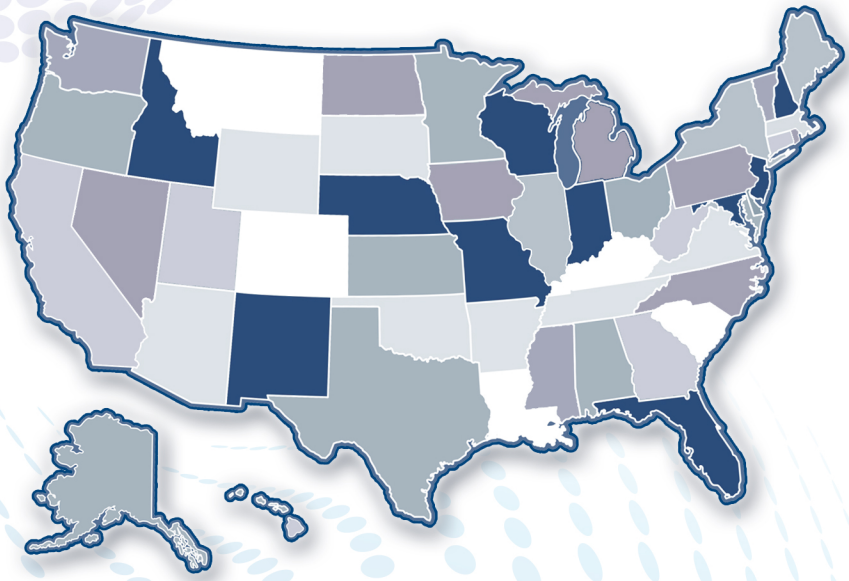
COUNCIL OF STATE AND TERRITORIAL EPIDEMIOLOGISTS

2013 NATIONAL ASSESSMENT OF EPIDEMIOLOGY CAPACITY

Findings and Recommendations for Chronic Disease, Maternal & Child Health, and Oral Health



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EXECUTIVE SUMMARY

Introduction

Chronic disease (CD), maternal and child health (MCH) and oral health (OH) are three specific program areas within state and territorial health agencies. These programs are responsible for monitoring, studying, predicting and preventing a wide range of diseases and conditions that occur throughout the lifespan. To accomplish these tasks, CD, MCH and OH programs need access to a cadre of skilled epidemiologists – health professionals with specialty training in the design of population studies, the collection and analysis of data, the interpretation of empirical findings and application to public-health practice, and the development and maintenance of surveillance systems to monitor health problems and hazards in target populations.

In the late 1990s, there was growing concern that state and territorial health agencies had an inadequate epidemiology workforce, which in turn limited the ability of health agencies to perform the 10 Essential Public Health Services (EPHS). To assess overall epidemiology capacity within state and territorial health agencies, the Council of State and Territorial Epidemiologists (CSTE) implemented an assessment of overall epidemiology capacity – referred to as the epidemiology capacity assessment (ECA). The first ECA was conducted in 2001 with follow-up assessments in 2004, 2006 and 2009. While these ECAs provided valuable information on a state's overall or "core" epidemiology capacity, they provided limited information on the capacity within specific program areas such as CD, MCH and OH.

To evaluate program-specific epidemiology capacity, CSTE conducted an MCH capacity assessment in 2001-2002 and a CD capacity assessment in 2003.[1,2] These standalone assessments confirmed there was an insufficient workforce of skilled epidemiologists to support CD and MCH programs. In 2009, CSTE incorporated CD and MCH supplemental modules into the ECA which allowed for the assessment of capacity trends for CD and MCH programs.

- *Conclusions from the 2009 Chronic Disease Supplemental Module:* Self-assessed overall CD epidemiology capacity has not changed; while more quality work is being done, it is being done with the same or fewer epidemiologists; nearly half of all states lack substantial capacity (a percentage that has not changed since 2001); a growing percentage (nearly one in five states) have minimal to no CD epidemiology capacity. Furthermore, the total number of epidemiologists at state health departments has decreased in the past five years, and the economic downturn is likely to result in decreased state funding to CD prevention efforts.[3]
- *Conclusions from the 2009 Maternal and Child Health Supplemental Module:* Nearly half of all states reported lacking substantial MCH epidemiology and surveillance capacity; in only a minority of states do MCH epidemiologists participate substantially in policy development, have access to important data sets, and work with colleagues in substance abuse, mental health, and occupational health.[4]

In 2013, CSTE conducted an additional ECA. The 2013 ECA included the core questionnaire regarding overall capacity and, as in 2009, included supplemental modules for CD and MCH. For the first time, a supplemental module for OH capacity was also included.

The purpose of this report is to present findings related to CD/MCH/OH epidemiology capacity from the 2013 core ECA and the CD/MCH/OH supplemental modules as well as trends where comparable information is available. **Funding:** This publication was supported by Cooperative Agreement Number 5U380T000143-02 from CDC. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC.

Methods

The 2013 ECA included three distinct components: a core questionnaire to be completed by the State Epidemiologist with help as needed from other departmental staff (i.e., Core ECA), questionnaires to be completed by each epidemiologist working in the health department (i.e., Individual Worksheet), and several supplemental questionnaires to be completed by the lead epidemiologist within specific program areas (i.e., Supplemental Modules).

Development of the CD, MCH, and OH Supplemental Modules began in 2012 with the convening of program-specific ECA workgroups. The workgroups comprised members from CSTE, professional associations representing the program areas, the Centers for Disease Control and Prevention (CDC), and state health departments. The core and module questionnaires were piloted in May 2013 in five states and revised on the basis of feedback from those states. The CD, MCH, and OH Supplemental Modules were sent with the 2013 ECA to the State Epidemiologist of each state and territory in August 2013. Data were collected from August 2013 to February 2014.

The 2013 Core ECA asked about overall surveillance and epidemiology capacity, designation of a lead epidemiologist within the program area, funding sources, and number of publications. The Individual Worksheets included questions about training, experience, categorization into four tiers based on experience, tier-specific self-assessed competency in each of about 30 skill domains, and related skill-specific training needed. The program-specific Supplemental Modules asked about organization of program-specific epidemiologic activities, capacity to meet the EPHS most related to epidemiology, leadership and decision making, spectrum of work covered by program-specific epidemiologists, access to data and professional journals, nature of data analysis performed, activities to disseminate data, plus collaborations with other state health department programs and with agencies outside the health department.

All 50 states and the District of Columbia completed the Core ECA. The CD, MCH, and OH Supplemental Modules were completed by 49 jurisdictions; two jurisdictions did not complete any of the Supplemental Modules. In this document, the terms jurisdictions and states are used interchangeably and refer to states and the District of Columbia; territories and tribes are not included.

Key Results and Conclusions

1. Several measures of program-specific capacity improved from 2009 to 2013. Although some capacity measures increased in all three program areas, MCH programs realized the largest gains in overall capacity.
   - The percentage of CD programs with almost full to full capacity decreased slightly from 22% in 2009 to 20% in 2013. The percentage of CD programs with minimal to no capacity decreased from 18% to 4%.
   - The percentage of MCH programs with almost full to full capacity increased from 20% in 2009 to 37% in 2013. The percentage of MCH programs with minimal to no capacity decreased from 12% to 6%.
   - The percentage of OH programs with almost full to full capacity increased from 2% in 2009 to 10% in 2013. Almost 60% of jurisdictions still reported minimal or no capacity for their OH programs, compared with 61% in 2009 and 77% in 2006.
   - Approximately 370 additional full-time equivalent epidemiologists are needed for all 51 jurisdictions to reach almost full to full capacity within their CD, MCH, and OH programs: 219 for CD, 117 for MCH, and 33 for OH.

2. Despite these improvements, many jurisdictions reported continuing to have less than substantial capacity to conduct several of the program-specific EPHS.
   - EPHS1 (monitor health status to identify community health problems): 61% of OH programs reported less than substantial capacity.
   - EPHS9 (evaluate effectiveness, accessibility, and quality of personal and population-based health services): 33% of CD, 25% of MCH, and 69% of OH programs reported less than substantial capacity.
   - EPHS10 (research for new insights and innovative solutions to health problems): 59% of CD, 49% of MCH, and 67% of OH programs reported less than substantial capacity.

3. Several factors increase a jurisdiction's CD, MCH, and OH overall capacity and capacity for the epidemiology-related EPHS.
   - For CD programs, having at least one CD epidemiologist (CDE) responsible for coordinating CD activities across programs and having at least five CDEs were the two factors most associated with higher-level capacity.
   - For MCH programs, having a lead MCH epidemiologist (MCHE), having an MCH leader with both scientific and administrative authority, and having at least five MCHEs were the factors associated with higher-level capacity.
   - For OH programs, having a full-time (>0.7 full-time equivalent) OH epidemiologist (OHE) and having current CDC Division of Oral Health State Oral Disease Prevention Program funding were most associated with higher-level capacity.
   - For all jurisdictions to reach the goal of having at least five CDEs, 5 MCHEs and 1 OHE, approximately 181 additional full-time equivalent epidemiologists are needed: 59 for CD, 90 for MCH, and 32 for OH.

4. The need continues for a strong CD, MCH, and OH epidemiology workforce development effort.
   - About half of the jurisdictions reported needing one or two additional epidemiologists in each program area.
   - A considerable percentage of the CD (14%), MCH (14%), and OH (25%) epidemiology workforce reported no formal training in epidemiology.
   - Regardless of their experience level, at least 10% of CDEs, MCHEs, and OHEs reported having minimal or no level of competency in a set of the CDC/CSTE Applied Epidemiology Competencies.
   - The most prominent needs for training were in use of informatics and information systems, fiscal issues, and community health assessments.
   - About 20% of the CD, MCH, and OH epidemiology workforce plans to retire or change careers out of epidemiology in the next 5 years.

5. Epidemiologists in many jurisdictions reported having limited access to the technology necessary to adequately fulfill the EPHS.
   - In 18% of jurisdictions, MCHEs have no access to scientific literature in peer-reviewed publications. The percentage of jurisdictions with no access to scientific journals is even higher for CD (27%) and OH (33%) programs.
   - For CD, 12% of jurisdictions reported needing statistical analysis software, and 20% reported needing encryption and geographic information system (GIS) software.
   - For OH, 12% of jurisdictions reported needing statistical and encryption software, and 25% reported needing GIS software.

Overall Recommendations

1. Develop a strategy to achieve optimal epidemiology funding and capacity within each of the three program areas. The strategy should prioritize capacity-building efforts, and jurisdictions and programs that have minimal to no capacity should be targeted.

2. Ensure that CD, MCH, and OH epidemiology capacity are included in national dialogues regarding overall state-based epidemiology capacity.

3. Within each program area, promote the factors associated with higher-level capacity.
    a. For CD: a dedicated lead epidemiologist, at least one epidemiologist responsible for coordinating CD epidemiology activities across programs, and at least five CDEs.
    b. For MCH: a dedicated lead epidemiologist, an MCH epidemiology leader with both scientific and administrative authority, and at least five MCHEs.
    c. For OH: a dedicated lead epidemiologist, at least one full-time OHE ($\geq$0.7 FTE), and adequate funding through CDC Division of Oral Health State Oral Disease Prevention Program funding or another source.

4. Continue to offer and enhance training opportunities, while increasing opportunities for coordinated training of the CD, MCH, and OH epidemiology workforce.
    a. Identified training needs should be shared with CD, MCH, and OH program national associations so that epidemiology-specific training and mentoring can be included in annual meetings, webinars, developed resources and mentorship programs; when possible and applicable, training opportunities should be promoted across CD, MCH, and OH program areas.

5. Organizations involved in training the public health workforce, including CDC, CSTE, and schools of public health, should ensure that programs include training in competencies identified by practicing epidemiologists as needing additional focus.

6. Build partnerships within and among state agencies, local academic institutions, and other appropriate organizations to efficiently and effectively use resources, conduct surveillance, and plan and implement evidence-based strategies for CD, MCH, and OH prevention and health promotion.

7. Ensure that all states have access to the technology needed to address the EPHS, including appropriate statistical software, GIS software, and encryption software and access to a wide variety of medical, dental, nursing, other health-care, and public health journals.

8. Continue to regularly evaluate CD, MCH, and OH program epidemiology capacity, identify needs, and disseminate results widely.

CSTE's Next Steps for Enhancing CD/MCH/OH Epidemiology Capacity

1. CSTE, in collaboration with the National Association of Chronic Disease Directors, the Association of Maternal and Child Health Programs, CityMatCH, and the Association of State and Territorial Dental Directors, shall advocate for additional state and federal funds to support a minimum cadre of epidemiologists within each program area in all states.

2. CSTE shall 1) use data from the ECAs to develop policy statements that establish numeric and structural goals for epidemiology capacity within each program area, 2) work with national partner organizations to encourage adoption of the goals by health agencies, and 3) encourage federal funders to incorporate the goals into cooperative agreements and other funding opportunities.

3. CSTE shall build on the findings of the 2013 ECA and CD Supplemental Module to develop/modify the list of CD epidemiology capacity indicators that correspond to the capacity domains described in the 2004 white paper on essential functions of CD epidemiology.

4. CSTE, in collaboration with national partners, shall develop educational materials highlighting the importance of a skilled epidemiology workforce within CD, MCH, and OH programs. These materials could be used to educate state health officers, state legislators, and other key decision makers about the role and importance of epidemiologists within these program areas.

5. Because training needs are similar across programs, CSTE, in collaboration with other professional organizations and federal agencies, shall develop joint training opportunities.

6. CSTE shall continue to routinely assess state health departments for CD, MCH, and OH epidemiology capacity and further clarify elements that are most likely to be useful for ongoing surveillance and support of public health programs. Continued monitoring, particularly of gaps in CD, MCH, and OH epidemiology capacity, is critical to make additional progress.

7. CSTE shall identify ways to expand access to peer-reviewed and scientific literature.

8. CSTE shall partner with the Association of State and Territorial Dental Directors to educate policy makers about the need for the expansion of the CDC Division of Oral Health State Oral Disease Prevention Program cooperative agreements from 21 to all 50 states and the District of Columbia.

QUICK FACTS

Overall Epidemiology and Surveillance Capacity

- Almost full to full capacity: Chronic disease (CD), 10 (20%) jurisdictions; maternal and child health (MCH), 19 (37%) jurisdictions; oral health (OH), 5 (10%) jurisdictions.
- Substantial to full capacity: CD, 33 (66%) jurisdictions; MCH, 37 (73%) jurisdictions; OH, 13 (26%) jurisdictions.
- Minimal to no capacity: CD, 2 (4%) jurisdictions; MCH, 3 (6%) jurisdictions; OH, 30 (59%) jurisdictions.

Trends in Overall Epidemiology and Surveillance Capacity

- From 2009 to 2013, the percentage of jurisdictions with almost full to full capacity increased for MCH and OH but not for CD: CD, 22% to 20%; MCH, 20% to 37%; OH, 2% to 10%.
- From 2009 to 2013, the percentage of jurisdictions with at least substantial capacity increased for all program areas: CD, 53% to 66%; MCH, 55% to 73%; OH, 6% to 26%.
- From 2009 to 2013, the percentage of jurisdictions with minimal to no capacity decreased substantially for CD and MCH but not for OH: CD, 18% to 4%; MCH, 12% to 6%; OH, 61% to 59%.

Capacity for the Essential Public Health Services (EPHS)

- Substantial to full capacity for EPHS1 (surveillance): CD, 44 (90%) jurisdictions; MCH, 41 (84%) jurisdictions; OH, 19 (39%) jurisdictions.
- Substantial to full capacity for EPHS2 (diagnosis/investigation): CD, data not collected; MCH, 37 (76%) jurisdictions; OH, 16 (33%) jurisdictions.
- Substantial to full capacity for EPHS9 (evaluation): CD, 33 (67%) jurisdictions; MCH, 36 (73%) jurisdictions; OH, 15 (31%) jurisdictions.
- Substantial to full capacity for EPHS10 (innovation): CD, 20 (41%) jurisdictions; MCH, 25 (51%) jurisdictions; OH, 16 (33%) jurisdictions.
- Almost full to full capacity for each of the EPHS that were assessed: <50% of CD programs, <60% of MCH programs, and <26% of OH programs.
    - Almost full to full capacity for EPHS1 (surveillance): CD, 23 (47%) jurisdictions; MCH, 27 (55%) jurisdictions; OH, 12 (25%) jurisdictions.
    - Almost full to full capacity for EPHS2 (diagnosis/investigation): CD, data not collected; MCH, 23 (47%) jurisdictions; OH, 12 (25%) jurisdictions.
    - Almost full to full capacity for EPHS9 (evaluation): CD, 12 (25%) jurisdictions; MCH, 19 (40%) jurisdictions; OH, 11 (22%) jurisdictions.
    - Almost full to full capacity for EPHS10 (innovation): CD, 4 (8%) jurisdictions; MCH, 14 (29%) jurisdictions; OH, 9 (18%) jurisdictions.
- MCH was the only program area with trend data on capacity for EPHS. From 2009 to 2013, the percentage of jurisdictions with at least substantial capacity increased for each MCH EPHS.

Epidemiology Workforce

- In 2013, approximately 354 full-time equivalent (FTE) epidemiologists were working in CD programs, 282 FTE epidemiologists in MCH programs, and 19 FTE epidemiologists in OH programs.
- 54% of jurisdictions reported having five or more CD epidemiologists (CDEs); 38% reporting having five or more MCH epidemiologists (MCHEs); and 26% reported having at least one OH epidemiologist (OHE).
- Approximately 370 FTE epidemiologists are needed for all jurisdictions to reach ideal capacity within their CD, MCH, and OH programs; 219 for CD, 117 for MCH, and 33 for OH.
- About 50% of all states reported needing one or two additional epidemiologists in each program area to meet almost full capacity.
- Most epidemiology positions (≥75%) were funded by federal dollars. Very few epidemiology positions were funded by state dollars.

- Most (≥96%) of the program-specific epidemiology workforce had a master's or higher degree, although the degree might not be in epidemiology. About half of the program-specific epidemiology workforce had at least master's-level training in epidemiology.
- 14% of the CD and MCH epidemiology workforce and 25% of the OH epidemiology workforce had no specific epidemiology training or credentials except that acquired on the job.
- Many epidemiologists reported having minimal or no competency for some of the CDC/CSTE Applied Epidemiology Competencies; especially those related to informatics, fiscal guidelines, and community needs assessments.
- Approximately 20% of the CD, MCH, and OH epidemiology workforce plans to retire or change careers out of epidemiology during the next 5 years.

Epidemiology Leadership, Organization and Decision Making

- Most jurisdictions reported having a lead epidemiologist for CD (78%) and MCH (78%), but fewer than half (44%) have a lead OHE.
- Most (69%) MCH programs reported having epidemiology leaders with both scientific and administrative authority. Only 31% of OH programs had an epidemiology leader with scientific and administrative authority. Data were not available for CD.
- When stratified by population tertile, jurisdictions with the smallest population had the lowest percentage with lead CDE and MCHE. For CD, 63% of low-, 94% of middle-, and 88% of high-population jurisdictions had a lead CDE. For MCH, 56% of low-, 94% of middle-, and 88% of high-population jurisdictions had a lead MCHE. For OH, the percentage of jurisdictions with a lead OHE did not differ by population tertile.
- There was no predominant organizational structure for CDEs, MCHEs, or OHEs, although MCHEs (46%) tended to be located in a larger MCH epidemiology unit.
- Three jurisdictions reported obtaining their MCH epidemiology support from an organization outside of the health department; five jurisdictions obtained their OH epidemiology support from an outside organization.
- Most CDEs and MCHEs contributed to key program-level activities, including needs assessment, priority setting, and program planning. Epidemiologists in these program areas, however, were substantially less likely to contribute to decision making for policy development issues. In contrast, very few OHEs directly contributed to any key program-level activity.

Access to Data, Data Dissemination, and Publications

- More than 70% of jurisdictions reported that CDEs and/or MCHEs have ready access to Behavioral Risk Factor Surveillance System (BRFSS), hospital discharge, cancer registry, Pregnancy Risk Assessment Monitoring System (PRAMS), linked birth–infant death, death certificate, and birth certificate data.
- Very few jurisdictions (<25%) reported having access to Medicaid or emergency medical service (EMS) data.
- CD and MCH programs had better access to data than OH programs.
- From 2009 to 2013, there **w**as an approximately 10 percentage point ***decrease*** in the percentage of jurisdictions in which CDEs had unfettered access to cancer registry (82% to 71%) and Medicaid (35% to 25%) data. For MCH programs, there was an approximately 10 percentage point ***increase*** in the percentage of jurisdictions in which the MCHEs have unfettered access to family planning (43% vs. 61%), hospital discharge (49% vs. 65%), emergency department (26% vs. 41%), Youth Risk Behavior Survey (YRBS) (41% vs. 53%), and BRFSS (57% vs. 71%) data.
- In most (≥65%) jurisdictions, CD and MCHEs were capable of meeting the most basic level of analytic needs: calculation of population-specific rates and confidence intervals and comparison with other rates. Substantially fewer OHEs (≤42%) conducted these basic analyses.
- Multivariable analyses were not conducted routinely by epidemiologists in any program area: 18%, 27%, and 15% of jurisdictions for CD, MCH, and OH, respectively.
- Epidemiologists in some jurisdictions did not have access to statistical, encryption and/or geographic information system (GIS) software. CD programs in 12% of jurisdictions need statistical analysis software; 12% of OH programs reported needing statistical analysis software.

- Fewer than half of the jurisdictions reported that their program-specific epidemiologists published articles in peer-reviewed journals. A higher percentage reported that epidemiologists submitted abstracts for presentations at state or national meetings (69% for CD, 59% for MCH, 12% for OH).
- Since 2009, the number of peer-reviewed publications by MCHEs increased, and the number by CDEs decreased. The number of peer-reviewed publications for OHEs did not change.
- 75% of jurisdictions reported having a publicly accessible online query system for CD, 39% for MCH, and 14% for OH.

Collaboration

- For most jurisdictions, collaboration among epidemiologists in the CD, MCH, and OH programs was routine or somewhat strong.
- There was very little collaboration with mental health, occupational health, public health preparedness, and substance abuse programs.
- Most jurisdictions (≥61%) reported having CDEs, MCHEs, and OHEs who collaborate with federal agencies.

Access to Published Literature and Support Services

- A number of jurisdictions reported that their epidemiologists had no access to peer-reviewed or scientific literature: 13 for CD, 9 for MCH, and 16 for OH.
- Epidemiologists reported having limited access to adequate information technology (IT) and clerical support. About 59% of jurisdictions had adequate IT support services for all CDEs but only 39% had adequate clerical support. Data were not available for MCHEs or OHEs.

Factors that Improve Capacity

- For CD programs, the three factors that are substantially associated with higher-level capacity were 1) having a CD epidemiologist with doctoral degree, 2) having at least one epidemiologist who is responsible for coordinating and integrating CD epidemiology activities across categorical programs, and 3) having 5+ CD epidemiologists.
- For MCH programs, the three major factors associated with higher-level capacity were 1) having a lead MCHE, 2) having MCH leaders with both scientific and administrative authority, and 3) having an MCH workforce with at least five MCHEs.
- For OH programs, the three factors associated with having higher-level OH epidemiology and surveillance capacity were 1) having a lead OHE, 2) having at least 0.7 FTE OHE, and 3) having CDC Division of Oral Health State Oral Disease Prevention Program funding.

Outcomes Associated with Higher-Level Capacity

- CD programs that reported having at least substantial capacity were significantly more likely to have published in a peer-reviewed journal and to have strong collaborations with epidemiologists in other program areas.
- MCH programs reporting at least substantial overall capacity were more likely to have substantial capacity for EPHS1, EPHS2, EPHS9, and translating analytic findings. Jurisdictions with substantial MCH capacity had MCHE more involved in decision making about needs assessment, program planning, performance measures, and program evaluation. They were also more likely to have presented at state and/or national meetings.
- OH programs reporting at least substantial overall capacity were more likely to have substantial capacity for EPHS1, EPHS2, EPHS9, data linkages, and translation of analytic findings. Jurisdictions with substantial OH capacity had OHEs more involved in decision making about needs assessment, priority setting, program planning, performance measures, program evaluation, and policy development. They were also more likely to have unfettered access to Medicaid and BRFSS data; to calculate confidence intervals; and to collaborate with MCH, children with special health-care needs, and CD, programs and government agencies; and work on social determinants of health.

Chronic Disease–Specific Trends, 2009–2013

- The percentage of jurisdictions with substantial to full capacity increased from 52% in 2009 to 66% in 2013. The percentage of jurisdictions with minimal to no capacity decreased from 18% to 4%.
- From 2009 to 2013, the percentage of CDEs with a master's degree in epidemiology increased from 37% to 48%, and the percentage of CDEs with "some epidemiology coursework" decreased from 25% to 16%.
- The percentage of jurisdictions reporting that CDEs work in the areas of OH, alcohol abuse, drug abuse, and high cholesterol increased from 2009 to 2013; the percentage of jurisdictions with CDEs working in the stroke area declined.
- From 2009 to 2013, the percentage of jurisdictions reporting unfettered access to cancer registry (83% to 69%) and Medicaid (35% to 25%) data decreased. Timely access to cancer registry data also decreased (83% to 69%).
- Timely access to state mortality data increased from 46% in 2009 to 72% in 2013.
- The percentage of jurisdictions needing encryption software increased substantially from 53% in 2009 to 74% in 2013.
- The percentage of jurisdictions with a queryable online system for CD data increased (51% to 67%), as did the percentage of jurisdictions in which CDEs presented at state/national meetings (78% to 92%).
- There was a substantial decline ($\geq$10 percentage points) in the percentage of jurisdictions that reported at least a somewhat strong collaboration with public health preparedness (37% in 2013 vs. 20% in 2009), environmental health (61% vs. 47%), and occupational health (37% vs. 25%).
- The percentage of jurisdictions that reported their CDEs had at least some access to current journals steadily increased (65% in 2009 to 74% in 2013). The percentage with clerical support and IT support also increased from 2009 to 2013.

Maternal and Child Health–Specific Results and Trends, 2009–2013

- 42% of jurisdictions reported having only full-time MCHEs; 52% had both full- and part-time MCHEs.
- Higher-population states reported having, on average, more full-time MCHEs than did low-population states. The mean number of part-time MCHEs did not differ by population tertile.
- The mean number of part- and full-time MCHEs was higher in jurisdictions in which MCHE leaders had both scientific and administrative authority.
- The percentage of jurisdictions with substantial to full capacity increased from 55% in 2009 to 73% in 2013. The percentage of jurisdictions with minimal to no capacity decreased from 12% to 6%.
- The percentage of jurisdictions that reported having at least substantial MCH epidemiology capacity for each of the four EPHS most relevant to epidemiology and the two other epidemiology-related services increased substantially.
- Since 2009, the percentage of MCHE leaders with both scientific and administrative authority increased substantially, from 49% in 2009 to 69% in 2013.
- The percentage of jurisdictions in which MCHEs are substantially to fully involved in decision making in performance measurement, program evaluation, and policy development increased substantially.
- From 2009 to 2013, unfettered access to family planning, hospital discharge, emergency department, YRBS, and BRFSS data increased by >10 percentage points.
- For states with unfettered access to data, the percentage reporting timely access increased by >10 percentage points for fetal death, abortion, Medicaid, and EMS data.
- From 2009 to 2013, there was a 10 percentage point increase in the percentage of jurisdictions reporting at least frequent collaboration with mental health (12% vs. 24%) and nongovernment organizations (59% vs. 77%). There was a 10 percentage point decrease in the percentage of jurisdictions reporting collaboration with CD (63% vs. 53%).
- The percentage of MCHEs with a master's degree in epidemiology increased from 30% in 2009 to 40% in 2013.

INTRODUCTION AND BACKGROUND

Chronic disease (CD), maternal and child health (MCH), and oral health (OH) are three specific program areas within state and territorial health agencies. These programs are responsible for monitoring, studying, predicting, and preventing a wide range of diseases and conditions that occur throughout the human lifespan. To accomplish these tasks, CD, MCH, and OH programs need access to a cadre of skilled epidemiologists: health professionals with specialty training in the design of population studies, the collection and analysis of data, the interpretation of empirical findings and application to public-health practice, and the development and maintenance of surveillance systems to monitor health problems and hazards in targeted populations.

Since 2001, the Council of State and Territorial Epidemiologists (CSTE) has periodically assessed the epidemiology capacity of state and territorial health departments in the United States. These Epidemiology Capacity Assessments (ECAs), which are structured around the Ten Essential Public Health Services (EPHS), have generated estimates of overall capacity and capacity within eight specific program areas: bioterrorism/emergency response, CDs, environmental health, infectious diseases, injury, MCH, occupational health, and OH. The initial ECA in 2001 showed inadequate capacity in almost all epidemiology programs and insufficient infrastructure to perform the four epidemiology-related EPHS.[5] After nearly $1 billion in federal bioterrorism funds was distributed during fiscal year 2002, CSTE conducted follow-up ECAs in 2004 and 2006. The 2004 assessment found both an overall increase in the number of epidemiologists working in state health departments and lower capacity in several epidemiology programs than in the 2001 ECA.[6] The findings from both reports prompted CSTE to focus its workforce priorities and activities on strengthening the public health system around four priority areas:[7]

1. Measuring epidemiology capacity and facilitating employment of trained epidemiologists needed within public health systems;
2. Establishing applied epidemiology competencies and addressing training gaps;
3. Identifying specific barriers to recruiting and retaining applied epidemiologists; and
4. Addressing funding gaps and leadership issues.

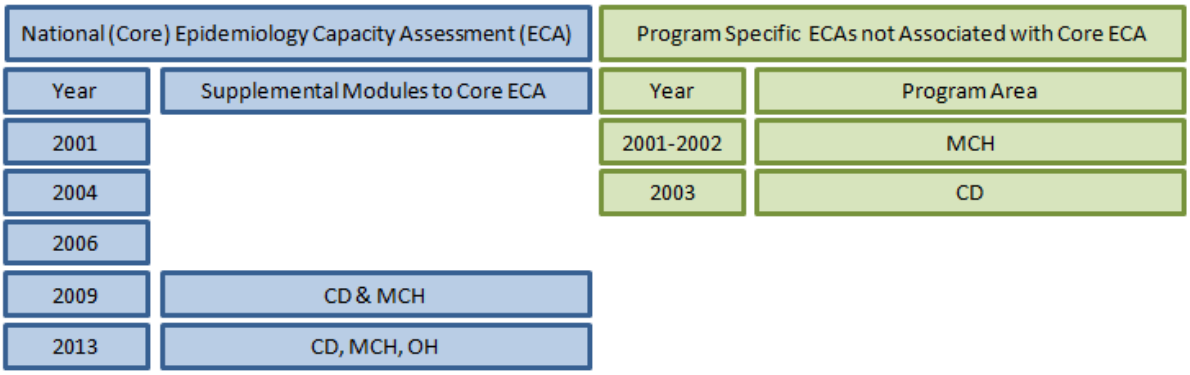
The 2006 ECA, in addition to measuring epidemiology capacity, evaluated the status of state workforce competency and training needs and barriers to recruitment and retention of epidemiologists. The 2006 assessment found that, even though the number of epidemiologists remained the same as in 2004, the workforce had a higher level of academic and on-the-job training. In addition, epidemiology capacity in several areas further improved. Regardless of improvements in academic and on-the-job training, however, workforce competency in some areas was suboptimal, and the need for additional training was clearly recognized.[8]

The results of the 2009 ECA generated four overarching conclusions: national epidemiology capacity eroded since 2004; a large percentage of states had minimal to no capacity to carry out epidemiology functions; many states did not have adequate technology capacity; and the need continues for a strong workforce development effort.[9]

Although the aforementioned ECAs provided valuable information about the overall or “core” epidemiology capacity of states and territories, they provided minimal information about program-specific capacity. To obtain more detailed information about epidemiology capacity within specific program areas, CSTE conducted a series of program-specific ECAs. This report focuses on the epidemiology capacity within three specific program areas: CD, MCH, and OH. Program-specific ECAs were previously conducted during 2001–2002 for MCH, 2003 for CD, and 2009 for both CD and MCH.[10,11,12,13] The 2001–2002 and 2003 assessments were stand-alone evaluations for the specific program area; the 2009 CD and MCH assessments were Supplemental Modules to the Core ECA previously described. In 2013, CSTE conducted an additional ECA. The 2013 ECA included a core questionnaire about overall capacity plus several additional modules in CD, environmental health, MCH, and OH to assess epidemiology and surveillance capacity in these specific program areas (Figure 1).

The purpose of this report is to present findings related to CD, MCH, and OH epidemiology capacity from the 2013 Core ECA and the CD/MCH/OH Supplemental Modules, as well as trends from the previous core ECA and supplemental modules where comparable information was obtained.

Figure 1: Years Epidemiology Capacity Assessments were Completed, Core and Supplemental



Abbreviations: ECA, Epidemiology Capacity Assessment; CD, chronic disease; MCH, maternal and child health; OH, oral health

METHODS

Instrument Development and Distribution

Development of the 2013 Epidemiology Capacity Assessment (ECA) that collected data on all program areas, including chronic disease (CD), maternal and child health (MCH), and oral health (OH) is described in the Council of State and Territorial Epidemiologists (CSTE) document *2013 National Assessment of Epidemiology Capacity: Findings and Recommendations*.[21] The 2013 ECA comprised two questionnaires. One was intended to be completed by the State Epidemiologist with help as needed from other departmental staff; this questionnaire is referred to as the Core ECA. The other was intended to be completed by each epidemiologist working in the state health department; this questionnaire is referred to as the Individual Worksheet.

In 2012, CSTE's CD, MCH, and OH ECA Workgroups began developing the program-specific Supplemental Modules for the 2013 ECA. The workgroups comprised members from CSTE, professional associations representing the program areas, the Centers for Disease Control and Prevention (CDC), and state health departments. The modules were piloted in May 2013 in five states (Alaska, Florida, Idaho, Massachusetts, and Tennessee) and revised on the basis of feedback from those states. The CD, MCH, and OH Supplemental Modules were sent with the 2013 ECA to the State Epidemiologist of each state and territory in August 2013 with the expectation that they would be forwarded to the lead epidemiologist within each program area. Data were collected during August 2013 to February 2014, with most responses collected by the end of September 2013.

The 2013 Core ECA asked about overall surveillance and epidemiology capacity, designation of a lead epidemiologist within the program area, funding source, and number of publications. The Individual Worksheets included questions about training, experience, categorization into four tiers based on experience, tier-specific self-assessed competency in each of about 30 skill domains, and related skill-specific training needed. The program-specific Supplemental Modules asked about organization of program-specific epidemiologic activities, capacity to meet the Essential Public Health Services (EPHS) most related to epidemiology, leadership and decision making, spectrum of work covered by program-specific epidemiologists, access to data and professional journals, nature of data analysis performed, activities to disseminate data, and collaborations with other state health department programs and with agencies outside the health department.

Statistical Analysis

Data for the Core ECA; CD, MCH, and OH Supplemental Modules; and Individual Worksheets were analyzed using SAS version 9.3 and Epi Info 7.1.3. Results were tabulated for all responses from the responding jurisdictions.

Sixteen jurisdictions responded "other" to Question 1 from the CD module: location of CD epidemiologists (CDEs) within the health department. The specific response provided by the jurisdictions was used, when appropriate, to recode the jurisdiction into one of the three response categories: CDEs embedded within separate categorical CD program units, CDEs located within a CD unit, CDEs located within an epidemiology or population health unit. Similarly, those that responded "other" to Question 1 from the OH module were also recoded into the appropriate location for OH epidemiology support.

The OH module asked jurisdictions for the full-time equivalent (FTE) for the primary OH epidemiologist (OHE) and the percentage of the primary OHE's time spent working for OH, MCH, CD, and other programs (Questions 3 and 4). The responses from these two questions were used to create a variable for total FTE spent working with the OH program.

The 2013 U.S. Census population estimates were used to classify jurisdictions into population tertiles. These tertiles were used when assessing the relationship between program capacity and population.

Additional Assessment Information and Instructions

The 2013 ECA explained who was considered a state health department epidemiologist and who was considered an epidemiologist within each program-specific area. These definitions are the same as those used in the 2006 and 2009 ECAs.

What is an epidemiologist? According to Last,[14] an epidemiologist is "an investigator who studies the occurrence of disease or other health-related conditions or events in defined populations. The control of disease in populations is often also considered to be a task for the epidemiologist." The discipline of epidemiology is 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." "Study" includes surveillance, observations, hypothesis testing, analytic research, and experiments. "Distribution" refers to analysis by time, place, and classes of persons affected. "Determinants" are all the physical, biological, social, cultural, and behavioral factors that influence health. "Health-related states and events" include diseases; causes of death; behaviors such as use of tobacco; reactions to preventive regimens; and provisions and use of health services. "Specified populations" are those with identifiable characteristics, such as precisely defined numbers. "Applications to control …" makes explicit the aims of epidemiology—"to promote, protect, and restore health."

Who should be counted as a state health department epidemiologist? Epidemiologists employed or contracted by the state health department. For example, epidemiologists who work at the local or state level who are employed or contracted by the state are considered state health department epidemiologists.

Who should be counted as a chronic disease epidemiologist (CDE)? Persons who analyze and interpret data related to CDs or risk factors for CDs. Depending on their duties and skills, Behavioral Risk Factor Surveillance System (BRFSS) coordinators, cancer registry workers, people in data analyst positions, and others might be considered CDEs. Contract epidemiologists whose employer was elsewhere were not to be counted.

Who should be counted as a maternal and child health epidemiologist (MCHE)? Persons who analyze and interpret data related to MCH outcomes and risk factors/risk markers for MCH outcomes. MCHEs combine data from different sources, such as vital statistics, survey, and program data, and calculate statistics for groups of persons (e.g., by age, health district, and time). MCHEs may assist programs in identifying and interpreting performance measures; working with programs to develop logic models; conducting and interpreting needs assessments and evaluations; and conducting surveillance, registry, and screening activities (e.g., newborn hearing and metabolic disorder screening and birth defects, Pregnancy Risk Assessment Monitoring System (PRAMS), childhood lead screening, immunizations, reproductive cancer surveillance) and review processes relating to stillbirths, fetal infant mortality, child death, and maternal mortality. State MCHEs also typically contribute to activities related to the Title V Block Grant. Depending on their duties and skills, PRAMS coordinators, birth defects registry workers, and data analysts might be considered MCHEs. For this assessment , MCHEs are classified as persons who 1) work at least 50% (2½ days per week) at the health department doing health department–related MCH epidemiology and 2) work in the health department even if they receive their paycheck from another organization (e.g., an academic institution).

