Public Health Workforce Enumeration, 2012

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LIST OF ABBREVIATIONS USED IN THIS REPORT

APHL	Association of Public Health Laboratories
ASTHO	Association of State and Territorial Health Officials
BLS	Bureau of Labor Statistics
CDC	Centers for Disease Control and Prevention
CPDF	Central Personnel Data File
CSTE	Council of State and Territorial Epidemiologists
DHHS	U.S. Department of Health and Human Services
ECAs	Epidemiology Capacity Assessments
EPA	U.S. Environmental Protection Agency
FTE	full-time equivalent
HRSA	Health Resources and Services Administration
LHDs	local health departments
NACCHO	National Association of County and City Health Officials
OPM	Office of Personnel Management
PHN	Public Health Nurse (Workforce Survey)
RN	registered nurse
RWJF	Robert Wood Johnson Foundation
UM CEPHS	University of Michigan Center of Excellence in Public Health Workforce Studies
USDA	U.S. Department of Agriculture

SUMMARY

Introduction: Regularly assessing the size and composition of the U.S. public health workforce has been a challenge for public health officials and public health systems and services researchers for decades. Enumeration of the public health workforce poses special challenges because of the breadth of the field, its multidisciplinary nature, the diverse settings for employment, and the lack of any standardized system for regularly and systematically collecting data on this segment of the health workforce. Periodic characterization of the public health workforce is necessary for ensuring it is large enough and skilled enough to deliver the essential public health services to the population. It also provides the data required for monitoring the impact of investment and advocating for additional resources; assessing gaps in workforce development; developing recruitment, retention, and competency compliance and credentialing efforts; permitting improved alignment of academic resources with workforce needs; and allowing for an improved understanding between workforce infrastructure and specific health outcomes. This report both complements and augments the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report. Specifically, this report outlines findings of a follow-on study undertaken during 2012 to reanalyze six data sources that provide the most reliable and valid data available for producing a national governmental public health workforce enumeration estimate of workers as described in the case definition developed for the study. Data sources used for this study include (1) the 2010 National Association of County and City Health Officials National Profile of Local Health Departments, (2) the 2010 Association of State and Territorial Health Officials Profile of State Public Health Departments, (3) the 2010 Council of State and Territorial Epidemiologists Epidemiology Capacity Assessment, (4) the 2011 Association of Public Health Laboratories/University of Michigan Center of Excellence in Public Health Workforce Studies (UM CEPHS) National Laboratory Capacity Assessment, (5) the 2012 UM CEPHS Public Health Nurse Workforce Survey, and (6) the Office of Personnel Management Federal Employment Statistics.
Methods: Five of the six data sources and all occupational categories included in this study were thoroughly described in the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report (available at: http://www.phf.org/resourcestools/Documents/Enumerating_the_Public_Health_Workforce_Final_Report_2012.pdf). Public health workforce enumeration estimates were calculated by using data sources that were statistically adjusted to address concerns regarding worker overcounting and undercounting. Lowest, midrange, and highest enumeration estimate ranges were developed in an attempt to address the problem of duplicate counting among surveys and overcounting in the Office of Personnel Management data.
Results: After making statistical adjustments, the best estimate for the lowest range enumeration estimate is 303,773 workers nationally, including 161,615 local, 66,846 state, and 75,312 federal public health workers. Approximately 326,602 public health workers comprise the midrange enumeration estimate, including 161,615 in local, 82,318 in state, and 82,669 in federal settings. The highest range enumeration estimate is 516,193 workers, with 161,615 workers in local public health, 110,547 in state public health, and 244,031 in federal public health agencies.
Conclusions: The availability of multiple data sources for developing a public health workforce enumeration potentially improves its accuracy but also adds methodologic complexity to the

estimates. Despite attempts to correct for integration among data sets and differences in occupational case definitions, these enumeration estimates still undercount the state workforce and overcount the federal workforce, although we believe these estimates represent an improvement over the simple use of raw data from the data sources. Available public health workforce data sources, although imperfect, can be used to generate a range of enumeration estimates, depending on how occupational classifications are defined and the extent to which the data source allows public health workers to be disaggregated from larger estimates of health professions workers. Improvement in the accuracy of data sources and development of a standardized methodology for continuously monitoring the size and composition of the public health workforce can help ensure that a competent and capable cadre of workers is available to promote and protect our nation's health.

BACKGROUND

Regularly assessing the size and composition of the U.S. public health workforce has been a challenge for public health officials and public health systems and services researchers for decades. In the Institute of Medicine's 2003 report, *The Future of the Public's Health in the 21st Century*, the authors recommended that the Centers for Disease Control and Prevention (CDC) and the Health Resources and Services Administration (HRSA) "periodically assess the preparedness of the public health workforce to document the training necessary to meet basic competency expectations, and to advise on the funding necessary to provide such training."[1] A necessary prerequisite for this undertaking is to enumerate the U.S. public health workforce as part of a larger effort to assess the U.S. health workforce overall.

Enumeration of the public health workforce poses special challenges because of the breadth of the field, multidisciplinary nature, diverse settings for employment, and lack of any standardized system for regularly and systematically collecting data on this segment of the health workforce. Further, lack of a standardized and acceptable national public health workforce monitoring system for collecting data in a systematic, consistent way has hampered researchers' ability to develop reliable workforce enumeration estimates (unpublished white paper, ML Boulton and R Hines, 2009). Despite these challenges, the importance of describing the size and composition of the public health workforce has long been recognized, with the earliest efforts in this country dating to the first decade of the 20th century.[2] The most recent enumeration was facilitated by HRSA in 2000 by using all available secondary data sources, with results detailed in the *Public Health Work Force: Enumeration 2000* report.[3] This effort revealed a national public health workforce of approximately 450,000 workers in governmental and voluntary agencies, representing a decline in estimated ratio of workers to population from 220/100,000 in 1980 to 158/100,000 in 2000.[2,3]

Periodic characterization of the public health workforce is necessary for ensuring it is large enough and skilled enough to deliver the essential public health services to the population. It also provides the data required for monitoring the impact of investment and advocating for additional resources; assessing gaps in workforce development; developing recruitment, retention, and competency compliance and credentialing efforts; permitting improved alignment of academic resources with workforce needs; and allowing for an improved understanding between workforce infrastructure and specific health outcomes. Ultimately, the public health system is best able to perform its core functions of assessment, assurance, and policy development through a comprehensive understanding of its workforce that can be achieved by using an enumeration methodology that is repeatable, affordable, and consistent over time (unpublished white paper, ML Boulton and R Hines, 2009).

Defining the Public Health Workforce

In 2011, the University of Michigan Center of Excellence in Public Health Workforce Studies (UM CEPHS) was contracted by CDC and HRSA to identify data sources that could be used to produce an updated estimate of the number of public health workers in federal, state, and local health departments (LHDs) and to assess their usability for ongoing monitoring of the size and

composition of the public health workforce. As described in the *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report published in 2012, a critical first step in enumerating the public health workforce is defining who should be designated as a public health worker.[4] The U.S. Department of Health and Human Services (DHHS) has defined public health workers as "all those responsible for providing the essential services of public health regardless of the organization in which they work."[5] In that report, Gebbie, Merrill, and Tilson emphasize that a public health worker can be defined on three different dimensions — the specific profession (e.g., epidemiologist), the work setting (e.g., all local health department workers, regardless of profession), or the work or job function (e.g., outbreak investigation).[6] Further, the educational and training background of the worker might not coincide with his or her profession or job function. For example, a local health department nurse might function as an epidemiologist by investigating and controlling an outbreak but have no formal training or education in epidemiology. These varying definitions should all be considered simultaneously, and piecing together an accurate enumeration from existing data sources, which primarily focus on job title, is difficult.[4]

For purposes of this study, the definition of *public health worker* includes those employed in specific work settings who hold one of the following job titles in governmental agencies (Box).

