The Centers for Disease Control and Prevention Office of Workforce and Career Development is committed to developing a competent, sustainable, and diverse public health workforce through evidence-based training, career and leadership development, and strategic workforce planning to improve population health outcomes. This article reviews the previous efforts in identifying priorities of public health workforce research, which are summarized as eight major research themes. We outline a strategic framework for public health workforce research that includes six functional areas (ie, definition and standards, data, methodology, evaluation, policy, and dissemination and translation). To conceptualize and prioritize development of an actionable public health research agenda, we constructed a matrix of key challenges in workforce analysis by public health workforce categories. Extensive reviews were conducted to identify valuable methods, models, and approaches to public health workforce research. We explore new tools and approaches for addressing priority areas for public health workforce and career development research and assess how tools from multiple disciplines of social sciences can guide the development of a research framework for advancing public health workforce research and policy.

KEY WORDS: Centers for Disease Control and Prevention, public health, social sciences, workforce

Reports have often described impending shortages in the capacity of the public health workforce in meeting future challenges and have called for increased investment in public health workforce development, training, and lifelong learning. The American Public Health Association reports that public health workforce shortages have been growing steadily worse since 1980. According to the report, at least 23 percent of the existing public health workforce—approximately 110,000 workers—will be eligible to retire within the next 5 years. By 2020, an additional 250,000 public healthcare workers might be required to avert a workforce shortage that can leave the nation vulnerable to wide-ranging pending threats, including infectious diseases (eg, pandemic influenza), bioterrorism, and natural disasters. The 2007 State Public Health Workforce Survey by the Association of State and Territorial Health Officials (ASTHO) also notes a continued shortage of public healthcare workers, particularly nurses, epidemiologists, laboratory technicians, and environmental healthcare workers. In response to the 2007 survey findings, the ASTHO recommends a multidimensional, long-term approach to strategic workforce development, which includes advocating for increased resources for states and localities to enhance their workforce activities, studying public health workforce needs through quantitative research and enumeration, and fostering innovative strategies to counter the impending workforce shortage.

Leading practitioners and researchers within the field of public health have long called for strategic

Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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public health workforce development and stressed the need for research to provide an evidence base to guide public health workforce programs and policies. In 2004, Tilson and Gebbie noted the “enormous legacy of neglect in conducting formal public health systems research, including workforce research, sorely needed to advance the evidence base upon which policy in building the public health workforce must rest.”

In 2005, Tilson and Berkowitz noted that evidence is lacking upon which to base workforce needs projections, mandate minimal staffing, or measure the quality or impact of public health programs and the effectiveness of public health policies. In addition, the evidence base for understanding and predicting the impacts of public health workforce size, composition, quality, and policies on the performance of public health services, including meeting specific public health challenges, remains limited. The existing lack of common understanding and consensus, combined with a lack of data detailing workforce structure, attributes, and function, highlights the need for interdisciplinary research that examines a range of challenges, including enumeration, quality, costs, incentives, accessibility, delivery, and measurable outcomes associated with the public health workforce.

The Centers for Disease Control and Prevention (CDC) has long been viewed by state, local, tribal, community, and nonprofit organizations as a key federal partner for influencing the science, policy, and practice of public health. The problem of supply and demand for qualified public healthcare workers is a topic of shared interest among these stakeholders. Although the Health Resources and Services Administration has the congressional mandate to monitor health workforce concerns and continues to study occupational trends on which to base national policy for physicians, nurses, dentists, and pharmacists, as well as urban versus rural distributions, the need to explore and conduct focused research on other public health workforce topics remains.

In 2004, the CDC completed a major reorganization that was intended to result in a more flexible, results-oriented, responsive, and interdisciplinary enterprise. The Office of Workforce and Career Development (OWCD) was formed and positioned within the Office of the CDC Director to ensure that a critical mass of staff was focused on the science, policy, and practice of workforce development to enable the achievement of 21st-century health protection goals, both domestically and globally. The mission of the OWCD is to improve health outcomes by developing a competent, sustainable, and diverse public health workforce through evidence-based training, career and leadership development, and strategic workforce planning. Achieving this mission, along with the research priorities aligned with the CDC’s Health Protection Goals, as described in Advancing the Nation’s Health: A Guide to Public Health Research Needs, 2006–2015, requires a solid evidence base for guiding public health workforce policies, programs, and practice.

