

EXPLORING THE ROLE AND READINESS OF STATE HEALTH DEPARTMENT
EPIDEMIOLOGISTS IN THE UNITED STATES TO WORK IN EMERGING AREAS OF
PUBLIC HEALTH PRACTICE

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ABSTRACT

Elizabeth R Daly: Exploring the Role and Readiness of State Health Department Epidemiologists in the United States to Work in Emerging Areas of Public Health Practice
(Under the direction of Leah Devlin)

Epidemiology is a discipline within the field of public health that focuses on studying the distribution and determinants of disease in the population. Epidemiologists are key professionals within the public health workforce, fulfilling core public health science functions as part of the ten essential public health services. As the role of public health agencies changes over time, epidemiologists will need to adapt and develop new skill sets to work in emerging areas of public health practice, which are areas of practice that are new or are growing in interest and use. This mixed methods research sought to explore the role and readiness of state health department epidemiologists in the United States to work in emerging areas of public health practice. The emerging areas of public health practice assessed in this research included quality improvement, public health and healthcare integration, evidence-based public health practice, Health in All Policies, multisectoral collaboration, informatics, social determinants of health and health disparities, and program evaluation. Three phases of data collection and analysis were conducted including secondary analysis of the Public Health Workforce Interests and Needs Survey, a survey of the designated state epidemiologist in all 50 states and the District of Columbia, and focus groups with early-, mid-, and senior-career epidemiologists working in state health departments. Participant state health department epidemiologists indicated that the studied emerging areas of public health practice were important to their work and that epidemiologists have some role in them. While there are significant barriers to practicing in these areas, participants were hopeful and offered suggestions for how to overcome these

barriers. Taken together, these three assessments identified several areas for future workforce development activities that are outlined in a plan for change to improve applied epidemiology capacity to work in emerging areas of public health practice. There is much opportunity for epidemiologists to be more engaged in emerging areas of public health practice. Not only can epidemiologists supply relevant data, but they can also bring skills and expertise to help improve the overall success of the work, with the ultimate goal of improving population health.

To my family, who graciously accepted my laptop computer as a permanent fixture in our lives for the better part of three years, and who responded to the void created by classes, travel, work, papers, and research with nothing but love and support.

To my fellow applied epidemiologists around the globe who carry out the work of our profession in pursuit of our shared goal to improve the health of the communities we serve.

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PREFACE

I conducted this study as a graduate student at the University of North Carolina at Chapel Hill while pursuing a Doctor of Public Health degree in Health Leadership. At the time of this research, I was employed as a senior administrator overseeing infectious disease epidemiology and prevention programs at the State of New Hampshire Department of Health and Human Services, Division of Public Health Services. I am an epidemiologist by training, having received my Master of Public Health degree in Epidemiology with a concentration in infectious diseases from the Rollins School of Public Health at Emory University in Atlanta, Georgia. My undergraduate degrees are in Zoology and English from the University of New Hampshire in Durham, New Hampshire. My engagement in the profession of epidemiology is broad, spanning across practice, teaching, workforce development, and now research. I have practiced as an applied epidemiologist in a state health department for more than 16 years, primarily in the area of infectious diseases. Additionally, I teach epidemiology to graduate students in the Master of Public Health program at Rivier University in Nashua, New Hampshire. Finally, at the time of this research, I was an active member of the Council of State and Territorial Epidemiologists and served as the organization's Workforce Sub-committee Co-Chair, helping to enhance workforce development activities. Given my significant professional interest in the field of epidemiology, and in recognition of the important role epidemiologists play in population health improvement, I sought to support and improve the competency and effectiveness of our profession, especially as we embark upon a new era of public health practice referred to as "Public Health 3.0", and this research was carried out to that end.

TABLE OF CONTENTS

LIST OF TABLES	xii
LIST OF FIGURES	xv
LIST OF ABBREVIATIONS	xvii
CHAPTER 1: THE TOPIC	1
Assessment of the Applied Epidemiology Workforce	2
Emerging Areas of Public Health Practice	6
Definitions of Key Terms	14
Research Questions and Aims	15
The Research in the Context of Population Health Improvement.....	16
CHAPTER 2: LITERATURE REVIEW	17
Methods.....	17
Results	20
Discussion	39
CHAPTER 3: METHODOLOGY.....	43
Study Design	43
Conceptual Model	44
Methods.....	46
Phase 1: Public Health Workforce Interest and Needs Survey.....	46
Phase 2: State Epidemiologist Survey	48
Phase 3: Focus Groups with State Health Department Epidemiologists	51
Timeline.....	58

CHAPTER 4: RESULTS	59
Phase 1: Public Health Workforce Interest and Needs Survey.....	59
Phase 2: State Epidemiologist Survey	68
Phase 3: Focus Groups with State Health Department Epidemiologists	83
CHAPTER 5: DISCUSSION	135
Key Findings in Relation to the Research Question and Aims	135
CHAPTER 6: PLAN FOR CHANGE.....	154
Framework	155
Recommendations.....	157
Implementation	171
Evaluation	175
Dissemination.....	177
CHAPTER 7: CONCLUSION	179
APPENDIX 1: CHARACTERISTICS OF STUDIES INCLUDED IN THE LITERATURE REVIEW	181
APPENDIX 2: PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS SURVEY	186
APPENDIX 3: PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS SURVEY VARIABLE LIST	218
APPENDIX 4: STATE EPIDEMIOLOGIST SURVEY RECRUITMENT AND REMINDER EMAILS.....	245
APPENDIX 5: STATE EPIDEMIOLOGIST SURVEY CONSENT FORM.....	251
APPENDIX 6: STATE EPIDEMIOLOGIST SURVEY	254
APPENDIX 7: EMERGING AREAS OF PUBLIC HEALTH PRACTICE DEFINITIONS FOR JOB CLASSIFICATION CONTENT ANALYSIS.....	268
APPENDIX 8: FOCUS GROUP RECRUITMENT EMAIL.....	269
APPENDIX 9: FOCUS GROUP RECRUITMENT FORM	271
APPENDIX 10: FOCUS GROUP CONSENT FORM	276
APPENDIX 11: FOCUS GROUP SELECTION NOTIFICATIONS	279
APPENDIX 12: FOCUS GROUP PRE-SESSION QUESTIONNAIRE.....	282
APPENDIX 13: FOCUS GROUP PRE-SESSION INFORMATION	286

APPENDIX 14: EMERGING AREAS OF PUBLIC HEALTH PRACTICE DEFINITIONS FOR FOCUS GROUPS	288
APPENDIX 15: FOCUS GROUP GUIDE.....	290
APPENDIX 16: CODEBOOK FOR FOCUS GROUP INDEXING.....	297
APPENDIX 17: SUPPLEMENTAL DATA TABLES AND FIGURES FOR PHASE 1 PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS SURVEY ANALYSIS	305
APPENDIX 18: SUPPLEMENTAL DATA TABLES AND FIGURES FOR PHASE 2 STATE EPIDEMIOLOGIST SURVEY ANALYSIS	317
REFERENCES	324

LIST OF TABLES

Table 1. Key Terms	14
Table 2. Research Question and Aims	15
Table 3. Literature Review Search Terms	18
Table 4. Summary of Inclusion and Exclusion Criteria	19
Table 5. Summary of Aims and Corresponding Methods	46
Table 6. Applied Epidemiology Competencies Tier Level Descriptions	52
Table 7. Modified Applied Epidemiology Competencies Tier Level Descriptions	55
Table 8. Dissertation Timeline	58
Table 9. Estimated Percentage of Self-Reported Demographic Characteristics, Education, and Experience Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017	60
Table 10. Estimated Percentage of Self-Reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Skill Domain, Public Health Workforce Interest and Needs Survey, 2017	63
Table 11. Characteristics of the Jurisdiction and Designated State Epidemiologist Position, State Health Departments and the District of Columbia (n=51)	71
Table 12. Reference to Emerging Areas of Public Health Practice in Epidemiology- Specific Job Classifications in State Health Departments (n=164)	77
Table 13. Top Barriers for Epidemiologist Participation in Training in State Health Departments and the District of Columbia as Identified by State Epidemiologists (n=49)	81
Table 14. Epidemiology Workforce Challenges Identified by State Epidemiologists in State Health Departments and the District of Columbia (n=51)	82
Table 15. Comparison of Focus Group Registrant Self-Reported AEC Career Stage to Assigned AEC Career Stage (n=57)	85
Table 16. Importance and Self-Reported Readiness of Emerging Areas of Public Health Practice, Focus Group Participants (n=21)	86
Table 17. Additional Emerging Areas of Public Health Practice Offered by Participants	88
Table 18. Focus Group Participant Characteristics	90

Table 19. Role of State Health Department Epidemiologists in Emerging Areas of Public Health Practice Identified by Focus Group Participants	128
Table 20. Barriers for State Health Department Epidemiologists to Work in Emerging Areas of Public Health Practice Identified by Focus Group Participants	130
Table 21. Facilitators for State Health Department Epidemiologists to Work in Emerging Areas of Public Health Practice Identified by Focus Group Participants	133
Table 22. Summary of Findings by Stated Aim	150
Table 23. Summary of Recommendations to Improve State Health Department Epidemiologists' Ability to Work in Emerging Areas of Public Health Practice.....	169
Appendix 17 Table 17-1. Estimated Percentage of Self-Reported Primary Program Area Among State Health Department Epidemiologists.....	305
Appendix 17 Table 17-2. Estimated Percentage of Self-Reported Job Satisfaction and Intention to Leave Among State Health Department Epidemiologists	306
Appendix 17 Table 17-3. Estimated Percentage of Self-Reported Level of Agreement with Statements Related to Training and Development Among State Health Department Epidemiologists.....	307
Appendix 17 Table 17-4. Estimated Percentage of Self-Reported Training Motivators Among State Health Department Epidemiologists	308
Appendix 17 Table 17-5. Estimated Percentage of Self-Reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Workforce Tier	309
Appendix 17 Table 17-6. Estimated Percentage of Self-Reported Skill Importance Among State Health Department Epidemiologists by Workforce Tier	313
Appendix 17 Table 17-7. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Awareness Among State Health Department Epidemiologists.....	314
Appendix 17 Table 17-8. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Impact Among State Health Department Epidemiologists.....	315
Appendix 18 Table 18-1. Importance of Emerging Areas of Public Health Practice in Day-to-Day Work of Epidemiologists Working in State Health Departments as Reported by State Epidemiologists (n=51)	317
Appendix 18 Table 18-2. Readiness of Epidemiologists Working in State Health Departments to Work in Emerging Areas of Public Health Practice as Reported by State Epidemiologists (n=51)	318

Appendix 18 Table 18-3. Use of Job Classification Systems and Epidemiology-Specific Job Classifications in State Health Departments and the District of Columbia (n=51)	319
Appendix 18 Table 18-4. Minimum Education and Experience Requirements Specified in Epidemiology-Specific Job Classifications in State Health Departments (n=157).....	320
Appendix 18 Table 18-5. Use of Epidemiology Career Ladders in State Health Departments and the District of Columbia (n=49)	321
Appendix 18 Table 18-6. Perceptions and Use of the Applied Epidemiology Competencies for Workforce Development Activities in State Health Departments and the District of Columbia (n=50)	322
Appendix 18 Table 18-7. Ranked Order of Barriers for Epidemiologist Participation in Training in State Health Departments and the District of Columbia (n=49)	323

LIST OF FIGURES

Figure 1. Population Health Driver Diagram	16
Figure 2. PRISMA Diagram	21
Figure 3. Number of Epidemiologists Working in State Health Departments, United States, 2001 – 2017	26
Figure 4. Theoretical Framework	45
Figure 5. Estimated Percentage of Self-reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Skill Domain and Tenure in Public Health, Public Health Workforce Interest and Needs Survey, 2017	64
Figure 6. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Awareness Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017	66
Figure 7. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Impact Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017	66
Figure 8. Importance of Emerging Areas of Public Health Practice in Day-to-Day Work of Epidemiologists Working in State Health Departments as Reported by State Epidemiologists (n=51)	72
Figure 9. Readiness of Epidemiologists Working in State Health Departments to Work in Emerging Areas of Public Health Practice as Reported by State Epidemiologists (n=51)	74
Figure 10. Minimum Education Requirements Specified in Epidemiology-Specific Job Classifications in State Health Departments by Career Stage (n=157)	76
Figure 11. Perceptions of Epidemiology-Specific Classifications’ and Career Ladders’ Positive Contribution to Recruitment and Retention in State Health Departments and the District of Columbia	79
Figure 12. Focus Group Participant Selection	84
Figure 13. Geographic Representation of Focus Group Participants	89
Figure 14. Percent of Respondents Reporting the Emerging Area of Public Health Practice is Important to or Impacts the Day-to-Day Work of Epidemiologists	136
Figure 15. Updated Population Health Driver Diagram	138
Figure 16. Percent of Respondents Reporting that Epidemiologists Are Ready or Very Ready to Work in the Emerging Area of Public Health Practice	139

Figure 17. Process to Improve Population Health Through a Competent Public Health
Epidemiology Workforce..... 155

Figure 18. Modified Workforce Development Framework 156

Appendix 17 Figure 17-1. Estimated Percentage of Self-Reported Age Group Among
State Health Department Epidemiologists..... 316

Appendix 17 Figure 17-2. Estimated Percentage of Self-Reported Tenure in Public
Health Practice Among State Health Department Epidemiologists 316

LIST OF ABBREVIATIONS

ACA	Affordable Care Act
AEC	Applied Epidemiology Competencies
ASTHO	Association of State and Territorial Health Officials
CDC	Centers for Disease Control and Prevention
CoP	Community of Practice
CSTE	Council of State and Territorial Epidemiologists
ECA	Epidemiology Capacity Assessment
IHI	Institute for Healthcare Improvement
IOM	Institute of Medicine* (now known as National Academy of Medicine)
IT	Information Technology
PHAB	Public Health Accreditation Board
PH WINS	Public Health Workforce Interest and Needs Survey
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
U.S.	United States
WHO	World Health Organization

* The Institute of Medicine changed its name to the National Academy of Medicine in 2015. In this document, the publications from this organization are referenced using the name of the organization at the time the publication was issued.

CHAPTER 1: THE TOPIC

Epidemiology is a discipline within the field of public health that focuses on studying the distribution and determinants of disease in the population. Epidemiology includes explaining the causal mechanisms of disease and other health-related events, as well as describing their occurrence in terms of person, place, and time (Friis & Sellers, 2014, p.7-8). In addition to describing what health events have already occurred, epidemiology can be used to identify the determinants of health and to “model” or predict the occurrence of disease in the future. The word “epidemiology” derives from the word “epidemic”, which reflects the important role of epidemiologists in outbreak investigation. The field of epidemiology, however, has expanded significantly from John Snow’s investigation of a cholera outbreak in London in the 1850’s. Today, epidemiologists are key professionals within the public health workforce, fulfilling core public health science functions as part of the ten essential public health services (CDC, 2017).

The field of epidemiology is interdisciplinary and draws upon biological sciences, clinical medicine, social and behavioral sciences, toxicology, law, informatics, and statistics (Friis & Sellers, 2014, p.15). The interdisciplinary nature of epidemiology continues to expand as public health practitioners learn more about the determinants of health, which are now considered to include environmental, behavioral, psychological, biological, sociological, genetic, and lifestyle factors (Whitehead and Dahlgren, 1991). Consistent with its multidisciplinary nature, epidemiologists (those who practice epidemiology) may specialize in a variety of areas. Specialization may be by disease topic area (e.g. infectious diseases, chronic diseases, environmental health, etc.) or by methodology (e.g. needs

assessments, pharmacoepidemiology, genetic epidemiology, health services research, modeling, etc.) (Friis & Sellers, 2014, p.703-705).

Epidemiologists can be found practicing in a variety of settings that can be generally differentiated as either “applied” or “research and academic”. In research and academic settings, epidemiologists may teach epidemiology and conduct epidemiologic research in schools of public health and related medical schools for the purpose of generating generalizable knowledge. Research may also be conducted in pharmaceutical companies, in the non-profit sector, and in medical centers. Many research organizations employ epidemiologists as part of study teams to aid in methodology/study design and data collection and analysis. In contrast to research, the term “applied” epidemiology is generally used to describe the application of epidemiologic methods to address public health issues. The most common settings in which to find applied epidemiologists are governmental public health agencies at the federal, state, local, tribal and territorial levels. These distinctions are fluid, however, and you may find epidemiologists conducting research in governmental settings or working in applied practice at a university. Rogawski and colleagues (2016) described the concept of this distinction as “public health” vs. “medical” epidemiology. In general, and for the purposes of this dissertation, applied epidemiology refers to the work of epidemiologists practicing in governmental public health agencies.

Assessment of the Applied Epidemiology Workforce

Calls to strengthen the governmental public health workforce capacity in the United States, and specifically epidemiologic capacity, date back to at least the 1970’s and 80’s (Detels R, 1979; Williams SJ, 1988). A 1988 report titled *The Future of Public Health* from the Institute of Medicine (IOM), now called the National Academy of Medicine, concluded that governmental public health was not well-understood nor appropriately supported (IOM, 1988). The report asserted that the practice of public health was defined by both technical knowledge and public values, both of which were problematic, and in particular, a lack of

scientific knowledge due to fiscal constraints and under-funding of public health. Of particular relevance to this dissertation, knowledge, skills, and expertise varied greatly across states and was exacerbated by a lack of epidemiologists and others trained in technical skills (IOM, 1988). The report noted that recruitment and retention of skilled public health employees was stymied by low salaries and challenging bureaucratic work environments. Many of these problems remain today, thirty years later. In regards to workforce, the report recommended improving surveillance and epidemiology practice, emphasizing leadership skills in academic training, and monitoring the public health workforce in order to take actions to assure appropriate public health workforce staffing and competency (IOM, 1988).

In 2003, the IOM issued an updated report called *The Future of the Public's Health in the 21st Century* (IOM, 2003). This report recognized many of the same issues identified in the 1988 report and recommended assuring workforce competence, developing defined competencies for public health practice, providing leadership development, and regularly assessing the adequacy and capacity of the governmental public health workforce (IOM, 2003). The importance of assessing and assuring a competent public health workforce were highlighted in both the 1988 and 2003 IOM reports on the future of the public's health and both called for ongoing assessment and monitoring of the public health workforce. There are two dimensions that can be considered when evaluating applied epidemiology workforce capacity: enumeration (how many) and competency (how skilled).

Assessment of Epidemiology Workforce Enumeration

Nationwide enumeration of state health department epidemiologists was first attempted in 1983 and, since the early 2000's, is now routinely assessed by the Council of State and Territorial Epidemiologists (CSTE), a professional membership organization for applied epidemiologists. CSTE conducted its first Epidemiology Capacity Assessment (ECA) in 2001, and again every 2-4 years thereafter (2004, 2006, 2009, 2013 and 2017). The purpose of the ECAs has been to monitor a number of aspects of the applied epidemiology

workforce in the United States, including the number of epidemiologists, their characteristics and training needs, and factors that affect epidemiology staffing and functioning (Boulton et al., 2013). From 2001 to 2017, epidemiology capacity in state health departments has increased overall, both in quantity and in the number of epidemiologists with formal epidemiology training. However, the number of epidemiologists is still not enough to meet the needs of state public health agencies and significant training gaps remain, especially in certain program areas such as substance use (Arrazola et al., 2018). These enumeration assessments are reviewed in detail in the literature review chapter.

Assessment of Epidemiology Workforce Competency and Training Needs

In order to assess competency of the epidemiology workforce, an agreed upon set of competencies for the profession is needed. There has been increasing emphasis on competency in healthcare and public health professions in the last two decades primarily due to changes in the delivery of health care that favor evidence-based medicine that is both clinically- and cost-effective (Hoge et al., 2005). Hoge et al., defined a competency as a “measurable human capability that is required for effective performance” (2005). The four elements of competency, as defined by Hoge et al., are knowledge, skills, abilities, and personal characteristics (2005). Knowledge is the awareness or understanding of information or concepts needed to successfully perform a task. A skill is a capacity to perform a task to achieve a specific effect, and ability is a cognitive or physical capability to perform the task with a wide range of possible outcomes (Marrelli, 1998). Finally, personal characteristics are individual values, attitudes, traits, and behaviors (Hoge et al., 2005). All of these elements interact together in a specific way to form a competency. In turn, multiple competencies are typically needed to perform a job task. These integrative experiences can then lead to successful demonstrations of competency (U.S. DOE, 2002).

In order to develop competencies for the general practice of public health, the Council on Linkages Between Academia and Public Health Practice undertook a process lasting more than two decades. This process resulted in the “Core Competencies for Public

Health Professionals”, first published in 2001 and most recently updated in 2014 (PHF, 2014). These competencies were framed in the ten Essential Public Health Services and were very broadly crafted such that they applied not only to practice, but also to education and research. The competencies represented skill areas stratified by “tiers” representing the career stages of public health professionals and included: 1) Analytic/Assessment, 2) Policy Development/Program Planning, 3) Communications, 4) Cultural Competency, 5) Community Dimensions of Practice, 6) Basic Public Health Sciences, 7) Financial Planning and Management, and 8) Leadership and Systems Thinking. The Core Competencies are regularly reviewed and revised by a “Core Competencies Workgroup”, comprised of a large group of representatives from academic and public health organizations, to ensure the competencies remain relevant and reflect changes in public health workforce competency needs over time (PHF, 2014).

In regards to specific competencies for epidemiologists, a multi-stakeholder group led by CSTE came together in 2004 – 2006 to develop the Applied Epidemiology Competencies (AECs), which have now been in place unchanged for over a decade (CSTE, 2008). In contrast to the competencies for general public health practice, the applied epidemiology competencies focus on the knowledge, skills, and abilities needed to practice epidemiology in governmental public health agencies. While they are intended to apply to governmental applied epidemiologists, the competencies may still be relevant to research and academic epidemiologists or those working in non-governmental settings (CSTE, 2008).

How well epidemiologists perform these competencies and their associated training needs have been less frequently assessed. In the 2006 ECA, CSTE asked state epidemiologists to rate all of their epidemiology staff as a group in regards to the AECs and found that competency was rated high for traditional epidemiology-specific technical skills, but lower for non-traditional, more general skills, such as leadership (Lightveld et al., 2008). In the 2009 ECA, CSTE attempted for the first time to collect information from individual epidemiologists on competency and training needs (CSTE, 2009). A total of 341

epidemiologists completed the survey. The results were stratified by “tier”, or career stage, and generally showed that self-reported competency increased as tier level increased. Entry-level staff noted higher training needs in technical skills, such as implementing surveillance systems and reporting findings, whereas mid- and senior-level epidemiologists noted higher training needs in less technical skills, such as developing program logic models, leading community public health planning processes, and financial and administrative processes (CSTE, 2009).

The 2013 ECA is the most robust assessment of individual epidemiology capacity in state health departments to date (CSTE, 2013). A total of 1,590 epidemiologists completed the survey, a response rate of nearly 60%. Similar to 2006 and 2009, some of the areas noted to have greatest training needs were those pertaining to leadership, systems thinking, fiscal and administrative approaches, and planning and evaluation (CSTE, 2013).

Outside of the 2009 and 2013 ECAs, epidemiology competency assessments have been conducted infrequently mostly relative to a specific focus area of epidemiology (e.g. maternal and child health) or geography (e.g. within a single health department or single state). For example, the states of Nebraska and Virginia used the AECs to assess their local epidemiology workforce (Buss 2011; Patel 2008). Other authors have more generally assessed “training needs” and not specifically competency explicitly. These competency assessments and training needs are reviewed in detail in the literature review chapter.

Emerging Areas of Public Health Practice

The role of public health agencies is rapidly changing due to several factors including (1) the growing contribution of chronic diseases to disability and death, (2) transformation of the U.S. healthcare system and integration of public health in healthcare, and (3) emphasis on addressing upstream determinants of health. These drivers and corresponding emerging areas of public health practice have been referred to as “Public Health 3.0”, which calls for public health agencies to position themselves as the “chief health strategist” for

their community (DeSalvo et al., 2016). Additional drivers of change in the profession of applied epidemiology include evolving technology, increasing availability of electronic health data, and new and emerging threats that require new epidemiologic methods.

The 2003 IOM report addressed emerging areas of public health practice and proposed six “areas of action and change”, which included (IOM, 2003):

- Consideration of the Social Determinants of Health;
- Strengthening the governmental public health infrastructure;
- Building intersectoral partnerships and engage communities in public health action;
- Developing systems to assure the quality and availability of public health services;
- Evidence-based decision-making and evaluation of programs; and
- Enhancing communication across the public health system.

One such way to assure a quality public health infrastructure is accreditation. As interest in assuring quality public health services grew during the 2000’s, the Public Health Accreditation Board (PHAB) was formed to offer voluntary accreditation to governmental public health agencies (Kronstadt J, 2016). The PHAB accreditation standards include 12 domains with 10 being based on the ten essential public health services and the remaining two addressing management and governance (PHAB, 2013). Several of the domains address specific areas of emerging public health practice, including multisector collaboration, Health in All Policies, quality improvement, and evidence-based decision making (PHAB, 2013). Additionally, the standards include ensuring a competent public health workforce through assessment, development, and fostering a supportive work environment (PHAB, 2013). Inclusion of these standards in an accreditation program clearly defines competency in these areas as an expectation of public health practice.

Public health is a rapidly changing field. Both the IOM reports and the PHAB accreditation standards highlight key areas of public health practice that have emerged over the last decade or so. As the role of public health agencies changes over time, epidemiologists necessarily need to adapt and develop new skill sets to be successful in

population health improvement activities. Assessment of the applied epidemiology workforce regarding emerging areas of practice is needed to understand the role of epidemiologists and what training is needed to improve practice. In recognition of this gap in knowledge, the Association of State and Territorial Health Officials (ASTHO) added questions to the Public Health Workforce Interest and Needs Survey (PH WINS) to assess the public health workforce in terms of their interest in and training needs for working in the following five areas of emerging public health practice (Bogaert et al., 2019), which were the areas pre-selected for inclusion in this research.

Public Health and Healthcare Integration

Integration of public health and healthcare services has increasingly been touted as an approach to improving population health. The IOM in its report *Primary Care and Public Health: Exploring Integration to Improve Population Health*, defined integration as “the linkage of programs and activities to promote overall efficiency and effectiveness and achieve gains in population health” (IOM, 2012). There are a range of activities that could constitute integration, such as basic mutual awareness, to sharing of data, or partnering on health promotion activities.

The United States healthcare system is in a period of great transition. Historically, the focus of healthcare has been on treating the individual, whereas the focus of public health has been on the population as a whole. Healthcare system reform and changes in payment models have driven the focus of healthcare delivery away from treating sick individuals to preventing illness and improving the health of populations (Miller Center, 2014). Integration aligns nicely with a vision of a transformed healthcare system that includes public health and engages partners across sectors; it can help drive the healthcare system’s focus away from clinical care and more towards improving population health by working together to address upstream systems issues and social determinants (ASTHO, 2017).

While interest in integration has grown in recent years, the concept of integrating public health and healthcare activities is not new. In the mid-1990s, the American Medical Association and the American Public Health Association worked together to create the Medicine and Public Health Initiative, an attempt to bring together the two disciplines more closely (Beitsch et al., 2005). Despite these two influential professional associations attempting to make progress 15 years earlier, integration only began receiving significant attention with the passage of the Affordable Care Act (ACA) in 2010 (PPACA, 2010). The ACA expanded healthcare coverage, implemented new requirements for healthcare quality improvement, and tied financial incentives to prevention and public health activities and outcomes. The National Prevention Strategy, first issued by the U.S. Surgeon General in 2011, built on the ACA by emphasizing clinical and community preventive services as one of four strategic directions to improve health (NPC, 2011). This strategy calls for healthcare to become more prevention-focused, rather than treatment-focused, and to integrate healthcare and community prevention efforts.

In 2012, an IOM committee sought to identify various examples of integration activities involving public health and primary care, specifically (IOM, 2012). Once identified, the committee reviewed the integration examples and developed a set of core principles that led to successful initiatives. The core set of principles included:

- Developing a common goal of improving population health;
- Involving the community in defining and addressing its needs;
- Strong leadership that works to bridge disciplines, programs, and jurisdictions;
- Sustainability; and
- Collaborative use of data.

Many influential healthcare and public health organizations have adopted the concept of integration as a key approach to improving population health. Key organizations with integration agendas or commitments include the American Medical Association (Beitsch et al., 2005), the American Public Health Association (Beitsch et al., 2005), the Association of

State and Territorial Health Officials (ASTHO, 2011), and the Institute for Healthcare Improvement's "Triple Aim" to improve the patient experience of care, the health of populations, and reduce per capita cost of healthcare (IHI, *n.d.*). Several of these organizations have developed strategic plans or frameworks to guide their work in the integration arena.

Multisectoral Collaboration

Closely related to integration of public health in healthcare is multisectoral collaboration, which involves the collaboration of entities across sectors (health, environment, housing, education, employment, etc.) to improve health. Multisectoral collaboration has become increasingly important as public health moves towards improving health by addressing "upstream" determinants of health, often referred to as, the social determinants of health. Social determinants of health are "the conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (US DHHS, 2019). Due to the wide range of factors that can ultimately impact population health, public health agencies must work across sectors, both public and private, to address these determinants.

There are many cross-sector collaboration approaches that can be used as a framework for integration initiatives. Many of these models have similar components and are based on similar theory. "Collective Impact" is one such model that has gained popularity in recent years. The collective impact model includes five components: a common agenda, shared measurement systems, mutually reinforcing activities, continuous communication, and backbone support organizations (Kania & Kramer et al., 2011). In February 2018, the Spark Policy Institute of Denver, CO and ORS Impact of Seattle, WA issued a report that summarized the work of 25 collective impact initiatives in the U.S. (Spark Policy Institute & ORS Impact, 2018). These initiatives were not specific to population health improvement, and instead more broadly demonstrated the effect of

collective impact models for desired population changes, which were defined as changes in the target population of the initiative (e.g. a social issue, education, health, etc.). In this study, 20 of the 25 study sites demonstrated changes in the targeted population. This report was the first methodologically rigorous study that attempted to quantitatively measure the impact of the collective impact model, which, until this report, was surrounded by many claims of effectiveness with little evaluation of these claims. Regardless of the model used, cross-sector collaboration has been identified as a crucial component of the strategy to improve population health in the U.S. (Towe et al., 2016).

Health in All Policies

Health in All Policies is an approach to improving population health by addressing the social determinants of health through policy (Rudolph et al., 2013). This concept is closely related to, and often requires, multisector collaboration during which partners across sectors come together with a common goal to promote healthier policies, including those outside of health, such as education, housing, employment, etc. Health in All Policies is a concept that has only recently been formalized as a concept in public health, following mounting recognition of the role of social determinants in health and the need for multisectoral collaboration. In the 2010 “Adelaide Statement on Health in All Policies”, the WHO declared a new role for the public health sector to not only learn to work in partnership with other sectors, but to do so in an innovative way that is “outward oriented” and open (WHO, 2010). The statement recognized that in order to this, the public health workforce must be equipped with the necessary knowledge, skills, and abilities, which include:

- Understanding the political agendas and administrative imperatives of other sectors;
- Building the knowledge and evidence base of policy options and strategies;
- Assessing comparative health consequences within the policy development process;
- Creating regular platforms for dialogue and problem solving with other sectors;
- Evaluating the effectiveness of intersectoral work and integrated policy-making;

- Building capacity through better mechanisms, resources, agency support and skilled and dedicated staff; and
- Working with other government agencies to achieve goals and improve health.

Evidence-Based Public Health Practice

Evidence-based public health practice is the concept that public health practitioners should always use the best scientific evidence available when designing and selecting public health interventions and developing public health policies (Brownson et al., 2009). This concept is related to evidence-based medicine, which is a similar concept practiced in clinical medicine. Evidence-based decision making in public health involves using the best available evidence but considers the realities of public health practice, including the political and environmental context, the population being served, and resource constraints (Brownson et al., 2009). The “evidence” for this decision-making means that specific public health interventions and policies have been researched and tested for efficacy before they are recommended and deployed for widespread use (Health Affairs, 2005).

The concept of evidence-based public health practice first appeared in the scientific literature two decades ago around the time Jenicek defined it as the “conscientious, explicit, and judicious use of current best evidence in making decisions about the care of communities and populations in the domain of health protection, disease prevention, health maintenance and improvement (health promotion)” (1997). With the concept being relatively new, it is not known to what extent evidence-based practice is taught formally as part of public health training programs or included in professional development on the job. However, the underlying skills required to practice evidence-based public health are not new, such as the ability to identify and evaluate scientific literature (Brownson et al., 2009). It is also likely there are variations in ability to practice evidence-based public health based on specific profession (e.g. epidemiologists vs. nurses) and formal training (e.g. none vs. Master of Public Health) (Brownson et al., 2009).

Quality Improvement

The concept of quality improvement has received increasing attention in public health practice, as well as other industries, in recent years. Riley et al. (2010) define quality improvement in public health as the “use of a deliberate and defined improvement process that is focused on activities that are responsive to community needs and improving population health. It refers to a continuous and ongoing effort to achieve measurable improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality in services or processes which achieve equity and improve the health of the community.”

