prepare for and respond to both routine and emergent health threats. Several studies have evaluated the measurement approaches used by the CDC’s National Public Health Performance Standards Program (NPHPSP) for their ability to detect meaningful differences in system performance. One studies used principal components analysis to examine the ability of the program’s Local Performance Instrument to differentiate multiple, underlying dimensions of system performance at the local level. This instrument was found to identify four unique dimensions of performance, including one related specifically to emergency preparedness and response capabilities, suggesting that NPHPSP could serve as a useful mechanism for monitoring progress toward preparedness goals. Other unique dimensions of performance identified in the analysis involved routine public health capabilities in community health assessment, health education and planning, and policy enforcement. In a related study, researchers analyzed data from more than 300 communities nationwide to evaluate the ability of the NPHPSP Local Instrument to detect differences in performance attributable to institutional and economic characteristics of local public health delivery systems. Consistent with other research, this study found large and significant differences in performance attributable to population size, public health agency staffing levels, and agency funding levels. Of particular note, this study found evidence of nonlinear associations between population size and performance, with performance diminishing once systems exceeded a threshold size of approximately 500,000 residents. Most recently, Dr. Mays and colleagues are engaged in a project to assist CDC and its partners in revising all of the NPHPSP assessment instruments so as to improve the validity and reliability of the performance measures and their utility for performance improvement.

In this same vein, researchers at the North Carolina Institute for Public Health are rapidly accumulating evidence about the design and implementation of public health accreditation programs through their work with the North Carolina Local Health Department Accreditation Program and the larger initiative to develop a voluntary national accreditation program for local and state agencies. An initial pilot test of the NC local accreditation program in six jurisdictions during 2004 provided evidence of the feasibility and perceived value of the accreditation process, while offering valuable feedback about the clarity and completeness of its assessment metrics. A more recent pilot test of NC’s state-level accreditation program offered similar findings. A process evaluation of participant experiences with the NC local accreditation program in 2007 found evidence that participating agencies adopted significant changes in practice while preparing for accreditation, such as updating agency policies and procedures, and activating internal quality improvement teams. Although a rigorous empirical study of the accreditation program’s impact on public health practice and outcomes has not yet been conducted, early findings from process evaluations and pilot tests are
suggestive of positive program effects. These findings provide motivation and direction for the proposed study of accreditation and its effects on public health system preparedness.

5. RESEARCH DESIGN AND METHODS

5.1 Overview of the Research Design

This project will support a multi-faceted investigation of the effects of public health agency accreditation on local preparedness and response capacities. North Carolina presents a unique opportunity for studying these issues because it is one of the first states to design and implement an accreditation program for local public health agencies, and because this program follows a phased process of implementation. A quasi-experimental research design is proposed in which we will compare local public health agencies that undergo the accreditation process at different points in time, using data collected both before and after agencies initiate the process. In addition to in-state comparisons, we will compare North Carolina agencies with a matched comparison group of public health agencies from outside the state that are not exposed to the accreditation process, using a propensity score method to identify a well-matched comparison group. To enhance external validity, some analyses will use observations from other states that have implemented accreditation programs to date, including Illinois, Michigan and Missouri. Because the metrics for assessing public health preparedness are still developing, we will use multiple data sources and measures, including self-reported structural and process-based measures from surveys and after-action reports from exercises and drills. An overview of the study design is presented in Table 1, including primary research questions, data sources, and analytical methods.

To accomplish **Aim 1**, cross-sectional comparisons will be employed to document the extent and nature of differences in preparedness between accredited and non-accredited public health agencies in North Carolina as well as nationally. This initial, descriptive study will determine whether accredited agencies appear better prepared than their non-accredited counterparts based structural and process-based measures of preparedness and response capacity. A within-state analysis will use data extracted from after-action reports of drills and exercises in which NC local health departments participate, along with data from a self-administered preparedness survey to be administered annually to all NC local health departments. A multi-state analysis will use self-reported measures of preparedness collected through the 2008 national census survey of local health departments conducted by NACCHO. This latter analysis will compare preparedness across three groups of local health departments: (1) those that have received accreditation through the programs in NC, Illinois, Michigan, or Missouri; (2) non-accredited departments that are located in one of the three states with an existing accreditation program; and (3) departments located in states without an accreditation program. Multivariate analysis methods will be used to test for differences in preparedness across the three groups after controlling for differences in institutional and community characteristics.

**Aim 2** of the research project will use a quasi-experimental, longitudinal research design to document changes in preparedness among NC public health agencies before versus after their participation in the accreditation process. Preparedness measures will be constructed using data extracted from after-action reports, along with data from the annual preparedness survey. Local public health agencies that seek accreditation in NC over a four-year period (2009 through 2012) will be compared with (1) their counterparts within the state that do not seek accreditation during the period, and (2) a propensity-score matched comparison group of local public health agencies from states that have not implemented an accreditation program. The two levels of comparison will allow us to test and control for selection bias regarding the types of agencies that elect to pursue accreditation during the study period, while also examining the possibility of a state-wide accreditation
effect that influences the preparedness capacities of both accredited and non-accredited agencies within North Carolina.