- Administrative or Clerical Personnel
- Behavioral Health Professional
- Emergency Preparedness Staff
- Environmental Health Worker
- Epidemiologist
- Health Educator
- Laboratory Worker
- Nutritionist
- Public Health Dentist
- Public Health Manager
- Public Health Nurse
- Public Health Physician
- Public Health Informatics Specialist
- Public Information Specialist
- Other Public Health Professional/Uncategorized Workers

Box. Public health worker case definition

The case definition for a public health worker includes all persons responsible for providing any of the 10 Essential Public Health Services who are employed in the following venues:

1. traditional nontribal state, territorial, and local governmental public health agencies/departments;
2. federal agencies with a clear mandate to provide public health services;
3. non–public health state, territorial, local, or federal governmental agencies providing environmental health services; and
4. non–public health state, territorial, local, or federal governmental agencies providing public health laboratory services.

Source: Centers for Disease Control and Prevention (CDC). National Public Health Performance Standards Program: 10 essential public health services. Atlanta, GA: US Department of Health and Human Services, CDC; 2010. Available at: http://www.cdc.gov/nphpsp/essentialservices.html. Accessed July 2, 2013.

Acknowledging that public health encompasses the work of all those who contribute to the health of the public, not merely those employed by governmental public health agencies, is important. However, certain groups of public health workers are not included in the working case definition used here. The scope of this initial project was limited intentionally to information that was readily accessible; thus, key sectors of the public health workforce are not considered. The major groups that are not included in this report — but should be considered for future public health workforce enumeration studies — include community health workers, faculty and students in schools and programs of public health, public health workers in private settings, Medicaid workers, school health workers, public health workers who principally provide clinical and population health services, tribal public health workers, and volunteer public health workers.[4]

Assessing Public Health Workforce Data Sources

As detailed in the *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report, a total of 15 potential data sources for public health workforce enumeration were identified and evaluated on a qualitative scale of “poor,” “fair,” and “good” on the basis of four main criteria — data reliability, data validity, frequency with which data are produced, and data accessibility.[4] An overall assessment of their usability in a public health workforce enumeration estimate was then developed, depending on the degree to which they met each criterion.

Two of these 15 data sources, organizational membership lists and a survey of public health dental directors, were deemed poor in all criteria and were therefore considered inadequate sources for public health workforce enumeration. Nine of the data sources were identified as fair or good in at least one of the four criteria; these sources all provide valuable supplemental workforce enumeration information or have the potential to contribute data for ongoing workforce monitoring, but are limited in either data depth (e.g., limited ability to disaggregate public health workers from other health professionals) or breadth (e.g., only collect data on one segment of the workforce) to serve as principal data sources. Finally, the other four data sources were characterized as fair or good for all four criteria and were considered essential for public

health enumeration efforts. These essential data sources include the National Association of County and City Health Officials (NACCHO) Profile Survey for LHDs; the Association of State and Territorial Health Officials (ASTHO) Profile Survey for state health agencies; Office of Personnel Management (OPM) data for federal employees; and internal agency personnel data (e.g., CDC personnel data), which can provide more descriptive information on federal employees. These sources all collect enumeration data on multiple public health workforce occupational classifications and do so frequently enough to furnish a reliable basis for ongoing monitoring of the public health workforce.[4]

Public Health Workforce Enumeration, 2012

This report both complements and augments the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report[4] and outlines findings of a follow-on study undertaken during 2012 to reanalyze data sources to provide an accurate national governmental public health workforce enumeration estimate. This study focuses on five data sources to generate an estimate of state and LHD workers, including the NACCHO and ASTHO Profile Surveys and three other data sources, as follows: the Council of State and Territorial Epidemiologists (CSTE) Epidemiology Capacity Assessment (epidemiologists); the UM CEPHS Public Health Nurse Workforce Survey (nurses); and the UM CEPHS/Association of Public Health Laboratories (APHL) National Laboratory Capacity Assessment (public health, environmental, and agricultural laboratory workers). To enumerate federal public health workers, CDC reanalyzed OPM data for the relevant federal agencies and provided estimates for this report because internal personnel data cannot be obtained for all federal agencies (unpublished data, CDC, 2012). Multiple data sources with potential for contributing enumeration data were eliminated from this study (e.g., Bureau of Labor Statistics [BLS] data because of its inability to specify the number of public health workers in their counts and data from the TrainingFinder Real-Time Affiliate Integrated Network learning management system, which might provide valuable supplemental public health workforce enumeration data in the future but lacks the capability to do so now).

These data sources have been analyzed and aggregated to develop a lowest, mid-, and highest range enumeration estimate for workers in local, state, and federal settings. The different estimates are based on the assumptions made about each data source, which are fully described in this report. Additionally, we summarize challenges to interpreting the data and the different methods for integrating the data to develop an overall workforce estimate.

METHODS

Data Sources

The data sources used to develop the enumeration estimates in this report are described in the following sections, and a summary is provided in Table 1.

Table 1. Summary of data sources used for 2012 enumeration estimates

	ASTHO	NACCHO	APHL	CSTE	UM CEPHS PHN	OPM
Year of most recent data	2010	2010	2011	2010	2012	2011
Worker type	State	Local	State and local	State and local	State and local	Federal
Occupational categories	All	All except Laboratory Worker and Public Health Dental Worker	Laboratory Worker	Epidemiologist	Public Health Nurse	All except Emergency Preparedness Staff, Epidemiologist, Public Health Informatics Specialist, and Public Information Specialist
Methodology	Online survey distributed to health officers	Online survey distributed to health officers	Online survey distributed to laboratory directors and laboratory workers	Online survey distributed to state epidemiologists	Online survey distributed to state and local nurse liaisons and RNs in health departments	Data collected from federal agencies and published quarterly
Level of data	Organizational	Organizational	Organizational and individual	Organizational	Organizational and individual	Organizational
Frequency	~3 years	~3 years	Disseminated once	~2–3 years	Disseminated once	Continuous
Type of data collected	Workforce size	Workforce size	Workforce size, composition, and characteristics	Workforce size	Workforce size, composition, and characteristics	Workforce size, composition, and characteristics
Strengths	• Comprehensive count of all state public health workers by occupation • High response rate	• Comprehensive count of all local public health workers by occupation • High response rate	• Reports workforce size and characteristics • Includes environmental and agricultural laboratories • Only count of local laboratory workers	• Comprehensive profile of state and local epidemiology workforce • 100% response rate • Counts workers by job function	• Comprehensive profile of size and composition of state and local RNs workforce • Includes all RNs regardless of title or function • High response rate	• Provides data on all civilian federal workers • Standardized, continuous data collection • Data are available by federal agency
Limitations	• Job title might not reflect job function • Might count workers captured in NACCHO survey • Does not collect worker characteristics	• Job title might not reflect job function • Does not collect worker characteristics	• Lower response rate for individual survey • Might not be repeated	• State epidemiologists estimated size of the local epidemiologist workforce • Worker characteristics not collected in 2010	• Organizational counts might not include certain RNs in nonnursing job titles • Five state health departments did not participate • Might not be repeated	• Occupational classifications do not easily correspond to case definition classifications • Difficult to disaggregate public health workers from counts • Excludes Commissioned Corps

APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CSTE = Council of State and Territorial Epidemiologists; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; RN = registered nurse; UM CEPHS PHN = Michigan Center of Excellence in Public Health Workforce Studies Public Health Nurse Workforce Survey.

ASTHO Profile of State Public Health Departments

ASTHO surveys state and territorial health departments[7] to collect information about their health agency responsibilities, structure, planning, quality-improvement activities, and workforce. The most recent survey occurred during 2010 and collected data regarding the number of full-time and part-time staff and full-time equivalent (FTE) and contract employees in all 15 public health occupations used in the project case definition, as previously described.[4] Demographic information and education and professional training characteristics of the workforce are not collected. A link to the Internet-based survey is sent by e-mail to the senior deputy in each state and territorial public health agency for completion. ASTHO staff follow up with nonresponding states through e-mail and telephone calls to encourage responses. ASTHO conducts profile studies at approximately 3-year intervals. The next survey is scheduled to be administered during 2013.

