

Big Cities Health Coalition Epidemiology Capacity Assessment, 2017



COUNCIL OF STATE AND
TERRITORIAL EPIDEMIOLOGISTS





Table of Contents

About	4
Big Cities Health Coalition	4
Council of State and Territorial Epidemiologists	4
Acknowledgements	4
Executive summary	5
Background	6
Methods	6
Key findings	6
Health department structure and leadership	6
Presence of programs and lead epidemiologists by program area	6
Staffing	6
Funding for epidemiologic activities	7
Health department epidemiology capacity	7
Hiring	7
Training priorities	7
Salaries for civil service epidemiologists	7
Critical issues facing health departments	7
Conclusions	8
Background	9
Methods	11
Survey instrument	12
Study population	12
Recruitment and administration	12
Definitions and response options	13
Epidemiology capacity	13
Analytic techniques	14
Results	15
Participating jurisdictions	16
Health department structure and leadership	17
Structure and general organization	17
Presence of programs and lead epidemiologists by program area	17
Staffing	18
Numbers of epidemiologists and rates per 100,000 population	18
Numbers of epidemiologists by program area	18
Number of epidemiologists needed to achieve full capacity	19
Additional and ideal positions by program area	19



Table of Contents

Funding for epidemiologic activities	20
Access to the peer-reviewed literature	21
Use of an outbreak management system	21
Health department epidemiology capacity	22
Overall health department capacity to conduct	
Essential Public Health Services	22
Program-level capacity	23
Hiring and recruitment	24
Minimum requirements	24
Use of Applied Epidemiology Competencies to define the	
epidemiology career path	25
Training priorities	26
Current civil service and contractor vacancies and intent to fill	
by program area	27
Salaries for civil service epidemiologists	28
Remarks from respondents on critical issues	29
Discussion	34
Health department structure and leadership	35
Staffing	35
Essential Public Health Service (EPHS) capacity	36
Funding and alignment of resources and priorities	36
Training and the Applied Epidemiology Competencies	37
Access to peer-reviewed literature	37
Recruitment and retention	37
Limitations	38
Conclusion	38
References	40



Big Cities Health Coalition

The Big Cities Health Coalition (BCHC or the Coalition) is a forum for leaders of America's largest metropolitan health departments to exchange strategies and work together to promote and protect the health and safety of the 55 million people they serve. Together, these public health officials directly affect the health and well-being of one in six US residents. For more information about BCHC, please visit www.bigcitieshealth.org.

The BCHC is an independent project of the National Association of County and City Health Officials (NACCHO), which represents the nation's nearly 3,000 local governmental health departments. These city, county, metropolitan, district, and tribal departments work daily to protect and promote health and wellbeing for all people in their communities. For more information about NACCHO, please visit www.naccho.org.

Council of State and Territorial Epidemiologists

The Council of State and Territorial Epidemiologists (CSTE) is the professional organization representing member state and territorial public health epidemiologists. CSTE works to establish more effective relationships among state and other health agencies. It also provides technical advice and assistance to partner organizations and to federal public health agencies, such as the Centers for Disease Control and Prevention (CDC). CSTE members have surveillance and epidemiology expertise in a broad range of areas, including occupational health, infectious diseases, environmental health, chronic diseases, injury prevention, maternal and child health, and more. CSTE supports effective public health surveillance and sound epidemiologic practice through training, capacity development, and peer consultation. For more information about CSTE, please visit www.cste.org.

Acknowledgements

This project was supported in part by the CDC cooperative agreement numbers 5U38OT000143-04 and 5U38OT000143-05. The contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC. The authors would like to acknowledge and thank our colleagues for their support and guidance on the project: Beth Daly, Rich Danila, Jeff Engel, Aaron Fleischauer, Bob Harrison, Sara Huston, Becky Lampkins, Jennifer Lemmings, Meredith Lichtenstein Cone, Amanda Masters, Joe McLaughlin, Dhara Shah, Kathy Turner, Patty Quinlisk, Sharon Watkins, epidemiologists in BCHC departments and the NACCHO local epidemiology workgroup. BCHC also thanks its foundation funders and members for enabling and supporting our participation in this work.

This report should be cited as: McGinty M, Arrazola J, Binkin N, Israel M, Juliano C. (2018). *Big Cities Health Coalition Epidemiology Capacity Assessment, 2017*. Washington, DC, and Atlanta, GA: National Association of County and City Health Officials and Council of State and Territorial Epidemiologists.

EXECUTIVE SUMMARY

Executive Summary



Background

Since 2001, the Council of State and Territorial Epidemiologists (CSTE) has conducted periodic Epidemiology Capacity Assessments (ECAs) to assess numeric and functional applied public health epidemiology capacity in the United States and its territories. In 2017, the ECA instrument was tailored for local health department use and administered in collaboration with the Big Cities Health Coalition (BCHC) to its member health departments. The 2017 ECAs were designed to achieve four goals:

1. Enumerate and describe the applied epidemiology workforce.
2. Describe the skills of the applied epidemiology workforce.
3. Describe the funding supporting the applied epidemiology workforce.
4. Describe epidemiology capacity in targeted health departments.

Methods

The state ECA was modified by CSTE and BCHC and pre-tested in a small number of cities. All BCHC members were invited to participate. Data collection occurred over a nine-week period from October to December 2017. Quantitative data were analyzed using Epi Info 7 and Excel 2017, and qualitative data were coded and grouped thematically. Where relevant, data were compared with those from the 2017 state ECA.

Key Findings

A total of 27 of the 30 BCHC members participated in the assessment. The combined population served by the participating health departments was over 55 million or about 17% of the total US population.

Health department structure and leadership

Nearly half (48%) of the health departments reported that their epidemiology workforce was decentralized across the health department. Approximately a fifth (18%) do not have a dedicated lead who oversees epidemiology activities. The vast majority (78%) have generalist epidemiologists who support several or all public health program areas.

Presence of programs and lead epidemiologists by program area

Most or all of the 27 health departments have programs in infectious disease (100%), maternal and child health (MCH, 100%), preparedness (100%), chronic disease (93%), vital statistics (92%), and environmental health (85%); fewer have programs in mental health (33%) and occupational health (19%). Programs that were most likely to have lead epidemiologists were infectious disease (85%), MCH (74%), and vital statistics (67%).

Staffing

There are 1,091 full time equivalent (FTE) epidemiologists working in the 27 participating BCHC departments (range 3-385; median 18). The median rate among the 27 BCHC jurisdictions is 1.4 epidemiologists per 100,000 people, with a range of 0.4 to 7.5. In comparison, the total number of epidemiologists in state health departments is 3,370, and the median rate is 1.0/100,000. A total of 43% of the BCHC epidemiologists work in infectious disease, with an additional 18% working as generalists. To reach full capacity, BCHC departments reported they would collectively need a 40% increase in epidemiology staff (n=434). The greatest perceived needs were in infectious disease (138), followed by generalists (40).

Funding for epidemiologic activities

On average, 47% of the funds for epidemiology activities in participating departments come from local sources, with the state and federal governments providing an additional 24% and 27%, respectively. Values were similar for epidemiology personnel, with 44% of funding coming from local sources, 24% from state sources, and 29% from federal sources.

Health department epidemiology capacity

Health departments were asked to rate their capacity to conduct the four essential public health services most closely related to epidemiology. Virtually all participating BCHC departments (93%) reported having substantial to full capacity to monitor health status to identify and solve community health problems. Most (78%) also have substantial to full capacity to diagnose and investigate health problems and health hazards in the community. However, only 41% reported substantial to full capacity for evaluating effectiveness, accessibility, and quality of personal and population-based health services, and even fewer reported substantial to full capacity for researching new insights and innovative solutions to health problems (33%). For these latter two essential services, 26% and 37%, respectively, reported minimal to no capacity. When asked about capacity to conduct the four essential services by program area, at least 80% of departments felt they had adequate capacity in infectious disease, MCH, chronic disease, injury, and preparedness. The program areas most frequently identified as a high priority for improving capacity were chronic disease (48%), substance abuse (44%), infectious disease (41%), and informatics (37%).

Hiring

Sixty percent of the 27 participating BCHC departments require a master's degree as a minimum hiring requirement for entry-level epidemiology positions in their department, and nearly half (48%) require two or more years of experience. More than half (56%) use contractors to fill vacancies for epidemiology/surveillance positions at the master's degree level and above. There are currently 83 vacant

positions, including 75 civil service positions (90%) and 8 (10%) contractor positions, with the greatest number of vacancies in infectious disease (19), general epidemiology (17) and chronic disease (15). However, vacancies represent a small fraction (19%) of the number of epidemiologists needed to achieve full capacity.

Training priorities

The most pressing staff training need was data analytics (e.g., informatics, translating and applying public health data). Other training priorities included systems thinking, persuasive communication, software skills, and general continuing education.

Salaries for civil service epidemiologists

Minimum and maximum civil service salaries in participating BCHC departments increased with educational attainment, although the median minimum and maximum salaries for physicians were considerably higher than for other doctoral-trained staff or veterinarians. Salaries also increased by career level. The median minimum and maximum salaries for the BCHC departments were generally higher than for state health departments, with the exception of physician salaries, which were higher in the states.

Critical issues facing health departments

Responding BCHC member departments reported major challenges communicating the value and role of epidemiologists to various audiences, obtaining adequate funding, and achieving and maintaining adequate functional capacity to carry out essential tasks, balancing routine activities with emerging problems and recruiting and training staff (especially in increasingly important areas like social determinants of health and health equity).

Conclusions

- BCHC member departments contribute substantially to national epidemiology capacity, employing nearly 1,100 epidemiologists, approximately one third the number working in state health departments.
 - The ratio of epidemiologists per 100,000 population exceeds the recommended value for state health departments, but the number of epidemiologists varies widely among departments, and some cities are woefully under-resourced. Even in well-staffed departments, there is a perceived need for a significant increase in capacity. Efforts are required to assess the ideal staffing ratios for large urban health departments and to increase epidemiology capacity in under-resourced departments.
 - While BCHC health departments have substantial capacity to conduct two of the four essential public health services most closely related to epidemiology—monitoring health status and diagnosing and investigating community health hazards—greater efforts are needed to improve capacity for the remaining two—evaluating population-based health services and researching innovative solutions to health problems. BCHC departments must explore opportunities to diversify funding to support research and evaluation and should also engage academic public health institutions to explore how they might partner to supplement existing capacity.
- Although BCHC departments differ considerably in organizational structure, all provide epidemiology capacity for core public health programs, including infectious diseases, MCH, and preparedness. Most also provide epidemiologic services in chronic disease, vital statistics and environmental health. There is a notable gap in capacity for mental health and informatics epidemiology services. Departments should consider increasing epidemiologists in underserved areas so that activities and staffing better align with disease burdens and public health priorities (e.g., violence, substance abuse, social determinants, of health and health equity) in their jurisdictions.
 - There are reported gaps in training. BCHC departments should explore partnerships with public health training centers and schools and programs of public health to address training gaps in informatics, data translation, systems thinking, and persuasive communication among current and future staff.