Who should be counted as an OHE? Persons who analyze and interpret data related to OH outcomes and risk factors/risk markers for OH outcomes, regardless of whether they are officially titled as such. OHEs or data analysts combine data from different sources, such as vital statistics, survey, and program data, and calculate population statistics. OHEs carry out simple data collection, analysis and reporting in support of surveillance and epidemiologic investigations, according to the CSTE definition of a "tier 1" epidemiologist. OHEs might

assist programs in identifying and interpreting performance measures, work with programs to develop logic models, conduct and interpret needs assessments and evaluations, and conduct surveillance/registries and screening activities (e.g., Association of State and Territorial Dental Directors State Synopsis, Basic Screening Survey, Workforce Surveys, Burden Document).

When indicated, the following scale was used to describe epidemiology capacity:

Not at all, none:	None of the activity, knowledge, or resources described within the question.
Minimal:	<25% (but >0%) of the activity, knowledge, or resources described within the question.
Partial:	≥25% (but <50%) of the activity, knowledge, or resources described within the question.
Substantial:	≥50% (but <75%) of the activity, knowledge, or resources described within the question.
Almost full:	≥75% (but <100%) of the activity, knowledge, or resources described within the question.
Full:	100% of the activity, knowledge, or resources described with the question.

Ten Essential Public Health Services

In 1994, the American Public Health Association adopted the Ten Essential Public Health Services (Box 1).[15] As in earlier ECAs, in the 2013 core and module assessments, CSTE examined each of the four EPHS that rely heavily on epidemiologic functions: EPHS 1, 2, 9, and 10.

Box 1: Ten Essential Public Health Services

1. **Monitor health status to identify and solve community health problems.**
2. **Diagnose and investigate health problems and health hazards in the community.**
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships and action to identify and solve health problems.
5. Develop policies and plans that support individual and community health efforts.
6. Enforce laws and regulations that protect health and ensure safety.
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
8. Assure competent public and personal health-care workforce.
9. **Evaluate effectiveness, accessibility, and quality of personal and population-based health services.**
10. **Research for new insights and innovative solutions to health problems.**

Assessment Limitations

As with all assessments, the 2013 ECA has limitations. First, we do not know whether the appropriate "lead" epidemiologist completed the Supplemental Module or whether the person who completed the module consulted with other epidemiologists within the specific program area. Second, as in past ECAs, information collected about perceived capacity is self-assessed data. Methods used by respondents to estimate this information might have varied between and within jurisdictions over time. Third, the response rate to the Individual Worksheets for specific program areas is unknown, and respondents might have differed from nonrespondents. Furthermore, because of the <100% response rate to the worksheets, the numbers and percentages of jurisdictions with an epidemiologist who had doctoral-level training and with at least five CDEs or five MCHEs are likely to be underestimates. Finally, the 2013 ECA and CD, MCH and OH Supplemental Modules measured epidemiology and CD capacity only at the state level. Local health department–level epidemiology capacity was not assessed, including local capacity in large city health departments serving populations as large as in many jurisdictions.

Another limitation relates to comparing responses among modules. Some questions that were identical across all three modules might have included different answer options. For example, the CD module had four answer options for the functional capacity questions, whereas the MCH and OH modules had six answer options.

Report Layout

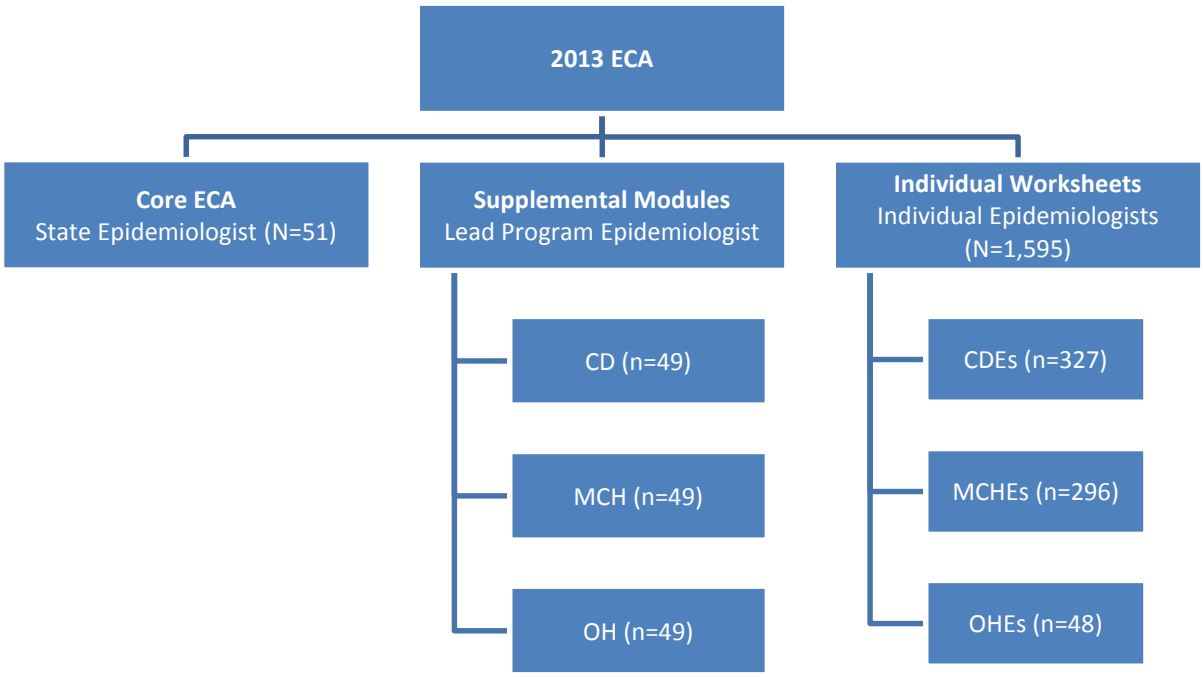
This report has four distinct chapters for the presentation of results. The first results chapter, "Overall Epidemiology Capacity Assessment for Chronic Disease, Maternal and Child Health, and Oral Health," presents results for items in the Core ECA or the Individual Worksheets or were similar across all three modules. This chapter also discusses the overall findings, as well as overall recommendations. The other three results chapters are program area specific. They present findings unique to the program area, including trends, when appropriate. These chapters also discuss program-specific findings and recommendations.

This report contains a large amount of data. For this reason, we have provided condensed findings in the "Quick Facts" section. In addition, the tables and figures presented in the body of the report are, in most cases, condensed. In other words, categories of responses may be collapsed or nonsignificant results not presented.

Overall Epidemiology Capacity Assessment for Chronic Disease, Maternal and Child Health, and Oral Health

All 50 states and the District of Columbia, referred to collectively as "jurisdictions," completed the 2013 Core Epidemiology Capacity Assessment (ECA) questionnaire. The chronic disease (CD), maternal and child health (MCH), and oral health (OH) Supplemental Modules were completed by 49 jurisdictions; two jurisdictions did not complete any of the Supplemental Modules. A total of 1,595 epidemiologists from 49 jurisdictions completed the Individual Worksheet portion of the ECA. Of these 1,595 epidemiologists, 530 from 48 jurisdictions were affiliated with CD, MCH, and/or OH programs. Following are results from responses relating specifically to CD, MCH, and OH from the 2013 Core ECA, the Supplemental Modules, and the Individual Worksheets. Unless otherwise specified, the data are based on responses to the three Supplemental Modules.

Figure 2: Components of the 2013 ECA, including responsible party and number of responses



Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist; OH, oral health; OHE, OH epidemiologist.

Functional Epidemiology Capacity

Overall Epidemiology: The 2013 Core ECA asked jurisdictions to specify the extent of their overall epidemiology and surveillance capacity in each program area on the basis of the percentage of the activity, knowledge, or resources they had; responses were separated into six categories ranging from none to full. Epidemiology capacity varied widely among the three program areas. For CD, 33 (66%) jurisdictions had substantial to full epidemiology capacity, compared with 37 (73%) for MCH and 13 (26%) for OH.

Having substantial to full capacity, however, means that a state might have the capacity to complete only 50% of the epidemiologic activities within the program area. Although previous ECAs have used substantial to full capacity as the standard, a better portrayal of functional epidemiology capacity is the percentage of jurisdictions with almost full to full capacity; which implies that they can complete at least 75% of the required activities. For CD, 10 (20%) jurisdictions had almost full to full epidemiology capacity, compared with 19 (37%) for MCH and 5 (10%) for

OH. At the other end of the capacity spectrum, 30 (59%) jurisdictions reported no or minimal capacity for OH, compared with 3 (6%) and 2 (4%) for MCH and CD, respectively (Table 1, Figure 3).

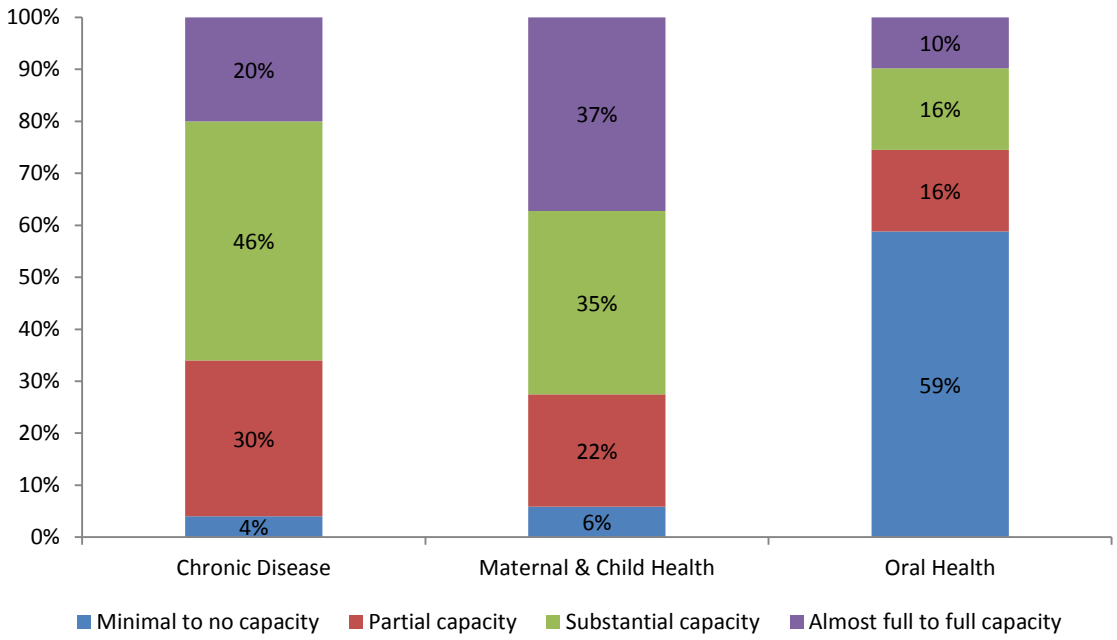
When overall capacity within the three program areas was evaluated, 27 (54%) jurisdictions did not have almost full to full capacity in any program area, 13 (26%) had almost full capacity in just one program area, 9 (18%) had almost full capacity in two program areas, and 1 (2%) jurisdiction had almost full capacity in all three program areas.

Table 1: Extent of epidemiology and surveillance capacity, 2013 Core ECA

EXTENT OF EPIDEMIOLOGY AND SURVEILLANCE CAPACITY	CHRONIC DISEASE (n=50)	MATERNAL AND CHILD HEALTH (n=51)	ORAL HEALTH (n=51)
	NO. (%)	NO. (%)	NO. (%)
Full: 100% (% yes)	2 (4.0)	4 (7.8)	3 (5.9)
Almost full: 75%–99% (% yes)	8 (16.0)	15 (29.4)	2 (3.9)
Substantial: 50%–74% (% yes)	23 (46.0)	18 (35.3)	8 (15.7)
Partial: 25%–49% (% yes)	15 (30.0)	11 (21.6)	8 (15.7)
Minimal: <25% (% yes)	2 (4.0)	2 (3.9)	13 (25.5)
None (% yes)	0	1 (2.0)	17 (33.3)
Substantial Capacity: 50%–100%	***33 (66.0)***	***37 (72.5)***	***13 (25.5)***
Almost Full Capacity: 75%–100%	***10 (20.0)***	***19 (37.2)***	***5 (9.8)***

Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Figure 3: Extent of epidemiology and surveillance capacity for chronic disease, maternal and child health, and oral health programs, 2013 Core Epidemiology Capacity Assessment



Trends in Overall Epidemiology Capacity: From 2009 to 2013, the percentage of jurisdictions with almost full to full capacity increased in MCH (from 20% to 37%) and in OH (from 2% to 10%) (Figure 4). Although jurisdictions with almost full to full capacity did not increase for CD, the percentage of jurisdictions with substantial CD capacity did increase (from 31% in 2009 to 46% in 2013). Jurisdictions with minimal or no capacity decreased from 2009 to 2013 for CD and MCH but remained relatively constant for OH at about 60%.

Previous ECAs used substantial to full capacity as a cut point for monitoring trends in epidemiology capacity. For MCH programs, the percentage of jurisdictions with substantial or higher-level epidemiology capacity increased steadily from 43% in 2004 to 73% in 2013. The percentage of jurisdictions with minimal or no MCH epidemiology capacity steadily declined. Substantial or higher-level OH capacity was somewhat stable from 2004 (8%) to 2009 (6%) but increased to 25% in 2013. The percentage of jurisdictions with no or minimal OH capacity decreased since 2004–2006 (Figure 5).

Substantial or higher-level CD capacity has fluctuated over time from a low of 48% in 2004 to a high of 66% in 2013. The percentage of jurisdictions with no or minimal capacity decreased from 18% in 2009 to 4% in 2013 (Figure 2). The CD Supplemental Module asked whether overall CD epidemiology capacity had changed since 2009; 15 (31%) jurisdictions reported that CD epidemiology capacity had increased, 15 (31%) reported a decrease, 16 (33%) reported no change, and 3 (6%3) did not know.

Figure 4: Overall epidemiology capacity for chronic disease, maternal and child health, and oral health programs, 2009 and 2013 Core Epidemiology Capacity Assessments

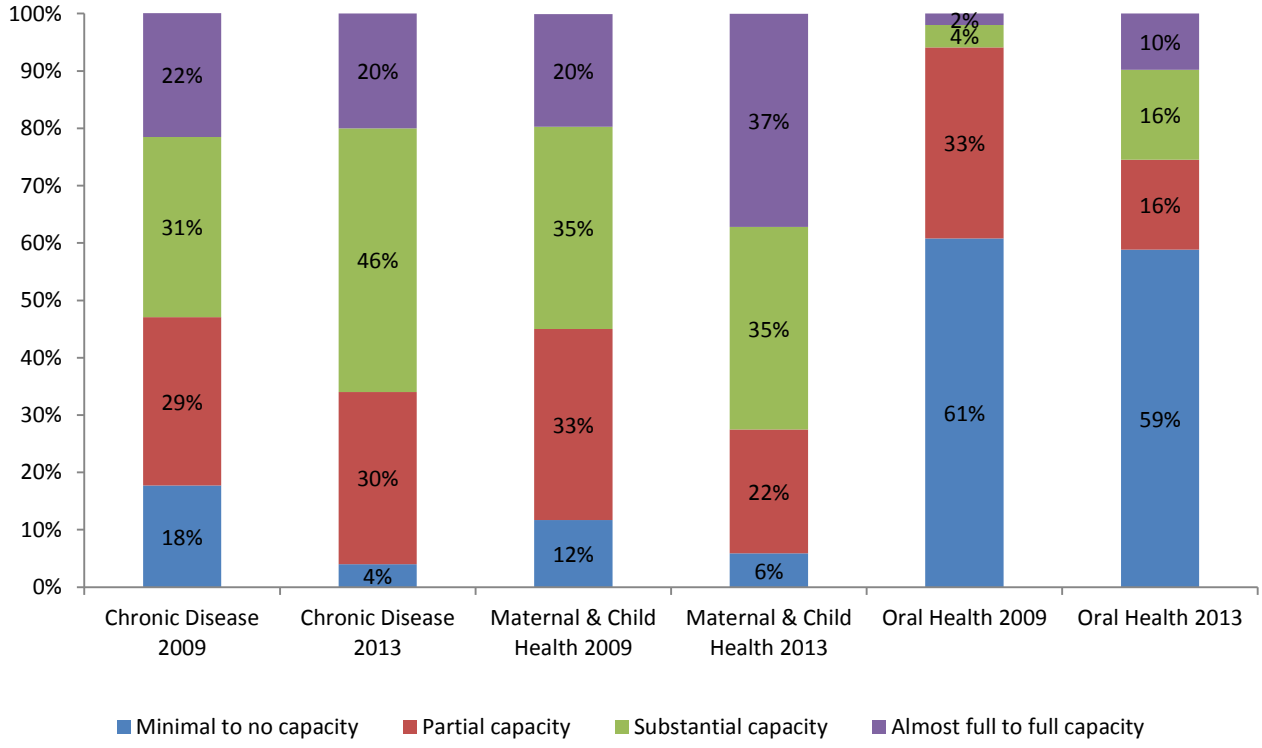
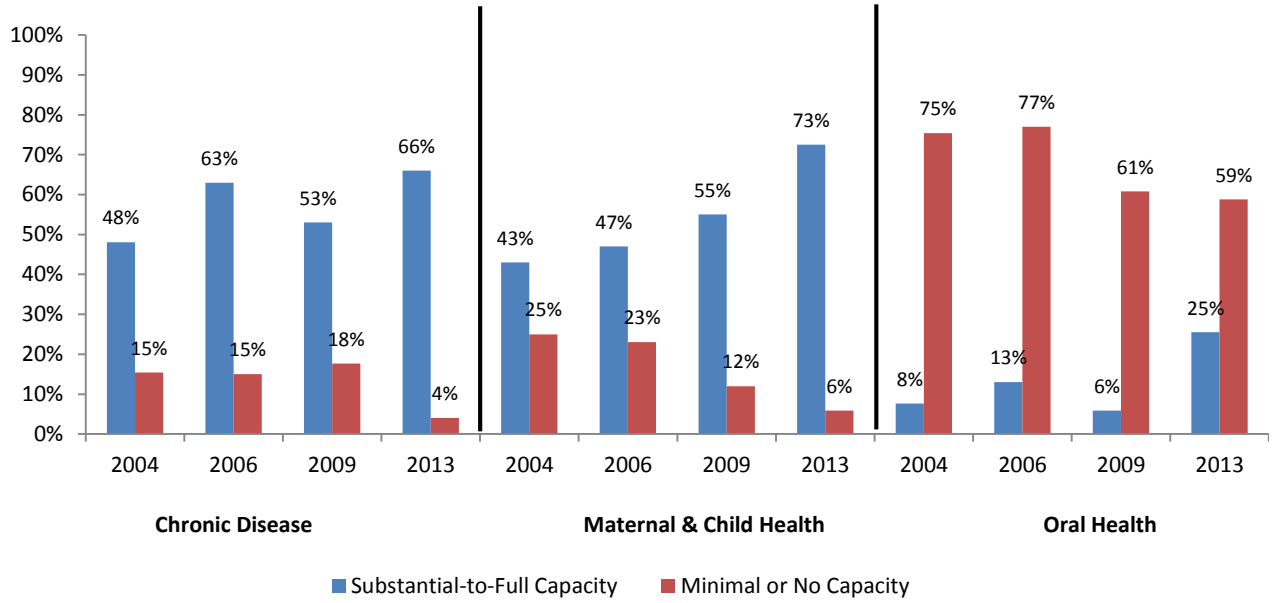


Figure 5: Overall epidemiology and surveillance capacity for chronic disease, maternal and child health, and oral health programs, 2004, 2006 2009, and 2013 Core Epidemiology Capacity Assessments

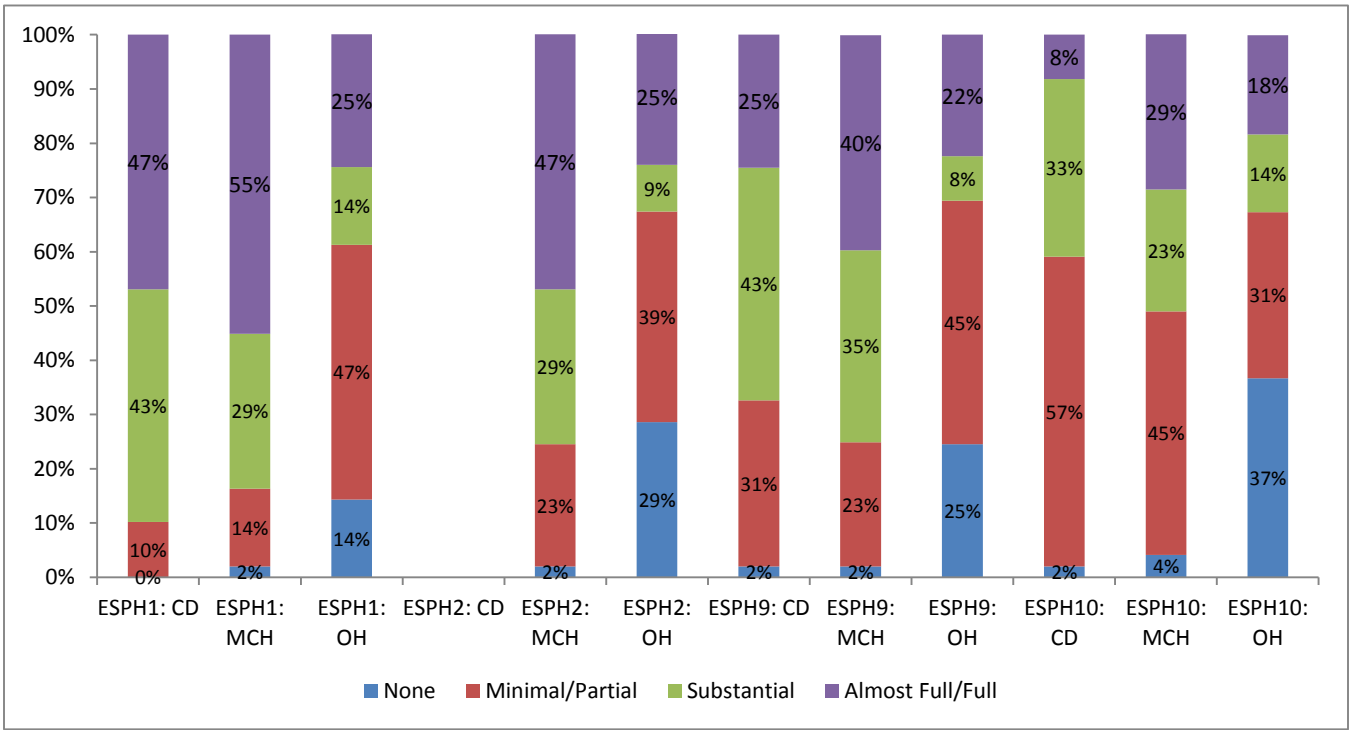


Epidemiology Capacity Related to the Essential Public Health Services: Four of the 10 EPHS rely heavily on epidemiologic functions: EPHS1 (surveillance), EPHS2 (diagnosis/investigation), EPHS9 (evaluation), and EPHS10 (innovation) (Box 1). The CD, MCH, and OH Supplemental Modules obtained information about program capacity related to EPHS1, EPHS9, and EPHS10; the MCH and OH modules also obtained capacity information related to EPHS2. When examined by capacity related to each EPHS, the percentage of CD, MCH, and OH programs with at least substantial capacity was highest for EPHS1. Most jurisdictions' CD and MCH programs had substantial to full capacity for EPHS1 (44 (90%) and 41 (84%) jurisdictions, respectively). Only 19 (39%) jurisdictions reported their OH program had substantial to full capacity for EPHS1 (Figure 6).

EPHS10 (research) had the lowest capacity for all program areas. Twenty-nine (59%) CD programs, 24 (49%) MCH programs, and 33 (67%) OH programs had partial to no capacity for EPHS10 (Figure 6).

Fewer than 50% of CD programs, <60% of MCH programs, and <26% of OH programs had almost full to full capacity for any of the EPHS (Figure 6). For each EPHS, MCH programs had the highest percentage of jurisdictions with almost full to full capacity.

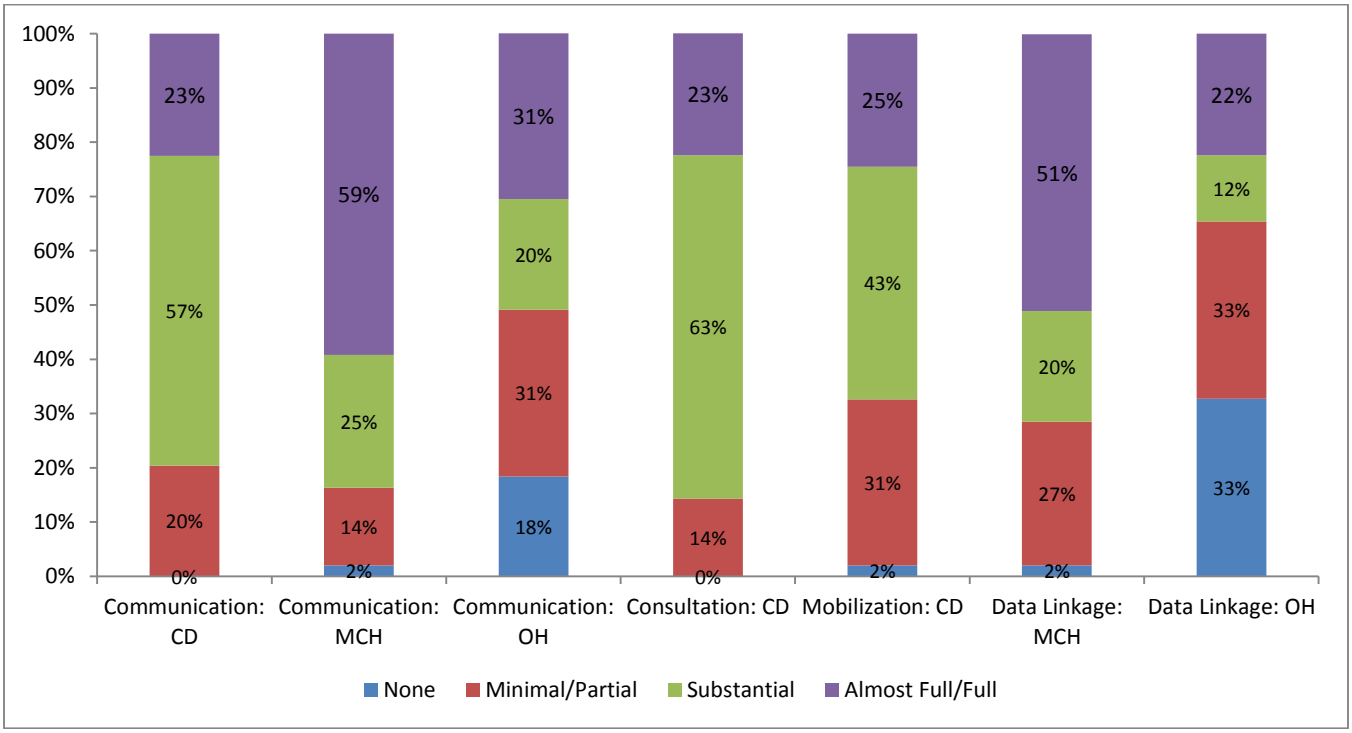
Figure 6: Capacity to perform epidemiology-related EPHS, 2013 ECA CD, MCH, and OH Supplemental Modules



Epidemiology Capacity for Other Epidemiology-Related Services: In addition to the EPHS, epidemiologists perform epidemiology-related services that vary by program area. The CD Supplemental Module asked about capacity for translating analytic findings (communication), providing technical assistance and data to aid in developing polices (consultation) and facilitating partnerships, and ensuring action plans are evidence-based (mobilization). The MCH and OH Supplemental Modules asked about capacity for translating analytic findings (communication) and promoting and contributing to the linkage of data systems (data linkage).

In terms of capacity for translating analytic findings, 39 (80%) CD programs, 41 (84%) MCH programs, and 25 (51%) OH programs had substantial to full capacity. Forty-two (86%) CD programs had substantial to full capacity to provide technical assistance and data to aid in developing policies, but the percentage of CD programs with substantial to full capacity to facilitate partnerships and ensure action plans are evidence based was substantially lower (33 [67%]). A total of 35 (71%) jurisdictions had substantial to full MCH capacity to promote and contribute expertise to the linkage of data systems; for OH, 17 (35%) jurisdictions had substantial to full capacity in this area (Figure 7).

Figure 7: Capacity to perform other epidemiology-related services, 2013 ECA CD, MCH, and OH Supplemental Modules



Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Trends in Epidemiology Capacity for the EPHS and Other Epidemiology-Related Services: In 2009, the CD Supplemental Module did not obtain information about capacity for the EPHS and related services but the MCH Supplemental Module did. As with overall MCH epidemiology capacity, the percentage of jurisdictions increased that reported having at least substantial MCH epidemiology capacity for each of the four EPHS and the two other epidemiology-related services (Table 2).

Table 2: Substantial or greater MCH epidemiology capacity for the EPHS, 2013 ECA MCH Supplemental Module

SELECTED PUBLIC HEALTH SERVICES	PERCENTAGE OF JURISDICTIONS WITH AT LEAST SUBSTANTIAL CAPACITY	
	MCH 2009	MCH 2013
	NO. (%)	NO. (%)
EPHS1: Monitor health status to identify community health problems	38 (74.4)	41 (83.7)
EPHS2: Diagnose and investigate health problems in the community	28 (54.8)	37 (75.6)
EPHS9: Evaluate effectiveness, accessibility, and quality of health services	19 (37.3)	36 (75.0)
EPHS10: Research for new insights and innovative solutions to health problems	17 (33.3)	25 (51.1)
Promote and contribute to the linkage of data systems	29 (56.9)	35 (71.4)
Translate analytic findings	35 (68.7)	41 (83.7)

Abbreviations: ECA, Epidemiology Capacity Assessment; EPHS, Essential Public Health Services; MCH, maternal and child health.

Barriers to Obtaining Almost Full Capacity: The percentage of states that reported having ***<75% of needed epidemiology capacity*** varied by program area and EPHS. For all three Supplemental Modules, respondents reporting <75% of epidemiology capacity were given an opportunity to indicate whether any of three specific potential barriers existed to achieving each EPHS and the other epidemiology-related capacities previously mentioned. These barriers were inadequate number of staff, staff with inadequate skills or training, and inadequate data resources. In addition, jurisdictions were given a fourth option that varied by program area and epidemiology service in question (outdated software, limited access to health communications staff or scientific literature, and lack of necessary relationships or partnerships).

For all program areas and epidemiology services, >75% of respondents indicated that having inadequate staff was a barrier. Inadequately skilled staff and inadequate data resources were also significant barriers, especially for EPHS9 and EPHS10. More than 10% of OH programs reported lack of or outdated analytic software as a barrier for each of the six services.

Program Area Epidemiology Capacity for Chronic Disease: In addition to a jurisdiction's overall CD epidemiology capacity, the CD Supplemental Module obtained information about funding for a specific program area and the level of CD epidemiology capacity for that program area. Most (>70%) jurisdictions had funding for all of the program areas except arthritis (29%) and healthy aging (10%). Arthritis and healthy aging programs had the highest percentage of jurisdictions reporting no CD epidemiology capacity (37% and 57%, respectively). Although most CD programs reported that their state has funding for OH and asthma, 20% reported no CD epidemiology capacity for OH and 14% reported no CD epidemiology capacity for asthma.

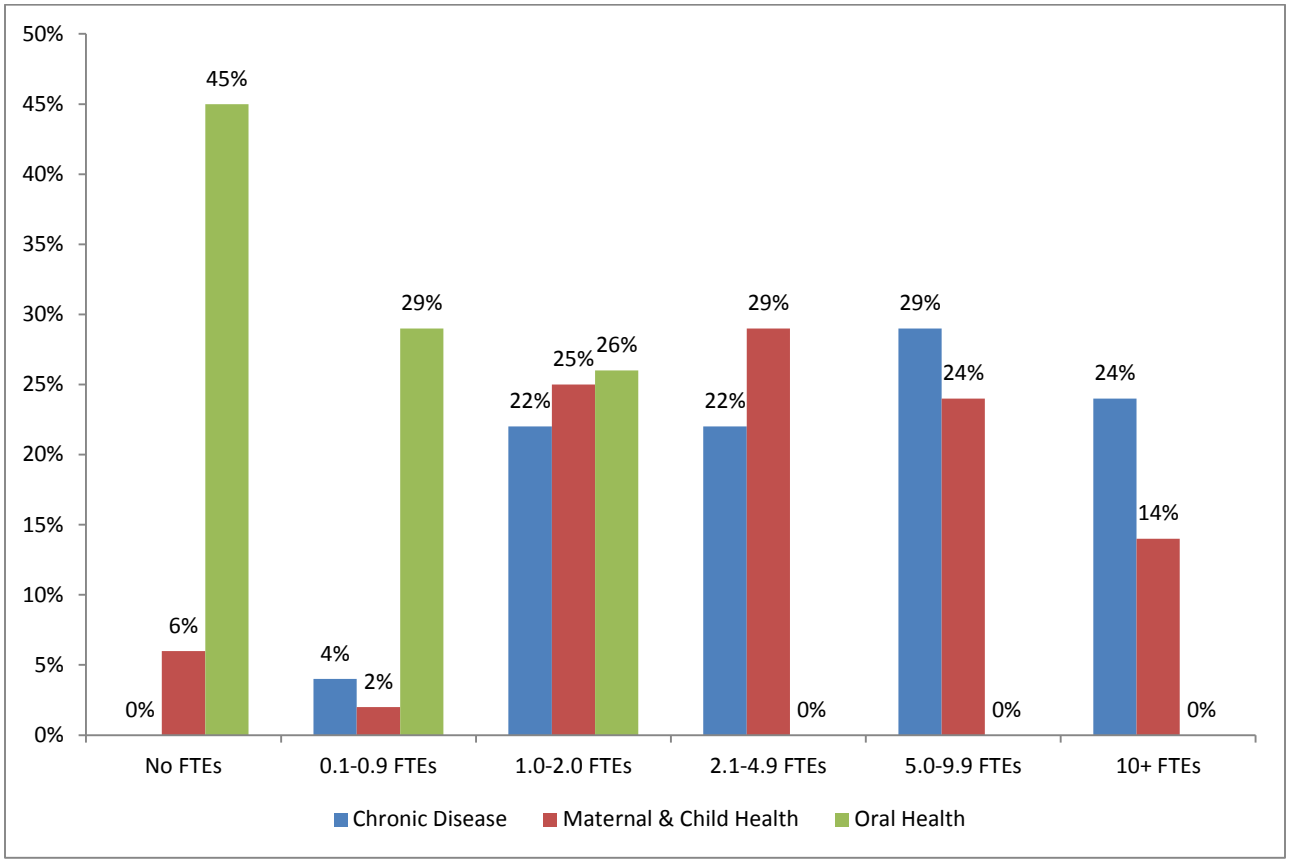
Epidemiology Workforce

Number of Epidemiologists: The Core ECA asked State Epidemiologists to provide information about the number of full-time-equivalent (FTE) epidemiologists who work in each program area. If an epidemiologist had responsibilities divided over more than one program area, the fraction of time given to each program area was given to the nearest 0.1 FTE. In 2013, there were approximately

- 354 FTE CD epidemiologists (CDEs) (mode=1.0, median=6.0),
- 282 FTE MCH epidemiologists (MCHEs) (mode=3.0, median=3.0), and
- 19 FTE OH epidemiologists (OHEs) (mode=0.0, median=0.1).

Staffing patterns varied widely by jurisdiction and program area. Twelve (24%) jurisdictions reported having $\geq$10 CDEs; and 7 (14%) reported having $\geq$10 MCHEs. About one quarter of all jurisdictions reported having 1-2 FTE epidemiologists in each of the three program areas. Twenty-three (45%) jurisdictions reported having no OHEs, compared with 3 (6%) and 0 (0%) for MCH and CD respectively (Figure 8).

Figure 8: Percent of FTE epidemiologists, by program area, 2013 Core ECA



The MCH Supplemental Module asked each state how many MCHEs work on MCH activities at least 50% of their time and how many work on MCH activities <50% of their time. Forty-six jurisdictions reported having one or more epidemiologists working on MCH activities at least 50% of their time. Across all jurisdictions, 284 epidemiologists worked on MCH activities at least 50% of their time, and 46 epidemiologists worked on MCH activities <50% of their time.

Number of Epidemiologists Needed to Achieve Full Capacity: In addition to current epidemiology workforce, the Core ECA asked State Epidemiologists to estimate the *ideal number of **additional*** FTE epidemiologists needed to reach full capacity within each program area. To reach full capacity, health jurisdictions reported needing

- 219 additional FTE CDEs (mode=2.0, median=2.0),
- 117 additional FTE MCHEs (mode=1.0, median=1.5), and
- 33 FTE additional OHEs (mode=1.0, median=1.0).

Sources of Funding: The Core ECA asked State Epidemiologists to provide information about the number of FTE epidemiologists supported by federal, state, and other funds. Most CD, MCH, and OH epidemiology positions (≥75%) were funded by federal dollars. The Centers for Disease Control and Prevention (CDC) was the primary funding source for CDEs; MCHEs and OHEs were funded by a combination of CDC and federal funds from other agencies. Very few epidemiology positions were funded solely by state dollars (Table 3).

