Building an Effective Workforce
A Systematic Review of Public Health Workforce Literature

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Context: The Robert Wood Johnson Foundation commissioned a systematic review of public health workforce literature in fall 2010. This paper reviews public health workforce articles published from 1985 to 2010 that support development of a public health workforce research agenda and address four public health workforce research themes: size and composition, effectiveness and health impact, demand, and policy.

Evidence acquisition: PubMed, ERIC, and Web of Science databases were used to search for articles; Google search engine was used to identify gray literature. The study used the following inclusion criteria: (1) the document was published in the U.S.; (2) the main theme(s) of the article address public health workforce research or relate to at least one of the four workforce research themes; and (3) the article focuses on the domestic workforce.

Evidence synthesis: A total of 126 public health workforce articles and gray literature documents were analyzed in this review, including 34 related to effectiveness and health impact, 32 summary articles, 30 articles on size and composition, 20 articles about demand, and 10 policy articles. The primary sources for identifying articles were PubMed (66%); Google (28%); and Web of Science (6%).

Conclusions: The majority of public health workforce articles are descriptive in nature; few empirical studies about the public health workforce have been published in the peer-reviewed literature. Future research should consider use of organizational theories to develop workforce capacity models for public health and development of quantifiable output measures on which to base models that incorporate workforce demand.
1. What is the size and composition of the workforce?
2. How can the workforce’s effectiveness and impact on population health be measured?
3. How can the workforce be monitored and demand projected?
4. What policy measures, including the Affordable Care Act, affect public health workforce development?

Evidence Acquisition
The study was conducted in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA).4

Eligibility Criteria
Although the public health workforce is the primary focus of this systematic review, relevant healthcare workforce literature was included when public health studies were insufficient to address the research questions. The following criteria were used to determine reference eligibility for inclusion: (1) peer-reviewed articles are published in a U.S. journal; gray literature is published by a U.S. organization or government agency; (2) the main theme(s) of the article address public health workforce research or relate to at least one of the following workforce focus areas: size and composition; forecasting demand; effectiveness and health impact; and policy; and (3) the article focuses on the domestic workforce.

Information Sources
Peer-reviewed articles were identified using PubMed, ERIC, and Web of Science databases. PubMed and Web of Science were chosen for use because of their overall breadth and inclusion of articles that span medical and social science literature. ERIC was used in this search process because of its potential to identify literature that pertains to education and training of the workforce and based on its frequent use in other public health workforce review studies.5 Google search engine was used to identify gray literature.

Additionally, a search was conducted for non-peer reviewed technical reports on websites of national professional associations commonly cited in the peer-reviewed literature as having contributed to workforce research. Examples include the Association of State and Territorial Health Officials (ASTHO) and the National Association of County and City Health Officials (NACCHO). Finally, an examination was made of the references cited by articles that provided descriptive information about the public health workforce and reviewed public health workforce literature in order to cross-check the current formal search results of the peer-reviewed and gray literature and identify relevant articles that had been missed.

Search Strategy
The time period of January 1, 1985, to December 10, 2010, was chosen for the search in order to maximize the probability of capturing publications associated with the launch of major national initiatives aimed at improving public health infrastructure such as the IOM’s Future of Public Health report and related recommendations.5,6 The search period ended on the date of study termination. The same search terms were used for all databases and search engines, and the search results were filtered by country, automatically excluding international literature.

Search terms were derived from thematic focus areas identified for each research question. Public health workforce was used as the first search term, and then in combination with the following terms and phrases: development, enumeration, capacity, policy, infrastructure, performance measures, and composition. Some search terms directly corresponded to one research theme, whereas others were broad and encompassed multiple themes. To frame the results in the context of the research questions, article summaries are presented by research theme as opposed to search term.

Evidence Synthesis

Description of Studies
The initial search of public health workforce returned 18,727 results in PubMed and 489 in Web of Science. A scan of abstracts revealed that the majority of these articles were not specific to public health; several more were either too general or did not address the research themes. The additional search terms outlined in the Evidence Acquisition section were used in combination with public health workforce to filter the results. Results ranged from 16 to 5269 articles in PubMed, and from five to 1549 articles in Web of Science (Table 1).

Article abstracts were grouped by theme, and those that did not focus specifically on the public health workforce were eliminated. In all, 192 articles initially were chosen for review from the PubMed search; 109 were later excluded for lack of focus on any of the review’s workforce research themes, leaving a total of 83 articles that met the inclusion criteria. The Web of Science database yielded 38 potential articles to be included in the review, 30 of which were later excluded because they were duplicates of articles found in PubMed, leaving eight articles used in the review.