In September 2006, the OWCD initiated a formal process of building this evidence base by seeking expert guidance on facilitating and conducting organized, well-informed public health workforce and career development research. To achieve this objective, the CDC invited partners with workforce and public health expertise to review existing research in the field of public health workforce and career development. A cadre of leading public healthcare researchers and practitioners from academia, research institutions, other federal agencies, state and local public health organizations, relevant nongovernmental organizations, and other relevant domestic and global partners was asked to provide recommendations for prioritization, development, funding, implementation, and evaluation of workforce and career development research. Specific input was sought on the initial steps that the OWCD should take to advance a coordinated research effort. Through this process, and supported by a literature review and an environmental scan, multiple priority areas for research were identified that built on and extended previous related initiatives.

This article explores new tools and approaches for addressing priority areas, provides a strategic direction, and indicates how tools from the social sciences, which have been successfully applied in other areas of workforce policy, can guide the development of an objective, evidence-based, and policy-focused framework for advancing public health workforce research and policy. Strategic human capital management is a challenge faced in every sector and industry, not just public health. Thus, developing the evidence and scientific investment for success in any human capital management plan is also a common challenge. Reviewing the evidence, best practices, and methodologic approaches used in other disciplines can provide methods, applications, and policy insights relevant for developing a strategic, policy-driven research framework to professionalize the public health workforce.

**Status of Public Health Workforce Research**

To support the development of a public health workforce research agenda, we conducted a literature review and an Internet-based environmental scan to examine key topics related to public health workforce development research. This extends prior work conducted by the CDC and other key partners in their review of the scholarly public health and medical-related journal.
literature for articles and institutional reports published during 2004–2006.7

**Literature review**

Initially, searches in the PubMed database identified review and research journal articles and institutional reports. Search terms were restricted to “public health workforce” and “research” to focus on the most relevant articles. These initial searches yielded approximately 50 articles from the peer-reviewed literature published during 1996–2006. Additional 23 institutional reports were identified as containing sections relevant to public health workforce development research. A second series of searches using the PubMed database identified relevant peer-reviewed literature published during 2003–2006. This second series of searches within PubMed was conducted by using the term “public health workforce” and seven additional search terms and phrases (“healthcare,” “career development,” “research,” “recruit,” “retention,” “training,” and “competencies”), both as exact phrases and with all words included.

Another comprehensive series of searches was performed by using Education Resources Information Center (ERIC) searches to identify any relevant peer-reviewed literature that was published during 2003–2006. These searches were conducted by using the term “public health workforce” and seven additional search terms and phrases (“healthcare,” “career development,” “research,” “recruit,” “retention,” “training,” and “competencies”), both as exact phrases and with all words included, as had been applied to the PubMed database. Of the limited number of potentially relevant citations that emerged from the ERIC searches, no identified articles presented information and data that were linked closely with the focus of the literature review. An additional ERIC search was conducted for the term “health manpower planning.” No citations from 2003 to 2006 were identified.

In addition to Google (http://www.google.com), we used Copernic Agent Basic. We chose a relatively narrow search strategy to focus on the public health sector by including only the search terms “public health workforce” and “research.” The search was also restricted to publication years 2003–2007. In addition, results were further narrowed by excluding Internet sites of schools of public health, conference announcements, duplicates, broken links, or other documents determined as irrelevant for research. We then expanded the environmental scan to include a review of key institutional documents from the World Health Organization, the National Science Foundation, and the ASTHO.

### Public Health Workforce Research Themes

Using findings from the literature review and environmental scan and considering the input from a 2007 partnership meeting, eight research themes were developed. These themes reorganize those developed by Cioffi et al7 to facilitate strategic implementation and include important research and policy questions and objectives identified by the partnership meeting and the literature after 2004. The following sections present the eight themes, including related research objectives and questions.