While all are different, quality improvement, program evaluation, and performance management are closely related concepts in regards to assuring delivery of high-quality and effective public health services. Together, they are key components of the program planning cycle and should be incorporated throughout the development, implementation and monitoring, and impact phases of a public health program (Woodhouse et al., 2013). Quality improvement has been emphasized so much so that it makes up one of the 12 domains (Domain 9) in the Public Health Accreditation Board’s standards and measures, and is incorporated into the overall accreditation process (PHAB, 2013). Quality improvement is central to the purpose of accreditation, which is to assure high-performing, continuously-improving, public health agencies (PHAB, 2013).

Definitions of Key Terms

In summary, the following key terms are relevant to this dissertation.

Table 1. Key Terms

Key Term	Definition
Epidemiologist	"An investigator who studies the occurrence of disease or other health related condition or events in defined populations. The control of disease in populations is often also considered to be a task for the epidemiologist." (Last J, A Dictionary of Epidemiology, 4th Ed., 2001)
Quality Improvement	"An integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization. The intent is to improve the level of performance of key processes and outcomes within an organization." (ASTHO PH WINS Survey)
Public Health and Healthcare Integration	"The linking of public health and health care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health." (IOM, 2012)
Evidence-Based Public Health Practice	"Making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned." (Brownson et al., 2009)
Multisectoral Collaboration	"Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest." (ASTHO PH WINS Survey)
Career Stage Based on Applied Epidemiology Competency Tiers	<p>Entry-level: Newly graduated from a master's degree program with a focus on epidemiology and/or analysis and assessment with less than 2 years' epidemiology experience, OR a bachelor's or other non-epidemiology professional degree or certification without formal academic epidemiology training and 2 or more years' epidemiology experience.</p> <p>Mid-level: Master's degree with a focus in epidemiology with 2 or more years' epidemiology experience, OR a doctoral-level</p>

	<p>epidemiologist, OR other non-epidemiology professional degree or certification with specific epidemiology training or at least 4 years' epidemiology experience.</p> <p>Senior-level: A master's degree with a focus in epidemiology and ≥ 4 years' epidemiology experience, OR a doctoral-level degree in epidemiology with ≥ 2 years' epidemiology experience at mid-level, OR other non-epidemiology professional degree or certification with specific epidemiology training and ≥ 4 years' epidemiology experience at mid-level.</p> <p>(CSTE, n.d.a)</p>
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Research Question and Aims

This study sought to answer the following specific research question in support of the stated aims listed below:

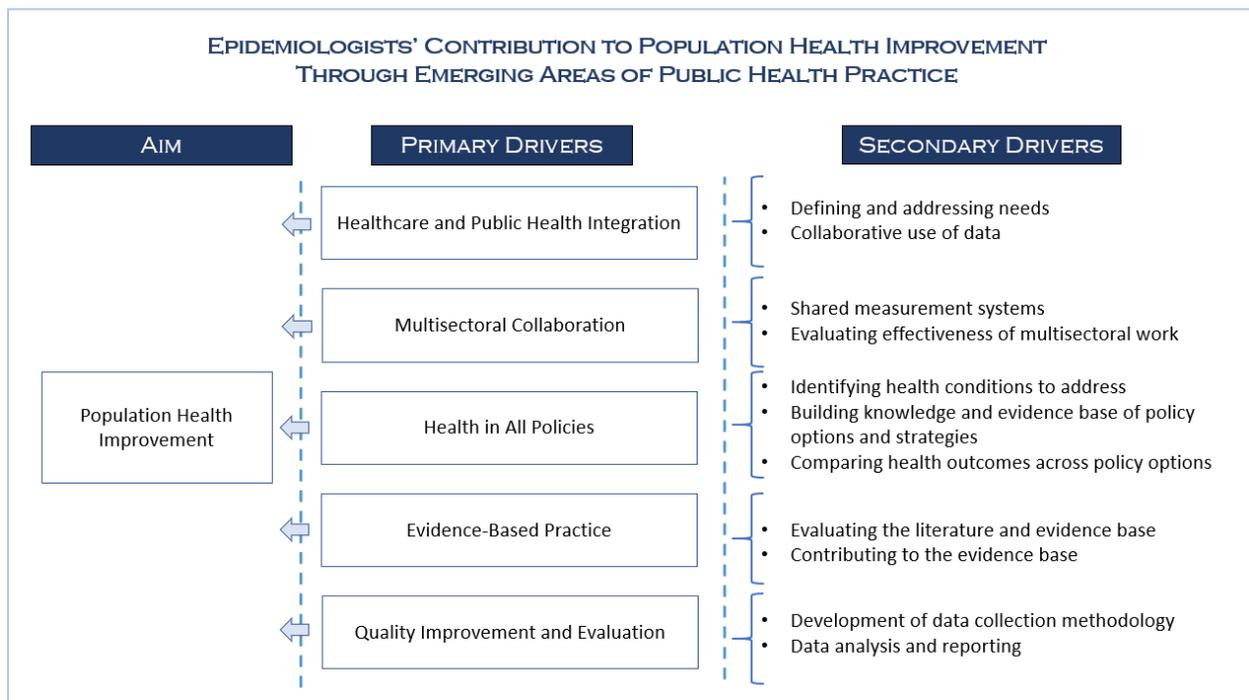
Table 2. Research Question and Aims

Research Question
What is the role and readiness of state health department epidemiologists to work in emerging areas of public health practice?
Aims
<u>Aim 1.</u> To define the role of state health department epidemiologists in emerging areas of public health practice.
<u>Aim 2.</u> To assess self-reported competency of state health department epidemiologists and identify differences in self-reported relevancy, competency, and training needs relative to working in emerging areas of public health practice based on "tier" (entry-, mid-, senior-level) of epidemiologist to inform workforce development activities.
<u>Aim 3.</u> To understand how epidemiology career ladders are used in state health departments to define the role of epidemiologists, to incorporate applied epidemiology competencies, and to inform workforce development activities.

The Research in the Context of Population Health

The 1988 IOM report *The Future of Public Health* and the subsequent 2003 IOM report *The Future of the Public's Health in the 21st Century* recognized that assuring an adequate public health workforce, both in volume and in competency, were critical to population health improvement efforts (IOM 1988; IOM, 2003). As a subgroup of the larger public health workforce, epidemiologists are key professionals that fulfill core public health science functions, such as conducting health surveillance, identifying and investigating risk factors and determinants of health, and assessing and evaluating effectiveness of public health services (CDC, 2017). Using a population health driver diagram approach (IOM, 2015), [Figure 1](#) depicts example primary and secondary drivers related to epidemiology workforce competency that can lead to population health improvement. One aim of this research was to better understand the role of epidemiologists in the emerging areas of public health practice, which further informed this diagram in terms of the specific drivers related to the epidemiology workforce that can lead to population health improvement.

Figure 1. Population Health Driver Diagram



CHAPTER 2: LITERATURE REVIEW

A review of the literature was conducted to identify articles published in the peer-reviewed literature relative to the applied epidemiology workforce in the United States. This systematized review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et al., 2009).

Search Methods for Identification of Studies

Database selection. PubMed, Embase, Scopus, and the Cochrane Library were searched using the strategy described below. PubMed was selected for its wide coverage of health science literature, which includes over 28 million citations in the fields of biomedicine and health, including life sciences, behavioral sciences, chemical sciences, and bioengineering (NCBI, *n.d.*). Embase is a biomedical literature database selected because it offers an additional 2,900 indexed journals unique to Embase (Elsevier, *n.d.*). Scopus was selected because it provides broader coverage than health and medicine journals alone and may include other journals where the interdisciplinary topic of workforce could be published. Scopus is the largest abstract and citation database of peer-reviewed literature and includes the fields of science, technology, medicine, social sciences, and the arts and humanities (Elsevier B.V., *n.d.*). The Cochrane Library was selected due to its focus on evidence-based practice. It is a collection of seven databases that contain high-quality and independent evidence to inform healthcare practice (WOL, *n.d.*). Any reviews identified from the Cochrane Library were not considered eligible for inclusion but their reference lists would be reviewed to identify any additional relevant studies not captured through the search

strategy. Additional articles were identified by manually reviewing the references in relevant review articles identified through the database searches.

Search terms. Article titles, abstracts, and key words were searched within each database for the terms in [Table 3](#).

Table 3. Literature Review Search Terms

Main Concept	Search Term(s)
Epidemiology	'epidemiology' OR 'epidemiologist' OR 'epidemiologic' OR 'epidemiological'
AND	
Workforce	'workforce' OR 'personnel' OR 'employee' OR 'manpower' OR 'worker' OR 'human resources'
AND	
Competency	'skill' OR 'competence' OR 'competency' OR 'knowledge' OR 'ability' OR 'abilities' OR 'capacity' OR 'capability'
OR	
Needs	'gap' OR 'need' OR 'assessment' OR 'training' OR 'education'
AND	
United States	'United States' OR 'US' OR 'U.S.' OR 'America' OR 'state'

Criteria for Considering Studies for this Review

Time period. Results were not limited by publication year and included all publications through December 31, 2019.

Types of studies. All study designs were eligible for inclusion including randomized controlled trials, quasi-experimental, ecologic, cross-sectional, and observational cohort and case-control studies. Case reports and commentaries were also eligible for inclusion. Review articles were excluded.

Types of participants. Studies involving epidemiologists in governmental public health agencies at the federal, state, or local levels in the United States were eligible for inclusion.

Exclusion criteria. Articles written in a language other than English, were a review article, or did not pertain to applied governmental epidemiologists were excluded from this review.

[Table 4](#) provides a comprehensive list of inclusion and exclusion criteria used for screening articles.

Table 4. Summary of Inclusion and Exclusion Criteria for Literature Review

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> <input type="checkbox"/> Published on any date through December 31, 2019 <input type="checkbox"/> Any study type including case reports <input type="checkbox"/> Includes information on applied governmental epidemiologists <input type="checkbox"/> Describes workforce training, competency, or capacity/enumeration: <input type="checkbox"/> Pertains to the United States epidemiology workforce <input type="checkbox"/> Written in English 	<ul style="list-style-type: none"> <input type="checkbox"/> Review articles and conference abstracts <input type="checkbox"/> Does not include information on applied governmental epidemiologists <input type="checkbox"/> Describes epidemiology training for general public health workforce <input type="checkbox"/> Does not describe training, competency, and capacity/enumeration of workforce <input type="checkbox"/> Pertains to the epidemiology workforce outside the United States <input type="checkbox"/> Written in a non-English language

Search Strategy and Data Collection

Study selection process. Studies meeting inclusion criteria were exported from search databases and imported into the systematic reviews production tool Covidence (Melbourne, Australia). All collected articles were deduplicated by Covidence, which was then used for title and abstract screening. Articles included after title and abstract screening were imported into the F1000 reference software (London, UK) for full-text screening, which was performed manually by a single reviewer to validate inclusion criteria were met and that no exclusion criteria were present. This process resulted in a final list of articles meeting inclusion criteria to be included in the review.

Assessment of quality in included studies. Each included article was evaluated for sources of bias and potential threats to validity. The risk of bias was assessed including

biases related to selection, performance, attrition, detection and reporting, and other potential sources. Additionally, generalizability of the study and appropriateness of the conclusions were evaluated. Each article was then rated as “low risk”, “medium risk”, or “high risk” of biases that would alter the results of the study.

Data extraction and management. All articles meeting inclusion criteria were systematically read in their entirety and a specialized data abstraction form was developed and used to abstract key information from each article. Abstracted data were entered into a table and summarized. Abstracted data included:

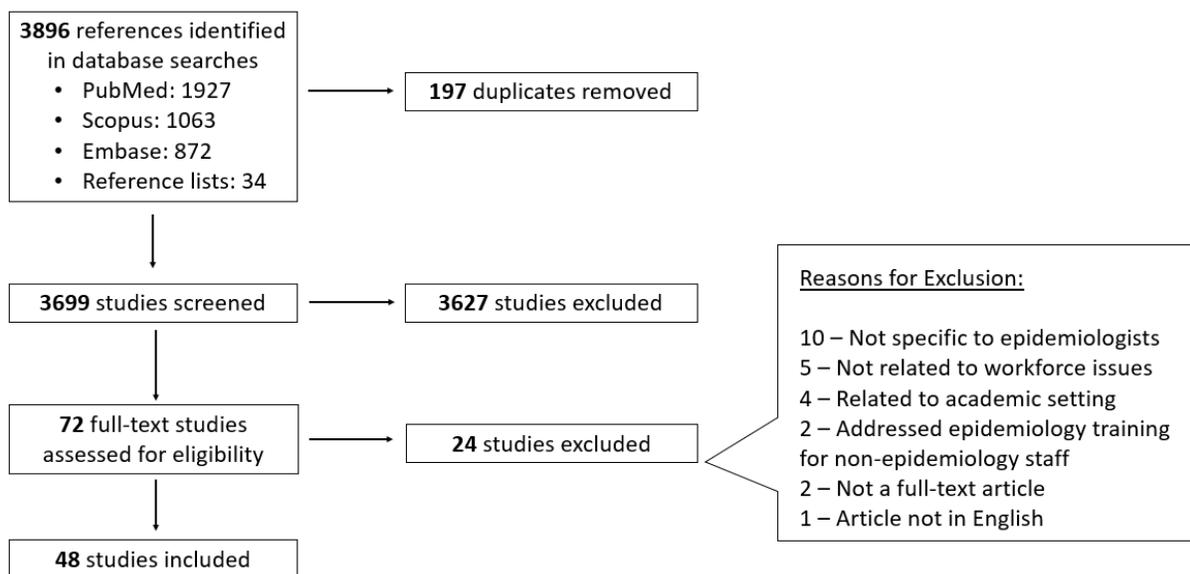
- Author (Year)
- Setting
- Setting type
- Participants
- Study type
- Study emphasis (capacity, capability)
- Assessment method (survey, interviews)
- Key findings
- Limitations of the study
- Generalizability of conclusions
- Appropriateness of conclusions
- Risk of bias rating

Results

The literature search identified 3,896 articles from the databases Embase (n=1,063), PubMed (n=1,927), and Scopus (n=872), as well as 34 from review of reference lists or related-article suggestions. No review articles were identified in the Cochrane Library search. After removing 197 duplicates across the three databases, 3,699 references remained for title and abstract screening. Among these, 3,627 were determined to be non-relevant and 72 under-went full-text review. Of these, 24 were excluded and 48 were included, all of which were applicable to governmental public health agency epidemiologists in the United States at the federal, state, and local levels. See [Appendix 1](#) for characteristics of the 48 included articles. Reasons for exclusion included articles that described workforce topics related to the general public health workforce and not epidemiologists specifically

(n=10), articles about epidemiology not related to workforce (n=5), articles about academic epidemiologists (n=4), articles about providing epidemiology training to non-epidemiology public health staff (n=2), references that were not full-text articles (n=2), and one article that was not written in English. [Figure 2](#) provides the PRISMA diagram summarizing the results of the search.

Figure 2. PRISMA Diagram



The 48 included articles were comprised of 27 empiric studies assessing the epidemiology workforce capacity specifically (n=23) or the public health workforce more generally but included specific information on epidemiologists (n=4). Among the remaining articles, three were case studies describing epidemiology capacity building activities and three described specific training programs designed to enhance epidemiologic capacity in governmental public health agencies. Two articles described the process of developing the applied epidemiology competencies. Finally, 13 articles were non-empiric editorials, commentaries, or viewpoint articles asserting new conceptual theories, opinions, or declaring a call to action related to the applied epidemiology workforce.

Thematic Analysis

Information abstracted from the 48 included articles was compiled and assessed to identify themes related to applied epidemiology workforce capacity in the United States.

Empiric Assessment of Epidemiology Workforce Enumeration

Prior to the first national Epidemiology Capacity Assessment conducted by CSTE in 2001, enumeration of epidemiologists working in state health departments had been infrequently assessed. The earliest survey of state health departments related to epidemiology capacity identified in this literature review was conducted in 1983 (Gunn, 1989). One earlier assessment was published in 1979, but it involved surveying epidemiologic capacity in federal agencies, schools of public health and medicine, and some large private research and international agencies (Detels, 1979). The 1983 state health department survey sought one response per state from the "state epidemiologist", which is generally the most senior epidemiology position found in state health departments. This survey identified 224 epidemiologists working in state health departments (1.1 per million population), most of whom were physicians (57%) and worked in infectious disease programs (Gunn, 1989).

After this first survey in 1983, two additional assessments of epidemiology capacity in the United States were conducted in the 1980s. Williams et al. (1988) estimated the number of epidemiologists in the United States based on professional association mailing list recipients, trainees in graduate programs, key informant interviews with experts, and review of epidemiology job announcements. This methodology resulted in a high estimate of 4,600 epidemiologists working in the United States across all sectors, governmental and non-governmental (Williams, 1988). Later, in 1989, a group of 12 southern states conducted an assessment of state health department capacity within their jurisdictions (Woernle, 1991). This survey identified 117 epidemiologists working in the 12 participating state health departments (1.7 per million), as reported by state epidemiologists. Similar to

the survey in 1983, most epidemiologists were working in infectious disease programs and approximately one third were physicians. Just over half (53%) the epidemiologists had a graduate degree in epidemiology or biostatistics and the rest had no graduate degree training (Woernle, 1991).

In 1991, Boss et al. (1994) conducted a nationwide survey to specifically assess non-infectious disease epidemiology capacity in state health departments. Unlike earlier surveys which sought one response per state, state epidemiologists were asked to distribute surveys to every epidemiologist working in non-infectious disease program areas (Boss et al., 1994). A total of 260 epidemiologists responded to the survey. In comparison to the 1983 survey, which found that 80% of epidemiologists were male, nearly a decade later this assessment observed that 56% were male. The authors attributed this change to the growing number of epidemiologists with master's degrees, who were more likely to be female than those with doctoral degrees, and possibly differences in who might practice in non-infectious disease topic areas, such as maternal and child health (Boss et al., 1994).

CSTE began conducting routine and standardized assessment of epidemiologists working in state health departments beginning in 2001 using a survey instrument referred to as the Epidemiology Capacity Assessment (ECA) (Boulton et al., 2003). Articles stemming from ECA surveys made up 11 (41%) of the 27 empiric assessments of epidemiology capacity in the United States in this literature review. ECAs have been conducted in 2001, 2004, 2006, 2009, 2010, 2013 and 2017 (Arrazola et al., 2018). For the purposes of the ECAs, CSTE defined epidemiology as the "study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems" and epidemiologist as "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." (CSTE, n.d.a). The ECAs sought one response per state, typically from the state epidemiologist; in 2004, 2006, 2009, and 2013, CSTE also asked the state

epidemiologist to collect information on individual characteristics of epidemiologists, such as highest educational level.

The 2001 ECA collected responses from 41 states and three U.S. territories (Boulton et al., 2003). This was a key period of time to deploy this first nationwide assessment because it was just prior to a large influx of public health emergency preparedness funds following September 11th, 2001. As such, the 2001 ECA provided a baseline of epidemiology capacity in state health departments at the turn of the century. Responding health departments reported employing 1,366 epidemiologists, nearly half (48%) of whom who worked in infectious disease programs (Boulton et al., 2003). This survey did not achieve a 100% response rate from state health departments in its first deployment; however, the six subsequent ECAs were able to collect responses from all jurisdictions.

The 2004 ECA collected responses from all 50 states, three U.S. territories and the District of Columbia. Responding health departments reported employing 2,580 epidemiologists, a 27% increase from the 2001 ECA when considering only those jurisdictions that responded to both surveys (Boulton et al., 2005). The number of epidemiologists remained relatively stable from 2004 to 2006. Health departments responding to the 2006 ECA, which collected responses from all 50 states and the District of Columbia, reported employing 2,436 epidemiologists (Boulton et al., 2009).

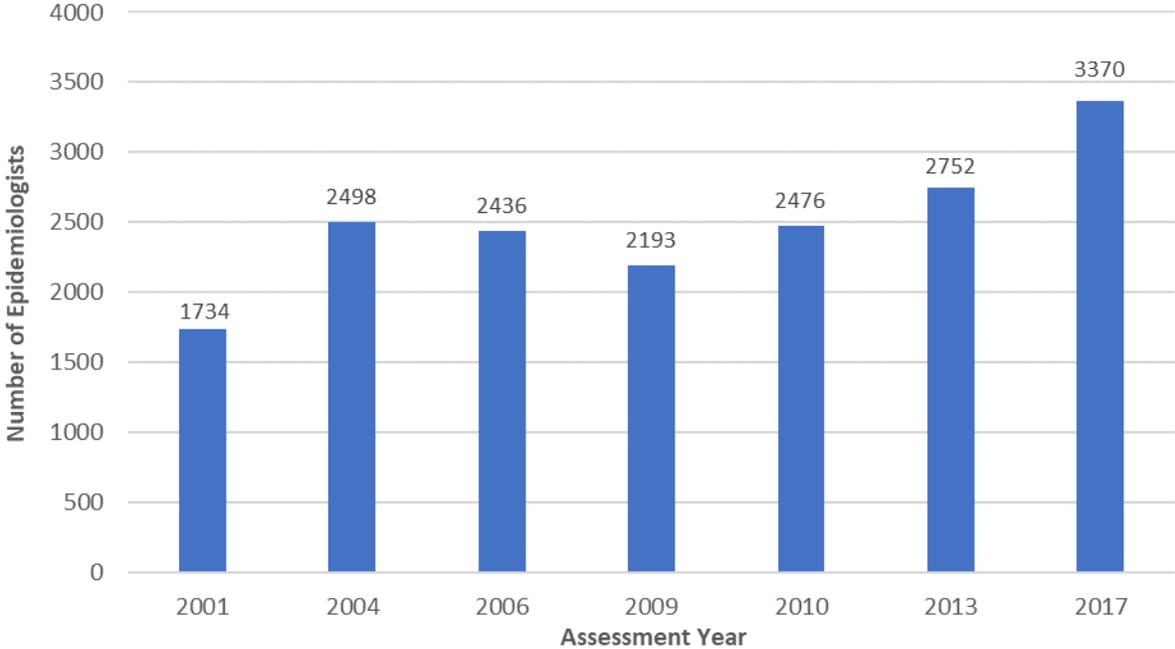
The 2009 ECA collected responses from all 50 states and the District of Columbia. Responding health departments reported employing 2,193 epidemiologists, a 10% decrease from 2006 (Boulton et al., 2009). Overall, from 2004 through 2009, ECAs for which all 50 states reported, there was a decrease of 12% in the number of epidemiologists (Boulton et al., 2011). Trend analysis of the 2004, 2006, and 2009 ECAs showed that epidemiologic capacity decreased in all program areas, except infectious diseases. While the number of epidemiologists decreased over the 5-year period, the characteristics of epidemiologists changed, specifically the rapid increase in formal epidemiology training. In 2004, 71% of

individuals working as epidemiologists had formal epidemiology training (degree, training, or coursework) and by 2009, this proportion had grown to 87% (Boulton et al., 2011).

Due to various state and federal funding changes at the time, CSTE conducted a special ECA in 2010 that collected information on epidemiologists in state health departments and also attempted to enumerate the number of local health department epidemiologists for the first time (Boulton et al., 2012). The assessment identified 2,476 epidemiologists in state health departments and 1,278 in local health departments in all 50 state health departments and the District of Columbia, for a total of 3,754 epidemiologists in the United States (Boulton et al., 2012). State health departments reported decreases in state funding but increases in federal funding that resulted in an overall 12% increase in the total number of epidemiologists in state health departments compared to 2009; however, this number masks the fact that 24% of state health departments reported a >10% decrease in epidemiologists (Boulton et al., 2012).

The 2013 ECA collected responses from all 50 states and the District of Columbia. Responding health departments reported employing 2,752 epidemiologists, a 25% increase from 2009 (Hadler et al., 2013). Increases were reported in all subject areas except substance abuse. A non-significant increase in the proportion of epidemiologists with formal epidemiology training was observed (87% in 2009 vs. 88% in 2013) (Hadler et al., 2013). The 2017 ECA again collected responses from all 50 states and DC, and 3,370 epidemiologists were reported representing a 22% increase over 2013 (Arrazola et al., 2018). While the number of epidemiologists increased, state epidemiologists identified significant unmet need, especially in the areas of substance abuse, mental health, and genomics. More than three quarters (77%) of epidemiology positions and epidemiology activities were reported as federally-funded (Arrazola et al., 2018). Overall, across all seven deployments, the ECA has shown variability in the number of epidemiologists over time based on key periods of both windfalls and restriction of federal funding ([Figure 3](#)).

Figure 3. Number of Epidemiologists Working in State Health Departments, United States, 2001 – 2017



Source: CSTE Epidemiology Capacity Assessments, 50 U.S. States and District of Columbia (Boulton et al., 2009; Bouton et al., 2011; Hadler et al., 2015; Arrazola et al., 2018).

In addition to the nationwide ECAs, a few disease- or program area-specific assessments of epidemiology capacity have been completed in recent years. In 2006, Rosenberg et al. (2011) conducted telephone interviews with state health departments to assess epidemiology “functioning” in Maternal and Child Health programs. The authors concluded that the following factors led to enhanced epidemiology functions: (1) involving external stakeholders, (2) use of consensus for setting the epidemiology agenda, (3) the number of doctoral-level trained staff, and (4) use of CDC assignees (Rosenberg, 2011). In 2010, CSTE conducted a nationwide assessment of foodborne disease epidemiology capacity in local, regional, and state health departments (Boulton et al., 2011). The assessment was intended to capture one response per state, completed by either the lead foodborne disease epidemiologist or the state epidemiologist. The survey collected information on enumeration and capacity to detect, investigate, and control foodborne diseases and outbreaks. The

survey identified 787 foodborne disease epidemiologists in state, regional, and local health departments in the United States. Most (78%) of these individuals had an epidemiology degree. The authors concluded that there was an insufficient number of foodborne disease epidemiologists and a need for additional formal training (Boulton et al., 2011).

In 2014, ASTHO conducted the Public Health Workforce Interests and Needs Survey (PH WINS), which was the first-ever survey of state health department employees in the United States (Sellers et al., 2015). While this web-based survey collected responses from over 10,000 state health department employees across all occupation types, it also included information on epidemiologists as a subset of the larger total. Chapple-McGruder et al. (2017) summarized the data collected from state health department epidemiologists via PH WINS in 2014. A total of 681 epidemiologists responded to the survey and study authors estimated there was a total of 2,850 epidemiologists working in state health departments. Approximately 88% of epidemiologists had a master's degree, 74% were female, and 31% worked in communicable disease program areas (Chapple-McGruder et al., 2017).

This review identified two state-level epidemiology capacity assessments in the peer-reviewed literature. In 2006, the Virginia Department of Health conducted an assessment of epidemiology capacity within the state health department based on the newly developed AECs (Patel, 2008). A total of 88 epidemiologists responded to the survey, of whom 69% had a master's degree or higher, and 71% had worked at the agency for less than 10 years. In 2008, the Nebraska Department of Health and Human Services surveyed the state and local health departments to assess the number and competency of governmental epidemiologists in Nebraska (Buss, 2011). Like in Virginia, competency was assessed using the AECs. In terms of enumeration, 74 epidemiologists were identified, of whom 32 (43%) had a master's degree or higher (Buss, 2011). Of note, just 11 of these degrees were in epidemiology. Nearly 80% had worked as an epidemiologist for less than 10 years and 65% for less than 5 years (Buss, 2011).

Finally, the American College of Epidemiologists (ACE) conducted an assessment of 1,348 attendees of the 2006 North American Congress of Epidemiology (Carter-Pokras et al., 2009). A total of 397 (30%) attendees completed the survey, of whom just over half had a doctoral degree (54%) and 21% worked in governmental public health settings. Due to this group being comprised mostly of epidemiologists working in academic settings, there were a number of differences from assessments of focused on governmental epidemiologists. Notable differences in the ACE respondents were higher pay, increased interest in basic science and methodologic training, and more responding epidemiologists working in non-infectious disease areas, such as cancer (Carter-Pokras et al., 2009).

Empiric Assessment of Epidemiology Workforce Competency and Training Needs

The peer-reviewed literature included three articles describing assessment of epidemiology workforce competency using the Applied Epidemiology Competencies (AECs) as well as 15 assessing capacity and competency outside of the framework of the AECs, some of which also enumerated the workforce and are described, in part, above.

While not assessments, two articles identified in this literature review described the process of developing the AECs and the AECs themselves. The AECs are summarized here first prior to describing the assessments of competency based on them. The AECs were developed by a multi-stakeholder group led by CSTE that came together in 2004 – 2006 (Birkhead, 2006). The AECs were developed within the framework of the Core Competencies for Public Health Professionals that had been developed in 2001 by the Council on Linkages Between Academia and Public Health Practice (PHF, 2014). In total, the AECs contain 149 “competency statements” grouped across eight domains and by four “tiers”, or career stage, of epidemiologic practice (Birkhead, 2008). The authors of the AECs clearly defined “applied” epidemiologists as those that work in governmental public health agencies and competency as knowledge, skills, and abilities needed to perform specific functions within professional practice (Birkhead, 2008). The eight domains are consistent with those of the Core Competencies for Public Health Professionals, but the underlying competency

statements are more specific to epidemiology practice. These domains are (1) Analytic/Assessment, (2) Basic Public Health Sciences, (3) Communication, (4) Community Dimension of Practice, (5) Cultural Competency, (6) Financial Planning and Management, (7) Leadership and Systems Thinking, and (8) Policy Development/Program Planning. The four tiers of applied epidemiology practice were defined as Tier 1 (entry-level with <2 years of experience), Tier 2 (mid-level with graduate degree and ≥ 2 years of experience), Tier 3a (senior-level functioning as a supervisor or manager), and Tier 3b (senior-level serving as a scientist/subject area expert in a epidemiology focus area) (Birkhead, 2008). The 149 competency statements are comprised of 34 to 39 primary competencies depending on tier, and then numerous subcompetencies and sub-subcompetencies (Birkhead, 2008).

In regards to assessment of epidemiology workforce competency using the AECs, competency assessment at the individual level using the AECs has occurred at the national level infrequently. As part of the 2006 ECA, CSTE asked state epidemiologists to rate all of their epidemiology staff as a group using the AECs (Lightveld et al., 2008). In general, this assessment found that competency was rated high for traditional epidemiology-specific technical skills, but lower for non-traditional, more general skills, such as leadership (Lightveld et al., 2008). For example, 82% of responding state health departments reported that epidemiology staff were competent in developing databases but that proportion dropped to 39% when asked about competency in convening and providing appropriate data for community planning processes (Lightveld et al., 2008). Other specific areas identified as needs for additional training included leadership and systems thinking, using knowledge of environmental and behavioral sciences in epidemiology practice, and evaluating surveillance systems (Lightveld et al., 2008). The 2009 and 2013 ECAs collected self-rated competency information at the individual level, though the results are not described in the peer-reviewed literature and are briefly discussed earlier.

The states of Nebraska and Virginia used the AECs to assess their local epidemiology workforce (Buss, 2011; Patel, 2008). The Virginia Department of Health assessment in 2006 collected self-reported competency ratings based on the AECs (Patel, 2008). Senior epidemiologists were noted to more commonly perform supervisory or managerial job functions, and require leadership, systems thinking, and policy development skills. The authors noted that training needs varied by career stage, years of experience, and level of formal epidemiology training but that overall, training needs were highest for epidemiology-specific skills (Patel, 2008). The Nebraska assessment in 2008 similarly identified differences in competency based on career stage, years of experience, and level of formal epidemiology training (Buss, 2011). Like in Virginia, more senior epidemiologists were noted to have greater management-related competency. The authors of all three assessments based on the AECs concluded that the AECs were a helpful framework from which to assess competency and also to develop training plans, in the case of the two state assessments.

As already described, the 2006 ECA assessed epidemiology competency in state health departments using selected AECs as reported by the state epidemiologist. The 2009 and 2013 ECAs assessed epidemiology competency using selected AECs as self-reported by individual epidemiologists. The remaining ECAs conducted to date (2001, 2004, 2010, and 2017) collected information on self-reported overall state capacity to perform core epidemiology functions based on the ten essential public health services. This self-reported capacity has changed over the nearly two decades that the ECAs have been administered and also reflects great variability across state health departments. In the 2001 ECA, the proportion of respondents reporting substantial to full capacity for monitoring health status was 55%, investigating community health problems was 60%, evaluation was 27%, and research was 7% (Boulton et al., 2003). By 2017, the proportion of states and DC reporting substantial to full capacity for monitoring health status was 84%, investigating community health problems was 92%, evaluation was 39%, and research was 22% (Arrazola et al., 2018; Arrazola et al., 2019). Capacity increased significantly at the same time that both the

overall number of epidemiologists as well as the proportion with formal training increased. However, in its 2017 assessment, CSTE noted that despite increases in the number of epidemiologists between 2013 and 2017, there were not concomitant significant increases in state capacity to carry out the essential public health services related to epidemiology between the two assessments, suggesting that capacity is not determined by numbers alone and that different skillsets may be needed as public health practice changes over time (Arrazola et al., 2018).