BACKGROUND

Background



In 2001, the Council of State and Territorial Epidemiologists (CSTE) began periodic assessments of the numeric and functional applied public health epidemiology capacity in US state and territorial health departments. So far, six assessments—formally known as Epidemiology Capacity Assessments (ECAs)—have been conducted, in 2001, 2004, 2006, 2009, 2013 and 2017. In addition, in 2014, CSTE and the National Association of County and City Health Officials (NACCHO) conducted a preliminary assessment of epidemiology capacity within local health departments. These ECAs serve several functions. They provide policymakers information on current epidemiology workforce strength and capacity. They permit State and Territorial Epidemiologists to compare their jurisdictions with others with respect to staffing, salaries, performance on key epidemiology competencies, and the relative contribution of federal and state funds to their budgets. And, by highlighting the skills and program area expertise students need to respond to changing workforce priorities, they inform the curricula of public health training programs and graduate schools.

The 2017 ECA was launched in April 2017 and completed in August 2017, with participation from all 50 states, the District of Columbia (DC), and three territories. Building upon recommendations from the 2013 ECA and

the 2014 Public Health Workforce Interest and Needs Survey (known as PH WINS and conducted by the Association of State and Territorial Health Officials and the de Beaumont Foundation), the 2017 ECA was designed to achieve four goals:

1. Enumerate and describe the applied epidemiology workforce.
2. Describe the skills of the applied epidemiology workforce.
3. Describe the funding supporting the applied epidemiology workforce.
4. Describe epidemiology capacity in state and territorial health departments.

Although these ECAs provide critical data, they do not reflect total US epidemiology capacity, since they do not capture local health department data; some large local health departments have even more staff and greater epidemiology capacity than their state health department.

To address this limitation, in 2017 CSTE partnered with the Big Cities Health Coalition (BCHC) to assess epidemiology capacity in large urban health departments. The two partners solicited input from local epidemiologists to tailor the ECA tool for local use. This report summarizes findings from the 27 of 30 BCHC member health departments (90%) that participated in this assessment.

METHODS



Survey instrument

The 2017 ECA was modified for local health departments between July and October 2017. CSTE and BCHC solicited input from local epidemiologists within BCHC member health departments to ensure the instrument's relevance for local use.

The final local assessment was organized into four sections:

- Section 1: Health department structure and resources
- Section 2: Health department epidemiology capacity
- Section 3: Health department epidemiology staffing
- Section 4: Leadership feedback

Specifically, the assessment solicited information on health department epidemiology leadership, epidemiology staffing and funding sources; capacity to perform the four Essential Public Health Services (Centers for Disease Control and Prevention, September 2017) most closely linked to epidemiology, civil service salary ranges, minimum hiring requirements, use of the Applied Epidemiology Competencies (AECs) (Birkhead et al., 2008), perceived training needs, and epidemiology vacancies and intended hires.

Most questions were short answer, multiple choice, scales, or matrix tables such as the fraction of full-time equivalent positions (FTEs) by program area. Wherever possible, questions, response categories, and definitions were consistent with the state ECA to ensure comparability. Two open-ended questions were included: (1) "With respect to epidemiologic

staffing and capacity, what are the most critical issues your department faces?" and (2) "What other thoughts, comments, concerns or questions would you like to share with NACCHO and CSTE with regard to the epidemiology workforce and training?" A final section asked respondents to confirm that all information provided is accurate.

Study population

BCHC is comprised of leaders of America's largest metropolitan health departments. To be eligible for BCHC membership, the city must *either* (1) have at least 400,000 residents and be among the top 30 most populous US urban areas (as defined by the US Census Bureau, 2010) or (2) have at least 800,000 residents. Additionally, the health department must be locally controlled and cannot be a state agency. Membership is extended to the health department with primary responsibility for public health within the jurisdiction, whether it is a city or county agency. As of July 2017, when the BCHC ECA began, there were 30 BCHC member health departments¹, all of which were invited to participate. Respondents are hereafter described as "BCHC departments."

Recruitment and administration

The "lead official" (i.e., the local health officer, health director, or health commissioner) for each BCHC department approved the department's participation in this assessment and designated a single person to coordinate the department's response. Of the 30 BCHC

¹BCHC membership criteria were expanded to this definition in July 2017 just as the ECA was about to begin data collection. Previously, eligible cities had to be within the top 30 most urban areas of the U.S. and have a minimum city population of 350,000. Despite this change in criteria, all existing members retained eligibility including Miami, which is part of the Florida Department of Health. Four new cities – Austin, TX; Columbus, OH; Indianapolis, IN; and Charlotte, NC – joined the Coalition in the fall of 2017. At the same time, two of the member cities left BCHC resulting in a total of 30 member departments at the time this assessment was conducted.

member departments, 28 health officials initially agreed to participate (93%). One department never responded to the invitation and a second department declined to participate, stating they lacked the resources to complete the assessment. One of the 28 health departments that initially agreed to participate ultimately withdrew indicating that participation was too onerous. Thus, 27 of the 30 BCHC member departments (90%) participated. In 2014, the combined population served by these 27 departments was roughly 55.3 million or about 17% of the total US population.

A hyperlink to the assessment instrument, which was administered on the Qualtrics platform (Qualtrics, Provo, UT), was emailed to the designated individual, who was asked to (1) coordinate with programmatic and human resources staff within their department as necessary to complete the questionnaire and (2) review all responses and certify their accuracy and completeness prior to submitting the assessment.

Data collection occurred over a nine-week period from October to December 2017.

Definitions and response options

Epidemiology and epidemiologists within the health departments

Respondents were asked to enumerate the current epidemiology workforce within their health department and to describe their health department's epidemiology capacity. The discipline of epidemiology was defined as the "study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems." An epidemiologist was defined as "an investigator who studies the occurrence of disease or other health-related conditions or events in defined populations" (Last, 2001). The assessment noted, "the control of disease in populations is also considered to be a task for the epidemiologist (Last, 2001)."

Respondents enumerated epidemiologists by program area to the nearest tenth of a FTE. Respondents were instructed to count each epidemiologist only once and to include not only all epidemiologists employed by the health

department, but also those epidemiologists working in the department as state or federal assignees or contract employees, including trainees. When considering who should be counted as an epidemiologist, respondents were asked to focus on job functions rather than job titles (i.e., employees did not need to have the title of epidemiologist to be enumerated but needed to serve the function of an epidemiologist). Respondents were provided a link to the AECs, which contain examples of epidemiology job functions.

A formal lead epidemiologist was defined as someone who leads activities and is a subject matter expert within a designated program area within the health department.

Epidemiology capacity

Respondents were asked to describe their health department's capacity to provide the four Essential Public Health Services (EPHS) most closely related to epidemiology:

1. Monitor health status to identify and solve community health problems.
2. Diagnose and investigate health problems and health hazards in the community.
3. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
4. Research for new insights and innovative solutions to health problems.

Epidemiology capacity was defined as the ability of the health department to lead epidemiologic activities; provide subject matter expertise; and apply for, receive, and manage resources to conduct key epidemiologic activities. Capacity for each of the four EPHS listed above was described according to the following scale:

- None: 0% adequate epidemiological capacity.
- Minimal: 1-24% adequate epidemiological capacity.
- Partial: 25-49% adequate epidemiological capacity.
- Substantial: 50-74% adequate epidemiological capacity.
- Almost full: 75-99% adequate epidemiological capacity.
- Full: 100% adequate epidemiological capacity.

For purposes of analysis and to ensure comparability with data from the 2017 state and territorial ECA, responses were further grouped as *none to minimal, partial, and substantial to full*.

Program areas, generalists

Respondents were presented with a list of program areas and asked (1) whether the health department has each program area and (2) if so, whether it has epidemiology capacity within that area. Response options for both questions were “yes” and “no.” Respondents were further instructed that “generalists” are epidemiologists who support several or all program areas within the health department (i.e., they are not specialists in any single program area).

Employees

Respondents were asked to differentiate between civil service epidemiologists and contractors. Civil service employees were defined as FTE staff (either salaried or paid on an hourly basis) employed by the health department or federal or state assignees (such as Epidemic Intelligence Service officers or CDC public health associates). Non-civil service employees included contract employees and temporary employees (e.g., CSTE trainees or individuals contracted from schools of public health or from private companies to work at or for the health department). The use of the term civil service did not connote anything related to whether the employee was a member of a labor union or in a permanent or provisional civil service position.

Salaries

Respondents were asked to provide the civil service annual salary range for epidemiologists working in their department by degree and career level. If there was more than one position or job title for a given degree, they were instructed to provide the low end of the lowest position in that level to the high end of the highest position in that level. For example, if an entry-level epidemiologist with an MD makes \$75,000 to \$100,000 and a senior-level epidemiologist with an MD makes \$125,000 to \$150,000, the salary range for an MD would be \$75,000 to \$150,000.

Vacancies and intent to fill positions

A vacancy was defined as an unfilled health department position that (1) could start within 30 days and (2) had work available to carry out. Respondents were instructed not to include unfilled positions that must be left vacant due to hiring freezes or other requirements. Respondents were also asked how many of these vacancies their department intended to fill (i.e., those for which human resources was actively recruiting).

Analytic Techniques

Data were analyzed using Epi Info 7 and Microsoft Excel 2016. Where relevant, results have been compared with findings from the 2017 state ECA, which contains data from the 50 US states and DC, hereafter collectively referred to as “the states” or “state health departments.”

Qualitative data from an open-ended question asking about the most critical problems and challenges faced by departments were coded and grouped thematically by CSTE staff and a CSTE consultant. Quotations illustrative of key themes were selected for inclusion.