#### Theme 1: Workforce size and composition

An in-depth assessment of the public health workforce size and composition is critical to implementing activities that target sustainability and effectiveness of the workforce and its resources.3,6,8,11 Lack of knowledge regarding the size and composition of the public health workforce complicates description of workforce trends (eg, size, diversity, distribution, qualifications, and experience), forecasting of future needs, identification of areas that require development, and collection of accurate data on recruitment and retention.6,8,12-17
Thus, to advance public health workforce and career development research, measuring, monitoring, and forecasting the workforce size and composition are necessary. This allows the assessment of the status of and historical trends in public health workforce size and distribution by age, sex, race/ethnicity, education (skills), occupation (job type), geographic location, and experience at national, state, and local levels, including relevant organizational settings (eg, US Department of Health and Human Services and the CDC). This also provides the data necessary to forecast public health workforce needs, mandate minimal staffing, and leverage the US Congress for funding to support necessary public health workforce capacity requirements. Methods for enumeration of the public health workforce should be standardized and a routine surveillance or tracking system should be employed. A standardized national system should be developed to classify the public health workforce and its functions, and standard categories should be established for age and race/ethnicity. Models should be developed to better identify the optimal composition of the public health workforce employed in specific public health venues, and these should be supported with effective measures of workforce composition and capacity.

**Theme 2: Workforce diversity**

In the broadest sense, diversity entails respect for the differences represented by individual persons in the workforce, including their varied perspectives, cultures, sociodemographic characteristics, and competencies. Recognizing, appreciating, and cultivating workforce diversity both to achieve a positive work environment and to enhance relationships with customers are critical because both will enhance workforce effectiveness. Diversity in the public health workforce is a concern that must be assessed so that the workforce is prepared to meet the existing and anticipated demands of an ever-diversifying national population. The public health workforce must be better equipped to handle concerns that arise from sociodemographic shifts in service areas, and leaders of the public health workforce should restructure their staff organizations and methods to respond effectively to a wide array of cultural, linguistic, and economic impediments confronted by new immigrants to the United States. Racial communities other than White, as well as certain ethnic groups, historically have been underrepresented in the public health workforce. Therefore, researchers should focus on demographic shifts in the workforce when estimating the future demand for public healthcare workers. Diversity among the workforce necessitates assessing workforce needs and effective workforce planning. However, estimates of diversity in the workforce are needed and models for making such estimates need to be developed to facilitate comparisons with the national labor force. This will enable comparison of the sociocultural and demographic profiles of the existing and projected public health workforce with the existing and projected profiles of the US population, a comparison necessary for effective local community workforce planning initiatives.

**Theme 3: Workforce effectiveness and health impact**

A capable and effective public health workforce is a critical resource for tackling ongoing public health challenges, emerging health risks, and national and global crises. However, empirical evidence on the health impact of an effective public health workforce is extremely sparse. Systematic assessment of training programs in meeting workforce capacity gaps is hindered by a lack of data, well-entrenched practices, and inadequate past research in the area. Nevertheless, understanding the impact of workforce size, composition, and quality on health outcomes and health services delivery, including disparities across demographic and socioeconomic groups, is crucial for understanding how best to develop a qualified, competent, and effective public health workforce.

Research in this area should focus on three different fronts. First, a comprehensive workforce surveillance system (see the following discussion) should include data and indicators that assess the impact of public healthcare professionals on targeted health outcomes or the delivery of public health services in specific situations, including emergencies and outbreaks. Testing program performance standards within the framework of the 10 Essential Public Health Services (as outlined by CDC’s National Public Health Performance Standards Program, http://www.cdc.gov/od/ocphp/nphpsp/essentialphservices.htm) will be critical for determining their impact on health services delivery and specific health outcomes. Second, the impact of public health training programs on workforce effectiveness should be evaluated by conducting longitudinal studies that assess the training and career experiences of trainees and alumni, including their impact as public healthcare professionals and leaders influencing public health research, policy, and practice. In addition, the impact of training and professional development, including that of credentialing of public healthcare workers, on the quality of public health services delivered should be studied. Finally, methods for evaluating the impact of public health workforce policies on workforce characteristics (eg, size and composition) and on the quality of health outcomes and health services delivery should be developed and applied. In particular, the impact of public health workforce
policies should be assessed regarding how they relate to the workforce effectiveness in achieving measurable health impacts.

**Theme 4: Recruitment, retention, separation, and retirement**

Recruiting and retaining qualified public healthcare practitioners, including identifying incentives and policies for succession planning, will be a fundamental task for maintaining and improving the public health workforce in the future. Existing governmental recruitment and retention efforts are inadequate to fill the needs for a well-trained, well-staffed public health workforce, and critical workforce shortages have been reported in all professions, with the worst shortages affecting workers in the nursing, epidemiology, laboratory science, and environmental health fields. A key gap for the field exists in the lack of understanding about when and how people make public health career decisions; therefore, identifying and studying factors related to the decision of a worker to enter the public health field are important, as well as monitoring trends and identifying key determinants of recruitment and retention in public health organizations. Also important are understanding which recruitment and retention strategies will produce the best public health workforce in the future and assessing the impact of workforce-shaping incentives on separation and retirement decisions so that interventions and policies for maintaining an effective public health workforce can be identified.

