

# Public Health Workforce Research in Review

## A 25-Year Retrospective

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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: (1) diversity; (2) recruitment, retention, separation, and retirement; (3) education, training, and credentialing; and (4) pay, promotion, performance, and job satisfaction.

**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) articles written in English published in the U.S.; (2) the main theme(s) of the article relate to at least one of the four public health workforce research themes; and (3) the document focuses on the domestic public health workforce.

**Evidence synthesis:** The literature suggests that the U.S. public health workforce is facing several urgent priorities that should be addressed, including: (1) developing an ethnically/racially diverse membership to meet the needs of an increasingly diverse nation; (2) recruiting and retaining highly trained, well-prepared employees, and succession planning to replace retirees; (3) building public health workforce infrastructure while also confronting a major shortage in the public health workforce, through increased education, training, and credentialing; and (4) ensuring competitive salaries, opportunities for career advancement, standards for workplace performance, and fostering organizational cultures which generate high levels of job satisfaction for effective delivery of services.

**Conclusions:** Additional research is needed in all four thematic areas reviewed to develop well-informed, evidence-based strategies for effectively addressing critical issues facing the public health workforce.

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### Context

#### Rationale

This systematic review was conducted on behalf of the Robert Wood Johnson Foundation (RWJF) and the Center for Public Health Services and Systems Research (CPHSSR) to inform public health services and systems research (PHSSR) activities at the CDC and RWJF. Little research has been conducted on the infrastructure required to address public health workforce issues. National reports from the 1980s docu-

mented the paucity of information available to support public health workforce planning and policy development.<sup>1</sup> More than 2 decades later, the IOM's 2003 report *Who Will Keep the Public Healthy?*<sup>2</sup> validated the importance of and need for a research agenda on workforce issues, and the research infrastructure necessary to undertake it.

In 2004, Cioffi et al.<sup>3</sup> published results from an interactive process to develop a research agenda for public health workforce development for those with an interest in the public health system. Expanding on that work, Crawford and colleagues<sup>4</sup> published a literature review on public health workforce research in 2009 titled *Perspectives on Public Health Workforce Research*. In this seminal article, Crawford et al. provided a guiding framework from which public health workforce initiatives may be developed and served as a model for this systematic review. 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

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the launch of major national initiatives aimed at improving public health infrastructure, such as the IOM's 1988 seminal report *The Future of Public Health*<sup>5</sup> and the related recommendations that followed.

## Objectives

The purpose of the current review was to further explore the literature using a systematic approach to identify articles, abstracts, peer review, and gray literature focused on four broad areas of the public health workforce: (1) diversity; (2) recruitment, retention, separation, and retirement; (3) education, training, and credentialing; and (4) pay, promotion, performance, and job satisfaction. This review focuses on four of eight public health workforce themes described by Crawford et al. This is one of two public health workforce reviews commissioned by RWJF and CPHSSR. The eight workforce themes in Crawford et al.<sup>4</sup> were divided among the research team while attempting to group loosely related themes in the two reviews. A systematic review<sup>6</sup> of the other four themes addressed by Crawford et al., not addressed in the current paper (i.e., workforce size and composition; workforce effectiveness and health impact; demand for the public health workforce; and public health workforce policy), is being developed in concert with this paper.

## Evidence Acquisition

### Information Sources

Literature searches were conducted using the U.S. National Library of Medicine, PubMed database, the Web of Science database, the Education Resources Information Center (ERIC) database, and the Google Internet search engine to identify peer-reviewed journal articles; proceedings of international conferences, symposia, seminars, colloquia, workshops, and conventions; and gray literature from organizations, institutions, and agencies for the systematic review.

### Search

The search strategy for review in PubMed was constructed using the Medical Subject Heading (MeSH) database. The MeSH terms and Boolean operators were used to identify literature in PubMed as follows: *public health/manpower* (rather than of *public health workforce*) AND *United States* followed by AND either *cultural diversity*, *personnel selection*, *retention*, *separation*, *retirement*, *credentialing*, *salaries and fringe benefits*, *career mobility*, *employee performance appraisal*, and *job satisfaction*. Education and training were explored with a different search string because other MeSH terms yielded more relevant results pertaining to that theme. *Education* and *training* are synonymous in PubMed. The search string for education and training employed was (*public health OR public health/manpower*) AND (*education*, *public health professional*, AND *education*,) AND *United States*.