**TABLE 1: Overview of the Research Design for Studying Accreditation and Preparedness**

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Aim 3 of the project will use cross-sectional analyses to examine the extent to which accreditation standards and measures detect meaningful differences in preparedness across local public health agencies. This aim will be accomplished by assessing the degree of concordance between the accreditation metrics used as part of the NC Accreditation Program and an independent set of measures developed specifically to assess performance in emergency preparedness and response. The accreditation program includes a subset of 18 measures that relate specifically to public health preparedness and response actions, and another 42 measures designated as supportive of preparedness and response actions. The independent set of measures to be used in the analysis includes: (1) structural and process measures of emergency preparedness as reported by local public health officials; and (2) measures of system performance on public health emergency response exercises and drills.

In Aim 4 of the proposed study, a quasi-experimental, longitudinal research design will be employed to examine the effects of structural and organizational characteristics of public health systems on the preparedness and response capabilities of these systems. As in Aim 1, two levels of analysis will be examined as part of the investigation. First, a single-state analysis will focus exclusively on public health agencies in North Carolina, using detailed measures of preparedness and response capacities obtained through primary data collection. Second, a multi-state analysis will examine all U.S. public health agencies using secondary data collected through the 2005, 2008, 2010, and 2012 waves of the NACCHO national survey of local health departments. In the multi-state analysis, accreditation outcomes will be examined only in the states that have implemented accreditation programs for local public health agencies (NC, IL, MI, MO).

5.2 Research Setting and Intervention: The North Carolina Accreditation Program

In 2002, the North Carolina Division of Public Health and the North Carolina Association of Local Health Directors undertook an initiative to develop a mandatory, standards-based system for accrediting local public health departments throughout the state. In doing so, North Carolina became the first state to enact legislation establishing mandatory accreditation of local public health agencies, and to appropriate recurring state funds for local agency accreditation. Additionally, North Carolina recently has piloted the first accreditation process aimed at a state public health agency. As a result, the state has become a laboratory for testing accreditation approaches and monitoring their effects on public health systems.

The objective of North Carolina’s Local Health Department Accreditation Program is to improve the capacity of local public health agencies to perform at a prescribed, basic level of quality the three core functions of assessment, assurance, and policy development as defined by the Institute of Medicine and the ten essential services as identified by the U.S. Department of Health and Human Services. The program focuses on a set of minimal standards that must be provided to ensure the protection of the health of the public, but it does not limit the services or activities an agency may provide to address specific local needs. The program does not create a wholly new accountability system; rather it links basic standards to current state statutes and administrative code, and to the many state contractual and program monitoring requirements that are already in place.

The program comprises three functional components: (1) an agency self assessment, which includes 41 benchmarks and 148 activities; (2) a three day site visit by a multidisciplinary team of peer volunteers to observe and verify performance of activities; and (3) the determination of accreditation status by the North Carolina Local Health Department Accreditation Board. Accreditation is achieved by appropriately meeting a set of capacity-based benchmarks as evidenced by documented completion of prescribed activities. An agency may meet a benchmark by performing the activity directly or by assuring that other community organizations perform the activity adequately (through contracts, memoranda of understanding, or other arrangements with
community providers). The Benchmarks used by the program are similar to those of the NACCHO Operational Definition of a Functional Local Public Health Agency,62 and the CDC National Public Health Performance Standards Program.11 However, the specific public health activities examined through the accreditation process are tailored to the practices of North Carolina local public health agencies. During four years of implementation history, the program has accredited 35 of the state’s 85 local health departments as of May 2008. Additionally, several health departments are eligible for reaccreditation during 2008.

5.3 Data Sources and Measures

The proposed research project will use data from a number of different sources in order to assess the preparedness and response capacities of local public health agencies and to measure accreditation and other factors that may contribute to variation and change in these capacities. Measuring public health preparedness remains an active topic of research and development, and the scientific and practice communities have yet to converge on a set of valid, reliable, and widely accepted metrics.41 While a number of instruments currently exist for measuring preparedness, each one entails important conceptual, methodological, and operational limitations. For this reason, this study will use multiple structural and process-based measures of preparedness taken from several different sources in order to characterize local agency capacities. The multi-measure and multi-method approach is designed to “triangulate” on actual levels of preparedness observed within communities, and thereby reduce the study’s vulnerability to measurement error and bias from any one set of measures. The data sources to be used include: (1) administrative data routinely collected through the NC Accreditation Program; (2) observations from a self-administered survey instrument to be fielded annually with all NC local public health agencies and a matched comparison group of agencies outside the state; (3) data extracted from standardized after-action reports that are completed by NC local public health agencies following each preparedness drill and exercise; and (4) data collected through NACCHO’s national census survey of local public health agencies fielded in 2008, 2010, and 2012. The data and measures to be derived from each of these data sources are described below.

5.3.1 Administrative Data from the NC Accreditation Program

The NC Accreditation Program routinely collects performance data on each public health agency that seeks accreditation through the program. The data elements include a series of 148 indicators reflecting whether or not the agency has been determined to meet established benchmarks in performing specific public health activities. The program includes indicators for each of the Institute of Medicine core functions (assessment, policy development, and assurance), along with indicators reflecting public health agency facilities and administrative services, and indicators reflecting local governance and board of health functions. The indicators are based on those used in the CDC’s National Public Health Performance Standards Program and NACCHO’s Operational Definition of a Functional Local Public Health Agency, with some modification to reflect state-specific public health responsibilities and priorities. A subset of 18 indicators address specific public health preparedness and response activities, including those related to the designated emergency preparedness coordinator, comprehensive emergency preparedness plan, incident command system, risk communication capacities, and the use of drills and exercises. Another 42 activities involve routine capacities in assessment, surveillance, investigation, and communication activities that are likely to be supportive of preparedness and response actions.