**Theme 5: Worker pay, promotion, performance, and job satisfaction**

A motivated and satisfied workforce is essential for developing an effective and productive public health workforce. State and local public health agencies provide relatively low pay, poor benefits, and adverse working conditions, compared with what is provided by the private sector. Research indicates that potential recruits to the public health workforce deem public health work to be of low status in the United States, in contrast with work in other health-related fields, and that it does not provide competitive enticements for students and young professionals choosing their respective career paths. However, considerable additional research is needed to identify and assess job-related characteristics that are specific to public health organizations and that contribute to worker perception of job satisfaction. For example, knowledge is limited regarding the effect of core competency attainment on overall job satisfaction among workers in public health organizations or the impact of career incentives (eg, promotions or rewards) and employee benefits (eg, medical leave, retirement and health benefits, flexible work schedules, and employee support groups) on employee performance and job satisfaction. In addition to individual-level benefits, the impact of organizational practices (eg, performance reward systems), organizational climate (eg, employee empowerment and open communication), and organizational culture and values (eg, whether employees feel valued or whether they trust and respect leaders) on employee job satisfaction should be studied.

**Theme 6: Demand for the public health workforce**

Periodic assessment of the demand for the public health workforce is critical to identifying the need for public health services and existing and future workforce challenges. Ongoing research should indicate the workforce capacity (including size, capability, training, and resources) needed at different levels to ensure that public health organizations have the capability to perform their roles within the broader public health system. Additional information is needed to assess how demand is likely to change in the future and to determine the characteristics of the public health workforce that will probably be affected by such changes. In addition, empirically based models for assessing the demand for the public health workforce must also be developed. These models will use historical data on burden of disease to estimate the impact of demographic (ie, aging and changing racial/ethnic composition), epidemiologic (ie, disease burden and risk factors), and technologic changes on future demand for public healthcare workers across different settings, occupational categories, and types of service. Other models can use historical data on changing demographics (ie, aging and changing racial/ethnic composition) at subnational settings (ie, state and county levels) to forecast the public healthcare worker demand that might be necessary to ameliorate the regional disparities in health by adequate supply of healthcare workers, especially in underserved regions. The development of workload-based models that focus on the specific needs of the population to be served, with changes in needs across time driving the workforce capacity necessary to provide services, will also be useful. Comparing the projected supply with demand for public healthcare workers will be critical for identifying gaps and estimating the investments necessary to ensure that the public health workforce remained effective (in size, composition, and training) in meeting existing and future public health challenges. Assessing upstream investments with respect to years of experience and the job-specific training necessary to achieve the successful development of a workforce prepared to meet future needs is also critical.
Theme 7: Education, training, and credentialing the public health workforce

Ensuring a highly and consistently trained national public health workforce is essential for addressing the needs of public health research, practice, and evaluation.\textsuperscript{6,10,12,28} Researchers should determine to what extent core competencies for public health practice are measurable, what would make them more measurable, and who would measure them.\textsuperscript{28} Training of the public health workforce is a crucial element of enhancing individual competency and building the capacity of the public health workforce to respond to existing and future public health needs. Providing training for the public health workforce remains an inadequately funded priority, and no specific standards for training the public health workforce are available.\textsuperscript{4,17,29,30}

Research topics related to public health also include workforce education, training, and credentialing. Research should explore the types of certification programs that exist and the impact they have on increasing the knowledge, skills, abilities, and competencies of public healthcare workers. Evaluations should be done to determine the capacity of public health organizations for providing training to different types of workers, the association between pre- and in-service trainings, and the politics germane to providing training. In addition, accreditation and certification practices used in other workforces (eg, engineering and the military) should be reviewed to gather useful information for understanding the potential value of credentialing the public health workforce. Identifying and validating core competencies for effective public health practice are critically important starting points for research because one first needs to define what functions should be performed by the workforce and what skills are required by individual workers or groups. Additional research is needed to determine the best methods for developing and defining competencies, the effectiveness of competencies and the impact of credentialing on hiring and promotion practices, the impacts of certification and credentialing on the health of populations and communities, the practice of professions, and the organization and delivery of services in the public sector.