The 2017 ECA was also fielded to 27 large urban health departments in partnership with the Big Cities Health Coalition, representing 90% of their members (McGinty et al., 2019). These health departments were found to provide similar services as state health departments (e.g. infectious diseases, chronic disease, emergency preparedness, etc.). They reported needing an increase of 40% more epidemiologists in order to achieve ideal epidemiology capacity. Overall, most reported substantial-to-full capacity to monitor and diagnose health problems but they reported lower capacity to conduct evaluations and perform applied research. The highest training priority noted was around data analytics and informatics.

The 2014 PH WINS collected information on self-rated competency in various training and competency areas. In regards to the emerging areas of public health practice described earlier, 62% of state health department epidemiologists reported that applying evidence-based approaches was very important to their work and 23% reported being an expert, 46% reported that engaging external partners to collaborate on projects was important to their work and 15% reported being an expert, 44% reported applying quality improvement concepts was important to their work and 16% reported being an expert, and 34% reported understanding the relationship between policy and health was important to their work and 7% reported being experts (Chapple-McGruder et al., 2017). The authors noted that epidemiologists, in general, reported being more competent in epidemiology-specific competencies than in cross-cutting skills, such as collaboration, communication, policy, etc.

This review of the literature identified three articles that were empiric studies assessing public health workforce capacity more broadly but included specific information on epidemiologists. Hopfer and colleagues (2009) assessed training needs in state cancer control programs relative to geographic information system (GIS) mapping. While not explicit to epidemiologists, the assessment is relevant because epidemiologists are typically the staff within many public health programs that perform GIS mapping, as it is one way to analyze and visualize health data. The authors concluded that the majority of cancer control programs reported a need for GIS training and identified epidemiologists as a key training audience (Hopfer et al., 2009).

In 2016, the University of Michigan Center of Excellence in Public Health Workforce Studies implemented the Public Health Workforce Gaps Study (Beck et al., 2017). This study sought responses from both state and local health departments and focused on which public health occupations had the greatest training needs and what their greatest workforce needs were in general (e.g. more positions, more qualified candidates, ability to offer better compensation, new or different skills, etc.) (Beck et al., 2017). The 46 responding state health agencies identified epidemiologists as having the highest-priority workforce needs (88% of respondents) (Beck et al., 2017). The greatest occupation affected by low salaries for recruitment and retention were epidemiologists (89% of respondents). Of note in this survey, state health agency leadership ranked epidemiologists the lowest in needing to learn new or different skills (14% of respondents) (Beck et al., 2017).

In another analysis of 2014 PH WINS data, Pourshaban and colleagues (2015) analyzed the data to identify determinants of workforce turnover. One of the study's findings was that epidemiologists may be particularly vulnerable to turnover not due to retirement, and that the strongest predictors of turnover were pay and job satisfaction (Pourshaban et al., 2015). Among responding epidemiologists, 22% reported intention to leave their current organization within one year, though most planned to continue working within the public health sector (Pourshaban et al., 2015).

In 2017, ASTHO in collaboration with CDC, fielded the Directors Assessment of Workforce Needs Survey. This assessment provided information on public health workforce development needs from the perspective of managers, including epidemiology managers, working in state health agencies (Leider et al., 2019). Wages or salaries were noted as the greatest perceived barrier to recruitment and retention within the agency. In terms of training needs relative to seven “strategic skills”, managers affiliated with CSTE reported that their staff were most proficient in collecting valid and reliable data (80%), delivering programs in a culturally-competent manner (78%), communicating in a way different audiences can understand (73%), and identifying evidence-based approaches (72%). The skills managers affiliated with CSTE reported staff were least proficient in were supporting quality improvement (59%), using community assets and resources to improve health in a community (57%), and assessing drivers in their environment (50%) (Leider et al., 2019).

While not an assessment of current capacity, Brownson and colleagues (2015) assessed the drivers of changing training needs in epidemiologic research and practice. The scope of this assessment was broad in that the authors attempted to address both research/academic and applied epidemiology, with the focus primarily on formal training; 10 of the 15 key informants interviewed worked in academic settings. The authors identified 12 key trends affecting epidemiology, which were (1) growing availability of data, (2) changing health communication environment, (3) healthcare reform, (4) changing demography, (5) globalization, (6) emerging high-throughput technologies, (7) focus on accountability, (8) privacy changes, (9) emphasis on “upstream” determinants of health, (10) emergence of translational sciences, (11) team and transdisciplinary science, and (12) changing funding environment (Brownson et al., 2015). The authors made recommendations for education and proposed specific competencies tied to each of these trends. The authors noted that their work is most applicable to formal academic training of epidemiologists, but acknowledged that continuing education is important and called for professional organizations to work with academia to address this need (Brownson et al., 2015).

Epidemiology Workforce Capacity Building

Three case studies describing epidemiology capacity building activities were identified. In one article, a CDC-funded CSTE workgroup came together in 2001 to explore and develop a framework and competencies for a state chronic disease epidemiologist mentor program (Lengerich et al., 2003). The article described the group's work and argues the value of such a mentorship program but does not state whether the mentorship program was ever implemented. In another article, the Ohio Department of Health describes increasing chronic disease epidemiology capacity by requiring all epidemiology staff to be cross-trained across programs to build depth without adding positions (Duffy, 2009). The last article describes a CDC-University of Illinois at Chicago effort to develop maternal and child health epidemiology capacity through distance-based training (Rankin, 2012). The authors evaluated the program, which had been in place from 2005 – 2012 at the time of the publication, and concluded that the program had been successful in increasing the quality and rigor of epidemiologic analyses in state health departments (Rankin, 2012).

Three articles described specific training programs designed to enhance epidemiologic capacity in governmental public health agencies including the CDC's Epidemic Intelligence Service (EIS), the CSTE Applied Epidemiology Fellowship, and CDC's "flexible" epidemiologist funding initiative. The iconic Epidemic Intelligence Service (EIS) program at CDC has been in place since 1946 and has trained more than 3,000 epidemiologists (Thacker et al., 2011). The primary goal of this program when it was established was to provide technical assistance and epidemiologic capacity to state health departments to control the spread of infectious diseases. Thacker et al. (2011) undertook an effort to describe the impact of the EIS program in its first 60 years. EIS officers responded to 4,484 requests for assistance during this time. The authors reported that the sophistication of epidemiologic methods advanced significantly over the six decades from basic rate calculations and measures of central tendency to complex modeling and time/space methods (Thacker et al., 2011). The authors also noted that the number of requests for

assistance decreased in recent years, likely a reflection of increased epidemiology capacity in the health departments (Thacker et al., 2011).

In 2003, CSTE implemented an Applied Epidemiology Fellowship program that placed masters-level trained epidemiologists in state and large local health departments (Dick et al., 2014). The goals of the fellowship program were two-fold: to increase epidemiologic capacity in health departments and to provide additional field-based training to epidemiology graduates. Dick et al. (2014) conducted an evaluation of the fellowship program that analyzed available administrative data as well as surveys of alumni fellows and their field-based mentors. Both fellows and their mentors reported significant positive career impacts through participation in the program. Fellows specifically reported increased employability and career success, whereas mentors reported improved skills and increased engagement in projects. The mentors also reported that having a fellow significantly increased their organization's epidemiology capacity (Dick et al., 2014).

In 2010, CDC began providing funding to 41 health departments through the Epidemiology Laboratory Capacity for Infectious Diseases (ELC) cooperative agreement for what was coined a "flexible" epidemiologist position (Chung et al., 2017). Prior to this time, funding for epidemiology positions through this cooperative agreement was categorical and tied to disease-specific funding streams such as foodborne diseases, arboviral diseases, healthcare-associated infections, etc. The purpose of this funding was to enhance health department epidemiology capacity for all infectious diseases. Chung et al. (2017), conducted an evaluation of the impact of these flexible epidemiologist positions. The evaluation showed that providing funding for flexible epidemiology capacity in health departments was reported as helpful to filling gaps and addressing priorities that were not funded under existing categorical funding and to cross train and build depth (Chung et al., 2017). These epidemiologists were also used for surge capacity during outbreak investigations, to support surveillance systems, and to collaborate with partners (Chung et al., 2017).

Non-empirical Articles, Editorials, and Calls for Action

Thirteen articles were non-empirical editorials, commentaries, or viewpoint articles asserting new conceptual theories, opinions, or declaring a call to action related to the applied epidemiology workforce. Of these ten, four articles were related to specific areas of epidemiologic practice, including maternal and child health (n=3) and surveillance (n=1). In the surveillance-related commentary, Smith et al. (2013) referenced the rapidly changing field of public health surveillance driven by new technology, information security issues, and healthcare reform. Due to these new drivers of change in surveillance, the authors called for epidemiologists to not only develop skills in epidemiologic methods, surveillance, and collaboration with partners, but also to increase their understanding of the field of informatics (Smith et al., 2013).

The three commentaries related to maternal and child health epidemiology had some overlapping authorship. Rosenberg et al. (2012) called for not only offering scientific technical training to epidemiology staff, but also offering leadership training. The authors argued that leadership training is critical because when an epidemiologist moves into a leadership position, they have both scientific and administrative authority, which can lead to organizational change that will improve epidemiology functioning, not just individual functioning (Rosenberg et al., 2012). Kogan et al. (2015) described the evolving role of leadership and change in maternal and child health epidemiology. The authors outlined the following five key areas of change that epidemiology leaders must be responsive to: (1) analytic methods, (2) measurement, (3) communications, (4) timeliness for collecting and disseminating data, and (5) leadership (Kogan et al., 2015). Philips et al. (2012) put forward a comprehensive strategy to continue improving the maternal and child health epidemiology workforce in the United States. This strategy included formal graduate training programs, internships and fellowships, applied training, short-term and long-term skills building training, and expanding the competencies for maternal and child health epidemiology practice (Philips et al., 2012). The specific competency development

recommended was related to translation science, or communicating epidemiologic data to the public and policy makers (Philips et al., 2012).

Two of the 13 commentaries spoke to training approaches for epidemiology education. Thacker and Brownson (2008) called for competency-based education and the importance of public health practitioners embracing the AECs. Koo and Miner (2010) presented a framework for outcome-based workforce development in public health using applied epidemiology as a demonstration. The authors' framework combines adult learning theory, competency-based education, and the Dreyfus model of skills acquisition (Koo & Miner, 2010). The article calls for academia to make education more practice-based and for the practice community to take a more academic approach to workforce development; further, that the two should strengthen their collaboration on public health education and professional development (Koo & Miner, 2010). Finally, the authors called for a discipline focused on public health workforce education.

The final seven commentaries presented opinions on the future of epidemiology spanning nearly four decades. In a 1980 article, Dr. Orchard at the University of Pittsburgh raised concerns about the practice of epidemiology. He called for more cooperation between epidemiologists and clinicians and suggested that epidemiologists take a more clinical, individual patient approach to studying health problems (Orchard, 1980). In a 1999 article, Savitz et al. (1999) argued that epidemiology is not the basic science of public health and that public health is not just applied epidemiology. The authors further argue that we should not expect epidemiologists to do it all: collect data, communicate those data, and implement interventions (Savitz et al., 1999). Instead, epidemiologists should be part of a public health team comprised of several disciplines that can carry out public health services (Savitz et al., 1999). In a 2001 article, Thacker and Buffington reviewed the literature to identify top issues in applied epidemiology at the time. The authors' primary conclusion was on the importance of applied, or practice-based training of epidemiologists (Thacker & Buffington, 2001). In their 2016 article, Rogawski and colleagues differentiate between what

they call “public health epidemiology” and “medical epidemiology”. The proposed differentiation is based on the intended beneficiary of the intervention being studied, the general population in public health epidemiology and the treatment of individuals in medical epidemiology (Rogawski et al., 2016). The authors argue that this distinction is useful to students in epidemiology training programs as they select a career path, and also call for this distinction to drive the development of epidemiologic methods that are better suited for public health practice (Rogawski et al., 2016).

Finally, in 2019, the American Journal of Epidemiology released a special issue on the future of epidemiology, which included a number of articles that met the search criteria of this literature review. Samet and Woodward (2019) provided a commentary on what it means to be an epidemiologist, especially in current times with increasing availability of electronic health data. The article addresses the debate among academicians regarding the epidemiologists’ role in not only analyzing the data, but using it to improve population health. The authors suggest that the profession of epidemiology in the future will become more interdisciplinary, that it will merge with data sciences for some purposes, that more attention will be placed on policy analysis and evaluation, and that it will have to refine its approach to problem identification (Samet & Woodward, 2019).

In the same issue of the American Journal of Epidemiology, Kuller (2019) provided a commentary on the historical evolution and future of epidemiologists. The author noted the many new technologies available to inform epidemiology practice and research (e.g. genomics, epigenetics, molecular epidemiology, etc.). The author calls for epidemiology training to more strongly emphasize biology and how to apply these new technologies (Kuller, 2019). Bensyl et al. (2019) also provided a commentary on the training needs of applied epidemiologists. The authors emphasized the importance of continued learning throughout the career and recommended training in the topics of informatics and use of digital technology, molecular epidemiology, working in multidisciplinary teams, delivery of population health services, and global health security (Bensyl et al., 2019).

Discussion

This review identified 48 articles discussing epidemiology workforce capacity, competency, or training needs in the United States. These articles described efforts to build, enumerate, and assess the competency of the applied epidemiology workforce in addition to putting forward opinions about it. Overall, the articles demonstrated significant prior work enumerating the applied epidemiology workforce, some prior work identifying epidemiology training needs, and few prior studies assessing competency.

Articles published in the 1970's, 1980's and 1990's describe very limited and basic epidemiologic capacity in state health departments. The profession began to grow and receive more attention in the late 1990's, which resulted in debate around which direction the field should go (Savitz et al., 1999). It was an interesting time for the field of epidemiology as well as the public health profession overall. The 2003 IOM report *The Future of the Public's Health in the 21st Century* was a pivotal point in public health practice. This report emphasized the importance of assuring workforce competence, developing defined competencies for public health practice, providing leadership development, and regularly assessing the adequacy and capacity of the public health workforce (IOM, 2003). It was around this time, and in the years immediately following, that interest in accreditation mounted and competencies for general public health practice and applied epidemiology were adopted.

Over the past two decades, epidemiology capacity in state health departments has increased, both in the absolute number of epidemiologists, as well as the number that have formal epidemiology training. The increase in the number of epidemiologists has been driven by new federal funding streams, such as the public health emergency preparedness funding that resulted from the terrorism events of 2001 and the ACA through the Prevention and Public Health Fund in 2010. Important gaps remain as these funds decline and new areas of need emerge (e.g. environmental health, substance use, etc.). During this time of

growth in epidemiology staffing, significant effort was made to establish professional competencies for applied epidemiologists and to build capacity through a variety of approaches. While comprehensive in scope, the AECs have not been updated in more than a decade, despite a rapidly changing healthcare and public health landscape. This changing landscape has made the practice of public health and epidemiology more complex, more multidisciplinary, and require more diverse skillsets. In the most recently published assessment of epidemiology training needs, the authors noted that epidemiologists reported being more competent in epidemiology-specific competencies than in cross-cutting skills, such as collaboration, communication, policy, etc. (Chapple-McGruder et al., 2017). This finding was in contrast to earlier assessments, which identified epidemiology-specific skills as the greatest need (Buss, 2008). This change likely reflects the increase in the number of epidemiologists with formal epidemiology training over time. Epidemiologists have learned epidemiology-specific skills through their formal training and degree programs, but are less likely to have received leadership training, for example.

In the 2014 PH WINS assessment, the authors noted that competency was determined by a combination of education and experience and commented that their data suggest that experience must be complemented with more formal professional development training (Chapple-McGruder et al., 2017). Among epidemiologists, roughly half (49%) were non-supervisors; the other half were team leads (20%) and supervisors or managers (31%). About half (48%) had worked in public health less than 10 years and a quarter less than 5 years. Training needs are not stratified by career status in this analysis. The Virginia Department of Health survey conducted in 2006 did look at training needs by career stage of epidemiologist and noted differences in findings based on career stage, and specifically, that senior epidemiologists more frequently performed financial planning than did entry- and mid-level epidemiologists (Buss, 2008). These findings support the conceptual model used as the basis of this dissertation in regards to the interaction between education, experience, and career stage, which is described further in the Methodology section.

There are many calls for increased training for epidemiologists to prepare them for the future of epidemiology practice. Some of the needs identified through this review are more technical such as those driven by the evolution of new technologies and availability of health data and, therefore, call upon additional informatics and data science training. However, many articles called for additional training in general skills related to leadership, working in multidisciplinary teams, and assessing external drivers. Given the key role that epidemiologists fulfill, there are many demands for them to be competent in a wide range of skills, many of which are cross-cutting and can support work in various areas of practice.

Strengths and Limitations

This review is subject to the strengths and limitations of the included studies as well as the literature review process itself.

Quality and validity of included studies

The included articles that represented empiric assessments of epidemiology capacity were assessed for quality and validity. The articles that were case reports describing initiatives to enhance epidemiologic capacity and the articles describing the AECs were not formally designed studies. As such, traditional limitations and sources of bias could not be more formally assessed; however, as is the nature of a case report versus a rigorously-designed study, the description itself and the conclusions of the authors are subject to bias due to their subjective nature. The articles that were opinions, commentaries, and viewpoints are, by their very nature, completely subject to bias.

Limitations of the literature review

There are several notable limitations to this literature review. As the basis of the search strategy, selection of search terms is a critical step in the literature review process. While the reviewer looked to prior published search strategies in reviews on similar topics, it is possible that relevant search terms may have been excluded. Based on the ratio of the number of screened articles compared to the final number of included articles, it is likely the

search strategy was sufficiently sensitive. Another limitation of this review is that a single reviewer screened articles for inclusion and exclusion criteria. Due to the need for some judgement in the screening process, the validity and reliability of the review process may be improved with additional objective reviewers, as is recommended (Liberati et al., 2009).

Implications

Epidemiologists are key professionals within the public health workforce. As the role of public health agencies changes over time, epidemiologists will need to develop new skill sets to be successful in population health improvement activities. This review provided information on topics related to the applied epidemiology workforce in the United States since the 1970s. Continued assessment of the workforce regarding these rapidly emerging areas is needed to understand the role of epidemiologists and what training is needed.

Future Areas of Research

The findings of this literature review pointed to several areas of potential research. In particular, there is a need to explore the role of epidemiologists in emerging areas of public health practice, how this role changes based on career stage, and to identify the associated training needs to improve practice. There is growing recognition that the public health workforce will need to adapt to filling new roles within the context of the transforming healthcare and public health environments; however, exactly what skills are needed for these new roles is not yet defined (ASTHO, 2011; Yeager et al., 2016; Wiley & Matthews, 2017). It is difficult to make progress on improving the applied epidemiology workforce without understanding the role of epidemiologists and what specific aspects of the workforce require development. While there was recognition that the role of epidemiologists may change over time, and that training needs likely vary by career stage, there has been little formal empiric assessment. Assessment of the skills needed by epidemiologists to work in emerging areas of practice and the extent to which they have them, is needed to better ready epidemiologists for the future of public health practice.

CHAPTER 3: METHODOLOGY

Study Design

This dissertation research sought to answer the research question: What is the role and readiness of state health department epidemiologists in the United States to work in emerging areas of public health practice? An explanatory sequential mixed methods design was used, which included three phases of data collection. Phase 1 of data collection involved quantitative analyses of secondary cross-sectional survey data on epidemiologists practicing in state health departments in 2017. These data provided self-reported competency and perceived relevance of emerging areas of public health practice stratified by tenure, supervisory status, and education level. Phase 2 of data collection involved quantitative analyses of primary cross-sectional survey data collected from a single senior epidemiologist (the state epidemiologist) from each state health department. This survey provided information on the state epidemiologist's perspective on emerging areas of public health practice and on the existence of formal epidemiology career ladders and how the Applied Epidemiology Competencies (AEC) are used in the creation or revision of the job descriptions that differentiate the stages within the career ladder. Phase 3 of data collection involved conducting exploratory qualitative analyses of focus group data to explain key findings from the survey data and to explore the role of applied epidemiologists in emerging areas of public health practice and the barriers and facilitators affecting epidemiologists' ability to work in these areas.

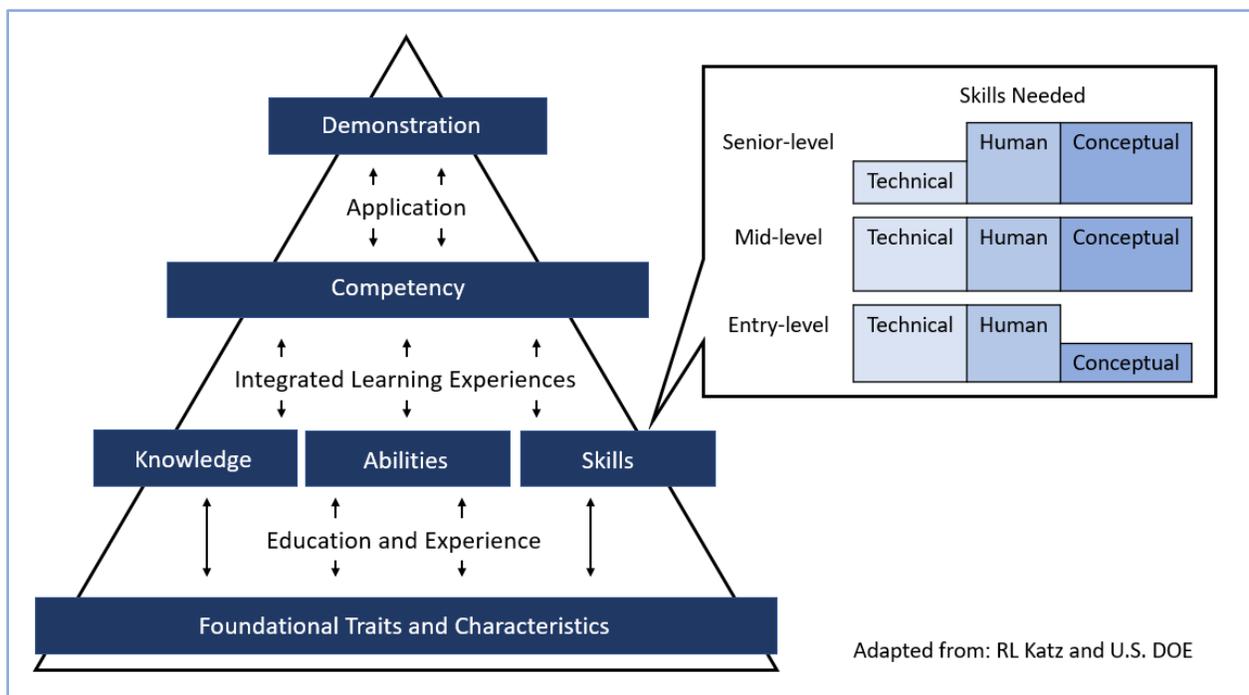
Conceptual Model

This dissertation research was rooted in learning and leadership theory. A simple way to think about workforce development is as a system that involves workers, their work environment, and the work they do (Kennedy & Moore, 2001). This workforce-related dissertation will address one arm, the workers themselves, in this case, applied epidemiologists in the United States working in state health departments. In order to explore whether or not the epidemiology workforce is ready to work in emerging areas of public health practice, the concept of competency must first be considered, including the factors that contribute to competency. In 2002, the U.S. Department of Education put forth a theoretical framework called the "Competency Learning Model" (U.S. DOE, 2002). In this framework, an individual's natural characteristics and traits form the foundation of learning. These innate characteristics may explain differences in career choice, interests, and competency, and form a foundation from which learning experiences are built. Learning experiences may come from education, as well as life and work experience. These learning experiences lead to the development of knowledge, skills, and abilities. This framework defines competency as the combination of knowledge, skills, and abilities needed in order to carry out a specific function or task. The key here is that competency is developed through integrative experiences that combine particular knowledge, skills, and ability areas to carry out that specific function or task. Finally, demonstrations are applications of the competencies. It is not enough to simply have a competency, but this must be coupled with the actual ability, or capability, to perform (see [Figure 4](#)).

This dissertation research provided information on self-identified competency of applied epidemiologists to work in emerging areas of public health practice. Per the Competency Learning Model described above, the factors that produce competency such as education and experience were explored. Of particular interest were differences in the self-reported relevancy and competence in emerging areas of public health practice based on

whether the epidemiologist is entry-, mid-, or senior-level in their career. Skills required for particular competencies may differ based on the level at which the epidemiologist is functioning. In the Skills Approach to leadership, Katz (1955) proposed a theoretical framework that illustrated the need for more technical skills on the front line and more human and conceptual skills as a person moves from middle to top management. While this theory is based on leadership and management “tiers’, the concept that skill requirements change by career stage is also applicable to epidemiologists, whereby senior epidemiologists may require more human and conceptual skills, and entry-level epidemiologists may require more technical skills. The theoretical framework for this dissertation research combines the competency learning model and the skills approach to leadership.

Figure 4. Theoretical Framework



Methods

To assess the role of and readiness of the applied epidemiology workforce in the United States to work in emerging areas of public health practice, a specific methodologic approach was deployed in support of each of the stated aims. See [Table 5](#).

Table 5. Summary of Aims and Corresponding Methods

Aim	Method
<p><u>Aim 1.</u> To define the role of epidemiologists in emerging areas of public health practice.</p>	<ul style="list-style-type: none"> • Literature Review • Phase 1: Secondary analysis of PH WINS data • Phase 3: Focus groups with state health department epidemiologists
<p><u>Aim 2.</u> To assess self-reported competency of epidemiologists and identify differences in self-reported relevancy, competency, and training needs relative to working in emerging areas of public health practice based on “tier” (entry-, mid-, senior-level) of epidemiologist to inform workforce development activities.</p>	<ul style="list-style-type: none"> • Phase 1: Secondary analysis of PH WINS data • Phase 2: Survey of state epidemiologists • Phase 3: Focus groups with state health department epidemiologists
<p><u>Aim 3.</u> To understand how epidemiology career ladders are used in state health departments to define the role of epidemiologists, to incorporate applied epidemiology competencies, and to inform workforce development activities.</p>	<ul style="list-style-type: none"> • Phase 2: Survey of state epidemiologists • Phase 3: Focus groups with state health department epidemiologists

Phase 1: Secondary Analysis of PH WINS Data

The purpose of Phase 1 was to assess self-reported awareness and impact on day-to-day work of emerging areas of public health practice stratified by tenure, supervisory status, and education level. This phase involved quantitative analyses of secondary data from PH WINS. Administered by ASTHO in collaboration with the de Beaumont Foundation, PH WINS is a nationally representative survey of individuals working in public health agencies in the United States (Sellers et al., 2015). First deployed in 2014, it was repeated

in 2017 with some changes. Broadly, the survey collects individual-level information on demographics, workplace environment, training needs, and emerging concepts in public health (Sellers et al., 2015). In the 2017 survey, the emerging concepts in public health section included the areas of cross-jurisdictional sharing of public health services, public health and primary care integration, evidence-based public health practice, quality improvement, multisectoral collaboration, and Health in All Policies (Bogaert et al., 2019).

The 2017 deployment of PH WINS was fielded from September 2017 to January 2018 (Leider et al., 2019). All participating health departments provided complete lists of employees and their email addresses and ASTHO sent the employees email requests to complete the electronic survey. A complex sample design was employed. For the state health agency central office frame, national sample weights were developed according to the methodology described by Leider et al. (2019), which generally involved adjusting for subsampling, nonresponse, and a post-stratification adjustment to align weighted counts with U.S. Health and Human Services (HHS) region-level staff totals. Detailed PH WINS methodology has been published elsewhere (Leider et al., 2019). A copy of the survey instrument is available in [Appendix 2](#).

Data Management

PH WINS data were provided in a Stata data file by the de Beaumont Foundation, the data steward, under a data use agreement. No identifying information was included in the dataset provided. All electronic data were saved on password-protected computers. Access to electronic files was restricted to study investigators. Files were stored until conclusion and publication of the study when the data were no longer needed. Original data files were stored unmanipulated to preserve integrity of data. A copy of files, maintained under the same electronic and physical security controls, was used for manipulation and analysis.

Data Analysis

Quantitative descriptive analyses were performed on the provided survey data, restricted only to respondents identifying as an epidemiologist working in a state health

agency central office. All variables were evaluated for quality and completeness. Continuous variables were provided as categorical variables to researchers so as to prevent constructive identification of individuals. Frequencies with associated proportions were calculated using balanced repeated replication weights to account for complex sample design. High impact / low skill gap analyses used the skill domain assignments developed and implemented in other PH WINS analyses (Bogaert et al., 2019). Analyses were carried out using Proc Survey Means procedures in SAS version 9.3 (SAS, Cary, NC).

To assess differences in survey responses by tenure (years' experience), education level (highest degree earned), and supervisory status, these variables were recategorized to include three strata for each variable with one designated referent group. The tenure in public health practice variable was categorized into three groups: 5 years or less, 6 to 15 years, and 16 or more years with 5 years or less considered the referent group. The supervisory status variable was categorized into three groups: Non-supervisor, Supervisor, and Manager or Executive with Non-supervisor considered the referent group. The highest degree earned variable was categorized into three groups: Bachelor's degree or less, Master's degree, and Doctoral or professional degree with Bachelor's degree or less considered the referent group. The variables were then analyzed independently and with covariates using Proc Survey Logistic procedures in SAS version 9.3 (SAS, Cary, NC) with $P < .05$ considered significant. Specific variables from the PH WINS survey analyzed are listed in [Appendix 3](#).

Phase 2: Survey of State Epidemiologists

Phase 2 of data collection involved quantitative analysis of primary cross-sectional survey data collected from the designated state epidemiologist in all 50 state health departments and the District of Columbia. This 38-item electronic survey provided information on the state epidemiologist's perspective on emerging areas of public health practice, the existence of epidemiology-specific job classifications and formal epidemiology career ladders, and how the AECs are used for workforce development activities. The

section on emerging areas of public health practice was modeled after the 2017 PH WINS (Leider JP et al., 2019), with some modifications due to the fact that PH WINS was designed to collect information from individual public health workers, whereas the state epidemiologists were asked to provide information on their epidemiology staff as a group. Prior to deploying the survey, the survey was piloted with five current state epidemiologists. The survey effort was a collaboration between the researcher and CSTE in order to achieve the highest response rate possible. One week prior to deployment, the Executive Director of CSTE sent an email to all state epidemiologists announcing the upcoming survey and encouraging participation ([Appendix 4](#)). The finalized electronic survey was sent via email to the designated state epidemiologist in all 50 state health departments, the District of Columbia, and six territories, as they were listed on the CSTE website on September 3, 2019. The email invited recipients to participate in the electronic cross-sectional survey via a Qualtrics survey software weblink (Qualtrics, Provo, UT). For completeness and consistency with CSTE assessments, Territorial Epidemiologists were invited to participate in the survey but their responses were excluded from this dissertation analysis. Data collection was open from September 4 to November 4, 2019. Reminders to complete the survey were sent approximately every 7 – 10 days until the survey closed ([Appendix 4](#)). The researcher collected and analyzed the data and the data were shared with CSTE. A statement of consent to share the data with CSTE was included in the survey consent form ([Appendix 5](#)). A copy of the survey instrument is available in [Appendix 6](#). State epidemiologists that reported having epidemiology-specific classifications in use at their agency were asked to upload their jurisdiction's epidemiology job classifications into the survey instrument. Those who did not provide the job classifications as part of the survey were contacted after survey completion to request copies of the jurisdiction's epidemiology job classifications.

Data Management

The data were exported from Qualtrics and saved in the form of a Microsoft Excel file. Electronic survey data included name and contact information of participants for the purpose of follow-up, if needed. Job descriptions were provided in electronic format, such as Word documents or PDF files. All electronic data were saved on password-protected computers. Access to electronic files was restricted to study investigators and CSTE. Electronic files and survey data were stored by the researcher until conclusion and publication of the study when the data were no longer needed. Original data files were stored unmanipulated to preserve integrity of data. A copy of files, maintained under the same electronic and physical security controls, was used for manipulation and analysis.

Data Analysis

Survey data were analyzed using SAS version 9.3 (SAS, Cary, NC). All variables were evaluated for quality and completeness. Means, standard deviations, ranges, and percentiles, were calculated for all continuous variables using the Proc Means procedure. Frequencies with associated proportions and Clopper-Pearson exact confidence intervals were calculated for all categorical variables using the Proc Surveyfreq procedure. To assess differences in survey responses related to the emerging areas of public health practice by tenure in the state epidemiologist position and jurisdiction public health services delivery infrastructure, these variables were recategorized. The tenure in the state epidemiologist position variable was categorized into two groups: Less than 5 years vs. 5 or more years. The jurisdiction public health services delivery infrastructure variable was categorized into two groups: Centralized vs. Decentralized, Mixed, or Other. Stratified analyses of the emerging areas of public health practice variables were evaluated using the Rao-Scott Chi-Square test generated through the Proc Surveyfreq procedure in SAS version 9.3 (SAS, Cary, NC) with $P < .05$ considered significant.