The ASTHO survey benefits from high response rates. The 2010 profile, for example, was completed by all 50 states, the District of Columbia, and two territories. Thus, the survey attained a 100% response rate among states and a 92% response rate among all entities that were provided the opportunity to respond; all nonrespondents were territories. The workforce information collected by the survey includes the size of the employed and contracted workforce by count and FTEs; full-time versus part-time status of workers; employee age; turnover rate; and number of vacant positions.

Main limitations of ASTHO data for public health workforce enumeration is approximately 46% of the state and territorial health department workforce is grouped as Other Public Health Professional or Uncategorized Worker either because of missing data or because these persons were employed in an occupation not selected for data collection in the profile survey. Additionally, certain states did not provide data for each occupational category, leading to an undercount of public health workers by occupation; the number of respondents ranged from 23 to 45 states for each occupation question, and only one U.S. territory provided workforce data. The survey uses occupational classification (i.e., job title) to count workers, possibly miscounting workers who perform other functions (e.g., a nurse who functions as an epidemiologist). The survey asks administrators to assess shortage levels qualitatively for each occupation, which might be a source of bias in the study.

This data set is likely the best source of state-level public health workforce data for selected occupations, particularly those that do not benefit from inclusion in assessments from other professional associations. Workforce data are provided by the human resources director at each state or territorial health agency; therefore, the counts provided by the health departments probably represent an accurate enumeration of their workforce. Payroll and other human resources data should provide replicable counts of state and territorial public health workers; however, the total number of state public health workers appears to be a crude estimate, and approximately half of the workforce is not described by occupational categories. Additionally, the results might undercount workers whose occupation is not listed in the survey, and workers might be misclassified if their job title and function are not the same. Qualitative assessments (e.g., workforce shortage assessments) might vary among state agencies, depending on which state official completed that section of the survey.

NACCHO National Profile of LHDs

NACCHO's national profiles of LHDs began in 1989–1990.[8] With funding support from CDC and the Robert Wood Johnson Foundation (RWJF), NACCHO has conducted six national profile studies, the most recent of which was completed in 2010; however, another profile study is under way. Workforce questions are among the seven core topics, collecting data regarding the total number of FTEs employed and contractor staff in 13 of the 15 case definition occupations, including an Other category, in all county and city health departments nationwide. NACCHO has not collected data on public health laboratorians or public health dentists. The NACCHO Profile Study provides the most comprehensive count of LHD workers of any national data source. The profile questionnaire has been disseminated by NACCHO staff through an e-mail sent to the top agency executive or designee of every LHD among the study population. The e-mail included a link to the Internet-based questionnaire, which was preloaded with identifying information for each LHD. Paper copies of questionnaires were provided upon request. NACCHO staff and a national group of profile study advocates undertook intensive follow-up to encourage a high response rate. The District of Columbia's health department was counted as an LHD; Hawaii and Rhode Island were excluded from the study because those state health departments provide all public health services and no substate governmental public health units exist. All LDHs received the core questionnaire. In addition, a stratified random sample of 625 health departments also received a module that included additional workforce and human resources questions.

NACCHO's 2010 Profile Study achieved an 82% response rate (2,107/2,565 LHDs), providing a substantial sample of LHDs. The occupations included in the questionnaire are similar to those included in ASTHO's survey, allowing comparative and trend analyses. LHD workforce counts are weighted estimates; 95% confidence intervals are provided. The list of occupations used by this study is not comprehensive, with approximately 29% (45,690/160,000) of LHD workers not being categorized in any occupation because of missing data or employment in an occupation not selected for data collection. In addition, contract workers are not distinguished from health department employees. The Profile Study does not collect data on critical workforce characteristics, including years of public health experience or educational and training background. As with the ASTHO study, the Profile Study uses occupational classification to count workers, which can lead to miscounting or mischaracterization.

The NACCHO Profile Study is considered an essential data source in monitoring workforce size and composition among LHDs. The studies are conducted at approximately 3-year intervals, and data are publicly available for research within 1 year of data collection. Workforce data typically are generated from human resources occupational data in each health department and therefore should be valid and reliable, but weighted estimates are used for worker counts, potentially affecting estimate precision. Weight methodology has been modified by NACCHO for the 2010 survey; therefore, caution should be used when analyzing the data longitudinally. In addition, given the data limitations, researchers should be cautious in interpreting size and composition of the national local public health workforce from Profile Study results.

UM CEPHS/APHL National Laboratory Workforce Capacity Assessment

In 2010, APHL developed organizational- and individual-level survey instruments in collaboration with UM CEPHS.[9] The individual-level survey was disseminated in April 2011 and the organizational-level survey in July 2011. The surveys provide comprehensive data about public health, environmental, and agricultural laboratories and are the most useful source of available information for enumerating laboratorians. APHL disseminated the Internet-based survey through an e-mail to directors of 105 member laboratories, including 50 state public health laboratories, 41 local public health laboratories, 8 environmental laboratories, and 6 agricultural laboratories. The directors or their designees were responsible for completing the organizational-level survey and for forwarding the individual-level survey to laboratorians employed by the state laboratory. APHL promoted the survey at their annual meeting and made follow-up telephone calls to laboratory directors to improve the response rate for the organizational-level survey.

The APHL survey captures data from laboratories with public health functions that are not captured in ASTHO data (e.g., agricultural and environmental laboratories). The data provide comprehensive information about demographic, educational, competency, and training characteristics of the workforce collected at an individual level, and the results enumerate scientific laboratory staff by job title, as well as administrative support staff and information technology or informatics staff. The organizational-level survey received responses from 76% (80/105) of sampled public health, environmental, and agricultural laboratories. Approximately two-thirds of respondents were from public health laboratories (61%); 4% were environmental; 5% were agricultural; and approximately 30% were a combination thereof. The individual-level survey garnered a 35% response rate with data for 1,942/5,498 laboratorians. Regarding data limitations, whether laboratories and laboratorians who did not respond to the survey are different from those who did is unknown. Additionally, not all agricultural laboratories are performing public health functions, although the majority of them are involved on some level with food regulatory activities. Determining which laboratories are primarily responsible for public health activities from the survey results might be possible, the determinations cannot be absolutely certain. Finally, although the survey collected data on state and local public health laboratories, because of item nonresponse, determining how many laboratory workers are employed in each setting is impossible.

APHL works closely with laboratory directors who completed the organizational-level survey on behalf of their laboratory in addition to completing and distributing the individual-level survey to their staff. The employment data provided by the laboratories is generated through human resources and payroll information; therefore, they probably accurately account for all laboratory staff employed in their department. The surveys were accompanied by comprehensive instructions on defining, categorizing, and counting workers. APHL staff followed up directly with the majority of laboratories to ensure that laboratory directors understood how to complete the assessment and also that workers were being categorized and counted consistently among laboratories.

CSTE National Assessment of Epidemiology Capacity

CSTE conducted the first in a series of five Epidemiology Capacity Assessments (ECAs) in 2001, with the most recent ECA completed in 2010[10]; another ECA is planned for late 2013. The last three ECAs achieved a 100% response rate from the 50 states and the District of Columbia. ECAs assess epidemiologic capacity of state and territorial health departments for providing the 10 Essential Public Health Services[11] and in the following eight program areas: bioterrorism or emergency response, chronic diseases, environmental health, infectious diseases, injury, maternal and child health, occupational health, and oral health. Assessment questions focus on enumerating and describing the public health epidemiology workforce, funding, training, and ability to provide essential services. The 2010 rapid ECA used core workforce questions from previous ECAs and added questions about the number of LHD epidemiologists. CSTE staff disseminated the Internet-based survey to state epidemiologists, who served as primary informants, by e-mail. They followed up with telephone calls and e-mails to improve the response rate.