RESULTS



Participating jurisdictions

A total of 27 of the 30 BCHC member health departments (90%) responded to the assessment. They include the following:²

BCHC Department	State
Alameda County Public Health Department	CA
Austin Public Health	TX
Baltimore City Health Department	MD
Boston Public Health Commission	MA
Chicago Department of Public Health	IL
Cleveland Department of Public Health	OH
Columbus Public Health	OH
Denver Department of Public Health and Environment	CO
District of Columbia Department of Health	DC
Florida Department of Health in Miami-Dade County	FL
Houston Health Department	TX
Long Beach Department of Health and Human Services	CA
Los Angeles County Department of Public Health	CA
Maricopa County Department of Public Health	AZ
Marion County Public Health Department	IL
Mecklenburg County Public Health	NC
Minneapolis Health Department	MN
Multnomah County Health Department	OR
New York City Department of Health and Mental Hygiene	NY
Philadelphia Department of Public Health	PA
Public Health Seattle-King County	WA
San Antonio Metropolitan Health District	TX
San Diego County Public Health	CA
San Francisco Department of Health	CA
Santa Clara County Public Health Department	CA
Southern Nevada Health District	NV
Tarrant County Public Health Department	TX

²Since Washington, DC is a member of both the CSTE and the BCHC, it was included in both the state and BCHC ECA analyses. However, the department completed only the state ECA instrument, which differs slightly from that used in the BCHC assessment. Additionally, Florida has a centralized system of health departments: all staff members are state employees, but services are provided and managed locally. The state's Miami office (a BCHC member) is the Florida Department of Health in Miami-Dade County. The central office of the Florida Department of Health (Florida Health, Tallahassee) may have included staffing data for the Miami-Dade department in its response to the state ECA, and thus staffing data for the Miami-Dade department may be double-counted in comparisons of Florida state and Miami BCHC assessment findings.

Health Department Structure and Leadership

Structure and general organization

Respondents were asked to describe the structure of their epidemiology workforce. Nearly half (48%) reported that the epidemiology workforce is decentralized across their health department, while 37% stated that it is centralized within one division or office. The remaining 15% of BCHC health departments reported that their epidemiology

workforce is organized in a “hybrid” structure.

When asked whether there is a dedicated lead who oversees all epidemiology activities in their departments, 18% responded “no.” Half of the remaining respondents (41% of total respondents) reported having a single lead epidemiologist who oversees

all program areas, and half (41%) reported having multiple leads across program areas.

A total of 78% of BCHC respondents reported that they have “generalist” epidemiologists who support several or all program areas in the health department.

Presence of programs and lead epidemiologists by program area

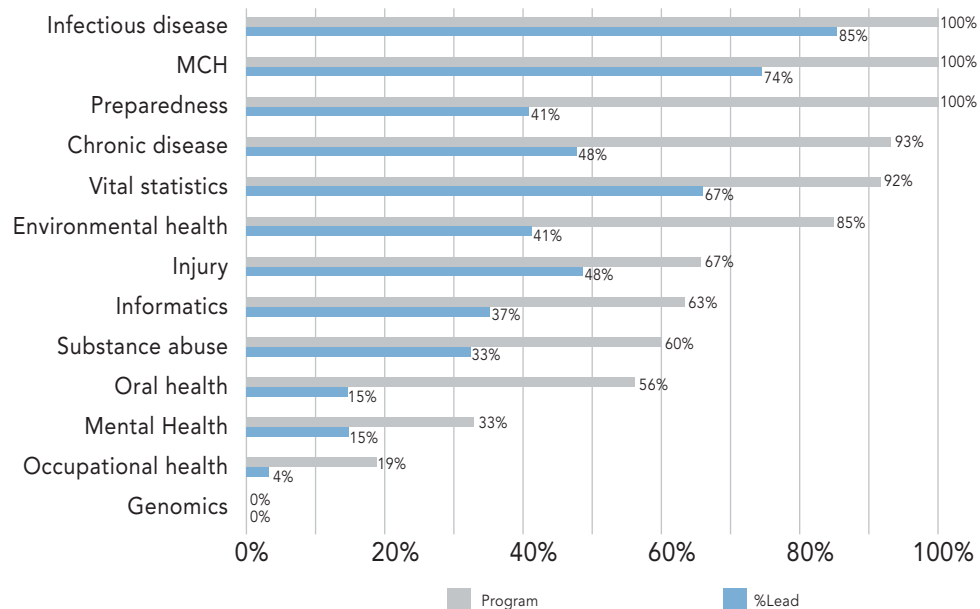
As shown in Figure 1, all respondents (100%) have programs in infectious disease, maternal and child health (MCH), and preparedness. Most also have programs in chronic disease (93%), vital statistics (92%), and environmental health (85%). In contrast, fewer have

programs in mental health (33%) and occupational health (19%), and none have genomics programs (0%).

The program areas most likely to be served by a formal lead epidemiologist are infectious disease (85%) of respondents reported

having a program lead), MCH (74%), vital statistics (67%), chronic disease (48%) and injury (48%). Existing program areas least likely to be served by a lead epidemiologist are occupational health (4%), mental health (15%) and oral health (15%).

Figure 1 Percentage of BCHC departments with specific program areas and formal lead epidemiologists in these areas



Staffing

Numbers of epidemiologists and rates per 100,000 population

There are 1,091 FTE epidemiologists working in the participating BCHC departments. The number of epidemiologists per health department ranged from

3 to 385, with a median of 18. The median rate of epidemiologists per 100,000 people among the 27 responding BCHC jurisdictions is 1.4, with

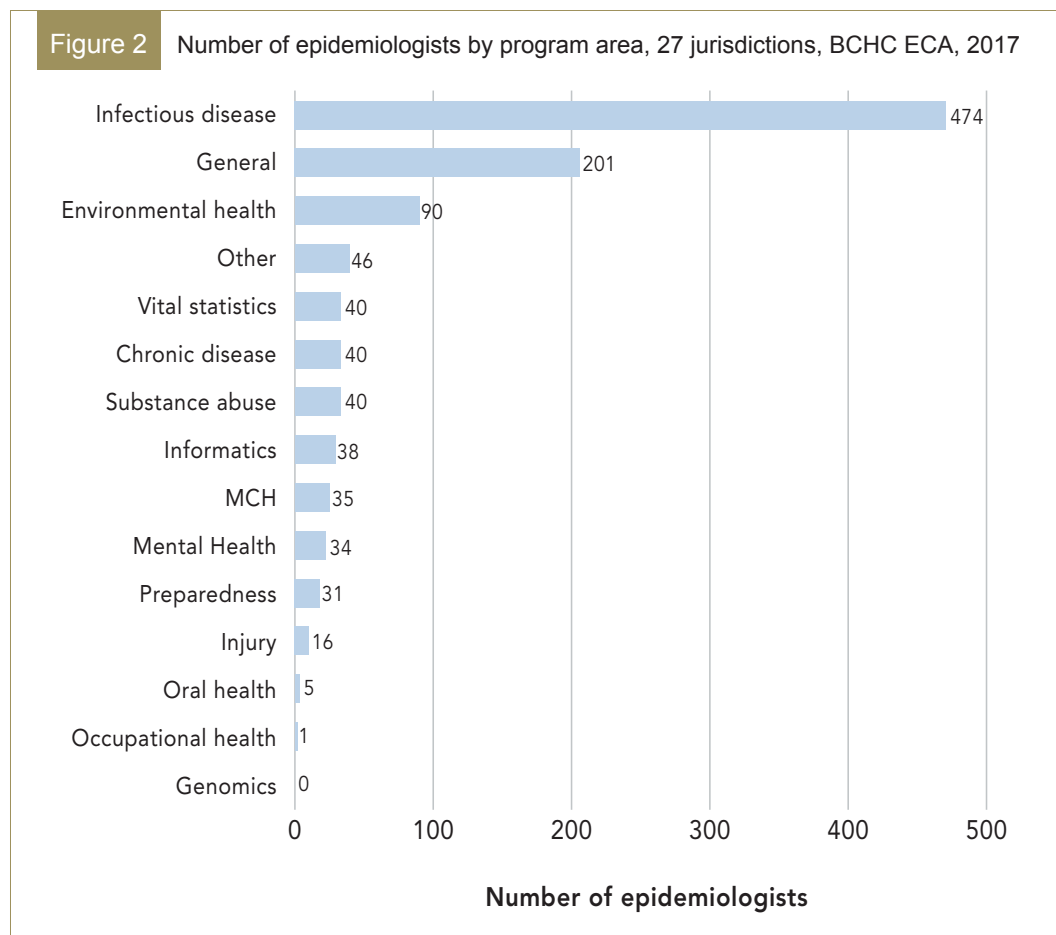
a range of 0.4 to 7.5. In comparison, the total number of epidemiologists in state health departments is 3,370, and the median rate is 1.0/100,000.

Numbers of epidemiologists by program area

As shown in Figure 2, most “big city” epidemiologists work in infectious disease programs (n=474); positions in this area accounted for 43% of the 1,091 epidemiologists in participating BCHC

departments. Eighteen percent (n=201) are generalists who support several or all program areas in their departments. Program areas supported by the fewest epidemiology FTEs are injury (n=16), oral health

(n=5), and genomics (n=0.5), which together accounted for 2% of the total number of epidemiologists working in participating departments.



³The 21 FTE epidemiologists in the District of Columbia have been included in both the state ECA and BCHC assessment totals.

Number of epidemiologists needed to achieve full capacity

Overall, respondents reported a need for an additional 434 epidemiologists across all the program areas to achieve full epidemiology capacity. The ideal number of epidemiologists, defined as the sum of current and additional, was 1,525. Thus, 28% of the current perceived need is unmet. To reach projected full capacity, BCHC departments would collectively need a 40% increase in epidemiologists (Table 1).