Job classifications were reviewed and information related to educational and experience requirements were extracted and compiled into a Microsoft Excel file. The

content of each job classification was read to identify key words related to emerging areas of public health practice. Reference to emerging areas of public health practice were recorded as either an “explicit” or “implicit” reference according to pre-established coding definitions ([Appendix 7](#)) and documented in the Microsoft Excel file. Job classification information was aggregated and summarized using simple counts and proportions to reflect the general distribution of references to emerging areas of public health practice in epidemiology-specific job classifications across jurisdictions. The minimum qualifications for epidemiologists by career stage were also summarized and compared to the Applied Epidemiology Competencies’ recommended qualifications.

Phase 3: Focus Groups with State Health Department Epidemiologists

Phase 3 of data collection involved conducting exploratory qualitative analyses of focus group data to explore the role of applied epidemiologists in emerging areas of public health practice and the factors affecting their ability to work in these areas.

Participant Recruitment

Focus group participants were recruited in collaboration with CSTE in order to access contact information for epidemiologists working in state health departments. A recruitment email was distributed to the CSTE membership, although CSTE membership was not a requirement to participate ([Appendix 8](#)). Epidemiologists of all career stages (early, mid, senior) working as a paid employee or contractor at a state health department or the District of Columbia were eligible to register interest in participating in the focus groups. Email recipients interested in participating in the focus groups were asked to complete a web-based electronic form (Qualtrics, Provo, UT) that collected the following information: name, phone number, email, number of years working as an epidemiologist and at their current agency, supervisory responsibility, state, educational degrees attained and whether they were concentrated in public health or epidemiology, program area (Infectious disease, Maternal and Child Health, Chronic disease, Injuries, Environmental health, Vital statistics, Preparedness, Oral health, Substance abuse, Occupational health, Informatics, Mental

Health, Genomics), self-declared career stage, and a question confirming they work at a state health department ([Appendix 9](#)). Registrants were also asked to read and agree to the participant consent form ([Appendix 10](#)) and indicate their availability for eight potential focus group session dates in October and November 2019. Registrants were asked to self-declare their career stage based on the AEC tier levels described in [Table 6](#).

Table 6. Applied Epidemiology Competencies Tier Level Descriptions

Level	Examples of Functional Responsibility	Examples of Educational and Experiential Criteria
Tier 1— Entry-level or basic epidemiologist‡	Carries out simple data collection, analysis, and reporting in support of surveillance and epidemiologic investigations.	<ul style="list-style-type: none"> • Newly graduated Master’s degree with minimal experience but from a Master’s program with a focus on epidemiology and/or analysis and assessment; or • Bachelor’s or other non-epidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) without formal academic epidemiology training and with at least 2 years’ experience performing epidemiology work under the guidance[†] of a Tier 2 or Tier 3 epidemiologist.
Tier 2—Mid-level epidemiologist	Carries out simple and more complex and nonroutine data collection, analysis, and interpretation task and can work independently; or may supervise a unit or serve as a project leader or surveillance coordinator.	<ul style="list-style-type: none"> • Master’s degree with a focus in epidemiology with 2 or more years’ work experience in epidemiology in a public health agency; or • Doctoral level epidemiologist; or • Other non-epidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) with specific epidemiology training (e.g., MPH degree, CDC Epidemic Intelligence Service program) or at least 4 years’ experience performing epidemiologic work under the guidance of a Tier 3 epidemiologist.

Tier 3 a & b— Senior-level epidemiologist	3a: Supervisor and/or manager, director of a major section, program, or bureau in a public health agency. 3b: Senior scientist/subject area expert in an epidemiologic focus area.	<ul style="list-style-type: none"> • A master’s degree with a focus in epidemiology and ≥ 4 years’ work experience in epidemiology in a public health agency; or • A doctoral-level degree in epidemiology, supplemented with ≥ 2 years’ work experience at a Tier 2 level; or • Other non-epidemiology professional degree or certification (e.g., RN, MD/DO, DDS/DMD, DVM, PhD, RS) with specific epidemiology training (e.g., MPH degree, CDC EIS program) and ≥ 4 years’ work experience at a Tier 2 level.
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¥ Entry-level or basic epidemiologists include persons who may not be titled an epidemiologist but who perform epidemiology functions at least part-time.

ƒ Guidance can be received from an epidemiologist in the same agency or in other organizations.

Source: CSTE, 2008.

Participant Selection

The focus groups were formed based on career stage with eight to 10 applied epidemiologists working in state health departments assigned to each of one of three focus groups based on self-reported early-, mid-, and senior-level career stage. The list of individuals interested in participating was used to form the focus groups according to the following procedure:

1. Incomplete registrations were removed, which included people who did not provide enough information to assign them to a focus group, did not agree to the consent form, or did not indicate their availability for the focus group sessions.
2. The completed registrations were reviewed to assign a career stage to the individual based on the AECs using reported education and experience information according to the criteria in [Table 7](#). The AECs did not provide for every possible combination of education and experience. As such, additional criteria were developed based on similar principles

within the AECs to be able to assign people with all possible combinations of education and experience to an AEC career stage. Specific gaps in the AEC definitions include a lack of how to categorize those with:

- Less than a Bachelor's degree;
 - Bachelors or non-epidemiology professional degree with no epidemiology-specific training and less than 2 years of experience; and
 - Masters/Doctoral degrees in a non-epidemiology concentration.
3. The assigned AEC tier was compared to each individual's self-declared AEC tier and discrepancies were reviewed and summarized to identify potential limitations of the AECs to inform recommendations for change.
 4. Three separate pools of registrants were formed based on self-declared career stage (early, mid, senior). The assigned AEC tiers were not used to make assignments.
 5. Within each registrant pool, the registrant's availability for potential focus group dates were looked at to assure there were enough potential participants to select one date to conduct each of the focus groups. A focus group session date was selected based on the best availability to maximize participation.
 6. Registrants were identified within each pool who indicated availability for the selected date of interest for conducting the focus group. From those available, 12 potential participants were randomly selected. The first 10 registrants were invited to participate and the last two were reserved as alternates to assure that the focus group size would maintain the desired size of eight.
 7. Selected registrants were sent an email invitation to participate and asked to confirm availability for the selected date. The email included a request to complete a pre-session questionnaire to seek feedback on emerging areas of public health practice to discuss in the session ([Appendix 11](#)).
 8. Procedures to replace potential participants were used in the event of cancellations except that participants who cancelled the day of or one day before the focus group

session were not replaced. If any registrants indicated they were no longer available to participate with adequate notice, alternates were invited.

Table 7. Modified Applied Epidemiology Competencies Tier Level Descriptions

Career Stage	Education Criteria	Join	Experience Criteria
Entry	Less than a bachelor's degree	AND	any
	Bachelor's or non-epi professional degree <i>with no</i> epi-specific training	AND	< 2 years in epi
	Bachelor's or non-epi professional degree <i>with no</i> epi-specific training	AND	≥ 2 years in epi
	Master's/Doctoral in non-epi concentration	AND	< 4 years in epi
	Master's in epi or analysis and assessment	AND	< 2 years
Mid	Non-epi professional degree <i>with no</i> epi-specific training	AND	≥ 4 years in epi
	Non-epi professional degree <i>with</i> epi-specific training	AND	< 4 years
	Master's/Doctoral in non-epi concentration	AND	≥ 4 years in epi
	Master's in epi or analysis and assessment	AND	≥ 2 years in epi
	Doctoral in epi or analysis and assessment	AND	< 2 years
Senior	Non-epi professional degree <i>with</i> epi-specific training	AND	≥ 4 years in epi
	Master's/Doctoral/Prof Degree in non-epi concentration	AND	≥ 8 years in epi
	Master's in epi or analysis and assessment	AND	≥ 4 years in epi
	Doctoral in epi or analysis and assessment	AND	≥ 2 years in epi

Note: Combinations of education and experience in shaded rows are not accounted for in the Applied Epidemiology Competences and were created by the researcher.

Pre-Session Questionnaire

Participants were sent a pre-session questionnaire ([Appendix 12](#)) that asked them to rate the importance of, and their readiness to work in, the five pre-selected emerging areas of public health practice: quality improvement, public health and primary care integration, evidence-based public health practice, Health in All Policies, and multisectoral collaboration. They were also asked if there were additional emerging areas of practice that were relevant to their day-to-day work, and if so, to rate the importance and readiness to work in these areas. Finally, they were asked to provide the age group, gender, race, and ethnicity that

best described them. Demographic information was aggregated and used to describe the characteristics of the focus group participants. Information on emerging areas of practice was used to inform development of the focus group guide in terms of topic selection.

Focus Group Sessions

Focus group sessions were recorded and the focus group facilitator and an observer also took notes, which were incorporated into the qualitative analysis. The topics to be covered during the focus group session and definitions of the emerging areas of public health practice were sent to participants in advance ([Appendix 13](#) and [Appendix 14](#)). The focus group guide was reviewed with three epidemiologists working in a state health department, each representing the early-, mid-, and senior-career stage, for feedback to make sure the questions were understandable and produced the intended type of response. A copy of the focus group guide is available in [Appendix 15](#).

Data Management

Information on people indicating interest in participating in the focus groups was downloaded from the online survey tool and stored in a Microsoft Excel file. Information on each participant as provided in the recruitment form was used for the purpose of organizing and scheduling the focus groups. No identifiers were recorded during the focus group and statements were not attributed to individuals. Focus groups were recorded and transcribed into a written Microsoft Word document. Once accuracy of the transcription process was verified, recordings were destroyed. Notes taken during the focus groups were securely stored. All electronic data, including notes, recordings, and transcriptions, were saved on password-protected computers. Access to all files were restricted to study investigators and CSTE. Electronic files were stored by the researcher until conclusion and publication of the study when the data were longer needed. Original data files were stored unmanipulated to preserve integrity of data. A copy of files, maintained under the same electronic and physical security controls, was used for manipulation and analysis.

Data Analysis

Transcribed focus group data were reviewed for accuracy and completeness prior to qualitative thematic analyses using the Framework Method described by Gale et al. (2013). A code book was created for thematic coding that included both deductive and inductive codes. A list of deductive codes was first generated based on literature review and expected barriers and facilitators. Next, transcripts were read in their entirety by the principle investigator and a second reviewer to develop inductive codes based on common themes that emerged from the focus group discussions. The final code book included codes to assist with reporting as well as deductive and inductive codes for the role of epidemiologists, barriers, facilitators, and other themes ([Appendix 16](#)). Transcripts were imported into MAXQDA qualitative data analysis software (VERBI Software, Berlin, Germany) and read in their entirety by the researcher and a second reviewer to assign descriptive codes to the data. Discrepancies in coding were resolved through deliberation among the two reviewers. Data were organized, categorized, and analyzed within the MAXQDA software. The coded data were used to identify themes and generate descriptions, which were summarized in tables. The summary of the qualitative thematic analysis was shared electronically with focus group participants for validation and to offer an opportunity to provide feedback.

Institutional Review Board Considerations

The Institutional Review Board at the University of North Carolina at Chapel Hill reviewed this research and determined it was exempt from further review (UNC IRB #18-2687). No other institutional review board review was required.

Delimitations/Boundaries of Research

This research focused on state health department epidemiologists and not on epidemiologists working in other governmental public health settings or in non-governmental public health settings, such as research or academia. This research assessed the role and readiness for work in areas of emerging public health practice and not

specifically on epidemiologic methods or technical aspects of epidemiology practice nor on emerging disease or health topic areas such as substance use or environmental health. Emerging areas of public health practice were defined broadly as areas of public health practice that are new or are growing in interest and use.

Timeline

This study was conducted over a 12-month period from April 2019 to April 2020 according to the timeline in [Table 8](#).

Table 8. Dissertation Timeline

Activity	Estimated Timeframe
Defend proposal	Apr 2019
Apply and receive IRB approval	Apr – Jun 2019
Phase 1	Jun 2019 – Sep 2019
Request PH WINS data and sign data use agreement	Jun 2019
PH WINS data analysis	Jun – Jul 2019
Draft summary of PH WINS data	Aug – Sep 2019
Submit PH WINS summary to de Beaumont Foundation for review	Sep 2019
Phase 2	Jul 2019 – Dec 2019
Deploy pilot state epidemiologist survey	Jul 2019 – Aug 2019
Full deployment of state epidemiologist survey	Sep – Nov 2019
Collect epidemiology career ladders from state epidemiologists	Sep – Nov 2019
Analyze state epidemiologist survey data	Nov 2019
Review and summarize epidemiology career ladders	Nov – Dec 2019
Draft summary of state epidemiologist survey	Dec 2019
Phase 3	Sep 2019 – Jan 2020
Recruit focus group participants	Sep 2019
Conduct focus groups	Oct – Nov 2019
Qualitative analysis of focus group data	Nov 2019 - Jan 2020
Draft summary of focus groups	Jan 2020
Final Report	Jan 2020 – Apr 2020
Synthesize all results into draft dissertation report	Jan 2020
Draft report reviewed by dissertation committee	Feb 2020
Final dissertation defense	Mar 2020
Submit final dissertation to graduate school	Apr 2020

CHAPTER 4: RESULTS

Results of the research are presented in this chapter by phase of data collection. In the next chapter the findings are further synthesized and discussed within the context of the stated research question and aims and existing literature.

Phase 1: PH WINS Secondary Data Analysis

The PH WINS was fielded to 102,305 governmental public health employees in the United States and 47,756 (48%) responded, which included approximately 983 who identified as an epidemiologist working in a state health department central office. After applying balanced repeated replication weights to account for complex sample design, the estimated weighted count of epidemiologists working in state health department central offices in PH WINS was 2,996 (95% confidence interval [CI]: 2,755 – 3,236), an estimated 6% (95% CI: 5.4% - 6.3%) of the state health department central office workforce.

Demographic Characteristics and Work Experience

Among epidemiologists working in state health department central offices, most were female (71%), white (69%), 40 years old or younger (62%), and had attained a master's (73%) or doctoral degree (20%). The majority of epidemiologists working in state health department central offices were not supervisors or managers (70%). Most worked in Epidemiology and Surveillance (37%) or Communicable Disease (24%) program areas. The vast majority of epidemiologists were newer to their positions with 74% reporting being in their current position for 5 years or less. In terms of tenure in public health practice, 32% had been in practice for 5 years or less, 23% for 6 to 10 years, 15% for 11 to 15 years, 14% for 16 to 20 years, and 16% for 21 or more years. See [Table 9](#).

Table 9. Estimated Percentage of Self-Reported Demographic Characteristics, Education, and Experience Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017

Characteristic	Level	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Gender	Male	849	28.38%	24.97%	31.79%
	Female	2130	71.23%	67.79%	74.66%
	Non-binary/Other	12	0.39%	0.00%	0.80%
Race / Ethnicity	American Indian or Alaska Native	10	0.33%	0.00%	0.73%
	Asian	206	7.00%	5.11%	8.88%
	Black or African American	362	12.30%	6.08%	18.52%
	Hispanic or Latino	183	6.23%	4.58%	7.88%
	White	2035	69.24%	63.72%	74.76%
	Two or more races	144	4.90%	2.84%	6.97%
Age Group (in years)	30 or under	851	28.42%	25.57%	31.26%
	31 to 40	1000	33.39%	27.95%	38.83%
	41 - 50	544	18.16%	14.37%	21.96%
	51 - 60	417	13.93%	11.59%	16.27%
	61 +	183	6.09%	4.08%	8.10%
Highest Degree attained	Bachelor's or less	191	6.39%	4.68%	8.10%
	Master's	2200	73.44%	70.03%	76.85%
	Doctoral	604	20.17%	17.36%	22.98%
Supervisory status	Non-supervisor	2083	69.68%	65.18%	74.18%
	Supervisor	708	23.68%	17.68%	29.68%
	Manager	190	6.37%	4.30%	8.44%
	Executive	8	0.27%	0.00%	0.59%
Tenure in Current Position	0-5 years	2184	73.83%	70.84%	76.83%
	6-10 years	413	13.96%	11.82%	16.11%
	11-15 years	177	5.97%	4.39%	7.55%
	16-20 years	111	3.77%	2.07%	5.47%
	21 or above	73	2.47%	1.52%	3.41%
Tenure in Public Health Practice	0-5 years	951	32.10%	25.78%	38.43%
	6-10 years	691	23.31%	20.31%	26.32%
	11-15 years	448	15.11%	12.73%	17.49%
	16-20 years	400	13.50%	10.72%	16.29%
	21 or above	473	15.97%	12.62%	19.31%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Epidemiologists working in state health department central offices with 16 or more years of experience were more likely than those with 5 or less years of experience to have a bachelor's degree (11% vs. 4%; OR = 3.06; P = .0024), to be older than 30 years old (96% vs. 35%; OR = 47.42; P < .0001), and to be a supervisor, manager, or executive (44% vs. 15%; OR = 4.55; P < .0001).

Job Satisfaction and Intention to Leave

Among epidemiologists working in state health department central offices, 84% were somewhat or very satisfied with their job. An estimated 29% reported they were considering leaving their organization within the next year, most commonly to take another governmental job in public health. Among those intending to leave, 16% selected "lack of training" as the top reason for considering to leave. There were no significant differences in job satisfaction or intent to leave by tenure, supervisory status, or education level.

Training and Development

Among epidemiologists working in state health department central offices, 51% agreed or strongly agreed that their training needs were assessed; 25% disagreed or strongly disagreed, and the rest were neutral. About 55% agreed or strongly agreed that they had sufficient training to fully utilize technology needed for their work; 25% disagreed or strongly disagreed and the rest were neutral. High proportions of epidemiologists reported feeling that employees learned from one another (86%), that their supervisor provided them with opportunities to demonstrate their leadership skills (73%), and that they felt engaged in their work (82%).

The factors that epidemiologists working in state health department central offices reported as the greatest motivators to participate in training were: personal growth/interest (91%), availability of in-person training (67%), covered time for training (63%), paid travel for training (62%), and availability of online training (60%).

There were significant differences identified in training motivators between epidemiologists with 5 or less years of experience and those with 16 or more years of

experience. Epidemiologists with 16 or more years of experience were less likely to report nearly all of the training motivators listed in the survey instrument than those with 5 or less years of experience and more likely to list an "Other" training motivator (12% vs. 4%; OR = 3.43; P = .0014). If "Other" was selected, the responder could enter a free-text answer. The most common "Other" reasons described as training motivators were relevance of training to job duties, availability of funding to support training, and the need for decreased routine workloads to allow time for training. Epidemiologists with 16 or more years of experience were also less likely to report that their supervisor provides them with opportunities to demonstrate their leadership skills than those with 5 or less years of experience (65% vs. 78%; OR = 0.51; P = .0018).

Both managers and executives and those with 16 or more years of experience were significantly less likely to respond that they agreed or strongly agreed that their training needs were assessed when compared to non-managers (38% vs. 52%; aOR = 0.60; P = .0468) and those with less than 16 years of experience (44% vs. 54%; aOR = 0.70; P = .0355), respectively.

Epidemiologists with doctoral or professional degrees were significantly less likely than those with bachelor's degrees or less to report that they were motivated to seek out training if it were a requirement of promotion (37% vs. 48%; OR = 0.42; P = .0032) or if it were expected by a supervisor (44% vs. 53%; OR = 0.69; P = .0320). Both epidemiologists with doctoral or professional degrees and those with 16 or more years of experience were significantly less likely to report that they were motivated to seek out training if peers were taking it when compared to those without doctoral or professional degrees (13% vs. 26%; aOR = 0.47; P = .0010) and those with less than 16 years of experience (18% vs. 26%; aOR = 0.70; P = .0099), respectively.

Training Needs

Training needs were analyzed by supervisory status to look for areas respondents identified as high impact to day-to-day work but that they self-rated as having low skill (i.e.

skill gaps). Overall, the general training areas listed as needs by epidemiologists working in state health department central offices were similar across supervisory statuses. Both supervisors and managers and non-supervisors identified the greatest high impact/low skill gaps in the areas of systems and strategic thinking and budget and financial management. Other skill gaps included developing a vision for a healthy community, cross sectoral partnerships, cultural competency, and change management. The areas less commonly identified as skill gaps among epidemiologists working in state health department central offices were effective communication and using data for decision-making. See [Table 10](#).

Table 10. Estimated Percentage of Self-Reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Skill Domain, Public Health Workforce Interest and Needs Survey, 2017

Skill Domain	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Systems and Strategic Thinking	1289	43.04%	38.39%	47.68%
Budget and Financial Management	1271	42.43%	37.93%	46.93%
Develop a Vision for a Healthy Community	1049	35.03%	30.41%	39.65%
Cross-Sectoral Partnerships	1002	33.44%	28.05%	38.83%
Cultural Competency	1001	33.40%	30.02%	36.79%
Change Management	989	33.01%	29.10%	36.93%
Effective Communication	688	22.96%	19.72%	26.20%
Data for Decision-Making	375	12.52%	9.57%	15.48%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Note: The weighted count is the estimated number of respondents who identified the skill domain as high impact to their day-to-day work but that self-rated as having low skill.

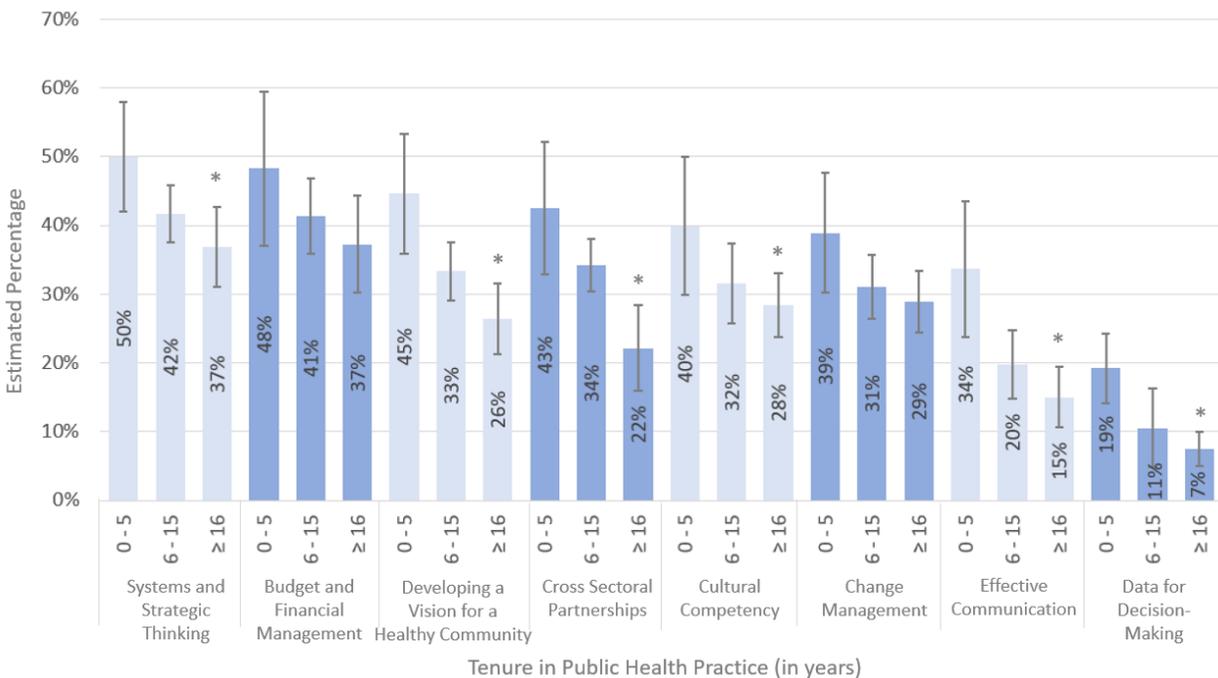
There were several significant differences identified in skill gaps between epidemiologists with 5 or less years of experience and those with 16 or more years of experience. In general, there were fewer epidemiologists reporting skill gaps across most of the skill domains with increasing years of experience working in public health. See [Figure 5](#).

The only significant difference identified by supervisory status was for using data for decision-making; managers and executives were significantly less likely to report skill gaps in this domain compared to non-supervisors (1% vs. 15%; aOR = 0.13; P = .0122).

Epidemiologists with a doctoral degree and those with 16 or more years of experience were also significantly less likely to report skill gaps in using data for decision-making compared to those with a bachelor’s degree or less (5% vs. 13%; aOR = 0.55; P = .0017) and those with 5 or less years of experience (7% vs. 19%; aOR = 0.13; P = .0016), respectively.

Epidemiologists with a doctoral degree and those with 16 or more years of experience were also significantly less likely to report skill gaps in effective communication compared to those with a bachelor’s degree or less (12% vs. 28%; aOR = 0.43; P = .0006) and those with 5 or less years of experience (15% vs. 34%; aOR = 0.54; P = .0178), respectively.

Figure 5. Estimated Percentage of Self-Reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Skill Domain and Tenure in Public Health, Public Health Workforce Interest and Needs Survey, 2017



* Denotes statistically significant difference at P < .05 between epidemiologists with ≥16 years of experience working in public health and those with 0 to 5 years of experience.

Note: The weighted count is the estimated number of respondents who identified the skill domain as high impact to their day-to-day work but that self-rated as having low skill.

Of skills identified as very important, respondents were asked which was the most important skill. The skill most frequently selected as most important by non-supervisors was to collect valid data for use in decision making (46%). Similarly, for supervisors and managers, the skill most frequently selected as most important was to use valid data to drive decision making (47%).

Emerging Areas of Public Health Practice

The emerging area of public health practice that epidemiologists working in state health department central offices reported as hearing the most about and having the greatest impact to their daily work was evidence-based public health practice. About 67% of epidemiologists reported hearing a lot about the topic and of those with some awareness, 79% reported the area impacted their daily work a fair amount or a great deal. Nearly half (46%) reported that they had heard a lot about fostering a culture of quality improvement and of those with some awareness, 61% felt the area impacted their daily work a fair amount or a great deal. For public health and primary care integration, about 34% reported hearing a lot about the topic, and of those with some awareness, about half (49%) reported the area impacted their daily work a fair amount or a great deal. For multisectoral collaboration, about 32% reported hearing a lot about the topic, and of those with some awareness, about 68% reported the area impacted their daily work a fair amount or a great deal. Finally, for Health in All Policies, only 15% reported hearing a lot about the topic, and of those with some awareness, 35% reported the area impacted their daily work a fair amount or a great deal. See [Figure 6](#) and [Figure 7](#).

Figure 6. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Awareness Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017

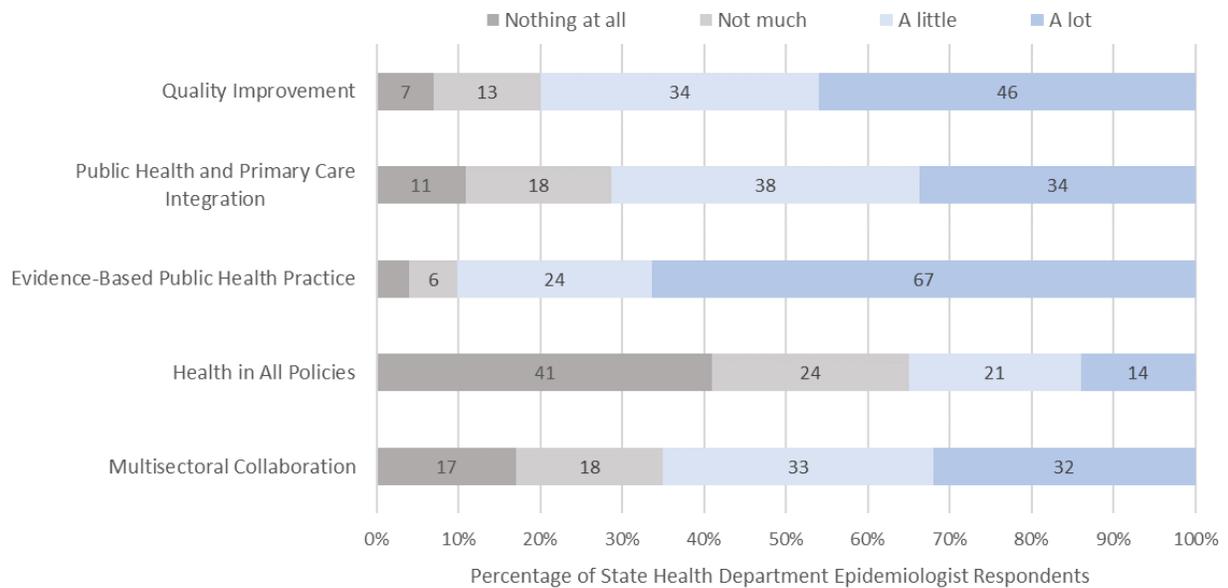
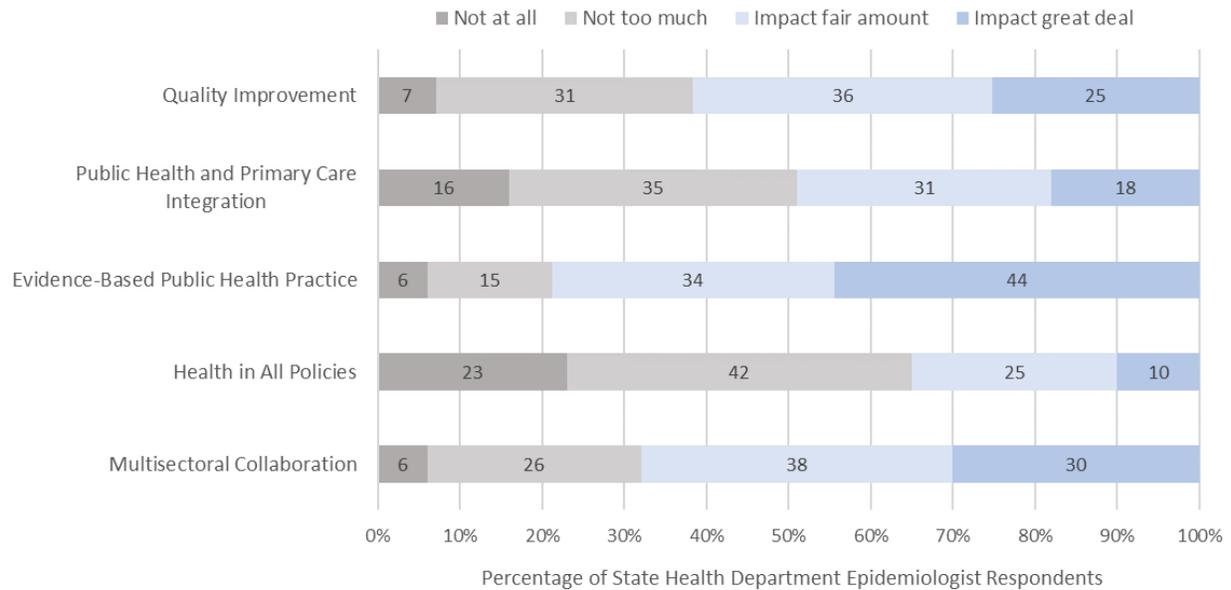


Figure 7. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Impact Among State Health Department Epidemiologists, Public Health Workforce Interest and Needs Survey, 2017



Analysis of responses related to emerging areas of public health practice did not significantly differ by supervisory status. Some significant differences were noted by experience and highest degree earned. Epidemiologists with between 6 and 15 years of experience were less likely to have heard a little or a lot about public health and primary care integration compared to those with 5 or less years of experience (67% vs. 73%; OR = 0.75; P = .0043). Epidemiologists with 16 or more years of experience were more likely to have heard a little or a lot about Health in All Policies compared to those with 5 or less years of experience (40% vs. 31%; OR = 1.44; P = .0301). Among those with some awareness of the topic, both epidemiologists with between 6 and 15 years of experience (61% vs. 57%; OR = 1.86; P = .0311) and those with 16 or more years of experience (67% vs. 57%; OR = 2.12; P = .0330) were more likely to report that quality improvement impacted their daily work a fair amount or a great deal than those with 5 or less years of experience. Epidemiologists with master's degrees were less likely than those with bachelor's degrees or less to have heard a little or a lot about Health in All Policies (31% vs. 46%; OR = 0.52; P = .0010) and to report that quality improvement impacted their daily work a fair amount, among those with some awareness of the topic (59% vs. 74%; OR = 0.57; P = .0374). Epidemiologists with doctoral or professional degrees were more likely to have heard a little or a lot about multisectoral collaboration compared to those with bachelor's degrees or less (72% vs. 61%; OR = 1.68; P = .0218).

See [Appendix 17](#) for supplemental data tables and figures summarizing Phase 1 analysis.

Phase 2: State Epidemiologists Survey

Results of Phase 2 from the state epidemiologists survey are described here and categorized by activity from pilot of the survey instrument to full deployment data collection and analysis.