ECA data tend to provide the most comprehensive enumeration and profile of the state-level epidemiology workforce. The 2010 rapid ECA provided workforce data on both state and local epidemiologists. Although the methodology for deriving a count of LHD epidemiologists consisted of requesting an estimate from the state epidemiologist, the reported estimate is comparable to estimates made by the NACCHO Profile Surveys and to that derived from BLS data. Because of definitional differences noted in the following section, CSTE data probably count more workers as epidemiologists than in such data sets as BLS. CSTE routinely surveys the epidemiology workforce employed in state health departments every 2–3 years. Given the multiple ECA iterations and the inclusion of a definition for an epidemiologist, survey results are likely capturing the most accurate numbers and providing useful workforce trend data.

UM CEPHS Public Health Nurse Workforce Survey

In 2012, UM CEPHS convened a national public health nursing workforce advisory committee as part of an RWJF study to assist in developing and disseminating a two-stage survey to assess the size and composition of the public health nurse workforce in state and LHDs. Organizational- and individual-level online surveys were distributed by the Association of Public Health Nurses to state liaisons who disseminated the surveys to health departments in the study sample. A total of 377 state and local health agencies were randomly selected for study inclusion. The enumeration estimate in this report was developed from results of the organizational-level survey, which received response from 45/50 (90%) state health agencies and 265/327 (81%) LHDs. Weights were used to create a national estimate for public health nurses employed or contracted by LHDs. The study did not estimate the number of public health nurses in the state health departments not participating in the survey.

The Public Health Nurse (PHN) Workforce Survey provides a comprehensive characterization of those workers. The high response rate achieved for the organizational-level survey allowed for calculation of national estimates, which might provide more specificity than data collected by the ASTHO or NACCHO Profile Surveys.

OPM Federal Employment Statistics

OPM publishes federal employment statistics acquired from the Central Personnel Data File (CPDF).[12] The data provide employment trends, demographic profiles, and retirement statistics for all federal civilian employees. According to OPM, two central human resources databases are maintained, CPDF and the Enterprise Human Resources Integration. Data as of fiscal year 2009 (inclusive) come from CPDF, and after fiscal year 2009, from the Enterprise Human Resources Integration. Production data typically are released quarterly. Status data (cross-sections; used for total employment aggregates) are available 1–2 months after the end of each quarter. Dynamics data (all personnel actions; used for determining hiring numbers, retirement figures, and so forth) require more time, approximately 4 months from the end of the quarter, to become production data.

OPM's federal employment data provide information for all federal civilian employees, including those specific to the agencies under the DHHS, the department that likely employs the majority of federal public health workers. This source uses two occupational classifications that might be specifically relevant to public health workers, Public Health Educators and Public Health Program Specialists. Data elements include occupation, length of service, and demographic characteristics. The data are published quarterly and are accessible through FedScope (http://www.fedscope.opm.gov/).

The majority of the occupations used by OPM include both public health and non–public health workers. As with other workforce surveys, the occupational classifications of workers might not accurately reflect their job functions. The U.S. Public Health Service, other noncivilian federal public health workers, and federal contractors, who are believed to compose a substantial portion of the federal public health workforce, are not included in this data source.

OPM's data are derived from a standardized DHHS human resources management system; therefore, the data should accurately account for the number of workers in each DHHS agency by occupational series. However, the occupational classifications used by OPM rarely are specific enough to be used for a national public health enumeration or workforce surveillance-like system. Assuming that OPM's data source provides consistent results is reasonable. OPM uses a standardized methodology for collecting and reporting human resources data. The only potential reliability concern is whether occupational classifications are redefined or otherwise modified across time, thus producing different estimates. The data are collected continually, published quarterly, and accessible for research purposes.

In 2012, a CDC project focused on reviewing OPM CPDF and BLS Occupational Employment Statistics data sources (unpublished data, CDC, 2012). OPM data for May 2011 were analyzed to enumerate federal workers in occupational classifications that correspond to the occupational categories identified in the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report.[4] Those data are used for the enumeration estimates in this report, along with estimates from the 2012 *Strategies* report.

Occupational Categories

The occupational categories used for the enumeration estimate were identified during the 2011–2012 project year by UM CEPHS and the University of Kentucky Center of Excellence in Public Health Workforce Research and Policy.[4] Definitions for the categories are based on definitions used in HRSA's *Public Health Work Force: Enumeration 2000* report.[3] Although UM CEPHS adopted these definitions for the purpose of this study, certain data sources used slightly different occupational category definitions in their surveys, which are noted.

Administrative or Clerical Personnel: Staff who work in business, finance, auditing, management, and accounting; trained at a professional level in their field of expertise before entry into public health; staff who perform support work in areas of business and financial operations; and staff who perform nontechnical support work in all areas of management and program administration.

Behavioral Health Professional: Workers who provide psychological support and assess, coordinate, and monitor provision of community services for patients or clients.

Emergency Preparedness Staff: Workers whose regular duties involve preparing for (e.g., developing plans, procedures, and training programs) and managing the public health response to all-hazards events.

Environmental Health Worker: Staff who plan, develop, implement, and evaluate standards and systems to improve the quality of the physical environment as it affects health; manage environmental health programs; perform research on environmental health problems; and promote public awareness of the need to prevent and eliminate environmental health hazards.

Epidemiologist: Staff who investigate, describe, and analyze the distribution and determinants of disease, disability, and other health outcomes and develop the means for disease prevention and control; investigate, describe, and analyze the efficacy of programs and interventions. (Note: The 2010 CSTE ECA characterized workers by their job tasks, rather than their job title, unlike the ASTHO or NACCHO Profile Surveys that obtain workforce data that are based on job titles.)

Health Educator: Workers who design, organize, implement, communicate, evaluate, and provide advice regarding the effect of educational programs and strategies designed to support and modify health-related behaviors of persons, families, organizations, and communities.

Laboratory Worker: Staff who plan, design, and implement laboratory procedures to identify and quantify agents in the environment that might be hazardous to human health, biologic agents believed to be involved in the etiology of diseases among animals or humans (e.g., bacteria, viruses, or parasites), or other physical, chemical, and biologic hazards; and laboratory technicians who plan, perform, and evaluate laboratory analyses and procedures not elsewhere classified, including performing routine tests in a medical laboratory for use in disease diagnosis and treatment; preparing vaccines, biologics, and serums for disease prevention; preparing tissue samples for pathologists or taking blood samples; and executing laboratory tests (e.g., urinalysis

and blood counts). The 2011 APHL National Laboratory Capacity Assessment developed specific definitions for laboratory worker job classifications, including aide or assistant, technician, scientist, scientist-supervisor, scientist-manager, developmental scientist, deputy director, and director.[4]

Nutritionist: Staff who plan, develop, implement, and evaluate programs or scientific studies to promote and maintain optimum health through improved nutrition; collaborate with programs that have nutrition components; might involve clinical practice as a dietitian.

Public Health Dental Worker: Staff who plan, develop, implement, and evaluate dental health programs to promote and maintain the public's optimum oral health, including public health dentists who can provide comprehensive dental care and dental hygienists who can provide limited dental services under professional supervision.

Public Health Informatics Specialist: Workers who systematically apply information and computer science and technology to public health practice, research, and learning (e.g., public health information systems specialists or public health informaticists).

Public Health Manager: Health service managers, administrators, and public health directors overseeing the operations of the agency or of a department or division, including the senior agency executive, regardless of education or licensing.

Public Health Nurse: Workers who plan, develop, implement, and evaluate nursing and public health interventions for persons, families, and populations at risk for illness or disability. This title covers all positions identified at the registered nurse (RN) level, unless specified as performing work defined under another professional title, and includes graduates of diploma and associate degree programs with the RN license. The 2012 UM CEPHS PHN Workforce Survey specifically defined this category of workers as "all RNs employed or contracted by the health department," without regard for job title, task, or function.