Table 1 Current, additional, and ideal numbers of epidemiologists overall and by program area, 27 jurisdictions, BCHC ECA, 2017

Program area	Current	Additional	Ideal (current + additional)	Unmet need (%) [*]	Increase needed to reach ideal (%) [^]
Infectious disease	474	138	612	22%	29%
General epidemiology	201	40	241	17%	20%
Environmental health	90	30	120	25%	34%
Vital statistics	40	24	64	37%	58%
Chronic disease	40	29	69	42%	72%
Substance abuse	40	20	60	34%	51%
Informatics	38	24	62	39%	63%
MCH	35	30	65	46%	86%
Mental health	34	15	49	31%	46%
Preparedness	31	21	52	40%	66%
Injury	16	20	36	55%	121%
Oral health	5	9	14	--	--
Occupational health	1	4	5	--	--
Genomics	0.2	1	1	--	--
Other	46	29	75	--	--
TOTAL	1091	434	1525	28%	40%

^{*}Additional/ideal *100; Percent unmet need is calculated only for program areas with >5 FTE epidemiologists
[^](Additional/current *100; Percent increase in FTEs needed to reach ideal is calculated only for program areas with >5 FTE epidemiologists

Additional and ideal positions by program area

To achieve full capacity, participating BCHC departments reported that they need the greatest number of epidemiologists in infectious disease (n=138), followed by general (n=40), MCH and environmental health (n=30 for each), and chronic disease (n=29) (Table 1). Among program areas currently served by more than five epidemiologists, the greatest percentage increase needed to achieve ideal levels of staffing are in injury (121%) and MCH (86%).

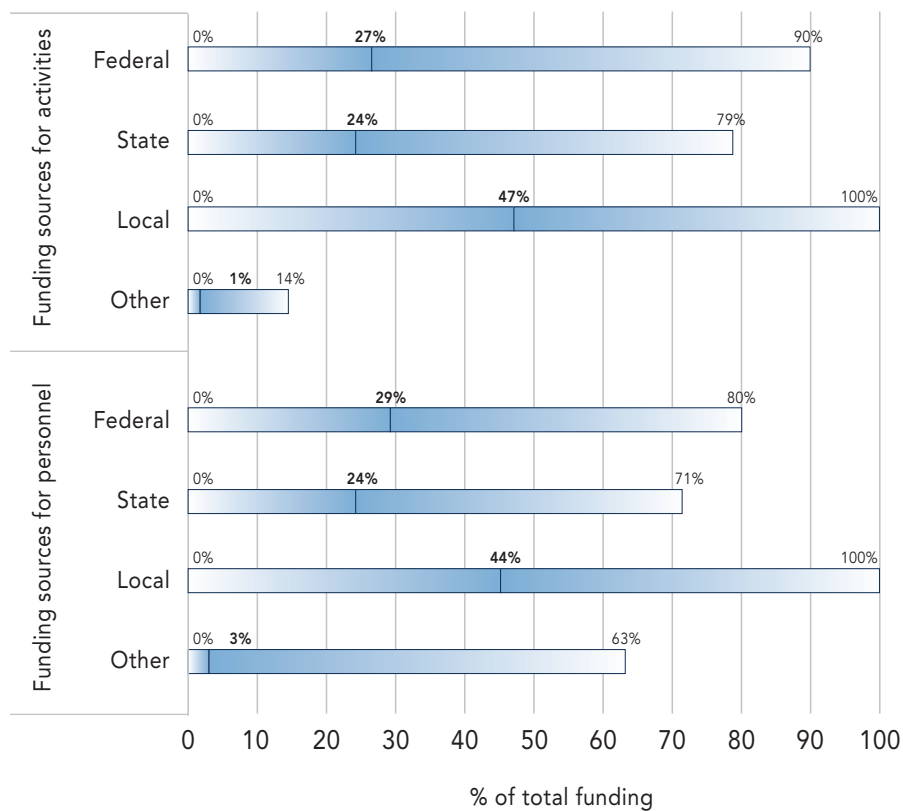
Funding for epidemiologic activities

Figure 3 shows the mean percentage of federal, state, local, and other non-governmental funding sources for epidemiology activities and for personnel, as well as the highest and lowest percentages reported for each funding source among participating BCHC departments. On average, 47% of funding for epidemiology activities comes from local sources, with the

federal and state governments providing an additional 27% and 24%, respectively. Values were similar for epidemiology personnel, with 44% of funding coming from local sources, 29% from federal sources, and 24% from state sources. These findings are in sharp contrast to state health departments, where, on average, more than two-thirds of funds are provided by the federal government and about

20% by state governments. Other non-governmental funding sources—such as private foundation or non-profit grants, donations, or corporate sponsorships—represented an average of 1% of funding for epidemiologic activities and 3% of funding for epidemiology personnel in BCHC departments. For all sources, however, the ranges were wide, from 0% to, in the case of local funds, 100%.

Figure 3 Means and range of percentage of funds for epidemiology activities and personnel provided by federal, state, local, and other sources, 27 jurisdictions, BCHC ECA, 2017*



*The central value, in bold, represents the mean percent of funding from each source. Percentages at the ends of each bar represent the range.

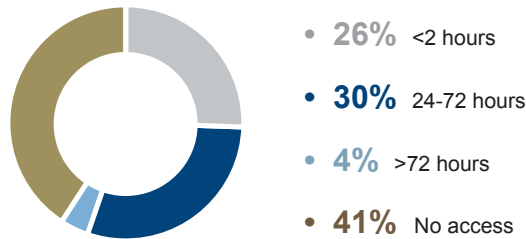
Access to the peer-reviewed literature

Having ready access to peer-reviewed literature that is not published in open-access journals is important to inform the response to emerging and ongoing health issues and to identify evidence-based

practices. Fifty-nine percent of BCHC departments had access to peer-reviewed literature that is not published in open-access journals, although 34% of departments had delayed access,

needing at least 24 hours to obtain articles (Figure 4). In comparison, 73% of state health departments had such access, though 24% required at least 24 hours.

Figure 4 Time required to access peer-reviewed literature, 27 jurisdictions, BCHC ECA, 2017



Use of an outbreak management system

Fifty-six percent of the participating BCHC departments use an outbreak management system to collect and analyze data to support

the initial characterization, investigation, response, and containment of outbreaks. This compares with 69% of state health departments.

Health department epidemiology capacity

Overall health department capacity to conduct Essential Public Health Services

Respondents were asked to assess their department's overall capacity to conduct each of the following four EPHS:

- EPHS #1: Monitoring health status to identify and solve community health problems.
- EPHS #2: Diagnosing and investigating health problems and health hazards in the community.
- EPHS #9: Evaluating effectiveness, accessibility, and quality of personal and population-based health services.
- EPHS #10: Researching for new insights and innovative solutions to health problems.

As seen in Figure 5, nearly all participating BCHC

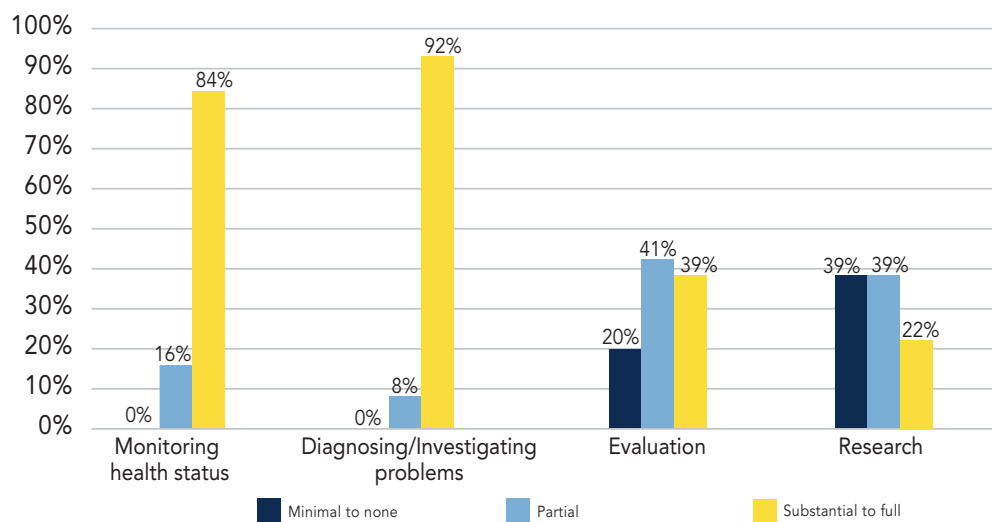
departments (93%) reported having substantial to full capacity for “monitoring health status to identify and solve community health problems.” Most (78%) also have substantial to full capacity for “diagnosing and investigating health problems and health hazards in the community.” Notably, one of the 27 departments reported minimal or no capacity to monitor health status and solve community health problems, and two reported minimal or no capacity to diagnose and investigate health problems and hazards.

In contrast to the high capacity for EPHS #1 and #2, only 41% reported substantial to full capacity for “evaluating effectiveness, accessibility,

and quality of personal and population-based health services,” while 33% reported partial capacity, and 26% reported minimal to no capacity. Even fewer BCHC departments (33%) reported substantial to full capacity for “researching new insights and innovative solutions to health problems,” with 39% reporting partial capacity, and the remaining 37% reporting minimal to no capacity.

The corresponding levels of substantial to full capacity in the states were 84% for monitoring health status, 92% for diagnosing and investigating problems, 39% for evaluation, and 22% for research.

Figure 5 Essential Public Health Services capacities, 27 jurisdictions, BCHC ECA, 2017