Theme 8: Public health workforce policy

Because public health workforce policies (eg, labor market, regulatory, and personnel) are a crucial part of the process of developing the workforce, research is needed to understand the role and impact of such policies on all aspects of the public health workforce. For example, understanding how workforce policies affect the outcomes realized by public health service delivery is important (eg, determining whether training makes a difference or whether workforce policy failures negate the development of public health careers). The direct impact of such policies on the workforce itself is also of interest (eg, measuring the impact of workforce policies on attracting, developing, and retaining talent within the workforce). Because policies can be adapted and developed to provide the best possible outcomes, beginning to evaluate the policies that are in place is crucial for defining best practices for effective public health workforce and career development.

● Strategic View

Ideally, future decisions regarding the public health workforce should be grounded in empirically driven and evidenced-based research that is coordinated and systematic. However, a substantial part of the public health workforce research conducted to date has been uncoordinated and fragmented (through time and in terms of topics, effort, and funding). Across the field of public health, no common language exists with which to discuss workforce research priorities, develop standard metrics linked with research questions, or evaluate broad workforce policies to determine their effectiveness when applied to workers in the field.

The collective task defined in the previous section cannot be accomplished by a limited number of persons or a single organization. Strategic partnerships among federal agencies (eg, the CDC, the Bureau of Labor Statistics, and the National Science Foundation), academic researchers and institutions, public health organizations (eg, the National Association of County and City Health Officials, the ASTHO, and the Council of State and Territorial Epidemiologists), philanthropic organizations (eg, the Robert Wood Johnson and the Bill and Melinda Gates foundations), other key stakeholders and partners (eg, the Council on Linkages Between Academia and Public Health Practice, the American Public Health Association, the Association of American Medical Colleges, and the Association of Schools of Public Health), and policy-focused research institutions (eg, the RAND Corporation) must be formed to advance the common goal of a prepared, effective public health workforce and to undertake the research necessary to support public health workforce policies, programs, and practice.

Although the previous sections delineated broad public health workforce themes, these were defined either by existing research in the field (through the literature review and the environmental scan) or by research needs deemed important by public health workforce researchers and leaders. Substantial research on the public health workforce has been conducted, yet many of
the most crucial research needs have not been met in spite of multiple research agendas and reports that have been developed on this topic. This begs the question as to how the research agenda described in this article, and indeed the entire special issue of this journal on public health workforce research, will be any different from what has gone before. Although every research study makes an important contribution to science, a single research study in any one area will do little to advance the field as a whole. This section synthesizes the results of the findings from the literature review and the environmental scan and the input from the partnership meeting into a more strategic framework for advancing public health workforce and career development research. The six functional areas of the strategic framework are described in the following section. These descriptions include the major initiatives needed to advance each functional area.

Definitions: Develop and promote a universal language, shared priorities, and standards

This broad area includes the development and promotion of a universal language and standards for describing the public health workforce, as well as the identification of shared priorities for public health workforce and career development research. The following crucial, overarching needs must be addressed to advance public health workforce research: a unified and sustained approach to determining research priorities, an agreed-upon definition of the public health workforce, standard occupational classification categories for the public health workforce, and an enumeration or estimation system based on consistent descriptive classification categories for the public health workforce (eg, functional roles, professions, and preparation). A consensus must be reached on these shared priorities and standards, and the partnerships described earlier will be crucial for making progress toward this initial goal.

Data: Build an empirical foundation for decision making

The data needed to address the important research questions in public health workforce and career development are lacking, incomplete, or unorganized. A strong need exists for a more comprehensive and systematic approach to data collection efforts. In addition to the relatively substantial comprehensive public health workforce data collection and tracking system called for earlier, a need also exists for standardized surveys that can be used to identify trends in recruitment and retention, diversity, and training of the public health workforce. Data systems to identify trends in the capacity of the public health workforce are also needed. Long-term, comparative studies are needed to identify and formulate best practices for training and career development. Even when valid data exist (eg, from National Association of County and City Health Officials’ profile study, the ASTHO, or the Council of State and Territorial Epidemiologists), they can be difficult to access and understand. Moreover, both redundancies and gaps are apparent in existing survey instruments. Concerted data collection efforts from different branches of the federal, state, and local governments can help managers monitor the public health workforce with improved cost-effectiveness.