Each indicator is rated as met or not met based on the outcome of a two-stage process that includes (1) a self-assessment instrument completed by the agency, and (2) a review of documentary evidence conducted by a team of trained site visitors to verify self-reported data. Data on individual indicators will be used to construct
composite measures of performance for each of the three IOM functions for use in subsequent analyses. The accreditation program also collects data on the institutional characteristics of each agency. These program administrative data are available for the 35 local public health agencies in NC that have completed the accreditation process as of May 2008. Another 6 agencies are scheduled to complete the accreditation process during calendar years 2008 and 2009.

5.3.2 After-Action Reports from Exercises and Drills

Each of the 85 local public health agencies in North Carolina is required to conduct annual exercises and drills that test local emergency preparedness and response capacities, and to submit standardized after-action reports of these experiences to the state public health agency. These activities take one of three basic forms: (1) operations-based exercises that involve implementation of a series of preparedness and response activities in reaction to a simulated emergency scenario; (2) operations-based drills that test a single function within the emergency preparedness plan; and (3) discussion-based (or “table-top”) exercises that involve review and discussion of preparedness plans and policies by a group of local decision-makers in response to a specific emergency scenario. Agencies are similarly required to develop and submit after-action reports in response to actual public health emergencies that involve activation of their emergency operations center. Agencies use a standard template to develop and submit an after-action report for each event, detailing the range of organizations and individuals involved, the processes used to develop and execute responses, the outcomes of these responses, and a self-assessment of strengths, weaknesses, and needed corrective actions. The data elements included on after-action reports are based on the performance metrics specified in CDC’s guidance to state grantees under the Cooperative Agreement on Public Health Preparedness and Response for Bioterrorism.

This project will use a standardized process to review and extract relevant data elements from each after-action report filed by each public health agency. Similar to the process used in medical records review and abstraction, this process will capture key information about the drill or exercise to be used for subsequent analyses. The review process and criteria will be based on the methodology developed and validated by RAND for the U.S. Department of Health and Human Services to evaluate the design of preparedness exercises and drills. The RAND review methodology uses a set of 14 review criteria, including those related to the clarity of goals and objectives, the appropriateness of the scenario, the comprehensiveness of the participating organizations and agencies, the clarity and specificity of guidance documents and materials, and the specificity of action items concerning deficiencies and lessons learned. Because the RAND review criteria focus exclusively on the design of each exercise, we will extract additional information about the implementation of each exercise, including the type of exercise/drill used; the scale of the exercise as indicated by the number and type of organizations and individual staff involved and the geographic area covered (to be analyzed in relation to the size of the agency and its jurisdiction); the breadth of the exercise as indicated by the components of the local emergency preparedness and response plan activated and tested; and the timeliness and completeness of response actions undertaken as part of the exercise (including timeliness of the after-action report itself). As with medical records review, information that is found to be missing or incompletely specified in after-action reports will be recorded as a special type of performance deficiency.

After-action reports will be reviewed by a team of trained abstractors using the standardized review protocol. Each report will be reviewed by three abstractors independently, and inter-rater reliability will be tested. Reports that show significant discrepancies among reviewers will be reviewed independently by a fourth abstractor, with final coding decisions based on a consensus process among the reviewers. A preliminary version of the review protocol will be pilot tested using an initial set of 5 after-action reports, and revised
based on feedback obtained from abstractors and local public health officials involved in each exercise and report. Individual data elements extracted from after-action reports will be used to construct composite measures of exercise design and exercise implementation for use in subsequent analyses.

5.3.3 NACCHO Survey Data

National data on the preparedness activities and institutional characteristics of local public health agencies will be obtained from NACCHO’s periodic National Profile of Local Health Departments survey. The NACCHO Profile survey collects self-reported information from these agencies through a process that targets all 2900 agencies in the 50 U.S. states and D.C. that meet the definition of a local health department: a unit of state or local government that is charged with addressing the public health needs of a geopolitical jurisdiction smaller than a state. The Profile survey collects basic information on the characteristics of each agency and its jurisdiction, including service mix, staffing characteristics, revenues and expenditures, governance, geographic area served, and population characteristics of the agency’s jurisdiction. The survey also includes an item indicating whether the agency has received accreditation from a state public health accreditation program. Beginning in 2005, the survey included a series of items reflecting preparedness and response activities undertaken by public health agencies, including development and management of a local medical reserve corps, development and updating of the local emergency response plan, participation in preparedness exercises and drills, appointment of a designated emergency response coordinator, assessment of preparedness competencies among agency staff, and development and testing of a process for deploying mass prophylaxis within the jurisdiction. The Profile survey will be re-administered in 2008, 2010 and 2012, providing four panels of data covering an eight year period. The response rate achieved for the 2005 Profile survey was 80 percent.

NACCHO Profile survey data will be used to characterize and compare the emergency preparedness and response activities of three important groups of local public health agencies: (1) agencies in North Carolina; (2) agencies in the two other states that have adopted statewide public health accreditation programs (Michigan and Missouri); and (3) agencies in the remaining states without accreditation programs. The first two groups of agencies will be sub-divided further into accredited and non-accredited agencies for comparison. Additionally, the NACCHO Profile survey will be used to identify a comparison group of agencies in the non-accreditation states that have institutional and population characteristics that match those of the 85 North Carolina agencies, using the propensity score methodology described below.