Pilot Deployment

The survey instrument was piloted between August 1 – 8, 2019 with five state epidemiologists with a range of education and experience from across the United States. The survey was piloted electronically so pilot participants could experience the survey questions authentically under realistic deployment conditions. At completion of the survey, a set of survey assessment questions were added to collect specific feedback about the survey. Feedback was reviewed and further discussed with pilot participants. Minor editorial changes throughout the survey instrument were made at the suggestion of pilot participants to improve clarity. Some significant changes to the instrument were made following the pilot deployment including:

- Adding explanation of why the specific areas of emerging areas of public health practice were included in the survey;
- Adding emphasis that state epidemiologists should suggest additional emerging areas of practice that are relevant to epidemiologists in their agency in the space provided;
- Addition of a matrix for state epidemiologists to rate importance and readiness for any new emerging area of practice the respondent suggested; *
- Modification of the Likert scale used for readiness of epidemiologists in the respondent's agency for working in emerging areas of practice;
- Focused collection of only epidemiology-specific job classification titles with better definition of "epidemiology-specific" rather than collection of all job classifications used for epidemiologists regardless of whether they were specific to epidemiologists;

- Removal of a question asking how many steps the epidemiology-specific career ladder in use in their jurisdiction had (if applicable) because this information could be determined from the submitted job classifications;
- Addition of a question to find out how epidemiologists progressed to the next level of the career ladder (if applicable), whether it was automatic, through reclassification or promotion, or some other process; *
- Addition of an option to indicate that the AECs were used in the jurisdiction to assess training needs; * and
- Addition of an option in several opinion questions related to the AECs for the respondent to select that they do not personally have experience using the AECs in their agency. *

Pilot participants were not required to participate in the full survey deployment. Instead, pilot participants were sent a subset of only questions that were significantly changed after the pilot and were asked to complete only the changed survey questions, which are denoted in the list above by an asterisk (*). These responses were combined with their pilot responses and used in analyses.

Full Deployment

The survey was deployed for an 8-week period from September 4 through November 4, 2019. The original due date for survey response was set as September 30, 2019; however, the due date was extended to October 18, 2019 due to the occurrence of several national public health responses that required the attention of state epidemiologists. At the close of the October 18, 2019 due date, 47 (92%) of 50 states and the District of Columbia had responded. Individual outreach efforts were made to the final four remaining state epidemiologists and all four completed the survey by November 4, 2019 for a final response rate of 100%. While not included in this dissertation research but collected for completeness for CSTE purposes, three of six territories responded.

Among the 50 states and the District of Columbia, responding state epidemiologists reported that public health services in their respective jurisdictions were delivered under a decentralized system (n=23, 45%), a centralized system (n=15, 29%), or under a mixed or other system (n=13, 26%).

The Jurisdictions Designated State Epidemiologist Position

Among 48 who responded to the question, state epidemiologists reported serving in their position for a median of 5 years with a range of 3 to 29 years (interquartile range: 3 – 10 years). Just over half (n=29, 57%) reported that the state epidemiologist in their jurisdiction participated on their agency’s leadership team. The designated state epidemiologist position in 35 (69%) jurisdictions was not considered an appointed position. Among those state epidemiologists that were appointed, most (n=15, 94%) were appointed by an agency head and one was appointed by a representative of the governor; only one jurisdiction required the appointment to be confirmed by a political body. Just over half (n=28, 55%) require the state epidemiologist to hold a doctoral degree, with 20 (39%) requiring a Medical Doctor or Doctor of Osteopathic Medicine degree, 1 (2%) requiring a Medical Doctor or Doctor of Veterinary Medicine, and one (2%) jurisdiction with two state epidemiologist positions that requires a Medical Doctor degree for one position and a PhD for the other. Among the rest, 12 (24%) state epidemiologist positions have no minimum educational requirements, nine (18%) require a master’s degree or higher, and two (4%) require a Bachelor’s degree or higher. See [Table 11](#).

Table 11. Characteristics of the Jurisdiction and Designated State Epidemiologist Position, State Health Departments and the District of Columbia (n=51)

Characteristic	Level	Count	Proportion	SE	95%CI LB	95%CI UB
Jurisdiction Public Health Services Delivery	Centralized	15	29.4	6.4	17.5	43.8
	Decentralized	23	45.1	7.0	31.1	59.7
	Mixed or other	13	25.5	6.2	14.3	39.6
State Epidemiologist Position Appointed	Yes	16	31.4	6.6	19.1	45.9
	Appointed by agency head	15	93.8	6.3	69.8	99.8
	Appointed by other person	1	6.3	6.3	0.2	30.2
	Appointment confirmed by political body	1	6.3	6.3	0.2	30.2
	Appointment not confirmed by political body	15	93.8	6.3	69.8	99.8
	No	35	68.6	6.6	54.1	80.9
State Epidemiologist on Agency Leadership Team	Yes	29	56.9	7.0	42.2	70.7
	No	17	33.3	6.7	20.8	47.9
	Other	5	9.8	4.2	3.3	21.4
State Epidemiologist Position Minimum Educational Requirements	Any doctoral degree (MD, PhD, DrPH, DVM, DDS, etc.)	6	11.8	4.6	4.4	23.9
	Medical Doctor only	19	37.3	6.8	24.1	51.9
	Master's degree or higher	9	17.6	5.4	8.4	30.9
	Bachelor's degree or higher	2	3.9	2.7	0.5	13.5
	No minimum education	12	23.5	6.0	12.8	37.5
	Other	3	5.9	3.3	1.2	16.2
Respondent Years in State Epidemiologist Position	0-1	9	17.6	5.4	8.4	30.9
	2-4	16	31.4	6.6	19.1	45.9
	5-9	9	17.6	5.4	8.4	30.9
	10-14	11	21.6	5.8	11.3	35.3
	15+	6	11.8	4.6	4.4	23.9

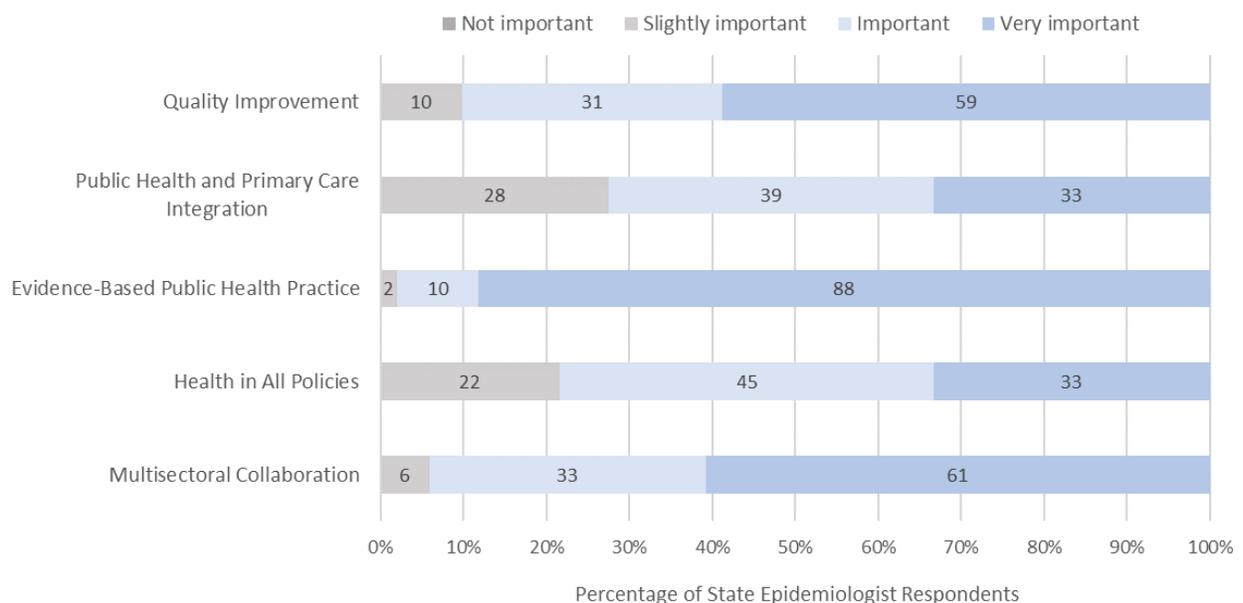
SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

Emerging Areas of Public Health Practice

State epidemiologists reported that most of the emerging areas of public health practice included in PH WINS were very important or important to the day-to-day work of epidemiologists working in their agency. See [Figure 8](#). The emerging area of practice reported as most important was evidence-based public health practice, with 50 (98%) state epidemiologists reporting the area was very important or important. Multisectoral collaboration and quality improvement were also both reported as having high importance with 48 (94%) and 46 (90%) state epidemiologists, respectively, reporting these areas as very important or important to the daily work of epidemiologists. The areas reported as having the lowest importance were Health in All Policies and public health and primary care integration with 40 (78%) and 37 (73%) state epidemiologists, respectively, reporting these areas as very important or important to the daily work of epidemiologists. State epidemiologists with 5 or more years of experience were significantly more likely than those with fewer than 5 years to report that Health in All Policies was very important or important to the daily work of epidemiologists (92% vs. 65%, $P = .0209$).

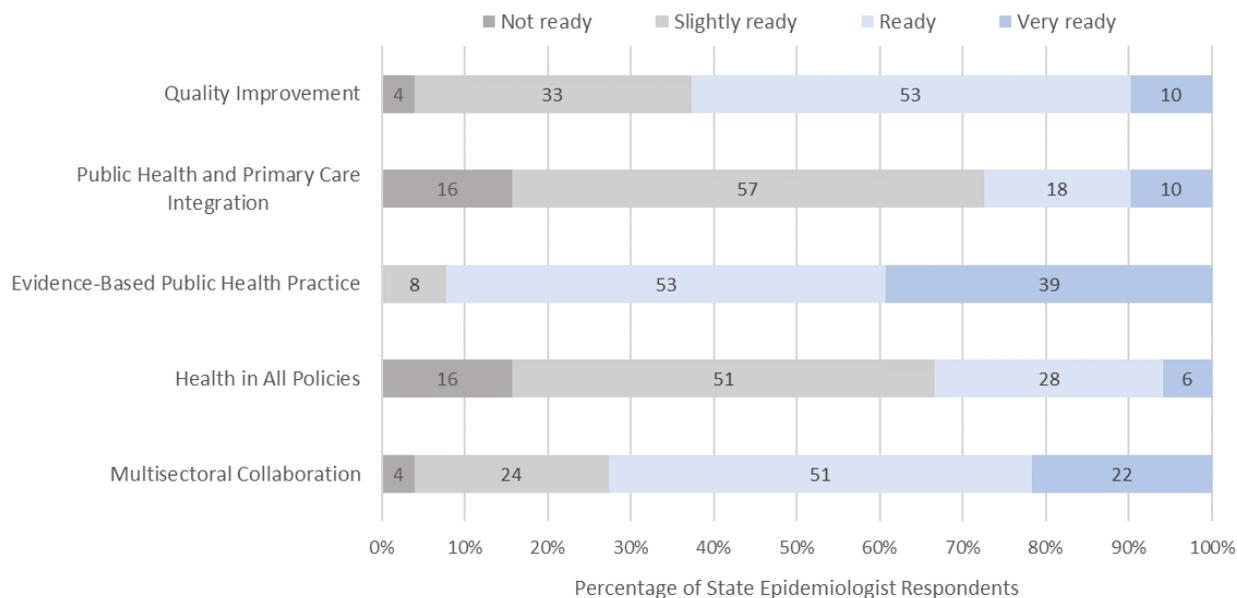
Figure 8. Importance of Emerging Areas of Public Health Practice in Day-to-Day Work of Epidemiologists Working in State Health Departments as Reported by State Epidemiologists (n=51)



Many (n=27, 53%) of the state epidemiologists offered additional areas of practice they felt were emerging in public health through free-text data entry into the survey instrument. The most commonly listed area of practice was informatics (n=15) and other data-related topics including data science and visualization (n=4) and data suppression and privacy (n=2). Another commonly listed area of practice was social determinants of health, health disparities, and health equity (n=13). Finally, the third area of practice that was listed by several state epidemiologists was program evaluation (n=4). In addition to these broad cross-cutting areas, state epidemiologists identified various infectious disease-related topics as emerging areas of practice as well as other topic areas only listed by one or two respondents. Other areas listed included health economics, health impact assessment, "local/regional epis", "Population Health - Public Health Integration", "precision medicine and applied public health research", "collaboration with environmental health for arboviral diseases", social media/communications, genomics, and migration.

In terms of readiness to work in emerging areas of public health practice, state epidemiologists reported that the emerging area of practice that epidemiologists in their agency were most ready to work in was evidence-based public health practice, with 47 (92%) reporting epidemiologists were very ready or ready. The area of practice that state epidemiologists reported the lowest readiness was Health in All Policies with 17 (33%) reporting that epidemiologists in their agency were very ready or ready. For multisectoral collaboration and quality improvement, 37 (73%) and 32 (63%) state epidemiologists, respectively, reported that epidemiologists were very ready or ready to work in these areas of practice. See [Figure 9](#).

Figure 9. Readiness of Epidemiologists Working in State Health Departments to Work in Emerging Areas of Public Health Practice as Reported by State Epidemiologists (n=51)



Use of Epidemiology-Specific Classifications

A job classification system uses a process to classify jobs in a standardized way based on accountabilities, educational and experience requirements, knowledge, skill, and abilities, or other areas. Only two (4%) state epidemiologists reported that their jurisdiction did not have a formal job classification system in place. Among those with job classification systems, 44 (90%) reported having epidemiology-specific job classifications, defined as classifications that are only used for epidemiologists and not for non-epidemiology positions. One of these state epidemiologists, however, reported that their jurisdiction did not actually use the epidemiology-specific job classification due to low pay grade. Among those with epidemiology-specific job classifications, 37 (84%) strongly agreed or agreed that having an epidemiology-specific classification positively contributed to recruitment of epidemiologists in their agency and 29 (66%) strongly agreed or agreed that having an epidemiology-specific classification positively contributed to retention of epidemiologists in their agency. Three (7%) state epidemiologists disagreed or strongly disagreed that epidemiology-specific

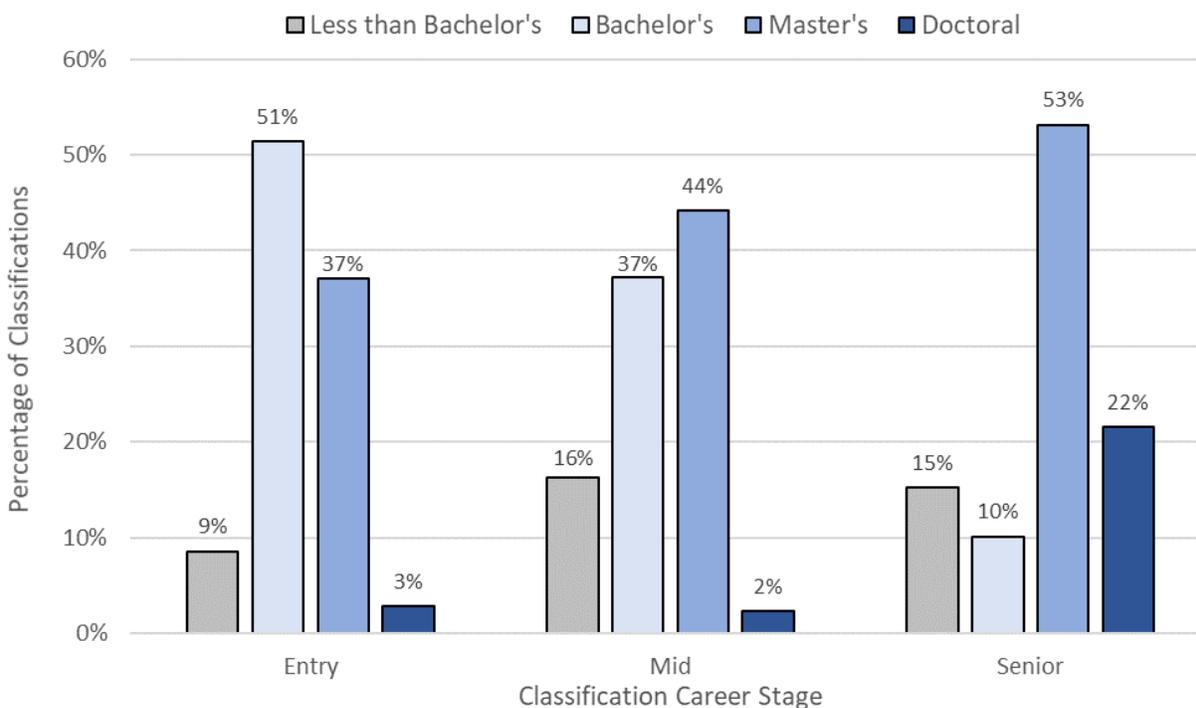
job classifications positively contributed to recruitment and eight (18%) disagreed or strongly disagreed that they positively contributed to retention.

State epidemiologists provided the titles of 182 epidemiology-specific job classifications. Of these, nine were determined to be unclassified positions, such as the jurisdiction's state epidemiologist position, and were excluded from the job classification assessment. One jurisdiction did not provide copies of its two epidemiology-specific job classifications so these were also excluded from the assessment. The remaining 171 classifications were reviewed and categorized as intended for early-career, mid-career, and senior-career incumbents based on the description of such intent in the classification, or its placement in the jurisdiction's career ladder. Jurisdictions reported having between one and nine (median = 4) epidemiology-specific job classifications. Among the 171 classifications, 39 (23%) were categorized as intended for early-career incumbents, 46 (27%) for mid-career incumbents, and 86 (50%) for senior-career incumbents. State epidemiologists reported that the AECs were used to develop or revise 63 (37%) of these classifications.

Minimum education and experience for epidemiology-specific job classifications varied greatly across jurisdictions, not only in the degree and number of years' experience required, but especially in the degree concentration, the specific type of experience desired, and in substitution options. In order to get a general sense of minimum requirements for classifications by career stage (entry, mid, senior), the minimum requirements for classifications were reviewed without regard to the nuanced variations (e.g. master's degree in epidemiology vs. non-epidemiology master's degree), but rather at the level of degree and overall years' experience. Among the 171 classifications, 14 (8%) did not specify minimum requirements. In terms of minimum educational requirements, overall, the most common degree required was a master's degree (n=74, 47%) among the 157 classifications with minimum requirements specified. However, this varied by career stage with bachelor's degrees being the more common minimum educational requirement for entry-level classifications (n=18, 51%). Minimum experience requirements varied by career stage and

by highest degree attained, typically with less experience required for entry-level positions and for incumbents with completion of higher levels of education. See [Figure 10](#).

Figure 10. Minimum Education Requirements Specified in Epidemiology-Specific Job Classifications in State Health Departments by Career Stage (n=157)



The content of epidemiology-specific job classifications was reviewed to identify references to emerging areas of public health practice. There were seven classifications that did not include detailed job accountabilities and were excluded, leaving 164 for the content analysis. Among the various areas of practice, no classifications included either explicit or implicit references to public health and healthcare integration, Health in All Policies, or multisectoral collaboration. The areas of practice most commonly referenced were evidence-based public health practice (90%) and informatics (60%). Program evaluation (32%) and quality improvement (30%) were referenced with some frequency in about 1/3 of classifications. Social determinants of health (18%) and engaging in legislative policy work (13%) were less commonly referenced. In general, reference to these areas of practice increased as career stage advanced. The only exception was for informatics, for which the area was most commonly referenced in mid-career classifications. See [Table 12](#).

Table 12. Reference to Emerging Areas of Public Health Practice in Epidemiology-Specific Job Classifications in State Health Departments (n=164)

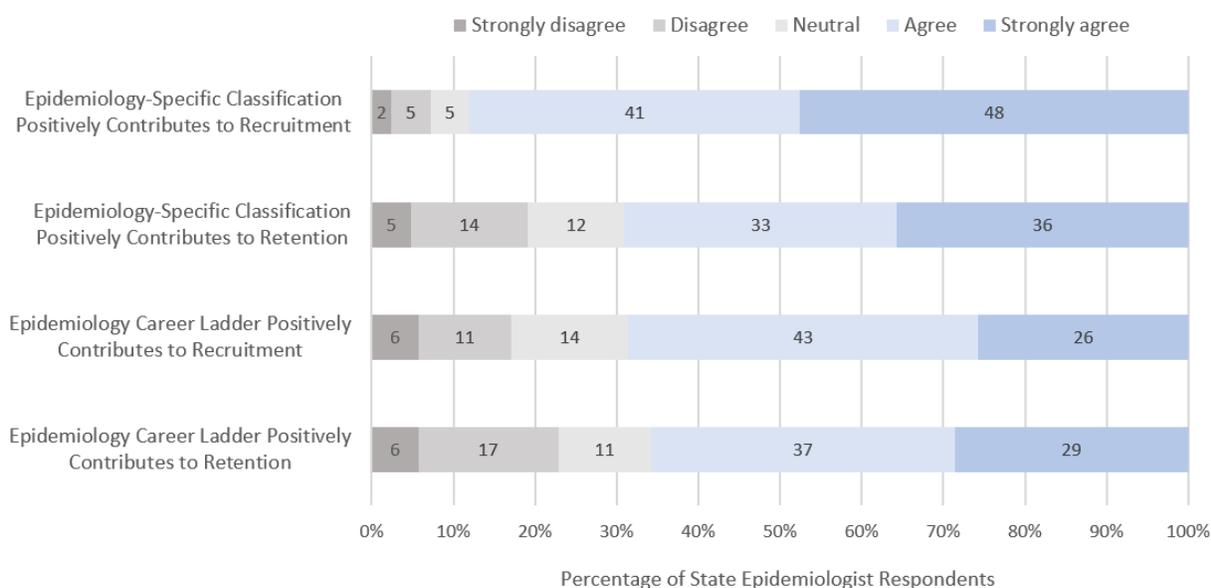
Emerging Area of Public Health Practice	Type of Reference*	Career Stage			Total (n=164)
		Entry (n=37)	Mid (n=45)	Senior (n=82)	
Fostering a culture of quality improvement	Explicit	3 (8%)	3 (7%)	7 (9%)	13 (8%)
	Implicit	3 (8%)	1 (2%)	13 (16%)	17 (21%)
	Any Total	6 (16%)	4 (9%)	20 (25%)	30 (18%)
Public health and healthcare integration	Explicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Implicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Any Total	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Evidence-Based Public Health Practice	Explicit	2 (5%)	3 (7%)	5 (6%)	10 (6%)
	Implicit	27 (73%)	35 (78%)	69 (84%)	131 (80%)
	Any Total	29 (78%)	38 (84%)	74 (90%)	141 (86%)
Health in All Policies	Explicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Implicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Any Total	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Policy	Explicit	1 (3%)	5 (11%)	24 (30%)	30 (18%)
	Implicit	n/a	n/a	n/a	n/a
	Any Total	1 (3%)	5 (11%)	24 (30%)	30 (18%)
Multisectoral collaboration	Explicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Implicit	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Any Total	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Informatics	Explicit	2 (5%)	3 (7%)	4 (5%)	9 (5%)
	Implicit	16 (43%)	28 (62%)	45 (55%)	89 (54%)
	Any Total	18 (49%)	31 (69%)	49 (60%)	98 (60%)
Social Determinants of Health	Explicit	2 (5%)	2 (4%)	3 (4%)	7 (4%)
	Implicit	4 (11%)	3 (7%)	7 (9%)	14 (9%)
	Any Total	6 (16%)	5 (11%)	10 (12%)	21 (13%)
Program Evaluation	Explicit	6 (16%)	11 (24%)	31 (38%)	48 (29%)
	Implicit	0 (0%)	0 (0%)	4 (5%)	4 (2%)
	Any Total	6 (16%)	11 (24%)	35 (43%)	52 (32%)

* Explicit means the topic was specifically referenced in the job classification. Implicit means the topic was generally referred to. See [Appendix 7](#) for definitions used for classification. n/a: An "implicit" reference to policy was not used because any reference to policy-making was counted as "explicit" to capture policy-related accountabilities that were not necessarily Health in All Policies-related.

Use of Epidemiology-Specific Career Ladders

Among 49 jurisdictions with job classification systems, 36 (73%) state epidemiologists reported having epidemiology career ladders, defined as a formal pathway that allows for progression from an entry level position to higher level positions of pay, skill, responsibility, or authority. Most of these career ladders were reported to be based on such advancement factors as increasing years' experience (n=29, 81%), increasing supervisory responsibility (n=26, 72%), acquiring new skills (n=23, 64%), demonstrating epidemiology competencies (n=19, 53%), and completing formal education (n=17, 47%). All jurisdictions reported that advancement to the next level was not automatic and instead required a reclassification, hiring, or promotion process with the exception of one jurisdiction that reported there was an automatic process for advancement between the first two levels, but that advancement to higher levels required a process. Among those with an epidemiology career ladder, 24 (69%) strongly agreed or agreed that having an epidemiology-specific career ladder positively contributed to recruitment of epidemiologists in their agency and 23 (66%) strongly agreed or agreed that having an epidemiology-specific career ladder positively contributed to retention of epidemiologists in their agency. Six (17%) state epidemiologists disagreed or strongly disagreed that epidemiology-specific career ladders positively contributed to recruitment and eight (23%) disagreed or strongly disagreed that they positively contributed to retention. Ten (29%) reported that the AECs were used to develop or revise their jurisdiction's epidemiology career ladder, 20 (57%) reported that the AECs were not used, and five (14%) were not sure whether they had been used for this purpose. See [Figure 11](#).

Figure 11. Perceptions of Epidemiology-Specific Classifications’ and Career Ladders’ Positive Contribution to Recruitment and Retention in State Health Departments and the District of Columbia



Use of the Applied Epidemiology Competencies

Of the 50 who completed this section of the survey, most (n=39, 78%) state epidemiologists reported using the AECs for workforce development activities within their jurisdiction. State epidemiologists reported using the AECs the most for assessing training needs (n=25, 50%) and developing and updating job descriptions (n=24, 48%). State epidemiologists less commonly reported using the AECs for developing training plans and using them to evaluate individual epidemiologist performance. Two-thirds (n=33) of 50 state epidemiologists who answered the question said that they felt the AECs were extremely, very, or moderately useful to managing epidemiologists in their agency. Example comments made by respondents about the usefulness of the AECs are presented below:

“These have been helpful to update job descriptions and assess training needs/develop training plans.”

“[Our agency career] ladder has recently been [revised] ... the AEC was invaluable in contributing a rational approach to the process and provided a vocabulary that administrators and HR personnel could understand.”

“I use the applied epidemiology competencies all the time to explain why someone's position is or is not an epidemiologist or why a specific role is the purview of an epidemiologist (in addition to, instead of or in collaboration with a statistician, QI consultant, or evaluator), and to justify why a reclassification is needed. It is crucial to have a national standard to show that we are in alignment with best practice.”

State epidemiologists reported that the AECs were relevant to both current and future practice, with 43 (86%) and 42 (84%) of 50 who responded reporting they were extremely, very, or moderately relevant. When asked if they felt the AECs should be updated, 18 (38%) said yes, 14 (29%) no, and 16 (33%) were unsure, some stating they were not familiar enough to offer an informed opinion while others did not comment further. In open-ended comment boxes, there were several suggestions made to incorporate skills related to informatics, “big data” and data science, data visualization, and new analytic tools in the AECs. Additional suggestions for change were related to incorporating “non-traditional” functions that epidemiologists perform to support programs such as evaluation and quality improvement, as well as a general comment to “incorporate new areas of practice”. One respondent commented that the AECs “... do not always cover all areas of epidemiology jobs well, with [Healthcare Associated Infections / Antibiotic Stewardship] and environmental areas, for examples, could use some updates.” Finally, another respondent commented the AECs should be updated and “made more practical.”

Training Barriers for Epidemiology Staff

State epidemiologists identified lack of time to participate in training as the greatest barrier for epidemiology staff. See [Table 13](#). Similarly, barriers related to lack of staff due to recruitment and retention challenges were also noted as top barriers to epidemiology staff participation in training. Lack of funding to support training, lack of training opportunities, lack of information on training needs, and lack of organizational support were ranked lower as barriers in comparison to time and staffing barriers. Additionally, 11 state epidemiologists offered “Other” barriers, several of which focused on lack of funding to hire

additional epidemiologists, challenges with recruitment and retention around compensation and the bureaucratic hiring process, and motivating epidemiologists to step into leadership roles and take time to work on epidemiology workforce development activities. See [Table 14](#) for a description of epidemiology workforce challenges identified by state epidemiologists.

See [Appendix 18](#) for supplemental data tables and figures summarizing Phase 2 analysis.

Table 13. Top Barriers for Epidemiologist Participation in Training in State Health Departments and the District of Columbia as Identified by State Epidemiologists (n=49)

Barriers	Count	Proportion	SE	95%CI LB	95%CI UB
Lack of time	11	22.4	6.0	11.8	36.6
Lack of staff due to recruitment challenges	11	22.4	6.0	11.8	36.6
Lack of staff due to retention challenges	9	18.4	5.6	8.8	32.0
Lack of funding for training	8	16.3	5.3	7.3	29.7
Lack of organizational support to attend training	3	6.1	3.5	1.3	16.9
Lack of information on training needs	1	2.0	2.0	0.1	10.9
Lack of training opportunities	0	0%	0.0	0.0	7.3
Other challenge	6	12.2	4.7	4.6	24.8

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound
Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

Table 14. Epidemiology Workforce Challenges Identified by State Epidemiologists in State Health Departments and the District of Columbia (n=51)

Recruitment Themes
<ul style="list-style-type: none"> • Not enough positions • Not enough funding to support positions • Low pay makes it difficult to compete with private sector and local health departments • Bureaucratic hiring processes <ul style="list-style-type: none"> ○ Good applicants do not certify ○ Preference for seniority ○ Slow process – loss of good applicants who do not wait • Academic preparation <ul style="list-style-type: none"> ○ Generalist MPH programs do not provide in-depth epidemiology or program-area training (e.g. environmental health, healthcare-associated infections, etc.) ○ Inadequate informatics training • Belief that “anyone can be an epi” with a few online courses
Retention Themes
<ul style="list-style-type: none"> • Low pay and lack of or small pay increases • Funding often cannot support pay increases or higher-level epidemiology positions • Limited career progression opportunities • Career advancement opportunities tend to be administrative • Motivating senior staff who have been in their positions or with the agency a long time • Career ladders, while theoretically helpful, are problematic and in reality, advancement requires cumbersome administrative processes (e.g. reclassification)
Training Themes
<ul style="list-style-type: none"> • Tools would be helpful such as training plans or a training catalogue (already vetted) based on the Applied Epidemiology Competencies • Time and cost to travel can be a barrier so other workforce development approaches, such as mentoring and job shadowing, would be useful • Lack of staff who are committed and have time to work on workforce development
Funding Themes
<ul style="list-style-type: none"> • Not enough funding to support the needed number of positions or the funding needed to support pay increases for retention • Influxes of funding for current events (e.g. opioids, Zika, etc.) and a lack of flexible funding creates significant inequity within the department in terms of epidemiology capacity across programs • Some federal funders, and programs within those funding agencies, over-emphasize certain functions (e.g. evaluation) at the expense of epidemiology

Note: These challenges were identified through qualitative analysis of open-ended survey questions asking respondents to comment on additional training barriers or to provide additional comments they would like to share about the topics of the role and readiness of epidemiologists to work in emerging areas of public health practice, epidemiology-specific job classifications, epidemiology career ladders, or the Applied Epidemiology Competencies.

Phase 3: Focus Groups

Results of Phase 3 are described here and categorized by activity from recruitment and selection to the qualitative analysis of focus group data.

Participant Selection

Recruitment was initially open from September 19 – September 27, 2019. Due to a low number of early-career registrations, additional targeted recruitment efforts were made via CSTE and the registration period closed on October 2, 2019. A total of 97 electronic registration forms were received and 40 were excluded due to ineligibility (n=13), insufficient information to assign to a focus group pool for random selection (n=22), lack of consent form agreement (n=4), and duplicate registration (n=1). See [Figure 12](#).

Among the 57 eligible registrations, the self-reported AEC tier matched the assigned AEC tier for 34 (60%). See [Table 15](#). For the 23 that were discordant, most epidemiologists self-reported a lower tier (n=18, 78%) rather than a higher tier (n=5, 22%). Most discrepancies (n=13, 57%) were minor, with the individual's number of years of experience or degree being close to the suggested criteria for the AEC tier. The remaining 10 (44%) had larger deviations, such as having double the experience required to be Tier 3 but identifying as Tier 2, or reporting one year of experience but identifying as Tier 2. Epidemiologists who identified as Tier 3 had the highest concordance with the assigned Tier (92%) followed by Tier 1 (63%). Tier 2 had the lowest concordance (28%), which was primarily driven by epidemiologists with significant experience (>10 years) who identified as Tier 2, when they met the criteria for Tier 3. This analysis is limited by the fact that the AEC Tier descriptions are not exhaustive and do not include every potential combination of degree and experience. Specific gaps in the definitions include a lack of how to categorize those with: (1) Less than a bachelor's degree, (2) Bachelor's or non-epidemiology professional degree with no epidemiology-specific training and less than 2 years of experience, and (3) Master's or doctoral degree in non-epidemiology concentration.