Table 3: Percentage of all CD, MCH, and OH epidemiology positions funded by federal, state, and other sources, 2013 Core ECA			
FUNDING SOURCE FOR EPIDEMIOLOGISTS *(% OF TOTAL FUNDED BY EACH SOURCE)*	**CD (n=50)**	**MCH (n=47)**	**OH (n=28)**
Federal funds from CDC (%)	70.8	42.9	57.3
Directly funded by CDC (%) *	4.0	2.2	3.6
Federal funds from other agencies (%)	3.1	39.0	26.0
State funds (%)	20.0	14.9	9.6
Funds from other sources (%)	2.1	1.1	3.6

*Directly funded by CDC = federal assignees, such as Epidemic Intelligence Service Officers, Career Epidemiology Field Officers, and Public Health Prevention Service.

Abbreviations: CD, chronic disease; CDC, Centers for Disease Control and Promotion; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Academic Training: Several questions on the 2013 Individual Worksheet provided data to characterize the CD, MCH, and OH epidemiology workforce. A total of 1,595 epidemiologists from 51 jurisdictions completed the Individual Worksheet portion of the ECA. Of these 1,595 epidemiologists, 530 from 50 jurisdictions were affiliated with CD, MCH, and/or OH programs.

Chronic Disease: A total of 327 individual epidemiologists, representing 181 FTE CDEs in 47 jurisdictions, completed Individual Worksheets showing their level of academic achievement and their level of epidemiology training. A total of 97% of the FTE epidemiologists had masters or higher degrees. Among the 58 FTE epidemiologists with doctoral degrees, 51 had PhD or DrPH degrees, and 7 had medical or veterinary degrees (Figure 9).

When examined by level of epidemiology-specific training, 67% had a master's or higher degree. The largest single group comprised those with master's-level epidemiology training, accounting for 48% of the total; 14% had no specific epidemiology training except that acquired on the job (Figure 10).

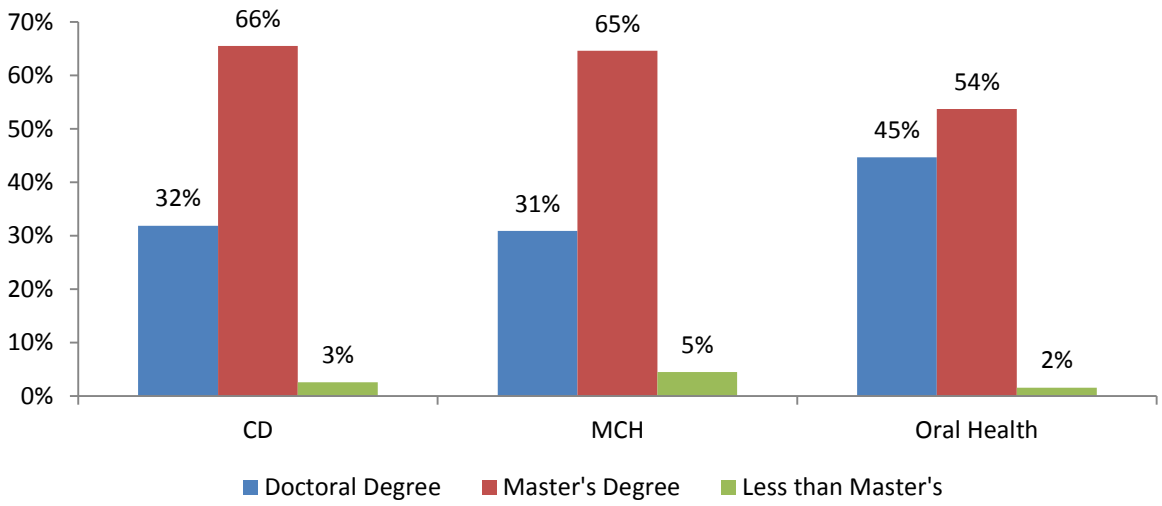
Maternal and Child Health: A total of 296 individual epidemiologists, representing 176 FTE MCHEs, completed Individual Worksheets showing their level of academic achievement and their level of epidemiology training. A total of 96% of the FTE epidemiologists had master's or higher degrees. Among the 54 FTE epidemiologists with doctoral degrees, 42 had PhD or DrPH degrees and 12 had medical, dental, or veterinary degrees (Figure 9).

When examined by level of epidemiology-specific training, 53% had a master's or higher degree. The largest single group comprised those with master's-level epidemiology training, accounting for 40% of the total; 14% had no specific epidemiology training except that acquired on the job (Figure 10).

Oral Health: A total of 48 individual epidemiologists, representing 13 FTE OHEs, completed individual work sheets showing their level of academic achievement and their level of epidemiology training. A total of 98% of the FTE epidemiologists had master's or higher degrees. Among the 6 FTE epidemiologists with doctoral degrees, 2 had PhD or DrPH degrees and 4 had medical, dental, or veterinary degrees (Figure 9).

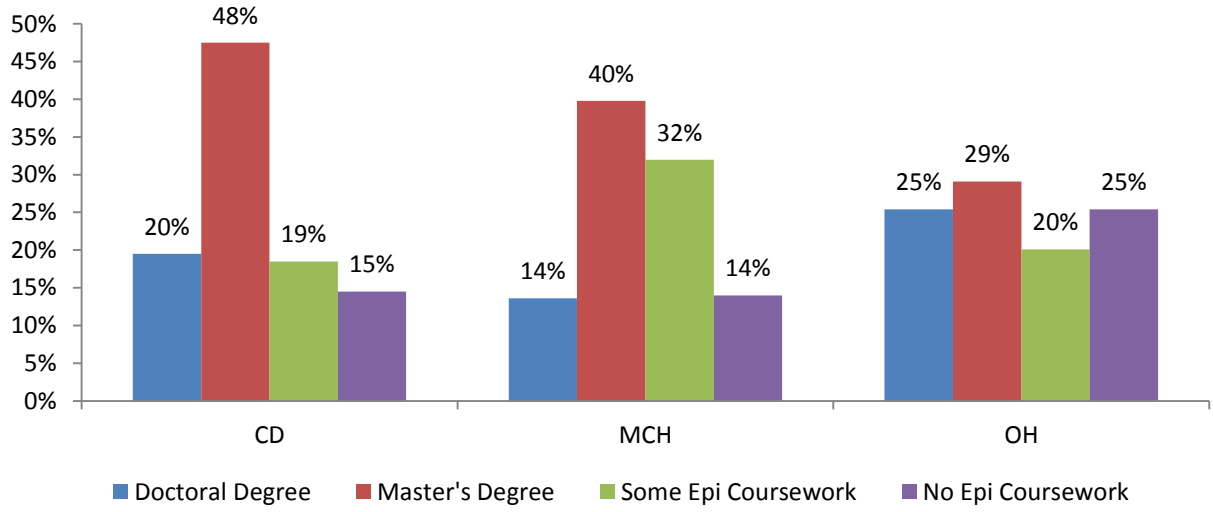
When examined by level of epidemiology-specific training, 55% had a master's or higher degree. The largest single group comprised those with master's-level epidemiology training, accounting for 29% of the total; 25% had no specific epidemiology training except that acquired on the job (Figure 10).

Figure 9: Academic training of persons (full-time equivalents) working as CD, MCH, and OH epidemiologists, 2013 ECA Individual Worksheets



Abbreviations: CD, chronic disease; ECA; Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Figure 10: Epidemiology training of persons (full-time equivalents) working as CD, MCH, and OH epidemiologists, 2013 ECA Individual Worksheets



Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Competencies: The 2013 ECA Individual Worksheets asked individual epidemiologists to assess their competency and training needs by using the framework of the CDC/CSTE Applied Epidemiology Competencies. Individual epidemiologists were asked to indicate the tier to which they belonged and then to assess themselves according to their tier's specific set of competencies. The four tiers are

- Tier 1: entry-level or basic epidemiologist;
- Tier 2: mid-level epidemiologist;
- Tier 3a: senior-level epidemiologist supervisor and/or manager; and
- Tier 3b: senior scientist or subject area expert.

The number and percentage of epidemiologists by tier level experience and program area is presented in Table 4. Because some epidemiologists work across program areas, the same person might be included in multiple program areas. For this reason, the total (n=527) is less than the sum of the three program areas (N=667).

Table 4: Tier level of experience in epidemiology for persons working as CD, MCH, and OH epidemiologists, 2013 ECA Individual Worksheets

TIER LEVEL	CD (n=325)	MCH (n=294)	OH (n=48)	ALL PROGRAM AREAS (n=527)
	NO. (%)	NO. (%)	NO. (%)	NO. (%)
Tier 1: Entry-level or basic epidemiologist	72 (22.2)	65 (22.1)	10 (20.8)	123 (23.3)
Tier 2: Mid-level epidemiologist	118 (36.3)	115 (39.1)	13 (27.1)	207 (39.3)
Tier 3a: Senior-level epidemiologist supervisor and/or manager	86 (26.5)	61 (20.8)	15 (31.3)	118 (22.4)
Tier 3b: Senior scientist or subject area expert	49 (15.1)	53 (18.0)	10 (20.8)	79 (15.0)

Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Tier 1 and Tier 3b epidemiologists were assessed in 30 competency areas, Tier 2 in 31 areas, and Tier 3a in 32 areas. Of the 527 CDEs, MCHEs, and OHEs who provided information about tier level experience, 507 completed the self-assessment: 120 (24%) Tier 1, 200 (39%) Tier 2, 112 (22%) Tier 3a, and 75 (15%) Tier 3b epidemiologists. Response options for each competency were as follows: minimal or none, basic, intermediate, advanced, and expert. CDEs were asked to rank their need for additional training on a scale of 1 (less training is needed) through 5 (more training is needed).

Tier 1 Competencies: Tier 1 CDEs, MCHEs, and OHEs indicated five competencies for which at least 70% had an intermediate, advanced, or expert level of competency: demonstrating ability to listen effectively when epidemiologic finding are presented (81%), preparing written and oral reports and presentations that communicate necessary information (75%), using analysis plans and analyzing data (75%), practicing professional development (72%), and using effective communication technologies (73%).

For 10 competencies, ≥15% respondents reported having minimal or no competency: applying appropriate fiscal and administrative guidelines (34%); identifying the role of laboratory resources (33%); using informatics tools in support of epidemiologic practice (23%); using knowledge of biology and behavioral sciences to determine mechanisms of disease (21%); recognizing the basic principles of risk communication (20%); describing how policy decisions are made within the agency (20%); assisting in conducting a community health status assessment (19%); describing human subjects research and applying Institutional Review Board processes (19%); providing epidemiologic input for community planning processes (16%); and assisting in design of investigation, including creating hypothesis (15%).

Tier 2 Competencies: At least 70% of Tier 2 CDEs indicated they had an intermediate, advanced, or expert level of competency in 22 (71%) of the 31 competencies. The four competencies for which at least 50% had an advanced or expert level of competency were following ethics guidelines and principles (56%), creating analysis plans and

conducting analysis of data (55%), defining database requirements and managing a database (50%), and articulating the need for further investigation from literature review (50%).

The four Tier 2 competencies for which ≥10% had minimal or no competency were using laboratory resources to support epidemiologic activities (24%), applying appropriate fiscal and administrative guidelines to epidemiology practice (17%), using leadership and systems thinking in epidemiologic planning and policy development (12%), and assisting in the development of program logic models and theories of action (10%).

Tier 3a Competencies: The 112 senior CDEs, MCHEs, and OHEs with program management and/or supervisory responsibilities indicated 25 (78%) of 32 competencies for which at least 70% indicated they had an intermediate, advanced, or expert level of competency. The 10 competencies for which at least 60% had an advanced or expert level of competency were ensuring management of data from surveillance (75%); evaluating conclusions and interpretations from investigations (72%); ensuring preparation of written and oral reports and presentations (70%); ensuring identification of public health problems (68%); overseeing surveillance activities (67%); using basic public health sciences in epidemiologic practice (65%); ensuring study design and data collection, dissemination, and use of ethical and legal principles (65%); evaluating analysis of data from an epidemiologic investigation or study (63%); modeling interpersonal skills in communication (63%); and promoting ethical conduct in epidemiology practice (60%).

The Tier 3a competencies for which ≥10% had minimal or no competency were leading epidemiology unit in preparing for emergency response (32%), ensuring the use of laboratory resources (29%), leading community public health planning processes (16%), formulating a fiscally sound budget (15%), overseeing implementation of operational and financial plans (14%), developing requests for extramural funding to support additional epidemiologic activities and special projects (14%), promoting the epidemiologic perspective in the agency strategic planning process (12%), creating operational and financial plans for future epidemiologic activities (12%), bringing epidemiologic perspective in the development and analysis of public health policies (10%), and enforcing policies that address security, privacy, and legal considerations when communicating epidemiologic information (10%).

Tier 3b Competencies: The 75 CD, MCH, and OH senior scientist epidemiologists indicated 26 (87%) of 30 competencies for which at least 70% considered themselves to have an intermediate, advanced, or expert level of competency. At least 50% had indicated an advanced or expert level of competency in 21 (70%) competencies.

The Tier 3b competencies for which ≥10% of respondents had minimal or no competency were developing processes for using laboratory resources to support epidemiologic activities (24%), preparing for emergency response (16%), implementing operational and financial plans for assigned projects (13%), describing financial and budgetary processes of the agency (13%), evaluating results of data analysis and interpreting conclusions (12%), validating identification of public health problems pertinent to the population (12%), promoting the epidemiologic perspective in the agency strategic planning process (12%), promoting epidemiology workforce development (12%), evaluating data from an epidemiologic investigation or study (11%), organizing preparation of written and oral presentations that communicate necessary information (11%), promoting ethical conduct in the epidemiology practice (11%), and conducting epidemiologic activities within the financial and operational plan of the agency (11%).

Training Needs: As would be expected, training needs varied by tier level; the percentage of CDEs, MCHEs, and OHEs who indicated the need for more training decreased as tier level increased. At least 30% of Tier 1 epidemiologists indicated they need more training in 10 competencies, and at least 30% of Tier 2 epidemiologists reported needing more training in seven competencies. For Tier 3a epidemiologists, at least 30% indicated they need more training for five competencies, and <30% of Tier 3b epidemiologists indicated they need more training for all competencies (Table 5).

Table 5: Competencies identified by CDEs, MCHEs, and OHEs requiring less and more training, 2013 ECA Individual Worksheets	
COMPETENCIES WITH LESS TRAINING NEEDED (PERCENTAGE INDICATING LEVEL 1 OR 2 ON A SCALE OF 1–5)	**COMPETENCIES WITH MORE TRAINING NEEDED (PERCENTAGE INDICATING LEVEL 4 OR 5 ON A SCALE OF 1–5)**
Tier 1	
Apply knowledge of privacy laws to protect confidentiality (62%)	Use identified informatics tools in support of epidemiologic practice (46%)
Demonstrate ability to listen effectively when epidemiologic finding are presented (61%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (44%)
Support the organization's vision in all programs and activities (59%)	Assist in conducting a community health status assessment (43%)
Prepare written and oral reports and presentations that communicate necessary information (58%)	Describe how policy decisions are made within the agency (41%)
Promote ethical conduct in epidemiologic practice (57%)	Use knowledge of biology and behavioral sciences to determine potential biological mechanisms of disease (38%)
Identify key findings from the study (57%)	Identify the role of laboratory resources in epidemiologic activities (37%)
Follow ethics guidelines and principles when planning studies; conducting research; etc. (57%)	Implement new or revise existing surveillance systems and report key surveillance findings (34%)
Maintain databases (52%)	Support evaluation of surveillance systems (33%)
Practice professional development (51%)	Provide epidemiologic input for community planning processes (31%)
Use effective communication technologies (50%)	Recognize the basic principles of risk communication (30%)
Tier 2	
Follow ethics guidelines and principles when planning studies; conducting research, etc. (66%)	Use leadership and systems thinking in epidemiologic planning and policy development (39%)
Collaborate with others inside and outside the agency to identify the problem and form recommendations (60%)	Conduct a community health assessment and recommend priorities (33%)
Promote ethical conduct in epidemiologic practice (59%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (33%)
Apply knowledge of privacy laws to protect confidentiality (57%)	Demonstrate the basic principles of risk communication (32%)
Use critical thinking to determine whether a public health problem exists (57%)	Assist in the development of program logic models and theories of action (32%)
Articulate the need for further investigation from literature review and assessment of current data (57%)	Establish cultural/social/political framework for recommendations or interventions (31%)
Communicate epidemiologic information through oral presentations or written documents to nonprofessional audiences (56%)	Use laboratory resources to support epidemiologic activities (30%)
Tier 3a	
Use basic public health sciences in epidemiologic practice (74%)	Lead epidemiology unit in preparing for emergency response (37%)
Ensure management of data from surveillance, investigations, or other sources (73%)	Ensure the use of laboratory resources to support epidemiologic activities (34%)
Evaluate conclusions and interpretations from investigations (71%)	Lead community public health planning processes (32%)
Ensure identification of public health problems pertinent to the population (69%)	Create operational and financial plans for future epidemiologic activities (32%)
Promote ethical conduct in epidemiology practice (68%)	Develop requests for extramural funding to support additional epidemiologic activities (31%)
Tier 3b	
Validate identification of public health problems pertinent to the population (84%)	Develop processes for using laboratory resources to support epidemiologic activities (20%)
Evaluate results of data analysis and interpret conclusions (81%)	Describe financial and budgetary processes of the agency (20%)
Manage data from surveillance, investigations, or other sources (81%)	Evaluate programs (19%)
Organize preparation of written and oral presentations that communicate necessary information (80%)	Implement operational and financial plans for assigned projects (17%)
Promote ethical conduct in the epidemiology practice (77%)	Prepare proposals for extramural funding for review and input from managers (17%)
Conduct epidemiologic activities within the financial and operational plan of the agency (76%)	Ensure application of understanding of biology and behavioral sciences to determine mechanisms of disease (17%)
Evaluate data from an epidemiologic investigation or study (76%)	Lead community public health planning processes (17%)

Abbreviations: CDE, chronic disease epidemiologist; ECA, Epidemiology Capacity Assessment; MCHE, maternal and child health epidemiologist; OHE, oral health epidemiologist.

Staff Retention and Retirement: The ECA Individual Worksheet questions measured experience and anticipated turnover. Data were analyzed from all CDEs, MCHEs, and OHEs who completed the Individual Worksheets. Sixty-

eight percent of CDEs, 71% of MCHEs, and 63% of OHEs reported at least 5 years' experience as an epidemiologist (Table 6). Approximately one fifth of the CD/MCH/OH epidemiology workforce planned to retire or change careers out of epidemiology in the next 5 years: 20% of CDEs, 19% of MCHEs, and 21% of OHEs (Table 7).

Table 6: Percentage of epidemiologists with ≥5 years' experience, by highest degree and program area, 2013 ECA Individual Worksheets

HIGHEST DEGREE	NO. (%) WITH ≥5 YEARS OF EXPERIENCE		
	CD (n=327)	MCH (n=295)	OH (n=48)
MD, DO	24 (85.7)	20 (87.0)	5 (100.0)
DVM, VMD	5 (100.0)	3 (75.0)	0
DDS, DMD	0	1 (100.0)	1 (33.3)
PhD, DrPH, other doctoral	68 (81.9)	66 (83.5)	10 (90.9)
MPH, MSPH, other master	118 (59.9)	110 (63.6)	14 (56.0)
RN, any other nursing	0	2 (100.0)	0
BA, BS, BSN, other bachelor	6 (50.0)	6 (46.2)	0
Associate/No post high school degree	1 (50.0)	0	0
TOTAL	**222 (67.9)**	**208 (70.5)**	**30 (62.5)**

Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Table 7: Percentage of epidemiologists planning to retire or change careers out of epidemiology in the next 5 years, by highest degree and program area, 2013 ECA Individual Worksheets

HIGHEST DEGREE	NO. (%) RETIRING OR CHANGING CAREERS IN NEXT 5 YEARS		
	CD (n=327)	MCH (n=295)	OH (n=48)
MD, DO	5 (17.9)	6 (26.1)	1 (20.0)
DVM, VMD	1 (20.0)	0	0
DDS, DMD	0	1 (100.0)	1 (33.3)
PhD, DrPH, other doctoral	20 (24.1)	17 (21.5)	2 (18.2)
MPH, MSPH, other master	36 (18.3)	28 (16.2)	5 (20.0)
BA, BS, BSN, other bachelor	3 (25.0)	4 (30.8)	1 (33.3)
Associate/No post–high school degree	1 (50.0)	0	0
TOTAL	**66 (20.2)**	**56 (19.0)**	**10 (20.8)**

Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Epidemiology Leadership, Organization, and Decision Making

Leadership: Responses of the State Epidemiologists in the Core ECA indicated that

- 40 (78%) jurisdictions had a "lead" CDE,
- 40 (78%) jurisdictions had a "lead" MCHE, and
- 22 (44%) jurisdictions had a "lead" OHE.

The MCH and OH Supplemental Modules asked whether the MCHE and OHE leaders had administrative and scientific authority. Most (69%) MCHE leaders had both scientific and administrative authority, and an additional 16% had scientific authority. Three jurisdictions reported that their MCHE leader had only administrative authority. Of 32 jurisdictions responding, 31% of OHE leaders had both scientific and administrative authority, and an additional 22% had scientific authority. Twelve jurisdictions reported their OHE leader had no scientific or administrative authority.

Impact of Jurisdiction's Population Size on Leadership and Authority: Leadership and authority are important markers for epidemiology capacity. Because of potential differences in availability of funding and demographic characteristics, we examined the association between a jurisdiction's population and CD/MCH/OH leadership and MCH/OH authority. Jurisdictions were classified by population tertile (i.e., low, middle, and high population).

- *Chronic Disease:* Sixty-three percent of low-population jurisdictions had a lead CDE, compared with 94% of middle-population and 88% of high-population jurisdictions (p=0.09).
- *Maternal and Child Health:* Fifty-six percent of low-population jurisdictions had a lead MCHE, compared with 94% of middle- and 88% of high-population jurisdictions (p=0.04). Among low-population jurisdictions, 38% of MCHE leaders had both scientific and administrative authority, compared with 100% of middle- and 71% of high-population jurisdictions (p=0.02).
- *Oral Health:* The percentage of jurisdictions with a lead OHE did not differ by population tertile: 50% for low-, 44% for middle-, and 35% for high-population jurisdictions (p=0.89). The percentage of OH leaders with scientific and administrative authority did not differ by population tertile: 36% for low-, 22% for middle- and 33% for high-population jurisdictions (p=0.99).

Organization: No organizational structure predominated for CDEs, MCHEs, and OHEs, although MCHEs tend to be located in a larger MCH unit (Table 8). Forty-six percent of jurisdictions reported that MCHEs are in a larger MCH unit; 33% reported that CDEs are in a larger CD unit. In about 27% of jurisdictions, CDEs were reported to be embedded in individual programs, compared with 19% for MCHEs and 27% for OHEs. The percentage of jurisdictions that reported having their CDEs, MCHEs, and OHEs located in a separate epidemiology or statistics unit varied from 16% for OH to 31% for CD. Three jurisdictions reported that MCH epidemiology activities are provided by staff residing in another institution or agency, and five jurisdictions reported obtaining OH epidemiology support through an institution or agency outside the health department.

Table 8: Location of most CDEs, MCHEs, and OHEs, 2013 ECA CD, MCH, and OH Supplemental Modules

LOCATION OF MOST EPIDEMIOLOGISTS	CD (n=49)	MCH (n=48)	OH (n=49)
Embedded in individual programs (% yes)	13 (26.5)	9 (18.8)	13 (26.5)
In larger (CD/MCH) unit (% yes)	16 (32.7)	22 (45.8)	17 (34.7)*
In separate epidemiology or statistics unit (% yes)	15 (30.6)	14 (29.2)	8 (16.3)
Institution/agency outside of health department (% yes)	0	3 (6.3)	5 (10.2)
Other	7 (10.2)	0	6 (12.2)

*From CD or MCH epidemiology unit/team.

Abbreviations: CD, chronic disease; CDE, chronic disease epidemiologist; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, maternal and child health epidemiologist; OH, oral health; OHE, oral health epidemiologist.

Decision Making: Most CDEs and MCHEs contributed to key program-level activities, including needs assessment, priority setting, and program planning. Epidemiologists in these program areas, however, were substantially less

likely to contribute to policy development. In comparison with their peers in CD and MCH programs, epidemiologists in OH programs were less likely to contribute to any program-level activity.

Chronic Disease: In most jurisdictions, CDEs directly contributed to key program-level activities. In at least half of the jurisdictions, CDEs contributed "a lot" to needs assessment (57%), grant planning/writing (55%), and program evaluation (51%). CDEs were substantially less involved in policy development, for which only 16% of jurisdictions reported "a lot" and 29% reported "none or a little."

Maternal and Child Health: In most jurisdictions, MCHEs directly contributed to key program-level activities. In at least two thirds of jurisdictions, MCHEs contributed substantially to fully to needs assessment (82%), priority setting (76%), program planning (69%), performance measurement (86%), and program evaluation (71%). For these five activities, ≥10% reported no or minimal contribution. MCHEs were substantially less involved in policy development: only 51% of jurisdictions reported substantial to full contribution, and 22% reported no or minimal contribution.

Oral Health: Few OHEs directly contributed to key program-level activities. In <50% of jurisdictions, OHEs contributed substantially to fully to needs assessment (39%), priority setting (35%), program planning (39%), performance measurement (45%), program evaluation (49%), and policy development (35%). For these six activities, ≤43% reported no or minimal contribution.

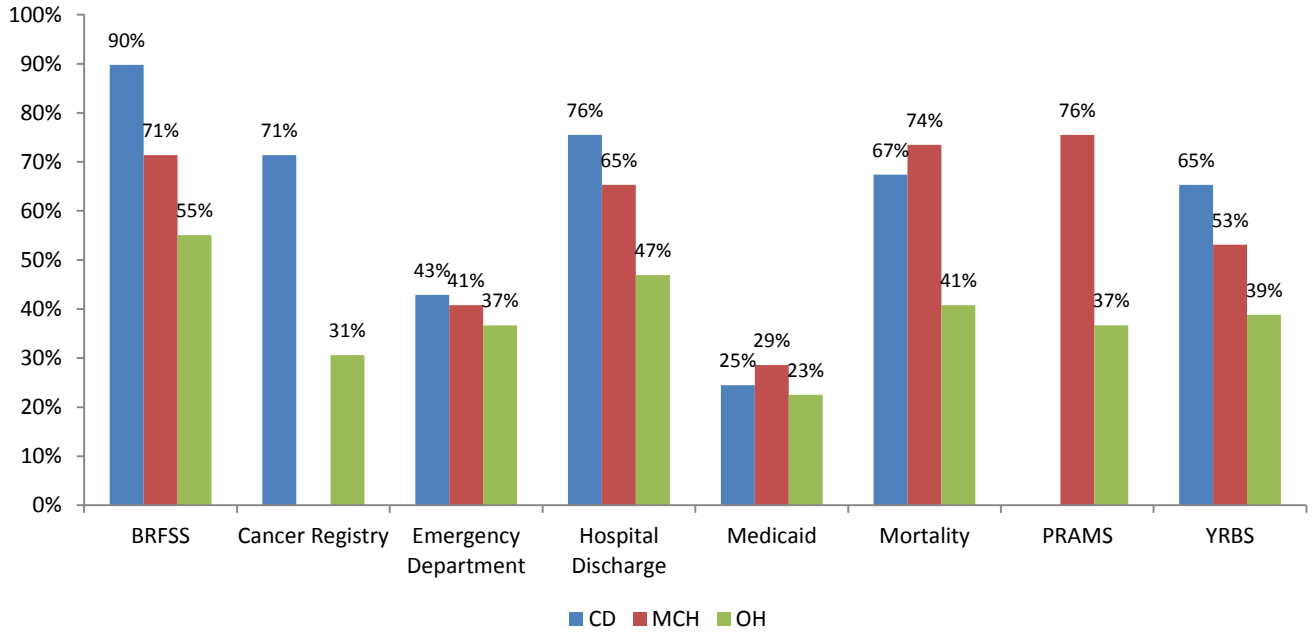
Access to Data, Data Dissemination, and Publications

Access to Data: Epidemiologists, regardless of program area, need access to a wide variety of data. This access should be unfettered (i.e., direct) and should be available in a timely manner. The CD, MCH, and OH Supplemental Modules asked whether one or more epidemiologist in each program area had unfettered access to a variety of data. No single data source was readily available to 100% of epidemiologists in the responding jurisdictions. More than 70% of jurisdictions reported their epidemiologists had unfettered access to the following data (Figure 11):

- For CD: BRFSS (90%), hospital discharge (76%), cancer registry (71%);
- For MCH: PRAMS (76%), linked birth–infant death (76%), death certificate (74%), birth certificate (71%), BRFSS (71%); and
- For OH: None.

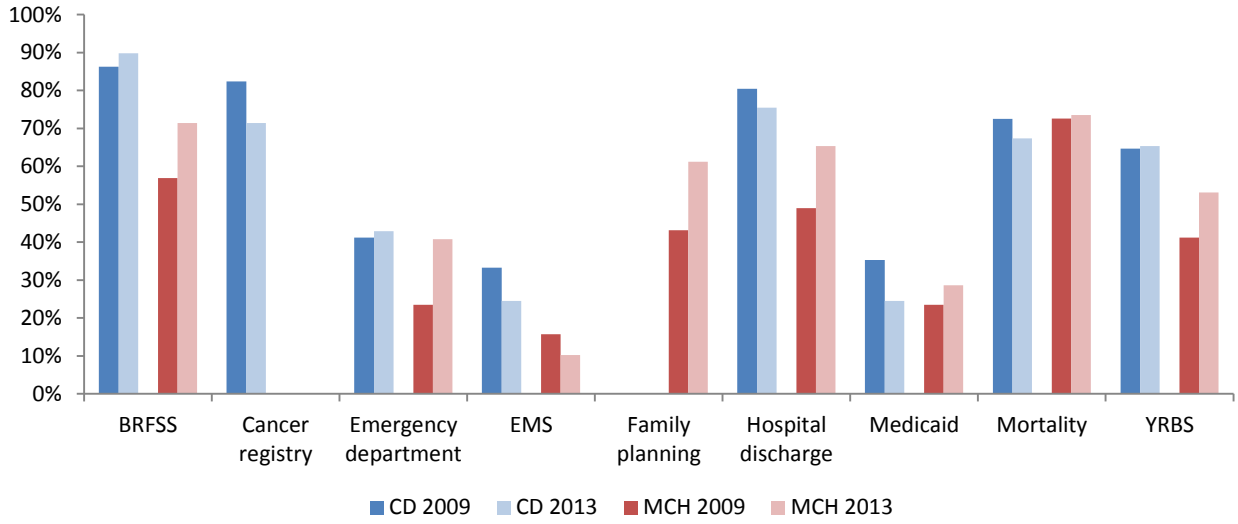
Few jurisdictions (<25%) had access to Medicaid or emergency medical service (EMS) data. CD and MCH programs had better access than OH programs; <60% of jurisdictions reported unfettered access to any data source for OHEs.

Figure 11: Percentage of jurisdictions in which epidemiologists had unfettered access to data, 2013 ECA CD, MCH, and OH Supplemental Modules



Trends in Access to Data: From 2009 to 2013, the percentage of jurisdictions in which CDEs had unfettered access to cancer registry and Medicaid data ***decreased*** approximately 10 percentage points, from 82% to 71% for cancer registry data and from 35% to 25% for Medicaid data (Figure 12). Access to other CD data sources changed minimally. For MCH programs, there was an approximately 10 percentage point ***increase*** in the percentage of jurisdictions in which MCHEs had unfettered access to family planning (43% vs. 61%), hospital discharge (49% vs. 65%), emergency department (26% vs. 41%), YRBS (41% vs. 53%), and BRFSS (57% vs. 71%) data. Access to other MCH data sources changed minimally. Trend data are not available for OH programs.

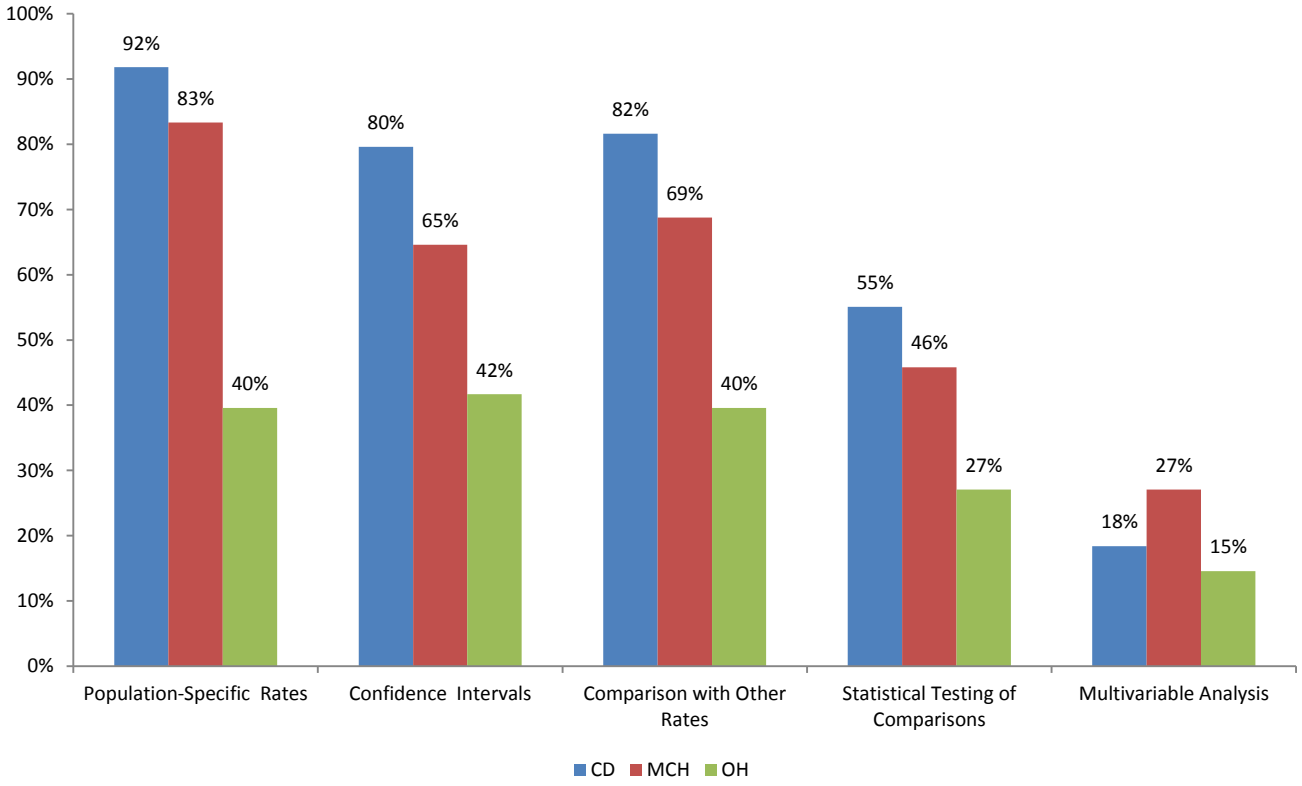
Figure 12: Percentage of jurisdictions in which CD and MCH epidemiologists had unfettered access to data, 2009 and 2013 ECA CD and MCH Supplemental Modules



Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

Sophistication of Analyses: Epidemiologic data lend themselves to multiple levels of analysis. CDEs and MCHEs in most jurisdictions appear capable of meeting the most basic analytic needs: calculation of population-specific rates, and confidence intervals and comparison with other rates. Substantially fewer OHEs than CDEs and MCHEs conduct these analyses. More complex analyses, especially multivariable analyses, are not conducted routinely by epidemiologists in any program area. Figure 13 compares the percentage of CDEs who report conducting the analyses "almost always" with MCHEs and OHEs who conduct the analyses "routinely." For jurisdictions that do not regularly conduct the analyses, no information is available about why the analyses were not conducted. For example, whether the analyses were not required, whether epidemiologists do not have the skills to perform the tasks, or whether the requisite data or analytic software programs are available for such analyses are not known.

Figure 13: Percentage of jurisdictions that almost always/routinely* performed different levels of statistical analysis, 2013 ECA CD, MCH, and OH Supplemental Modules



*For CD, response was "almost always"; for MCH and OH, response was "routinely."
Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; OH, oral health.

Access to Software: To conduct their analyses duties, epidemiologists need ready access to a variety of software packages, such as statistical analysis, geographic information system (GIS), and—in some instances—encryption software. The CD and OH Supplemental Modules asked about access to software. CDEs and OHEs in most jurisdictions had ready access to statistical analysis software (88% and 76%, respectively) and GIS software (78% and 49%, respectively) but less access to encryption software (51% and 37%, respectively). For CDEs, six (12%) jurisdictions reported needing statistical analysis software, and about 20% needed encryption and GIS software (Table 9). For statistical analysis software, SAS was the most commonly available to CDEs (27 of 31 reporting jurisdictions), followed by SPSS, Stata, and SUDAAN (10, seven, and six jurisdictions, respectively). OHEs in six (12%) jurisdictions reported needing SAS and encryption software, and 12 (25%) needed GIS software.