5.3.4 Preparedness Survey

An annual preparedness survey will be used to collect additional data on preparedness and response capacities of the 85 local public health agencies in North Carolina and of a comparison group of agencies located outside the state. A number of instruments have been created to collect self-reported measures of preparedness among local and state public health agencies, but relatively few have been subjected to formal validity and reliability testing, and no instruments currently have strong scientific evidence confirming that the capacities being measured are effective in preventing, detecting, or responding to public health emergencies. Given the lack of scientific consensus on appropriate metrics for measuring preparedness, the preparedness survey will draw on elements from several different instruments that have been found to offer reasonable clarity in measurement, a balance between structural and process measures, and support from prior validity and/or reliability testing. The instruments to be used in survey development include:

- The Public Health Preparedness and Response Capacity Inventory developed by CDC. The instrument contains 79 questions and approximately 700 sub-questions that measure capacity in six
preparation domains, including planning and assessment, laboratory capacity, general communications and information technology, risk communication and dissemination, and education and training.

- The National Public Health Performance Standards Program, Local Instrument (version 2.0) developed through a partnership between CDC and other national public health organizations. This instrument contains 27 items in its performance standard devoted to emergency preparedness, investigation and response.
- The CDC’s Public Health Preparedness Cooperative Agreement Performance Measures. The current reporting period guidance includes a set of six items related to detection and reporting, communication and control, and after-action improvement.
- The Connectivity in Public Health Preparedness Measurement Tool, a more recent instrument developed to measure connectivity among preparedness-related organizations and personnel. The instrument contains 28 items reflecting information exchange, communication, and interaction at the system, organizational, and interpersonal levels.

**Instrument development.** Selected items from these existing instruments will be chosen for use in the preparedness survey so as to achieve a balance among structural and process measures and among different domains of activity within the preparedness and response continuum. The items selected for use will not provide a comprehensive assessment of preparedness capacities, but rather they will represent a diverse collection of preparedness activities that can be assessed reliably across agencies and over time. An expert panel process will be used to select items from each instrument, using a four-cycle Delphi method involving the project’s external advisory group of members with expertise in public health preparedness research and practice. Once a consensus set of survey items has been identified, the items will be organized on a self-administered survey instrument and pilot tested with public health officials from five diverse local public health agencies located outside North Carolina. Cognitive interviews will be fielded with pilot test respondents following survey completion to examine how respondents arrived at their responses and to identify items that were found to be unclear, overly subjective, or otherwise difficult to answer. The instrument will be revised to clarify or eliminate problematic items based on this pilot testing.

**Survey administration.** The preparedness survey instrument will be administered annually to all of North Carolina’s 85 local public health agencies and to a comparison group of agencies located outside of the state, using a methodology for comparison group selection that is detailed in Section 5.4 below. The instrument will be programmed for web-based administration, and a modest incentive for survey participation will be offered. Letters of invitation will be sent to the director and emergency preparedness director of each selected local public health agency, with information on the study purpose and instructions for completing the survey. Postcard and telephone reminders will be sent to the selected agencies, and after eight weeks we will attempt to complete the survey via telephone with non-responding agencies. Response rates of at least 80 percent are expected based on the use of intensive follow-up combined with the research team’s prior experience in surveying local health department officials. The preparedness survey will be administered during the final quarter of project years 1, 2, 3, and 4.

5.4 Statistical Analysis and Comparison Groups

5.4.1 Cross-Sectional Analysis (Aim 1)

The project’s first set of analyses will involve descriptive, cross-sectional comparisons of preparedness measures in accredited vs. non-accredited local public health agencies. These analyses will not be used to
support causal inferences about the effects of accreditation, but rather will be used to describe patterns of variation in preparedness across accredited and non-accredited agencies. The within-state analysis will use preparedness measures extracted from after-action reports of drills and exercises in which NC local health departments participate, along with measures constructed from the self-administered preparedness survey to be administered annually to all NC local health departments. In project Year One, observations on the state’s 36 accredited agencies will be compared with observations on the remaining 49 non-accredited agencies, yielding a minimum detectable difference in the proportion of agencies meeting a preparedness standard of 18% (assuming a proportion of 50% among non-accredited agencies and p=0.05).

The multi-state analysis will use self-reported measures of preparedness collected through the 2008 national census survey of local public health agencies conducted by NACCHO. This latter analysis will compare preparedness across three groups of local public health agencies: (1) those that have received accreditation through the programs in NC, Illinois, Michigan, or Missouri; (2) non-accredited departments that are located in one of the three states with an existing accreditation program; and (3) departments located in states without an accreditation program. Multivariate analysis methods will be used to test for differences in preparedness across the three groups of agencies after controlling for differences in the public health system characteristics surrounding each agency. Multivariate models will follow the empirical specification reflected in Figure 2 and used in prior studies of public health system performance, including controls for public health agency staffing levels, scope of services delivered, annual agency expenditures per capita, population size served, socioeconomic characteristics of the community, and other health resources within the community.6, 7 Because agency perceptions of preparedness may vary based on whether the agency has recently responded to an actual public health emergency,40 the multivariate models will include controls for the number and types of actual emergencies experienced in the prior 12 months as reported by agency officials. Generalized estimating equations will be used to account for possible correlation among agencies located in the same state, and to examine patterns of spatial correlation among geographically contiguous public health agencies.