Public Health Physician: Physicians who identify persons or groups at risk for illness or disability and who develop, implement, and evaluate programs or interventions designed to prevent, treat, or ameliorate such risks; might provide direct medical services within the context of such programs, including medical doctor and doctor of osteopathy generalists and specialists, some of whom have training in public health or preventive medicine.

Public Information Specialist: Staff who represent public health topics to the media and public, act as a spokesperson for public health agencies, engage in promoting or creating good will for public health organizations by writing or selecting favorable publicity material and releasing it through different communications media, or prepare and arrange displays, make speeches, and perform related publicity efforts.

Other Public Health Professional: Workers in positions in a public health setting occupied by professionals (prepared at the baccalaureate level or higher) who are not listed under the specific categories listed previously.

Uncategorized Public Health Worker: Workers who cannot be placed in any category because of underreporting by the public health agency or missing data.

Statistical Analysis: Calculation of Estimates

Public health workforce enumeration estimates were calculated by using data sources statistically adjusted to address worker overcounting and undercounting as previously noted. The NACCHO, ASTHO, APHL, and UM CEPHS PHN Workforce Survey data sources all have missing data, leading to worker undercounting. The NACCHO Profile Study counts are based on weighted estimates, which might have been adjusted for missing data in their enumeration figures. Therefore, adjustments were made only to ASTHO, APHL, and PHN Workforce Survey data. For ASTHO data, one state did not report workforce size in the 2010 Profile Survey. An estimate was made for this state health department's workforce by comparing the number of local public health workers reported in the *Public Health Work Force: Enumeration 2000* report with the number of workers reported in the 2010 NACCHO Profile Survey and applying the same proportional change (45% increase) to the number of state public health workers reported in 2000.

The APHL survey data produced workforce estimates for laboratory workers in state and local public health, environmental, and agricultural laboratories. Because no previous data exist from APHL, NACCHO, or other comprehensive surveys of the local laboratorian workforce, estimates cannot be made to address survey nonresponse from local laboratories. A similar problem was encountered for state agricultural and environmental laboratories. However, enumeration estimates for state public health laboratory workers are available from the ASTHO Profile Study data. Despite the possibility of slightly different case definitions for laboratory workers between the surveys, ASTHO data from six states were used to supplement the laboratory workforce numbers from the APHL survey for those states that had not participated.

Finally, for UM CEPHS PHN Workforce Survey data, estimates were developed for the five state health agencies that did not participate in the survey. Three of the five states reported the number of public health nurses in their state health department in the 2010 ASTHO Profile Survey; those estimates were incorporated into this data set. For the remaining two states, approximations of the number of public health nurses were developed by applying the overall proportion of public health nurses in the state health agency workforce nationally (8%) to the number of FTEs reported by each state health agency. Also, according to ASTHO data, 47% of workers employed by one of these five state health departments are located in local units. This estimate was applied to the number of public health nurses employed by the state health agency so that an approximation of the number of public health nurses working in the state health department, compared with the LHD, could be made. Adjustments to the LHD figures were unnecessary because they represent a national sample.

To address concerns of potential duplicate counting of public health workers, results of the NACCHO and ASTHO Profile Studies were examined further. The primary challenge of using these two data sources in a worker enumeration is the possibility that state health department employees who work in local units are double-counted (i.e., counted in both surveys). The 23

states with centralized, mixed, or shared governance structures, as defined by ASTHO, are more likely to have state-employed workers in LHD units, which increases the likelihood that these workers were counted in both the ASTHO and NACCHO Profile Studies. The exact number of workers enumerated in both surveys is unknown, although respondents to the ASTHO survey did estimate the proportion of state workers who work in local units. Proportional adjustments for duplicate counting are made for the number of public health workers in each occupational classification, although precise figures are impossible to determine. In this report, we are primarily interested in where workers are providing services, as opposed to who their employer is; therefore, duplication adjustments for the state and local workforce were made on the basis of the job setting of the worker. For example, state public health employees working in local units are counted as part of the local workforce in this study. OPM data provide information on federal civilian workers in health-related professions, but cannot specifically identify public health workers. Although the exact number of federal public health workers captured in these data is unknown, adjustments needed to be made to the estimate to address the substantial overcounting of workers.

This report provides the following three possible ranges for the enumeration estimate in an attempt to address the problem of duplicate counting among surveys and overcounting in the OPM data.

Lowest Range Enumeration Estimate: The lowest estimate reduces the number of state workers enumerated by ASTHO by the 42% among all occupational categories, except Epidemiologists, Laboratory Workers, and Public Health Nurses. This percentage reflects the proportion of state public health workers who work in local public health, according to ASTHO survey respondents. CSTE, APHL, and UM CEPHS PHN Workforce Survey data were used to estimate the number of Epidemiologists, Laboratory Workers, and Public Health Nurses, respectively. No adjustments were made to these data. This estimate also limits the enumeration of federal workers to those working in DHHS agencies.

Midrange Enumeration Estimate: The midrange estimate adjusts for the number of workers who potentially are counted by both the ASTHO and NACCHO surveys. UM CEPHS researchers developed an approximate duplicate count rate, which accounts for health department governance structure (e.g., centralized or decentralized) and occupational category and applies it to the state public health worker enumeration. The formula for approximating duplicate count is described in this report's results section. For the federal workforce, in addition to using OPM data for all DHHS workers, workers from the U.S. Department of Agriculture (USDA) and U.S. Environmental Protection Agency (EPA) were included in the job categories of Behavioral Health Professional, Environmental Health Worker, Laboratory Worker, Nutritionist, Public Health Nurse, Public Health Physician, and Other Public Health Professional or Other Uncategorized Worker. Workers in occupational categories that might not be specific to public health (e.g., Administrative or Clerical Personnel) were omitted from the estimate to reduce the possibility of including non–public health workers in the enumeration. The lowest and midrange estimates use OPM data collected for the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report.[4]

Highest Range Enumeration Estimate: The highest estimate makes no adjustments for potential duplicate counts or overcounting of state and local public health workers and uses all OPM data provided by CDC[10] to develop the federal public health workforce estimate.

Table 2 presents a summary of the data sources used for each estimate range and the adjustments made to them; details are provided in this report's results section.

Table 2. Summary of data sources used and data adjustments made for lowest, mid-, and highest range enumeration estimates

		Lowest range estimate	Midrange estimate	Highest range estimate
Local	Data sources	NACCHO, CSTE, APHL, UM CEPHS PHN	NACCHO, CSTE, APHL, UM CEPHS PHN	NACCHO, CSTE, APHL, UM CEPHS PHN
	Data adjustments	Uses NACCHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN)	Uses NACCHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN)	Uses NACCHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN)
State	Data sources	ASTHO, CSTE, APHL, UM CEPHS PHN	ASTHO, CSTE, APHL, UM CEPHS PHN	ASTHO, CSTE, APHL, UM CEPHS PHN
	Data adjustments	Uses ASTHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN); proportionally reduces all ASTHO occupational categories by 42% to account for state workers in local units	Uses ASTHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN); uses a UM CEPHS-developed formula to reduce ASTHO occupational categories to account for state workers in local units	Uses ASTHO data for all occupational categories except Epidemiologists (CSTE), Laboratory Workers (APHL), and Public Health Nurses (UM CEPHS PHN); no additional adjustments made to account for state workers in local units
Federal	Data sources	OPM	OPM	OPM
	Data adjustments	Limits federal worker count to those employed in DHHS agencies	Includes all DHHS workers and USDA and EPA workers in 7 occupational categories in the case definition	Estimates provided by CDC for all federal public health workers; no adjustments made

APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CDC = Centers for Disease Control and Prevention; CSTE = Council of State and Territorial Epidemiologists; DHHS = U.S. Department of Health and Human Services; EPA = U.S. Environmental Protection Agency; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey; USDA = U.S. Department of Agriculture.