Data Dissemination and Publications: The ability to interpret and disseminate information is an important epidemiology-related service and a key element of any state-based health surveillance system. The 2013 Core ECA examined several types of publications in 2012 by program area. Forty-nine jurisdictions responded. In 2012, CDEs, MCHEs, and OHEs were instrumental in the following publications:

- Chronic Disease
  - 22 (45%) jurisdictions published 61 CD-related articles in peer-reviewed journals;
  - 34 (69%) jurisdictions had a total of 142 abstracts accepted at national conferences; and
  - 34 (69%) jurisdictions published 290 other formal reports (i.e., those approved by a state process and published electronically or on paper and/or posted on a website for public consumption).
  - The numbers of peer-reviewed manuscripts, abstracts, and other reports ***decreased*** since from 2009 to 2014 (from 89 to 61, 165 to 142, and 366 to 290, respectively).
- Maternal and Child Health
  - 16 (33%) jurisdictions published 93 MCH-related articles in peer-reviewed journals;
  - 29 (59%) jurisdictions had a total of 204 abstracts accepted at national conferences; and
  - 29 (59%) jurisdictions published 199 other formal reports (i.e., those approved by a state process and published electronically or on paper and/or posted on a website for public consumption).
  - The numbers of peer-reviewed manuscripts, abstracts, and other reports ***increased*** from 2009 to 2013 (from 43 to 93, 123 to 204, and 122 to 199, respectively).
- Oral Health
  - 4 (8%) jurisdictions published 9 OH-related articles in peer-reviewed journals;
  - 6 (12%) jurisdictions had a total of 10 abstracts accepted at national conferences; and
  - 13 (27%) jurisdictions published 19 other formal reports (i.e., those approved by a state process and published electronically or on paper and/or posted on a website for public consumption);
  - The numbers of peer-reviewed manuscripts, abstracts, and other reports published in 2012 were ***similar*** to those published in 2008 (9 and 7, 10 and 9, and 19 and 27 in 2013 and 2009, respectively).

The CD Supplemental Module asked whether CD staff had prepared grant proposals, publications, presentations, or surveillance system evaluations. Almost all jurisdictions reported that CDEs had prepared the epidemiology section of a grant proposal (98%), prepared reports on a single CD (100%), prepared reports integrating data about more than one CD (100%), or made presentations at state or national meetings (92%). Sixty-one percent of jurisdictions reported that CDEs prepared manuscripts for submission to a peer-reviewed journal, and 49% evaluated a CD surveillance system.

The MCH Supplemental Module asked whether MCH staff had been actively involved in preparing, publishing, or presenting MCH topics or other topics of public health concern. More than three quarters of jurisdictions reported that MCHEs submitted grant or cooperative agreement applications (92%), published state reports (88%), participated in national workgroups (80%), or made presentations at state or national meetings (78%). Slightly fewer than half of jurisdictions reported that MCHEs published articles in a peer-reviewed journal (49%) or presented in a state or national meeting (41%).

Online Query System: All three Supplemental Modules asked whether programs have a publicly accessible online system that displays program-specific epidemiologic data either as a queryable system or as static tables. For their CD programs, 33 (67%) jurisdictions reported having such a system for multiple CD content areas; an additional 4 (8%) reported having a system for one CD content area. A total of 19 (39%) MCH programs reported having such a system; for OH, 7 (14%) jurisdictions had such a system.

Collaboration

CD, MCH, and OH activities span a wide range of health problems, health behaviors, and risk factors that transcend program areas. Thus, CDEs, MCHEs, and OHEs have the potential to collaborate among themselves and with epidemiologists in other program areas within a jurisdiction's health department.

Collaboration among CD, MCH, and OH Programs: For most jurisdictions, epidemiologists in CD, MCH, and OH programs collaborate. For CDEs, 65% and 41% of jurisdictions reported somewhat strong to strong collaborations with MCH with OH programs, respectively. More than half of jurisdictions reported routine to frequent collaboration between MCHEs and CD (53%) and OH (63%) programs. Forty-five percent of OH programs reported routine to frequent collaboration with CD programs, and 59% reported routine to frequent collaboration with MCH programs (Table 9).

Table 9: Collaboration* among CD, MCH, and OH epidemiologists, 2013 ECA CD, MCH, and OH Supplemental Modules

HAS SOMEWHAT STRONG OR FREQUENT COLLABORATION WITH …	REPORTED BY		
	CD (n=49)	MCH (n=49)	OH (n=49)
CD (% yes)	–	53.1	44.9
MCH (% yes)	65.3	–	59.2
OH (% yes)	40.8	63.3	–

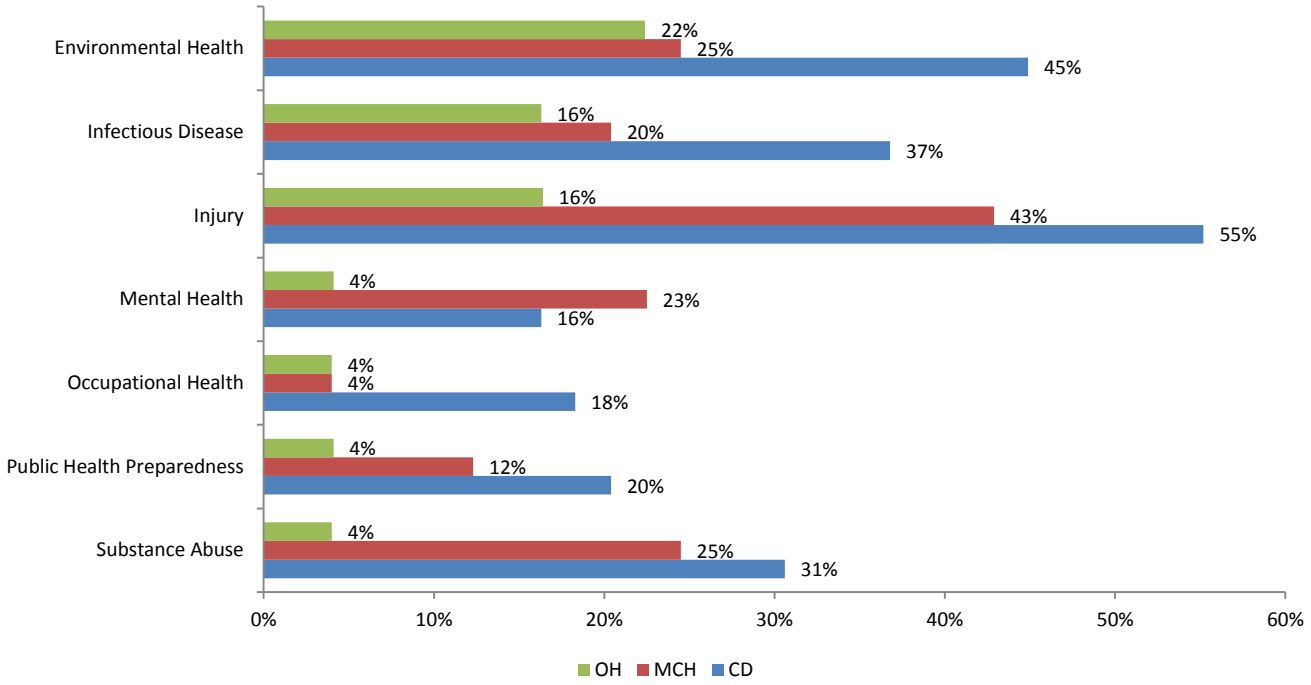
*CD = strong or somewhat strong collaboration; MCH and OH = routine or frequent collaboration.

Collaboration with Other Program Areas: For CD, the program areas in which respondents in most jurisdictions indicated somewhat strong or strong collaboration were: MCH (65% of jurisdictions), injury (55%), environmental health (45%), and OH (41%). Program areas with the lowest level of collaboration were mental health (16%), occupational health (18%), public health preparedness (20%), substance abuse (31%), and infectious disease (37%) (Figure 14). In addition, CDEs reported needing to collaborate with other CDEs working on different categorical CD program areas. Seventeen jurisdictions (35%) reported a strong collaboration among CDEs, 45% reported somewhat strong collaborations, and 8% reported very little collaboration. Six (12%) jurisdictions reported that CDEs were located in an epidemiology unit and work across CD program areas.

Within program areas that are traditionally MCH related, frequent to routine MCHE collaboration was highest for Title V (96% of jurisdictions) and lowest for Women, Infants, and Children programs (WIC) (61%). For program areas outside the traditional MCH realm, frequent to routine MCHE collaboration was highest for OH (63%), CD (53%), and injury (43%). Although substance abuse, mental health, and occupational health programs are potentially important to women of reproductive age and among children and youth, frequent to routine MCHE collaboration in these programs was reported in only 25%, 23%, and 4% of jurisdictions, respectively (Figure 14).

For OH, most (59%) jurisdictions reported collaborating with MCH programs, possibly because many state OH programs are located or have traditionally been located within MCH programs or focus on the OH of children. Forty-nine percent of OHEs reported collaborating with the jurisdiction's OH coalition, 45% with CD programs, 31% with children with special health-care needs programs, and 26% with birth defects programs. Twenty-two percent reported collaborating with environmental health, an important partner in efforts to fluoridate community water systems (Figure 14). Reported collaboration with other programs was minimal ($\leq$16%).

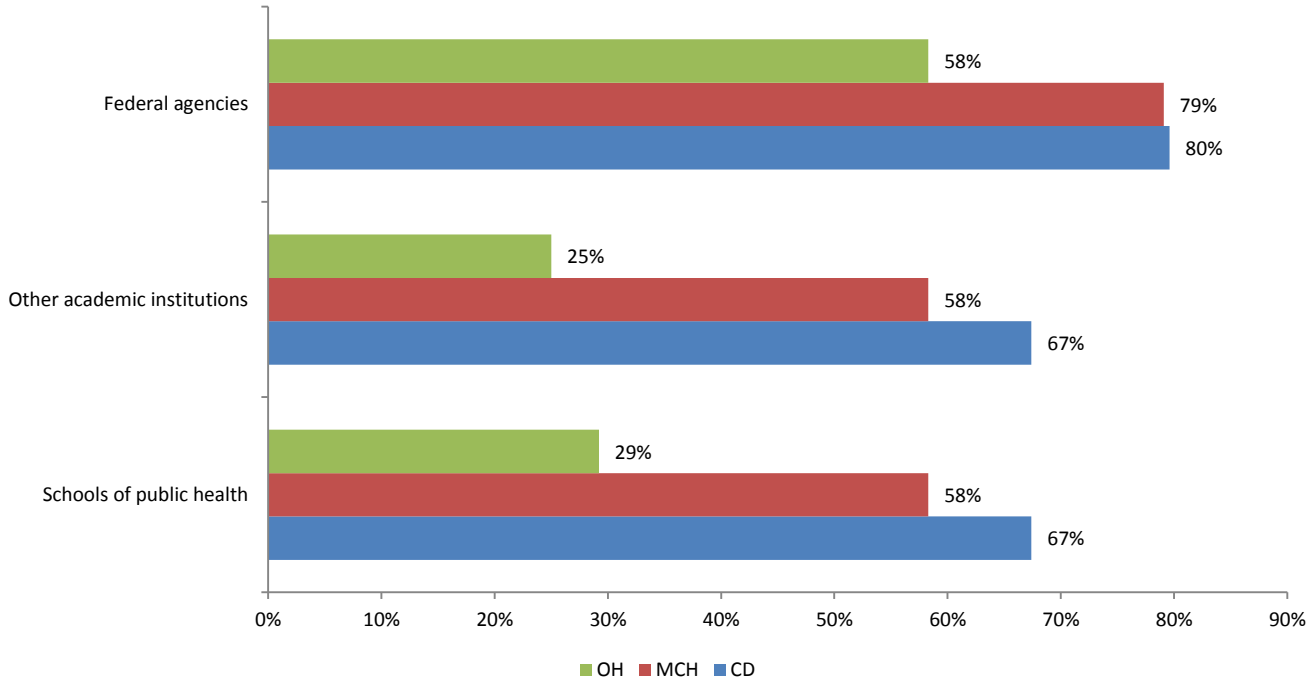
Figure 14: Percentage of jurisdictions with somewhat strong to strong CDE collaboration and routine to frequent MCHE and OHE collaboration with other state programs,* 2013 ECA CD, MCH, and OH Supplemental Modules



*CD = strong or somewhat strong collaboration; MCH and OH = routine or frequent collaboration

Collaboration with Outside Agencies and Organizations: CDEs, MCHEs, and OHEs need to collaborate with staff in agencies outside the state health agency that have an interest in the program area and/or might deliver program-related services, such as researchers, local health agencies, health-care providers, federal funding agencies, and nongovernment organizations (NGOs). Most commonly, CDEs collaborated with federal agencies (80%), statewide health coalitions (76%), private volunteer organizations (74%), or nonprofit organizations (71%) and less often with managed-care organizations (33%). Most jurisdictions had MCHEs who collaborate with staff in each of the four types of agencies asked about: federal agencies (84%), schools of public health (61%), NGOs (59%), and other academic institutions (55%). Within the OH program, most jurisdictions had OHEs who routinely or frequently collaborate with staff in two of the four types of agencies asked about federal agencies (61%) and NGOs (58%). Half of the OHEs never collaborated with schools of public health or other academic institutions (Figure 15).

Figure 15: Percentage of jurisdictions with close CDE collaboration and routine to frequent MCHE and OHE collaboration with external organizations,* 2013 ECA CD, MCH, and OH Supplemental Modules



*CD = collaborated closely on a project; MCH and OH = routine or frequent collaboration

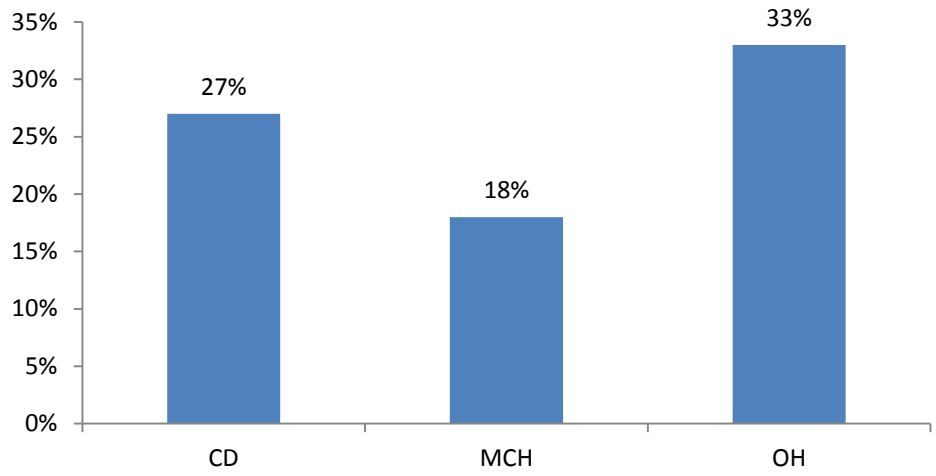
Access to Published Literature and Support Services

Published Literature: To be effective, epidemiologists need ready access to the full-text medical, epidemiologic, public health, and specialty professional literature. In 23 (47%) jurisdictions, CDEs were reported to have access adequate to meet CDEs' needs; in 13 (27%) jurisdictions, CDEs had access but it was too limited. In 10 (20%) jurisdictions, MCHEs had full access; in six (12%), almost full access (access to most journals needed); and in 24 (49%), partial access (access to only a portion of needed journals). In 11 (22%) jurisdictions, OHEs had full access; in eight (16%), substantial access (>25 journals but not full access); and in 14 (29%), partial access (<25 journals). A number of jurisdictions reported their epidemiologists had no access to published literature; 13 for CDEs, 9 for MCHEs, and 16 for OHEs (Figure 16).

The MCH Supplemental Module asked how MCHEs obtained the professional journals necessary to their position. Requesting journals through an academic collaboration was the most common (11 [33%]) method for obtaining needed scientific information, followed by personal or health department subscriptions (4 [12%]) and interlibrary loan requests (3 [9%]).

Support Services: The CD Supplemental Module inquired about whether CDEs in each jurisdiction had adequate support in several areas. About 59% of jurisdictions had adequate information technology (IT) support services for all CDEs, but only 39% had adequate clerical support for all CDEs.

Figure 16: Percentage of jurisdictions with no access to current medical, epidemiologic, public health, or specialty professional journals, 2013 ECA CD, MCH, and OH Supplemental Modules



Spectrum of Work

Chronic Disease: The CD Supplemental Module asked about the extent to which CDEs conducted work in specific CD program areas during the past 12 months (referred to as spectrum of work). Whereas most jurisdictions had CDEs who performed "some" or "a lot" of epidemiologic disease-related work in cancer (98%), diabetes (87%), heart disease (89%), stroke (75%), and asthma (72%), substantially fewer jurisdictions had CDEs who performed work in OH (51%), mental health (26%), or arthritis (26%) programs.

CDEs in >80% of jurisdictions performed work in risk factor areas related to tobacco use (85%), cancer screening (85%), and obesity (83%). Although only a minority of CDEs had performed work related to breastfeeding (38%), drug abuse (26%), and alcohol abuse (23%), epidemiologists in other program areas, such as injury, substance abuse, and MCH, might have been doing work related to these issues.

Maternal and Child Health: Each jurisdiction was asked how frequently its MCHEs worked in nine selected health areas during the past 12 months. In most (≥69%), MCHEs frequently to routinely worked in all but one area: men's health (10%). Men's health did not appear to be a priority or a component for most MCH programs. In 57% of jurisdictions, MCHEs rarely to never spent any time in this area. In at least 80% of jurisdictions, MCHEs frequently to routinely spent their time in maternal/infant health (94%), child health (88%), women's health (84%), and racial/ethnic disparities (82%). Of interest given increasing emphasis on disparities and socioeconomic determinants of health, in 69% of jurisdictions, MCHEs frequently to routinely worked on social determinants of health.

Oral Health: Each jurisdiction was asked how frequently its OHEs worked in nine selected health areas during the past 12 months. In most (≥55%) jurisdictions, OHEs frequently to routinely worked in child health (61%) and maternal/infant health (55%). Forty-nine percent of OHEs frequently to routinely worked on social determinants, and 43% worked on racial/ethnic disparities. In 82% of jurisdictions, OHEs rarely to never spent any time in area of men's health.

Discussion

One conclusion from the 2009 CD and MCH ECAs was that the epidemiology capacity glass was half full. The good news: from 2009 to 2013, the glass continued to fill, and several leaks were plugged. The bad news: disparities were evident in epidemiology capacity. Although MCH capacity continued to grow, CD capacity was somewhat stagnant, and OH capacity was almost nonexistent. Why did MCH capacity grow? What can CD and OH learn from this joint capacity assessment?

Improved MCH capacity did not occur overnight. Decades of programs have culminated in a skilled workforce with the capacity to meet most of the epidemiology-related EPHS. A detailed history of efforts to improve MCH capacity has been published elsewhere.[16] One difference between MCH and CD/OH relates to sources of funding and technical support. MCH historically has received, and currently still receives, support from CDC and the Health Resources and Services Administration Maternal and Child Health Bureau (HRSA/MCHB). CD and OH programs, on the other hand, rely heavily on funding from one source: CDC. By relying on one predominant funding stream, CD and OH might not have the ability to sustain themselves during economic downturns.

What else can we learn from this joint capacity assessment? One answer relates to unfettered access to data. Although 90% of CDEs reported having unfettered access to BRFSS data only 71% of MCHEs and 55% of OHEs had similar access. If a jurisdiction has strong collaboration among program areas, does access to data improve for all program areas? Although the 2013 ECA was not designed to answer that question, its results might spur development of a best practices approach that assesses strong internal collaboration and ways more health agencies can achieve it.

Similarities among CD, MCH, and OH programs far outweigh differences. Epidemiologists in these three program areas use similar datasets, statistical methods, and data dissemination tools. Their targeted populations overlap. The disparities observed in CD programs mirror those in MCH and OH. Programs. So why, especially in regard to training, are many of these epidemiologists placed into separate boxes? One organization might offer training for CDEs, whereas another offers training for MCHEs. By pooling resources, organizations and agencies could provide more in-depth joint training opportunities to a wider array of epidemiologists. (See the program-specific discussions for additional information.)

Overall Recommendations

1. Develop a strategy to achieve optimal epidemiology funding and capacity within each of the three program areas. The strategy should prioritize capacity-building efforts, and jurisdictions and programs that have minimal to no capacity should be targeted.

2. Ensure that CD, MCH, and OH epidemiology capacity are included in all national dialogues regarding overall state-based epidemiology capacity.

3. Within each program area, promote the factors associated with higher-level capacity.
    d. For CD: a dedicated lead epidemiologist, at least one epidemiologist responsible for coordinating CD epidemiology activities across programs, and at least five CDEs.
    e. For MCH: a dedicated lead epidemiologist, an MCH epidemiology leader with both scientific and administrative authority, and at least five MCHEs.
    f. For OH: a dedicated lead epidemiologist, at least one full-time OHE ($\geq$0.7 FTE), and adequate funding through CDC Division of Oral Health State Oral Disease Prevention Program funding or another source.

4. Continue to offer and enhance training opportunities, while increasing opportunities for coordinated training of the CD, MCH, and OH epidemiology workforce.

   b. Identified training needs should be shared with CD, MCH, and OH program national associations so that epidemiology-specific training and mentoring can be included in annual meetings, webinars, developed resources and mentorship programs; when possible and applicable, training opportunities should be promoted across CD, MCH, and OH program areas.

5. Organizations involved in training the public health workforce, including CDC, CSTE and schools of public health, should ensure that programs include training in competencies identified by practicing epidemiologists as needing additional focus.

6. Build partnerships within and among state agencies and with local academic institutions to efficiently and effectively use resources, conduct surveillance, and plan and implement evidence-based strategies for CD, MCH, and OH prevention and health promotion.

7. Ensure that all states have access to the technology needed to address the EPHS, including appropriate statistical software, GIS software, and encryption software and access to a wide variety of medical, dental, nursing, other health-care, and public health journals.

8. Continue to regularly evaluate CD, MCH, and OH program epidemiology capacity, identify needs, and disseminate results widely.

CHRONIC DISEASE: ASSESSING AND BUILDING CAPACITY

Chronic disease (CD) epidemiology has been an emerging subject matter area in public health since the 1980s, with creation of a chronic disease center at the Centers for Disease Control and Prevention (CDC) in 1988. Shortly thereafter, CDC began funding for state-based prevention activities. Cooperative agreements now support surveillance and prevention activities related to heart disease and stroke, cancer, diabetes, asthma, arthritis, obesity, tobacco use, physical activity, nutrition, and others.

The number of CD epidemiologists (CDEs) practicing in states has increased with the number of CD programs and funded prevention activities during the past 25 years. In addition, since 1991, CDC has assisted many states through the State Chronic Disease Epidemiology Assignee Program by providing staff or salary support. The CDC Epidemic Intelligence Service and, more recently, the CDC/Council of State and Territorial Epidemiologists (CSTE) Applied Epidemiology Fellowship have provided states an opportunity to recruit epidemiologists into 2-year CD epidemiology positions. For several years, the National Association of Chronic Disease Directors' Applied Chronic Disease Mentoring Program has provided an opportunity for in-depth technical assistance to increase state and local epidemiology capacity.

In 2000, CDC, CSTE, and the National Association of Chronic Disease Directors developed a strategic plan, "Developing Nationwide State-based Chronic Disease Epidemiology Capacity," with the primary objective of establishing in each state by 2004 a designated lead CDE who would be the point of contact with CDC for CD. In 2003, CSTE conducted a state-level national assessment of epidemiologic capacity for CD. The major finding was that, despite efforts to develop capacity in all states, CD epidemiology capacity was unevenly distributed and, on the basis of a 10-point scale, 26% of the 47 responding jurisdictions reported minimal to no capacity (i.e., a rating of 0–3). Specific findings included the following: 43% of jurisdictions had no state CDE or lead CDE; 38% had no state funding for CD epidemiology; 57% had fewer than five CDEs; and 55% did not have timely access to state mortality data. A number of specific recommendations were made toward improving specific aspects of CD programs and urging further research to determine what factors foster a productive CD epidemiology unit. Key capacity-related recommendations included the following: every state should have a designated CD point of contact with CDC; a minimum of five full-time CDEs; at least one doctoral-level CDE; easy and timely access by CDEs to state mortality data; and an organizational structure to support coverage of the breadth of CDs and their related behaviors and risk factors; and every state should provide easy access to a medical library and adequate clerical support. In addition, measures of CD epidemiology capacity were created as a future barometer for measuring capacity against that of 2003. The final recommendation was that CSTE should continue to improve the description and measurement of the CD epidemiologic capacity of state health departments.

In 2004, the CSTE Chronic Disease Chronic Disease Epidemiology Capacity Building Workgroup published a white paper on the essential functions of CD epidemiology in state health departments. This report described the role that CDEs play in supporting the 10 Essential Public Health Services and identified the primary role they play in surveillance, communication, and consultation.[17] In 2007, CSTE passed a position statement on state CD epidemiology capacity.[18] This position statement defined the minimum recommended CD epidemiology workforce as

- at least one senior CDE with doctoral-level training and 5 years' experience in CD or master's-level training and at least 10 years' experience in CD epidemiology;
- at least one CDE who is responsible for coordinating/integrating activities across categorical programs; and
- five or more full-time CDEs, at least one of whom has a doctoral degree.

Key steps recommended to monitor state CD epidemiology capacity included 1) developing a list of capacity indicators that correspond to the capacity domains described in the 2003 CD Epidemiology Capacity Assessment (ECA) and 2) developing and conducting an online rapid-assessment tool to measure these key indicators every 2

years. In 2009, in follow-up to the position statement, CSTE conducted a second assessment of CD capacity as a supplement to the Core ECA. The results of the 2009 ECA confirmed CSTE's positions: having a lead CDE and at least 5 CDEs were both strongly associated with having at least substantial CD epidemiology and surveillance capacity; having a doctoral-level epidemiologist was strongly associated with collaborating with epidemiologists in other program areas, including injury, maternal and child health (MCH), environmental health, mental health, substance abuse, and occupational health.

The general results of the 2013 Core ECA and 2013 CD Supplemental Module are presented in the "Overall Epidemiology Capacity Assessment for Chronic Disease, Maternal and Child Health and Oral Health" section of this report. The purpose of this section, "Chronic Disease—Assessing and Building Capacity," is to present more detailed information about the findings that relate specifically to CD epidemiology, the role of state CDEs, and the minimum recommended CD workforce.

> The purpose of this section is to present more detailed information about the findings that relate specifically to CD epidemiology, the role of state CD epidemiologists, and the minimum recommended CD workforce.

Minimum Recommended Chronic Disease Workforce

As previously mentioned, the minimum recommended CD epidemiology workforce should have

- at least one senior CDE with doctoral-level training and 5 years' experience in CD epidemiology or master's-level training and at least 10 years' experience in CD epidemiology;
- at least one CDE who is responsible for coordinating/integrating activities across categorical programs; and
- five or more full-time CDEs, at least one of whom has a doctoral degree.

For consistency with the analysis of the 2009 ECA, three questions from the different assessments included in the 2013 ECA were used to estimate the percentage of jurisdictions that met the criteria for a minimum workforce; doctoral degree in any field, at least one CDE responsible for coordinating/integrating CD epidemiology activities across categorical programs; and at least five full-time CDEs. Of the 46 jurisdictions for which information from both the CD Supplemental Module and Individual Worksheets was available, 21 (46%) had all three factors (Table 10).

Table 10: Number (%) of jurisdictions that had at least one CDE with a doctoral degree, 1 CDE responsible for coordinating activities across programs, and at least 5 full-time CDEs, 2013 Core ECA, Individual Worksheets, and CD Supplemental Module

FACTOR	YES	NO
	NO. (%)	NO. (%)
One or more CDE with doctoral-level training (Individual Worksheet)*	37 (78.7)	10 (21.3)
CDE responsible for coordinating activities (Supplemental Module)	40 (93.9)	9 (18.4)
Five or more full-time CDEs (Core)	32 (62.7)	19 (37.3)
ALL 3 FACTORS (MINIMUM CD WORKFORCE)	**21 (45.7)**	**25 (54.3)**

*Doctoral degree (MD, DO, DVM, DDS, PhD, DrPH) as highest degree obtained, as noted on the Individual Worksheet
Abbreviations: CD, chronic disease; CDE, chronic disease epidemiologist; ECA, Epidemiology Capacity Assessment.

Factors Associated with Substantial Capacity

In 2013, having the minimum recommended CD workforce and having at least one CDE responsible for coordinating CDE activities across programs were significantly associated with substantial epidemiology and surveillance capacity. Ninety percent of jurisdictions with the minimum workforce had at least substantial capacity, compared with 54% of jurisdictions without the minimum workforce (odds ratio [OR] 7.8). Of jurisdictions with a coordinating epidemiologist, 77% had at least substantial capacity, compared with 33% of jurisdictions without a coordinating epidemiologist (OR 6.7). Having at least substantial epidemiology capacity was not significantly associated with having a lead CDE, a CDE with a doctoral degree, or at least five CDEs. Substantial epidemiology capacity also was not significantly associated with organizational structure (Table 11). In multivariable modeling, the one factor most associated with substantial capacity was having a coordinating CDE.

Table 11: Association of jurisdictions that reported having at least 50% of needed CD epidemiology and surveillance capacity with selected CD program features, 2013 Core ECA, Individual Worksheets, and CD Supplemental Module

PROGRAM CHARACTERISTIC	NO. JURISDICTIONS		ODDS RATIO	P VALUE
	>50% Capacity	0%–49% CAPACITY		
Have CDE with doctoral-level training (Individual Worksheet, n=45)				
Yes	26	10	2.1	0.34
No	5	4	Reference	
Have lead CDE (Core, n=48)				
Yes	29	10	3.6	0.09
No	4	5	Reference	
Have at least 1 CDE who is responsible for coordinating CDE activities across programs (n=48)				
Yes	30	9	6.7	0.02
No	3	6	Reference	
Have at least 5 CDEs (Core, n=48)				
Yes	22	7	2.3	0.19
No	11	8	Reference	
Have minimum recommended CD workforce (CDE with doctoral degree, coordinating CDE, and ≥5 CDEs)				
Yes	18	2	7.8	0.01
No	15	13	Reference	
Have CDEs located … (n=48)				
Within separate categorical CD program units				
Yes	7	6	0.4	0.18
No	26	9	Reference	
In either a CD epidemiology unit or a larger epidemiology unit				
Yes	22	8	1.8	0.38
No	11	7	Reference	

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment.

Outcomes Associated with Substantial Capacity

Associations were examined between a state jurisdiction having at least substantial epidemiology and surveillance CD capacity and a number of other measured program outcomes in the past year, such as publishing in journals, publishing technical reports, giving presentations at state or national meetings, having an online queryable data system, and being involved in CD program areas beyond those for which federal funding is available to most states (Table 12). Associations were significant ($p<0.05$) for publishing in peer-reviewed journals, having CDEs collaborate with epidemiologists in three other major program areas with overlapping interests (injury, MCH, and environmental health), and having CDEs collaborate with areas outside the traditional CD realm (mental health, substance abuse, or occupational health). Associations with other areas examined—especially five major CD categories for which federal funding is available to most jurisdictions (asthma, cancer, diabetes, heart disease, and stroke)—were nonexistent.

Table 12: Association of jurisdictions that reported having at least 50% of needed CD epidemiology and surveillance capacity with selected CD program outcomes, 2013 Core ECA and CD Supplemental Module				
PROGRAM CHARACTERISTIC	NO. JURISDICTIONS		ODDS RATIO	P VALUE
	>50% CAPACITY	0%–49% CAPACITY		
Published in peer-reviewed journal in 2012 (Core, n=48)				
Yes	19	3	7.4	0.01
No	12	14	Reference	
Prepared abstract accepted at national meeting (Core, n=48)				
Yes	22	12	1.0	0.77
No	9	5	Reference	
Prepared "other" formal report approved by state process (Core, n=48)				
Yes	23	11	1.6	0.33
No	8	6	Reference	
Prepared an evaluation of a CD surveillance system (n=46)				
Yes	17	7	1.4	0.60
No	14	8	Reference	
Shared data with public via a queryable online data system displaying CD data (n=48)				
Yes	25	12	0.8	0.75
No	8	3	Reference	
Worked in past year on asthma, cancer, diabetes, heart disease, and stroke (n=48)				
Yes	27	11	1.6	0.50
No	6	4	Reference	
Worked in past year on cancer screening, high cholesterol, hypertension, nutrition, obesity, physical activity, and tobacco use (n=48)				
Yes	25	11	1.1	0.86
No	8	4	Reference	
Had at least somewhat strong collaboration with injury, MCH, and environment health epidemiologists in past year (n=48)				
Yes	15	2	5.4	0.04
No	18	13	Reference	
Had at least somewhat strong collaboration with mental health, substance abuse, or occupational health in past year (n=48)				
Yes	18	3	4.8	0.03
No	15	12	Reference	

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

Outcomes and Individual Workforce Factors Associated with Capacity

As previously outlined, five workforce factors could increase capacity. The association between these five indicators and program outcomes were examined. Each indicator was associated with some of the program outcomes, and each provided a somewhat different index of the spectrum of capacities.

Doctoral-level CDE: Having at least one CDE with a doctoral degree was significantly associated with publishing technical reports (OR 14.0) and working with asthma, cancer, diabetes, heart disease, and stroke (OR 5.1) (Table 13).

Lead Epidemiologist: Having a lead epidemiologist had a statistically significant association with having a queryable online data system (OR 5.9) but was not significantly associated with any of the other factors (Table 13).

Coordinating Epidemiologist: Jurisdictions with a coordinating epidemiologist were significantly more likely to collaborate with cancer screening, high cholesterol, hypertension, nutrition, obesity, physical activity, and tobacco use programs (OR 5.9) (Table 13).

Five or More CDEs: Having at least five CDEs had statistically strong (OR >3.0) and significant associations with evaluating a CD surveillance system, at least somewhat strong collaboration with injury, MCH and environmental health; plus somewhat strong collaboration with mental health, substance abuse, or occupational health (Table 13).

Minimum Workforce: Jurisdictions with the recommended minimum workforce were significantly more likely to have CDEs who prepare an evaluation of a CD surveillance system (OR 4.1) and have somewhat strong collaboration with injury, MCH, and environmental health (OR 7.3). CDEs in these jurisdictions were also more likely to have somewhat strong collaborations with mental health, substance abuse, or occupational health in the past year (OR 3.5) (Table 13).

Table 13: Association of CD workforce factors with program outcomes, 2013 ECA and CD Supplemental Module

FACTOR	HAS DOCTORAL DEGREE CDE	HAS LEAD CDE	HAS COORDINATING CDE	HAS ≥5 CDEs	HAS MINIMUM WORKFORCE
	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)
Published in peer-reviewed journal	1.2 (NS)	1.8 (NS)	3.5 (NS)	1.7 (NS)	2.2 (NS)
Had abstract accepted at national meeting	3.6 (NS)	0.6 (NS)	2.0 (NS)	1.5 (NS)	1.5 (NS)
Prepared "other" formal report	14.0 (0.004)	0.6 (NS)	1.1 (NS)	1.0 (NS)	2.3 (NS)
Prepared evaluation of surveillance system	2.5 (NS)	2.5 (NS)	3.9 (NS)	3.9 (0.03)	4.1 (0.03)
Shared data via queryable online system	2.1 (NS)	5.9 (0.02)	3.2 (NS)	2.9 (NS)	2.3 (NS)
Worked in past year on asthma, cancer, diabetes, heart disease, **and** stroke	5.1 (0.05)	1.1 (NS)	2.4 (NS)	3.0 (NS)	4.2 (NS)
Worked in past year on cancer screening, high cholesterol, hypertension, nutrition, obesity, physical activity, **and** tobacco use	1.0 (NS)	1.7 (NS)	5.9 (0.02)	1.9 (NS)	1.6 (NS)
Somewhat strong collaboration with injury, MCH, **and** environment health	5.5 (NS)	5.3 (NS)	2.1 (NS)	4.7 (0.03)	7.3 (0.004)
Somewhat strong collaboration with mental health, substance abuse, **or** occupational health	1.1 (0.94)	3.5 (NS)	3.5 (NS)	3.7 (0.04)	3.5 (0.05)

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; NS, not significant (p>0.05); OR, odds ratio.

Chronic Disease Workforce Competency

Tier-Level Epidemiologist Perspective: The 2013 ECA Individual Worksheets asked individual epidemiologists to assess their competency and training needs by using the framework of the CDC/CSTE Applied Epidemiology Competencies. Individual epidemiologists were asked to indicate the tier to which they belonged and then to assess themselves according to their tier's specific set of competencies. The four tiers are:

- Tier 1: entry-level or basic epidemiologist;
- Tier 2: mid-level epidemiologist;
- Tier 3a: senior-level epidemiologist supervisor and/or manager; and
- Tier 3b: senior scientist or subject area expert.

Tier 1 and Tier 3b epidemiologists were assessed in 30 competency areas, Tier 2 in 31 areas, and Tier 3a in 32 areas. A total of 313 CDEs completed the self-assessment; 71 (23%) Tier 1, 114 (36%) Tier 2, 80 (27%) Tier 3a, and 48 (15%) Tier 3b epidemiologists. Response options for each competency were minimal or none, basic, intermediate, advanced, and expert. In terms of training needs, CDEs were asked to rank their need for additional training on a scale of 1 (less training needed) through 5 (more training needed).

Tier 1 Competencies: Tier 1 CDEs indicated seven competencies for which at least 70% had an intermediate, advanced, or expert level of competency: demonstrating ability to listen effectively when epidemiologic finding are presented (86%), preparing written and oral presentations (75%), practicing professional development (75%), using analysis plans and analyzing data (74%), identifying key findings from a study (73%), using effective communication technologies (73%), maintaining databases (71%), promoting ethical conduct in epidemiologic practice (71%), recognizing the existence of a public health problem (71%), and identifying surveillance data needs (71%).

For 11 competencies, ≥10% of CDEs had minimal or no level of competency: applying appropriate fiscal and administrative guidelines (28%), identifying the role of laboratory resources (22%), using informatics tools in support of epidemiologic practice (17%), describing how policy decisions are made (15%), describing human subjects research and applying Institutional Review Board processes (14%), preparing written and oral presentations (13%), using knowledge of biology and behavioral sciences to determine mechanisms of disease (12%), defining cultural/social/political framework for recommended interventions (11%), maintaining databases (10%), following ethics guidelines and principles (10%), and assisting in evaluation of programs (10%).

Tier 2 Competencies: At least 70% of Tier 2 CDEs said they had an intermediate, advanced, or expert level of competency in 23 (74%) of the 31 competencies. The six competencies for which at least 50% had an advanced or expert level of competency are following ethics guidelines and principles (57%), creating analysis plans and conducting analysis of data (55%), communicating epidemiologic information through oral presentations or written documents (53%), articulating the need for further investigation from literature review (53%), collaborating with others inside and outside the agency (51%), and defining database requirements and managing a database (51%).