Program-level capacity

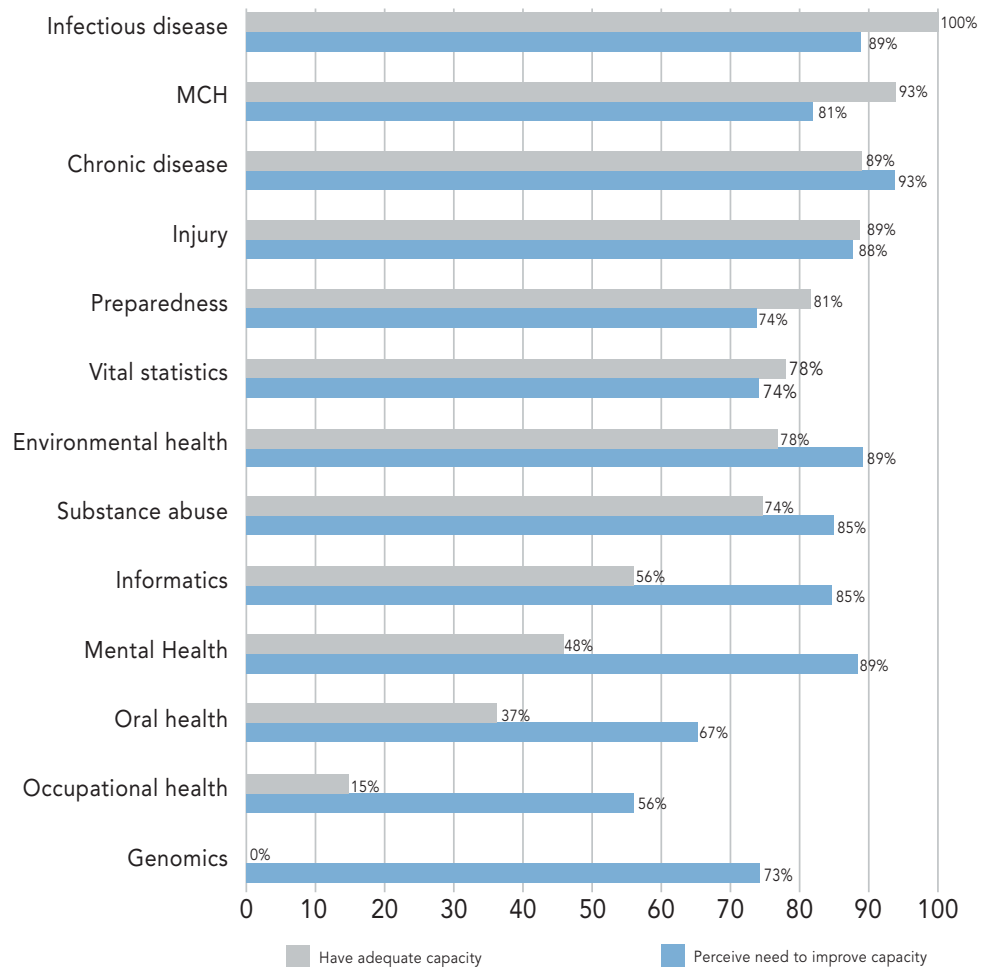
In the areas of infectious disease, MCH, chronic disease, injury, and preparedness, at least 80% of the BCHC departments reporting having adequate capacity to conduct the four key public health epidemiology functions (Figure 6), where capacity was defined as the ability to lead epidemiologic activities, provide subject matter expertise, and

apply for, receive, and manage resources to conduct key epidemiologic activities. Less than half reported having adequate capacity in mental health, oral health, and occupational health. And none reported adequate capacity in genomics.

The percentage of BCHC respondents indicating a need to improve

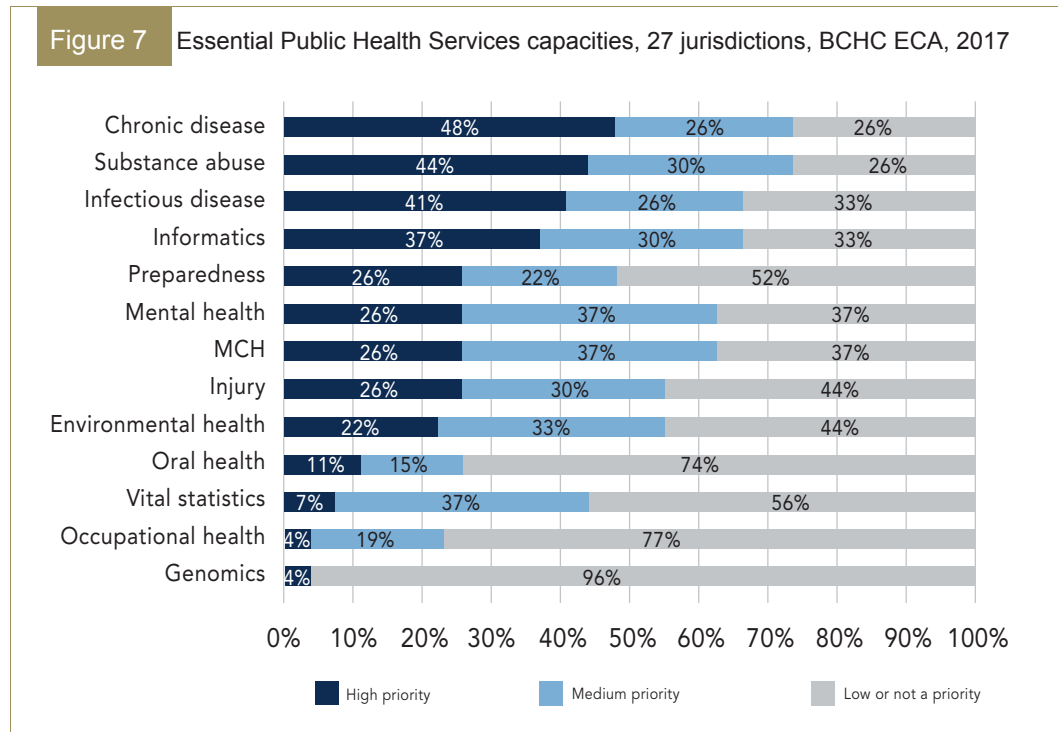
epidemiology capacity in specific program areas ranged from 56% for occupational health to 93% for chronic disease. A high percentage also reported a need to improve capacity even in areas with well-established programs and relatively large numbers of epidemiologists, such as infectious diseases (89%), MCH (81%), and injury (88%).

Figure 6 Current capacity* and perceived need for improvement in the Essential Public Health Services, 27 jurisdictions, BCHC ECA, 2017



*Capacity was defined as having the ability to lead epidemiologic activities, provide subject matter expertise, and apply for, receive, and manage resources to conduct key epidemiologic activities.

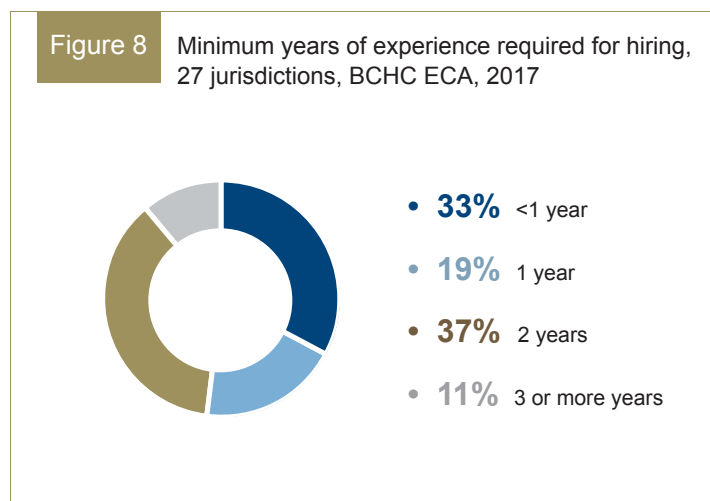
The program areas most frequently identified as a *high priority* for improving capacity were chronic disease (48%), substance abuse (44%), infectious disease (41%) and informatics (37%) (Figure 7).



Hiring and recruitment

Minimum requirements

The majority (60%) of the 27 participating BCHC departments require a master's degree or higher as a minimum hiring requirement for entry-level epidemiology positions. A third (33%) require a bachelor's degree, and 7% require an associate's degree or less. In contrast, only 33% of the state health departments require at least a master's degree. Nearly half (48%) of the 27 participating departments require two or more years of experience (Figure 8), compared with 35% of state health departments. In the BCHC departments, paid



work and full-time work most commonly qualify as experience (93% and 89%, respectively), followed by internships (81%) and volunteer work (52%).

Use of Applied Epidemiology Competencies to define the epidemiology career path

The Applied Epidemiology Competencies (AECs) describe the skills needed by epidemiologists working in governmental public health agencies as entry-level, mid-level and senior epidemiologists, as well as epidemiology supervisors and managers and senior epidemiologists serving as scientists and subject matter experts. They are intended to help employers create career ladders, write job descriptions aligned with appropriate competencies at a given level, and assess epidemiology capacity (Birkhead et al., 2008).

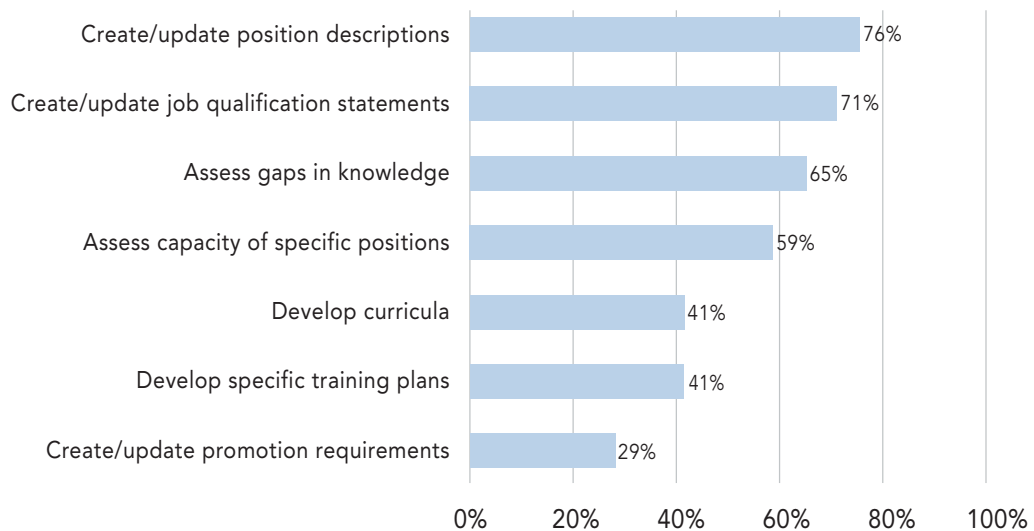
Almost two thirds (63%) of participating BCHC

departments use the AECs for one or more purposes; the remaining 37% do not use them or were unsure if they used them. In contrast, 76% of state health departments report using the AECs.

As shown in Figure 9, among the 17 respondents who reported using the AECs, the most common uses were to create or update position descriptions (76%), followed by creating or updating job qualification statements (71%), assessing knowledge gaps (65%), and assessing the epidemiology capacity of specific positions (59%). The AECs were

less frequently used to develop training plans to address knowledge gaps, to develop curricula for continuing education or training programs, or to create or update promotion requirements. Uses were similar to those of the state health departments; among the 39 states reporting AEC use, the most common purposes were to create or update position descriptions (85%), create or update job qualification statements (77%), assess the epidemiological capacity of specific positions (69%), and assess gaps in knowledge (54%).