Technical reports, issue briefs, and annual reports were among the types of documents included in the gray literature analysis. The majority of gray literature relevant to the current review is published by national professional associations/organizations, and governmental public health agencies, and is therefore generally accessible on the organizations’ websites. Google searches using all search terms yielded between zero and 155,000 results. Thirty-five documents were included in the review. Seventeen documents were published by public health professional organizations; 15 were by governmental health agencies; and the remaining three were published by university academic centers focused on public health workforce studies.

A total of 126 articles met the inclusion criteria (Appendix). Preliminary search results produced 230 peer-reviewed articles and 35 technical reports that were initially selected for inclusion. A comprehensive review of
the selected literature resulted in removal of 78 duplicate articles; an additional 22 records were excluded for being too general or focusing on the international workforce, and 39 more full-text articles were eliminated because they discussed workforce themes outside the scope of the current review (Figure 1).

Eighty-three articles (66%) were identified using PubMed; 35 (28%) gray literature documents were identified through Google; and Web of Science contributed eight articles (6%; Table 1). Only nine potential articles were identified in ERIC, none of which was chosen for inclusion. These articles focused primarily on public health workforce training and evaluation of worker competency, both outside the scope of the current review.

The articles and documents selected for inclusion are divided among five focus areas. Thirty-two (25%) of the articles are considered “cross-cutting” because they may discuss aspects of several research themes or give context to the research themes by providing historical information and general insights about addressing public health workforce issues. Although these articles are not research based, they are important to include in the systematic review because they help define important research questions and themes in the PHSSR workforce agenda. Workforce size and composition is addressed by 30 (24%) articles; 34 articles (27%) focus on assessing workforce effectiveness through capacity and performance measures and/or relating workforce and organizational performance to health impact; 20 articles (16%) discuss issues of workforce shortage and strategies for workforce management; and 10 articles (8%) provide policy suggestions for strengthening the public health workforce (Figure 2).

Summary of Results
A review of the 126 documents selected for inclusion found that only one quarter were based on research studies; the rest were primarily articles broadly describing aspects of the public health workforce. Data analysis was limited to descriptive statistics for nearly all studies. Study findings by research theme follow.

<table>
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<th>Search term, and article count</th>
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<th>ERIC</th>
<th>Web of science</th>
<th>Google</th>
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Cross-Cutting Public Health Workforce Articles: Framing the Workforce Agenda

The IOM published a seminal report in 1988, *The Future of Public Health*,5 that described the public health system as being in “disarray” and urged better preparation of the public health workforce. In response, numerous public health practitioners, federal officials, and researchers published reports, editorials, and commentaries, most of which constituted general calls to action and/or provided suggestions to strengthen the public health system. All uniformly maintain that the workforce is the backbone of the public health infrastructure, critical to the success of public health programs, and requires immediate intervention to improve capacity to deliver essential public health services.6–10

The inherent challenges in building an adequately trained, adaptable public health workforce are emphasized in several articles.11 Roper et al.12 stated in 1992 that “as the scope of public health programs broadens and they become more complex, limitations in the capacity of the public health workforce to perform basic practices are apparent.” By the end of the decade, a highly trained workforce was deemed the “key” to public health infrastructure, and a continuing education core curriculum for all public health professionals was suggested to enhance workforce development efforts and increase workforce competence.13

In addition to proposing strategies for strengthening the public health workforce, several articles and technical reports14–18 focused on the development of public health workforce research frameworks. Proposed priority research areas include determining predictive relationships between performance indicators for workforce systems and health outcomes; identifying effective methods for building individual competency; determining best indicators for measuring workforce performance; establishing systems to track and monitor data about the workforce; and describing the components of the employment system in public health.19 These ideas were expounded in a 2009 *Journal of Public Health Management and Practice* supplement featuring articles from leading PHSSR researchers who highlighted eight public health workforce research themes and encouraged the development of more analytically focused, quantifiable models for assessing workforce demand.3,20

Federal health agencies have also provided key input into developing strategies for assessing and strengthening the public health workforce. A 2005 report21 released by the Health Resources and Services Administration (HRSA) pointed out that despite the substantial number of studies focused on the public health workforce, questions remain about workforce composition, availability, functions, and preparation to carry out duties because the workforce is difficult to define, is found in many settings, and serves as a provider of a wide range of services, all of which make measurement difficult. The report’s21 key recommendations call for developing innovative workforce recruitment strategies; providing continuing education training and educational advancement opportunities for the current workforce; developing loan repayment programs for public health workers; developing a model public health curriculum; and monitoring size and composition of the public health workforce on a regular basis.