RESULTS

The data sources used to develop enumeration estimates include the five data sets summarized in the 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report[4] in addition to the UM CEPHS PHN Workforce Survey. The raw numbers extracted from each data set for the occupational classifications included in the study are presented in Table 3.

Table 3. Raw counts of public health workers, by data source

Occupational category	2010 NACCHO		2010 ASTHO		2010 CSTE		2011 APHL		2012 UM CEPHS PHN		2011 OPM
	Local*	State	Local	State	Local	State	Local*	State	Federal
Administrative or Clerical Personnel	40,400	18,481	—	—	85	809	—	—	58,850
Behavioral Health Professional	5,600	2,974	—	—	—	—	—	—	15,533
Emergency Preparedness Staff	2,700	43	—	—	—	—	—	—	—
Environmental Health Worker	13,800	5,780	—	—	—	—	—	—	7,504
Epidemiologist	1,500	2,550	1,278	2,476	—	—	—	—	—
Health Educator	4,900	2,440	—	—	—	—	—	—	56
Laboratory Worker	—	3,965	—	—	546	4,952	—	—	13,139
Nutritionist	4,600	1,557	—	—	—	—	—	—	2,100
Public Health Dental Worker	—	236	—	—	—	—	—	—	1,662
Public Health Informatics Specialist	1,100	1,317	—	—	16	191	—	—	—
Public Health Manager	9,500	3,826	—	—	—	—	—	—	11,383
Public Health Nurse	27,900	11,071	—	—	—	—	29,191	11,600	60,139
Public Health Physician	1,800	1,157	—	—	—	—	—	—	27,663
Public Information Specialist	510	332	—	—	—	—	—	—	—
Other Public Health Professional or Uncategorized Worker	45,690	47,551	—	—	—	—	—	—	46,002
Total	**160,000**	**103,280**	**1,278**	**2,476**	**647**	**5,952**	**29,191**	**11,600**	**244,031**

*Weighted estimates.

APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CSTE = Council of State and Territorial Epidemiologists; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey.

NACCHO estimates a total of 160,000 workers in LHDs among the 15 job classifications, including Other or Uncategorized Workers, whereas ASTHO reports 103,280 workers in state health agencies. A 2010 CSTE study enumerates 2,476 Epidemiologists in state health departments and 1,278 in LHDs. APHL estimates 546 Laboratory Workers in local and 4,952 in state public health, environmental, and agricultural laboratories, as well as 894 Administrative Personnel and 207 Informatics staff in state and local laboratories. The UM CEPHS PHN Workforce Survey estimated 29,191 RNs in LHDs and 11,600 in state health agencies. Finally, CDC reports that 244,031 workers in federal agencies were classified in a job occupation that might be public health-related by using OPM data (unpublished data, CDC, 2012).

Missing Data Adjustments

As described previously, adjustments were made to ASTHO, APHL, and the UM CEPHS PHN Workforce Survey data by either supplementing missing data with data from similar surveys or by approximating the number of workers on the basis of trend data from *The Public Health Work Force: Enumeration 2000* results.[3] For ASTHO data, 4,392 workers were added to the Other Public Health Professional or Uncategorized Worker category, for a total of 107,672 state health department workers. Supplementing the APHL data with ASTHO Profile Survey data for Laboratory Workers resulted in an increase of 747 workers in this category, for a total of 5,699. Adjusting APHL estimates for Administrative or Clerical Personnel, Information Technology Workers, and Laboratory Workers in local, agricultural, or environmental laboratories was not possible; thus, those estimates remain unchanged. The count of state health department public health nurses in the UM CEPHS PHN Workforce Survey data was increased by 686 public health nurses for a total of 12,286; the local estimate is unadjusted (Table 4).

Table 4. Number of workers, by occupational category, after adjusting Table 3 estimates for missing data — ASTHO, APHL, and UM CEPHS PHN Workforce Survey

	Data source*				
	ASTHO	APHL		UM CEPHS PHN	
Occupational category	State	Local	State	Local	State
Administrative or Clerical Personnel	18,481	85	809	—	—
Behavioral Health Professional	2,974	—	—	—	—
Emergency Preparedness Staff	43	—	—	—	—
Environmental Health Worker	5,780	—	—	—	—
Epidemiologist	2,550	—	—	—	—
Health Educator	2,440	—	—	—	—
Laboratory Worker	3,965	546	5,699	—	—
Nutritionist	1,557	—	—	—	—
Public Health Dental Worker	236	—	—	—	—
Public Health Informatics Specialist	1,317	16	191	—	—
Public Health Manager	3,826	—	—	—	—
Public Health Nurse	11,071	—	—	29,191	12,286
Public Health Physician	1,157	—	—	—	—
Public Information Specialist	332	—	—	—	—
Other Public Health Professional or Uncategorized Worker	51,943	—	—	—	—
Total	**107,672**	**647**	**6,699**	**29,191**	**12,286**

*ASTHO data supplemented with *Enumeration* 2000 estimates; APHL state data and Public Health Nurse Workforce Survey state data supplemented with 2010 ASTHO Profile Data.
APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey.

Duplicate Counting and Overcounting Adjustments

After addressing possible undercounting in the different data sources, we adjusted the data to account for duplicate counting and overcounting. Data were combined on the basis of the worker's job setting. For example, state-employed public health workers located in LHDs are counted in the local category for the purposes of this enumeration because they are providing services at the local level.

The local and state categories include data from NACCHO and ASTHO, respectively, for all occupational categories except Epidemiologists, for which 2010 CSTE data are used, Laboratory Workers, for which 2011 APHL data are used, and Public Health Nurses, whose estimate is derived from 2012 UM CEPHS PHN Workforce Survey results. All estimated counts for federal workers are derived from OPM data.

Lowest Range Enumeration Estimate

The lowest enumeration range presents the most conservative set of assumptions regarding public health worker numbers applied to each set of enumeration data sources. Subtracting the number of state health agency employees working in LHDs from the ASTHO Profile data resulted in a total of 33,444 state public health workers in all occupational categories except Epidemiologist, Laboratory Worker, and Public Health Nurse. The estimates for Epidemiologists and Laboratory Worker were not modified because CSTE and APHL data are not believed to include a substantial number of state health agency employees in LHDs. The estimate for public health nurses working in state health agencies was reduced by 5,865 workers, on the basis of duplicate counting estimates provided by the UM CEPHS PHN Workforce Survey, for a total of 6,421 (Table 5).

This estimate demonstrates that the majority of the 303,773 workers provide services at the local level, with 53% (161,615) of enumerated workers in that setting. An additional 22% (66,846) of the governmental public health workforce work in a state health agency. Approximately 25% (75,312) of workers are civilian federal public health workers employed in a DHHS agency (Table 5).

Administrative or Clerical Personnel compose the largest proportion of workers in this enumeration estimate at 19%, followed by Public Health Nurses (14%), Environmental Health Workers (6%), and Public Health Managers (4%). All other occupational categories represent 3% or fewer of the governmental public health workforce. Approximately 43% of all workers in this estimate were categorized as Other/Unclassified (Table 5).