For the search in the Web of Science database, the actual terms that describe the themes of interest were used directly. The following terms and Boolean operators were included as topics in the

search strings: *public health AND (workforce OR employ\* or manpower)*, followed by AND either *diversity*, *recruitment*, *retention*, *separation*, *retirement*, *education*, *training*, *credentialing*, *pay*, *promotion*, *performance*, and *job satisfaction*. The asterisk (\*) represents truncation, which can be used in PubMed to find all terms beginning with a given text string. In this case, searching *employ\** retrieved words such as *employee*, *employer*, and *employment*. The searches were refined using the term *United States*.

In the ERIC database, the thesaurus feature was used to create appropriate search terms used to build the most relevant search strategy. The terms *public health* and *workforce* were entered in the thesaurus. *Labor force development* was the search term identified as synonymous with *workforce*. Thus, after inserting *public health* and *labor force development* in the thesaurus, the following search string was built: (DE *Public Health*) AND (DE *Labor Force Development* OR DE *Management Development* OR DE *Professional Development* OR DE *Staff Development*). "DE" is a standard abbreviation used in ERIC to help locate subject-related materials that may not contain the keyword in the indexed record. ERIC contains literature and information primarily relevant to the field of education.

Google was used to identify gray literature where there were information gaps in the three databases. Search terms were *public health*, *workforce*, combined with one of the following: *diversity*, *recruitment*, *retention*, *separation*, *retirement*, *education*, *training*, *credentialing*, *pay*, *promotion*, *performance*, and *job satisfaction*.

### Eligibility Criteria

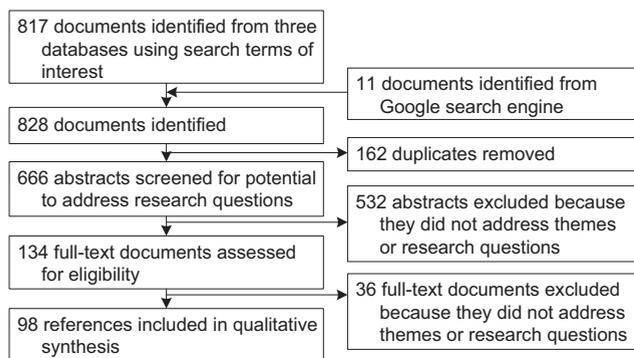
Twenty-five years of literature were reviewed in each information source. All searches were limited to English language documents published from 1985 to 2010, which presented studies or reports specifically on the public health workforce in the U.S. The public health workforce was defined as those people who provide essential public health services, regardless of the nature of the employing agency.<sup>7</sup> This definition encompasses workers in governmental public health organizations, other governmental organizations that provide public health services, nongovernmental and community-based organizations, and private or for-profit organizations, among others.

To limit the scope of the review, articles on international health or the broader health workforce including medicine, dentistry, nursing, and social work were excluded if no reference to or connection with public health was made in the abstract or full text. Nearly all of the literature obtained focused on the governmental public health workforce, with virtually no other references to or literature available on private sector public health workers. Each of the articles was coded for references to the four major workforce themes of interest, which were then summarized to generate conclusions related to the U.S. public health workforce. Research findings were reported using an abbreviated version of the Preferred Reporting Items for Systematic reviews and Meta-Analysis (the PRISMA Statement) because some elements of these standard guidelines were not relevant to this review with respect to the design of workforce studies.

## Evidence Synthesis

### Study Selection

Searches using the terms and limits described yielded 828 records (Figure 1). A reviewer selected relevant results via



**Figure 1.** Flow of information through the systematic review of select workforce issues in public health

abstracts and full-text then coded them manually according to the themes of interest. From the 828 records, 162 duplicates resulting from search overlap were removed, leaving 666 abstracts for additional screening. Among the 666 abstracts considered for inclusion, 532 were excluded because of their lack of relevance for the thematic or research questions. The remaining 134 full-text documents were assessed for eligibility and 36 were excluded that did not address the study themes, after the entire document was carefully reviewed. This left a total of 98 references (Appendix) to be included in the qualitative synthesis for this systematic literature review. Among these 98 references, seven articles pertained to diversity; 34 articles addressed recruitment, retention, separation, and retirement; 51 articles addressed education, training, and credentialing; and ten articles addressed pay, performance, and job satisfaction (Figure 2).