5.4.2 Longitudinal Analysis (Aim 2)

Longitudinal analyses will examine changes in preparedness among NC public health agencies before versus after their participation in the accreditation process. These analyses will focus on a cohort of 49 local public health agencies that have not participated in the NC accreditation program as of 2008. Agencies that seek accreditation during one of the subsequent three years (2009 through 2011) will be compared with three different groups of contrasting agencies: (1) agencies within the state that do not seek accreditation during the period; (2) agencies within the state that received accreditation prior to 2009; and (3) a propensity-score matched comparison group of local public health agencies from states that have not implemented an accreditation program. These analyses will use preparedness measures constructed from after-action report data (for NC agencies only) and from the annual preparedness survey (for all agencies). The propensity score matching analysis will be conducted early in the first year of the project so that agencies selected for the comparison group can be included in each year of the annual preparedness survey.

**Propensity Score Matching.** To identify a comparison group of local public health agencies that have not been exposed to NC’s accreditation program, a propensity score matching methodology will be employed.68-70 Each of NC’s 85 local public health agencies will be matched with one or more agencies located outside of the state using characteristics of the agency and the community/system it serves as matching variables. Several exclusion criteria will be applied to ensure close matching. Because NC has a decentralized public health system structure in which local public health agencies operate independently of the state health agency, we will restrict the matching process to agencies operating in the 35 other states that use a similar decentralized
structure. Additionally, we will exclude agencies located in Illinois, Missouri and Michigan because these states administer accreditation programs that share some similarities with the NC program. After implementing exclusions, approximately 1900 local public health agencies will be eligible for possible matching with NC agencies. Matching will be performed using data from the 2008 NACCHO Profile survey, containing measures of the organizational, financial, and operational characteristics of local public health agencies and their service areas.

Propensity scores will be estimated from a logistic regression equation that models the likelihood of exposure to the NC accreditation program as a function of public health agency characteristics and community/system characteristics. This model's empirical specification will reflect the conceptual model in Figure 2 following the approach we have used in prior studies of public health system performance, including controls for public health agency staffing levels, scope of services delivered, annual agency expenditures per capita, population size served, socioeconomic characteristics of the community, and other health resources within the community. The nearest neighbor method will be used to pair each NC agency with a comparison agency from another state, with random selection used to choose among comparison agencies having the same propensity score. To ensure closely matched pairs of observations, a matching-with-replacement methodology will be used, along with a caliper width of 0.01 for defining the maximum allowed difference in scores between paired observations.

**Data Analysis.** Repeated measures models will be used to assess the magnitude and statistical significance of changes in preparedness measures across groups of public health agencies defined by their exposure to the NC accreditation program. We will conduct both single-state and multi-state matched analyses. In the single-state analysis, the change in a preparedness measure ($P$) over the period between year $t$ and year $t+1$ will be estimated using the following statistical model:

$$(P_{t+1} - P_t) = \beta_0 + \beta_1 \text{NewAccred}_{t+1} + \beta_2 \text{PriorAccred}_{t+1} + \epsilon$$

where agencies that were new participants in accreditation during the period (NewAccred=1) and agencies that were participants prior to the period (PriorAccred=1) are contrasted with the reference category of agencies that never participated in accreditation through year $t+1$. The estimated coefficients $\beta_1$ and $\beta_2$, along with their standard errors, will be used to test the hypothesis that current and/or prior participation in accreditation is associated with larger increases in preparedness over time. This model implicitly controls for confounding due to time-invariant differences between agencies by allowing each agency to serve as its own control.

A second set of estimates will be generated using the multi-state, propensity-score matched analysis that provides additional protection against confounding and selection bias. In this analysis, a “difference in difference” model will be estimated as follows:

$$(P_{NC,t+1} - P_{NC,t}) - (P_{Match,t+1} - P_{Match,t}) = \beta_0 + \beta_1 \text{NewAccred}_{t+1} + \beta_2 \text{PriorAccred}_{t+1} + \epsilon$$

where each observation on each NC agency is contrasted with the corresponding observation on a matched comparison group agency. Like the single-state model, this propensity score model distinguishes between new participation, prior participation, and no participation in the NC accreditation program, and the estimated coefficients $\beta_1$ and $\beta_2$ are used to test the associations between participation and preparedness. To test for the possibility that the NC accreditation program has a statewide effect on both participating and non-participating agencies within the state, we will estimate a second, simpler form of the propensity score model that excludes the program participation variables (NewAccred and PriorAccred). Estimates from this simpler model will be more vulnerable to bias due to unmeasured confounding than will estimates from the full propensity score model, so results will be interpreted with caution.
5.4.3 Analysis of Accreditation Standards and Measures (Aim 3)

The NC accreditation program measures compliance with each of 148 specific public health activities, including a subset of 18 activities that relate specifically to public health preparedness and response actions, and another 42 activities designated as supportive of preparedness and response actions. This analysis will extract and summarize the program’s preparedness-related measures and test their correspondence with an independent set of preparedness measures collected from after-action reports and responses to the self-administered preparedness survey. The number of public health agencies that participate in the NC accreditation program in any given year is relatively small, and observed variation in compliance with accreditation measures among participating agencies has been relatively low to date. Consequently, the proposed analysis is exploratory and descriptive in nature.