Size and Composition of the Public Health Workforce

Systematic monitoring of the size and composition of the public health workforce is a research theme repeatedly emphasized by public health officials, policymakers, and PHSSR researchers. The most recent effort to enumerate the U.S. public health workforce occurred in 2000, when an analysis of secondary data estimated just under 450,000 people working in multiple occupational categories.22,23 Although the authors noted limitations, the results provided the first comprehensive national enumeration of public health workers. Other enumeration studies24–36 performed at both the state and federal levels also often included information about workforce location, occupations, education, and areas of public health practice.

National professional organizations have actively monitored workforce characteristics in governmental public health settings for several years. The ASTHO published five reports25–31 from 2005 to 2007 that provided strategies for enumerating the workforce and summarized the composition of various sectors of the public health workforce. Similarly, the NACCHO32,33 released profile data of local health departments, including summaries of the size and composition of the national local public health workforce. Finally, a few organizations have taken the lead in estimating the number of workers in subdisciplines of public health, although few of these studies are in the peer-reviewed literature, with the notable exception of epidemiology and public health nutrition workforce studies.24,34–36

Workforce Effectiveness and Health Impact

Those who conduct PHSSR have repeatedly underscored the importance of conducting empirical research studies to determine whether workforce characteristics and effectiveness are associated with population health outcomes.17–20 However, the current review found no such studies in the public health literature. Instead, studies in the review include public health studies focused on organizational capacity and performance measurement, both
of which would likely be considered intermediaries in any relationship between workforce effectiveness and health outcomes. In addition, articles from the healthcare literature are included that provide models for assessing organizational and workforce capacity that may be applied to public health.

Turnock introduced the concept of organizational capacity and performance measurement in public health in 1995 when he surveyed local health departments to assess change in ability of the organization to carry out public health functions effectively.37 His study emphasized the role of strong leadership and sufficient availability of staff as key factors influencing positive performance. Subsequently, the Council of State and Territorial Epidemiologists assessed epidemiology capacity and workforce characteristics in all state and territorial health departments four times, since 2001, by surveying State Epidemiologists on current and needed workforce levels as well as capacity in eight program areas to perform essential public health services.38–40 Although the studies failed to uncover significant correlations between workforce factors and epidemiology capacity, associations were found between states’ population and the number of epidemiologists employed at state health departments \( (p<0.0001) \) and between agencies’ organizational structure of epidemiologists and number of epidemiologists \( (p<0.05) \).34

Overall, the public health workforce literature makes a strong argument for conducting research that can better measure performance of public health agencies and document the outcomes of public health practice to assist health departments with quality improvement efforts and help highlight successes for policymakers.41 The workforce is a vital component of the structural capacity of a public health agency and, therefore, must be considered in measures of organizational performance.42 Notably, a recent article highlights the first study to attempt correlation of local health department resources with changes in state-level health outcomes. Results showed that increases in local health department expenditures were associated with decreases in infectious disease morbidity at the state level \( (p=0.037) \) and increases in staffing were associated with decreases in cardiovascular disease mortality \( (p=0.014) \) using multivariate regression. However, health department factors were not associated with other health outcomes, such as smoking prevalence, obesity prevalence, infant mortality, cancer deaths, or years of potential life lost.43

**Forecasting Public Health Workforce Demand**

Studies that use measures to forecast public health workforce demand are scarce in the literature, requiring supplementation by relevant articles in the healthcare literature. Several reports44–47 have been released forecasting a shortage of public health workers, although specific details related to worker discipline, training level, and functional ability are not generally known, and quantitative methods for predicting workforce shortage in the public health system have not been established. Authors who foresee a “workforce crisis” in public health emphasize the use of recruitment and retention strategies to avoid potential negative impact on the public health system and population health.44–46 Challenges to sustaining the workforce include the reduction of federal bioterrorism funds, which have supported thousands of new public health workers, including epidemiologists, laboratory researchers, and preparedness personnel over the past decade. An additional challenge is the expected departure of up to 25% of retirement-eligible governmental public health workers within the next few years.44,47

The healthcare workforce literature features quantitative methods for estimating workforce demand. For example, a model developed to predict needed nursing staff levels based on various hospital conditions relies on a mathematical formula using nurse–patient ratios, bed utilization, number of admissions, and admission days as formula inputs.48 Similarly, an analytic framework for determining desired characteristics of the healthcare workforce uses variables relating to health needs and provider productivity.49 Finally, Buerhaus50 suggests economic factors that may help predict demand and employment turnover among nurses, including staff attitude toward job, job satisfaction, and spouse’s employment status. These articles provide support for developing analytic measures of workforce capacity that can be applied to public health to ensure that workforce demand is understood and addressed.