The Tier 2 competencies for which ≥10% had minimal or no level of competency are using laboratory resources to support epidemiologic activities (21%), applying appropriate fiscal and administrative guidelines to epidemiology practice (15%), and using leadership and systems thinking in epidemiologic planning and policy development (11%).

Tier 3a Competencies: The 80 senior-level CDEs with program management and/or supervisory responsibilities indicated 22 (63%) of 32 competencies for which at least 70% indicated they had an intermediate, advanced, or expert level of competency. The 11 competencies for which at least 50% had an advanced or expert level of competency are ensuring management of data from surveillance (70%); evaluating conclusions and interpretations from investigations (66%); ensuring preparation of written and oral reports and presentations (65%); ensuring identification of public health problems (63%); overseeing surveillance activities (63%); using basic public health sciences in epidemiologic practice (61%); ensuring study design and data collection, dissemination, and use of ethical and legal principles (59%); modeling interpersonal skills in communication (58%); promoting ethical conduct in epidemiology practice (56%); evaluating analysis of data from an epidemiologic investigation or study (55%); and using management skills (53%).

The Tier 3a competencies for which ≥10% had minimal or no level of competency are leading epidemiology unit in preparing for emergency response(34%); ensuring the use of laboratory resources (30%); formulating a fiscally sound budget (18%); leading community public health planning processes (18%); overseeing implementation of operational and financial plans (16%); creating operational and financial plans for future epidemiologic activities (16%), promoting the epidemiologic perspective in the agency strategic planning process (15%); developing requests for extramural funding to support additional epidemiologic activities and special projects (15%); enforcing policies that address security, privacy, and legal considerations when communicating epidemiologic information (13%); promoting ethical conduct in epidemiology practice (11%); practicing culturally sensitive epidemiologic activities (11%); evaluating conclusions and interpretations from investigations (10%); bringing

epidemiologic perspective in the development and analysis of public health policies (10%); and determining evidence-based interventions and control measures in response to epidemiologic findings (10%).

Tier 3b Competencies: The 48 senior scientist epidemiologists indicated 28 (93%) of 30 competencies for which at least 70% considered themselves to have an intermediate, advanced, or expert level of competency. At least 50% indicated an advanced or expert level of competency in 24 (80%) of the competencies.

The Tier 3b competencies for which ≥10% had minimal or no level of competency are implementing operational and financial plans for assigned projects (13%), developing processes for using laboratory resources to support epidemiologic activities (13%), evaluating results of data analysis and interpreting conclusions (10%), organizing preparation of written and oral presentations that communicate necessary information (10%), validating identification of public health problems pertinent to the population (10%), bringing epidemiologic perspective in the development and analysis of public health policies (10%), and promoting the organization's vision in all epidemiologic program activities (10%).

Training Needs: As expected, training needs varied by tier level; the percentage of CDEs indicating the need for more training decreased as tier level increased. At least 30% of Tier 1 and Tier 2 CDEs indicated they needed more training in nine competencies. For Tier 3a CDEs, at least 30% indicated needing more training for 7 competencies, and <30% of Tier 3b CDEs indicated needing more training for all competencies. Table 14 compares the competencies for with a lower need for training and the competencies with the largest need for more training by tier.

Table 14: Competencies identified by CDEs requiring less training and more training, 2013 ECA Individual Worksheets

COMPETENCIES WITH LESS TRAINING NEEDED (PERCENT INDICATING LEVEL 1 OR 2 ON A SCALE OF 1–5)	COMPETENCIES WITH MORE TRAINING NEEDED (PERCENT INDICATING LEVEL 4 OR 5 ON A SCALE OF 1–5)
Tier 1	
Demonstrate ability to listen effectively when epidemiologic finding are presented (59%)	Use identified informatics tools in support of epidemiologic practice (46%)
Apply knowledge of privacy laws to protect confidentiality (58%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (44%)
Maintain databases (57%)	Describe how policy decisions are made within the agency (43%)
Prepare written and oral reports and presentations that communicate necessary information (57%)	Assist in conducting a community health status assessment (42%)
Identify key findings from the study (57%)	Use knowledge of biology and behavioral sciences to determine potential biological mechanisms of disease (39%)
Promote ethical conduct in epidemiologic practice (55%)	Identify the role of laboratory resources in epidemiologic activities (35%)
Support the organization's vision in all programs and activities (54%)	Describe human subjects research and apply Institutional Review Board (IRB) processes (34%)
Follow ethics guidelines and principles when planning studies; conducting research; etc. (50%)	Provide epidemiologic input for community planning processes (30%)
	Define cultural/social/political framework for recommended interventions (30%)
Tier 2	
Follow ethics guidelines and principles when planning studies; conducting research; etc. (66%)	Use leadership and systems thinking in epidemiologic planning and policy development (43%)
Collaborate with others inside and outside the agency to identify the problem and form recommendations (61%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (38%)
Use critical thinking to determine whether a public health problem exists (60%)	Assist in the development of program logic models and theories of action (36%)
Promote ethical conduct in epidemiologic practice (58%)	Establish cultural/social/political framework for recommendations or interventions (35%)
Communicate epidemiologic information through oral presentations or written documents to nonprofessional audiences (57%)	Demonstrate the basic principles of risk communication (35%)
Articulate the need for further investigation from literature review and assessment of current data (57%)	Conduct a community health assessment and recommend priorities (35%)
Assist in the development of measurable and relevant goals and objectives (54%)	Use laboratory resources to support epidemiologic activities (32%)

Describe differences between public health practice and public health research (54%)	Assess the need for special analyses (31%)
Apply knowledge of privacy laws to protect confidentiality (54%)	Conduct evaluation of surveillance systems (30%)
Create analysis plans and conduct analysis of data (53%)	
Tier 3a	
Use basic public health sciences in epidemiologic practice (75%)	Develop requests for extramural funding to support additional epidemiologic activities and special projects (35%)
Ensure management of data from surveillance, investigations, or other sources (73%)	Create operational and financial plans for future epidemiologic activities (35%)
Evaluate conclusions and interpretations from investigations (71%)	Ensure application of principles of informatics, including data collection, processing, and analysis, in support of epidemiologic practice (34%)
Promote ethical conduct in epidemiology practice (69%)	Lead epidemiology unit in preparing for emergency response (34%)
Ensure identification of public health problems pertinent to the population (69%)	Ensure the use of laboratory resources to support epidemiologic activities (33%)
Oversee surveillance activities (66%)	Develop and manage information systems to improve effectiveness of surveillance, investigation, etc. (31%)
Model interpersonal skills in communication with agency personnel, colleagues, and the public (65%)	Lead community public health planning processes (30%)
Ensure preparation of written and oral reports and presentations to professional and nonprofessional audiences and ensure basic principles of risk communications are followed (63%)	
Enforce policies that address security, privacy, and legal considerations when communicating epidemiologic information (61%)	
Ensure investigation of acute and chronic conditions or other adverse outcomes in the population (60%)	
Tier 3b	
Validate identification of public health problems pertinent to the population (90%)	Develop processes for using laboratory resources to support epidemiologic activities (21%)
Organize preparation of written and oral presentations that communicate necessary information (83%)	Prepare proposals for extramural funding for review and input from managers (19%)
Conduct epidemiologic activities within the financial and operational plan of the agency (81%)	Implement operational and financial plans for assigned projects (17%)
Evaluate results of data analysis and interpret conclusions (81%)	Evaluate programs (17%)
Manage data from surveillance, investigations, or other sources (79%)	Ensure application of understanding of biology and behavioral sciences to determine mechanisms of disease (17%)
Model interpersonal skills in communications with agency personnel, colleagues, and the public (75%)	Describe financial and budgetary processes of the agency (17%)
Promote ethical conduct in the epidemiology practice (75%)	Lead community public health planning processes (17%)

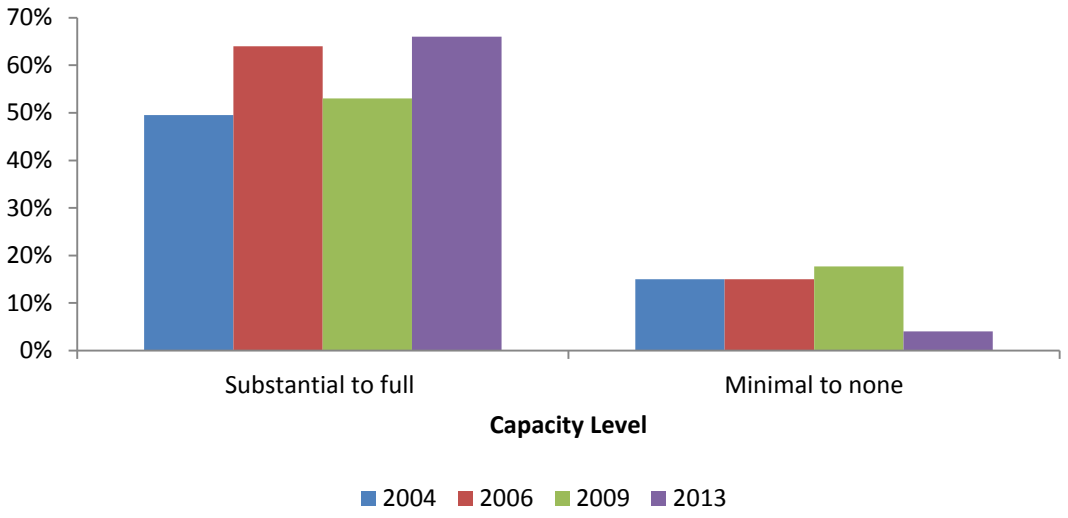
Abbreviations: CDE, chronic disease epidemiologist; ECA, Epidemiology Capacity Assessment.

Trends, 2003–2013

In 2004, 2006, 2009, and 2013, the Core ECAs asked a number of comparable questions about CD epidemiology capacity. In addition, the 2003 special CD ECA and the 2009 and 2013 ECA CD Supplemental Modules contained similar questions that could be used to assess trends. For the 2004–2013 Core ECAs, all 50 states and the District of Columbia responded. Forty-seven jurisdictions completed the 2003 special CDE capacity assessment; 51 completed the 2009 and 49 completed the 2013 CD Supplemental Modules. The information presented in this section is for all responding jurisdictions and is not restricted to jurisdictions that responded in all years.

Chronic Disease Epidemiology Functional Capacity: The Core ECA asked jurisdictions to specify the extent of their epidemiology and surveillance capacity in each program area on the basis of the percentage of their activity, knowledge, or resources, with percentages separated into six categories ranging from none to full (100%). Figure 17 shows trends in the percentage of jurisdictions since 2004 that reported having at least substantial (≥50%) and minimal to no (<25%) capacity. The percentage with at least substantial capacity fluctuated, whereas the percentage with minimal to no capacity decreased substantially from 2009 (18%) to 2013 (4%).

Figure 17: Trends in percentage of jurisdictions with substantial to full and minimal to no chronic disease epidemiology and surveillance capacity; 2004, 2006, 2009, and 2013 Core ECAs



Training in Epidemiology: Examination of data from 2004 through 2009 found no striking trends in the makeup of the CD epidemiology workforce. From 2009 to 2013, however, the percentage of CDEs with a master's degree in epidemiology increased (from 37% to 48%) and the percentage of CDEs with "some coursework" declined (from 25% to 16%) (Table 15).

Table 15: Trends in level of epidemiology training of CDEs , 2004, 2006, 2009, and 2013 ECA Individual Worksheets

TRAINING LEVEL*	NO. FTE (%)		NO. FTE (%)	
	2004 ECA	2006 ECA	2009 ECA	2013 ECA
PhD, DrPH	36 (11.5)	57 (17.9)	21.5 (12.0)	25.2 (13.9)
MD, DVM, DDS + Master's	19 (6.1)	19.5 (6.1)	11 (6.1)	10.2 (5.6)
Master's in epidemiology	116 (37.1)	123.3 (38.7)	66 (36.9)	85.7 (47.5)
Bachelor's in epidemiology	11 (3.5)	3 (0.9)	1 (0.6)	–
EIS or other formal program	24 (7.7)	5 (1.6)	8.5 (4.7)	5.1 (2.8)
Some coursework	55 (17.6)	66.9 (21.0)	44 (24.6)	28.3 (15.7)
On-the-job training	42 (13.4)	37.6 (11.8)	24 (13.4)	21.5 (11.9)
None	10 (3.2)	6.5 (2.0)	3 (1.7)	4.2 (2.3)
Unknown	–	–	–	0.3 (0.2)
Total	313 (100)	318.8 (100)	179 (100)	180.5

*Training level is hierarchical, with the highest level of epidemiology-specific training being the relevant category. For example, a physician completing EIS who had a master's degree in epidemiology would be listed as being a "MD + Master's," not "EIS or other formal program."
Abbreviations: EIS, Epidemic Intelligence Service; FTE, full-time equivalent.

Spectrum of Work: In 2003 and 2009, the CD ECAs asked jurisdictions whether CDEs had in the past 12 months done CDE work related to a set of conditions, behaviors, and risk factors (Table 16). The response options were yes or no. The 2013 ECA CD Supplemental Module asked jurisdictions a similar question, but the response options were none, a little, some, or a lot. Although the response choices were not entirely comparable, there appears to be a trend toward more CDE work in the areas of OH, alcohol abuse, drug abuse, and high cholesterol. From 2009 to 2013, the percentage of jurisdictions reporting that CDEs work in the stroke area declined substantially.

Table 16: Percentage of jurisdictions involved in the past 12 months in work related to chronic conditions and CD behaviors and risk factors, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules

VARIABLE	2003	2009	2013

	NO. JURISDICTIONS	YES NO. (%)	NO. JURISDICTIONS	YES NO. (%)	NO. JURISDICTIONS	A LITTLE, SOME OR A LOT NO. (%)
Condition						
Arthritis	44	32 (72.7)	51	27 (52.9)	47	29 (61.7)
Asthma	45	35 (77.8)	51	46 (90.2)	47	40 (85.1)
Cancer	46	41 (89.1)	51	50 (98.0)	47	46 (97.9)
Diabetes	47	43 (91.5)	51	48 (94.1)	47	47 (100.0)
Heart disease	46	38 (82.6)	51	47 (92.2)	47	47 (100.0)
Oral health	41	17 (41.5)	51	26 (51.0)	47	29 (61.7)
Stroke	–	–	51	44 (86.3)	47	34 (72.3)
Risk Factor						
Alcohol abuse	–	–	51	20 (39.2)	47	25 (53.2)
Breastfeeding	–	–	–	–	47	33 (70.2)
Cancer screening	44	36 (81.8)	51	46 (90.2)	47	44 (93.6)
Drug abuse	–	–	51	15 (29.4)	47	26 (55.3)
High cholesterol	38	21 (55.3)	51	37 (72.6)	47	43 (91.5)
Hypertension	40	30 (75.0)	51	47 (92.2)	47	44 (93.6)
Nutrition	44	35 (79.5)	51	46 (90.2)	47	44 (93.6)
Overweight/obesity	45	40 (88.9)	51	48 (94.1)	47	45 (95.7)
Physical activity	46	40 (87.0)	51	46 (90.2)	47	45 (95.7)
Social determinants	–	–	–	–	47	45 (95.7)
Tobacco use	–	–	51	49 (96.1)	47	44 (93.6)

Abbreviations: CD, chronic disease; ECA, Epidemiology Capacity Assessment.

Access to Data: The same questions were asked about unfettered access to selected datasets in the 2003 CD ECA and the 2009 and 2013 CD Supplemental Modules. For most of the datasets, no substantial changes occurred (<10% difference in percentage of jurisdictions with unfettered access). However, unfettered access to cancer registry and Medicaid data decreased from 82% to 71% and from 35% to 25%, respectively. Unfettered access did not increase substantially from 2009 to 2013 (Table 17).

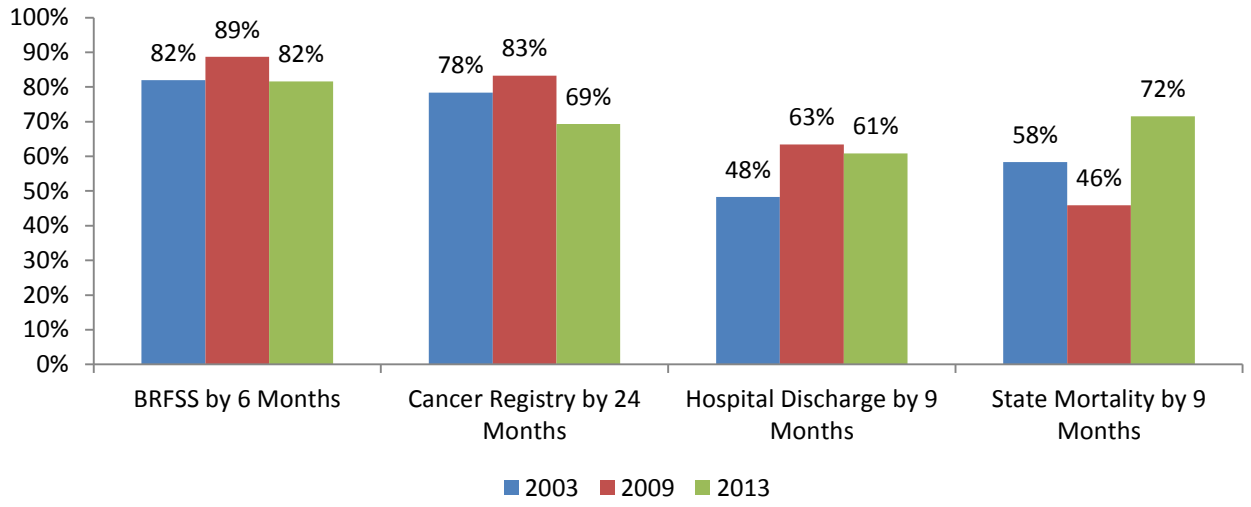
Timeliness of access among jurisdictions with unfettered access was measured for four datasets (Figure 18). The percentage of jurisdictions with timely access to cancer registry data decreased substantially from 83% in 2009 to 69% in 2013. The percentage of states with timely access to state mortality data increase from 46% in 2009 to 72% in 2013.

Table 17: Percentage of jurisdictions in which CDEs had with unfettered access to selected state datasets, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules

DATASET	2003			2009			2013		
	YES NO. (%)	NO NO. (%)	UNKNOWN/ DON'T COLLECT NO. (%)	YES NO. (%)	NO NO. (%)	UNKNOWN/ DON'T COLLECT NO. (%)	YES NO. (%)	NO NO. (%)	UNKNOWN/ DON'T COLLECT NO. (%)
Mortality	38 (80.9)	9 (19.1)	–	37 (72.5)	13 (25.5)	1 (2.0)	33 (67.4)	15 (30.6)	1 (2.0)
Hospital discharge	32 (68.1)	12 (25.5)	3 (6.4)	41 (80.4)	7 (13.7)	3 (5.9)	37 (75.5)	9 (18.4)	3 (6.1)
Cancer registry	39 (83.0)	8 (17.0)	–	42 (82.4)	8 (15.7)	1 (2.0)	35 (71.4)	13 (26.5)	1 (2.0)
Medicaid	16 (34.0)	30 (63.8)	1 (2.1)	18 (35.3)	30 (58.8)	3 (5.9)	12 (24.5)	36 (73.5)	1 (2.0)
Medicare	9 (19.1)	34 (72.3)	4 (8.5)	3 (5.9)	40 (78.4)	8 (15.7)	4 (8.2)	44 (89.8)	1 (2.0)
BRFSS	41 (87.2)	6 (12.8)	–	44 (86.3)	7 (13.7)	–	44 (89.8)	5 (10.2)	–
YRBS	30 (63.8)	12 (25.5)	5 (10.6)	33 (64.7)	15 (29.4)	3 (5.9)	32 (65.3)	15 (30.6)	2 (4.1)
ED	9 (19.1)	25 (53.2)	13 (27.7)	21 (41.2)	21 (41.2)	9 (17.6)	21 (42.9)	16 (32.7)	12 (24.5)
EMS	9 (19.1)	29 (61.7)	9 (19.1)	17 (33.3)	28 (54.9)	6 (11.7)	12 (24.5)	30 (61.2)	7 (14.3)

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; ED, emergency department; EMS, emergency medical services; YRBS, Youth Risk Behavior Survey.

Figure 18: Percentage of jurisdictions with unfettered access to datasets for which data were available within 6–24 months after collection, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules



Abbreviations: BRFSS, Behavioral Risk Factor Surveillance Summary; CD, chronic disease; ECA, Epidemiology Capacity Assessment.

Access to Software: Software questions asked in 2003, 2009, and 2013 differed substantially. For this reason, the only comparisons that can be made relate to the need for and access to encryption and geographic information systems (GIS) software in 2009 and 2013 (Table 18). The percentage of jurisdictions needing encryption software increased substantially, from 53% in 2009 to 74% in 2013. The percentage of jurisdictions in which CDEs have ready access to GIS software increased slightly, from 73% in 2009 to 81% in 2013.

Table 18: Percentage of jurisdictions in which CDEs had unfettered access to selected software, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules

SOFTWARE	2009			2013		
	NEED SOFTWARE	HAVE READY ACCESS*	DO NOT HAVE READY ACCESS*	NEED SOFTWARE	HAVE READY ACCESS*	DO NOT HAVE READY ACCESS*
	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)
Encryption	27 (52.9)	20 (74.1)	7 (25.9)	36 (73.5)	25 (69.4)	11 (30.6)
GIS	48 (94.1)	35 (72.9)	13 (27.1)	47 (95.9)	38 (80.9)	9 (19.1)

*Among jurisdictions that need it.
Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; GIS, geographic information systems.

Data Dissemination: The two data dissemination questions that are comparable for 2003 to 2013 relate to having a queryable online system for CD data and preparation of scientific presentations or posters for state or national meetings (Table 19). Since 2003, the percentage of jurisdictions that had a queryable online system increased steadily, from 36% in 2003 to 51% in 2009 to 67% in 2013. The percentage of jurisdictions in which CDEs presented at state or national meetings increased from 78% in 2009 to 92% in 2013.

Table 19: Percentage of jurisdictions in which CD data were available or CDEs presented data, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules

MEANS OF DISSEMINATION	2003	2009	2013
	YES NO. (%)	YES NO. (%)	YES NO. (%)
Interactive/queryable online system for chronic disease data	17 (36.2)	26 (51.0)	33 (67.3)
Scientific presentations at state or national meeting requiring abstract submission by CDE	33 (73.3)	40 (78.4)	45 (91.8)

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment.

Collaborations: The three CD assessments asked several questions about collaborations with organizations external to the jurisdiction's health agency. Collaboration with private voluntary organizations was common but

decreased from 2009 to 2013 (82% to 74%, respectively). Collaboration with managed-care organizations and health-care professional organizations was lower and remained relatively stable across the years (Table 20).

Table 20: Percentage of jurisdictions in which CDEs collaborated with outside organizations, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules

ORGANIZATION TYPE	2003			2009			2013		
	YES	NO	UNKNOWN	YES	NO	UNKNOWN	YES	NO	UNKNOWN
	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)
Private volunteer	38 (80.9)	7 (14.9)	2 (4.3)	42 (82.4)	5 (9.8)	4 (7.8)	36 (73.5)	11 (22.5)	2 (4.1)
Managed-care organizations	19 (40.4)	23 (48.9)	5 (10.6)	17 (33.3)	27 (52.9)	7 (13.7)	16 (32.7)	29 (59.2)	4 (8.2)
Health-care professional	–	–	–	29 (56.9)	17 (33.3)	5 (9.8)	25 (51.0)	21 (42.9)	3 (6.1)

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment.

The 2009 and 2013 CD Supplemental Modules asked about the current level of collaboration between CDEs and epidemiologists in other health department program areas. Response options in 2009 and 2013 were not identical. In 2009, the response options were strong, somewhat strong, very little, no collaboration, don't know, or no epidemiologists in this program area. The 2013 questionnaire had an additional response option: CDEs work in this area. For this report, the percentage of jurisdictions that reported strong or somewhat strong collaborations in 2009 is compared with the percentage of jurisdictions that reported strong, somewhat strong, or CDEs work in this program area in 2013 (Table 21). The percentage of jurisdictions that reported at least a somewhat strong collaboration declined substantially (≥10 percentage points) in the following program areas: public health preparedness (37% in 2009 vs. 20% in 2013), environmental health (61% vs. 47%), and occupational health (37% vs. 25%).

Table 21: Percentage of jurisdictions in which CDEs had somewhat strong to strong collaborations with epidemiologists in other program areas, 2009 and 2013 ECA CD Supplemental Modules

PROGRAM AREA	2009 ECA (N=51)	2013 ECA (N=49)
	STRONG OR SOMEWHAT STRONG COLLABORATION NO. (%)	STRONG, SOMEWHAT STRONG, OR CDES WORK IN PROGRAM AREA NO. (%)
Infectious disease	23 (45.1)	18 (36.7)
Public health preparedness	19 (37.3)	10 (20.4)
Injury	32 (62.7)	29 (59.2)
Oral health	26 (51.0)	25 (51.0)
Mental health	14 (27.5)	9 (18.4)
Substance abuse	16 (31.4)	17 (34.7)
Maternal and child health	36 (70.6)	34 (69.4)
Environmental health	31 (60.8)	23 (46.9)
Occupational health	19 (37.3)	12 (24.5)

Abbreviations: CD, chronic disease; CDE, chronic disease epidemiologist; ECA, Epidemiology Capacity Assessment.

Support Services: In 2003 and 2009, questions about support services had response options of yes, no, and don't know. Response options in 2013 were 1) yes, meets needs; 2) yes, but doesn't meet needs or access is limited; 3) no access; and 4) don't know. The percentage of jurisdictions reporting that their CDEs had at least some access to current journals steadily increased since 2003. The percentage with clerical support and information technology (IT) support increased from 2009 to 2013, although the difference could be due to a change in the response options (Table 22).

Table 22: Percentage of jurisdictions in which CDEs reported having access to current journals, clerical support, and IT support, 2003 CD ECA and 2009 and 2013 ECA CD Supplemental Modules			
SUPPORT SERVICE	2003 YES NO. (%)	2009 YES NO. (%)	2013 MEETS NEEDS OR LIMITED ACCESS NO. (%)
Ready access to current journals	29 (61.7)	33 (64.7)	36 (73.5)
Adequate clerical support	27 (57.4)	22 (43.1)	32 (65.3)
Adequate IT services	–	38 (74.5)	40 (81.6)

Abbreviations: CD, chronic disease; CDE, CD epidemiologist; ECA, Epidemiology Capacity Assessment; IT, information technology.

Discussion

CDs, such as heart disease, asthma, cancer, and diabetes, are among the greatest threats to Americans' health. More than 133 million Americans—45% of the population—have at least one chronic condition. CDs are a major contributor to rising health-care costs. Of each dollar spent on health care, >75 cents—about $1.7 trillion annually—goes toward treating chronic illness.[19] To monitor trends in the prevalence of CD, to develop and evaluate the population-based programs necessary to address this growing health concern, and to research for new insights and innovations, state and territorial health jurisdictions need a cadre of skilled CDEs. Because CD prevention depends on the availability of population-based datasets, such as mortality and hospital discharge data, CDEs must have the skills and statistical software necessary to manipulate large datasets. They must also have the ability to interpret the data and to assist in developing prevention programs based on current data and evidence-based approaches.

Since creation of CDC's chronic disease center (now called the National Center for Chronic Disease Prevention and Health Promotion) in 1988, CD epidemiology capacity in state and territorial health departments has improved. As of 2013, >85% of jurisdictions had CDEs who worked with each of five major program areas (asthma, cancer, diabetes, heart disease and stroke) and with each of eight major CD focus areas (tobacco use, hypertension, nutrition, obesity, physical activity, high cholesterol, cancer screening, and social determinants). Most (66%) jurisdictions have at least substantial CD epidemiology and surveillance capacity. This level of capacity resulted in publishing and presenting data and somewhat strong to strong collaboration of CDEs with epidemiologists in three other major program areas with overlapping interests (injury, MCH, and environmental health).

Although many of the aforementioned improvements in overall CD epidemiology capacity occurred in previous decades, markers of CD capacity have improved since the 2009 ECA. The percentage of jurisdictions reporting at least substantial CD capacity increased from 52% to 66%, and the percentage reporting minimal to no capacity decreased from 18% to 4%. Thirty-one percent of jurisdictions reported that since 2009 their overall CDE capacity increased. This increase might be due partially to improvements in the training of the CDE workforce; more CDEs have a master's degree in epidemiology (37% to 48%) and fewer have only "some epidemiology coursework" (25% to 16%). In addition, the percentage of jurisdictions reporting their CDEs have at least some access to current journals increased (65% to 74%), as did CDE access to clerical and IT support.

Concurrent with improvements in markers of CD capacity, outcomes associated with having substantial capacity also improved. The percentage of jurisdictions reporting that CDEs worked in the areas of oral health, alcohol abuse, drug abuse, and high cholesterol increased by at least 10 percentage points. Some data dissemination outcomes also improved; more states share information through public access queryable online data systems (51% to 67%), and a higher percentage had CDEs who presented at state or national meetings (78% to 92%).

Although progress has been made, full capacity remains elusive. Only 20% of jurisdictions have almost full to full CDE capacity, and that percentage has not changed since 2009. In addition, 31% of jurisdictions reported that their overall CDE capacity decreased since 2009. Unfettered access to cancer registry data declined (83% to 69%), as did access to Medicaid data (35% to 25%). Although 88% of jurisdictions reported that their CDEs had ready access

to statistical software, and CDEs in all jurisdictions conducted standard data analyses (population-specific rates and confidence intervals and comparisons with other rates), for <20% of jurisdictions, CDEs routinely performed more sophisticated data analyses (multivariable analysis, data related to systems or environmental indicators). Access to software and support services also showed gaps. Almost 23% of jurisdictions had CDEs who needed access to encryption software, and 18% needed access to GIS software. Clerical support and IT support remained unavailable to most CDEs in 61% and 41% of jurisdictions, respectively. Along with these declines in markers of capacity were declines in outcomes. The percentage of jurisdictions that reported somewhat strong to strong collaboration with certain programs declined by >10 percentage points: public health preparedness (37% to 20%), environmental health (61% to 47%), and occupational health (37% to 25%).

This assessment validated three key indices of CD epidemiology capacity highlighted by CSTE in its report on the 2003 CD ECA and again in its 2007 position statement on CD capacity: having an epidemiologist position to coordinate and integrate CD epidemiology activities across program areas, having at least one doctoral-level CDE, and having at least five CDEs.[20,21] Each was associated either with a higher level of CD epidemiology and surveillance capacity or more directly with some of the benefits that capacity brings. In particular, having a coordinating CDE and having at least five CDEs were strongly associated with having at least substantial epidemiology capacity and having involvement in all CD subject areas. Having a doctoral-level epidemiologist was most strongly associated with data dissemination and involvement in a wide array of CD subject areas. Continued monitoring of these measures of capacity should provide a reliable index of overall CD epidemiology capacity.

Conclusions

- State CD epidemiology capacity increased since 2009, with more jurisdictions having at least substantial capacity and fewer having minimal to no capacity.
- Jurisdictions that reported having a coordinating CDE and jurisdictions that had the minimum recommended CDE workforce had higher levels of CD epidemiology capacity than did jurisdictions without them.
- Despite the advances since 2009, the epidemiology capacity glass is less than half full: only 20% of jurisdictions have almost full to full CD capacity, and 33% of jurisdictions reported that their CD capacity decreased since 2009.

Chronic Disease Recommendations

1. CD epidemiology and related technology capacity should be a specific part of the national dialogue about addressing the overall state-based epidemiology capacity gaps identified in the Core ECA and ensuring that jurisdictions have the capacity needed to provide essential data for public health action.

2. Improving capacity in jurisdictions that currently have minimal to no CD epidemiology capacity should be a priority. At a minimum, every state should have a lead CDE to oversee and coordinate data gathering, analysis, interpretation and dissemination, and translation to public health practice.

3. Continued monitoring and identification of gaps in CD epidemiology capacity are critical, particularly as needs increase because of increasing life expectancy, an increasingly higher percentage of the population in older age groups, and increasing CD prevalence in younger age groups in the United States.

4. All state CD epidemiology programs should have access to GIS software and, to the extent that personnel capacity permits, use GIS software to analyze spatial aspects of CD, including putting systems in place for routine geocoding of population-based CD data that lends themselves to geocoding, beginning with birth and death data.

5. State CDEs should build partnerships with substance abuse, mental health, occupational health, and public health preparedness epidemiologists, in addition to partnerships with injury, environmental health, OH, and

MCH programs. In the absence of state substance abuse and/or mental health surveillance capacity, CD programs should consider incorporating substance abuse and mental health surveillance into their surveillance activities. CD and mental health are major public health issues during times of natural and human-made disasters, and CDEs should be prepared in advance to assist in a public health emergency.

6. State CD programs should work to build partnerships among state agencies and with local academic institutions to efficiently and effectively use resources, conduct surveillance, and plan and implement evidence-based strategies for CD prevention and health promotion.

7. Organizations involved in training the public health workforce, including CDC, CSTE and schools of public health, should ensure that programs include training in competencies identified by practicing CDEs as needing additional focus. The most prominent needs for training were in use of informatics and information systems, fiscal issues, and community health assessments.

9. Many of the areas for which recommendations were made in the 2009 CSTE CD ECA need continued work. CSTE shall work with CDC to develop a specific plan to increase the number of epidemiologists and the access and use of tools to support their work so that all state CD epidemiology programs
    - have a designated coordinating/lead CDE and a minimum of five full-time CDEs , one of whom should have doctoral-level training;
    - have unfettered timely access, ability, and technical support to analyze key datasets, including state mortality data, hospital discharge data, tumor registry data, Behavioral Risk Factor Surveillance System (BRFSS) data, emergency department and emergency medical services (EMS) data, and Medicare data. Special attention should be given to access to mortality and Medicare data because both have recently been decreasing, as has the timeliness of availability of mortality data;
    - calculate confidence intervals for BRFSS prevalence estimates and death rates; and
    - have easy and ready access to medical journals and adequate information technology and clerical support services.

MATERNAL AND CHILD HEALTH: ASSESSING AND BUILDING CAPACITY

Building maternal and child health (MCH)–related analytic capacity in state health departments began in 1987, when the MCH Epidemiology Program, a collaborative effort between the Centers for Disease Control and Prevention (CDC) and the Health Resources and Services Administration (HRSA), began assigning MCH epidemiologists (MCHEs) to public health agencies to serve as senior scientists. Since then, a wide variety of workforce development initiatives, national and regional conferences, internships, and fellowship opportunities have occurred, including establishment of the joint CDC/Council of State and Territorial Epidemiologists (CSTE) Applied Epidemiology Fellowship Program in 2003. In parallel to these capacity-building activities aimed at improving the skills of the MCH workforce, the Title V Block Grant provided supplemental funding to states through the State Systems Development Initiative to facilitate improvements in components of data infrastructure. MCH epidemiology in the states evolved and matured as states recognized the need for, and took advantage of, these and other capacity-building opportunities.

For many years, no effort was made to systematically assess state and territorial epidemiology capacity in specific program areas. In 2001, an assessment specifically assessing MCH epidemiology capacity was designed by CSTE's MCH Workgroup, which included input from the Association of Maternal and Child Health Programs (AMCHP), HRSA'S Maternal and Child Health Bureau (HRSA/MCHB), CDC's Division of Reproductive Health, and several state and local public health agencies. The assessment was conducted during November 2001–March 2002 and identified many gaps. On the basis of the assessment findings, CSTE passed a position statement with recommendations in three areas. For human capacity, the workgroup recommended that each state have a minimum of one doctoral-level MCHE serving as the lead MCHE and each program have adequate MCH epidemiology support. For systems capacity, the workgroup recommended that MCH epidemiology and data staff members strengthen and expand their data use, including use of MCH-related databases, and that MCH program directors and MCH epidemiology staff collaborate closely, especially when developing and evaluating policies and plans to conduct the 10 Essential Public Health Services (EPHS). For MCH data-related activities, the workgroup recommended that MCH directors and MCHEs actively participate in national, regional, and state meetings to exchange information.

During 2004–2007, the CDC/HRSA MCH Epidemiology Program supported a detailed assessment of factors related to improved MCH epidemiology capacity in state health agencies, culminating in a 2008 report. The assessment documented what had worked to build MCH capacity, the characteristics of the capacity, and factors that make the difference between successful and unsuccessful models of MCH epidemiology capacity. The main findings were that a number of features of an MCH epidemiology program were associated with a higher level of functioning: 1) an increasingly formal and visible presence in the state agency, particularly a named MCH epidemiology unit or section; 2) an agenda-setting process based on consensus with an array of relevant stakeholders; 3) the combination of a critical mass of key staff who have advanced training, along with CDC assignees, fellows, or interns; 4) an environment that promotes and permits data sharing, both internally and externally; and 5) publications in the peer-reviewed literature and submission of abstracts to the MCH Epidemiology conference.

Concurrent with development of the 2009 Core Epidemiology Capacity Assessment (ECA), the CSTE MCH Workgroup assessed progress since the 2003 CSTE position statement and determined the relationship between the level of self-assessed epidemiology capacity and constellations of MCH program structure and other factors associated with MCH epidemiology functioning identified in the 2008 report. The Core ECA and the MCH Supplemental Module had several MCH-related objectives. First, the Supplemental Module aimed to describe MCH epidemiology and surveillance capacity overall and the ability to perform Core EPHS; organization of MCH programs within state health departments; percentage of time that primary MCHEs work on MCH issues and extent of decision making by MCHEs for MCH programs; degree of access to state datasets; and level of internal and external collaboration; and spectrum of activities in which MCHEs are involved and resources available to

them. Second, the MCH Supplemental Module aimed to develop national and state-specific profiles of key MCH epidemiology capacity indicators.

Findings from the 2009 Core ECA and 2009 MCH Supplemental Module resulted in three general conclusions.