## Evidence for Themes

**Diversity.** The literature on public health workforce diversity was meager. The limited literature on this topic first began to appear in 2003, and has focused primarily on the need to increase diversity, rather than identifying or assessing actual activities undertaken to accomplish it. Increasingly, it has been argued that the failure of the nation's health professions to reflect the changing demographic composition of the population may contribute more to disparities in health access and outcomes than the persistent lack of health insurance for tens of millions of Americans.<sup>8</sup>

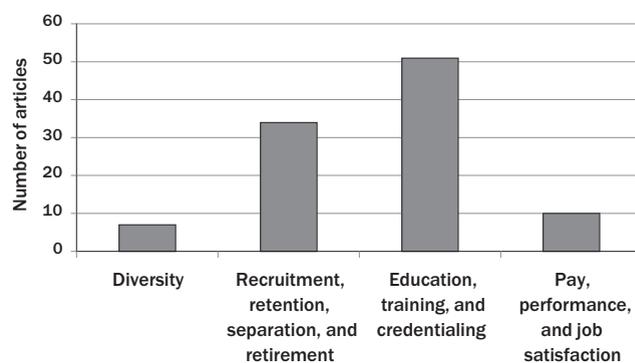
Although U.S. schools of public health have led the way in providing professional training for under-represented racial/ethnic groups compared to other health professions schools,<sup>9</sup> clearly not enough is being done to diversify public health academic institutions. For example, in 2004, only 7.4% of public health doctoral graduates were from under-represented minority groups yet they represent 25.7% of the U.S. population.<sup>10,11</sup> This glaring discrepancy in representation among doctoral trainees cre-

ates an intransigent barrier to the profession's capacity for placing under-represented minorities in prominent leadership roles in public health, and this divergence will only grow because under-represented minorities are expected to comprise 40% of the U.S. population by 2050.<sup>11</sup>

Previous research has suggested that individuals from minority groups are more likely to be willing to acknowledge and actively address minority health disparities.<sup>10,12</sup> The IOM 2003 report called for public health training to be "strengthened to meet the needs of future public health professionals," while emphasizing that changing global demographics continually transform and challenge the future of public health education and health disparity reduction.<sup>13</sup> Therefore, initiating comprehensive efforts aimed at increasing diversity in the public health workforce and raising awareness about health disparities is vitally important in preparing for the future national and global demographic. Former U.S. Surgeon General David Satcher addressed the need for diversity in the public health workforce as "important because it defines the parameters of opportunities for our children; it enriches the lives of our future professionals; and because if we are going to achieve the goal of eliminating disparities in health, we'll need a diverse group of health professionals to accomplish it."<sup>14</sup>

## Recruitment, Retention, Separation, and Retirement

Current and future personnel shortages in the public health workforce are well documented, prompting a call for recruitment and retention practices to be re-evaluated and improved.<sup>3,8,15–20</sup> In 2000, there were approximately 50,000 fewer public health employees in the U.S. than there were in 1980.<sup>8</sup> In order for the 1980 workforce-to-population ratio of 220 per 100,000 to be sustained in 2020, approximately 250,000 more workers would need to be recruited (and retained) in addition to those currently in the public health workforce.



**Figure 2.** Number of public health workforce articles by themes reviewed

In the IOM's 2003 report,<sup>15</sup> the most notable worker shortage areas were identified in environmental health, nursing, epidemiology, and laboratory science. According to the Association of State and Territorial Health Officials (ASTHO) 2007 State Public Health Workforce Report,<sup>21</sup> states also have identified shortages of nutritionists, dietitians, public health physicians, and social workers. The most commonly identified worker shortage area in this literature review was on the recruitment, retention, and training of epidemiologists, which has more published articles than any other public health discipline.<sup>16–27</sup>