As a first step we will conduct a retrospective analysis of the preparedness-related accreditation measures for all 36 public health agencies that have participated in the accreditation program from inception through 2008. The accreditation measures for these 36 agencies will be extracted and compared with independent preparedness measures taken on these same agencies from after-action reports and the first year of the preparedness survey. Pairwise tests of association will be computed for each accreditation measure and each independent preparedness measure. Agencies with one or more deficiencies noted in the set of accreditation measures will be flagged and reviewed qualitatively for evidence of deficiencies in the set of independent preparedness measures. A parallel qualitative review will be conducted starting with agencies having deficiencies in the independent measures. On the basis of these reviews, measures of quasi-sensitivity and quasi-specificity will be constructed for the set of accreditation measures, based on their performance in detecting deficient agencies noted in the independent measures. We will compile an inventory of preparedness-related deficiencies that cause inconsistencies (i.e. “false negatives” or “false positives”) in the correspondence between accreditation measures and independent measures of preparedness. These analyses of correspondence will be repeated in each year of the project as new agencies participate in the accreditation program.

5.4.4 System Characteristics Associated with Preparedness and Accreditation (Aim 4)

The analyses proposed under Aim Four will explore whether there are specific structural characteristics of local public health systems that consistently predict preparedness capabilities and accreditation outcomes. The structural characteristics to be studied include major classes of system attributes summarized in the conceptual model above (Figure 2), including the scope of public health activities performed within the system (differentiation), the range of organizations participating within the system (integration), and extent to which effort is distributed among organizations within the system (concentration). As in Aims 1 and 2, two levels of analysis will be examined as part of this investigation. First, a single-state analysis will focus exclusively on public health agencies in North Carolina, using detailed measures of preparedness and response capacities obtained from after-action reports and the annual preparedness survey. Second, a multi-state analysis will examine all U.S. public health agencies using secondary data collected through the 2008, 2010, and 2012 waves of the NACCHO Profile survey of local health departments.

**Structural Classifications.** This analysis will use the Public Health System Typology developed through preliminary studies to characterize local public health agencies based on the system-level measures of differentiation, integration, and concentration. NACCHO Profile survey data will be used to construct these measures for each responding agency and for each of the survey years 2008, 2010, and 2012. For the single-state analysis, these structural measures will be linked with the detailed preparedness measures collected on
each of the state’s 85 local public health agencies in 2009 through 2012, and with accreditation indicators from the NC accreditation program. For the multi-state analysis, structural measures will be linked with self-reported measures of preparedness and accreditation collected on the NACCHO Profile survey.

**Data Analysis.** Multivariate general estimating equations models for panel data will be used to estimate the associations between system structure and system preparedness while controlling for autocorrelation and the influence of other institutional and community characteristics. These models will use an empirical specification that reflects the conceptual model shown in Figure 2 and that follow previous studies of public health system performance, similar to the specifications used in Aims 1 and 2.6,7 One set of models will use preparedness measures as the dependent variables, and a second set of models will use accreditation outcomes as dependent variables. The larger degrees of freedom available in the multi-state analysis will allow for the testing of more expansive models that control for a larger array of potentially confounding characteristics, including control for the hierarchical clustering of local agencies within states. Because multiple measures of preparedness are used in this analysis, we will test the computational feasibility of using a latent class estimation strategy known as Multiple Indicator Multiple Cause (MIMC) modeling to control for unmeasured heterogeneity in system preparedness and thereby derive more precise estimates of the associations between system structure and preparedness. Estimates from these models will be used to test hypotheses about the types of public health systems that appear to have the strongest preparedness and response capacities, as well as the types of systems that appear to perform best on accreditation standards (H4.1 through H4.4).

5.5 **Translating Analysis Results into Accreditation Improvements (Aim 5)**

Results from the analyses conducted under Aims 1 through 4 of the study will be used to identify opportunities for enhancing public health accreditation programs so as to achieve sustained effects on local preparedness and response capabilities. These enhancements will be tested for feasibility and effectiveness in North Carolina during the final two years of the project period. Although the full range of strategies to be tested will depend on findings from the proposed analyses, we anticipate that the following types of enhancements will be examined:

- Revising accreditation performance standards and measures to include more specific elements of emergency preparedness and response capacity, including the results of exercises, drills, and after-action reports of actual emergencies.
- Providing periodic, comparative feedback to local public health agencies in the form of a preparedness report that profiles each agency’s rating on structural and process measures of preparedness, along with each agency’s performance on preparedness exercises and drills, compared to peer agencies and norms across the state.
- Incorporating expectations and incentives for the use of quality improvement (QI) methods as part of emergency preparedness activities, such as through QI guidelines and training, multi-agency learning collaboratives, and accreditation performance standards tied explicitly to the use of QI.

Each enhancement will be designed in collaboration with state and local public health officials, implemented in conjunction with the North Carolina accreditation program, and then assessed to determine how local public health agencies respond to the innovation and whether these responses are likely to lead to improvements in emergency preparedness and response capacities. Findings and recommendations based on these assessments will be disseminated broadly to state policy-makers as well as state and local public health officials in order to inform future changes in the state’s accreditation program. Because findings from this study will have application well beyond North Carolina’s accreditation program, we will synthesize all of the study’s single-state and multi-state findings in order to identify generalized implications for the design and
implementation of public health accreditation programs in other states and, of particular importance, implications for the national public health accreditation program currently under development.