- MCH epidemiology and surveillance capacity continued to grow well into 2009 despite the economic downturn. The setting of MCH epidemiology milestones—including development of a centralized MCH epidemiology unit and strong leadership with both scientific and administrative authority—and achievement of the milestones in many states appeared to have contributed to continued growth.
- MCH programs in most jurisdictions had substantial capacity in many areas, participated in all areas of decision making, had unfettered access to the most basic datasets, conducted sophisticated statistical analyses, and were involved in a broad spectrum of MCH activities. Their most pressing need is additional staff.
- Despite the achievements, the MCH epidemiology capacity glass was only half full: nearly half of all states lacked even substantial MCH epidemiology and surveillance capacity, and in only a minority of jurisdictions did MCHEs participate substantially in policy development; have access to important datasets; and work with colleagues in substance abuse, mental health, and occupational health programs.

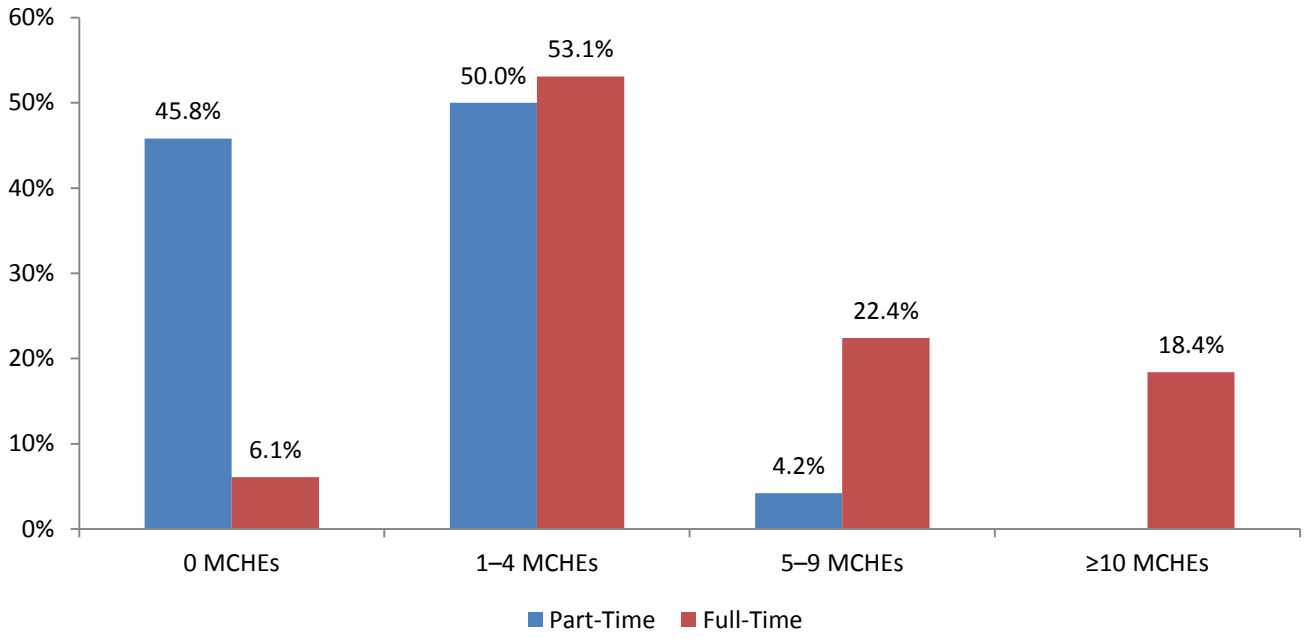
In 2013, the third assessment of MCH epidemiology capacity was completed. The general results of the 2013 Core ECA and 2013 MCH Supplemental Module are presented in the "Overall Epidemiology Capacity Assessment for Chronic Disease, Maternal and Child Health and Oral Health" section of this document.

The purpose of this section, "Maternal and Child Health—Assessing and Building Capacity," is to present more detailed information about the findings that specifically relate to MCH epidemiology, including workforce and the impact of organizational structure, leadership, and state size on MCH epidemiology capacity.

Maternal and Child Health Epidemiology Workforce

Full-Time vs. Part-Time MCH Epidemiology Workforce: The MCH Supplemental Module asked jurisdictions to provide information about the number of epidemiologists who work on MCH activities at least 50% of their time (full-time) and the number who work on MCH activities <50% of their time (part-time). Of the 48 jurisdictions that provided information, 20 (42%) reported having only full-time MCHEs, and 25 (52%) had both full- and part-time MCHEs. One jurisdiction reported having only part-time MCHEs, and two jurisdictions reported having no full- or part-time MCHEs. About half of the jurisdictions had one to four full-time MCHEs, and about 20% had five to nine full-time MCHEs, and 20% had ≥10 full-time MCHEs. Two (4%) jurisdictions reported having five part-time MCHEs, and no jurisdiction had more than five part-time MCHEs (Figure 19).

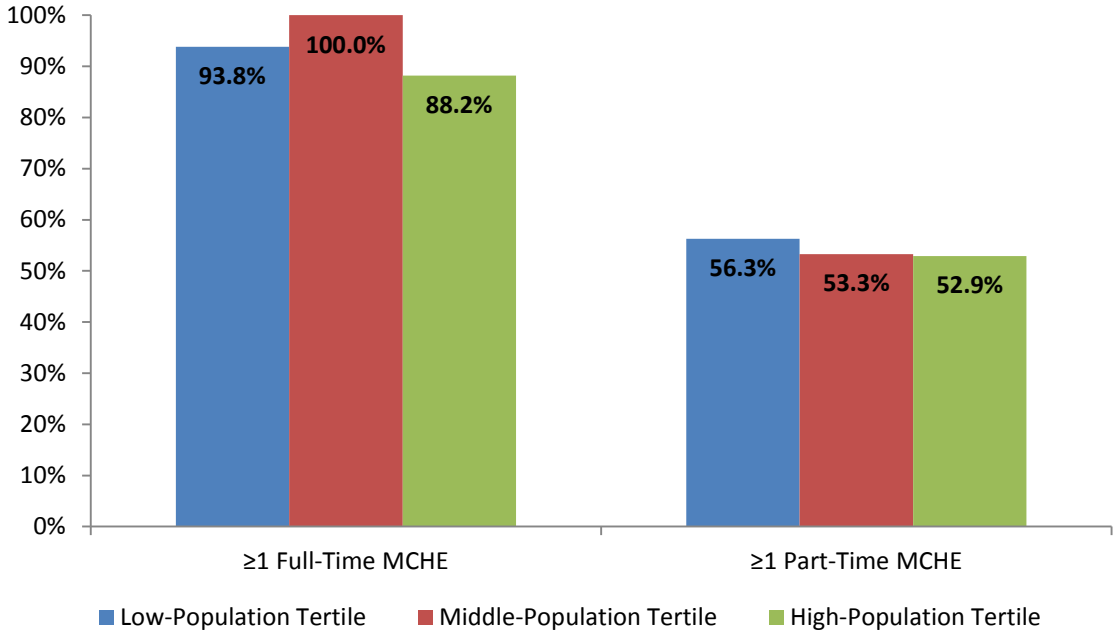
Figure 19: Percentage of jurisdictions with 0, 1–4, 5–9, or ≥10 part- and full- time MCHE, 2013 ECA MCH Supplemental Module



Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist.

Impact of State Population on MCH Epidemiology Workforce: We evaluated the prevalence and mean number of part- and full-time epidemiologists by tertile of state population. The percentage of jurisdictions with at least one part-time or one full-time MCHE did not differ significantly by population tertile (Figure 20). In addition, differences in the mean number of part-time MCHEs by population size were minimal (Table 23). However, the number of full-time MCHE staff differed substantially by jurisdiction's population. The mean number of full-time MCHEs increased from three in low-population jurisdictions to just over nine in high-population jurisdictions. The mean number also increased with population size from two in low- to six in high-population jurisdictions (Table 23). We also evaluated the joint impact of population size and MCHE authority on workforce. Within each population tertile, jurisdictions in which MCH leaders had both scientific and administrative authority had a higher mean number of part- and full-time MCHEs than did jurisdictions in which MCH leaders had less authority (Table 23).

Figure 20: Percentage of jurisdictions with at least one part-time or one full-time MCHE, by population tertile; 2013 ECA MCH Supplemental Module



Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist.

Table 23: Number of part- and full-time MCHEs, by population tertile and MCHE authority,* 2013 ECA MCH Supplemental Module

POPULATION TERTILE	NO. JURISDICTIONS	MEAN	STANDARD DEVIATION	MEDIAN	MODE	MINIMUM	MAXIMUM
Part-time MCHEs							
Low population tertile (total)	16	0.88	0.96	1	0	0	3
S/A authority	6	1.33	1.21	1.5	0	0	3
No S/A authority	10	0.60	0.70	0.5	0	0	2
Middle population tertile (total)	15	0.87	1.30	1	0	0	5
S/A authority	15	0.87	1.30	1	0	0	5
No S/A authority	–	–	–	–	–	–	–
High population tertile (total)	17	1.12	1.41	1	0	0	5
S/A authority	12	1.33	1.56	1	0	0	5
No S/A authority	5	0.60	0.89	0	0	0	2
Full-time MCHEs							
Low population tertile (total)	16	3.02	2.44	2	2	0	9
S/A authority	6	4.67	2.80	4	2	2	9
No S/A authority	10	2.03	1.63	2	1	0	6
Middle population tertile (total)	16	4.78	4.40	4	1	1	16.5
S/A authority	16	4.78	4.40	4	1	1	16.5
No S/A authority	–	–	–	–	–	–	–
High population tertile (total)	17	9.37	8.40	6	6	0	27
S/A authority	12	10.44	7.06	9.65	6	1	23
No S/A authority	5	6.80	11.56	1	0	0	27

*MCH leader had both scientific and administrative authority vs. had scientific only, administrative only, or no authority.
Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist; S/A, scientific and administrative.

Factors Associated with Substantial Capacity

A number of analyses were conducted to examine the relationship between several factors thought to be associated with higher levels of epidemiology capacity and having at least substantial (≥50% of activities) MCH epidemiology capacity (Table 24). Having at least substantial overall MCH epidemiology and surveillance capacity was significantly associated with two milestones previously identified as important for building MCH epidemiology capacity: having a lead MCHE and having MCH leaders with both scientific and administrative authority (vs. scientific only, administrative only, or neither). In addition, having an MCH workforce with at least five MCHEs was significantly associated with having substantial capacity. The relationships between overall capacity and having a doctoral-level MCHE, organizational structure, and jurisdiction population size were not significant (p>0.05).

Table 24. Association of substantial to full overall MCH epidemiology and surveillance capacity with leadership, workforce, organizational structure, and jurisdiction population, 2013 ECA MCH Supplemental Module

MCH EPIDEMIOLOGY STRUCTURE/MILESTONES SUBSTANTIAL–FULL		OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO*	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
Lead MCHE (Core)	Yes	33	7	8.3	0.01
	No	4	7		
MCH leader with scientific and administrative authority	Yes	29	5	6.6	0.01
	No	7	8		
Doctoral-level MCHE	Yes	30	9	1.7	0.52
	No	6	3		
Five or more MCHEs	Yes	17	2	4.9	0.05
	No	19	11		
MCHEs scattered in MCH programs	Yes	6	3	0.6	0.52
	No	30	9		
MCHEs within an MCH program unit	Yes	16	6	0.8	0.74
	No	20	6		
MCHEs in a larger epidemiology structure	Yes	12	2	2.5	0.28
	No	24	10		
Jurisdiction's population (tertile)	High/Middle	26	8	1.8	0.38
	Low	11	6		

*The odds that jurisdictions with substantial to full overall epidemiology and surveillance capacity had the particular epidemiology structure.
Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist; S/A, scientific and administrative.

Outcomes Associated with Substantial Capacity

In several analyses, the meaning of the measure of "overall epidemiology and surveillance capacity" was examined: Does it correlate with more specific capacities, such as the EPHS? Does it improve a jurisdiction's ability to access and disseminate data? Is it associated with internal factors, such as epidemiologists' involvement in decision making?

Selected and Essential Public Health Services: Four EPHS have an epidemiology component: EPHS1 (monitoring health status), EPHS2 (diagnosing and investigating health problems), EPHS9 (evaluating effectiveness), and EPHS10 (research for new insights and innovations). Two other selected public health services also are essential to MCHEs: linking data systems and translating analytic findings. Having at least substantial epidemiology and surveillance capacity was positively associated with all six public health services examined but was significant only for EPHS1, EPHS2, EPHS9, and translating analytic findings (Table 25).

Table 25: Association of overall MCH epidemiology and surveillance capacity with MCH epidemiology capacity to provide selected public health services, 2013 ECA MCH Supplemental Module					
SELECTED PUBLIC HEALTH SERVICE	LEVEL OF CAPACITY TO PROVIDE SELECTED PUBLIC HEALTH SERVICE	NO. JURISDICTIONS WITH OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO*	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
EPHS1: Monitor health status to identify community health problems	Substantial–full	34	7	14.6	0.003
	None–partial	2	6		
EPHS2: Diagnose and investigate health problems in the community	Substantial–full	32	5	12.8	0.001
	None–partial	4	8		
EPHS9: Evaluate effectiveness, accessibility, and quality of health services	Substantial–full	30	6	5.0	0.03
	None–partial	6	6		
EPHS10: Research for new insights and innovative solutions to health problems	Substantial–full	21	4	3.2	0.10
	None–partial	15	9		
Link data systems that can facilitate high-level epidemiologic analysis	Substantial–full	28	7	3.0	0.11
	None–partial	8	6		
Translate analytic findings into information directly usable to decision-makers	Substantial–full	33	8	6.9	0.02
	None–partial	3	5		

*Odds of jurisdictions reporting at least substantial overall MCH epidemiology and surveillance capacity to also have at least substantial capacity for the given public health service, compared with jurisdictions reporting less overall MCH epidemiology and surveillance capacity.
Abbreviations: ECA, Epidemiology Capacity Assessment; EPHS, Essential Public Health Services; MCH, maternal and child health.

Decision Making and Program Outcomes: Associations were examined between a jurisdiction having at least substantial MCH epidemiology capacity and participating in decision making, and a number of other measured program outcomes in the past year, such as statistical analyses, publishing in journals, publishing technical reports, giving presentations at state or national meetings, having an online queryable data system, and collaborating with other program areas (Table 26).

Having at least substantial MCH epidemiology capacity was significantly associated with MCHE participation in decision making for needs assessment (odds ratio [OR] 5.0), program planning (OR 4.1), performance measures (OR 30.0), and program evaluation (OR 8.0). Jurisdictions with substantial MCH capacity were also more likely to present at state and national meetings (OR 3.9). Significant associations were nonexistent with other areas examined.

Table 26: Association of overall MCH epidemiology capacity with decision making and MCH program outcomes, 2013 ECA MCH Supplemental Module					
MARKERS OF EPIDEMIOLOGY CAPACITY	LEVEL OF EPIDEMIOLOGY CAPACITY	NO. JURISDICTIONS WITH OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
Participate in decision making, re: needs assessment	Substantial–full	32	8	5.0	0.04
	None–partial	4	5		
Participate in decision making, re: priority setting	Substantial–full	30	8	3.1	0.11
	None–partial	6	5		
Participate in decision making, re: program planning	Substantial–full	28	6	4.1	0.04
	None–partial	8	7		
Participate in decision making, re: performance measures	Substantial–full	35	7	30.0	0.003
	None–partial	1	6		
Participate in decision making, re: program evaluation	Substantial–full	30	5	8.0	0.004
	None–partial	6	8		
Participate in decision making, re: policy development	Substantial–full	20	5	2.0	0.29
	None–partial	16	8		
Have unfettered access to: birth certificate data, death certificate data, and BRFSS data	Yes	21	6	1.8	0.38
	No	16	8		
Have unfettered access to: WIC, newborn screening, family planning, and abortion data	Yes	3	2	0.5	0.51
	No	34	12		
Calculate confidence intervals	Yes	26	5	3.6	0.06
	No	10	7		
Conduct multivariable analysis	Yes	10	3	1.2	0.85
	No	26	9		
Collaborate with mental health	Frequently–routinely	9	2	1.8	0.48
	Never–infrequently	27	11		
Collaborate with substance abuse	Frequently–routinely	9	3	1.1	0.89
	Never–infrequently	27	10		
Collaborate with WIC	Frequently–routinely	21	9	0.6	0.49
	Never–infrequently	15	4		
Collaborate with oral health	Frequently–routinely	24	7	1.7	0.41
	Never–infrequently	12	6		
Published at least one peer-reviewed article	Yes	13	3	2.2	0.30
	No	22	11		
Had at least one abstract at national meeting	Yes	24	5	3.9	0.04
	No	11	9		
Published state reports	Yes	22	7	1.7	0.41
	No	13	7		
Have online queryable data system	Yes	14	5	1.0	0.98
	No	22	8		

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; WIC, Women, Infants and Children program.

Outcomes and Individual Factors Associated with Substantial Capacity

The specific leadership and workforce factors that correlate with overall epidemiology and surveillance capacity (Table 24) were examined to determine whether they were associated with the desired level of involvement of MCHEs in various MCH program decision-making activities, with ready access to data, and with more regularly performing broader epidemiologic activities. These leadership and workforce factors included having a lead MCHE, having MCH epidemiology leaders with both scientific and administrative authority, and having at least five MCHEs. Although not significantly associated with having substantial to full MCH epidemiology capacity, having at least one doctoral-level MCHE and having MCHEs located within a program unit are considered capacity-building milestones. For this reason, we also included having a doctoral-level epidemiologist and having the majority of MCHEs located within a MCH program unit in this evaluation.

Lead MCHE: Jurisdictions with a lead MCHEs were significantly more likely to have substantial to full capacity for EPHS1 (OR 5.8) and EPHS2 (OR 4.6). MCHEs were more likely to participate in the decision-making process in terms of needs assessment (OR 8.8), priority setting (OR 5.5), and performance measures (OR 8.0) if the jurisdiction had a lead MCHE. Having a lead MCHE also was significantly associated with collaborating with the oral health (OH) program (OR 11.6) and publishing in peer-reviewed journals (OR undefined, p=0.01) (Table 27).

MCH Epidemiology Leaders with Scientific and Administrative Authority: A jurisdiction with MCH leaders who had both scientific and administrative authority were significantly more likely ($p \leq 0.01$) to have substantial to full capacity for each of the epidemiology-related EPHS and to have MCHEs substantially to fully involved in decision making for all aspects except program evaluation and policy development. Collaboration with the OH program and publishing peer-reviewed manuscripts were also significantly associated with having MCH leaders with authority (Table 27).

Five or More MCHEs: Having five or more MCHEs was significantly associated ($p \leq 0.03$) with having substantial to full capacity for all four of the epidemiology-related EPHS. It was also associated with involvement of MCHEs in decision making for performance measures and program evaluation. Having five or more MCHEs was also significantly associated with collaborating with the OH program (OR 5.3) and publishing in peer-reviewed journals (OR 4.0) (Table 27).

Doctoral-Level MCHE: There were no strong associations with markers of epidemiology capacity in jurisdictions with at least one doctoral-level MCHE, compared with jurisdictions without an MCHE with a doctoral degree (data not presented).

MCHEs Located Predominantly within an MCH Program Unit: Having most MCHEs located within an MCH program unit was significantly associated with having at least substantial capacity for EPHS2 (OR 5.3) and EPHS10 (OR 5.0). It was also significantly associated with three of the decision-making activities: needs assessment (OR undefined, p=0.004), priority setting (OR 11.1), and program planning (OR 4.6) (data not presented).

Table 27: Association of MCH workforce factors with selected programs measures and outcomes, 2013 ECA MCH Supplemental Module			
FACTOR	HAS LEAD MCHE	HAS MCHE LEADER WITH SCIENTIFIC AND ADMINISTRATIVE AUTHORITY	HAS ≥5 MCHEs
	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)
EPHS1: Monitor health status to identify health problems (substantial to full)	5.8 (0.03)	28.9 (0.003)	Undefined (0.01)
EPHS2: Diagnose and investigate health problems (substantial to full)	4.6 (0.04)	32.0 (<0.001)	Undefined (0.001)
EPHS9: Evaluate effectiveness, accessibility of health services (substantial to full)	2.5 (NS)	8.3 (0.004)	11.0 (0.03)
EPHS10: Research for new insights and innovative solutions (substantial to full)	3.0 (NS)	7.3 (0.007)	3.3 (NS)
Participate in decision making, re: needs assessment (substantial to full)	8.8 (0.01)	14.0 (0.003)	6.5 (NS)
Participate in decision making, re: priority setting (substantial to full)	5.5 (0.03)	6.6 (0.01)	1.9 (NS)
Participate in decision making, re: program planning (substantial to full)	2.9 (NS)	11.6 (0.001)	3.6 (NS)
Participate in decision making, re: performance measures (substantial to full)	8.0 (0.02)	22.0 (0.01)	Undefined (0.02)
Participate in decision making, re: program evaluation (substantial to full)	1.9 (NS)	3.4 (NS)	5.7 (0.04)
Participate in decision making, re: policy development (substantial to full)	1.1 (NS)	2.9 (NS)	2.2 (NS)
Have unfettered access: birth certificate data, death certificate data, and BRFSS data	3.7 (NS)	1.1 (NS)	1.9 (NS)
Have unfettered access to: WIC, newborn screening, family planning, and abortion data	Undefined (NS)	1.9 (NS)	1.1 (NS)
Calculate confidence intervals	2.8 (NS)	2.4 (NS)	2.0 (NS)
Conduct multivariable analysis	0.7 (NS)	1.5 (NS)	0.9 (NS)
Collaborate with mental health	3.1 (NS)	2.3 (NS)	3.8 (NS)
Collaborate with substance abuse	1.4 (NS)	1.4 (NS)	2.9 (NS)
Collaborate with WIC*	1.8 (NS)	2.4 (NS)	1.1 (NS)
Collaborate with oral health	11.6 (0.005)	6.5 (0.01)	5.3 (0.02)
Published at least one peer-reviewed article	Undefined (0.01)	5.1 (0.05)	4.0 (0.03)
Had at least one abstract at national meeting	1.3 (NS)	2.9 (NS)	3.3 (NS)
Published state reports	0.8 (NS)	2.9 (NS)	1.0 (NS)
Have online queryable data system	1.6 (NS)	2.2 (NS)	1.3 (NS)

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; ECA, Epidemiology Capacity Assessment; EPHS, essential public health services; MCH, maternal and child health; MCHE, MCH epidemiologist; NS, not significant (p>0.05); OR, odds ratio; WIC, Women, Infants, and Children program.

Outcomes Associated with Substantial Capacity for Essential Public Health Services

In addition to evaluating the outcomes and metrics associated with overall MCH epidemiology and surveillance capacity, we examined the association between having at least substantial capacity for the four epidemiology-related EPHS and two other important public health services: data linkages and translation of analytic findings.

EPHS1: Monitoring Health Status: Jurisdictions that had at least substantial MCH epidemiology capacity for EPHS1 were much more likely than those with less capacity to participate in the spectrum of decision-making activities that should be data-driven, such as needs assessment (OR 136.5), priority setting (OR 64.8), program planning (OR 28.9), performance measurement (OR undefined, $p<0.001$), program evaluation (OR undefined, $p<0.001$), and policy development (OR Undefined, $p=0.002$). They were also significantly more likely ($p<0.05$) to collaborate with OH programs, with others on work related to social determinants of health, and with government agencies. They were not more likely to calculate confidence intervals, conduct multivariable analysis, or have unfettered access to key MCH datasets (Table 28).

EPHS2: Diagnose and Investigate Health Problems: Having substantial to full capacity to diagnose and investigate health problems was significantly associated ($p\leq0.01$) with all of the decision-making activities except policy development. It was also associated with increased collaborations with the OH program (OR 5.4), schools of public health (OR 13.0), and government agencies (8.6). Two data dissemination outcomes—publishing in peer-review journals and presenting at conferences—also were significantly associated with at least substantial capacity for EPHS2 (Table 28).

EPHS9: Evaluate Effectiveness, Accessibility and Quality of Health Services: Jurisdictions that had at least substantial capacity to evaluate the effectiveness, accessibility, and quality of health services were significantly more likely ($p\leq0.01$) to have substantial to full capacity for all of the decision-making activities assessed. In addition, these jurisdictions were more likely to generate confidence intervals (OR 5.3), collaborate with OH programs (OR 9.0), and work on issues relating to social determinants of health (OR 8.3) (Table 28).

EPHS10: Research for New Insights and Innovative Solutions to Health Problems: Jurisdictions with at least substantial MCH capacity for EPHS10 were much more likely than those with less capacity to participate in the spectrum of MCH program decision-making activities that should be data-driven, such as needs assessment (OR 12.0), priority setting (OR 17.1), program planning (OR 7.3), performance measurement (OR undefined, $p=0.004$), and program evaluation (OR 3.8). These jurisdictions were also significantly more likely to routinely perform multivariable analyses (OR 4.4) (Table 28).

Promote and Contribute Expertise to the Linkage of Data Systems: Having substantial to full capacity to promote and contribute expertise to the linkage of data systems was significantly associated ($p\leq0.04$) with all of the MCH program decision-making activities. Jurisdictions with at least substantial capacity for linkage of data systems were significantly more likely to conduct multivariable analyses (OR undefined, $p=0.01$) and collaborate with government agencies (OR 5.6) (Table 28).

Translate Analytic Findings into Information Useful to Others: Jurisdictions with at least substantial MCH capacity to translate analytic findings into information directly usable to decision makers were much more likely than those with less capacity to participate in the spectrum of MCH program decision-making activities that should be data-driven, such as needs assessment (OR 38.0), priority setting (OR 9.7), program planning (OR 10.7), performance measures (OR 32.5), program evaluation (OR 34.0), and policy development (OR undefined, $p=0.002$). They were also more likely to collaborate with OH programs (OR 9.0), schools of public health (OR 5.6), and government agencies (OR 11.7) and work on social determinants of health (OR 5.2). In addition, jurisdictions with capacity for translating analytic finding were more likely to calculate confidence intervals (OR 6.0) (Table 28).

Table 28: Association of substantial to full capacity for public health services with desired MCHE involvement and activities, 2013 ECA MCH Supplemental Module

DESIRED MCH EPIDEMIOLOGIST INVOLVEMENT/PERFORMING SELECTED EPIDEMIOLOGY ACTIVITIES	EPHS1 MONITOR HEALTH	EPHS2 DIAGNOSE AND INVESTIGATE	EPHS9 EVALUATE EFFECTIVENESS	EPHS10 RESEARCH NEW INSIGHTS	PROMOTE DATA LINKAGE	TRANSLATE ANALYTIC FINDINGS
	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)	OR (P VALUE)
Participate in decision making, re: needs assessment (substantial–full)	136.5 (<0.001)	11.3 (0.004)	23.8 (0.001)	12.0 (0.03)	8.0 (0.01)	38.0 (<0.001)
Participate in decision making, re: priority setting (substantial–full)	64.8 (<0.001)	6.4 (0.01)	11.2 (0.002)	17.1 (0.01)	14.2 (0.001)	9.7 (0.01)
Participate in decision making, re: program planning (substantial–full)	28.9 (0.003)	8.6 (0.004)	5.8 (0.01)	7.3 (0.01)	8.7 (0.003)	10.7 (0.01)
Participate in decision making, re: performance measurement (substantial–full)	Undefined (<0.001)	36.0 (0.002)	Undefined (<0.001)	Undefined (0.004)	25.5 (0.005)	32.5 (0.001)
Participate in decision making, re: program evaluation (substantial–full)	Undefined (<0.001)	6.0 (0.01)	55.0 (<0.001)	3.8 (0.05)	4.0 (0.04)	34.0 (0.002)
Participate in decision making, re: policy development (substantial–full)	Undefined (0.002)	2.6 (NS)	8.9 (0.01)	3.0 (NS)	11.5 (0.004)	Undefined (0.002)
Have unfettered access to: birth certificate data, death certificate data and BRFSS data (yes)	2.4 (NS)	2.1 (NS)	3.1 (NS)	2.1 (NS)	2.0 (NS)	1.3 (NS)
Have unfettered access to: WIC, newborn screening, family planning, and abortion data (yes)	0.8 (NS)	0.4 (NS)	1.4 (NS)	1.5 (NS)	0.6 (NS)	0.8 (NS)
Calculate confidence intervals (routinely)	2.9 (NS)	2.8 (NS)	5.3 (0.02)	2.0 (NS)	1.9 (NS)	6.0 (0.05)
Conduct multivariable analysis (routinely)	Undefined (NS)	4.8 (NS)	2.0 (NS)	4.4 (0.04)	Undefined (0.01)	2.5 (NS)
Collaborate with mental health (frequently–routinely)	2.3 (NS)	4.1 (NS)	3.7 (NS)	1.9 (NS)	1.1 (NS)	2.3 (NS)
Collaborate with substance abuse (frequently–routinely)	2.6 (NS)	4.7 (NS)	1.7 (NS)	2.4 (NS)	1.3 (NS)	2.6 (NS)
Collaborate with WIC (frequently–routinely)	1.7 (NS)	1.2 (NS)	1.1 (NS)	1.8 (NS)	2.9 (NS)	3.2 (NS)
Collaborate with oral health (frequently–routinely)	7.3 (0.03)	5.4 (0.02)	9.0 (0.004)	3.2 (NS)	2.2 (NS)	7.3 (0.03)
Collaborate with schools of public health (frequently–routinely)	2.8 (NS)	13 (0.003)	2.4 (NS)	2.9 (NS)	1.6 (NS)	5.6 (0.05)
Collaborate with government organizations (frequently–routinely)	5.7 (0.04)	8.0 (0.01)	4.3 (NS)	2.9 (NS)	5.6 (0.02)	11.7 (0.01)
In last 12 months, collaborated on work, re: social determinants of health (frequently–routinely)	28.9 (0.003)	8.6 (0.004)	8.3 (0.004)	1.9 (NS)	3.4 (NS)	5.2 (0.04)
Published at least one peer-reviewed article (yes)	1.7 (NS)	8.3 (NS)	1.9 (NS)	2.0 (NS)	2.4 (NS)	1.7 (NS)
Had at least one abstract at national meeting (yes)	5.4 (NS)	6.5 (0.01)	2.6 (NS)	2.2 (NS)	3.6 (NS)	5.4 (NS)
Published state reports (yes)	2.7 (NS)	3.8 (NS)	2.3 (NS)	1.5 (NS)	2.3 (NS)	2.7 (NS)
Have online queryable data system (yes)	1.1 (NS)	2.3 (NS)	2.4 (NS)	1.6 (NS)	3.1 (NS)	1.1 (NS)

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; ECA, Epidemiology Capacity Assessment; EPHS, Essential Public Health Services; MCH, maternal and child health; MCHE, MCH epidemiologist; NS, not significant (p>0.05); OR, odds ratio; WIC, Women, Infants and Children program.

Assessing Maternal and Child Health Epidemiology Capacity by the Numbers

Evaluating epidemiology capacity by assessing a multitude of categorical analyses might not always provide a meaningful picture of a jurisdiction's overall epidemiology and surveillance capacity. Thus, "domain" scores were developed and used to determine the impact of key metrics on program outcomes and desired MCH epidemiology-related activities. The eight domains were capacity, decision making, unfettered access to data, analytic techniques, internal collaboration, external collaboration, spectrum of work, and data dissemination. For each question in the domain, a numeric score was assigned to the responses; the most desired response received the highest score. For example, if a question had four responses (never, rarely, occasionally, and routinely) the least desirable response was coded 0, and the most desirable response was coded 3. The numeric scores were summed across all questions in the domain to obtain an overall domain score.

Jurisdictions with an MCH leader who had scientific and administrative authority and jurisdictions with at least five MCHEs had significantly higher ($p \leq 0.01$) mean scores for all domains except those associated with access to data and analytic techniques (Table 29). Having a lead MCHE increased mean domain scores but they were only significantly higher for the collaboration, spectrum of work, and data dissemination domains (Table 29). Domain scores did not differ by population tertile. Domain scores did not differ for jurisdictions with and without doctoral-level MCHEs or by population tertile (data not shown).

Table 29: Mean domain scores by key MCH epidemiology capacity metrics, 2013 ECA MCH Supplemental Module

DOMAIN	JURISDICTION HAS LEAD MCHE			MCH LEADER HAS SCIENTIFIC AND ADMINISTRATIVE AUTHORITY			JURISDICTION HAS ≥5 MCHEs		
	YES (MEAN)	NO (MEAN)	P VALUE	YES (MEAN)	NO (MEAN)	P VALUE	YES (MEAN)	NO (MEAN)	P VALUE
Capacity	23.5	18.3	0.13	24.7	17.5	0.004	25.0	20.8	0.02
Decision making	20.6	16.2	0.18	21.5	15.5	0.01	22.6	17.8	0.01
Access to data	6.0	4.6	0.16	5.9	5.3	0.55	5.8	5.6	0.77
Analytic techniques	17.1	14.0	0.21	17.4	14.4	0.07	17.4	16.0	0.17
Internal collaboration	37.7	29.0	0.01	39.0	28.9	0.004	40.3	33.2	0.01
External collaboration	12.5	8.3	0.01	12.7	9.3	0.01	13.4	10.5	0.001
Spectrum of work	29.5	19.1	0.02	29.4	22.7	0.04	31.4	24.8	0.001
Data dissemination	5.1	3.1	0.01	5.2	3.4	0.001	5.4	4.2	0.01

Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist.

Maternal and Child Health Workforce Competency

Tier-Level Epidemiologist Perspective: The 2013 ECA Individual Worksheets asked individual epidemiologists to assess their competency and training needs by using the framework of the CDC/CSTE Applied Epidemiology Competencies. Individual epidemiologists were asked to indicate the tier to which they belonged and then to assess themselves according to their tier's specific set of competencies. The four tiers are

- Tier 1: entry-level or basic epidemiologist;
- Tier 2: mid-level epidemiologist;
- Tier 3a: senior-level epidemiologist supervisor and/or manager; and
- Tier 3b: senior scientist or subject area expert.

Tier 1 and Tier 3b epidemiologists were assessed in 30 competency areas, Tier 2 in 31 areas, and Tier 3a in 32 areas. A total of 285 MCHEs completed the self-assessment; 63 (22%) Tier 1, 111 (39%) Tier 2, 61 (21%) Tier 3a, and 50 (18%) Tier 3b epidemiologists. The response options for each competency were minimal or none, basic,

intermediate, advanced, and expert. In terms of training needs, MCHEs were asked to rank the need for additional training on a scale of 1 (less training needed) to 5 (more training needed).

Tier 1 Competencies: Tier 1 MCHEs indicated three competencies for which at least 70% had an intermediate, advanced, or expert level of competency: demonstrating ability to listen effectively when epidemiologic finding are presented (78%), using analysis plans and analyzing data (72%), and preparing written and oral presentations (70%).

There are 10 competencies for which 20% or more had minimal or no level of competency: identifying the role of laboratory resources (39%), applying appropriate fiscal and administrative guidelines (38%), using informatics tools in support of epidemiologic practice (30%), using knowledge of biology and behavioral sciences to determine mechanisms of disease (28%), recognizing the basic principles of risk communication (25%), describing human subjects research and applying Institutional Review Board processes (23%), assisting in conducting community health status assessments (23%), describing how policy decisions are made (22%), knowing how causes of disease affect epidemiologic practice (21%), and providing epidemiologic input for community planning processes (20%).

Tier 2 Competencies: At least 70% of Tier 2 MCHEs said they had an intermediate, advanced, or expert level of competency in 21 (68%) of the 31 competencies. The nine competencies for which at least 40% had an advanced or expert level of competency were creating analysis plans and conducting analysis of data (57%); following ethics guidelines and principles (55%); defining database requirements and managing a database (49%); articulating the need for further investigation from literature review (48%); assisting in the development of measurable and relevant goals and objectives (45%); applying knowledge of privacy laws to protect confidentiality (44%); promoting ethical conduct in epidemiologic practice (41%); collaborating with others inside and outside the agency (41%); and assisting in design of an investigation, including hypothesis generation (40%).

The Tier 2 competencies for which ≥10% of MCHEs had minimal or no level of competency were using laboratory resources to support epidemiologic activities (26%), applying appropriate fiscal and administrative guidelines to epidemiology practice (19%), providing epidemiologic input for community planning processes (12%), using leadership and systems thinking in epidemiologic planning and policy development (12%), creating analysis plans and conducting analysis of data (10%), defining database requirements and managing a database (10%), communicating epidemiologic information through oral presentations or written documents (10%), and establishing cultural/social/political framework for recommendations or interventions (10%).

Tier 3a Competencies: The 61 senior-level MCHEs with program management and/or supervisory responsibilities indicated 22 (63%) of 32 competencies for which at least 70% had an intermediate, advanced, or expert level of competency. The 12 competencies for which at least 50% had an advanced or expert level of competency were ensuring management of data from surveillance (74%); evaluating conclusions and interpretations from investigations (74%); overseeing surveillance activities (69%); ensuring identification of public health problems (67%); ensuring preparation of written and oral reports and presentations (67%); ensuring study design and data collection, dissemination, and use of ethical and legal principles (66%); evaluating analysis of data from an epidemiologic investigation or study (66%); promoting ethical conduct in epidemiology practice (66%); using basic public health sciences in epidemiologic practice (62%); modeling interpersonal skills in communication (62%); enforcing policies that address security, privacy, and legal considerations when communicating epidemiologic information (61%); and ensuring application of principles of informatics, including data collection, processing, and analysis, in support of epidemiologic practice (61%).

The Tier 3a competencies for which ≥10% of MCHEs reported having minimal or no level of competency were ensuring the use of laboratory resources (33%); leading epidemiology unit in preparing for emergency response (28%); leading community public health planning processes (15%); ensuring identification of public health problems pertinent to the population (13%); developing requests for extramural funding to support additional

epidemiologic activities and special projects (13%); determining evidence-based interventions and control measures in response to epidemiologic findings (13%); evaluating conclusions and interpretations from investigations (12%); enforcing policies that address security, privacy, and legal considerations when communicating epidemiologic information (12%); using management skills (12%); bringing epidemiologic perspective in the development and analysis of public health policies (12%); formulating a fiscally sound budget (12%); and overseeing implementation of operational and financial plans (16%).