Studies suggested balancing public health workforce management, and recruitment and retention initiatives, against anticipated retirements may present challenges for the public health workforce.<sup>28</sup> ASTHO<sup>21</sup> reported that states most frequently use flexible hours, career development, and rehiring retirees as retention strategies, followed by tuition assistance, telecommuting, succession planning, monetary incentives/bonuses, job sharing, and mentoring programs. Evidence indicates that training programs may be successful in recruiting and retaining public health workers while also building capacity within the related public health system.<sup>24,29–34</sup>

Scholarships, reduced tuition, loan repayment, and loan forgiveness programs have all been recommended as useful incentives to recruiting professionals into academe or other public health positions where they can fill service gaps.<sup>35–39</sup> Certificate programs also have been cited as possible solutions to meet demand for increased capacity, eliminating financial and nonfinancial barriers associated with obtaining advanced degrees, and ultimately improving rates of recruitment and retention of students. These also have been promoted as a dual strategy for recruiting and retaining students and young professionals from under-represented minorities, providing exposure to public health while also diversifying the workforce.<sup>40</sup>

As of 2002, it was estimated that one quarter of the public health workforce were eligible for retirement.<sup>15</sup> The public health workforce is aging at a higher rate than the general workforce, and as older more-experienced workers retire, a substantial gap in leadership is anticipated.<sup>19</sup> Forecasts suggested that by 2012, a total of more than 100,000 public health workers (or 23% of current workforce) will retire, including more than 50% of some state health agency workforces,<sup>21</sup> leaving a large void of expertise to be filled.<sup>8</sup>

In the public sector, the estimated retirement potential is extremely high. The potential void will be extremely prevalent if replacements are not identified for retirees. A study investigating succession planning in Ohio's LHDs revealed only one in four had a succession plan in place.<sup>41</sup> The literature addressing retirement projections for pub-

lic health professionals in the private sector was limited. Gaps in the literature were indicative of a need for the provision of more systematic information about the public health workforce and the factors contributing to recruitment and retention issues facing public health.<sup>42</sup>

Recent surveys conducted by the National Association of County & City Health Officials demonstrate the impact of the recent economic recession on local health departments' (LHDs') jobs and budgets, which has substantial implications for recruitment, retention, and separation. From January 2008 to December 2009, 23,000 LHD jobs were lost to layoffs or attrition,<sup>43–45</sup> roughly 15% of the American LHD workforce. Nearly three quarters (73%) of the U.S. population live in jurisdictions of LHDs that lost staff between June and December 2009,<sup>45</sup> when nearly half of LHDs (46%) lost skilled workers as 8000 LHD jobs were eliminated.

This substantial loss of LHD employees depletes long-term experience, community connectedness, and institutional memory from highly trained staff. Increased workload, cuts to employee hours and compensation, wage freezes, and job insecurity present a substantial challenge to the recruitment and retention of the LHD workforce in light of recent budget constraints,<sup>21</sup> particularly when many public health professionals can secure more-competitive wages in other disciplines.

### Education, Training, and Credentialing

The Association of Schools of Public Health (ASPH) comprised 46 fully accredited institutions and six associate member institutions in December 2010. ASPH-accredited schools have grown markedly in the past decade, and they have been the primary providers of public health education in the U.S., training more than 85% of public health graduates.<sup>46,47</sup> The Council on Education for Public Health also has accredited 74 other programs that award public health degrees<sup>48</sup> but are not yet accredited as schools of public health. In 2004, the Association of Schools of Public Health developed a list of ten core competencies that every MPH student should possess at graduation<sup>49</sup> whether from an accredited school or program of public health.

It has been projected that attaining a goal of producing more than 250,000 additional well-trained public health workers by 2020 will require SPHs to increase their number of graduates threefold over the next 10 years.<sup>48</sup> In response to this critical pipeline issue, some schools have expanded their public health program offerings to include undergraduate majors, minors, and newly developed introductory courses to increase exposure to the field, and prepare more students for entry-level public health positions.<sup>50,51</sup> Paradoxically, the explosive growth

in public health schools, programs, and educational offerings has been accompanied by a steady erosion of federal financial support for public health professional training since 1980.<sup>8</sup> In a recent reversal of this 30-year trend, health reform measures in the 2010 U.S. Affordable Care Act provided unprecedented levels of funding to important public health training programs, including \$16.8 million awarded to support 27 Public Health Training Centers at schools of public health, \$9 million to 15 Public Health/Preventive Medicine Residency programs,<sup>52</sup> in addition to a number of other public or non-profit institutions across the country.<sup>53</sup>