Table 5. Number and percentage of local, state, and federal public health workers in lowest range enumeration estimate, by occupational category

Occupational category	Worker job setting*			Total	%
	Local	State	Federal		
Administrative or Clerical Personnel	40,400	10,719	5,303	**56,422**	**19**
Behavioral Health Professional	5,600	1,725	123	**7,448**	**2**
Emergency Preparedness Staff	2,700	25	—	**2,725**	**1**
Environmental Health Worker	13,800	3,352	210	**17,362**	**6**
Epidemiologist	1,278	2,476	—	**3,754**	**1**
Health Educator	4,900	1,415	54	**6,369**	**2**
Laboratory Worker	546	5,699	1,772	**8,017**	**3**
Nutritionist	4,600	903	122	**5,625**	**2**
Public Health Dental Worker	—	137	444	**581**	**<1**
Public Health Informatics Specialist	1,100	764	—	**1,864**	**1**
Public Health Manager	9,500	2,219	1,554	**13,273**	**4**
Public Health Nurse	29,191	6,421	5,678	**41,290**	**14**
Public Health Physician	1,800	671	6,401	**8,872**	**3**
Public Information Specialist	510	193	—	**703**	**<1**
Other Public Health Professional or Uncategorized Worker	45,690	30,127	53,651	**129,468**	**43**
Total	**161,615**	**66,846**	**75,312**	**303,773**	**100**
%	**53**	**22**	**25**		

*__Data sources:__
Local — NACCHO; CSTE; APHL; and UM CEPHS PHN.
State — ASTHO; CSTE; APHL; and UM CEPHS PHN.
Federal — OPM.
APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CSTE = Council of State and Territorial Epidemiologists; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey.

Midrange Enumeration Estimate

The middle enumeration range uses the same total numbers of workers in LHDs (161,615) as the lowest enumeration estimate, but makes further adjustments to the state and federal worker enumeration. The percentage of state health agency workers reported to be working in local public health in the 2010 ASTHO Profile was reviewed in the context of state governance structure. Centralized states reported, on average, approximately 30% of state workers assigned to local units; mixed or shared states reported approximately 32% of the state workers working in LHDs, and decentralized states reported approximately 10% of their state health agency's staff working in local units. Evidence from reviewing these data indicates that certain states might have skewed the overall average of the percentage of state workers in LHDs. To adjust for this, a proportional reduction of 24% was taken among all occupational categories of state public health workers, except Epidemiologist, Laboratory Worker, and Public Health Nurse for reasons previously noted. Although the exact proportion of state public health workers assigned to LHDs is impossible to calculate, this estimation seems to be a more reasonable assessment of duplicate reporting than the 42% figure used in the lowest range enumeration estimate.

The estimate of civilian federal public health workers was modified by including workers in specific occupational categories, as noted in the methods section, from USDA and EPA. These additions resulted in an increase of 7,357 workers in occupational categories of Behavioral

Health Professional, Environmental Health Worker, Laboratory Worker, Nutritionist, Public Health Nurse, Public Health Physician, and Other Public Health Professional or Uncategorized Worker.

In total, the midrange enumeration estimates 326,602 governmental public health workers in local, state, and federal settings. Approximately 50% (161,615) of workers provide services in local public health settings; 25% (82,318) provide services in a state health agency setting; and 25% (82,669) are employed in a federal agency. At 18%, Administrative or Clerical Personnel compose the largest group of categorized workers. Public Health Nurses are the next largest group (12%), followed by Environmental Health Workers (7%), Public Health Managers (4%), Public Health Physicians (3%), and Laboratory Workers (3%). The remainder of the categorized workers compose 2% or fewer of the governmental public health workforce. Approximately 43% of workers in this estimate were Other Public Health Professional or Uncategorized Workers (Table 6).

Table 6. Number and percentage of local, state, and federal public health workers in midrange enumeration estimate, by occupational category

	Worker job setting*				
Occupational category	**Local**	**State**	**Federal**	**Total**	**%**
Administrative or Clerical Personnel	40,400	14,046	5,303	**59,749**	**18**
Behavioral Health Professional	5,600	2,260	125	**7,985**	**2**
Emergency Preparedness Staff	2,700	33	—	**2,733**	**1**
Environmental Health Worker	13,800	4,393	4,922	**23,115**	**7**
Epidemiologist	1,278	2,476	—	**3,754**	**1**
Health Educator	4,900	1,854	54	**6,808**	**2**
Laboratory Worker	546	5,699	2,206	**8,451**	**3**
Nutritionist	4,600	1,183	266	**6,049**	**2**
Public Health Dental Worker	—	179	444	**623**	**<1**
Public Health Informatics Specialist	1,100	1,001	—	**2,101**	**1**
Public Health Manager	9,500	2,908	1,554	**13,962**	**4**
Public Health Nurse	29,191	5,678	5,739	**40,608**	**12**
Public Health Physician	1,800	879	6,425	**9,104**	**3**
Public Information Specialist	510	252	—	**762**	**<1**
Other Public Health Professional or Uncategorized Worker	45,690	39,477	55,631	**140,798**	**43**
Total	**161,615**	**82,318**	**82,669**	**326,602**	**100**
%	**50**	**25**	**25**		

*__Data sources:__
Local — NACCHO; CSTE; APHL; and UM CEPHS PHN.
State — ASTHO; CSTE; APHL; and UM CEPHS PHN.
Federal — OPM.
APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CSTE = Council of State and Territorial Epidemiologists; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey.

Highest Range Enumeration Estimate

Given the difficulties in calculating an accurate estimate for the degree of overcounting, the highest enumeration range uses data from all sources, after adjustments were made to account for

missing data or undercounted workers (i.e., data from Tables 3 and 4) to develop estimates. Although this range undoubtedly overestimates the number of public health workers in local, state, and federal health agencies, it also serves as an upper limit for the possible number of governmental public health workers, as supported by these data sources.

This enumeration estimates a total of 516,193 public health workers in local, state, and federal agencies. Approximately half (244,031; 47%) of all governmental public health workers are located in federal agencies on the basis of the broadened use of OPM data. Approximately 31% (161,615) of governmental public health workers are providing services in local settings, and 21% (110,547) are working in state health agencies. The largest group of workers is Other Public Health Professional or Uncategorized Worker (28%), followed by Administrative or Clerical Personnel (23%), Public Health Nurse (20%), Public Health Physician (6%), Behavioral Health Professional (5%), Environmental Health Worker (5%), and Public Health Manager (5%), and Laboratory Worker (4%). All other occupational categories represent 1% or fewer of the governmental public health workforce (Table 7).

Table 7. Number and percentage of local, state, and federal public health workers in highest range enumeration estimate, by occupational category

Occupational category	Worker job setting*			Total	%†
	Local	State	Federal		
Administrative or Clerical Personnel	40,400	18,481	58,850	**117,731**	**23**
Behavioral Health Professional	5,600	2,974	15,533	**24,107**	**5**
Emergency Preparedness Staff	2,700	43	—	**2,743**	**1**
Environmental Health Worker	13,800	5,780	7,504	**27,084**	**5**
Epidemiologist	1,278	2,476	—	**3,754**	**1**
Health Educator	4,900	2,440	56	**7,396**	**1**
Laboratory Worker	546	5,699	13,139	**19,384**	**4**
Nutritionist	4,600	1,557	2,100	**8,257**	**2**
Public Health Dental Worker	—	236	1,662	**1,898**	**<1**
Public Health Informatics Specialist	1,100	1,317	—	**2,417**	**<1**
Public Health Manager	9,500	3,826	11,383	**24,709**	**5**
Public Health Nurse	29,191	12,286	60,139	**101,616**	**20**
Public Health Physician	1,800	1,157	27,663	**30,620**	**6**
Public Information Specialist	510	332	—	**842**	**<1**
Other Public Health Professional or Uncategorized Worker	45,690	51,943	46,002	**143,635**	**28**
Total†	**161,615**	**110,547**	**244,031**	**516,193**	**100**
%	**31**	**21**	**47**		

*Data sources:
Local — NACCHO; CSTE; APHL; and UM CEPHS PHN.
State — ASTHO; CSTE; APHL, and UM CEPHS PHN.
Federal — OPM.
†Totals might not sum to 100% because of rounding.
APHL = Association of Public Health Laboratories; ASTHO = Association of State and Territorial Health Officials; CSTE = Council of State and Territorial Epidemiologists; NACCHO = National Association of County and City Health Officials; OPM = Office of Personnel Management; UM CEPHS PHN = University of Michigan Public Health Nurse Workforce Survey.