Tier 3b Competencies: The 50 senior scientist epidemiologists indicated 26 (87%) of 30 competencies for which at least 70% considered themselves to have an intermediate, advanced, or expert level of competency. At least 50% indicated an advanced or expert level of competency in 17 (57%) of the competencies.

The Tier 3b competencies for which ≥15% of MCHEs reported having minimal or no level of competency were developing processes for using laboratory resources to support epidemiologic activities (28%), evaluating results of data analysis and interpreting conclusions (18%), validating identification of public health problems pertinent to the population (18%), promoting the epidemiologic perspective in the agency strategic planning process (18%), organizing preparation of written and oral presentations that communicate necessary information (16%), evaluating data from an epidemiologic investigation or study (16%), and preparing for emergency response.

Training Needs: As would be expected, training needs varied by tier level, and the percentage of MCHEs indicating the need for more training decreased as tier level increased. At least 30% of Tier 1 MCHEs indicated needing more training in 12 competencies, and at least 24% of Tier 2 MCHEs indicated needing more training in 10 competencies. For Tier 3a MCHEs, at least 30% indicated needing more training in three competencies, and 30% of Tier 3b MCHEs indicated needing more training in only two competencies (Table 30).

Table 30: Competencies identified by MCHEs requiring less training and more training, 2013 ECA Individual Worksheets

COMPETENCIES WITH LESS TRAINING NEEDED (PERCENT INDICATING LEVEL 1 OR 2 ON A SCALE OF 1–5)	COMPETENCIES WITH THE MORE TRAINING NEEDED (PERCENT INDICATING LEVEL 4 OR 5 ON A SCALE OF 1–5)
Tier 1	
Demonstrate ability to listen effectively when epidemiologic finding are presented (68%)	Use identified informatics tools in support of epidemiologic practice (47%)
Apply knowledge of privacy laws to protect confidentiality (67%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (47%)
Follow ethics guidelines and principles when planning studies; conducting research; etc. (67%)	Assist in conducting a community health status assessment (42%)
Support the organization's vision in all programs and activities (67%)	Implement new or revise existing surveillance systems and report key surveillance findings (42%)
Promote ethical conduct in epidemiologic practice (61%)	Describe how policy decisions are made within the agency (40%)
Identify key findings from the study (60%)	Identify the role of laboratory resources in epidemiologic activities (38%)
Describe human subjects research and apply IRB processes (59%)	Use knowledge of biology and behavioral sciences to determine potential biological mechanisms of disease (38%)
Prepare written and oral reports and presentations that communicate necessary information (58%)	Support evaluation of surveillance systems (37%)
Practice professional development (58%)	Provide epidemiologic input for community planning processes (32%)
Use analysis plans and analyze data (54%)	Recognize the basic principles of risk communication (32%)
Use effective communication technologies (51%)	Identify surveillance data needs (31%)
Maintain databases (51%)	Know how causes of disease affect epidemiologic practice (30%)
Tier 2	
Follow ethics guidelines and principles when planning studies; conducting research; etc. (66%)	Conduct a community health assessment and recommend priorities (33%)
Apply knowledge of privacy laws to protect confidentiality (65%)	Use leadership and systems thinking in epidemiologic planning and policy development (31%)
Promote ethical conduct in epidemiologic practice (64%)	Apply understanding of biology and behavioral sciences to determine potential biological mechanisms of disease (30%)
Describe human subjects research, and apply IRB processes, as necessary (59%)	Demonstrate the basic principles of risk communication (28%)

Collaborate with others inside and outside the agency to identify the problem and form recommendations (59%)	Use laboratory resources to support epidemiologic activities (28%)
Articulate the need for further investigation from literature review and assessment of current data (58%)	Assess the need for special analyses (27%)
Define database requirements, and manage a database (57%)	Establish cultural/social/political framework for recommendations or interventions (25%)
Communicate epidemiologic information through oral presentations or written documents to nonprofessional audiences (56%)	Assist in the development of program logic models and theories of action (25%)
Use scientific evidence in preparing recommendations for action (56%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (25%)
Use critical thinking to determine whether a public health problem exists (55%)	Conduct evaluation of surveillance systems (24%)
Tier 3a	
Use basic public health sciences in epidemiologic practice (77%)	Lead epidemiology unit in preparing for emergency response (34%)
Ensure identification of public health problems pertinent to the population (75%)	Ensure the use of laboratory resources to support epidemiologic activities (30%)
Ensure management of data from surveillance, investigations, or other sources (75%)	Lead community public health planning processes (28%)
Promote ethical conduct in epidemiology practice (72%)	Use management skills (28%)
Evaluate conclusions and interpretations from investigations (70%)	Promote collaborations, strong partnerships, and team-building to accomplish epidemiology program objectives (25%)
Oversee surveillance activities (69%)	Develop requests for extramural funding to support additional epidemiologic activities (25%)
Ensure study design and data collection, dissemination, and of use ethical and legal principles (66%)	Create operational and financial plans for future epidemiologic activities (25%)
Evaluate analysis of data from an epidemiologic investigation or study (66%)	Bring epidemiologic perspective in the development and analysis of public health policies (25%)
Practice culturally sensitive epidemiologic activities (66%)	
Model interpersonal skills in communication with agency personnel, colleagues, and the public (66%)	
Tier 3b	
Organize preparation of written and oral presentations that communicate necessary information (86%)	Develop processes for using laboratory resources to support epidemiologic activities (22%)
Evaluate results of data analysis and interpret conclusions (84%)	Describe financial and budgetary processes of the agency (22%)
Manage data from surveillance, investigations, or other sources (82%)	Implement operational and financial plans for assigned projects (20%)
Validate identification of public health problems pertinent to the population (80%)	Evaluate programs (18%)
Evaluate data from an epidemiologic investigation or study (78%)	Ensure application of understanding of biology and behavioral sciences to determine mechanisms of disease (18%)
Promote ethical conduct in the epidemiology practice (76%)	Bring epidemiologic perspective in the development and analysis of public health policies (16%)
Synthesize principles of good ethical/legal practice for application to study design and data collection, dissemination, and use (76%)	Prepare for emergency response (16%)

Abbreviations: ECA, Epidemiology Capacity Assessment; MCHE, maternal and child health epidemiologist.

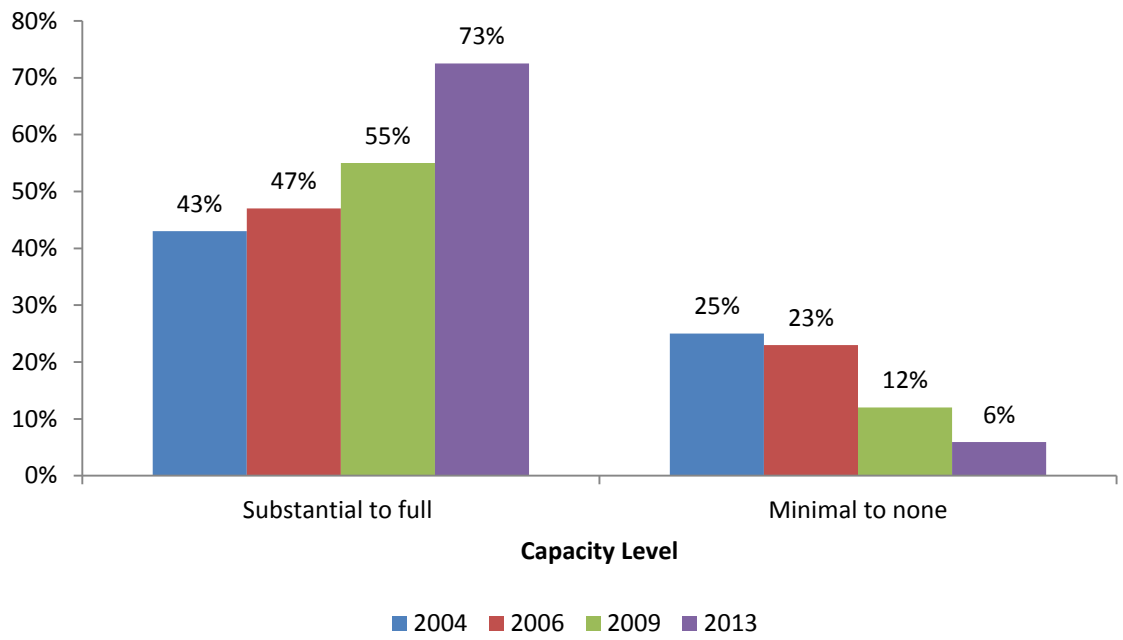
Trends, 2004–2013

In 2004, 2006, 2009, and 2013, the Core ECAs asked a number of comparable questions about MCH epidemiology capacity. In addition, the 2009 and 2013 ECA MCH Supplemental Modules contained similar questions that can be used to asses trends. For the 2004–2013 Core ECAs, all 50 states and the District of Columbia responded. Fifty-one jurisdictions completed the 2009 MCH Supplemental Module and 49 completed the 2013 Supplemental Module. The information presented in this section is for all responding jurisdictions and is not restricted to jurisdictions that responded in all years.

Maternal and Child Health Epidemiology Functional Capacity: The Core ECA asked jurisdictions to specify the extent of the epidemiology and surveillance capacity they had in each program area based on the percentage of the activity, knowledge, or resources they had; percentages were categorized into six groups ranging from none to full (100%). Figure 21 shows trends in the percentage of jurisdictions since 2004 that reported having at least substantial (≥50%) and minimal to no (<25%) capacity. The percentage of jurisdictions with at least substantial

capacity steadily increased, with a substantial increase from 2009 (55% of jurisdictions) to 2013 (73%). A concomitant decline occurred in the percentage of jurisdiction with minimal to no capacity.

Figure 21: Trends in percentage of jurisdictions with substantial to full and minimal to no MCH epidemiology and surveillance capacity, 2004, 2006, 2009, and 2013 Core ECAs



Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

Functional Capacity for the Essential Public Health Services and Related Services: As with overall MCH epidemiology capacity, there was a substantial increase in the percentage of jurisdictions that reported having at least substantial MCH epidemiology capacity for each of the four EPHS most relevant to epidemiology and the two other epidemiology-related services (Table 2). The increase in percentage points ranges from nine for EPHS1 to 38 for EPHS9.

Barriers to Achieving Almost Full to Full Capacity: In both 2009 and 2013, jurisdictions were asked to identify barriers to achieving almost full to full capacity for six services of public health: the four relevant EPHS, data linkages, and translation of analytic findings (Table 31). In 2013 substantially more jurisdictions reported "staff with inadequate skills" and "inadequate data resources" than they did in 2009 as reasons for not achieving at least almost full capacity. Jurisdictions could select multiple barriers.

Table 31: Number (%)* of jurisdictions that identified barriers to reaching almost full to full capacity, 2009 and 2013 ECA MCH Supplemental Modules

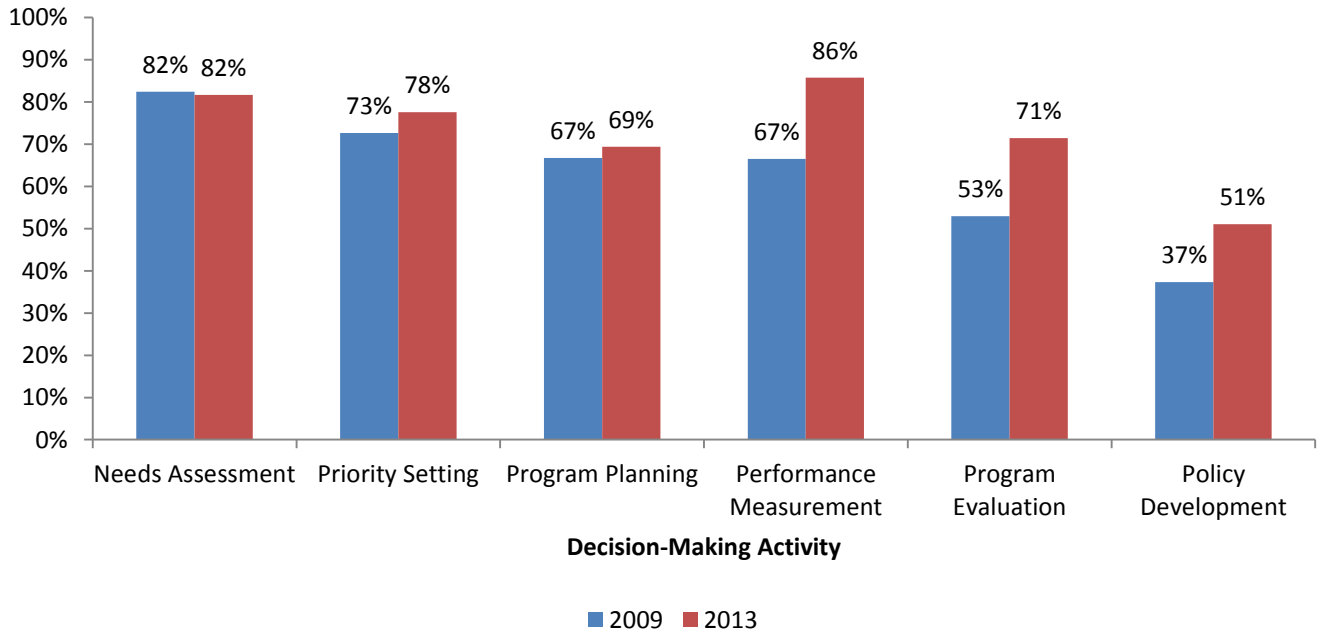
BARRIER	2009			2013		
	INADEQUATE NO. OF STAFF	STAFF WITH INADEQUATE SKILLS	INADEQUATE DATA RESOURCES	INADEQUATE NO. OF STAFF	STAFF WITH INADEQUATE SKILLS	INADEQUATE DATA RESOURCES
	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)	NO. (%)
EPHS1: Monitor health status	35 (100.0)	0	0	20 (90.9)	5 (22.7)	8 (36.3)
EPHS2: Diagnose and investigate	37 (86.0)	0	0	24 (92.3)	6 (23.1)	8 (30.8)
EPHS9: Evaluate effectiveness	38 (88.4)	1 (2.3)	1 (2.3)	27 (93.1)	15 (51.7)	12 (41.4)
EPHS10: Research for new insights	40 (88.9)	1 (2.2)	1 (2.2)	29 (82.9)	13 (37.1)	10 (28.6)
Link data systems	33 (84.6)	3 (7.7)	0	21 (87.5)	11 (45.8)	11 (45.8)
Translate analytic findings	29 (90.6)	3 (9.4)	0	16 (80.0)	8 (40.0)	3 (15.0)

*Denominator = number of jurisdictions that reported less than almost full capacity; Jurisdictions could select multiple responses so percents may exceed 100%.
Abbreviations: ECA, Epidemiology Capacity Assessment; EPHS, Essential Public Health Services; MCH, maternal and child health.

Leadership and Authority: The percentage of MCHE leaders with both scientific and administrative authority substantially increased from 49% in 2009 to 69% in 2013. The percentage of jurisdictions with a lead MCHE did not change from 2009 (80%) to 2013 (78%).

Role of MCHEs—Decision Making: Since 2009, the percentage of jurisdictions in which MCHEs were substantially to fully involved in decision making in performance measurement, program evaluation, and policy development increased substantially. The percentage of MCHEs involved in decision making about policies, however, was still only 51% (Figure 22).

Figure 22: Trends in percentage of jurisdictions in which MCHEs contributed at least substantially to decision-making activities, 2009 and 2013 ECA MCH Supplemental Modules



Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health; MCHE, MCH epidemiologist.

Access to Data and Types of Analyses Performed: The same questions were asked about unfettered access to selected datasets in the 2009 and 2013 MCH Supplemental Modules. For most of the datasets, no substantial changes occurred (<10% difference in percentage of jurisdictions with unfettered access). However, unfettered

access to family planning, hospital discharge, emergency department, Youth Risk Behavior Survey, and Behavioral Risk Factor Surveillance System data increased by >10 percentage points (Table 32). For states with unfettered access to data, the percentage reporting timely access increased by >10 percentage points for fetal death, abortion, Medicaid, and emergency medical services (EMS) data (data not presented).

The percentage of jurisdictions that reported their MCHEs conducted a variety of statistical analyses, such as population-specific rates, confidence intervals, statistical testing of comparisons, and multivariable analyses, at least frequently did not change from 2009 to 2013 (data not presented).

Table 32: Percentage of jurisdictions that reported having unfettered access to datasets, 2009 and 2013 ECA MCH Supplemental Modules

DATASET	2009 % YES	2013 % YES
Birth certificate	72.6	71.4
Death certificate	72.6	73.5
Fetal death	68.6	65.3
Linked birth–infant death	72.6	75.5
Medicaid	23.5	28.6
Newborn screening	54.9	55.1
Birth defects registry	54.9	61.2
Family planning	43.1	61.2
Abortion	39.2	38.8
Immunization	23.5	26.5
Women, Infants and Children program (WIC)	45.1	40.8
Hospital discharge	49.0	65.3
Emergency department	23.5	40.8
Emergency medical services)	15.7	10.2
Pregnancy Risk Assessment Monitoring System	72.6	75.5
Youth Risk Behavior Survey	41.2	53.1
Behavioral Risk Factor Surveillance System	56.9	71.4

Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

Collaborations with Internal and External Organizations: From 2009 to 2013, the percentage of jurisdictions that reported at least frequent collaboration with mental health programs (12% to 24%) and nongovernment organizations (59% to 77%) increased by 10 percentage points. The percentage of jurisdictions that reported collaboration with chronic disease (63% to 53%) decreased by 10 percentage points (Table 33).

Table 33: Percentage of jurisdictions that reported routine or frequent collaboration with internal and external organizations, 2009 and 2013 ECA MCH Supplemental Modules		
ORGANIZATION	2009 ROUTINE/FREQUENT COLLABORATION NO. (%)	2013 ROUTINE/FREQUENT COLLABORATION NO. (%)
Title V staff	49 (96.1)	47 (95.9)
Title V director	48 (94.1)	44 (89.8)
Children with special health-care needs staff	39 (76.5)	37 (75.5)
Title V director for children with special health-care needs	37 (72.5)	36 (73.5)
WIC staff	28 (54.9)	30 (61.2)
Infectious diseases	13 (25.5)	10 (20.4)
Public health preparedness	7 (13.0)	6 (12.2)
Injury	27 (52.9)	21 (42.9)
Oral health	30 (58.8)	31 (63.3)
Mental health	6 (11.8)	11 (22.4)
Substance abuse	11 (21.6)	12 (24.5)
Chronic diseases	32 (62.7)	26 (53.1)
Environmental health	15 (29.4)	12 (24.5)
Occupational health	4 (7.8)	2 (4.1)
Birth defects	32 (62.7)	33 (67.3)
Schools of public health	31 (60.8)	28 (58.3)
Other academic institutions	28 (54.9)	28 (58.3)
Federal government organizations	43 (84.3)	38 (79.1)
Nongovernment organizations	30 (58.8)	37 (77.1)

Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health: WIC, Women, Infants and Children program.

Spectrum of Work: In both 2009 and 2013, each jurisdiction was asked how frequently its MCHEs worked in nine selected health areas during the past 12 months. The percentage of jurisdictions reporting frequent to routine work did not differ in any of the nine areas in 2009 and 2013 (Table 34).

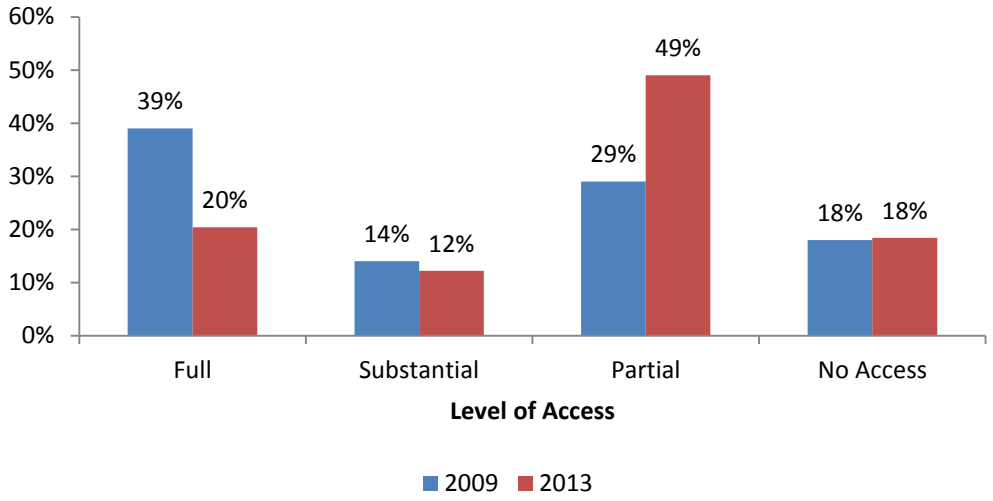
Table 34: Percentage of jurisdictions that reported routine or frequent work in selected health areas during the past 12 months, 2009 and 2013 ECA MCH Supplemental Modules		
HEALTH AREA	2009 ROUTINE/FREQUENT WORK NO. (%)	2013 ROUTINE/FREQUENT WORK NO. (%)
Maternal/infant health	48 (94.1)	46 (93.8)
Child health	44 (86.2)	43 (87.7)
Women's health	42 (82.3)	41 (83.6)
Racial/ethnic disparities	44 (86.2)	40 (81.6)
Adolescent health	42 (82.3)	35 (71.4)
Social determinants of health	35 (68.6)	34 (69.3)
Case reviews*	33 (64.7)	35 (71.4)
Children with special health-care needs	33 (64.7)	36 (73.4)
Men's health	6 (11.7)	5 (10.2)

*Case reviews might include fetal, infant, child, and maternal death reviews.
Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

Access to Published Literature: MCHEs need ready access to the full-text medical, epidemiologic, and public health literature. Ready access was defined as 0–3 days' return by electronic or hard copy after submission of a request. In 2009, 39% of jurisdictions had full access, compared with only 20% in 2013. The response options to this question differed in the 2 years. In 2009, the response options were full access, substantial access (>25 journals but no full access), partial access (<25 journals), and no access. The response options for 2013 were unlimited full access, almost full access (access to most of the scientific journals needed), partial access (access to

only a portion of the scientific journals needed), and no access. Differences noted might be due solely to differences in the response options.

Figure 23: Trends in access to full-text medical, epidemiology, and public health literature, 2009 and 2013 ECA MCH Supplemental Modules



Abbreviations: ECA, Epidemiology Capacity Assessment; MCH, maternal and child health.

MCH Epidemiology Workforce—Level of Epidemiology Training: Examination of data from 2004 through 2009 found no striking trends in the make-up of the MCH epidemiology workforce. From 2009 to 2013, however, the percentage of MCHEs with a master's degree in epidemiology increased from 30% to 40% (Table 35).

Table 35: Trends in level of epidemiology training of MCHEs, 2004, 2006, 2009, and 2013 ECA Individual Worksheets

TRAINING LEVEL*	2004 ECA	2006 ECA	2009 ECA	2013 ECA
	NO. FTE (%)	NO. FTE (%)	NO. FTE (%)	NO. FTE (%)
PhD, DrPH	21 (9)	29.0 (12)	23.5 (16.0)	14.7 (8.3)
MD, DVM, DDS + Master's	18 (8)	20.8 (9)	12.5 (8.5)	9.4 (5.3)
Master's in epidemiology	66 (29)	72.7 (30)	44 (29.9)	70.0 (39.8)
Bachelor's in epidemiology	16 (7)	4.0 (2)	1 (0.7)	–
EIS or other formal program	6 (3)	10.9 (4)	8.5 (5.8)	7.3 (4.2)
Some coursework	39 (17)	61.8 (25)	36 (24.5)	48.8 (27.8)
On-the-job training	41 (18)	22.6 (9)	18.5 (12.6)	15.9 (9.0)
None	20 (9)	18.8 (8)	3 (2.0)	8.7 (5.0)
Unknown	–	2.0 (1)		1.1 (0.6)
Total	**227 (100)**	**242 (100)**	**147 (100)**	**175.7 (100)**

*Training level is hierarchical, with the highest level of epidemiology-specific training being the relevant category. For example, a physician completing EIS who has a master's in epidemiology will be listed as being a "MD + Master's," not "EIS or other formal program. Abbreviations: ECA, Epidemiology Capacity Assessment; EIS, Epidemic Intelligence Service; FTE, full-time equivalent; MCHE, maternal and child health epidemiologist.

Discussion

MCH programs address issues affecting families; women of reproductive age; and infants, children, and adolescents, including those with special health-care needs. Certain health indicators for these populations improved but others got substantially worse. For example, infant mortality rates declined, but the percentage of children with special health-care needs and the percentage of obese children increased. To monitor trends in the

prevalence of MCH-related health concerns and conditions, to develop and evaluate the population-based programs necessary to address these health concerns, and to research for new insights and innovations, state and territorial health jurisdictions need a cadre of skilled MCHEs. Because MCH depends on the availability of population-based datasets, such as birth and fetal death data, MCHEs must have the skills and statistical software necessary to manipulate large datasets. They must also have the ability to interpret the data and to assist in developing prevention programs based on current data and evidence-based approaches.

Of the three program areas evaluated, MCH had the largest gains in epidemiology and surveillance capacity. The percentage of jurisdictions with substantial to full MCH capacity increased from 55% in 2009 to 73% in 2013, and the percentage with almost full to full capacity increased from 20% to 37%. Concomitant to the increase in overall capacity was an increase in capacity for each of the four epidemiology-related EPHS, data linkages, and the ability to translate analytic findings. Although the MCH Supplemental Module did not attempt to measure all possible reasons for this increase, it did collect data that suggested that programs that had adopted two key features of the recommended ideal MCH program structure had a higher level of epidemiology functioning than did those that had not. These features included having a lead MCHE and having an MCH epidemiology leader with both scientific and administrative authority. A third factor associated with improved epidemiology capacity was having a minimum workforce of at least five MCHEs. Since 2009, the percentage of jurisdictions in which MCH epidemiology leaders have both scientific and administrative authority increased (49% to 69%). MCH authority and workforce are correlated; the mean number of part- and full-time MCHEs is higher in jurisdictions in which MCHE leaders have full authority.

As MCH capacity increased, so did metrics and outcomes. Since 2009, a higher percentage of MCHEs had a master's degree in epidemiology (30% to 40%) and a substantially higher percentage of jurisdictions reported that their MCHEs were substantially to fully involved in decision-making activities related to performance measurement (67% to 86%), program evaluation (53% to 71%), and policy development (37% to 51%). More jurisdictions had unfettered access to family planning, hospital discharge, emergency department, Youth Risk Behavior Survey, and Behavioral Risk Factor Surveillance System data and more timely access to fetal death, abortion, Medicaid, and EMS data. The percentage of jurisdictions reporting at least frequent collaboration increased for mental health programs (12% to 24%) and nongovernment organizations (59% to 77%). Unfortunately, collaboration with chronic disease programs decreased from 63% to 53% of jurisdictions.

Underlying these developments are a long series of efforts by CDC, HRSA, CSTE, and the Association of Maternal and Child Health Programs to strengthen MCH epidemiologic leadership and to develop state standards and milestones for MCH epidemiology capacity development. Since the late 1980s, MCHEs have formed workgroups and developed plans and progress measures and worked toward these plans and measures. Not surprisingly, MCH is one of the best developed program areas in terms of epidemiology capacity: 73% of jurisdictions reported at least substantial capacity in 2013. The process MCH has undergone should be a lesson for developing higher-level epidemiology capacity in other underdeveloped program areas.

Although substantial progress has been made, more is needed. Only 37% of jurisdictions had almost full to full MCH capacity, and <50% of jurisdictions had unfettered access to key datasets: Medicaid; abortion; immunization; Women, Infants and Children; emergency department; and EMS. Although MCHEs in most ($\geq$88%) jurisdictions reported conducting standard data analyses (population-specific rates, confidence intervals, and comparisons with other rates), <30% of jurisdictions had MCHEs who routinely performed multivariate analyses. Collaboration with key programs also needs to be improved. More than 50% of jurisdictions reported infrequent or no collaboration with mental health, substance abuse, environmental health, and occupational health programs. This gap is potentially serious because many MCH issues have large mental health, substance abuse, environmental health, and occupational health components.

Conclusions

- MCH epidemiology and surveillance capacity continued to grow well into 2013. The setting of MCH epidemiology milestones—including strong leadership with both scientific and administrative authority—and achievement of the milestones in many states appeared to have contributed to continued growth.
- MCH programs in most jurisdictions had substantial capacity in many areas, participated in all areas of decision making, had unfettered access to the most basic datasets, conducted sophisticated statistical analyses, and were involved in a broad spectrum of MCH activities. Their most pressing need was additional staff and training of existing staff.
- Despite achievements, the MCH epidemiology capacity glass is only half full: nearly two-thirds of states lacked almost full MCH epidemiology and surveillance capacity, and in only a minority of jurisdictions did MCHEs participate almost fully in policy development; have access to important datasets; and work with colleagues in substance abuse, mental health, environmental health, and occupational health programs.

Maternal and Child Health Recommendations

1. MCH epidemiology capacity should be explicitly considered in the national dialogue about addressing the gaps identified in the Core ECA in overall state-based epidemiology capacity and ensuring that states have the capacity needed to provide essential data for effective program planning, public health action, evaluation, and policy development.

2. Improving capacity in states that have minimal to no MCH epidemiology capacity should be a priority. At a minimum, every state should have a lead MCH epidemiologist (MCHE), an MCH leader with both scientific and administrative authority, and at least five MCHEs. These were the factors associated with higher-level capacity.

3. The CSTE MCH Workgroup may be a model for other program areas that need development of epidemiology and surveillance capacity (e.g., substance abuse, mental health, OH). The CSTE MCH Workgroup, which includes AMCHP, HRSA/MCHB, CDC's Division of Reproductive Health, and state and local MCH programs, should assist other program areas by sharing lessons learned and best practices.

4. State MCHEs should build partnerships to collaborate with substance abuse, mental health, and occupational health epidemiologists, in addition to partnerships with injury, environmental health, CD, and OH programs.

ORAL HEALTH: ASSESSING AND BUILDING CAPACITY

Before 2000, very few state oral health (OH) programs had the epidemiology capacity necessary to meet any of the epidemiology-related Essential Public Health Services (EPHS). OH programs did not employ epidemiologists, and very little collaboration occurred between OH and epidemiologists in other program areas. Thus, OH programs often "borrowed" a faculty member or graduate student from an academic institution to complete one-time projects. The prevalence of oral disease among at-risk populations at the state level remained largely undocumented, surveillance of oral conditions was relatively limited, and most states lacked an OH surveillance system and the capacity to conduct basic surveillance (EPHS1).[22]

A major event occurred in 1999 that paved the way for recognition of OH epidemiology capacity as an important aspect of state OH programs: the Council of State and Territorial Epidemiologists (CSTE) approved two position statements that added several OH indicators to the National Public Health Surveillance System.[23,24] In the early 2000s, as demand from states expanded, technical assistance from two doctoral-level OH epidemiologists (OHEs) was funded through the Centers for Disease Control and Prevention (CDC) cooperative agreement with the Association of State and Territorial Dental Directors (ASTDD). Although this mechanism allowed for increases in state OH epidemiology capacity, supply to all states was limited.

Through the CDC State Chronic Disease Epidemiology Program (formerly the State-based Epidemiology for Public Health Program Support [STEPPS] program), CDC assigned epidemiologists to three states (New Hampshire, Ohio, Colorado) to serve as both the lead chronic disease epidemiologist (CDE) and the lead OHE. In fiscal year 2001, CDC's Division of Oral Health implemented multiyear cooperative agreements with 12 states to support OH capacity. In 2013, CDC funded 21 state health departments with a 5-year cooperative agreement to build and/or maintain effective public health capacity for implementation, evaluation, and dissemination of best practices associated with evidence-based strategies and improvement of OH in these states. All CDC grantees are required to develop or enhance OH surveillance as measured by the enhanced operational definition of a state OH surveillance system proposed for Healthy People 2020 objective OH-16. Grantees can assess their data and determine which indicators can translate into readable, comparable, and actionable data points to highlight the state burden of oral diseases and/or factors that might influence oral diseases. CDC has made OH epidemiology one of the preferred public health skill sets for this grant. State OH programs have the flexibility to share the epidemiology position with other programs. Most state programs do not employ a full-time OHE. This particular cooperative agreement encourages state OHEs to build their skills by participating in CSTE and activities of the ASTDD Data Committee.

Even with these efforts, state-level OH epidemiology capacity is abysmal. According to the 2009 Epidemiology Capacity Assessment (ECA), 61% of jurisdictions had minimal or no OH capacity. Although both CDC and ASTDD recognize that having a robust OH surveillance system is an essential ingredient to a successful OH program, no information is available about what factors are associated with increased OH epidemiology and surveillance capacity. To better understand state capacity for OH epidemiology, the first OH Supplemental Module was included in the 2013 ECA. The OH Supplemental Module was developed through a CDC/CSTE cooperative agreement project that included collaborations among CSTE, ASTDD, and CDC. The OH Supplemental Module was designed to provide an in-depth assessment of the infrastructure, workforce, and skills of state OHEs and how this capacity supported EPHS in states (e.g., higher-level interpretation of data, formulation of new research or evaluation questions, and contribution to decision making about program priorities).

CSTE and ASTDD have been important CDC partners in defining core elements of a state OH surveillance system, assessing the epidemiology workforce to determine existing capacity and needed skills, and developing a 3-year plan to train epidemiologists to fill capacity and education gaps identified through this assessment.

The general results of the 2013 Core ECA and 2013 OH Supplemental Module are presented in the "Overall Epidemiology Capacity Assessment for Chronic Disease, Maternal and Child Health and Oral Health" section of this document.

> The purpose of this section, "Oral Health—Assessing and Building Capacity," is to present more detailed information about the findings that relate specifically to OH epidemiology, the role of state OH epidemiologists, and the factors associated with improved OH epidemiology capacity.

Oral Health Epidemiology Workforce

Lead/Primary OHE: Earlier in this document we presented information about the percentage of jurisdictions with a lead epidemiologist in each program area. This information was obtained from the Core ECA, which asked the state epidemiologist whether the jurisdiction had a lead epidemiologist for a variety of program areas. The OH Supplemental Module asked whether a jurisdiction's OH program had a designated primary OHE. Responses from the Core ECA and the OH Supplemental Module were similar for 74% of jurisdictions (Table 36).

Table 36: Number (%) of jurisdictions with a lead and primary OH epidemiologist, 2013 Core ECA and OH Supplemental Module

STATE EPIDEMIOLOGIST REPORTED HAVING LEAD OHE	OH SUPPLEMENTAL MODULE REPORTED HAVING PRIMARY OHE		
	YES NO. (%)	NO NO. (%)	TOTAL NO. (%)
Yes	17 (34.7)	4 (8.2)	21 (42.9)
No	8 (16.3)	19 (38.8)	27 (55.1)
Unknown	0	1 (2.0)	1 (2.0)
TOTAL	**25 (51.0)**	**24 (49.0)**	**49 (100.0)**

Abbreviations: ECA, Epidemiology Capacity Assessment; OH, oral health; OHE, OH epidemiologist

According to information from the OH Supplemental Module, 25 (51%) jurisdictions reported having a designated primary OHE. Of these, 12 (48%) OHEs were full time (0.7–1.0 full-time equivalent [FTE]), 4 (16%) were half time (0.4–0.5 FTE), and 9 (36%) were less than half time (0.05–0.25 FTE). Most (64%) primary OHEs had training at the master's level, and 36% had a doctoral degree (DDS/DMD, DVD, MD, PhD).

OH Epidemiology Support from Other Program Areas: In addition to the primary OHE, 32 (65%) jurisdictions reported working with an epidemiologist or data analyst from another program to analyze and interpret OH data. The jurisdiction's maternal and child health (MCH) program was the unit most used by the OH program. Of the 49 responding jurisdictions, 8 (16%) reported having a primary OHE and no other epidemiology support, 17 (35%) had a primary OHE and support from another program unit, 15 (31%) had no OHE but obtained support from another unit, and 9 (18%) had no epidemiology support for their OH program.

Factors Associated with Substantial Capacity

For OH programs, three general factors were independently associated with having at least substantial epidemiology and surveillance capacity: having a lead/primary OHE, having at least 0.7 FTE OHE, and having CDC Division of Oral Health State Oral Disease Prevention Program funding (Table 37). For the 25 jurisdictions with a primary OHE, having a doctoral-level OHE was not associated with overall epidemiology and surveillance capacity. Logistic regression analyses showed that two factors were significant in a multivariable model: current CDC

Division of Oral Health State Oral Disease Prevention Program funding (odds ratio [OR] 5.8, p=0.03) and state epidemiologist indication that the jurisdiction had a lead OHE (OR 10.2, p=0.01).

Table 37: Association of substantial to full overall OH epidemiology and surveillance capacity with leadership, workforce, organizational structure, and population of jurisdiction, 2013 ECA OH Supplement

OH EPIDEMIOLOGY STRUCTURE/MILESTONES SUBSTANTIAL–FULL		OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO*	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
Lead OHE (Core)	Yes	11	10	14.3	0.002
	No	2	26		
Primary OHE (Supplemental Module)	Yes	11	14	8.6	0.01
	No	2	22		
Primary OHE ≥0.4 FTE	Yes	7	9	3.5	0.06
	No	6	27		
Primary OHE ≥0.7 FTE	Yes	6	6	4.3	0.04
	No	7	30		
OHE housed in OH program	Yes	6	7	3.6	0.07
	No	7	29		
OHE housed in OH program or MCH/CD	Yes	8	22	0.8	0.78
	No	4	9		
Long-term funding from CDC Division of Oral Health†	Yes	9	11	5.5	0.01
	No	4	27		
Current funding from CDC Division of Oral Health‡	Yes	10	11	8.2	0.005
	No	3	27		
Current and long-term funding from CDC Division of Oral Health§	Yes	8	7	7.1	0.006
	No	5	31		

*The odds that jurisdictions with substantial to full overall epidemiology and surveillance capacity had the particular epidemiology structure.