The DHHS, Health Resources and Services Administration, Bureau of Health Professions estimates that only 20% of the nation's approximately 500,000 current public health professionals have the education and training needed to do their jobs effectively,<sup>47</sup> with the remaining 80% lacking formal education or training in the field of public health.<sup>54,55</sup> "The majority of this latter group, who tend to be older workers, have largely relied on on-the-job training or short courses on public health and related topics."<sup>3</sup> Research conducted on workers in state and local public health agencies have documented difficulties training staff, which in turn negatively affects capacity to effectively deliver essential public health services.<sup>56</sup> For example, a 2002 national assessment by the Council of State and Territorial Epidemiologists revealed that a surprising 48% of epidemiologists in state health departments had received no academic coursework or formal training in epidemiology<sup>57</sup> although this has improved markedly in three subsequent surveys to less than 25%.<sup>19</sup>

Well-prepared public health professionals are necessary for an effective public health system, yet there continue to be concerns about both the adequacy of the worker supply and their skills and competencies.<sup>58</sup> New skills and competencies must be developed. For example, James et al. urged the incorporation of cross-cutting disaster medicine and public health preparedness education and training in lifelong learning programs for all public health professionals, and for education in schools, continuing education, and certification programs.<sup>59</sup>

Partnerships between local health departments and academic institutions have been a successful mechanism by which public health professionals have received training for preparedness and lifelong learning.<sup>60–63</sup> Such partnerships also have demonstrated success in increasing the number of diverse professionals recruited to the public health workforce.<sup>64</sup> However, substantial gaps between public health practice and academia remain.<sup>65</sup> These gaps set public health apart from most other health professions where

practice is an integral component of professional training and education. Consideration should be given to the investment of substantial funding to build these partnerships and narrow the divide.

At the federal level, various educational and training programs have been successfully implemented at the CDC to prepare and encourage youth and health professionals to pursue careers in public health, including elective rotations in epidemiology<sup>66</sup> and outreach for exposing physicians to population health<sup>67</sup> to increase the likelihood of them pursuing public health careers. Management and leadership programs for professionals<sup>68</sup> and youth outreach programs<sup>69</sup> also have been offered by the CDC to attract and develop public health workers although many of these programs are small with limited enrollments. At the state level, leadership development, recruiting, and on-the-job training are the top three strategies for workforce planning, respectively.<sup>21</sup> Challenges to implementing state's workforce planning activities identified are lack of executive buy-in, few human resources staff, lack of measurable goals and objectives, and constraints due to budget, time, and civil service rules.<sup>19</sup>

Distance education and on-the-job training have been recommended as a mechanism by which the public health workforce may be strengthened.<sup>55,70–73</sup> In addition, training programs targeting scholars from under-represented backgrounds promoting education, mentoring relationships, and networking opportunities have been instrumental in launching the research and academic careers of some public health professionals by addressing challenges often faced by minorities secondary to the lack of diversity in the public health workforce.<sup>74–79</sup>

The presence of a well-accepted and valued credentialing system has presented ongoing challenges for many subgroups of professionals in the public health workforce and the public health field as a whole. Public health nurses comprise the largest profession in the public health workforce and they have established a community/public health nursing credential,<sup>80</sup> but it has been underutilized. The lack of external recognition for the credential, and related financial or other benefit, has been the strongest barrier to its wider acceptance.<sup>80</sup> Research indicates that utilization of the credential might be improved by increasing its visibility outside of the academic setting and directly linking it to salary increases or enhanced career advancement opportunities at the system level.<sup>81</sup> Similar recommendations have been made for increasing the number of certified public health dentists through incentivizing dental public health training and credentialing programs.<sup>82,83</sup>

Since August 2008, a new credentialing exam developed by National Board of Public Health Examiners (NBPHE) has been administered annually for public health professionals to become *Certified in Public Health* (CPH).<sup>84,85</sup> Despite a sustained national marketing campaign, very few academic programs have incorporated it as a graduation requirement and it has yet to be widely sought after by the majority of public health graduates. Relatively few public health graduates take the exam, many citing registration costs as a factor, and there is almost no evidence that hiring or salary preferences are given to those who are certified. As of December 2010, approximately 1500 public health graduates were officially Certified in Public Health.<sup>84</sup> Individuals who have passed this credentialing exam are required to maintain certification through continuing education,<sup>86</sup> resulting in additional fees.