Figure 12. Focus Group Participant Selection

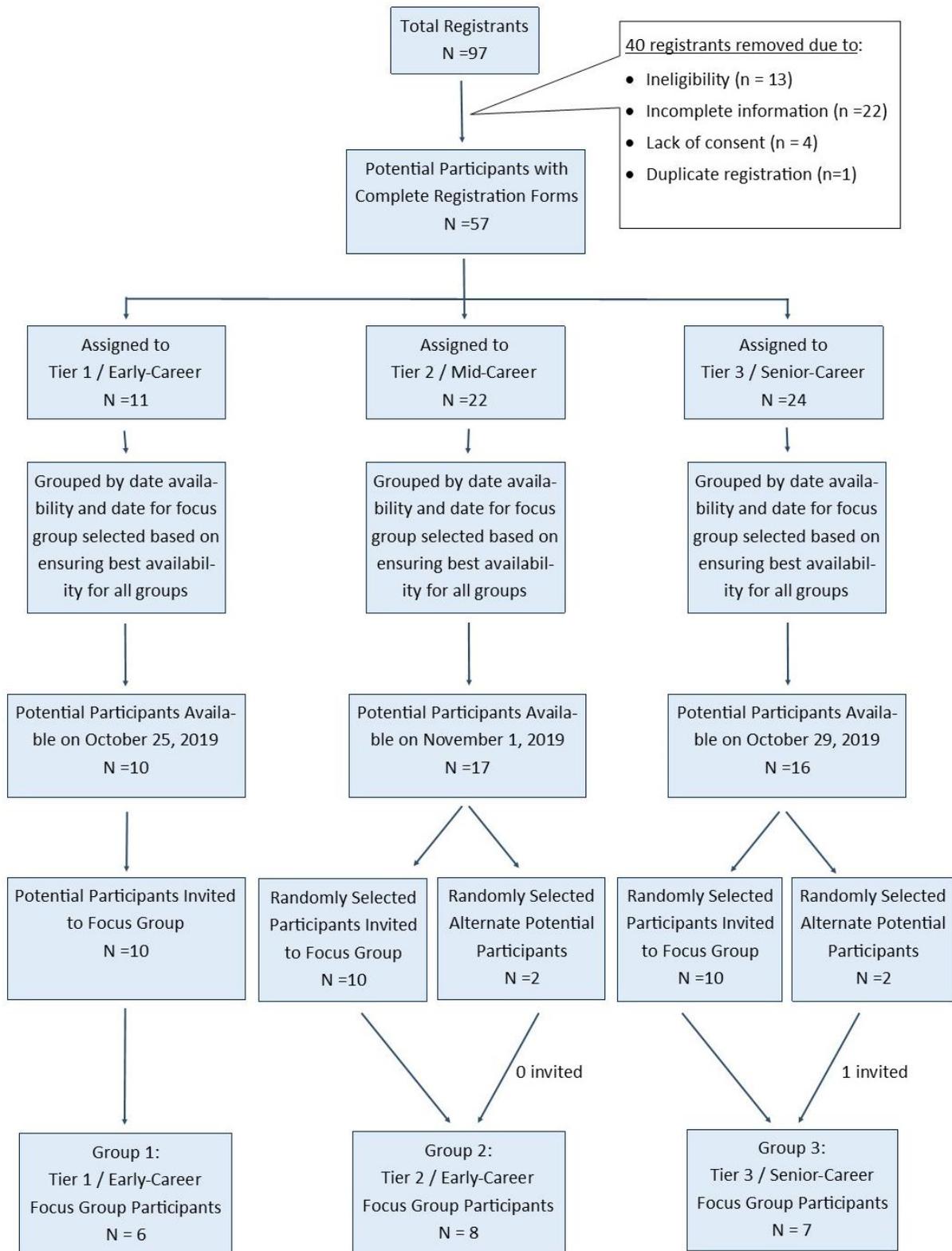


Table 15. Comparison of Focus Group Registrant Self-Reported AEC Career Stage to Assigned AEC Career Stage (n=57)

		Assigned AEC Tier			Total
		Tier 1 - Early	Tier 2 - Mid	Tier 3 - Senior	
Self-Reported AEC Tier	Tier 1 - Early	5 (63%)	3 (37%)	0 (0%)	8
	Tier 2 - Mid	3 (12%)	7 (28%)	15 (60%)	25
	Tier 3 - Senior	0 (0%)	2 (8%)	22 (92%)	24

- Ultimately assigned to Tier 1 – Early career for focus groups
- Ultimately assigned to Tier 2 – Mid career for focus groups
- Ultimately assigned to Tier 3 – Senior career for focus groups

Among the 57 completed registration forms, 11 (19%) registrants were assigned to the Tier 1: Early-Career focus group pool, which included eight self-designated as AEC Tier 1 and three self-designated as AEC Tier 2 but who reported one year of experience. Due to the low number of Tier 1 registrants and the goal of inviting 10 registrants to participate in each focus group, these three registrants with just one year of experience were moved to the Tier 1: Early-Career focus group pool. A total of 22 (39%) registrants were assigned to the Tier 2: Mid-Career focus group pool and 24 (42%) were assigned to the Tier 3: Senior-Career pool. Due to only having 11 registrants for the Tier 1: Early-Career registrant pool, the focus group date was selected based on the date the greatest number of registrants were available, which resulted in exactly 10 registrants being invited. There were no available alternates in the event a registrant was no longer available. After selecting focus group dates to assure the best availability for each of the two remaining focus group sessions, 12 registrants were randomly selected from among those available on the selected date, which was 17 registrants for Tier 2: Mid-Career (12 of 17 selected = 71%) and 16 for Tier 3: Senior-Career (12 of 16 selected = 75%). Those who were not selected were sent an email thanking them for their interest.

Pre-Session Questionnaire

The pre-session questionnaire collected information on participant-rated importance and readiness to work in the five pre-selected emerging areas of public health practice and solicited additional emerging areas of practice that participants felt were relevant to their day-to-day work or to the day-to-day work of epidemiologists like them. In regards to the pre-selected emerging areas of practice, all three tiers / career stages of focus group participants largely rated all areas as being important to their daily work. See [Table 16](#). In general, Tier 1: Early-Career epidemiologists rated readiness to work in these areas lower than Tier 2: Mid-Career and Tier 3: Senior-Career epidemiologists. Of note, across all three tiers / career stages of epidemiologists, the two areas rated lowest in importance and readiness were public health and primary care integration and Health in All Policies.

Table 16. Importance and Self-Reported Readiness of Emerging Areas of Public Health Practice, Focus Group Participants (n=21)

Emerging Areas of Practice	Tier 1 / Early-Career Epidemiologists (n=6)		Tier 2 / Mid-Career Epidemiologists (n=8)		Tier 3 / Senior-Career Epidemiologists (n=7)	
	Important	Ready	Important	Ready	Important	Ready
Fostering a culture of quality improvement	5 (83%)	2 (33%)	7 (88%)	6 (80%)	5 (71%)	5 (71%)
Public health and primary care integration	5 (83%)	1 (17%)	6 (75%)	4 (50%)	4 (57%)	4 (57%)
Evidence-based public health practice	6 (100%)	4 (66%)	8 (100%)	6 (75%)	7 (100%)	6 (86%)
Health in All Policies	5 (83%)	0 (0%)	6 (75%)	1 (13%)	3 (43%)	3 (43%)
Multisectoral collaboration	5 (83%)	2 (33%)	8 (100%)	5 (63%)	7 (100%)	5 (71%)

Focus group participants listed several additional emerging areas of practice they felt were relevant to the day-to-day work of epidemiologists. Two Tier 1: Early-Career epidemiologists listed additional emerging areas of practice in the domains of informatics (n=2), social determinants of health and health disparities (n=1), and advanced molecular detection (n=1). Six Tier 2: Mid-Career epidemiologists listed a broad range of additional

emerging areas of practice with half listing topics in the domain of informatics (n=3). Seven Tier 3: Senior-Career epidemiologists listed additional emerging areas of practice with five listing topics in the domain of informatics (n=3). See [Table 17](#) for a list of areas offered by focus group participants and state epidemiologists that were considered in developing the focus group guide. In consideration of all three phases of data collection, the topics selected for inclusion in the focus group discussion were the five emerging areas of public health practice from PH WINS and the additional areas of informatics, social determinants of health and health disparities, and program evaluation. Demographic information collected from the pre-session questionnaire are reported in the section describing the focus group sessions.

Focus Group Guide Pilot

The survey instrument was piloted on October 18, 2019 with three epidemiologists working in a state health department, each representing the early-, mid-, and senior-career stage. The focus group guide was reviewed with participants to evaluate timing and solicit feedback on flow and participant interpretation of question wording. The session was also recorded using video conferencing software to ensure technology functioned properly. Some significant changes to the instrument and procedure were made following the pilot deployment including:

- Sending participants the definitions for the emerging areas of public health practice to be discussed in advance of the focus group so they could review and also have available to refer to during the discussion ([Appendix 14](#));
- Rephrasing the introduction activity to avoid redundant information and set a less formal tone for the discussion;
- Simplification and refinement of the questions aimed at assessing the role of epidemiologists to work in each of the emerging areas of public health practice and the associated barriers and facilitators to improved practice.

Minor editorial changes throughout the focus group guide were also made at the suggestion of pilot participants to improve clarity of wording.

Table 17. Additional Emerging Areas of Public Health Practice Offered by Participants, State Epidemiologists (n=51) and Focus Group Participants (n=21)

Participant-Identified Emerging Areas of Practice	State Epidemiologists (n = 51)³	Tier 1 / Early-Career Focus Group (n = 6)	Tier 2 / Mid-Career Focus Group (n=8)	Tier 3 / Senior-Career Focus Group (n=7)
Participants who listed additional areas of practice	27 (53%)	2 (33%)	3 (38%)	5 (71%)
Informatics	15	3	2	4
SoDH/ Disparities/ Equity	13	1	-	1
Non-Infectious Diseases ¹	10	-	-	-
Data Science / Visualization	4	-	-	-
Program Evaluation	4	-	-	1
Advanced Molecular Detection	3	1	-	-
Climate Change	2	-	1	-
Data Suppression / Privacy	2	-	1	-
Other ²	8	-	2	2

na: not assessed; n/a: not applicable; nc: not calculated due to the variety of areas included in the category.

Important: Respondents who answered that the area of practice was “important” or “very important” to the day-to-day work of epidemiologists.

Ready: Respondents who answered that epidemiologists were “ready” or “very ready” to work in the area of practice.

¹Non-infectious disease areas included emerging contaminants, behavioral health, substance use, adverse childhood experiences, and capacity to respond to clusters or “outbreaks”.

²Other areas included health economics, health impact assessment, “local/regional epis”, “Population Health - Public Health Integration”, “precision medicine and applied public health research”, “collaboration with environmental health for arboviral diseases”, social media/communications, genomics, migration, demographic transitions, policy analysis, workforce development.

³Results from Phase 2 State Epidemiologist Survey

Focus Group Sessions

A total of 21 epidemiologists working in state health departments participated in one of the three 90-minute focus group sessions. Participant characteristics are described in [Table 18](#) and [Figure 13](#). Focus group sessions occurred as follows:

Tier 1: Early-Career Session – A total of six epidemiologists working in state health departments participated in the Tier 1: Early-Career focus group session, which was held on October 25, 2019 from 2 – 3:30pm ET.

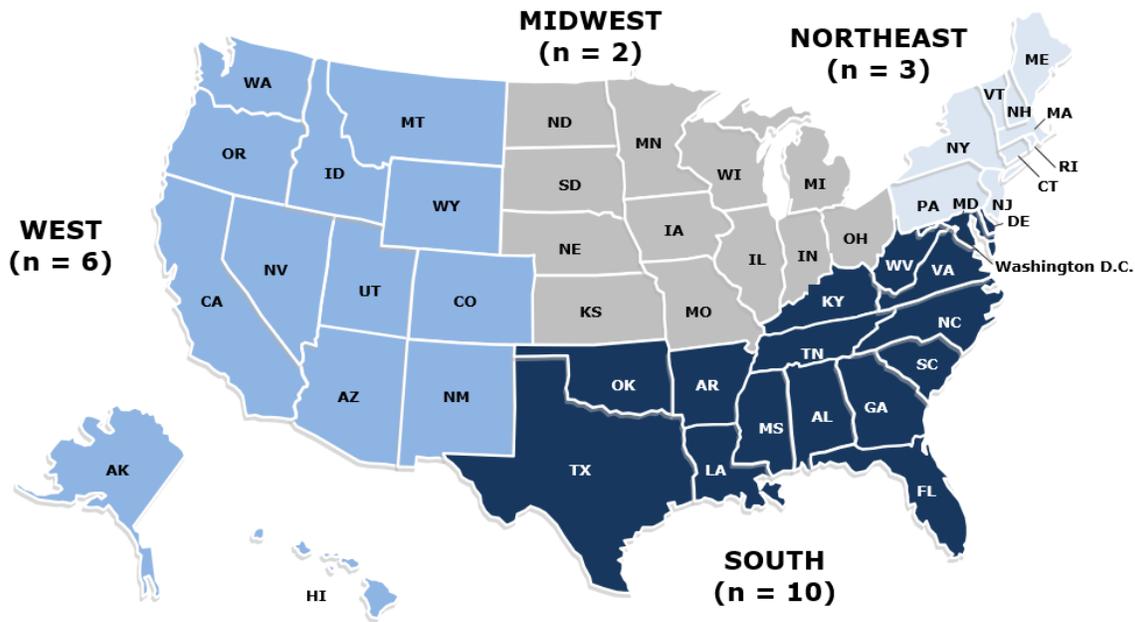
Tier 2: Mid-Career Session – A total of eight epidemiologists working in state health departments participated in the Tier 2: Mid-Career focus group session, which was held on November 1, 2019 from 2 – 3:30pm ET.

Tier 3: Senior-Career Session – A total of seven epidemiologists working in state health departments participated in the Tier 3: Senior-Career focus group session, which was held on October 29, 2019 from 2 – 3:30pm ET.

Participant Validation of Focus Group Findings

Focus groups were sent a summary of the focus groups sessions that described the major themes, conclusions, and recommendations that emerged from the focus group sessions. Six focus group participants provided feedback on the summary and all indicated that they felt the content reflected the discussions.

Figure 13. Geographic Representation of Focus Group Participants



Note: Total participants = 21. Geographic divisions are based on U.S. Census Regions.

Table 18. Focus Group Participant Characteristics

Characteristic	Tier 1 / Early- Career	Tier 2 / Mid- Career	Tier 3 / Senior- Career	Total n (%)
Number of Participants	6	8	7	21 (%)
Gender (female)	5	5	4	14 (67%)
Age				
30 or less	3	4	0	7 (33%)
31 – 40	2	2	3	7 (33%)
41 – 50	1	0	1	2 (10%)
51 – 60	0	2	2	4 (19%)
61 or greater	0	0	1	1 (5%)
Race				
White	5	5	7	17 (81%)
Black or African American	1	3	0	4 (19%)
Asian	0	0	0	0 (0%)
Spanish, Hispanic, or Latino	0	0	0	0 (0%)
Work experience (median years)	1 (1 – 3)	4 (3 – 20)	19 (4 – 41)	4 (1 – 41)
Supervisor Status ¹				
Non-Supervisor	6	7	3	16 (76%)
Supervisor	0	1	1	2 (10%)
Manager	0	0	3	3 (14%)
Level of Education				
Master’s degree	5	7	3	15 (71%)
Doctoral degree	1	1	4	6 (29%)
Program Area				
Infectious Disease	5	1	5	11 (52%)
Maternal and Child Health	0	2	0	2 (10%)
Environmental Health	1	1	0	2 (10%)
Chronic Disease	0	1	0	1 (5%)
Genomics	0	1	0	0 (0%)
Informatics	0	0	0	1 (5%)
Substance Use	0	1	0	1 (5%)
Other	0	1	2	3 (14%)

¹ Definitions of supervisory status from PH WINS were used (see Appendices 2 and 9).

Focus Group Analysis

There were 106 structural, thematic, and reporting codes applied and analyzed across 2,783 coded segments over the three transcribed focus group sessions. Prior to any resolution of coder discrepancies, the overall intercoder agreement (kappa statistic) between the two coders was 0.70.

Key Themes by Emerging Areas of Public Health Practice

Themes that emerged from the focus group discussions are summarized by emerging area of public health practice and include the topics of the epidemiologist's role, barriers, and facilitators to working within each area.

1. Quality Improvement

Using the same definition as was used in PH WINS, this area was defined as "An integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization."

In discussing the role of epidemiologists in quality improvement, participants provided typical functions of epidemiologists such as collecting, analyzing, interpreting, and disseminating data. In particular, participants emphasized the importance of engaging epidemiologists early in the process so that they could be involved in the design of the data collection process to ensure the resulting data would be useful and meaningful. Participant quotes illustrating this theme include:

"...whenever someone is looking at quality improvement, having an epidemiologist as part of this team allows us to also kind of poke and prod a little bit about what are the questions that you're specifically trying to answer because that impacts the type and kind of data that you're trying to collect and so I think we bring that kind of approach to that process as a whole, but oftentimes I think people that may not have as much of the data science background, try to just collect data without really thinking through the questions that they're trying to ask and how that might actually impact what they're trying to uncover or discover."

- Tier 3: Senior-Career Epidemiologist

"I think involving epis early in the in the planning discussion process... can help ensure that maybe the right types of data metrics are collected or the

right approach is undertaken at the very beginning, or even before the project has started to ensure that the data that's collected is meaningful and analyzable versus sort of [ending up] with messy and dirty data that is really hard to make heads or tails of after the project is done."

- Tier 3: Senior-Career Epidemiologist

In addition to not being engaged early enough, some participants reported that not being involved at all was a barrier to work in this area. Participant quotes illustrating this theme include:

"I feel like we have very little role currently in quality improvement."

- Tier 1: Early-Career Epidemiologist

"I don't know that this is an area that I naturally think maybe that... my job includes...."

- Tier 3: Senior-Career Epidemiologist

Additional key barriers identified by participants included staffing, not having time to do the work, and competing priorities. Participant quotes illustrating these themes include:

"I think it's resources. And so, it's having time or staff time to do things a lot... there's just so much that just can't be done by one person, so [with a] staff of one and trying to do quality improvement along with everything else is just really challenging."

- Tier 1: Early-Career Epidemiologist

"We were basically just so busy all the time that we never had time to think about QI. So, I mean, I think understaffing. And I think, you know, unfortunately, overcoming understaffing is very, very difficult task, but I think that is a pretty significant barrier or at least it has been in my experience."

- Tier 2: Mid-Career Epidemiologist

"... a lot of times [you get assignments] last minute and then you're trying to figure out how you're going to get this done... And then when it comes to quality improvement, all of a sudden, they're saying, "oh, I need this, I need that,"... So that's what hinders you, you know, all the different people that are pulling at you and then, especially if because, in my case, our quality improvement department is not even part of epi. It's another whole other branch inside of our agency and then they all of a sudden come and ask you for numbers and you're like, "how is that even quality improvement?"

- Tier 2: Mid-Career Epidemiologist

Lack of training and lack of knowledge were all also identified as barriers. Participant quotes illustrating these themes include:

"Measurement of risk factors and disease status and health outcomes are one traditional role of an epidemiologist and often it's one of the principal things that are taught in an epidemiologist's curriculum --- quality comes in later. I think it certainly came later to me in my career, but it was really applied to the delivery of programs. That's where I saw quality coming up most and that was a little bit different than my training in epidemiology, which focused more on health status."

- Tier 3: Senior-Career Epidemiologist

"I would also say terminology and learning, learning the terminology that others are using or other disciplines are using. I think epidemiologists have been doing quality improvement for a long time, as part of our day to day but we may not be using the same language that some of the other players within the department or within government agencies are using for describing the quality improvement process."

- Tier 3: Senior-Career Epidemiologist

Lack of organizational support, silos, and political barriers were also identified as barriers. Participant quotes illustrating these themes include:

"I think it's partially also management interest in this kind of work. And it may come down to time as well. So they may not prioritize it because they know there's many other things that we need to be working on, but to me it seems like... something that would help would be just telling all epidemiologists, or all people in the health department, how important this type of work is."

- Tier 1: Early-Career Epidemiologist

"[It has] become normal to want to achieve more with less and during my over four years of experience, we would lose personnel; however, the jobs still have to be done and I guess to substitute, those tasks were placed on the other epis... and it was non-negotiable. And you try to communicate that with your superiors or supervisors and it is falling on deaf ears because they're like, "well, I'm overworked, too." Well what can be done to fix it? And unfortunately, I just don't ever see a solution that comes from our comments to them."

- Tier 2: Mid-Career Epidemiologist

"[Some] topics are very political and it seems like we're kind of strayed--- are pushed away from developing protocols and things like that. But it seems like a good way of supporting our work and making sure if the topic is political

that there's a quality improvement process in place that kind of protects us from some of that negative publicity.”

- Tier 1: Early-Career Epidemiologist

“... things can get really siloed. Not just within a department or within state agencies, but even within infectious disease epi things can get pretty siloed and there can be a lack of sharing knowledge and sharing skills and sharing your processes that may be well documented and may not be.”

- Tier 1: Early-Career Epidemiologist

“[Partners] may not always know what an epidemiologist is and when we're talking about like [healthcare partners], they can get a little defensive when it comes to QI and so I've had to sort of convey to people that I'm not here to judge you, I'm not trying to come in and do anything negative with your work. I just want to support you in being able to do that.”

- Tier 2: Mid-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area of quality improvement, participants identified organizational support, training, bringing epidemiologists into the process early, and learning from others as key themes. Participant quotes illustrating these themes include:

“... time to do the work [can be a barrier], but it is both even having time to take to do trainings can be challenging... My office is great at giving dedicated space and wanting its epis to do training. So that's really supportive, but it's just that sometimes it just can't happen.”

- Tier 1: Early-Career Epidemiologist

“More thought towards management in higher levels to reach out to the epidemiologists to participate in quality improvement work.”

- Tier 1: Early-Career Epidemiologist

“... the culture of the organization --- If the higher pay grades feel like it's necessary, then they're going to help you achieve those goals, but if it's not even at the highest levels and it's always kind of hit or miss, then you're going to continually kind of struggle with it.”

- Tier 2: Mid-Career Epidemiologist

“I think just how does an epidemiologist get to the table? You know, if the planners of the project or the intervention are thinking about how to analyze the data at the end, how does an epidemiologist get to the table to be there from day one, as opposed to being brought in once the data are collected and are kind of a mess?”

- Tier 3: Senior-Career Epidemiologist

“Because we're siloed, there can be a lack of information sharing and knowledge sharing and processes. So, I think just overcoming that by creating opportunities to have those conversations with colleagues in other agencies and other departments to share things that we're doing so we're not reinventing the wheel.”

- Tier 2: Mid-Career Epidemiologist

“I think that when you apply the definition about quality throughout the organization, I think it's important that the epidemiologists, not only in your bureau, but other bureaus talk and collaborate with one another because quality improvement can apply to, again across the organization... I think it's knowing how the organization is set up and these cross linkages between the programs, especially around data and how you capture the data is important.”

- Tier 2: Mid-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

2. Public Health and Healthcare Integration

This area was defined as “The linking of public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health” (IOM, 2012).

In discussing the role of epidemiologists in public health and healthcare integration, participants provided typical functions of epidemiologists such as analyzing, interpreting, and disseminating data. In particular, participants emphasized epidemiologists’ role in disseminating data, communicating evidence, educating the healthcare community, and providing subject matter expertise. Participant quotes illustrating these themes include:

“... the epidemiologist’s role in this area would be data support... it's a matter of trying to figure out how to capture the data in a way that we are able to analyze it later on. Once we get data points there. And in that way, we will [look at the data] to see if we're doing all we need to do in order to serve the population that we're trying to serve.”

- Tier 2: Mid-Career Epidemiologist

“I think often, also at the state level, our job is sometimes to communicate. Use our communication skills with clinicians and sort of as educates the healthcare community on issues, on what are the big public health issues. What data looks like and what they should be paying attention to on a larger

scale. And we often have the data to do that and they might be interested in it. And so just making sure that the issues that we're working on are addressed, and that they're aware of them."

- Tier 2: Mid-Career Epidemiologist

"This is about providing data, and more importantly, actionable data."

- Tier 3: Senior-Career Epidemiologist

"I think when you look at the definition of public health surveillance. It is all about data to action... so, from a state level, when we look at things like the opioid crisis and trying to identify how our surveillance data can inform other programs to help serve folks that are high risk..."

- Tier 3: Senior-Career Epidemiologist

"I feel like we should be enabling people to use their own data in ways that help them. [They] have a huge [data] repository... but people don't always understand sort of how to run reports on that or what they could be doing with their own data. So, I think that it's really important to empower those healthcare providers to make decisions for themselves about what their priorities are and then sort of to support them in that."

- Tier 2: Mid-Career Epidemiologist

"I would say a piece also, or maybe not always bringing that data, but bringing some of the methods to be able to look at the data, maybe in the event when that's not available within the healthcare systems."

- Tier 3: Senior-Career Epidemiologist

Unique to this area of practice, participants also identified the role of conducting investigations and linking patients to care. Participant quotes illustrating these themes include:

"... We use the data sources available to us to identify persons living with HIV that we determine may be out of care... I use the data and analyze or identify individuals that may no longer be in care and ... provide a list of names to those agencies that are responsible for investigating and trying to locate and re-engage those clients into care. But if I was not able to provide them a list of names, based on the data that's collected and reported to the health department, they may not be able to obtain that information in other ways."

- Tier 1: Early-Career Epidemiologist

"When you have epidemiologists in the field that are conducting investigations and then kind of working with those individuals to gather information at that point, you could also try to figure out some way to help give them resources to provide to those cases and link them to care as well."

- Tier 3: Senior-Career Epidemiologist

Within the roles of conducting investigations and linking patients to care, participants reported various and sometimes conflicting levels of engagement with these activities indicating that the epidemiologist's involvement may vary depending on the program they work in and whether they work at the state or local level. These topics were primarily discussed in the Tier 1: Early-Career group, most likely because these epidemiologists represent the "front-line" and have direct responsibility for conducting investigations.

Participant quotes illustrating these themes include:

"I very seldom directly interact with patients--- well I interact with patients quite a bit to interview them to learn about risk factors, but I would never directly link them to any sort of care... I know for other diseases, and other branches of epi in the state do that... I'm sure the HIV folks and the environmental folks do that more than me."

- Tier 1: Early-Career Epidemiologist

"I think that at the state level, that I don't do any patient interaction generally or connection to care. I know some of... our local health jurisdictions... refer people to get vaccines or to get some screening done or for their contacts... but there is a role of linkage, just not at my level, the state level."

- Tier 1: Early-Career Epidemiologist

Participants, especially in the Tier 1: Early-Career group, discussed that the role of epidemiologists in the area of public health and healthcare integration is not always clear.

Participant quotes illustrating this theme include:

"I think it is an important role. I think that we have a lot of opportunity to help people out. There's just no, sometimes, clear way to do that in my position."

- Tier 1: Early-Career Epidemiologist

"When I think about this topic, I actually think about what public health can contribute and what healthcare delivery can contribute and how they're integrated with each other. So those are two worlds that traditionally have stood apart and now they're being asked to work together more than ever in my opinion. And so, it really begs the question about what and why we do this."

- Tier 3: Senior-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included time to do the work, funding, and clarity of partner roles. Participant quotes illustrating these themes include:

"I think it's a time issue. We have a program here [that engages hospitals] and trying to get out there and do the training and then follow up with them on an ongoing basis. It's been tough just to keep the other projects going when you're out of the office and you come back."

- Tier 2: Mid-Career Epidemiologist

"Competing priorities [are a barrier], whether both sides are at the table and have the same timeline, the same goal, same priorities at the same time. And... as far as sharing data... what that mechanism is, what the privacy concerns are, and getting access to data, what can... [and] can't be shared. Getting all of that worked out can take a considerable amount of time."

- Tier 3: Senior-Career Epidemiologist

"The practical reality of funding comes into play here because, at least in our agency, the healthcare side of or department has a lot more money and public health doesn't. So, the imbalance there contributes to data collection and data analysis right on down the line."

- Tier 3: Senior-Career Epidemiologist

"Sometimes we come across facilities that don't maybe fully understand our role as the State Public Health Department and that we're really kind of consultants here to help... we're not necessarily part of a regulatory body that's going to be punitive. So, I think a lot of education on what our actual role is and why we care about this from a broader public health perspective rather than individual patient level perspective. That is something we have, over a long time, identified as a huge barrier for our work in healthcare."

- Tier 1: Early-Career Epidemiologist

"I think one of the big challenges, [as] we're all trying to actively integrate public health into healthcare practice, is understanding who the decision makers are on the clinical side. So, while we're on different groups or have sometimes some really close partnerships with some of our key clinicians, they may not be the persons within their organization to actually make things happen and I think that's one of our biggest challenges."

- Tier 3: Senior-Career Epidemiologist

Usability of healthcare data, data linkage challenges, and data sharing concerns were also identified as barriers. Participant quotes illustrating these themes include:

“One of the big things on our end is almost sort of technological siloing. So, we have a lot of agencies and hospitals that all have their own record system and that don't want to give anybody else access. So, there's literally no way for us to integrate and help [healthcare facilities], because we don't have access to their data.”

- Tier 2: Mid-Career Epidemiologist

“I think a lot of parsing of text field kind of data, especially with dealing with EMRs. There don't tend to be a lot of checkboxes and yes / no variables that I'm more used to working with other sources of data, and you have to do a lot more data mining of text fields to get any useful information out of them.”

- Tier 2: Mid-Career Epidemiologist

“One of the things that we learned from our hospital colleagues was what they have the data in. They know what happens to a patient within the facility, within the primary care office within the hospital, but what they don't have are all of the other data related to health, and the social determinants, like transportation information. And so it's, I think, finding a way to link up that and knowing, I think, public health, what we can provide is [that] we have partners with transportation, we have all of these, and it's just getting to the table and speaking kind of the same language.”

- Tier 3: Senior-Career Epidemiologist

In terms of key facilitators to improving their ability to work in the area of public health and healthcare integration, participants identified organizational support and having an organizational strategy. Participant quotes illustrating these themes include:

“I think, for me, the biggest factor that would hinder my ability in the past has just been lack of, I guess, buy in or support from the higher ups in the agency. I think it does take a lot of time and dedicated effort to do these kinds of things and if you don't get buy in from the top, you basically probably can't even do it at all.”

- Tier 2: Mid-Career Epidemiologist

“We can get very siloed across state agencies, departments, and even within Epi. As a result, there is a lack of sharing of knowledge and processes and data that could be overcome by creating dedicated time/space for different groups to connect and share things that would improve our work and prevent us from reinventing the wheel every time we start a new project.”

- Tier 2: Mid-Career Epidemiologist

“From an organizational standpoint, you have to have a path in a direction versus different programs and siloed programs going out and trying to accomplish this. So... it's coming up with a plan and how to best implement that plan.”

- Tier 2: Mid-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

3. Evidence-Based Public Health Practice

This area was defined as “Making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned” (Brownson et al., 2009).

In discussing the role of epidemiologists in evidence-based practice, participants provided typical functions of epidemiologists such as collecting, analyzing, and interpreting, data. In particular, participants emphasized epidemiologists’ role in finding, using, and communicating evidence. Participant quotes illustrating these themes include:

“Certainly, understanding and applying analytic tools, doing a community health assessment, quantifying the issue, evaluation --- I mean, these fundamental building blocks of evidence-based public health practice are what epidemiologists learn and practice in their work. So, I think there's a lot of overlap and need for having epidemiologists at the table when this topic is being implemented.”

- Tier 3: Senior-Career Epidemiologist

“I would say that it's to communicate what the evidence says. We don't necessarily advocate for certain policies necessarily, but it's at least to elevate what the science is saying and what the data are saying.”

- Tier 1: Early-Career Epidemiologist

“I think sometimes it's about translating science for the public or folks who maybe don't necessarily understand the processes that we use to come across that evidence and to do the data analysis. So, kind of making that accessible for everybody, instead of just accessible only to epis.”

- Tier 2: Mid-Career Epidemiologist

“Not only on evidence that we're collecting ourselves but also evidence we find in the literature, being able to identify what's in the literature as well as what's applicable in the literature.”

- Tier 3: Senior-Career Epidemiologist

“Most of us are subject matter experts in one thing or another and I think it's, in my role, very important to stay up to date on the literature, and sometimes challenging because maybe you know, last year we were recommending one thing in response to an outbreak and then, you know, maybe some new literature has come out to show that the best evidence-based practice isn't necessarily what we were recommending last year. So sometimes the continuity of that can be challenging but overall, I think my role is just to stay as up to date as possible.”

- Tier 1: Early-Career Epidemiologist

“We have a responsibility to make sure that we're collecting our data in a way that is evidence-based not just sharing it in a way that's evidence-based. I think the way we develop surveys, the way we develop surveillance systems - -- There's a good way to do that and a bad way to do that and I think we have a responsibility to look at the best evidence when we're doing that.”