Figure 9 Uses of Applied Epidemiology Competencies by the 17 jurisdictions that reported using them, BCHC ECA, 2017



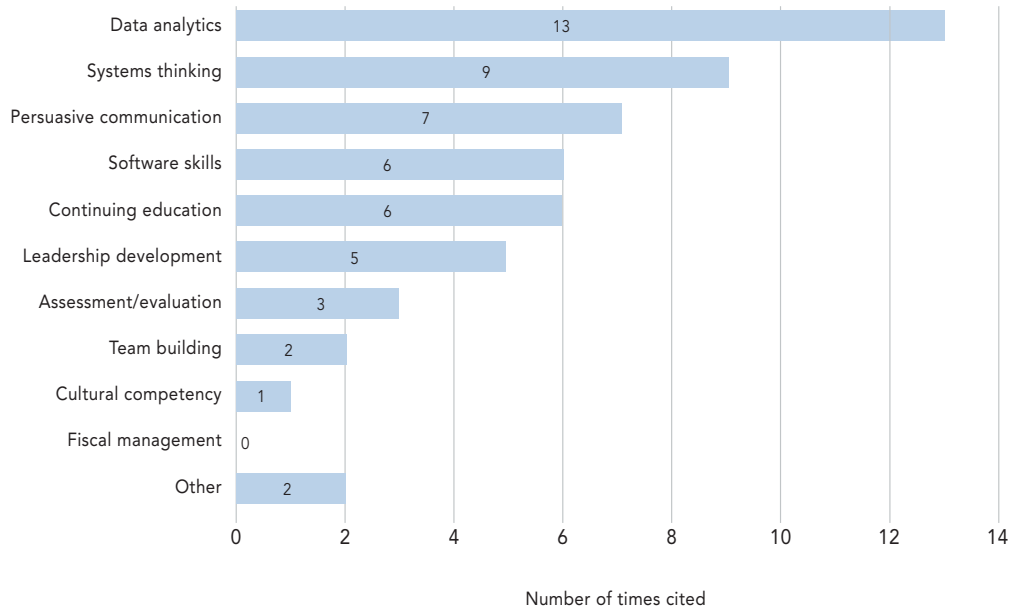
Training priorities

Each participating BCHC department selected its two most pressing staff training needs from a list of 11 broad training areas, so there were 54 possible votes for the 27 jurisdictions. As seen in Figure 10, the highest priority, by a considerable margin, was data analytics (e.g., informatics, translating and applying

public health data). Other training priorities included systems thinking (e.g., systems development, change management, strategic planning, and/or flexibility), persuasive communication (e.g., articulating a message to the public, communicating public health research and data, policy engagement, etc.), software skills (e.g.,

Epi Info, SAS, SPSS, R, etc.) and general continuing education (e.g., basic epi refreshers, novel methodologies, updates to the field/literature, etc.). Notably, no departments reported fiscal management—including planning, budgeting, or monitoring resources—as a pressing training need for epidemiologists.

Figure 10 Top training needs identified, 27 jurisdictions, BCHC ECA, 2017



Current civil service and contractor vacancies and intent to fill by program area

More than half (56%) of the 27 participating BCHC departments use contractors to fill vacancies for epidemiology/surveillance positions at the master's degree level and above, similar to the 58% of state health departments that do so.

There are an estimated 83 vacant positions at the master's degree level and above in the participating BCHC departments, including 75 civil service

positions (90%) and 8 (10%) contractor positions (Table 2). The greatest number of vacancies is in infectious disease (19), followed by general epidemiology (17) and chronic disease (15).

BCHC departments reported that they intend to fill 91 positions, 88% of which are civil service positions. The number of intend-to-fill positions exceeded vacancies, perhaps because positions

had been approved, but not yet listed, or because funding is pending.

Vacancies reflect a small portion of the number of epidemiologists needed to achieve full capacity. Overall, the 83 vacant positions and 91 intend-to-fill positions represent 19% and 21%, respectively, of the perceived 434 positions needed for BCHC departments to operate at full epidemiology capacity.

Table 2 Vacant and intend-to-fill civil service and contractor positions, 27 jurisdictions, BCHC ECA, 2017

Program area	Civil Service		Contractor		Total Vacant	Total Intent to Fill
	Vacant	Intent to Fill	Vacant	Intent to Fill		
Infectious disease	14	14	5	6	19	20
General epidemiology	17	17	0	0	17	17
Chronic disease	15	15	0	0	15	15
Informatics	10	11	0	1	10	12
Environmental health	7	7	0	0	7	7
Preparedness	4	4	1	1	5	5
Maternal-child health	2	2	1	1	3	3
Oral health	2	2	0	0	2	2
Injury	1	2	0	0	1	2
Mental health	1	1	0	1	1	2
Vital statistics	0	2	1	1	1	3
Genomics	0	0	0	0	0	0
Occupational health	0	0	0	0	0	0
Substance abuse	0	0	0	0	0	0
Other disciplines	2	3	0	0	2	3
TOTAL	75	80	8	11	83	91

Note: In some instances, respondents indicated that they intend to fill more positions than they reported being vacant. The reason for this discrepancy is unknown.

Salaries for civil service epidemiologists

Table 3 shows the medians of the minimum and maximum civil service salaries for the 27 BCHC departments, as well as the ranges of the minimum and maximum salary values for each of the six degree categories and the three career-level categories based on the AECs. All jurisdictions reported at

least one salary range. Minimum and maximum salaries increased with educational attainment, although the median minimum and maximum salaries for physicians were considerably higher than for other doctoral-level staff or for veterinarians, who have a comparable number of years of education.

Salaries also increased by career level. The median minimum and maximum salaries for the BCHC departments were generally higher than for state health departments, with the exception of physician salaries, which were higher in the states.

Table 3 Median minimum and maximum salaries and ranges by degree and career level, 27 jurisdictions, BCHC ECA, 2017

Category*	Median minimum	Range, minimum	Median maximum	Range, maximum
By degree				
Associate (5)	\$44K	\$31K - \$71K	\$71K	\$50K - \$123K
Bachelor's (14)	\$51K	\$30K - \$71K	\$73K	\$60K - \$123K
Master's (27)	\$58K	\$32K - \$75K	\$101K	\$65K - \$162K
Doctorate (18)	\$71K	\$44K - \$92K	\$117K	\$77K - \$200K
Veterinarian (5)	\$71K	\$60K - \$95K	\$130K	\$123K - \$162K
Physician (13)	\$100K	\$46K - \$186K	\$150K	\$85K-\$277K
By title				
Entry level (21)	\$56K	\$31K - \$72K	\$77K	\$39K - \$101K
Mid level (23)	\$70K	\$44K - \$92K	\$94K	\$55K - \$112K
Senior level (23)	\$80K	\$50K - \$98K	\$120K	\$80K - \$270K

*Values in parentheses represent number of respondents

Remarks from respondents on critical issues

This ECA included an open-ended question: “With respect to epidemiologic staffing and capacity, what are the most critical issues your department faces?”

Several themes emerged from the responses including critical issues with funding, capacity (including balancing

routine activities with emerging problems), recruitment and retention, and training, especially in important areas such as social determinants of health and health equity. Below, we summarize themes from respondent’s comments and provide illustrative quotes.

Communicating value of public health and epidemiologists

The role of the epidemiologist and health departments is not well understood outside local health departments (LHDs), making it difficult to advocate for resources.

There is also a continued lack of understanding about epidemiology and public health by city leadership outside the LHD and its contributions in safeguarding and preventing illness or conditions in the community. Many elected officials and the general public believe that public health is primary care for the indigent population, and we need to better market our role and value. It makes it challenging during budget sessions to get additional funding for epidemiology positions. So, we are often operating a small-town health department in a large city (Health department #2).

Capacity and funding

Lack of predictable, sustainable funding hinders ability to build workforce capacity.

BCHC respondents mentioned major problems with reliance on time-limited grant funding for core functions and the unpredictability of funding from year to year. Short-term funding for specific program areas and emergency responses, while necessary to respond once disasters and epidemics have occurred, does allow for capacity to be built or sustained hindering the ability to respond to the next emergency.

Given federal uncertainties and the fact that much of our Epi [sic] workforce is contract, federally funded, there are ongoing concerns about the impact of future funding cuts, etc. (Health department #24)

[!]In the next 12 months we anticipate funding ending for 14 positions, both permanent and contract...These short-term bonuses of disease response specific funding are often delayed, not getting to the local level until after the wave of response has crested, and not allowing departments to build sustainable capacity. Departments spend time and money training and orienting staff, only to have to let them go until the next crisis and bolus of money, when we enter into the cycle all over again (Health department #5)

Current staffing levels make it difficult to respond to emergencies and disasters and to meet increasing demand for epidemiological services. Funding is typically siloed, resulting in uneven capacity across programs and often limiting the ability to provide epidemiology services to programs that are not directly funded. BCHC departments reported the need for more epidemiologists to meet demand for increased information, to conduct research and evaluation, and to provide surge capacity for disaster response. A gap exists between demand for and funding of these priorities.

Generalists are often spread thin or dedicated to specific programs due to grant/contractual obligations. This makes it challenging to pursue interests outside of their program area. (Health department #3).

A critical issue facing our Health Department's epidemiologic staffing and capacity is identifying the appropriate number of trained staff; distributing FTEs across programmatic areas to resonate with organizational priorities; (Health department #8)

...the area of behavioral health (mental health, tobacco, substance use and violence) remains a priority for the department. External funding for epidemiological positions in these areas remains elusive. (Health department #10)

Program siloes limit internal and external collaboration and lead to inefficiencies, confusion and lost opportunities.

Team-building between programs is an area of focus that would greatly benefit the department, both in operating more efficiently and building capacity to better respond to illness events and outbreaks across a wide array of regulated and non-regulated settings. Cross-training is needed to build these bonds between program areas. Not being able to use shared technologies or shared platforms between programs creates a huge bridge that causes inefficiencies and confusion. (Health department #9)

In our department our staff either specializes in Infectious Disease epi [sic] [Human Immunodeficiency Virus/Sexually Transmitted Diseases/Tuberculosis/Acute Communicable Disease] or Other (chronic disease, injury). The prior is case finding/ investigation etc. and outbreak management while the latter is analyzing secondary surveillance data sources and program evaluation. We do not have or develop cross-over skills and we end up being quite siloed. (Health department #18)

...Why are HIV, TB, STD separate from CD [communicable disease]; why isn't HBV [hepatitis B virus] and HCV [hepatitis C virus] together with HIV? (Health department #4)

Each [health department] tends to do epi [sic] work with little coordination or resource sharing with epis [sic] from other [health departments], even though a huge portion of what we all do is the same. We should be standardizing dataset across [health departments], and sharing programs and other tools to analyze them or to produce reports, so epis [sic] could spend more time interpreting results. It is in interpreting and communicating results that epis [sic] can add the greatest value to public health. (Health department #19)

Dealing with new and shifting demands for information and urgent and emerging problems often distracts from routine epidemiologic functions and lead to staff burnout.