A 2007 review<sup>87</sup> of public health workforce certification and credentialing revealed a paucity of quality research or compelling evidence linking certification or credentialing to any related outcome. Public health professionals often have been educated as specialists in their primary discipline and often have little to no exposure to theory or practice of public health prior to employment. Typically, only one in five employees in public health leadership roles has earned an MPH degree.<sup>88</sup> Many individuals in these positions have been known to identify and comply with some certification or other credentialing process separate from the newly created CPH exam.<sup>89</sup>

There has been no commonly accepted unit for public health continuing education (CE) that ensures quality and consistency of training activities at the national level.<sup>90</sup> Baker<sup>91</sup> recommended the development of a set of well thought out incentives to increase participation in lifelong learning and to improve competencies. It also has been suggested that for any credentialing mechanisms to become standard, they would have to become widely accepted as a requirement for employment in public health.<sup>92</sup>

### **Worker Pay, Promotion, Performance, and Job Satisfaction**

Employees with high levels of job satisfaction are generally thought of as an important component of a strong and effective public health workforce. In a 2009 review of workforce issues in public health, Crawford et al. identified a substantial gap in the literature regarding the inter-relationship between workers' pay and benefits, promotion potential and career advancement options, performance, and perceived job satisfaction.<sup>4</sup> This finding was substantiated in the database

search, which revealed very little or no research literature published in several of these related areas.

Only one article<sup>70</sup> on public health workers' pay was found in the review. The study reported findings of a 1998 survey of public health nutrition personnel. Most employees were paid through federal funding and indicated that at increased levels of responsibility, their pay generally increased. Another article on pay was found via Google, which called for financial compensation and career development opportunities to be linked with incentives and certification mechanisms, in order to ensure workers' core competencies are met.<sup>93</sup>

The database search investigating public health workers' performance yielded results regarding only organization-level performance rather than that of the individual employee.<sup>91,94–97</sup> There was no public health workforce research identified regarding how pay, promotion potential, or job satisfaction might affect individual employee's performance or how it might be measured. Similarly, only a single article turned up on public health worker promotion.

In a survey of public health nutritionists, Haughton and Shaw<sup>98</sup> found that advanced public health nutrition practice and assumption of new job responsibilities typically occur only after at least 6 years of experience. Finally, there was a single article on public health workers' job satisfaction, which was found in the public health nursing literature. The results of this study on organizational structure and job satisfaction among public health nurses suggested that work environments in which supervisors and subordinates consult together concerning job tasks and decisions, and in which individuals are involved with peers in decision making and task definition, are positively related to job satisfaction.<sup>32</sup>

## **Discussion**

### **Summary**

This systematic review revealed a related research literature that was often limited in many of the thematic areas of interest. Frequently, various workforce topics had been researched by a single job classification of public health professionals (e.g., epidemiologists, public health nurses or physicians) with regard to how the topic pertained to that specific profession. At times, the relevant literature was completely nonexistent in the body of public health workforce research literature.

Fewer articles were identified regarding the public health workforce addressing the topical areas of diversity, retention, separation, and retirement, worker pay, worker performance, worker promotion, and job satisfaction compared to those that dealt with recruitment, education, training, and credentialing. The largest gaps in research evidence existed where there was virtually no related literature for a given

area as was found for issues related to or incentives for retirement or departure from a public health career for work in other fields. There was also negligible information on public health workers' pay, promotion, performance, and job satisfaction.<sup>99</sup>

The public health workforce research literature was most plentiful with respect to recruitment, education, training, and credentialing. The current shortages of public health workers creates an opportunity to initiate the development of outreach and training programs specifically geared to under-represented youth. This could generate a pipeline of individuals into the public health workforce who may be better equipped to more effectively address health disparities among minority communities.