Methodology: Create general methodologic approaches for measurement and analysis

This functional area involves development of metrics, economic indices, analytic models, and general methodologic approaches for understanding, describing, and analyzing all aspects of public health workforce and career development. Empirical research methods from evaluation science, economics, and the social sciences should be adapted for use in public health workforce research to (1) measure and forecast demand; (2) develop effective measures of workforce composition and capacity; (3) determine how best to describe career paths in public health; (4) measure the impact of workforce strategies and training methods on public health workforce capacity; and (5) identify, track, assess, and validate the core competencies needed for public health practice by professionals at different points along the career continuum (eg, from entry level to advanced professionals).

Evaluation: Develop a comprehensive evaluation framework

An evaluation framework for public health workforce training and career development programs is needed. Work indicated in earlier goals can provide information for this functional area (eg, efforts to define measures and indicators for workforce training and career development outcomes). This framework should include the necessary inputs required for strong workforce training and career development, typical activities and associated outputs, and intended outcomes, both short and long term. Indicators and data sources for key components of the framework should also be included. Methodologies and instruments should be developed for evaluating the needs and best methods for implementing highly specialized training programs to increase competencies. Evaluation tools, including defining indicators for key activities or outputs and outcomes and potential data collection methods and sources for these indicators, should be developed.
Policy analysis: Conduct research to establish the connection between policies and outcomes

Evidence-based policy studies that are capable of influencing decision making and the political agenda necessary to professionalize the field of public health are crucial for developing, sustaining, and ensuring the effectiveness of the public health workforce. Although existing data are limited, conducting research to establish the connection between policies and key outcomes is important for providing the public health leadership with essential information for setting targets and shaping the future of the workforce.

Dissemination and translation: Translate and disseminate research findings to guide the development of recommendations and guidelines and future direction

A coordinated approach to sharing research and translating results is important and virtually unprecedented in the field of public health workforce research. Translation, communication, and outreach to communities are all important; however, this functional area often is overlooked in public health workforce research.

Perspectives From Other Disciplines

Workforce studies have a long and rich tradition in both the healthcare professions and government, but research has been limited regarding the public health workforce. This article highlights the range of critical concerns facing the public health workforce (see the “Status of Public Health Workforce Research” section) and notes the scanty evidence base available within the field of public health to provide the research necessary to resolve these questions. Thus, exploring other disciplines (eg, economics, sociology, education, public policy, business, and human resources) that have employed rigorous methodologic and innovative empirical approaches in addressing critical and relevant concerns in workforce research is instructive. Do other disciplines enumerate their workforce, and if so, how? Does professional credentialing (eg, in nursing and engineering) affect workforce effectiveness, quality, and productivity? What data and methods do other disciplines use to measure workforce capacity and to estimate existing and future workforce demand? Are any proven approaches available to guide best practices for recruitment and retention? What is the empirical evidence for workforce-shaping incentives and policies that work (or do not work) and what additional empirical evidence is needed? What are the general tools and methods that have been used to evaluate these strategies or policies? Most important, have other disciplines undertaken policy-driven workforce research that might be relevant for public health?

To learn from other approaches and disciplines with the intent to apply best practices or highly promising techniques in order to better characterize the public health workforce, we constructed a matrix of key elements or topics in workforce analysis by public health workforce categories (Table 1). In addition, we identified different workforce sectors (described in the following text) that might share these key elements or face similar challenges. The matrix helped conceptualize and prioritize development of an empirical, policy-focused research agenda for the public health workforce that uses proven methods, evidence, and best practices from other disciplines.

To develop the matrix, we first delineated selected problems with which the public health workforce is grappling, many of which are based directly on the research themes presented in the previous section; others arose from important aspects of the public health mission. These key elements include (1) enumeration and classification; (2) professional certification and licensing (regulation) and accreditation; (3) public versus private differentials in compensation and benefits; (4) support for core methodologies and innovative research; (5) labor market forces (ie, supply and demand and regulation); (6) educational pipeline, precareer planning, succession planning; (7) mission or inspiration to service; (8) emergency response; and (9) global mission.

Next, we identified multiple broad public health workforce categories comprising professional groups of workers represented in the public health workforce. These included senior medical professionals (eg, public healthcare physicians), science, technology, engineering, and mathematics (STEM) professionals, technical support and communications occupations (eg, information technology, health communication specialists, and laboratory technicians), public health-care practice professionals (eg, nurses, epidemiologists, community health workers, and educators), managerial/leadership roles, and administrative service professionals (eg, accounting, clerical, and human resources).