- Tier 2: Mid-Career Epidemiologist

Senior-career epidemiologists also recognized the role for epidemiologists to create evidence through contribution to the peer-reviewed literature. A participant quote illustrating this theme includes:

“Often it's the epis that are bringing together the real-world data to make protocols and plans and schematics that then we subsequently operate off of. So, for example, you know, I work a lot in [X disease] and so we really rely heavily on the surveillance data that's collected during outbreaks that then inform the national guidance and algorithms that are put in place to then inform how we approach future outbreak investigations and the cycle repeats itself. So, I think that role of collecting that really important data and then really applying it as data for action is really critical.”

- Tier 3: Senior-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included staffing and time to do the work. Participant quotes illustrating these themes include:

“In our health department when we lose positions, sometimes they literally never replace them. We have like 20-30% vacancy at any given time. Kind of a revolving door.”

- Tier 2: Mid-Career Epidemiologist

"In recent years here at our agency, that's what is the driver of everything we do --- it has got to be evidence-based... that's a lot of work on our part because it goes back to... you lose positions and then everybody else has got to cover... it takes a lot to fill the positions because we're state workers and state epis don't get paid much and so when we don't get paid that much people don't want to take a job [because] they get paid more working for a company like say [private company name]."

- Tier 2: Mid-Career Epidemiologist

"I think having time to sit down and critically read something takes a lot of time and mental space and sometimes in the middle of the day, and especially in the middle of an outbreak, it's just not possible.... it's very hard to get through an entire paper and distill the message."

- Tier 1: Early-Career Epidemiologist

"The ability to have dedicated time to pursue it would be very helpful."

- Tier 3: Senior-Career Epidemiologist

Organizational support, lack of an established process, and political barriers were also identified as barriers to working in evidence-based practice. Participant quotes illustrating these themes include:

"I think another challenge that I face is more the internal approval process to implement some of these practices, even if I come across something that may be of interest. I know there's just a very lengthy approval process in order to even consider having it implemented. I don't always have the liberty to make those decisions."

- Tier 1: Early-Career Epidemiologist

"I think the barrier is more that there is not a formal process to request change. So, it looks a lot more like recommending something to a manager or a supervisor and then attempting to get leadership in one room in order to give them a proposal and then having time for them to review it and for a decision to be made. But there's not a formal structure for that process and so you can hit a barrier at any point."

- Tier 1: Early-Career Epidemiologist

"Whether we like it or not, the fact that we all work in government, there is sometimes inherent politics and some of these decisions to the things that we respond to and work on and that can certainly hinder or complicate our ability to... make recommendations to leadership that maybe are not acted upon or that are acted upon slightly differently because of other perceived pressures or other factors and maybe these are the sort of factors worker bees aren't aware of, but it can certainly make things more messy and complicated."

- Tier 3: Senior-Career Epidemiologist

Unique to this area of practice, participants also identified access to literature as a key barrier. Participant quotes illustrating this theme include:

"Sometimes accessing journals can be hard. I don't have access to any journals, I guess anything that's open source and then whatever interns that are students that we can badger to download papers. So, I feel like there's never been something I want to read that I can't get to, but sometimes I have to jump through some extra hoops."

- Tier 1: Early-Career Epidemiologist

"Being able to review the literature, rather initially at any rate, and not having access to literature definitely hinders our ability."

- Tier 3: Senior-Career Epidemiologist

"I think there's... not evidence-based public health practice available for everything. And I think certainly within infectious disease we constantly are having to respond when the best practice may not have been figured out yet. So, I feel like we need to be able to deal with implementing best practices when those are available and evidence-based practices when those are available, but then also being able to adjust and be flexible and move forward when the best answer isn't necessarily provided."

- Tier 3: Senior-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area of evidence-based practice, participants identified organizational support. In terms of addressing lack of access to the literature, one participant identified that having an academic affiliation facilitated access to literature. Participant quotes that illustrates these points include:

"I would say having leadership who really advocates for using evidence-based practice and allowing you to make recommendations based on it is helpful. So, having a key, very much higher up person who has direct access to policymakers, who will have my back when I say I found evidence for this, [says] "Let's do it" and understands that is really helpful."

- Tier 1: Early-Career Epidemiologist

"I think that having... a champion within your organization that sees the vision to change things and move things along, although slow sometimes, you still have somebody there to kind of champion and move things along."

- Tier 2: Mid-Career Epidemiologist

"Here within [my organization], unfortunately, we have limited access to scientific literature. My one workaround is that I'm also adjunct faculty, so I can access the library where I also teach but that's just one workaround, but this definitely would be a hindrance if you don't have that type of access."

- Tier 3: Senior-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

4. Health in All Policies

Using the same definition as was used in PH WINS, this area was defined as "A collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people."

In discussing the role of epidemiologists in Health in All Policies, participants provided typical functions of epidemiologists such as collecting, analyzing, interpreting, and disseminating data. In particular, participants emphasized epidemiologists' role in disseminating data, using data to inform policy, and conducting policy analysis. Participant quotes illustrating these themes include:

"I can envision a way in which epidemiologists are... looking at the data, asking the questions, perhaps analyzing the data and bringing that information to the discussion about what those policies should be."

- Tier 3: Senior-Career Epidemiologist

"I think it's our role to provide data and think about the health implications of policies."

- Tier 1: Early-Career Epidemiologist

"We can provide the data, we can provide the information about what policies need addressing and how... evidence-based practice can inform that, but also communicating when there is no data about something and how important it is to collect that and be able to demonstrate the needs for health advocacy and in all policies."

- Tier 2: Mid-Career Epidemiologist

Participants, especially in the Tier 1: Early-career group, discussed that the role of epidemiologists in the area of Health in All Policies is not always clear. Participant quotes illustrating this theme include:

"The example I had in my head is that we're also dealing with a hepatitis A outbreak here and my colleagues that are working on that have been asked by policymakers to explain these really complicated infectious diseases like hepatitis A and try to get money to help people... So, I think that's a good example, but I don't have in my field any experience and I don't really know very clearly what my role is in this area."

- Tier 1: Early-Career Epidemiologist

"I think there's always the challenge of knowing exactly how much I'm able to provide... I can provide data for anything... but my job in terms of advocating for specific policy or supporting something specifically... I know that, as government employees, there's restrictions around that and I don't ever want to do the wrong thing in terms of that... I feel a little bit afraid to be an advocate for a certain policy or advocate for a certain political bill or anything like that just because I don't want it to cause a problem with my career and I don't know those lines very well... it's not easy for me to understand my agency's policies around these things."

- Tier 1: Early-Career Epidemiologist

The most predominant barrier discussed across all tiers related to Health in All Policies was that epidemiologists are generally not involved in this area of practice.

Participant quotes illustrating this theme include:

"...I think that there's definitely a role there. I don't know how much epis actually go to the table, though, and explain our data and talk about it. I know that people use it, which is good. But I think it would be nice if we were also at the table."

- Tier 1: Early-Career Epidemiologist

"Here in [my organization]... the programmatic staff are really the ones that push and advocate for the policies. They're more on the ground, working with the clients, working with the clinicians and so they seem to know more of what the need is, things like housing and transportation... but for me it, it typically comes down to providing the data in my role. So maybe if we worked together...."

- Tier 1: Early-Career Epidemiologist

"I think the barrier is that this is not something I intersect with at all within the role that I have."

- Tier 3: Senior-Career Epidemiologist

"It seems like some of these policies may also be policies that are initiated by others, whether that's other government agencies or commercial entities or whatever, and that you know it may take requesting assistance or participation, collaboration from the health department but then I would also think that's probably happening in a much higher level than epis where I am working. That kind of request might come to the Director of the Health Department."

- Tier 3: Senior-Career Epidemiologist

Because overwhelmingly participants reported not being involved in Health in All Policies work, participants across all career stages spoke to their role in this area more theoretically, such as what the epidemiologist's role could or should be. Participant quotes illustrating this theme include:

"I think it's our role to provide data and think about, you know, the health implications of policies... I think there's definitely a role there. I don't know how much epis actually go to the table though, and explain our data and talk about it."

- Tier 1: Early-Career Epidemiologist

"I can envision a way in which epidemiologists are... looking at the data, asking the questions, perhaps analyzing the data and bringing that information to the discussion about what those policies should be. I think the barrier... is that this is not something I intersect with at all within the role that I have..."

- Tier 3: Senior-Career Epidemiologist

Additional key barriers to working in this area of practice identified by participants included lack of an established process, silos, and political barriers. Participant quotes illustrating these themes include:

"One thing that I've seen is that people want to put health into policies, but then they don't want to actually collect the right kind of health data to measure the policy's impact and sometimes putting health type of things into policies could actually have unforeseen consequences and adverse consequences that maybe nobody thought about, but we have to be able to measure it properly, to make sure that when we try to make healthier policies in sort of non-health arenas that we're not inadvertently causing additional problems that weren't there to begin with."

- Tier 2: Mid-Career Epidemiologist

"Sometimes in gathering an evidence base and having the data available, getting to a point where you are ready to put it into practice - it gets very political, where the numbers do not lie but the best practices to make an improvement go against cultural norms. Very frustrating."

- Tier 2: Mid-Career Epidemiologist

"I think there's often a really big communication barrier, because at least in my public health program, like there was a policy track and then there was an epidemiology track, like you were choosing between those two things. So, I didn't take a lot of classes and I don't have a ton of background in policy. And so, it's a challenge for me sometimes to understand how that's constructed and what our role is in contributing to it. But I also think the flip side of that coin is that lawmakers definitely don't understand what I do and don't understand the amount of work that goes into it... So, I think there's just kind of a two-way street of not understanding each other's jobs and communication barriers."

- Tier 2: Mid-Career Epidemiologist

"Our work is dictated by our grant funding and it's very hard to expand into any activities beyond what we're funded for."

- Tier 3: Senior-Career Epidemiologist

"I think the one of the principle aims of a health and all policies intervention is to change social determinants of health... and some of the social determinants of health are easier to measure than other ones. So, the measurement of those social determinants --- finding data sources for the determinants will force the epidemiologist to go farther afield than perhaps they typically do if they're just working with a state health department... So, I think there's a learning curve for epidemiologists to overcome and getting good at this area as well."

- Tier 3: Senior-Career Epidemiologist

"I think the fact that often as epidemiologists we're siloed on a specific project just really prevents us from, you know, talking with people higher than us who are defining policy. So, I think that that fact is probably the biggest one."

- Tier 2: Mid-Career Epidemiologist

"I think from a practical level working in Health in All Policies often means working with other state agencies other than health, and those agencies have their own data systems and their target populations may be less specifically defined as the general population in a community. For example, teachers or their students. So, I think it's not only working across agencies, but it's working across data systems. That to me would be the two main challenges for epidemiologists. It's not as cut and dry as it is if you're working in a health department and the data system office is right down the hall."

- Tier 3: Senior-Career Epidemiologist

“It's also linking disparate data sources --- that's a big challenge.”

- Tier 3: Senior-Career Epidemiologist

In terms of facilitators to improving their ability to work in Health in All Policies, one participant identified taking a broader, non-health centered approach to try and engage non-health sector partners. A participant quote illustrating this theme is:

“One state that has worked on this... doesn't prioritize the Department of Health over other departments. So, I feel that's a good way --- almost like a top down approach --- that would help us work on aggregating the data and things like that. Because then it's not just health coming to the table saying we want all of you to care about health. It's thinking about it more broadly.”

- Tier 1: Early-Career Epidemiologist

An additional facilitator to improving the ability to work in Health in All Policies was organizational support. A participant quote illustrating this theme is:

“I think encouragement from people above me to share that data more. And part of it is on me, or on my colleagues or on us, to go to our superiors and go to outside organizations and say, “hey, this is what we found, and this is how we think it can be valuable to what you're doing.” But I mean it really just takes more buy in from everyone involved, I guess.”

- Tier 2: Mid-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

5. Multisectoral Collaboration

Using the same definition as was used in PH WINS, this area was defined as “Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest.”

In discussing the role of epidemiologists in multisectoral collaboration, participants provided typical functions of epidemiologists such as collecting, analyzing, interpreting, and disseminating data. In particular, participants emphasized epidemiologists' role in engaging

and connecting partners and providing subject matter expertise. Participant quotes illustrating these themes include:

"I can think of a lot of examples of this in my day to day work. I do a lot of One Health work where we work closely with ... many other partners, looking at issues that touch both environmental human and animal health and collecting and analyzing data, that helps address some of those problems, often bringing data together from multiple agencies or data sources to get a more comprehensive and sort of cross cutting look at what the impact of certain issues might be and then also program implementation and development of educational programs. Those are all things that epis in our shop work on related not just to one health but I think we've also done a lot of multisectoral collaboration in our space in the opioid epidemic. Lots of engagement with community partners and healthcare community and others that I think often involved almost every part of all of those processes. And in many ways, I don't know that I can think of many tasks that I do that, or that my team works on, that don't touch other sectors in some way."

- Tier 3: Senior-Career Epidemiologist

"I think we can provide the perspective of I guess trends in the conditions, maybe the risk factors of different conditions, and just kind of the, I guess, perspective of how often they're happening and who they're happening to."

- Tier 1: Early-Career Epidemiologist

"I think we also have a responsibility to make sure that, especially when you're collaborating with people outside of the public health sphere, to make sure that you really make clear what your data means, what data you actually have, what the data is saying and what it's not saying, what the limitations are as opposed to just, giving someone else data that they asked for it."

- Tier 2: Mid-Career Epidemiologist

"I think it comes down to, we hold a lot of data, we have expertise.... I think that we can sit at the table as the subject matter experts and drive the conversation.... So, I think epis can lead, and again, in a collaborative creative way in a group setting. I just feel like, you know, when we all come together, when you learn from each other... that's kind of a win-win in my book."

- Tier 2: Mid-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included staffing and time to do the work. Participant quotes illustrating these themes include:

"In my public health department, we have some areas that have really good relationships with [some partners]. But there are other areas, including mine, where we don't have very many pre-established relationships there.... it can

definitely be a challenge if you don't already have those relationships developed..."

- Tier 2: Mid-Career Epidemiologist

"We had a lot of turnover and with those, relationships kind of they go away. They dissolve. So I found myself kind of spinning the wheel and taking initiative and trying to reestablish some of these broken or lost relationships, whether it be on a county level or just internal with other different divisions and there is just not a lot of communication or willingness to communicate, because... its really going to take effort on both parts --- this is really just trying to get people to just go a little bit extra, I guess."

- Tier 2: Mid-Career Epidemiologist

"... [this] process takes a lot of time and energy and effort and grants don't fund a lot of time and energy and effort often. And so, I think, just the funding and having the time to really form these strong collaborations is a challenge."

- Tier 3: Senior-Career Epidemiologist

Additional key barriers to working in this area of practice identified by participants included lack of organizational support, lack of an established process, silos, lack of clarity in partner roles. Participant quotes illustrating these themes include:

"[A barrier is] management interest in doing this kind of thing. I think it seems like in our Bureau... it's done more on a topic by topic basis and not something that's always there --- a sustainable infrastructure for doing this kind of collaboration."

- Tier 1: Early-Career Epidemiologist

"So much of multisector collaboration is process... And I think this area has not been very well worked out yet. It's still kind of at an infancy. So those of us who are pushing this and doing this are limited. We're limited by not having a lot of ground broken already in this area. It's still pretty new."

- Tier 3: Senior-Career Epidemiologist

"Working across sectors, often... they're not interested. It's not part of their grant requirement or they might not have a grant and it might not be something that's interesting to them. And so it's hard to get buy in."

- Tier 2: Mid-Career Epidemiologist

"Expertise is definitely a hindrance. If I don't have a particular expertise in an area on a given project then there's nothing for me to participate in."

- Tier 3: Senior-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area, participants identified organizational support, training, availability of best practices, and having supplemental epidemiology program staffing. Participant quotes illustrating these themes include:

"... we're siloed in some regards.... I think giving yourself that opportunity to create working groups or cross collaborative projects --- And it takes a champion at your agency to kind of think outside the box on how to do this but I know we have tried to do this a little bit more. And it's been a challenge because I think everyone has their data and you want to collaborate and you want to share, but when it comes down to it, people don't really kind of want to share.... I think having a place at the table to discuss this collaboratively and creatively, I think is a win-win for everybody across government, private, public sectors."

- Tier 2: Mid-Career Epidemiologist

"One of the things I'm trying to do is work internally with my own division and getting us to work together because I can't really expect other people to work with us if we're not working together as well... then also, I guess maybe the Bureau supervisors getting them on board and pushing everyone to meet together."

- Tier 2: Mid-Career Epidemiologist

"You know we are often not the best about publishing and sharing those experiences with a wide audience. And I think it can really help build buy-in with other organizations and agencies when we can point to examples from other states or jurisdictions about how things have been done. And it's one thing to say "Oh, I talked to my friend Susie." It's another thing to show them peer-reviewed literature that this was the path or approach that was taken in this jurisdiction to approach this problem and develop a solution. Again, those things take time and I realize that many of us don't have the time or bandwidth or staffing to always complete things like that, but I think it can be really helpful for all of us to build that foundation in the literature when possible. [In my jurisdiction], publication has been a real priority for our agency on a variety of topics, and we're also fortunate to often have CSTE fellows and EIS officers and CDC public health associate program fellows who can often do a lot of the... work... putting it together....I am certainly an advocate for [contributing to the literature] but I definitely acknowledge that it takes a lot of time and energy and that's often something we don't all have a lot of."

- Tier 3: Senior-Career Epidemiologist

"For really for any team, I think when you're working in that collaboration, then you get a lot more respect up front if you can talk the lingo and have the qualifications that they might look for in their peers...."

- Tier 3: Senior-Career Epidemiologist

“The continuity for the collaboration is really important. I think getting the collaboration up and running can take a lot of work and then when you have that solid relationship, if it lapses at some point, then you have to go through again getting it up and running. So being able to have the continuity of staff, continuity over time, has been really valuable for us and sometimes funding is tied to the continuity.”

- Tier 3: Senior-Career Epidemiologist

“I know there are such frameworks and models out there for collaboration. I'm not sure that's the job of epidemiologists to gather those, but to find them and to critique them and to make them part of the policy discussions, I think would be really, really good because I think this area has been studied a lot by the research community, which may or may not have involved epidemiologists, but that's certainly what we would benefit from in our evaluation work.”

- Tier 3: Senior-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

6. Informatics

This area was defined as “The effective use of information and information technology to improve population health outcomes” (PHII).

In discussing the role of epidemiologists in informatics, participants provided typical functions of epidemiologists such as analyzing, interpreting, and disseminating data. In particular, participants emphasized epidemiologists’ role in data collection design.

Participant quotes illustrating these themes include:

“We use informatics for surveillance... epis work to set up those electronic reporting mechanisms... And... molecular epidemiology and using whole genome sequencing data... we have to be able to interpret whole genome sequencing data with epi data to reach conclusions.”

- Tier 1: Early-Career Epidemiologist

“I think epidemiologists have been doing this, just kind of de facto because we're the data people and we're the people that have to store the data in some sort of IT system. So, we've really crossed that bridge. The other piece is that as data sources get larger and larger... informatics is not going away. And then, data linkage is a huge area and we're currently working on some machine learning and AI to do data linkages.”

- Tier 3: Senior-Career Epidemiologist

“Being able to understand how to query the information that you might need or pull the records that you might need exactly when and how you need them is important. So that kind of data gathering and analysis aspect. And then another thing that I also thought of it is with [notifiable disease reporting]. I think there's a lot of onboarding of different conditions to send messages through message mapping guides to CDC... as an epidemiologist, I've been asked to provide a role in looking at the messages and making sure that it's capturing what we need to be sending for reporting...”

- Tier 1: Early-Career Epidemiologist

“We definitely need to be at the table at the onset of designing these information systems where we're going to be extracting this data from, whether it's qualitative or quantitative, seeing what the export is going to look like, making sure we have the relevant data points in order to analyze the data, even if we're not doing it directly. I think is really important to have the epis there and I think that's where our contribution is in this area.”

- Tier 2: Mid-Career Epidemiologist

Serving as liaison between the IT department and program staff and providing subject matter expertise were also identified as key roles of epidemiologists working in the area of informatics by participants. Participant quotes illustrating these themes include:

“I kind of am the liaison between the programmatic epidemiologist and the IT... so I'm a big proponent of being at the table with fellow epis and kind of wearing two hats as an epi and an informatician. It's just key when you build your system. Anything you do you have to think about the downstream effect of what you capture and how you report it out...”

- Tier 2: Mid-Career Epidemiologist

“...those that... are inclined to be more data science and computer savvy, that have an interest in more the surveillance aspect of informatics, [they] are really there to kind of bridge the gap between those IT teams and the stakeholders, or the epis that are trying to use those data in order to drive decision making, and I feel like a number of the different topics that we've already covered here, whether it's quality improvement, evidence-based decision making or multisectoral collaboration, public health informatics highlights all those as a need within itself as sort of a program in general.”

- Tier 3: Senior-Career Epidemiologist

“I'll just say we work with data all the time and we get that data electronically and if we're unable to get that data, it's often an electronic issue. So it's incumbent upon us, unfortunately, to often be spearheading efforts to get informatics capacity in our departments and so more often than not, I feel like I have to, as an epidemiologist, educate myself on informatics and insert myself into those conversations to sure that the needs are addressed.”

- Tier 2: Mid-Career Epidemiologist

"We have a team of epis that are really technical experts in a lot of our data systems and surveillance systems. They work very closely with our IT people on the back end of these very complex databases. They're really the owners of those data sets and are fluent in HL7 and other languages to speak that technical language that's needed to really hash out some other really complex aspects of these problems."

- Tier 3: Senior-Career Epidemiologist

While discussing the topic of informatics, some participants differentiated between epidemiologists who work primarily in informatics (i.e. "informatics" epidemiologists) versus those who work doing traditional epidemiology work in programs (i.e. program or "traditional" epidemiologists), such as outbreak response and disease control. Participant quotes illustrating this theme include:

"Even though I think there are epis focused on informatics, I think SME-style epis like myself are expected to have a basic understanding that we can do our jobs and inform the informatics work. So, it's not the same as full informatics epis, but still a basic understanding is expected and important."

- Tier 1: Early-Career Epidemiologist

"I'm not sure that delving into the depths of informatics would be a good fit for the majority of public health epidemiologists. I think there's definitely a role for that knowledge and in our agency, the folks that have those skills are not in the traditional epi response positions. I think the skill sets for my colleagues that favor more the informatics approach are not necessarily compatible skill sets with folks that are more epi outbreak responders... It just seems to be a little bit more toward what folks gravitate. Given that... our activities are so prescribed by our grant duties, that employees who came to choose the response focus would not necessarily have time to investigate informatics and if they were interested more in data sets and informatics, they would not take a job in the response division."

- Tier 3: Senior-Career Epidemiologist

"I think that there's kind of two very related but distinct roles that epis are filling within [public health]. One is the void of people that are perhaps trained in informatics or have that expertise going in and so I think... the more technical minded epis can step into that, but I think that the related but distinct role is also that bridge, that translation between the two. One is very technical."

- Tier 3: Senior-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included training and lack of knowledge. Participant quotes illustrating these themes include:

“When I first started, and the SNOMED and LOINC, HL7, MMG [language], and it's hard to even know where to start, and asking those kinds of questions when we don't even know what the context of that language is.”

- Tier 1: Early-Career Epidemiologist

“I think there's no informatics training. There's no molecular epi training, none of that existed in my MPH program... And when I started at the Department of Health, there's no informatics 101 or anything like that. And so having that kind of basic understanding of how we're getting information would be good so that we can better design it since part of our jobs is to design what we use for that information for and then having both trainings and even manuals on how to do some things would be useful for me with molecular epi.”

- Tier 1: Early-Career Epidemiologist

“I think, unless people take a particular interest in... more technical approaches, there are plenty of master's level folks that come out of grad school that have one to no exposure to some of these concepts, depending on the program and their particular track and whatnot. And I think a lot of it is that even just exposing people to these concepts, they might even not know that they have an interest in it because they're not exposed to it until they're a couple of years into their career...”

- Tier 3: Senior-Career Epidemiologist

“We tend to have a hard time recruiting epis to work in informatics in large part because so few are exposed to / trained in it.”

- Tier 3: Senior-Career Epidemiologist

“[In a prior informatics project] a lot of the initial work was just mapping out who does what and what and where and when. So those are the kinds of questions that epidemiologists are very good at answering, but it involves skills like developing a logic model or path diagrams, logical flows and that may or may not be part of the epidemiologists training. So, it's certainly a skill area that undergirded a lot of our work... because it meant figuring out how things fit together. So, I would guess that area which is relatively new, I think, lack of knowledge in that area would be a hindrance.”

- Tier 3: Senior-Career Epidemiologist

Not engaging epidemiologists early enough in informatics initiatives was another barrier identified by participants. Participant quotes illustrating this theme include:

“Some of our partners, some of our supervisors... they go out there and create data systems and then say “analyze this for me.” But they hadn't even told you that they were doing it or what it is and why they did it like that.”

- Tier 2: Mid-Career Epidemiologist

"It's so important that we're there before even design wherever you're collecting that data because, I mean you can collect stuff, but that doesn't mean it's going to be meaningful."

- Tier 2: Mid-Career Epidemiologist

Information technology (IT) department challenges was a unique barrier to working in this area of practice identified by participants. Participant quotes illustrating this theme include:

"One of our challenges is the bureaucracy because the informatics work is basically done in the IT Department and we talk to them, but we're not really able to change their preconceived way of doing things. So, it's frustrating because it wasn't really designed with an epidemiologists' background in mind. It was whatever they decided to do at the time and then we have to kind of fit it to our purpose."

- Tier 1: Early-Career Epidemiologist

"Another thing to add, from my experience, is that even if [the IT department] would, in theory, want to help you, if you don't have dedicated line item funding for that project, they can't because a lot of the agencies where I've worked the IT department essentially works as sort of a consultant, where they have to... be able to bill each shop in the department for whatever services they render. And so, if you don't have funding from a grant to do the upgrades you need, they're never going to happen."

- Tier 2: Mid-Career Epidemiologist

"When we were first [implementing a new surveillance] system, we couldn't get IT to load it. They were just kind of like, "We'll do that whenever." That's the kind of thing we have. I mean, if you have the new software and they don't want to put it on the server, what are you supposed to do?"

- Tier 2: Mid-Career Epidemiologist

"We don't have enough IT people and the first [several] months I worked in this position, I [borrowed a] laptop because there was no one who had enough time to, not only the process of ordering, but setting up all of the security and programs and everything on my work computer. So, I was literally using this tiny little miniature thing with no processing speed that couldn't open Excel documents for... months. So, [IT department challenges] is a massive part of this and just them not having the resources and not understanding the priorities."

- Tier 2: Mid-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area, participants identified training and improving IT department relationships. Participant quotes illustrating these themes include:

“I think there are a lot of opportunities to just share and educate more people about some of these concepts but particularly trying to target masters level programs and training for those folks that are just after grad school, I think, could be hugely helpful. Growing things like the CDC Applied Informatics Fellowship Program--- more of those kinds of programs.”

- Tier 3: Senior-Career Epidemiologist

“I think it could be helpful to expose all MPH grads to these concepts in the hopes of identifying additional folks that gravitate to that area early in their career.”

- Tier 3: Senior-Career Epidemiologist

“Informatics training would be valuable both in school curricula and on-the-job.”

- Tier 3: Senior-Career Epidemiologist

“Often we just get so much pushback from our IT department in terms of our informatics needs. Their perspective is often, “well, this has worked up until then, why do you need to change it? and, so their mindset is status quo, whereas our mindset is often trying to advance. And so, I guess in terms of helping that, maybe there’s ways that epidemiologists and public health practitioners can work with IT departments to change that mindset.”

- Tier 2: Mid-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

7. Social Determinants of Health and Health Disparities

This area was defined as “The complex, integrated, and overlapping social structures and economic systems that are responsible for most health inequities. This includes the social environment, physical environment, health services, and structural and societal factors, which can lead to differences in health status” (WHO, 2008).

In discussing the role of epidemiologists in addressing social determinants of health and health disparities, participants provided typical functions of epidemiologists such as

analyzing, interpreting, and disseminating data. In particular, participants emphasized epidemiologists' role in data collection design. Participant quotes illustrating these themes include:

"It's that analysis, but it's also designing how we collect data, and asking the right questions, and engaging with the right partners to determine which questions to ask... and then I think that there's a responsibility when we present information--- Like we're always breaking down by race, ethnicity, things like that--- And I think that when we provide a table, that always we can rely on literature to also explain why things exist in terms of social determinants of health and to avoid stigmatization..."

- Tier 1: Early-Career Epidemiologist

"I think our role is basically identifying those areas within our communities that are most vulnerable or affected."

- Tier 2: Mid-Career Epidemiologist

"I think we're often the first group in the state to identify trends and I mean, obviously from a health perspective, but, I think it's our role to--- we oftentimes--- really act as a gatekeeper to some of these trends and that can really influence policy and other things to help adjust health inequities."

- Tier 1: Early-Career Epidemiologist

"I also use my data to identify a lot of health disparities and that information goes into the grants that we apply for and our annual reporting and things like that."

- Tier 1: Early-Career Epidemiologist

"A lot of what we do as epidemiologists revolves around taking demographics into consideration so I think we're naturally inclined to be looking in terms of social determinants of health."

- Tier 3: Senior-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included availability of relevant data, inaccurate data, and usability of healthcare data. Participant quotes illustrating these themes include:

"One barrier to changing survey instruments [to better collect social determinants of health variables] that I've seen on our end is cost. So, for example, there's a lot of discussion in our state right now over whether we should add an additional gender category option for transgender folks... It's like thousands and thousands of dollars to add an extra question... So, there

is really a financial component to it as well and if people don't think it's a valuable question then they're way less likely to want to pay for it."

- Tier 2: Mid-Career Epidemiologist

"We have a pretty good idea what the social determinants of health are... the bigger question that I see is how do we measure those? How do we get information on the prevalence of social determinants and the resulting health or the health disparities that may result from differential exposure to social determinants? But, that to me is the crux of the issue and because the social determinants fall way across the line from health into transportation and education and aging, it means working at very high levels within the political system or the governmental public health system to really get a handle on them. It goes well beyond the state health department and what it has. It means working with other agencies and with other realms of the health of the community... That to me has been a big challenge for us."

- Tier 3: Senior-Career Epidemiologist

"I think silos... You're talking about healthcare and health equity and the data that they have. I think there's a lot of work that's going on that's duplicative and I know public health is trying to figure out health equity and the hospitals and health systems are trying to figure out health equity and we aren't talking and sharing our knowledge and our data. So, I think that is a big challenge."

- Tier 3: Senior-Career Epidemiologist

"One of the biggest barriers is, I think, just data sharing, because the Health Department has the reportable disease data but they either can't or aren't allowed to collect individual level social determinants data... So, the health department has the [exposure] data, but then the Census Bureau is where you have to go to get social determinant data, but then it's like area level data as opposed to individual level. And there's just a whole lot of issues with crossing those different levels of data. And I think we can easily serve as the bridge between those levels of data, but it is definitely a barrier of just having different data sources that are sometimes semi compatible, but not always."

- Tier 2: Mid-Career Epidemiologist

"I understand the imperative of public health agencies to be judicious in what kinds of questions they add to their questionnaires and while I love to ask people about their educational attainment and their income. Those are very sensitive things that people may not want to share to begin with. So, I think it is a very serious question to ask as to whether or not you actually can add those questions to your questionnaire."

- Tier 2: Mid-Career Epidemiologist

"Even just getting some very basic health equity data from healthcare systems is very challenging. And so that, we feel, really hampers some of our very basic health equity work because, as many of you know, race and

ethnicity, for example, is rarely asked on medical records and oftentimes, if it is recorded, it may not be accurate. It may be based on a provider making a judgment about someone and so just at a very basic level, we have identified that as one of our challenges in sort of getting at the social determinants and health equity data collection piece.”

- Tier 3: Senior-Career Epidemiologist

Political barriers were also identified as a barrier to working in this area of practice by participants. Participant quotes illustrating this theme include:

“One barrier that comes to mind is a political barrier of problems of citizenship status being reported given current political climate and [limited ability to collect] data on race and country of birth... which obviously poses a lot of problems for better understanding diseases and being able to target intervention.”

- Tier 1: Early-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area, participants identified organizational support, training, and building public trust for collecting sensitive social determinants information. Participant quotes illustrating these themes include:

“[Figuring out] who makes the decision to add [collection of social determinants of health data]... you might have this burning question and you think about adding it to the system and then everybody shoots it down. I think part of it is just knowing who has the data and how to get to it. And again, it's those relationships that you build over time... But... it's getting those higher up folks to kind of buy into it and to see the collaboration and how you need those collaborations to make a meaningful project or to present the data.”