**Public Health Workforce Policy**

Although development and implementation of policy initiatives to strengthen the public health workforce are supported throughout the literature, no empirical studies on workforce policy were identified in the current review. A 2001 article51 cited the need for a strong public health infrastructure to protect community health and outlined possible policies for implementation, many of which focused on assessment of workforce composition and competency, including further development of an array of workforce development programs funded by the CDC. Other researchers have noted the need to address the IOM’s extensive policy recommendations for strengthening the public health infrastructure, including the workforce.52

A 2001 report53 published by the HRSA as a companion piece to Healthy People 2010 promoted several workforce development policy initiatives to strengthen the

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public health workforce, such as increasing the number of under-represented minorities entering health professions programs; increasing the number of public health agencies offering continuing education courses; and increasing the number of public health agencies building personnel and training systems around competencies in the essential public health services. These policies served as the foundation for developing and administering workforce development grant programs supported by the HRSA.

Discussion

Summary of Evidence

The 126 articles in this systematic review included few that provide any evidence-based findings, as the preponderance of articles in the systematic review are principally descriptive or suppositional in nature. Although the public health literature contains numerous and repeated calls to action about the importance of conducting empirical research to address critical public health workforce issues, it has largely failed to produce the quantitative evidence needed to scientifically buttress the many recommendations related to workforce development, effectiveness, and policy called for by public health leaders and researchers. These weaknesses are all the more glaring compared with the healthcare workforce literature and speak to the strong need for public health researchers to actively assess the utility of quantitative methods drawn from other fields for monitoring workforce size and composition, shortage and demand, and associations with health outcomes.

When comparing the availability of empirical workforce research in the healthcare literature to the public health literature, it is important to point out that healthcare workforce research benefits from more federal funding support, systematic federal monitoring of much of the health professions workforce, precise and measurable clinical outcomes focused at the individual level, rather than population level, and the availability of workforce certification and licensure data. In addition, compared to the public health workforce, the healthcare workforce is more clearly defined and generally uses narrower job classifications. Although the breadth and diversity of the public health workforce greatly contributes to the effective delivery of public health services, it also presents a formidable challenge for public health researchers in the design of empirical studies.

The review articles elucidated multiple strategies for enumerating, assessing capacity, developing policy, and determining demand for the public health workforce, although no methodologic “gold standard” is identified. Nearly half (45%) of the peer-reviewed publications in the current review were found in the same journal. This fact could be perceived as a potential weakness, both because of the overconcentration in a single journal and because the journal may not reach a wider audience, which could help promote, highlight, and generate dialogue about PHSSR among researchers. In addition, almost one third of all references cited in the publications reviewed are drawn from non–peer reviewed technical reports, some of which were included in this review. Again, this speaks to the general paucity of public health workforce research literature and the pressing need to encourage new researchers with novel ideas to publish in the peer-reviewed literature in a wide variety of public health journals to reach as broad a readership as possible.

The workforce literature could also be bolstered through a more frequent use of theory as a foundation for developing quantitative models and designing research for published studies. Organizational development theory and interorganizational relations theory are examples of theories that consider organizational factors, including workforce factors, and their impact on organizational effectiveness and how organizations work together, which could be useful when considering measures of organizational and workforce capacity. Fewer than five of the 126 publications reviewed mentioned any type of theory either as a basis for developing a study or as a recommendation for the research agenda.

Organizational and systems theories should be incorporated to guide development of conceptual models and frameworks for measuring capacity, something that has been mostly overlooked in the literature thus far. Finally, very few articles in this systematic review cited workforce or capacity studies in medicine or nursing despite remarkable progress in those fields. Public health could potentially benefit from a more interdisciplinary approach by consulting with experts in other health fields, as well as business, economics, and other nontraditional collaborators, to gain greater insight into measurement of public health workforce capacity.