5.6 Project Staffing and Management

The proposed study will be conducted by a multi-disciplinary team of researchers and analysts, who collectively bring expertise in public health systems research, health economics, preparedness, and public health practice. The proposed principal investigator, Glen Mays, Ph.D., has extensive experience in designing and executing quantitative studies of public health systems using the methods of health services research and econometrics. He serves as professor and chairman of the Department of Health Policy and Management at UAMS. Mays’ research focuses on strategies for organizing and financing public health services, health insurance, and medical care services for underserved populations. His work in public health systems has included a series of national studies examining how public health services are organized, financed, and delivered across local communities, and what factors influence the availability and quality of these services. His work has been among the first to quantify local and regional variation in the availability of core public health services, and to estimate the effects of organizational structures and spending patterns on this variation. Mays also serves as co-director of the AHRQ-funded Arkansas Consortium for Health Services Research, where he directs studies on health care access and costs. He was a founding chair of the Public Health Systems Research Interest Group at AcademyHealth and has served on various federal advisory committees concerning public health research, policy and practice. Mays serves as a member of the research and evaluation committee for the Public Health Accreditation Board, formed in 2007 to develop a national accreditation program for public health agencies. He received Ph.D. (1999) and M.P.H. (1996) degrees in health policy and administration from the University of North Carolina at Chapel Hill, completed a postdoctoral fellowship in health economics at Harvard Medical School (2000). Mays will provide overall scientific direction for the proposed project, including primary responsibilities in overseeing the project’s data collection and data analysis activities. He will devote 2.4 calendar-months to the project in year one to accommodate project start-up and developmental activities, and 1.8 calendar-months in years two through five to oversee research execution, dissemination, and translation.

Mary Davis, DrPH, will serve as co-principal investigator for the proposed project, bringing in-depth expertise in public health accreditation processes and applied public health evaluation. Dr. Davis will assume primary responsibility for the project’s interface with the NC accreditation program and for the translation of findings into enhancements for the state’s accreditation and preparedness activities. Dr. Davis is a program planner and evaluator at the North Carolina Institute for Public Health (NCIPH) at UNC-Chapel Hill. She assisted in the writing of Section G of the North Carolina state proposal for Bioterrorism in 2007. Dr. Davis conducted the first process evaluation of the North Carolina Local Health Department Accreditation Program, which involved surveys and interviews with accreditation participants, site visitors, and other key stakeholders. She has also served as a North Carolina representative on the Robert Wood Johnson Foundation-supported Multi-State Learning Collaborative, which supports states in testing the implementation and impact of quality improvement processes within public health agencies. Among her current research projects, she is leading a national study funded by the Robert Wood Johnson Foundation that examines the attitudes and preferences of local public health agency administrators toward accreditation and incentives for accreditation. She also serves as a member of the research and evaluation committee for the national Public Health Accreditation Board. Dr. Davis earned her doctorate from the Johns Hopkins University School of Public Health in 1994 and her masters from the University of Alabama at Birmingham in 1991. Dr. Davis will contribute approximately 1.2 calendar months to the project each year but her effort will be supported in the UNC-Chapel Hill budget.
John Wayne, PhD, professor of health policy and management at UAMS, will serve as an investigator on the project, providing expertise in health economics and management science along with extensive experience in state and local public health preparedness and workforce development activities. Dr. Wayne has led evaluation and assessment activities for two of Arkansas’ major public health preparedness initiatives, including its workforce preparedness education and training program and its major disaster incident response plan. In these capacities he has designed and conducted surveys to assess the knowledge and competencies of state and local public health workers concerning preparedness and response actions, and developed instruments for accessing the content and clarity of state and local disaster response plans in Arkansas and other areas of the south central region. Dr. Wayne will carry out primary responsibilities in developing and executing the project’s annual preparedness survey and the standardized reviews of preparedness after-action reports. Dr. Wayne will contribute approximately 2.4 calendar months to the project in all five years.

James Bellamy, MPH, will serve as a research analyst and predoctoral fellow on the project and work under the direction of Dr. Mays and Dr. Wayne in fielding the annual preparedness survey and reviews of after-action reports, and in analyzing the data from these activities. Mr. Bellamy serves as an assistant professor of nuclear medicine technology at UAMS and is a student in the PhD Program in Health Systems Research at UAMS. Mr Bellamy has considerable experience in emergency preparedness planning and assessment activities through his work on the CDC-funded Arkansas Statewide Emergency Preparedness Committee and the HRSA-funded Bioterrorism Training and Curriculum Development Committee for the state of Arkansas. His experience also includes preparedness workforce development activities through his service as a regional coordinator for Arkansas’ Medical Reserve Corps. Mr. Bellamy will devote 2.4 calendar months to the project in the first year, increasing to 3.0 calendar months in years two through five as data collection and analysis activities increase.

Dorothy Cilenti, MPH, MSW, will serve as an investigator on the proposed project and contribute to the review and evaluation of after-action reports, the analysis of local health department data, and the development and testing of enhancements to state accreditation and preparedness activities under Aim 5. Ms. Cilenti serves as deputy director for operations and management at the NC Institute for Public Health and as adjunct assistant professor of maternal and child health at UNC-Chapel Hill. She brings extensive experience in the organization and operation of local health department preparedness activities from her former roles as a local health officer in two county health departments in NC and as deputy director of NC’s state division of public health. She earned MPH and MSW degrees from UNC-Chapel Hill and is currently pursuing a DrPH at this institution. Ms. Cilenti will contribute approximately 1.2 calendar months to the project each year but her effort will be supported in the UNC-Chapel Hill budget.