[A]ccomplishing planned work is challenging, due to competing demands for ad hoc requests. This relates to communicating the value of information we have produced and what we can offer in-house. (Health department #6)

Constant need to respond to requests for information makes new project and report development challenging. In our local health department, data analysis, interpretation and especially translation on whatever topic rises to the top on any given day dominates the workload. (Health department #13)

Our epidemiologists, particularly infectious disease epidemiologists, are tired. Just over the last few years they have been working through crisis after crisis from Ebola to Zika to hurricanes and flooding and now Hepatitis A is looming on the horizon. (Health department #5)

Recruitment, hiring and retention

Recruitment of high-quality epidemiologists is a problem. Respondents mentioned difficulties finding epidemiology candidates with appropriate skillsets in epidemiology and biostatistics and adequate field experience.

We typically have many [master of public health graduates] apply with global health or community health experience and it is hard to get strong epi [sic] backgrounds. (Health department #17)

We have had some trouble recruiting candidates with adequate statistical skills and applied experience. Much of the applicant pool has been recent MPH graduates who have not had well developed field experiences that require application of analytic skills. (Health department #24)

Approximately 150 applications were reviewed, and three candidates interviewed for a lead epidemiologist position. However none had the required skillset. (Health department #21)

We are currently recruiting an injury epidemiologist. The pool of people with experience and the ability to interface with partner organizations has been very small. (Health department #11)

Organizational issues adversely affect hiring and retention and threaten programmatic continuity. Resources for hiring, hiring freezes and delays, and the resulting lack of programmatic continuity and institutional knowledge were frequently cited by BCHC respondents as challenges. Retaining quality staff was also cited as a major issue. Among the factors identified as contributing to high staff turnover are lack of competitive compensation, limited career ladders, and lack of promotion – even where career ladders do exist – because of limited funding and mobility. Because of these organizational problems, respondents report losing staff to other departments or to the private sector.

When an epidemiology employee leaves a program, there is often a delay of at least a few months in acquiring a new employee to fill the vacancy. Due to the nature of how hiring occurs in the department, there is generally no overlap between the former and newly acquired staff to exchange knowledge of the program. This process may limit the epidemiologic capacity of a particular program within the department for an unspecified time frame. (Health department #14)

With budget projections, we are currently in a hiring freeze and cannot increase the overall FTE count for our organization, even if we are awarded grants. The hiring freeze has been an incredible challenge to continue to meet the needs of public health programs. (Health department #7)

We just recently were able to give our MPH and above epidemiologists a pay raise, after over a year of working on it. Despite this, we have seen over 50% turnover in our informatics program. Those who leave are seeing at least a 20% or greater increase in their salaries. (Health department #5).

Retention of skilled epidemiologic staff is an ongoing concern. There are limited positions of advancement available to these staff, and promotions within programs are not always an option. Therefore, after investing time and training into staff at both entry and advanced levels, they are often lost to other programs within the department or businesses outside the department that have opportunities for advancement. (Health department #14)

[Staff] are frustrated with a lack of career progression. We've had a shift to flatten out our org [sic] charts, which has resulted in the sunsetting of manager level positions. Lack of promotional opportunities ties into both career growth and satisfaction as well as salary increases. Our department does not routinely do annual increases, so promotions are the main way for employees to increase their income. (Health department #5)

Training, capacity building and mentoring

New or different knowledge and skillsets are needed to fill current gaps in capacity, to respond to emerging public health challenges, and to adapt to new technologies. In particular, the need to improve skills in systems thinking, informatics, and data analysis was cited by several respondents. Additionally, there is a growing need for epidemiologists to be able to effectively communicate to various audiences and to translate health data for others within and outside the department. However, training opportunities, as well as funding for such training, is limited.

Most of our epidemiologists perform only basic descriptive data analysis and classic epi [sic] approaches to solving health problems. As the technical aspects of the field continue to change towards data science approaches to analytics, use of less traditional data sources from cross-sector partners (often unstructured and/or administrative data) to help solve problems, surveillance data to action, open source analysis software, and web-based visualizations and apps to disseminate data, we find the resources and implementation required to integrate these advances challenging. (Health department #10)

Epidemiologists need more training in public health informatics and data science. With the availability of electronic health records and other data sources, epidemiologists who are trained in Schools of Public Health need to have solid training in public health informatics for them to be able to support fully local agencies and their programs. (Health department #7)

[The most critical issues our health department faces are] attracting and retaining epidemiologists that are competent across the continuum of skills, specifically those that have strong communications skills. (Health department #23)

[A]nother aspect of epidemiology which is rapidly changing is the movement towards community engagement, developing cross-sector partnerships, and developing epidemiologists as subject-matter experts and “ambassadors” which have become increasingly relevant to fields like community development, health impact assessment, and evaluation of municipal services. Program evaluation has become a more frequently requested service of epidemiologists. (Health department #10)

Our department has a need to broaden its epidemiology-based skillsets in order to more effectively serve our large community. Specifically, our department would like to expand its focus in health economics, prevention effectiveness, modeling/forecasting, social epidemiology, and systems science. (Health department #14)

Some important non-infectious disease program areas remain under-developed, especially social determinants of health, health equity, and mental health.

Given the importance of understanding the public health impacts of social determinants of health, the department has limited staff with social epidemiology skills. (Health department #22)

There is need for population mental health surveillance, but it is not supported. [O]ur unit contracts with [the] behavioral health department to evaluate service programs, but there is very little [Alcohol and Other Drugs]/Mental Health surveillance work that is expressly supported. We look at deaths and hospital visits to understand the burden of those issues in the population but so much more could be done. (Health department #18)

We need to shift staff effort toward chronic disease, health equity, and social determinants of health, but the urgent needs in acute disease and other day-to-day operations occupy too much epi [sic] staff time. (Health department #19)

Training and mentoring are essential to ensure programmatic continuity and a high level of expertise (especially in areas requiring unique and advanced skillsets), but resources for these activities and opportunities to share experiences are limited.

We are able to provide a high level of support via trained epis [sic] with strong subject matter expertise in some, but not all, program areas. Ideally, we would have this level of capacity agency-wide. Designated epidemiologists provide ongoing access to the existing evidence base and conduct robust program evaluations, ad hoc analyses, and research. (Health department #15)

[[It is a challenge to provide epidemiologists with sufficient opportunities to network, learn and collaborate with their epi [sic] peers outside of the department. (Health department #22)

[It] would be great to have a national or regional conference for local, state and federal epidemiologists to engage, train and share best practices. (Health department #20)

DISCUSSION



Structure and leadership

- **BCHC departments vary considerably in their structure and organization.** Almost half (48%) have an epidemiology workforce that is decentralized across the health department. Most of the remaining departments (37%) have a centralized structure, where staff is located within a single division or office. The remainder reported a “hybrid” arrangement. Four in ten of the participating departments (41%) have a single lead epidemiologist who oversees all program areas, while the same proportion has multiple leads across program areas. The remainder has no dedicated lead for epidemiology activities (18%). The decentralized structure and leadership in BCHC departments is likely a function of how local public health is funded in program- or disease-specific streams.
- **All the BCHC departments have programs in infectious disease, MCH, and preparedness, and at least 85% have programs in chronic disease, vital statistics, and environmental health. Coverage for other program areas is lower.** It is not surprising that these six programs exist consistently across BCHC departments, both because they are supported by federal and state funding and because they are long-standing, “core” public health activities. In some BCHC jurisdictions, the health department does not have responsibility for mental/behavioral health, and epidemiology services are provided by other city or county agencies. As the burden of substance misuse and mental health conditions continues to grow, BCHC departments may, as part of their responsibility to protect and promote health, need to expand their capacity to monitor these health hazards and effects and to evaluate effectiveness of interventions. To address this need, it will be important to seek

resources for data collection and analysis on the substance misuse and mental health burden in their communities.

- **Not all programs have lead epidemiologists.** While BCHC departments have a wide variety of programs, far fewer departments have epidemiologic leads within each program. Cross-agency collaboration is necessary to address public health challenges in which multiple programs have a stake. The common lack of an epidemiologic lead may hinder a department’s ability to such necessary collaboration. Exploring the effect of having a lead epidemiologist—or not having one—is an area ripe for additional consideration in thinking about workforce needs and challenges.
- **The majority of health departments have general epidemiologists on staff who cover multiple areas.** Although these generalists may lack deep subject matter expertise compared with epidemiologists who specialize in a single area, they may enable more flexibility in the use of scarce epidemiology resources. However, even in departments with generalists, their numbers are inadequate to meet routine demand for epidemiology functions, as well as surge for disaster response.

Staffing

- **The overall number of epidemiologists in participating BCHC departments was nearly 1,100, and BCHC jurisdictions have a median of 1.4 epidemiologists/100,000 population.** Although this rate is higher than the CSTE-suggested staffing ratio for state health departments⁴ —1.0/100,000 (Boulton et al., 2009)—rates for individual jurisdictions range from 0.4 to 7.5 per 100,000. Moreover, 10 departments had rates below 1.0/100,000. Departments with

⁴A recommended staffing ratio does not exist for local health departments. Many local departments defer to the ratio recommended for state health departments.

less than 1.0 epidemiologist per 100,000 population may not have adequate staffing to perform essential public health services and lack surge capacity to address emerging threats and respond to disasters. In terms of absolute numbers, department epidemiology staff sizes range widely, from 3 to 385 FTEs. While this is first evaluation to assess local capacity, arguably local capacity for tracking disease outbreaks should be higher than state capacity, especially in states with limited staffing, because these departments are responding on the ground to outbreaks. In advocating for additional resources, these BCHC departments should communicate the magnitude of the difference between their ratios of epidemiologists per 100,000 population with the median value for BCHC members.