Combined Estimates

The three enumeration estimates for the local, state, and federal public health workforce ranged from 303,773 on the low end to 516,193 on the high end. The estimation of the local public

health workforce remained unchanged among the three estimates, although the state public health worker count varied from 66,846 to 110,547, depending on the assumptions made in an attempt to address duplicate reporting between NACCHO and ASTHO Profile Surveys. The federal public health worker estimate varied the most, because approximations ranged from 75,312 to 244,031, depending on which agencies and federal job classifications were included in the count. A best estimate and 5% range for each estimate is presented in Table 8.

Table 8. Estimated enumeration ranges of local, state, and federal public health workers

	Lowest range		Midrange		Highest range	
Setting	Range (±5%)	Best estimate	Range (±5%)	Best estimate	Range (±5%)	Best estimate
Local	153,534–169,696	161,615	153,534–169,696	161,615	153,534–169,696	161,615
State	63,504–70,188	66,846	78,202–86,434	82,318	105,020–116,074	110,547
Federal	71,546–79,078	75,312	78,536–86,802	82,669	212,829–235,233	244,031
Total	**288,584–318,961**	**303,773**	**310,272–342,932**	**326,602**	**490,383–542,003**	**516,193**

CONCLUSIONS

The availability of multiple data sources for public health workforce enumeration potentially improves its accuracy but also adds methodologic complexity to generating an estimate of workforce size. The NACCHO and ASTHO Profile Surveys are highly comparable, more so than the other data sources used, because the data in those two surveys were collected in the same year and used similar occupational classification definitions. The Profile Surveys collect enumeration data related to all of the occupational classifications selected for this study and, similarly, should be used in any enumeration estimate generated for the public health workforce in state and local health departments. Using the occupation-specific data from CSTE, APHL, and UM CEPHS PHN Workforce Survey in combination with the NACCHO and ASTHO estimates is challenging because of the variable methodologies used to collect the data and the difficulty in determining the comparability of occupational case definitions across surveys. Despite these challenges, UM CEPHS recommends using all five data sets when constructing a workforce enumeration estimate.

Although we attempted to correct for integration of the different data sets and for differences in their use of occupational case definitions, these enumeration estimates still undercount the state workforce and overcount the federal workforce. However, we believe these estimates are better than using raw, unadjusted data from the multiple sources. We were unable to address the problem of missing data in the APHL survey because of nonresponse from 15 local public health laboratories and four environmental laboratories; consequently, undercounting remains a concern. Extrapolation of missing data on the basis of information reported in *The Public Health Work Force: Enumeration 2000*[3] study and through aggregation of data from different sources is imperfect, but that extrapolation is preferable to reporting zero workers for those states that chose not to respond to certain segments of the surveys.

Given the three sectors of the public health workforce — local, state, and federal — the most difficult to accurately estimate is the federal public health workforce. The methods section describes the limitations inherent in all of the workforce data sources used; however, OPM is unique in that distinguishing between the occupational classifications of public health workers and workers in other health professions is impossible. Applying the OPM occupational classifications to public health workers is difficult. For example, if using the federal government's method of classifying workers, this study would report that no epidemiologists are employed in the federal public health workforce, which is clearly inaccurate and represents a typical misclassification error in this data set. In this sense, OPM data both undercount segments of the workforce (e.g., epidemiologists) and likely substantially overcounts multiple occupational classifications because workers are being counted on the basis of the agency employing them rather than the work they perform. For example, all RNs in a governmental setting would be included in a public health worker count, although the majority of them are unlikely to be involved in the delivery of essential public health services.

The lowest range enumeration estimate presented in this report probably undercounts the federal public health workforce in certain categories because federal public health workers likely exist outside the DHHS agencies (e.g., EPA and USDA). We also believe that the percentage applied to the state public health workforce data to address duplicate counting (42%) is too large and might underestimate the number of workers in state health agencies, maybe substantially so. Finally, concerns regarding the counts by occupational classification for workers in state public health settings are evident in this estimate, in that the physical placement of state health department employees in local units in the same proportion in each occupational category is improbable. For example, in decentralized states, state health department employees in such occupational categories as Emergency Preparedness Staff, Environmental Health Worker, Epidemiologist, Laboratory Worker, and Public Health Nurse might be more likely to be assigned to local units than Administrative or Clerical Personnel. However, in fully centralized, mixed, or shared states, the type of state health department employee working in an LHD can vary. Developing a methodology for adjusting enumeration estimates by occupational category to address this problem on the basis of the type of data available was not possible. However, future enumerations should attempt to take state governance structure and occupational category into account when adjusting for overcounting, which would likely have to be accomplished on a state-by-state basis.

The highest range enumeration estimate is probably a substantial overcount of the actual number of local, state, and especially federal public health workers because it does not adjust the number of state public health workers for potential overcounting or duplicate counting and it does not refine federal workforce estimates by either agency type or occupational classification. For example, all administrative and clerical staff employed by the federal agencies included in the study are accounted for in this estimate, many of whom would not be considered public health workers. The highest range enumeration estimate is not recommended for use, but is presented more as an example of the difficulty researchers have had in comparing, aggregating, and reconciling enumeration data from among the different data sources.

We consider the midrange enumeration estimate of 310,272–342,932 workers to be the best estimate because it is based on reasonable assumptions about the data sources and data collection methods available for this report. The limitations of this estimate, as noted previously, should be acknowledged. This estimate approximately translates to a worker-to-population ratio from 99/100,000 to 110/100,000. When comparing this ratio with those estimated in previous studies, the reader should bear in mind that this ratio refers to number of governmental public health workers only (i.e., it does not include community workers as in the HRSA 2000 enumeration), and it uses different data sources from those used to generate a worker-to-population ratio in other studies. The findings of this study highlight the need for developing a more systematic methodology for collecting workforce data that does not rely on surveys administered by different public health professional groups, at varying intervals, and by using divergent methodologies for classifying and counting workers.

Available public health workforce data sources, although imperfect, can be used to generate a range of enumeration estimates, depending on how occupational classifications are defined and the extent to which the data source allows public health workers to be disaggregated from larger estimates of health professions' workers. As noted by Gebbie et al., national public health workforce enumeration will continue to challenge researchers, policymakers, and practitioners until a methodology for regular enumeration is instituted, data definitions are developed and consistently used, federal labor surveys are modified to better facilitate public health workforce enumeration, and groups and agencies that use workforce data engage in more regular and active collaboration to address the multiple methodologic and logistic concerns confronting enumeration efforts.[13]

The 2012 *Strategies for Enumerating the U.S. Governmental Public Health Workforce* report[4] highlighted seven recommendations for developing and implementing a system for continuous workforce monitoring, as follows:

1. Secure stable funding for enumeration and workforce monitoring efforts.

2. Identify a lead agency or organization for public health workforce enumeration and monitoring efforts.

3. Develop a consensus definition of the public health workforce and adopt a common taxonomy to describe public health workers.

4. Engage federal agency partners who have extensive knowledge of federally supported data sources.

5. Work toward modifying existing data sources to help support enumeration efforts.

6. Identify ways to encourage public health organizations and workers to participate in a workforce surveillance process.

7. Develop and test methods to examine the impact of variations in workforce characteristics, including those captured by enumeration, on public health systems output and community health outcomes.

Adoption of these recommendations can substantially improve enumeration efforts. Studies of the public health workforce remain fragmented, are largely uncoordinated, and use multiple survey methodologies, depending on the agency or public health specialty group involved. The field of public health has not adopted an overarching definition for who constitutes the national public health workforce, a consensus-driven listing of occupations and disciplines included in that workforce, or a common taxonomy for describing them. Reliable, quantifiable data that accurately depict the number and characteristics of those providing the essential public health services and the impact of variations in workforce characteristics on community health are necessary for developing constructive, relevant workforce policy.[4] Improvement of data sources and development of a standardized methodology for continuously monitoring the size and composition of the public health workforce can help ensure that a competent and capable cadre of workers is available to promote and protect our nation's health.

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