The research team will also include a project manager/graduate research assistant to provide overall support with research administration, instrument development, data collection, and data analysis (50% effort); a data analyst at the North Carolina Division of Public Health who will provide assistance with accessing, extracting, and retrieving administrative data related to state public health preparedness and accreditation programs (15% effort); and a programmer to execute data processing and data analysis tasks involving the primary and secondary sources of data (25% effort).

5.7 Work Plan and Time Line

Due to the relatively large number of analyses and the complexities of the different data sources used, the proposed investigation will be implemented on a phased basis over the 5 year project period. Figure 1 displays the proposed work plan and timeline for the investigation. Year One of the project will focus on
design and initial implementation of primary data collection activities. The cross-sectional analysis activities under Aims 1 and 3 will begin during the last quarter of this year and will repeat in subsequent years. Longitudinal analysis activities under Aims 2 and 4 will begin in Year Three and extend through the final year of the project. The translation and enhancement activities identified in Aim 5 will occur during the final two years of the project. As noted above, a project advisory board will be appointed to provide guidance in the design and conduct of the research activities, including the development of the preparedness survey instrument and protocol for standardized review of after-action reports. The board will be comprised of 5 voluntary members who are either local or national experts in preparedness research and/or public health systems research. Board members will be convened twice per year by teleconference to review instruments and analysis plans and comment on research products.

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![Interim activity](image.png)  
![Final product/report/presentation](image.png)
6. INCLUSION ENROLLMENT REPORT

Not applicable

7. REFERENCES

8. HUMAN SUBJECTS

8.1. Risks to Subjects

Human subjects will be involved in the proposed research as local public health officials who will report on the preparedness capacities and activities of their agencies through participation in the annual preparedness survey, participation in the NACCHO survey of local health departments, completion of after-action reports following drills and exercises, and participation in the agency accreditation process. We anticipate that the proposed research using these data will be classified as exempt under Category 3 because the subjects are appointed public officials and the data reflect surveys and observations on activities that constitute official, observable governmental responsibilities. Nevertheless, the individual and agency identifiers contained in these data will only be used to link records across different years. Once these linkages are performed we will purge all study databases of any identifying information such as agency names, individual respondent names, and addresses. This research poses no substantial risk to the health officials represented in the data outside of the risk of unintentionally disclosing information about gaps in agency preparedness. This information, if disclosed to parties outside the research team, could be damaging to a health official’s reputation or employability.

8.2. Adequacy of Protection Against Risks

The study will protect against the disclosure of study data through the following activities: (1) maintaining all data on a secure, password-protected computer system accessible only to investigators on the study; and (2) purging all analytical data files of all personal identifiers and agency identifiers such as names, employee numbers, and addresses and replacing them with a unique study identification number for each study agency that cannot be linked to any personal identifiers.

8.3. Potential Benefits of the Proposed Research

The proposed research may lead to the discovery of new strategies for improving the preparedness and response capabilities of local public health agencies and the communities they serve. Because these potential benefits would enhance significantly the safety and wellbeing of the populations served by local public health agencies, and because the risk of disclosure of study data can be reduced to a very low probability through strict data processing and management procedures, the possible benefits presented by the study far outweigh the possible risks.

8.4. Importance of the Knowledge to be Gained

The research to be supported by this proposed project will produce new knowledge about the preparedness and response capabilities of local public health systems, and new insight into strategies for improving these capabilities. This knowledge will enable a more efficient and effective use of resources to protect communities from emergent health threats.

9. INCLUSION OF WOMEN AND MINORITIES

The local public health systems to be examined in this study serve all residents within local communities, including women and minority racial and ethnic groups. The 85 local public health jurisdictions to be studied in North Carolina include selected communities with relatively large shares of racial and ethnic minority
populations. The matched comparison group of public health jurisdictions outside the state will include similarly diverse communities, because matching will be performed based in part on measures of racial and ethnic composition. The analyses to be conducted will test specifically for evidence of differences in preparedness across communities with different racial and ethnic compositions.

10. TARGETED/PLANNED ENROLLMENT TABLE

Not applicable

11. INCLUSION OF CHILDREN

Although they will not be examined specifically in this study, children represent an important and potentially vulnerable population that may benefit considerably from efforts to improve local emergency preparedness and response capabilities.

12. VERTEBRATE ANIMALS

No vertebrate animals are used in this study.

13. SELECT AGENT RESEARCH

Not applicable

14 MULTIPLE PD/PI

Not applicable

15 CONSORTIUM/CONTRACTUAL AGREEMENT

The proposed research will be carried out through a collaboration between investigators at UAMS and UNC-Chapel Hill. Each entity brings a critically important knowledge base and analytical skill set to the project, including expertise in public health system performance measurement and public health systems research at UAMS, and expertise in public health agency accreditation and applied public health systems development at UNC and the North Carolina Institute for Public Health. The consortium will be administered through designated leaders at each institution, including the PI based at UAMS and the Co-PI based at UNC-Chapel Hill. The project has delineated clear areas of responsibility for each investigator at each institution, and it will establish regular meetings and modes of communication to ensure coordination across the two institutions. The two institutions have a history of successful collaboration on related research projects involving public health systems.