- **More than four in 10 epidemiologists work in infectious diseases, and nearly one in five are general epidemiologists.** Except for infectious disease (45% of epidemiology positions), general epidemiology (18%), and environmental health (8%), the remaining program areas each account for <5% of the workforce. This distribution is likely a result of how public health programs are funded in disease-specific streams, as well as public health's historical focus on infectious diseases. As social determinants of health increasingly drive health department activities, and the leading causes of death continue to be chronic diseases and injuries (Centers for Disease Control and Prevention, March 2017), BCHC departments will need to consider new staffing models that rely more on generalists to support under-resourced program areas. Further, as resources allow, departments should consider increasing program-specific epidemiologists in underserved areas, so that activities and staffing better align with the disease burdens in each jurisdiction and with departmental priorities, often including violence, tobacco, substance use, social determinants of health, and health equity.
- **There is a perceived need for additional staffing, even in program areas that already have many epidemiologists.** Participating BCHC departments expressed the need for 434 additional FTEs at a master's level or higher to reach full capacity to carry out the essential public health functions, representing a 40% increase over

current levels. The area with the greatest number of epidemiologists needed was infectious disease (138 FTEs), which already accounts for 45% of current FTEs. The area with the greatest percentage of unmet need (125%) was injury, where there are currently only 16 epidemiologists in the 27 participating departments and an additional 20 FTEs are needed.

Essential Public Health Service (EPHS) capacity

- **EPHS capacity is high for monitoring health status to identify and solve community health problems and to diagnose and investigate health problems and health hazards in the community, but is much lower for evaluating effectiveness, acceptability, and quality of health services and researching new insights and innovative solutions to health problems.** These findings suggest that health agencies may wish to hire epidemiologists with evaluation and research skills, provide existing staff with evaluation and research training, and diversify funding to support evaluation and research activities.
- **The perceived need for enhanced EPHS capacity exceeded 70% in nearly all program areas, including those that appear to be well staffed.** Perceived need, as measured by the number of epidemiologists required to reach full capacity, was highest for chronic disease, infectious disease, environmental health, injury, and substance abuse. Three of these areas, chronic disease, infectious disease, and substance abuse were most frequently designated as high priorities for improvement. Respondents' perceived need for expanded capacity, even in infectious disease, suggests that the current workforce may lack the skills needed to achieve adequate EPHS capacity.

Funding and alignment of resources and priorities

- **Funding for BCHC departments comes from a wide variety of sources and may result in siloing of activities that make it difficult to cover some essential public health functions.** About half of BCHC department epidemiology funding is local, and about half comes

from state and federal sources combined. Frequently, state and federal funds may be earmarked for specific programs, which drives priorities and creates programmatic “silos.” The overall effect is to leave some essential functions—e.g., maintaining surveillance systems and conducting routine health department investigations—underfunded. In this assessment, respondents reported inefficiencies, variable capability and capacity, and lack of centralized data systems and cross-training of staff, all of which are at least partially caused or exacerbated by siloed funding. This decentralization may limit health departments’ agility, with regard to refocusing priorities and quickly responding to emerging public health threats.

- **In many BCHC departments, there is a misalignment between needs and resources.** As previously mentioned, state and federal funds, which constitute a substantial portion of BCHC budgets, may be earmarked for specific programs or diseases. The overall effect is to leave some programs and essential functions—particularly cross-cutting activities like maintaining surveillance systems—significantly underfunded, especially if local health departments also have limited discretion in how local funding can be used. There is a need to explore how best to align epidemiology capacity with the disease burdens in big cities, as well as how to ensure adequate capacity to evaluate innovative prevention strategies. CSTE, NACCHO and other partner organizations have a critical role in educating funders about the importance of flexible, sustained epidemiology funding.

Training and the Applied Epidemiology Competencies

- **By a considerable margin, the greatest training priority was analytics, defined as informatics and the application and translation of public health data.** Other training priorities include systems thinking and persuasive communication. Partnerships to facilitate the integration of these subjects into the curricula of public health schools and programs could help develop these much-needed skills in the applied epidemiology workforce.

- **More than a third of BCHC departments have not used the 2008 Applied Epidemiology Competencies.** The use of the AECs—a comprehensive, four-tiered list of competencies that defines the discipline of applied epidemiology and describes the skills needed at progressive levels of epidemiology practice—is suboptimal. Use of the AECs has been limited primarily to developing or updating position descriptions and job qualification statements and to assessing the epidemiology capacity of specific positions. They have been less commonly used to develop training plans to address knowledge gaps or to develop training or continuing education activities. Further exploration is needed to understand the BCHC departments’ perception of the utility of the AECs and limitations and obstacles to their use.

Access to peer-reviewed literature

- **Access to non-open-access, peer-reviewed literature is suboptimal.** Four in ten BCHC departments report that they do not have full access to the scientific literature, and an additional third report that access was delayed by more than 24 hours. Such access is essential to inform the response to emerging issues and to ensure that ongoing activities are evidence-based. Understanding how health departments with rapid access have arranged to obtain literature may assist those with slow or no access by illuminating potential solutions, such as university partnerships or participation in the National Network of Libraries of Medicine.

Recruitment and retention

- **Recruitment, hiring, and retention present major challenges for many BCHC programs.** BCHC departments report difficulties finding qualified applicants and hiring them in timely fashion. Challenges to recruitment and retention include providing competitive salaries and opportunities for advancement. Some jurisdictions report that they are working to improve epidemiology career paths, but that limited funding remains a sticking point for boosting salaries and raises. While BCHC department salaries

are generally higher than those in state health departments, they may, in an era of increasing student debt, become less and less competitive with other employers (Baum and Ma, 2016). Although non-financial rewards—stimulating work environment, the opportunity to contribute to community health, and employee recognition—may improve retention, efforts are needed both to highlight the unique and rewarding aspects of epidemiology practice and to achieve more competitive compensation.

- **The majority of BCHC departments require a master's degree or higher for epidemiology positions, and nearly half require two or more years of experience.** Yet even with the requirements of a graduate degree and experience, newer staff may not bring needed skills in evaluation, research, data analytics, and systems thinking, all of which tend to require advanced training and for which on-the-job training may be difficult. These findings suggest the need to work with public health schools and programs to strengthen epidemiology curricula in these core areas.

Limitations

The 2017 BCHC ECA has several limitations:

- The results described in this report reflect the responses of participating BCHC member departments and may not be generalizable to the three BCHC departments that did not participate in the assessment or to local health departments that are not BCHC members.
- The District of Columbia health department staffing numbers (n=21) were included in both the state and BCHC ECA estimates.
- The Florida Health Department may have included staff from Miami-Dade County when enumerating its epidemiology workforce; if so, the combined state and BCHC numbers would over-estimate national capacity.
- Although the ECA defines epidemiologist for purposes of the questionnaire, it does not necessarily align with job titles and has a subjective component to it, which may affect comparisons among health departments.
- Questions regarding desired staffing were limited to epidemiologists at the MPH level or above, which may underestimate total program needs.

Conclusion

The 27 responding BCHC member departments contribute substantially to national epidemiology capacity, employing nearly 1,100 epidemiologists, approximately a third the number working in state health departments.

While the ratio of epidemiologists per 100,000 population exceeds the nationally recommended value, the number of epidemiologists per health department varies widely. Some cities are woefully under-resourced. Yet, even in well-staffed metropolitan health departments, there is a perceived need for a significant increase in capacity.

The assessment revealed that the role of epidemiologists is not well understood outside health departments, a potential impediment to enhancing capacity. Existing recommendations for staffing, developed for states, may be inadequate for big cities, given the demand for routine epidemiologic services and responses to emerging public health threats. And there is a consequent need to assess the ideal staffing ratios for large urban health departments and to increase epidemiology capacity in under-resourced big city health departments.

The assessment evaluated the four essential public health services most closely related to epidemiology. BCHC health departments have substantial capacity to conduct two of these services—monitoring health status and diagnosing and investigating health hazards in their communities. Focus should be placed on improving the capacity of BCHC departments for the remaining two—evaluating population-based health services and researching innovative solutions to health problems—both of which are currently inadequate. BCHC departments must explore opportunities to diversify funding to support research and evaluation and engage academic public health institutions to explore how they might partner to supplement existing capacity.

While BCHC departments differ considerably in organizational structure, all provide epidemiology capacity for core public health programs, including infectious diseases, MCH and preparedness. A vast majority also provides epidemiologic services in chronic

disease, vital statistics and environmental health. But there is a notable gap in capacity for mental health and informatics epidemiology services. As resources allow, departments should consider increasing epidemiologists in underserved program areas so that activities and staff better align with disease burdens in their jurisdictions and with public health priorities including violence, substance misuse, social determinants of health, and health equity.

There are also reported gaps in staff training, especially for informatics, translation of public health data, systems thinking, and persuasive communication. BCHC departments should explore partnerships with public health training centers and public health programs and schools to address these.

Approximately half of funding for the responding BCHC departments is provided by federal and state sources, with the rest provided by local government. Federal and state government funding, for example, is

commonly earmarked for specific programs or activities, and such siloed funding has resulted in uneven capacity across programs and limited health department ability to serve program areas that are not directly funded. Further efforts are needed to identify additional funding sources to support routine activities such as surveillance and outbreak investigation.

Big city health departments, as well as membership organizations representing epidemiologists and public health agencies, need to better communicate epidemiologists' role in safeguarding health and preventing illness and advocate for consistent, stable resources to support this essential public health capacity. This first-ever comprehensive assessment of epidemiology capacity in BCHC member departments provides insightful information and serves as a benchmark as the nation continues to grow and improve epidemiology capacity to protect and promote the health of all US residents.

REFERENCES

References



- Birkhead G, Davies J, Miner K, Lemmings J, Koo, D. (2008). Developing competencies for applied epidemiology: from process to product. *Public Health Reports*, 123, 67-118. doi:10.1177/00333549081230S114
- Boulton, ML, Lemmings J, Beck AJ. (2009). Assessment of epidemiology capacity in state health departments, 2001-2006. *J Public Health Manag Pract*, 15(4), 328-336. doi:10.1097/PHH.0b013e3181a01eb3.
- Centers for Disease Control and Prevention. (March 17, 2017). Leading Causes of Death. Atlanta, GA: CDC; <https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm>.
- Centers for Disease Control and Prevention. (September 20, 2017). The Public Health System & the 10 Essential Public Health Services. Atlanta, GA: CDC; <https://www.cdc.gov/stltpublichealth/publichealthservices/essentialhealthservices.html>
- Last, JM. (Ed.) (2001). *A Dictionary of Epidemiology* (4 ed.). New York, NY: Oxford University Press, Inc.