Despite the limitations, the current body of literature provides an important foundation for beginning to answer the many questions related to our national public health workforce. Of note, the majority of this literature is less than 10 years old and only recently has PHSSR gained greater credibility as an important area of research inquiry as measured by increases in funding support. Thus far, the lack of a sustained funding stream in this area has contributed to a negative feedback loop between too little research and too little funding support. However, the recent increases in available funding should help improve the intellectual currency of PHSSR in academia, making it a more attractive area for younger researchers while also enhancing the recognition of PHSSR as a viable area of
inquiry, and serving faculty as a respected and acceptable research concentration in their pursuit of promotion and tenure. Until PHSSR generally, and workforce research specifically, adequately addresses these concerns, the field will likely persist in attracting relatively few researchers and the literature will continue to languish.

Limitations of Systematic Review

There are several limitations to the methods used for this systematic review. First, the numerous results obtained in PubMed were not easily filtered; it is possible that relevant literature was unintentionally excluded. The use of additional MeSH terms or Boolean operators may have yielded additional or different results. However, the cross-checking of results with reference lists of highly cited public health workforce articles should have minimized the number of relevant articles excluded from the review.

Second, in some cases literature with more healthcare relevance was included in the review for the research themes. These articles were obtained using public health search terms, despite being less specific to public health. They are included because of their value in developing strategies to measure public health workforce capacity and forecast workforce demand.

Finally, the scope of this review was limited to four main research focus areas. Public health workforce articles tend to address several workforce development and infrastructure concerns, including worker competency, training, recruitment, and workforce diversity. These focus areas were outside the scope of the current review; however, excluding articles that highlight these areas would have resulted in a substantial decrease in the number of articles. Therefore, it is likely that the articles cited here have been used in other public health workforce reviews. Additionally, several articles addressed more than one research theme and could have been categorized differently.

Conclusion

A critical analysis of the literature from this systematic review of public health workforce research was largely insufficient to definitively answer most of the attendant research questions. Although policymakers, practitioners, and public health leaders alike—many of whom were authors of articles in this review—have continued to stress the importance of monitoring the size and composition of the public health workforce, surprisingly little progress has been made in that regard over the past decade since the last national public health workforce enumeration. The challenges to advancing research in this area will require the successful resolution of financial and organizational barriers to the implementation of a workforce surveillance system, including development of a standard taxonomy for public health workforce job classifications. Establishing a system for monitoring the public health workforce may be the most critical step in promoting a research agenda given the importance of a timely supply of workforce data to the accurate characterization of future workforce shortages, understanding capacity and effectiveness, and informing policy initiatives.

The few quantitative public health workforce studies that have been completed to date are an encouraging start. The finding of an association between staffing level and health outcomes points to the need to further explore capacity models that consider workforce inputs, organizational processes, delivery of public health services, and the resulting population health outcomes. Linear relationships between population size and epidemiologist workforce size suggest that the development of a workforce ratio may help public health officials in determining ideal staffing levels and monitoring workforce demand.

The key findings of this review suggest that programs that support additional empirical research studies on the public health workforce should be a priority in health systems reform. Without quantifiable measures of public health functions that can be used to gauge workforce supply and demand, combined with consistent data on workforce size and composition, it will be difficult to develop an accurate assessment of workforce effectiveness and its impact on population health. Systematic collection of workforce data would help researchers undertake empirical studies on a more consistent basis.

The Patient Protection and Affordable Care Act (PPACA), signed into law in March 2010, includes provisions to increase the public health workforce and strengthen quality measurement. Loan repayment programs, workforce grants for state and local programs, public health fellowships, preventive medicine training grants, and reauthorization of public health workforce programs are all initiatives proposed by the PPACA. Given the emphasis on quality measurement, it would be ideal for PPACA funding recipients to be required to systematically collect and report data on workers recruited, trained, and supported with federal dollars. Reporting mandates are common requirements for grants; therefore, a coordinated effort for collecting data that could provide measurable inputs for workforce capacity models, as well as quantifiable outputs, could benefit PHSSR studies substantially.
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MLB received funding from the NIH, the CDC, the Health Resources and Services Administration, Public Health Foundation, The Kresge Foundation, the Robert Wood Johnson Foundation, and the American Cancer Society while conducting this work. He has previously worked as a paid workforce consultant to the Council of State and Territorial Epidemiologists.

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References

2. DHHS. The public health workforce: an agenda for the 21st century.
Appendix: Full List of Studies in the Review


Elkhuizen SG, Bor G, Smeenk M, Klazinga NS, Bakker PJM. Capacity management of nursing staff as a vehicle for organizational improvement. BMC Health Serv Res 2007;7:196.