We then identified relevant workforces, disciplines, or sectors that either are a part of or have certain similarities with the public health workforce in mission, training, or function. We considered the following workforces or sectors for our initial review: physicians, nurses, teachers/educators, lawyers, STEM group (academics), nonprofit sector (volunteemsim), military/other governmental, public safety, business management, and public policy. For each cell in the matrix presented in Table 1, we identified the occupational workforce or workforce sector that had researched an
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<th>Public health workforce category</th>
<th>Enumeration and classification</th>
<th>Certification and licensing</th>
<th>Public vs private differentials in compensation and benefits</th>
<th>Support for core methodologies and innovative research</th>
<th>Labor market forces (supply and demand, regulation)</th>
<th>Educational pipeline/precareer planning</th>
<th>Inspiration to service</th>
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Abbreviations: B, business management; L, lawyers; M, military; M/O, military/other governmental; N, nurses; NP, nonprofit sector (volunteerism); P, physicians; Policy, public policy; PS, public safety; STEM, science, technology, engineering, and mathematics, including academics in those fields; T, teachers/educators.
attribute or concern that was also relevant for a public health occupational group. For example, considerable study has been done on the licensing of physicians and certain STEM disciplines have considered the positive and negative attributes of licensing or credentialing their members. We then cross-classified attributes and concerns with professional groups to produce the matrix presented in Table 1. The goal of this matrix was to develop a comprehensive, yet succinct, view of the public health workforce that can form the basis for a literature review in other workforce disciplines. Our objective was to identify promising study designs or areas of applications in other disciplines that addressed concerns relevant and critical for the public health workforce as well.

Finally, we conducted an extensive multidisciplinary review on methods, evidence, and best practices in workforce-related topics and policies across a range of disciplines to identify valuable ideas, approaches, and recommendations that can guide the development of an empirical, policy-focused research agenda on the public health workforce. We did not intend to focus on each of the cells in the matrix but rather strategically select areas that met the following criteria:

1. deemed a high-need area for the public health workforce analysis;
2. based on data-driven technologies that can apply to public health workforce analysis; and
3. technologies/methods/approaches that can be adapted to inform and influence policy makers in their decisions regarding public health workforce development.

The particular entries in the matrix identify a sector—key element—professional group for which we identified literature meeting the specified criteria. For example, considerable literature exists regarding private versus public employment compensation for physicians, lawyers, teachers, and military personnel.

Any concerted initiative to move the intellectual underpinnings of public health workforce research forward requires initiating a dialogue between leading social science, biomedical, and public healthcare researchers and practitioners. As the first step in this direction, we organized a 2008 workforce research conference that brought together prominent researchers identified from this literature review, who have used social science methods to examine workforce policy concerns, with experts in public health and the public health workforce. The purpose of the meeting was to assess how the tools from the social sciences, which have been successfully applied in other areas of workforce policy, can guide the development of an objective, evidence-based, and policy-focused framework for advancing public health workforce research and policy. This special journal issue highlights the key articles and commentaries from that meeting. The major articles feature summaries of research from leading scholars who have played a meaningful role in transforming workforces in different fields and who can illustrate exemplary perspectives and methodologies that can be used to guide and inform public health workforce and career development research. Selected articles are followed by commentaries by public health experts who address ways in which the field of public health can benefit from similar initiatives, analyses, models, and data collection efforts.

Research topics covered in this special issue are wide ranging, as illustrated in the following:

- creating the right incentives for defining and regulating the profession, including accreditation and credentialing, to ensure that the workforce has the right skills and competencies;
- developing methods for enumerating the workforce size and composition;
- developing models for assessing existing and future workforce needs and shortfalls in workforce capacity;
- examining methods and lessons learned to identify effective policies and strategies for strategic recruitment of the best and the brightest, scaling programs and policies for talent management and for nurturing lifelong learning, creating the right incentives for shaping retirement and separation decisions, and nurturing leadership development programs to implement succession planning;
- using the right approaches to extend the outreach of career path programs to attract middle, high school, and college students to science and public health; and last, but not the least; and
- identifying effective strategies to counter severe shortages and deficiencies in the global public health workforce.

We sincerely hope that the breadth of innovative ideas, approaches, and insights from these articles will help us collaboratively to advance a sustainable, evidence-based, and well-coordinated workforce research initiative for tackling existing and future public health workforce challenges.

REFERENCES