†States with longer term, funding, including those that no longer received support: Colorado, Connecticut, Georgia, Kansas, Louisiana, Maryland, Michigan, Minnesota, New York, North Dakota, Rhode Island, South Carolina, Vermont, Virginia, Wisconsin, Alaska, Arkansas, Maine, Nevada, and Texas.

‡States currently funded by CDC: Colorado, Connecticut, Georgia, Hawaii, Idaho, Iowa, Kansas, Louisiana, Maryland, Michigan, Minnesota, Mississippi, New Hampshire, New York, North Dakota, Rhode Island, South Carolina, Vermont, Virginia, Wisconsin, West Virginia

§States with longer-term CDC funding that still received funds: Colorado, Connecticut, Georgia, Kansas, Louisiana, Maryland, Michigan, Minnesota, New York, North Dakota, Rhode Island, South Carolina, Vermont, Virginia, Wisconsin

Abbreviations: CD, chronic disease; CDC, Centers for Disease Control and Prevention; ECA, Epidemiology Capacity Assessment; FTE, full-time equivalent; OH, oral health; OHE, OH epidemiologist; MCH, maternal and child health.

Outcomes Associated with Substantial Capacity

The 2013 ECA is the first assessment of OH epidemiology capacity and provides an opportunity to determine whether substantial OH epidemiology capacity is associated with epidemiology-related outcomes, such as ability to meet the EPHS, decision making, collaboration, and data dissemination. Following are the results of several analyses that examined the association between substantial to full OH epidemiology capacity and several outcomes.

Selected and Essential Public Health Services: Four EPHS have an epidemiology component: EPHS1 (monitoring health status), EPHS2 (diagnosing and investigating health problems, EPHS9 (evaluating effectiveness), and EPHS10 (research for new insights and innovations). Two other selected public health services also are essential to OHEs: linkage of data systems and translation of analytic findings. Having at least substantial epidemiology and surveillance capacity was positively and significantly ($p \leq 0.02$) associated with all six public health services examined (Table 38).

Table 38: Association of overall OH epidemiology and surveillance capacity with OH epidemiology capacity to provide selected public health services, 2013 ECA OH Supplemental Module					
SELECTED PUBLIC HEALTH SERVICES	LEVEL OF CAPACITY TO PROVIDE SELECTED PUBLIC HEALTH SERVICE	NO. JURISDICTIONS WITH OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO*	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
EPHS1: Monitor health status to identify community health problems	Substantial–full	11	8	19.3	0.001
	None–partial	2	28		
EPHS2: Diagnose and investigate health problems in the community	Substantial–full	9	7	9.3	0.002
	None–partial	4	29		
EPHS9: Evaluate effectiveness, accessibility and quality of health services	Substantial–full	8	7	6.6	0.01
	None–partial	5	9		
EPHS10: Research for new insights and innovative solutions to health problems	Substantial–full	9	7	9.3	0.002
	None–partial	4	29		
Link data systems that can facilitate high-level epidemiologic analysis	Substantial–full	8	9	4.8	0.02
	None–partial	5	27		
Translate analytic findings into information directly usable to decision-makers	Substantial–full	12	13	21.1	0.005
	None–partial	1	23		

*Odds of jurisdictions reporting at least substantial overall OH epidemiology and surveillance capacity to also have at least substantial capacity for the given public health service, compared with jurisdictions reporting less overall OH epidemiology and surveillance capacity.
Abbreviations: ECA, Epidemiology Capacity Assessment; EPHS, essential public health services; OH, oral health.

Decision Making and Program Outcomes: Associations were examined of a jurisdiction having at least substantial OH epidemiology capacity with decision making and a number of other measured program outcomes in the past year, such as statistical analyses, publishing in journals, publishing technical reports, giving presentations at state or national meetings, having an online queryable data system, and collaborating with other program areas (Table 39).

Having at least substantial OH epidemiology capacity was significantly associated with OHE participation in decision making for needs assessment (OR 49.7), priority setting (OR 13.8), program planning (OR 10.0), performance measures (OR 31.2), program evaluation (OR 24.0), and policy development (OR 13.8). Jurisdictions with substantial OH capacity were also more likely to have unfettered access to Medicaid and Behavioral Risk Factor Surveillance System (BRFSS) data and to routinely calculate confidence intervals. Jurisdictions with substantial OH epidemiology capacity are more likely to collaborate with MCH, children with special health-care needs, and chronic disease (CD) programs and government agencies and to work on social determinants of health. Having substantial capacity was not associated with the data dissemination metrics.

Table 39: Association of overall OH epidemiology capacity with decision making and OH program outcomes, 2013 ECA OH Supplemental Module					
MARKERS OF EPIDEMIOLOGY CAPACITY	LEVEL OF EPIDEMIOLOGY CAPACITY	NO. JURISDICTIONS WITH OVERALL EPIDEMIOLOGY AND SURVEILLANCE CAPACITY		ODDS RATIO*	P VALUE
		SUBSTANTIAL–FULL	NONE–PARTIAL		
Participate in decision making, re: needs assessment	Substantial–full	12	7	49.7	0.001
	None–partial	1	29		
Participate in decision making, re: priority setting	Substantial–full	10	7	13.8	0.001
	None–partial	3	29		
Participate in decision making, re: program planning	Substantial–full	10	9	10.0	0.003
	None–partial	3	27		
Participate in decision making, re: performance measures	Substantial–full	12	10	31.2	0.002
	None–partial	1	26		
Participate in decision making, re: program evaluation	Substantial–full	12	12	24.0	0.004
	None–partial	1	24		
Participate in decision making, re: policy development	Substantial–full	10	7	13.8	0.001
	None–partial	3	29		
Have unfettered access to Medicaid data	Yes	7	4	9.3	0.004
	No	6	32		
Have unfettered access to YRBS data	Yes	7	12	2.2	0.22
	No	6	23		
Have unfettered access to BRFSS data	Yes	12	15	16.0	0.01
	No	1	20		
Calculate confidence intervals	Yes	9	11	6.8	0.01
	No	3	25		
Conduct multivariable analysis	Yes	2	5	1.2	0.81
	No	10	31		
Collaborate with MCH program	Frequently–routinely	11	18	5.5	0.04
	Never–infrequently	2	18		
Collaborate with children with special health-care needs program	Frequently–routinely	8	7	6.4	0.01
	Never–infrequently	5	28		
Collaborate with OH coalition	Frequently–routinely	9	15	3.1	0.10
	Never–infrequently	4	21		
Collaborate with chronic disease	Frequently–routinely	11	11	12.5	0.003
	Never–infrequently	2	25		
Collaborate with environmental health	Frequently–routinely	5	6	3.1	0.12
	Never–infrequently	8	30		
Collaborate with schools of public health	Frequently–routinely	4	10	1.1	0.88
	Never–infrequently	9	25		
Collaborate with government agencies	Frequently–routinely	11	17	5.8	0.04
	Never–infrequently	2	18		
Work on social determinants of health	Frequently–routinely	11	13	9.7	0.01
	Never–infrequently	2	23		
Published at least one peer-reviewed article	Yes	1	3	1.0	0.98
	No	11	34		
Had at least one abstract at national meeting	Yes	3	3	3.8	0.14
	No	9	34		
Published state reports	Yes	5	8	2.6	0.18
	No	7	29		
Had online queryable data system	Yes	1	6	0.4	0.44
	No	12	30		

NS: Not significant, p-value>0.05

Outcomes Associated with Substantial Capacity for Essential Public Health Services

In addition to evaluating the outcomes and metrics associated with overall OH epidemiology and surveillance capacity, the association between having at least substantial capacity for the four epidemiology-related Essential Public Health Services (EPHS) and two other important public health services – data linkages and translating analytic findings was examined.

EPHS1 – Monitoring Health Status: Jurisdictions that had at least substantial OH epidemiology capacity for EPHS1 were much more likely than those with less capacity to participate in the spectrum of decision-making activities that should be data-driven, such as needs assessment ($p<0.01$), priority setting ($p<0.01$), program planning ($p<0.01$), performance measurement ($p<0.01$), program evaluation ($p<0.01$), and policy development ($p<0.01$). They also were significantly more likely ($p\leq0.03$) to calculate confidence intervals and collaborate with MCH, CSHCN programs, their OH coalition, chronic disease, schools of public health, government agencies, and with others on work related to social determinants of health (Table 40).

EPHS2 – Diagnose and Investigate Health Problems: Having substantial to full capacity to diagnose and investigate health problems (EPHS2) had a significant positive ($p\leq0.01$) association with all of the decision making activities. It was also significantly associated with routinely calculating confidence intervals ($p<0.01$) and working on social determinants of health ($p<0.01$). In terms of collaboration, having at least substantial capacity for EPHS2 had a significant positive association ($p\leq0.02$) with all areas of collaboration except for environmental health (Table 40).

EPHS9 – Evaluate Effectiveness, Accessibility and Quality of Health Services: Jurisdictions that have at least substantial capacity to evaluate the effectiveness, accessibility and quality of health services (EPHS9) are significantly ($p\leq0.02$) more likely to have substantial to full capacity for all of the decision making activities assessed. In addition, these states are more likely to have unfettered access to BRFSS data ($p=0.03$), generate confidence intervals ($p<0.01$), collaborate with CSHCN programs ($p=0.02$), collaborate with CD ($p<0.01$), and work on issues relating to social determinants of health ($p=0.01$) (Table 40).

EPHS10 – Research for New Insights & Innovative Solutions to Health Problems: Jurisdictions with at least substantial OH capacity for EPHS10 (research for new insights and innovative solutions to health problems) were much more likely than those with less capacity to participate in the spectrum of OH program decision making activities that should be data-driven, such as needs assessment ($p<0.01$), priority setting ($p<0.01$), program planning ($p<0.01$), performance measurement ($p<0.01$), program evaluation ($p<0.01$) and policy development ($p<0.01$). These states also were significantly more likely to have unfettered access to BRFSS data ($p=0.02$), routinely calculate confidence intervals ($p=0.01$) and collaborate with a variety of different internal and external programs (Table 40).

Promote and Contribute Expertise to the Linkage of Data Systems: Having substantial to full capacity to promote and contribute expertise to the linkage of data systems had a significant positive ($p\leq0.002$) association with all of the OH program decision making activities. Jurisdictions with at least substantial capacity for linkage of data systems were significantly more likely to have unfettered access to Medicaid ($p=0.03$) and BRFSS ($p=0.04$) data, calculate confidence intervals ($p<0.01$) and collaborate with MCH ($p=0.02$), CSHCN ($p<0.01$), CD ($p<0.01$), schools of public health ($p=0.01$) and governmental agencies ($p<0.01$). They also were more likely to have collaborated on work regarding social determinants of health ($p<0.01$) (Table 40).

Translate Analytic Findings into Information Useful to Others: Jurisdictions with at least substantial OH capacity to translate analytic findings into information directly usable to decision-makers were much more likely than those with less capacity to participate in the full spectrum of OH program decision making activities that should be data-driven, such as needs assessment ($p<0.01$), priority setting ($p<0.01$), program planning ($p<0.01$), performance measures ($p<0.01$), program evaluation ($p<0.01$), and policy development ($p<0.01$). They also were significantly

($p \leq 0.03$) more likely to collaborate with the range of partners assessed and work on social determinants of health ($p<0.01$). In addition, jurisdictions with capacity for translating analytic finding were more likely to have unfettered access to BRFSS data ($p=0.02$) and calculate confidence intervals ($p<0.01$) (Table 40).

Outcomes and Individual Factors Associated with Substantial Capacity

The specific leadership, workforce and funding factors that correlate with overall epidemiology and surveillance capacity (Table 37) were examined to determine whether they were associated with the desired level of involvement of OHEs in various OH program decision-making activities, with ready access to data and with more regularly performing broader-level epidemiologic activities. These leadership and workforce factors included having a lead OHE, having a full-time OHE ($\geq$0.7 FTE) and having current CDC Division of Oral Health infrastructure funding.

Lead OHE: Jurisdictions with a lead OHE are significantly more likely to have substantial to full capacity for EPHS1 (OR 6.0), EPHS2 (OR 5.1), EPHS9 (OR 6.6), EPHS10 (OR 3.3), and translation of analytic findings (OR 4.5). OHEs are more likely to participate in all of the decision-making activities measured (OR $\geq$4.0) if the jurisdiction has a lead OHE. Having a lead OHE was also significantly associated with having access to BRFSS data (OR 7.2), calculating confidence intervals (OR 3.8), collaborating with CD programs and government agencies (OR 3.4 and 10.2, respectively), working with social determinants of health (OR 3.6), and publishing state reports (OR 4.5) (Table 40).

Full-Time ($\geq$0.7) OHE: Jurisdictions with full-time OHEs were significantly more likely ($p \leq 0.01$) than those without full-time OHEs to have substantial to full capacity for each of the epidemiology-related public health services except EPHS9 ($p=0.10$). They are also significantly ($p \leq 0.01$) more likely to have OHEs substantially to fully involved in all aspects of decision making. Collaboration with MCH programs, OH coalitions, and government agencies and work in the area of social determinants of health were also significantly associated with having a full-time OHE. In terms of data dissemination, jurisdictions with a full-time OHE were more likely to have published in a peer-review journal and to have published state reports on OH issues (Table 40).

Current CDC Division of Oral Health Infrastructure Funding: Having current CDC Division of Oral Health infrastructure funding was significantly associated ($p \leq 0.02$) with having substantial to full capacity for all six of the epidemiology-related public health services and with OHEs being involved in all aspects of decision making except for policy development. Jurisdictions with CDC Division of Oral Health funding were also more likely to collaborate with CD programs (OR 4.1) and government agencies (OR 8.8) and to work on issues related to social determinants of health (OR 4.4) (Table 40).

Table 40: Association of OH epidemiology leadership, workforce, and funding with selected program measures and outcomes, 2013 ECA OH Supplemental Module			
MARKERS OF EPIDEMIOLOGY CAPACITY	HAS LEAD OHE	HAS FULL-TIME OHE	HAS CURRENT CDC DIVISION OF ORAL HEALTH FUNDING
EPHS1: Monitor health status (substantial–full)	6.0 (0.01)	4.7 (0.03)	11.2 (0.001)
EPHS2: Diagnose and investigate health problems (substantial–full)	5.1 (0.01)	7.3 (0.01)	9.4 (0.002)
EPHS9: Evaluate effectiveness (substantial–full)	6.6 (0.01)	3.1 (NS)	13.0 (0.001)
EPHS10: Research for new insights (substantial–full)	3.3 (0.06)	7.3 (0.01)	5.9 (0.001)
Link data systems (substantial–full)	1.9 (NS)	6.2 (0.01)	7.2 (0.003)
Translate analytic findings (substantial–full)	4.5 (0.02)	18.1 (0.01)	14.9 (<0.001)
Participate in decision making			
Needs assessment (substantial–full)	6.0 (0.01)	15.6 (0.002)	7.1 (0.003)
Priority setting (substantial–full)	4.0 (0.03)	10.9 (0.002)	4.7 (0.02)
Program planning (substantial–full)	4.0 (0.03)	15.6 (0.002)	4.7 (0.01)
Performance measures (substantial–full)	11.7 (0.004)	10.4 (0.01)	9.4 (0.001)
Program evaluation (substantial–full)	12.8 (<0.001)	20.3 (0.006)	10.5 (0.001)
Policy development (substantial–full)	6.1 (0.006)	6.2 (0.01)	3.1 (NS)
Have unfettered access to Medicaid data (yes)	3.0 (NS)	0.6 (NS)	2.1 (NS)
Have unfettered access to YRBS data (yes)	1.8 (NS)	1.1 (NS)	2.1 (NS)
Have unfettered access to BRFSS data (yes)	7.2 (0.004)	3 (NS)	2.7 (NS)
Calculate confidence intervals (frequently or routinely)	3.8 (0.03)	2 (NS)	3.1 (NS)
Conduct multivariable analysis (frequently or routinely)	0.5 (NS)	1.4 (NS)	1.2 (NS)
Collaborate with MCH (frequently or routinely)	2.5 (0.14)	Undefined (<0.001)	2.2 (NS)
Collaborate with children with special health-care needs program (frequently or routinely)	1.2 (NS)	3 (NS)	3.0 (NS)
Collaborate with OH coalition (frequently or routinely)	2.5 (NS)	20.3 (0.01)	3.0 (NS)
Collaborate with chronic disease (frequently or routinely)	3.4 (0.04)	2.1 (NS)	4.1 (0.02)
Collaborate with environmental health (frequently or routinely)	1.8 (NS)	1.2 (NS)	1.3 (NS)
Collaborate with schools of public health (frequently or routinely)	1.0 (NS)	3.5 (NS)	2.4 (NS)
Collaborate with government agencies (frequently or routinely)	10.2 (0.002)	12.3 (0.02)	8.8 (0.003)
Work on social determinants of health (frequently or routinely)	3.6 (0.04)	20.3 (0.01)	4.4 (0.02)
Published at least one peer-reviewed article (yes)	4.5 (NS)	13.9 (0.03)	4.9 (NS)
Had at least one abstract at national meeting (yes)	3.1 (NS)	30.8 (0.004)	3.4 (NS)
Published state reports (yes)	4.5 (0.03)	5.3 (0.02)	1.3 (NS)
Had online queryable data system (yes)	0.5 (NS)	0.5 (NS)	0.2 (NS)

Abbreviations: ECA, Epidemiology Capacity Assessment; EPHS, Essential Public Health Service; MCH, maternal and child health; NS, not significant (p-value>0.05); OH, oral health

Outcomes and Individual Elements Associated with Substantial Capacity

The specific leadership, workforce and funding elements that correlate with overall epidemiology and surveillance capacity (Table 37) were examined to determine whether they were associated with the desired level of involvement of OH epidemiologists in various OH program decision-making activities, with ready access to data and with more regularly performing broader-level epidemiologic activities. These leadership and workforce factors include having a lead OH epidemiologist, having a full-time OHE (≥0.7 FTE) and having current CDC DOH infrastructure funding.

Lead OH Epidemiologist: States with a lead OH epidemiologist are significantly more likely to have substantial to full capacity for EPHS1 (p=0.01), EPHS2 (p=0.01), EPHS9 (p=0.01) and translating analytic findings (p=0.02). OHEs are more likely to participate in the all of the decision making activities measured (p≤0.03) if the state has a lead OH epidemiologist. Having a lead OH epidemiologist also is significantly associated with having access to BRFSS data (p<0.01), calculating confidence intervals (p=0.03), collaborating with chronic disease and government

agencies (p≤0.04), working with social determinants of health (p=0.04), and publishing state reports (p=0.03) (Table 41).

Full-Time (≥0.7) OH Epidemiologist: If a state has a full-time OHE they are significantly (p≤0.01) more likely to have substantial to full capacity for each of the epidemiology related services of public health except for EPHS9 (p=0.10). They are also significantly (p≤0.01) more likely to have OHEs substantially to fully involved in all aspects of decision making. Collaboration with maternal and child health, the states' OH coalition, government agencies, along with work in the area of social determinants of health are also significantly associated with having a full-time OHE. In terms of data dissemination, states with a full-time OHE are more likely to have published in a peer review journal and to have published state reports on OH issues (Table 41).

Current CDC DOH Infrastructure Funding: Having current CDC DOH infrastructure funding is significantly associated (p≤0.02) with having substantial to full capacity for all six of the epidemiology related Essential Public Health Services and with OHEs being involved in all aspects of decision making except for policy development. States with CDC DOH funding are also more likely to collaborate with chronic disease (p=0.02), government agencies (p<0.01) and work on issues related to social determinants of health (p=0.02) (Table 41).

Table 41: Association between OH epidemiology leadership, workforce, funding and selected program measures and outcomes; 2013 ECA OH supplement

MARKERS OF EPIDEMIOLOGY CAPACITY	HAS LEAD OH EPIDEMIOLOGIST	HAS FULL-TIME OH EPIDEMIOLOGIST	HAS CURRENT CDC DOH FUNDING
	OR (p-value)	OR (p-value)	OR (p-value)
EPHS1: Monitor health status (substantial–full)	6.0 (0.01)	4.7 (0.03)	11.2 (0.001)
EPHS2: Diagnose & investigate health problems (substantial–full)	5.1 (0.01)	7.3 (0.01)	9.4 (0.002)
EPHS9: Evaluate effectiveness (substantial–full)	6.6 (0.01)	3.1 (NS)	13.0 (0.001)
EPHS10: Research for new insights (substantial–full)	3.3 (0.06)	7.3 (0.01)	5.9 (0.001)
Linkage of data systems (substantial–full)	1.9 (NS)	6.2 (0.01)	7.2 (0.003)
Translate analytic findings (substantial–full)	4.5 (0.02)	18.1 (0.01)	14.9 (<0.001)
Participate in decision making			
Needs assessment (substantial–full)	6.0 (0.01)	15.6 (0.002)	7.1 (0.003)
Priority setting (substantial–full)	4.0 (0.03)	10.9 (0.002)	4.7 (0.02)
Program planning (substantial–full)	4.0 (0.03)	15.6 (0.002)	4.7 (0.01)
Performance measures (substantial–full)	11.7 (0.004)	10.4 (0.01)	9.4 (0.001)
Program evaluation (substantial–full)	12.8 (<0.001)	20.3 (0.006)	10.5 (0.001)
Policy development (substantial–full)	6.1 (0.006)	6.2 (0.01)	3.1 (NS)
Have unfettered access to Medicaid data (yes)	3.0 (NS)	0.6 (NS)	2.1 (NS)
Have unfettered access to YRBS data (yes)	1.8 (NS)	1.1 (NS)	2.1 (NS)
Have unfettered access to BRFSS data (yes)	7.2 (0.004)	3 (NS)	2.7 (NS)
Calculate confidence intervals (frequently or routinely)	3.8 (0.03)	2 (NS)	3.1 (NS)
Conduct multivariable analysis (frequently or routinely)	0.5 (NS)	1.4 (NS)	1.2 (NS)
Collaborate with MCH (frequently or routinely)	2.5 (0.14)	NA (<0.001)	2.2 (NS)
Collaborate with CSHCN program (frequently or routinely)	1.2 (NS)	3 (NS)	3.0 (NS)
Collaborate with OH coalition (frequently or routinely)	2.5 (NS)	20.3 (0.01)	3.0 (NS)
Collaborate with chronic disease (frequently or routinely)	3.4 (0.04)	2.1 (NS)	4.1 (0.02)
Collaborate with environmental health (frequently or routinely)	1.8 (NS)	1.2 (NS)	1.3 (NS)
Collaborate with schools of public health (frequently or routinely)	1.0 (NS)	3.5 (NS)	2.4 (NS)
Collaborate with government agencies (frequently or routinely)	10.2 (0.002)	12.3 (0.02)	8.8 (0.003)
Work on social determinants of health (frequently or routinely)	3.6 (0.04)	20.3 (0.01)	4.4 (0.02)
Published at least one peer reviewed article (yes)	4.5 (NS)	13.9 (0.03)	4.9 (NS)
Had at least one abstract at national meeting (yes)	3.1 (NS)	30.8 (0.004)	3.4 (NS)
Published state reports (yes)	4.5 (0.03)	5.3 (0.02)	1.3 (NS)
Online queryable data system (yes)	0.5 (NS)	0.5 (NS)	0.2 (NS)

NA: Not available because one cell had a zero value; NS: Not significant, p-value>0.

Assessing OH Epidemiology Capacity by the Numbers

Evaluating epidemiology capacity by assessing a multitude of categorical analyses may not always provide a meaningful picture of a state's overall epidemiology and surveillance capacity. Because of this, "domain" scores were developed and used to determine the impact of key metrics on program outcomes and desired OH epidemiology related activities. The eight domains included: capacity, decision making, and unfettered access to data, analytic techniques, internal collaboration, external collaboration, and spectrum of work. For each question in the domain, a numeric score was assigned to the responses with the most desired response receiving the highest score. For example, if a question had four responses (never, rarely, occasionally, and routinely) the least desirable response was coded 0 while the most desirable response was coded 3. The numeric scores were summed across all questions in the domain to obtain an overall domain score.

States with a lead OH epidemiologist had significantly ($p \leq 0.02$) higher mean scores for all domains (Table 42). Having a full-time (≥ 0.07 FTE) OHE significantly ($p \leq 0.03$) increased mean domain scores for all domains except access to data (Table 42). States with current CDC DOH funding had significantly ($p \leq 0.04$) higher mean domain scores for capacity, decision-making, analytic techniques, internal collaboration and external collaboration. Domain scores did not differ by population tertile (data not shown).

Table 42: Mean domain scores by key OH epidemiology capacity metrics; 2013 OH ECA supplement

DOMAIN	STATE HAS LEAD OHE (core)			STATE HAS ≥0.7 FTE OH EPIDEMIOLOGIST			STATE HAS CURRENT CDC DOH FUNDING		
	YES (MEAN)	NO (MEAN)	P-VALUE	YES (MEAN)	NO (MEAN)	P-VALUE	YES (MEAN)	NO (MEAN)	P-VALUE
Capacity	18.7	9.4	0.001	22.0	10.5	<0.001	18.8	9.5	0.001
Decision-making	17.6	7.8	0.001	21.8	8.8	<0.001	17.3	8.3	0.002
Access to data	3.9	2.2	0.01	3.3	2.8	0.43	3.6	2.4	0.08
Analytic techniques	13.8	8.5	0.01	15.5	9.4	0.001	13.6	8.9	0.03
Internal collaboration	19.4	11.6	0.02	21.6	13.0	0.03	19.4	12.2	0.04
External collaboration	9.8	6.2	0.02	11.0	6.8	0.001	9.8	6.4	0.03
Spectrum of work	19.0	11.4	0.02	23.6	12.1	0.002	18.8	12.4	0.06

Oral Health Workforce Competency

Tier-Level Epidemiologist Perspective: The 2013 ECA individual worksheets asked individual epidemiologists to assess their competency and training needs using the framework of the CDC/CSTE Applied Epidemiology Competencies.[25] Individual epidemiologists were asked to indicate the tier to which they belonged and then to assess themselves according to their tier's specific set of competencies. The four tiers are:

- Tier 1 – entry-level or basic epidemiologist;
- Tier 2 – mid-level epidemiologist;
- Tier 3a – senior-level epidemiologist supervisor and/or manager; and
- Tier 3b – senior scientist or subject area expert.

Tier 1 and Tier 3b epidemiologists were assessed in 30 competency areas, Tier 2 in 31 areas and Tier 3a in 32. A total of 47 OHEs completed the self-assessment; 10 (21%) Tier 1, 12 (26%) Tier 2, 15 (32%) Tier 3a, and 10 (21%) Tier 3b epidemiologists. The response options for each competency were minimal or none, basic, intermediate, advanced, and expert. In terms of training needs, OHEs were asked to rank the need for additional training on a scale from 1 to 5 with 1 indicating less training needed and 5 indicating more training needed.

Tier 1 Competencies: Tier 1 OHEs indicated five competencies for which at least 70% had an intermediate, advanced or expert level of competency: identifying key findings from a study (80%), using analysis plans and analyzing data (70%), preparing written and oral presentations (70%), demonstrating ability to listen effectively when epidemiologic finding are presented (70%), and using effective communication technologies (70%).
There are four competencies for which 40% or more had minimal or no level of competency: identifying the role of laboratory resources (50%), applying appropriate fiscal and administrative guidelines (40%), using informatics tools in support of epidemiologic practice (40%), and describing how policy decisions are made (40%).

Tier 2 Competencies: At least 70% of Tier 2 OHEs said they had an intermediate, advanced or expert level of competency in 18 (58%) of the 31 competencies. The nine competencies for which at least 40% had an advanced or expert level of competency are: following ethics guidelines and principles (67%), creating analysis plans and conducting analysis of data (58%), applying knowledge of privacy laws to protect confidentiality (50%), assisting in the development of measurable and relevant goals and objectives (50%), defining database requirements and managing a database (42%), promoting ethical conduct in epidemiologic practice (42%), applying knowledge of epidemiologic principles to make recommendation regarding the validity of data (42%), describing differences between public health practice and research (42%), and describing human subjects research an applying IRB processes (42%).

The eight Tier 2 competencies for which 10% or more had minimal or no level of competency are: defining database requirements and managing a database (25%), creating analysis plans and conduct analysis of data (17%), providing epidemiologic input for community planning processes (17%), communicating epidemiologic information through oral presentations or written documents (17%), following ethics guidelines and principles when planning studies (17%), describing differences between practice and research (17%), assisting in design of an investigation (17%), and practicing culturally sensitive epidemiologic activities (17%).

Tier 3a Competencies: The 15 senior level OHEs with program management and/or supervisory responsibilities (Tier 3a) indicated 24 out of 32 competencies (75%) for which at least 70% indicated they had an intermediate, advanced or expert level of competency. The 11 competencies for which at least 60% had an advanced or expert level of competency are: evaluating conclusions and interpretations from investigations (93%), promoting ethical conduct in epidemiology practice (86%), ensuring management of data from surveillance and investigations (80%), ensuring study design and data collection use ethical and legal principles (80%), ensuring application of principles of informatics (73%), ensuring identification of public problems (71%), enforcing polices that address security and privacy when communicating epidemiologic information (67%), ensuring preparation of written and oral reports (67%), evaluating analysis of data from an epidemiologic investigation (67%), overseeing surveillance activities (67%), and modeling interpersonal skills in communication (60%).

The Tier 3a competencies for which 20% or more had minimal or no level of competency are: ensuring the use of laboratory resources (47%), leading epidemiology unit in preparing for emergency response (43%), determining evidence-based interventions and control measures in response to epidemiologic findings (20%), and leading community public planning processes (20%).

Tier 3b Competencies: The 10 senior scientist (Tier 3b) epidemiologists indicated 27 out of 30 competencies (90%) for which at least 70% considered themselves to have an intermediate, advanced or expert level of competency. At least 50% had indicated an advanced or expert level of competency in 26 of the competencies (87%).

The Tier 3b competencies for which 40% or more had basic, minimal or no level of competency are: developing processes for using laboratory resources to support epidemiologic activities (60%), preparing for emergency response (50%), and describing financial and budgetary processes of the agency (40%).

Training Needs: As would be expected, training needs vary by tier level, and the percent of OHEs indicating the need for more training decreases as tier level increases. At least 60% of Tier 1 OHEs indicated that they need more training in seven competencies while at least 33% of Tier 2 OHEs indicated that they need more training in seven competencies. For Tier 3a OHEs, at least 36% indicated more training needs for eight competencies while 20% of Tier 3b OHEs indicated more training needs for only one competency. Table 43 lists the competencies for which the majority of OHEs indicated a lower need for training plus the competencies with the largest percent of OHEs indicating the need for more training.

Table 43: Competencies identified by OHEs requiring less training and more training; 2013 ECA individual worksheets

Competencies with LESS Training Needed (Percent Indicating Level 1 or 2 on a scale of 1-5)	Competencies with MORE Training Needed (Percent Indicating Level 4 or 5 on a scale of 1-5)
Tier 1 OHEs	
Apply knowledge of privacy laws to protect confidentiality (70%)	Identify the role of laboratory resources in epidemiologic activities (70%)
Describe human subjects research and apply Institutional Review Board (IRB) processes (60%)	Describe how policy decisions are made within the agency (70%)
Follow ethics guidelines and principles when planning studies; conducting research; etc. (60%)	Implement new or revise existing surveillance systems and report key surveillance findings (70%)
Use analysis plans and analyze data (60%)	Use identified informatics tools in support of epidemiologic practice (60%)
Support the organization's vision in all programs and activities (60%)	Use knowledge of biology and behavioral sciences to determine potential biological mechanisms of disease (60%)
Promote ethical conduct in epidemiologic practice (60%)	Assist in conducting a community health status assessment (60%)
Prepare written and oral reports and presentations that communicate necessary information (60%)	Practice culturally sensitive epidemiologic activities (60%)
Tier 2 OHEs	
Define database requirements, and manage a database (67%)	Use laboratory resources to support epidemiologic activities (58%)
Communicate epidemiologic information through oral presentations or written documents to nonprofessional audiences (58%)	Assist in design of an investigation, including hypothesis generation (50%)
Follow ethics guidelines and principles when planning studies; conducting research; etc (58%)	Use leadership and systems thinking in epidemiologic planning and policy development (42%)
Create analysis plans and conduct analysis of data (58%)	Conduct a community health assessment and recommend priorities (33%)
Implement new or revise existing surveillance system and identify key surveillance findings (58%)	Apply appropriate fiscal and administrative guidelines to epidemiology practice (33%)
Use scientific evidence in preparing recommendations for action (58%)	Conduct evaluation of surveillance systems (33%)
	Establish cultural/social/political framework for recommendations or interventions (33%)
Tier 3a OHEs	
Ensure management of data from surveillance, investigations, or other sources (79%)	Determine evidence-based interventions and control measures in response to epidemiologic findings (47%)
Ensure application of principles of informatics, including data collection, processing, and analysis, in support of epidemiologic practice (71%)	Lead epidemiology unit in preparing for emergency response (43%)
Enforce policies that address security, privacy, and legal considerations when communicating epidemiologic information (71%)	Bring epidemiologic perspective in the development and analysis of public health policies (43%)
Promote ethical conduct in epidemiology practice (71%)	Create operational and financial plans for future epidemiologic activities (43%)
Evaluate conclusions and interpretations from investigations (67%)	Lead community public health planning processes (36%)
Use basic public health sciences in epidemiologic practice (60%)	Develop requests for extramural funding to support additional epidemiologic activities (36%)
	Use management skills (36%)
	Promote collaborations, strong partnerships, and team-building to accomplish epidemiology program objectives (36%)
Tier 3b OHEs	
Evaluate results of data analysis and interpret conclusions (100%)	Develop processes for using laboratory resources to support epidemiologic activities (20%)
Organize preparation of written and oral presentations that communicate necessary information (90%)	
Conduct epidemiologic activities within the financial and operational plan of the agency (90%)	
Evaluate data from an epidemiologic investigation or study (90%)	
Promote ethical conduct in the epidemiology practice (90%)	
Use basic public health sciences in epidemiologic practice (90%)	
Validate identification of public health problems pertinent to the population (90%)	

Synthesize principles of good ethical/legal practice for application to study design and data collection, dissemination, and use (90%)
Design investigation of acute and chronic conditions or other adverse outcomes (90%)
Organize surveillance (90%)
Manage data from surveillance, investigations, or other sources (90%)

- ### Discussion

In the United States, the two most common oral diseases are dental caries (tooth decay) and periodontal (gum) disease. Although less common, oral and pharyngeal cancers, orofacial clefts (cleft lip and cleft palate), malocclusion, oral-facial pain, and other OH problems can severely affect general health and quality of life. For example, poor OH impacts the ability to eat, communicate, and learn and affects how people look and interact with others, sometimes making it difficult to find jobs for which public interaction is important. To monitor trends in the prevalence of OH-related diseases and conditions, to develop and evaluate the population=based programs necessary to address these OH concerns, and to research for new insights and innovations, state and territorial health jurisdictions need a cadre of skilled OHEs. Because monitoring OH depends on the availability of population-based datasets, such as cancer registry and BRFSS data, OHEs must have the skills and statistical software necessary to manipulate large datasets. They must also have the ability to interpret the data and to assist in the development of prevention programs based on current data and evidence based approaches.

Unfortunately, compared with CD and MCH, OH has substantially less capacity, both overall and for the epidemiology-related services of public health. Although the exact reason for poor OH capacity is unknown, it might be related to a variety of factors, including 1) small and underfunded OH programs, 2) lack of collaboration between OH programs and other program areas, 3) the perception that OH is not an important health issue, and 4) undervaluation of epidemiology by state OH program staff.

This initial assessment of OH capacity provides valuable insights. States with improved capacity share three characteristics: a lead OHE, a full-time OHE, and CDC Division of Oral Health funding. Having a designated lead OHE is a small but valuable step that most jurisdictions can accomplish. Not only does it bridge the gap between OH program staff and epidemiology support staff, but it also increases awareness of OH among the health agency leadership that assign staff to lead roles.

As would be expected, having adequate OH epidemiology staffing was associated with higher-level capacity, but the definition of “adequate” was previously unknown. According to the results of this assessment, jurisdictions with higher-level capacity had a full-time ($\geq$0.7 FTE) OHE. Whether all jurisdictions need this level of staffing is unknown, and the exact FTE required would depend on such factors as skill level and degree of coordination with other OH program staff. For example, epidemiology staffing requirements might be lower if other OH program staff had the skills necessary to disseminate OH data. For small programs, such as OH, having staff with a variety of skills, including epidemiology, might be one method to increase capacity.

As previously mentioned, CDC Division of Oral Health funding is key to having higher-level OH epidemiology capacity. Without this funding stream, very few states would have any OH epidemiology capacity. To increase capacity, this funding stream must be expanded and the lessons learned passed to other jurisdictions. Although CDC Division of Oral Health is likely to be the primary source of funding for OH capacity, states should not overlook other federal and nongovernment funding sources.

Conclusions

- The status of state OH epidemiology and surveillance capacity is abysmal; most jurisdictions have minimal to no capacity.

- To improve capacity, funds must become available for additional positions, and efforts must to be made to ensure that each state has a designated lead OHE.

Oral Health Recommendations

1. OH epidemiology capacity should be explicitly considered in the national dialogue about addressing the gaps identified in the Core ECA in overall state-based epidemiology capacity and ensuring that states have the capacity needed to provide essential data for effective program planning, public health action, evaluation, and policy development.

2. Improving capacity in states that have minimal to no OH epidemiology capacity should be a priority. At a minimum, every state should have a full-time lead OHE.

3. The Association of State and Territorial Dental Directors (ASTDD) should continue to provide epidemiology technical assistance and support to states.

4. All state OH epidemiology programs should have access to peer-reviewed and scientific literature and statistical analysis software.

5. State OH epidemiologists should build partnerships to collaborate with CD, MCH, and environmental health programs.

6. Continued monitoring of gaps in OH epidemiology capacity is critical for additional progress.

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