Funding agencies should invest in such training and outreach programs, with highest levels of investment targeting populations under-represented in the public health workforce and to individuals committed to careers addressing health disparities. Internships, training programs, mentorship programs, service grants, and loan forgiveness and repayment programs may all provide viable options to recruit, and retain a critical mass of diverse employees with incentives for participation in the public health labor market. Fortunately, there has been a recent increase in the availability of loan forgiveness programs available to public health workers through the passage of the Affordable Care Act in 2010.

Although graduate education is the traditional gold standard in training public health professionals, schools' capacity to offer short courses and certificate programs should be expanded to meet existing professionals' continuing education needs. This could have the added benefit of diversifying and increasing the public health workforce with well-trained employees who also incur less cost with a reduced time commitment. In addition, the provision of incentives to encourage continuing education may help to facilitate the adoption of a more general lifelong learning orientation among public health employees throughout their careers. Incentives might include paid time off to attend conferences, travel reimbursement, or offering in-house continuing education training. Education and training of this sort could likely increase employees' knowledge base, increase their ability to be fairly compensated for their services, enhance their promotion potential, add to job satisfaction, and ultimately improve overall capacity of the public health workforce.

Advances have been made in creating a standard credentialing process for public health workers although it may ultimately prove unrealistic to assume that a single credential would willingly be adopted or sought after by a multidisciplinary public health workforce. Unless the Certified in Public Health credential is more directly

linked to tangible benefits in the workforce market (e.g., higher pay, career advancement, increased employability), it will likely continue to generate low levels of interest among schools of public health and graduating public health students. In addition, it may be difficult to secure the potential benefits of credentialing in the governmental public health workforce because of existing civil service policies and regulations, which can be notoriously difficult to change.

## Limitations

This review was subject to a number of limitations. Foremost among these, "public health workforce" and "public health services and systems research" (PHSSR) are not well-established concepts in the literature. For example, PubMed, the database used that produced the largest number of search results, did not have a search term established for PHSSR. PubMed also has 13 various terms related to "public health" within which relevant articles may potentially have been archived exclusively based on the focus of the manuscript.

Findings from this review were reliant on relevant studies retrieved from the three main databases and Google. It is possible that other search strategies that were not employed in this review may have yielded results that vary slightly from those obtained. However, the approach used in each database should have produced the least-biased searches through mechanisms available to determine the most appropriate search strings.

The review also may have been limited because only one reviewer selected relevant results via abstracts and full text, then coded them manually according to the themes of interest. There was no second reviewer or coder to determine inter-rater reliability and validity of the study selection process. Other databases not used for this review may offer additional information on public health workforce issues related to the four themes of interest, particularly in the gray literature. However, those databases were excluded because greater resources would have been required to conduct a comprehensive search of them.

## Conclusion

Evidence from a comprehensive literature review suggests that much more needs to be done to diversify the public health workforce and to support the conduct of related research as to how this is best accomplished. Although an unprecedented number of schools and programs of public health are supplying an ever-increasing number of MPH graduates, the gap between practice and academic public health remains and optimal strategies need to be developed to ensure public health grad-

uates have the appropriate knowledge, skills, and abilities to function effectively in the practice arena. The current public health workforce is under siege, with daunting challenges confronting the nation's public health system secondary to retirements, departures, inadequate training and education, and successful retention of well-qualified workers collectively challenging its capacity to meet the health needs of the public. Underpinning these all is the pressing need to support the public health services and systems research needed to help improve understanding of how to effectively address these many issues.

Additional research is needed in all four thematic areas reviewed to develop well-informed, evidence-based strategies for tackling these critical issues in the public health workforce. The public health services and systems research agenda, including workforce research, must become a priority in academia and for funding agencies. Sustainable funding is critical to supporting evidence-based workforce development initiatives necessary for the continuous improvement, preparedness, and capacity building to maintain and strengthen the public health workforce. A strong public health workforce must be in place to effectively deliver services that protect and promote the health of the public.

Addressing the looming workforce shortage and improving the public health system must be approached strategically. Looking ahead, students, professionals, and systems must remain committed to further research being conducted to illuminate the issues facing the public health workforce and to identify more evidence-based approaches to expanding and strengthening the public health workforce. This research should remain a critical priority, as the health of the public is ultimately at stake.

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## Appendix: Full List of Studies in the Review

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