- Tier 2: Mid-Career Epidemiologist

“We like to say that your data is confidential... but you know, especially when you're talking about working for the state, we're the big bad government to some people and so even though we're just trying to help, government as a whole may have a bad association for some people and I think that's not necessarily something that we can overcome just by ourselves... I guess the thing that we can do, when we have the resources and the time is just becoming more known to your community. And that's where at least me working at the state, I have to kind of lean on the local jurisdictions to have good relationships with their communities so that they can be trusted, and maybe be a proxy for us. If the state calling seems too scary or too overwhelming--- we just don't have trust.”

- Tier 1: Early-Career Epidemiologist

"I had an interview with a woman and every sociodemographic question I asked, she said, I'm an American. So, she then kind of questioned why I was asking education and occupation and things like... So, I think maybe like a broader understanding... society in general doesn't really think about these things that much, even though they're happening to them."

- Tier 1: Early-Career Epidemiologist

"[In regards to improving use of area-based estimates and linking social determinants of health data], ultimately, I think it would depend on research studies being funded, which is a huge lift that may or may not be actually feasible or reasonable..."

- Tier 2: Mid-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

8. Program Evaluation

This area was defined as "The systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future program development" (CDC, 2019).

In discussing the role of epidemiologists in program evaluation, participants provided typical functions of epidemiologists such as collecting, interpreting, and disseminating data.

In particular, participants emphasized epidemiologists' role in data collection design.

Participant quotes illustrating these themes include:

"As an epidemiologist, you're creating measurable variables that you can then report on at the end. So, you're doing data collection. But you're also trying to evaluate something--- trying to measure something that actually represents improvement in health."

- Tier 2: Mid-Career Epidemiologist

"I think program evaluation is certainly very important--- that what you're doing is actually doing something and do something good. I think measuring that is really challenging... So, kind of figuring out the best ways to measure interventions is, I think, important and very challenging but that epidemiologist can play a role in that because we think about the data and we think about the trends of disease."

- Tier 1: Early-Career Epidemiologist

"When I think of this, I think of surveillance evaluation as falling under this and so I do that as an epidemiologist... the role of epidemiologists is to design and conduct those evaluations and share the results..."

- Tier 1: Early-Career Epidemiologist

"I often come across evaluation measures that don't seem very relevant to health, or may not be very meaningful. For example, "number of trainings conducted on x or y". To address this, epis should be involved in creating evaluation measures that are both measurable and meaningful for programs and health issues."

- Tier 2: Mid-Career Epidemiologist

Key barriers to working in this area of practice identified by participants included staffing and time to do the work. Participant quotes illustrating these themes include:

"I think there's always a time challenge... And I think there is a big challenge in terms of, finding a problem, but then actually implementing the fix, which can be really challenging... I think following it through all the way can really be a challenge in terms of resources and things like that."

- Tier 1: Early-Career Epidemiologist

"Here at our organization, I don't think that evaluation is something that epis typically do, but there is a push for it with the limited resources that we have. And we are not able to hire contractors or go to different universities to try to bring on board some program evaluators so now we're having to do that."

- Tier 2: Mid-Career Epidemiologist

"In two of the agencies where I've worked, the program evaluation tended to happen on the program side of the house, not on the other side of the house. So, I haven't really had a role at all."

- Tier 2: Mid-Career Epidemiologist

"I guess in my situation, the biggest hindrance in program evaluation I have noticed is it was becoming an afterthought, because our [specific] program was being rebuilt and [there were] new people coming in and we have all these great ideas coming in left and right... but we had no measurable baseline or anything. No one was documenting anything... So I guess what's hindering in my situation is just trying to educate internal staff on the importance of program evaluation because right now they don't feel like it's a need or a necessity and just trying to convey that "hey this is going to help show our program is working--- proven where our dollars from our grant are being spent."

- Tier 2: Mid-Career Epidemiologist

Lack of knowledge and training were also identified as barriers to working in this area by participants. Participant quotes illustrating these themes include:

"I think... from an academic standpoint... just as the policy classes tended to be in a different department, mostly in my experience, the evaluation classes were usually in the sort of Community Health focused department, rather than the epidemiology department, which, unless you had a free elective and you were able to take those classes, oftentimes, they're not part of the program."

- Tier 2: Mid-Career Epidemiologist

"I know in my program, if you were part of the epidemiology track, evaluation is not something that you delve deeply into."

- Tier 2: Mid-Career Epidemiologist

"I, to be honest, I'm struggling to think about how you would evaluate an epi program. I also was not trained on that during school or anything. And it's not something we talk about much here and... I think a lot of times, we're the ones giving the data to the program side to make sure they can evaluate their programs.... It's just not built into what we normally do. I think we just lack the knowledge and the experience to do it well, I guess."

- Tier 2: Mid-Career Epidemiologist

"I feel like as far as formal program evaluation, there is methodology, formal methodology, formal terminology that I was not trained in as an epidemiologist. And I don't think that we had been necessarily using it a lot. And we had a brief time when we could have an official program evaluator on our staff and I think we learned a lot about the process during that time. So, I think some training in the terminology to approach program evaluation may be helpful for many of us."

- Tier 3: Senior-Career Epidemiologist

"In thinking about gaps or needs, would be in the area of qualitative evaluation because I don't that tends to be as well understood, or even taught, in many of the master's programs for epidemiologist. I know I didn't have it when I was going through school. And now, so much of the work that particularly accompanies some of the topics we talked about--- health across all policies and social determinants--- I think qualitative evaluation fits very nicely with that as a method, and certainly as an evolving area, qualitative evaluation is powerful."

- Tier 3: Senior-Career Epidemiologist

While most participants felt they did not receive any, or enough, training on program evaluation during their formal academic program, this was not an area of consensus among participants. Participant quotes reflecting this discussion include:

"I think it all depends on the school you went to. [At the school I went to] there were a fair amount of teachers that were very interested in program evaluation. So, it was always built into it."

- Tier 2: Mid-Career Epidemiologist

"I don't think program evaluation is an emerging role for epidemiologists. I think it's a very traditional role and as far back as I can look at my work in the health department, most of the epidemiologists that I have worked with were involved with program evaluation. I was taught program evaluation in my MPH program. I think it's a basic skill. It's not an emerging role."

- Tier 3: Senior-Career Epidemiologist

In terms of facilitators to improving their ability to work in the area, participants identified organizational support, training, learning from others, best practices, and having supplemental epidemiology program staffing. Participant quotes illustrating these themes include:

"In my previous epi job, our [leadership] required all the epis to [be trained in program evaluation]... so I have actually been trained in evaluation... so I feel perfectly comfortable doing evaluation and evaluation is a role that our epis have been tasked with for the last several years now so... some of us have the ability to do evaluation pretty well."

- Tier 2: Mid-Career Epidemiologist

"Something that really helped me--- and I didn't get any training on this in school --- was to find somebody who is specifically good at program evaluation and she wasn't an epidemiologist, but she helped me a lot about understanding the general process of how you go about it. So, I think sometimes maybe mentorship from people who aren't epis is really valuable for this and probably for policy."

- Tier 2: Mid-Career Epidemiologist

"Sometimes it's hard to come up with a standardized metric to evaluate [a specific program]... so maybe some sort of metric or rubric system to evaluate a program would be helpful, or at least something that can be tailored to your specific state, like a basic thing."

- Tier 1: Early-Career Epidemiologist

"Maybe I think just hearing about other [program evaluations] and challenges that were associated with those always helps kind of build your own experience and your own knowledge base. So just maybe highlighting different [programs] that really took the time to evaluate their program... and what that looks like would be helpful to watch or listen to."

- Tier 1: Early-Career Epidemiologist

"I have CSTE fellows who do [surveillance evaluation] as part of their fellowship... it's something that we're always doing... it's nice to have fellows and people who can do it and you can serve as a SME in that process."

- Tier 1: Early-Career Epidemiologist

Additional roles, barriers, and facilitators identified by participants are listed in [Tables 19 – 21](#).

Other Themes

Importance and negativity are two themes not already been presented that spanned across the emerging areas of public health practice.

In the pre-focus group session questionnaire, participants rated all of the emerging areas of public health practice as mostly important to their day-to-day work, with the exception of Health in All Policies. During the focus group sessions, participants reaffirmed that these areas of practice are important to the work of epidemiologists, again with the exception of Health in All Policies, which was expressed as more of a theoretical importance if epidemiologists could be engaged more in the process. An illustrative quote from one participant is presented for each of the eight topic areas below:

"I would say probably the majority of us have a lot of work to do and not a lot of resources so quality improvement is important, especially when it comes to the collection of our data or how we use it just because that definitely informs what our priorities are and where our resources and time go."

- Tier 1: Early-Career Epidemiologist
comment about Quality Improvement

"Working in [my program] it's kind of a huge... just because that is one of the things I have to do a lot is talk to healthcare workers, people within, not necessarily in public health, but, in all kinds of healthcare settings."

- Tier 1: Early-Career Epidemiologist
comment about Public Health and
Healthcare Integration

"In recent years here at our agency, that's what is the driver of everything we do --- it has got to be evidence-based."

- Tier 2: Mid-Career Epidemiologist
comment about Evidence-Based Public Health Practice

"I love Health in All Policies and think it makes so much sense, especially getting to those social determinants of health."

- Tier 1: Early-Career Epidemiologist
comment about Health in All Policies

"I think if we are trying to implement anything by ourselves, with public health, whether that's control measures, preventative measures, even just surveillance and reporting, there's only so much that we can do without them, so really having those collaborations and partnerships is how we can get a whole lot more done."

- Tier 3: Senior-Career Epidemiologist
comment about Multisectoral Collaboration

"... informatics is not going anywhere. This is really the future of public health in many ways as we get better at extracting data from electronic health records... It's incredibly important..."

- Tier 3: Senior-Career Epidemiologist
comment about Informatics

"I think program evaluation is certainly very important--- that what you're doing is actually doing something and doing something good."

- Tier 1: Early-Career Epidemiologist
comment about Program Evaluation

A theme of negativity also emerged among participants, which was not specific to any one area but occurred primarily within the Tier 2: Mid-Career group. This theme involves participants describing feelings of negativity about their work environment, such as criticizing bureaucracy, feeling overworked or underpaid, being "told what to do" by supervisors, or not having access to basic needed equipment like a working computer, etc. Participant quotes illustrating this theme include:

"[It has] become normal to want to achieve more with less and during my over four years of experience, we would lose personnel; however, the jobs still have to be done and I guess to substitute, those tasks were placed on the other epis... and it was non-negotiable. And you try to communicate that with

your superiors or supervisors and it is falling on deaf ears because they're like, "well, I'm overworked, too." Well what can be done to fix it? And unfortunately, I just don't ever see a solution that comes from our comments to them."

- Tier 2: Mid-Career Epidemiologist talking about Quality Improvement

"You lose positions and then everybody else has got to cover... it takes a lot to fill the positions because we're state workers and state epis don't get paid much and so when we don't get paid that much, people don't want to take a job [because] they get paid more working for a [private] company like say."

- Tier 2: Mid-Career Epidemiologist talking about Evidence-Based Public Health Practice

"I think the answer is that you're talking about the government. That's the answer to a lot of these problems... We're just dealing with government and that can be difficult and frustrating."

- Tier 2: Mid-Career Epidemiologist talking about Evidence-Based Public Health Practice

"I think that just being in a bureaucracy, sometimes in and of itself, creates the barriers... [It] would be very helpful if we could somehow change that culture of the way we've always done it and it just kind of gets ingrained and then when you try to do something different, rethinking or re-imagining how you want to do something... it's frustrating sometimes..."

- Tier 2: Mid-Career Epidemiologist talking about Evidence-Based Public Health Practice

"Often we just get so much pushback from our IT department in terms of our informatics needs. Their perspective is often, "well, this has worked up until then, why do you need to change it? and, so their mindset is status quo, whereas our mindset is often trying to advance. And so, I guess in terms of helping that, maybe there's ways that epidemiologists and public health practitioners can work with IT departments to change that mindset."

- Tier 2: Mid-Career Epidemiologist talking about Informatics

"For me personally, what hinders me is what the agency expects and what the agency allows you to do because a lot of times [you get assignments] last minute and then you're trying to figure out how you're going to get this done... So that's what hinders you, you know, all the different people that are pulling at you..."

- Tier 2: Mid-Career Epidemiologist talking about Quality Improvement

Table 19. Role of State Health Department Epidemiologists in Emerging Areas of Public Health Practice Identified by Focus Group Participants

Area of Practice	Tier 1: Early-Career	Tier 2: Mid-Career	Tier 3: Senior-Career
Quality Improvement	Common to all tiers: <ul style="list-style-type: none"> • Interpret data 		
	<ul style="list-style-type: none"> • Collect data • Disseminate data • Develop and Implement Prevention and Control Activities 	<ul style="list-style-type: none"> • Analyze data • Disseminate • Data collection design 	<ul style="list-style-type: none"> • Collect data • Analyze data • Data collection design • Unclear role[¥]
Public Health and Healthcare Integration	Common to all tiers: <ul style="list-style-type: none"> • Disseminate data • Provide subject matter expertise 		
	<ul style="list-style-type: none"> • Analyze data • Use evidence • Communicate evidence • Educate healthcare community • Conduct investigations • Linkage to care • Unclear role[¥] 	<ul style="list-style-type: none"> • Analyze data • Interpret data • Communicate evidence • Educate healthcare community • Data collection design 	<ul style="list-style-type: none"> • Interpret data • Use evidence • Conduct investigations • Linkage to care • Engage and connect partners • Data collection design • Unclear role[¥]
Evidence-Based Public Health Practice	Common to all tiers: <ul style="list-style-type: none"> • Find evidence • Use evidence 		
	<ul style="list-style-type: none"> • Interpret data • Use data to inform policy • Communicate evidence • Provide subject matter expertise 	<ul style="list-style-type: none"> • Analyze data • Interpret data • Communicate evidence • Data collection design 	<ul style="list-style-type: none"> • Collect data • Analyze data • Create evidence • Develop and Implement Prevention and Control Activities
Health in All Policies	Common to all tiers: <ul style="list-style-type: none"> • Collect data • Disseminate data • Use data to inform policy 		
	<ul style="list-style-type: none"> • Analyze data • Use evidence • Policy analysis • Other: Advocate for good policy • Unclear role[¥] 	<ul style="list-style-type: none"> • Interpret data • Find evidence • Use evidence • Communicate evidence 	<ul style="list-style-type: none"> • Analyze data • Interpret data

Multisectoral Collaboration	Common to all tiers:		
	<ul style="list-style-type: none"> • Interpret data • Engage and connect partners 		
	<ul style="list-style-type: none"> • Disseminate data 	<ul style="list-style-type: none"> • Provide subject matter expertise • Other: Convene partners 	<ul style="list-style-type: none"> • Collect data • Analyze data • Disseminate data • Create evidence • Communicate evidence • Develop and Implement Prevention and Control Activities
Informatics	Common to all tiers:		
	<ul style="list-style-type: none"> • Data collection design 		
	<ul style="list-style-type: none"> • Collect data • Analyze data • Interpret data • Provide subject matter expertise 	<ul style="list-style-type: none"> • Liaison between IT department and program • Other: Advocate for informatics needs 	<ul style="list-style-type: none"> • Collect data • Engage and connect partners • Liaison between IT department and program • Provide subject matter expertise
Social Determinants of Health	Common to all tiers:		
	<ul style="list-style-type: none"> • Analyze data • Interpret data 		
	<ul style="list-style-type: none"> • Disseminate data • Data collection design • Engage and connect partners • Use evidence • Use data to inform policy • Develop and Implement Prevention and Control Activities • Other: Apply for funding 	No additional roles	<ul style="list-style-type: none"> • Disseminate data • Data collection design
Program Evaluation	Common to all tiers:		
	<ul style="list-style-type: none"> • Data collection design 		
	<ul style="list-style-type: none"> • Interpret data • Disseminate data 	<ul style="list-style-type: none"> • Collect data • Disseminate data 	<ul style="list-style-type: none"> • Collect data • Interpret data

IT: Information Technology

¥ Used when a participant stated that the role of epidemiologists / their role is not clear.

Table 20. Barriers for State Health Department Epidemiologists to Work in Emerging Areas of Public Health Practice Identified by Focus Group Participants

Area of Practice	Tier 1: Early-Career	Tier 2: Mid-Career	Tier 3: Senior-Career
Quality Improvement	Common to all tiers: None		
	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Time to do the work • Time for training • Organizational support – unspecified • Not involved at all • Competing priorities • Political barriers 	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Staffing challenges due to retention • Time to do the work • Organizational support – unspecified • Organizational support – to do the work • Not involved early • Clarity in partner roles • Competing priorities • Interest • Silos 	<ul style="list-style-type: none"> • Training opportunities – during academic program • Not involved at all • Not involved early • Knowledge • Relevant data
Public Health and Healthcare Integration	Common to all tiers:		
	<ul style="list-style-type: none"> • Time to do the work • Clarity in partner roles • Knowledge 	<ul style="list-style-type: none"> • Organizational support – to do the work • Funding to do the work • Competing priorities • Knowledge • Silos • Usability of the healthcare data • Data linkage challenges • Data sharing concerns 	<ul style="list-style-type: none"> • Funding to do the work • Clarity in partner roles • Competing priorities • Silos • Data linkage challenges • Data sharing concerns • Other: Many unspecified barriers
Evidence-Based Public Health Practice	Common to all tiers: None		
	<ul style="list-style-type: none"> • Time to do the work • Organizational support – to do the work • No established process or policy 	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Staffing challenges due to retention • Staffing challenges due to recruitment • Organizational support – unspecified 	<ul style="list-style-type: none"> • Time – unspecified • Time to do the work • Access to the literature • Political barriers • Other: Availability of relevant literature

	<ul style="list-style-type: none"> • Access to literature • Knowledge • Other: Staying current • Other: Mental space 	<ul style="list-style-type: none"> • Not involved early • Political barriers • IT department challenges • Relevant data 	<ul style="list-style-type: none"> • Other: High volume of literature to wade through 	
Health in All Policies	<p>Common to all tiers:</p> <ul style="list-style-type: none"> • Political barriers 	<ul style="list-style-type: none"> • Not involved at all • No established process or policy • Competing priorities 	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Organizational support – unspecified • Training opportunities – during academic program • Clarity in partner roles • Interest • Knowledge • Silos • Relevant data • Other: Culture of status quo 	<ul style="list-style-type: none"> • Funding to do the work • Not involved at all • Competing priorities • Silos • Relevant data • Data linkage challenges • Knowledge
Multisectoral Collaboration	<p>Common to all tiers: None</p>	<ul style="list-style-type: none"> • Organizational support – to do the work • Funding to do the work • No established process or policy 	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Staffing challenges due to retention • Time to do the work • Clarity in partner roles • Competing priorities • Knowledge • Silos • Interest • Data sharing concerns • Other: Loss of partner relationships • Other: Lack of existing partner relationships 	<ul style="list-style-type: none"> • Staffing challenges – unspecified • Staffing challenges due to recruitment • Time to do the work • Funding to do the work • No established process or policy • Interest • Knowledge • Other: Loss of collaboration continuity

Informatics	Common to all tiers:		
	<ul style="list-style-type: none"> • Knowledge 		
	<ul style="list-style-type: none"> • Time – unspecified • Time for training • Training opportunities – unspecified • Training opportunities – on the job • Training opportunities – during academic program • Silos • IT department challenges 	<ul style="list-style-type: none"> • Staffing challenges – Unspecified • Training opportunities – unspecified • Funding to do the work • Not involved early • Silos • IT department challenges • Inaccurate data • Other: Advocate 	<ul style="list-style-type: none"> • Staffing challenges due to recruitment • Time to do the work • Training opportunities – during academic program • Funding to do the work • Interest
Social Determinants of Health	Common to all tiers:		
	<ul style="list-style-type: none"> • Inaccurate data 		
	<ul style="list-style-type: none"> • Political barriers • Data linkage challenges 	<ul style="list-style-type: none"> • Staffing challenges due to recruitment • Training opportunities – during academic program • Funding to do the work • Relevant data • Usability of healthcare data • Data linkage challenges 	<ul style="list-style-type: none"> • Not involved at all • Silos • Relevant data • Usability of healthcare data • Other: Working at high-levels across agencies
Program Evaluation	Common to all tiers:		
	<ul style="list-style-type: none"> • Time to do the work 		
	No additional barriers	<ul style="list-style-type: none"> • Staffing challenges due to recruitment • Training opportunities – on the job • Training opportunities – during academic program • Not involved at all • Knowledge 	<ul style="list-style-type: none"> • Staffing challenges due to retention • Training opportunities – during academic program • No established process or policy • Knowledge

IT: Information Technology

¥ Used when a participant stated that the role of epidemiologists / their role is not clear.

Table 21. Facilitators for State Health Department Epidemiologists to Work in Emerging Areas of Public Health Practice Identified by Focus Group Participants

Area of Practice	Tier 1: Early-Career	Tier 2: Mid-Career	Tier 3: Senior-Career
Quality Improvement	<ul style="list-style-type: none"> • Staffing • Time to do the work • Time for training • Organizational Support • Funding • Learning from other programs • Learning from other people 	<ul style="list-style-type: none"> • Organizational support • Learning from other programs • Learning from other people • Organizational strategy • Other: Involve epidemiologists 	<ul style="list-style-type: none"> • Training - unspecified • Other: Involve epidemiologists earlier
Public Health and Healthcare Integration	<ul style="list-style-type: none"> • Best practices 	<ul style="list-style-type: none"> • Organizational support • Learning from other programs • Best practices • Organizational strategy 	None identified
Evidence-Based Public Health Practice	<ul style="list-style-type: none"> • Organizational support • Best practices • Organizational strategy 	<ul style="list-style-type: none"> • Organizational support 	<ul style="list-style-type: none"> • Best practices • Other: Access to literature • Other: Adjunct affiliation
Health in All Policies	<ul style="list-style-type: none"> • Other: Taking a broad, not health-centered approach 	<ul style="list-style-type: none"> • Organizational support 	None identified
Multisectoral Collaboration	None identified	<ul style="list-style-type: none"> • Organizational support • Other: Being proactive to have data on hand so easier to engage when partners are ready 	<ul style="list-style-type: none"> • Organizational support • Training on the job • Funding • Best practices • Learning from other programs • Supplemental epidemiology staffing programs • Other: Having shared goals and objectives • Other: Continuity of staff over time to support collaboration

Informatics	<ul style="list-style-type: none"> • Training – unspecified • Best practices • Organizational strategy 	<ul style="list-style-type: none"> • Other: Being involved early • Other: Strong relationship with IT department 	<ul style="list-style-type: none"> • Training – unspecified • Training on the job • Training during academic program
Social Determinants of Health	<ul style="list-style-type: none"> • Training – unspecified • Other: Good partner relationships • Other: Building trust in government to share sensitive information 	<ul style="list-style-type: none"> • Organizational support • Best practices • Training – unspecified • Other: More research 	No specific facilitators identified
Program Evaluation	<ul style="list-style-type: none"> • Best practices • Supplemental epidemiology staffing programs 	<ul style="list-style-type: none"> • Organizational support • Training – unspecified • Training on the job • Training during academic program • Learning from people • Other: Internal education for non-epidemiology staff 	<ul style="list-style-type: none"> • Staffing • Training on the job • Training during academic program • Funding • Learning from people • Organizational strategy

IT: Information Technology

¥ Used when a participant stated that the role of epidemiologists / their role is not clear.

CHAPTER 5: DISCUSSION

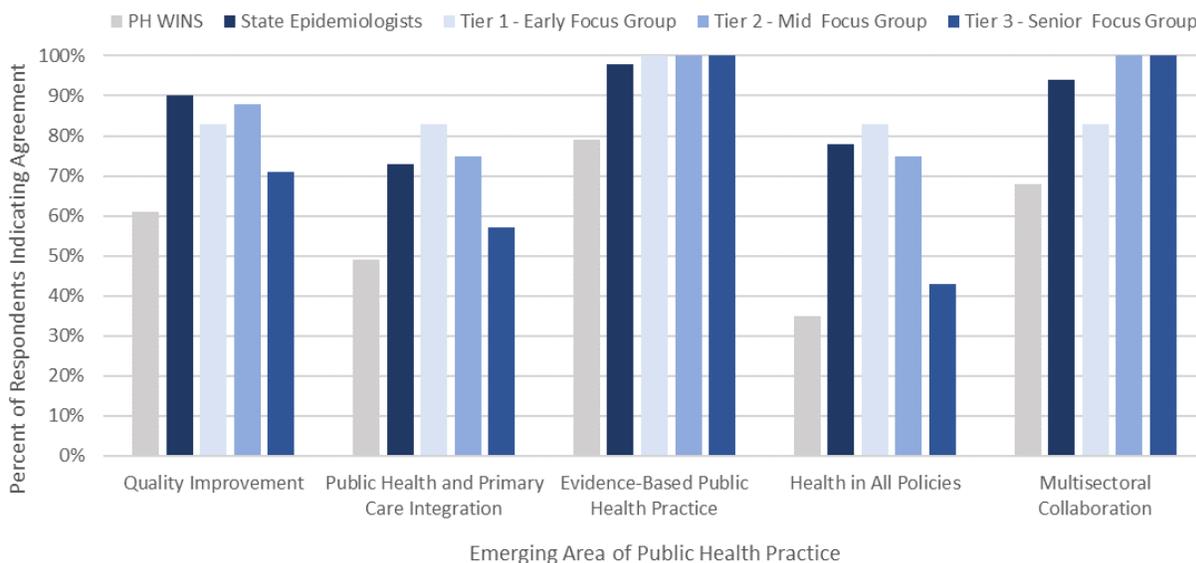
This research sought to answer the question: What is the role and readiness of state health department epidemiologists to work in emerging areas of public health practice? Two aims of this research were, therefore, to define the role of epidemiologists and their readiness, based on career stage, to work in emerging areas of practice. A third aim centered on understanding the use epidemiology career ladders to inform a plan for change to improve epidemiology practice in emerging areas of practice. In this chapter, the results of the three phases of research described extensively in the prior chapter are considered collectively and discussed in relation to each of the stated aims of this research and in consideration of existing literature. See [Table 22](#) for a summary of findings by each aim.

Key Findings in Relation to the Research Question and Aims

Aim 1. To define the role of state health department epidemiologists in emerging areas of public health practice.

Overall, participant state health department epidemiologists indicated that the studied emerging areas of public health practice were important to their work and that epidemiologists have some role in them. Broadly, focus group participants identified the role of epidemiologists in many areas of emerging public health practice as collecting, analyzing, interpreting and disseminating data; however, some additional roles were identified specific to certain areas of practice. In survey data across epidemiologist respondents in PH WINS, the state epidemiologist survey, and all three tiers / career stages of focus group participants, the two areas rated lowest in importance to their day-to-date work were public health and primary care integration and Health in All Policies. See [Figure 14](#).

Figure 14. Percent of Respondents Reporting the Emerging Area of Public Health Practice is Important to or Impacts the Day-to-Day Work of Epidemiologists



Note: PH WINS respondents were counted if they agreed or strongly agreed the area impacted their day-to-date work. Other respondents were counted if they reported the area was important or very important to their day-to-day work.

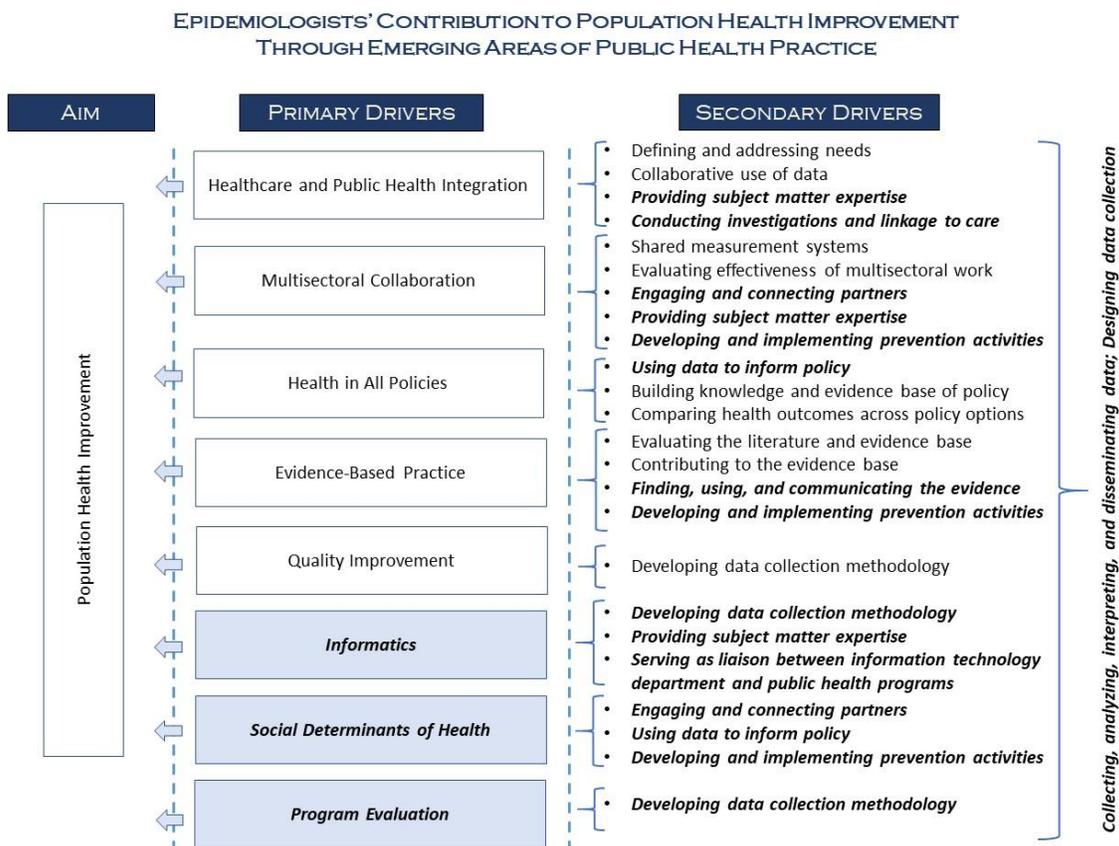
According to PH WINS participants, epidemiologists working in state health department central offices reported hearing the most about evidence-based public health practice and also reported this area impacted their work the most. This area was also rated as important or very important by the greatest number of state epidemiologists and focus group participants. Evidence-based public health practice is the concept that public health practitioners should use the best scientific evidence available when designing and selecting public health interventions and policies (Brownson et al., 2009). Given epidemiologists' training in study designs and critically evaluating scientific literature, it is not surprising that epidemiologists report this area is of greatest importance and impact to their day-to-day work. Epidemiologists can contribute to public health initiatives by critically reviewing literature to identify promising evidence-based practices for implementation. Epidemiologists can also help contribute to the evidence base by using their skill sets to evaluate and document the impact of public health programs. These roles were validated by focus group participants.

According to PH WINS participants, most epidemiologists working in state health department central offices also reported hearing a little or a lot about quality improvement and multisectoral collaboration, and among those with some awareness, most felt they impacted their daily work. They also reported hearing a little or a lot about public health and primary care integration; however, among those with some awareness, most felt public health and primary care integration did not impact their work. This area was also an area that focus group participants expressed some lack of clarity in the role of epidemiologists.

According to PH WINS participants, epidemiologists working in state health department central offices reported hearing the least about Health in All Policies and among those with awareness, 65% felt it had little to no impact on their daily work. Health in All Policies is an approach to improving population health by addressing the social determinants of health through policy (Rudolph et al., 2013). This concept is closely related to, and often requires, multisector collaboration. Given the relationship between Health in All Policies and multisector collaboration, and the observation that most epidemiologists reported multisector collaboration impacted their work, it is surprising that epidemiologists did not report greater impact of Health in All Policies to their work. Policy development involves analyzing and interpreting relevant data to identify potential policy solutions to address health problems (Bardach, 2016). This activity aligns with data analysis functions that epidemiologists perform. There may be an underappreciation for the role that epidemiologists can play in Health in All Policies work because this area of practice is still emerging and knowledge of the area was lowest among all assessed, with 24% of epidemiologists working in state health department central offices reporting they had not heard much and 41% reporting they had not heard at all about this area. Focus group participants confirmed that most epidemiologists are not currently engaged at all in Health in All Policies activities but theoretically expressed that they believe there is a role for epidemiologists to provide data and evidence to support policy and to evaluate the impact of policies on health.

In the PH WINS analysis, responses related to emerging areas of public health practice did not significantly differ by supervisory status. Some significant differences were noted by experience and highest degree earned; however, no clearly defined pattern emerged and further exploration to better understand these results is recommended. Comments made by focus group participants across the three career stages largely reflected similar perspectives in terms of roles, with some differences. In general, early-career epidemiologists had a more personalized, or inward, perspective of the various areas, whereas the mid-career and senior-career epidemiologists tended to express a broader, more systems, perspective. In consideration of the data collected in this research, the population health driver diagram presented in Chapter 1 (Figure 1) has been updated to include additional roles for epidemiologists in emerging areas of public health practice (see Figure 15). This figure depicts drivers related to epidemiology workforce competency.

Figure 15. Updated Population Health Driver Diagram

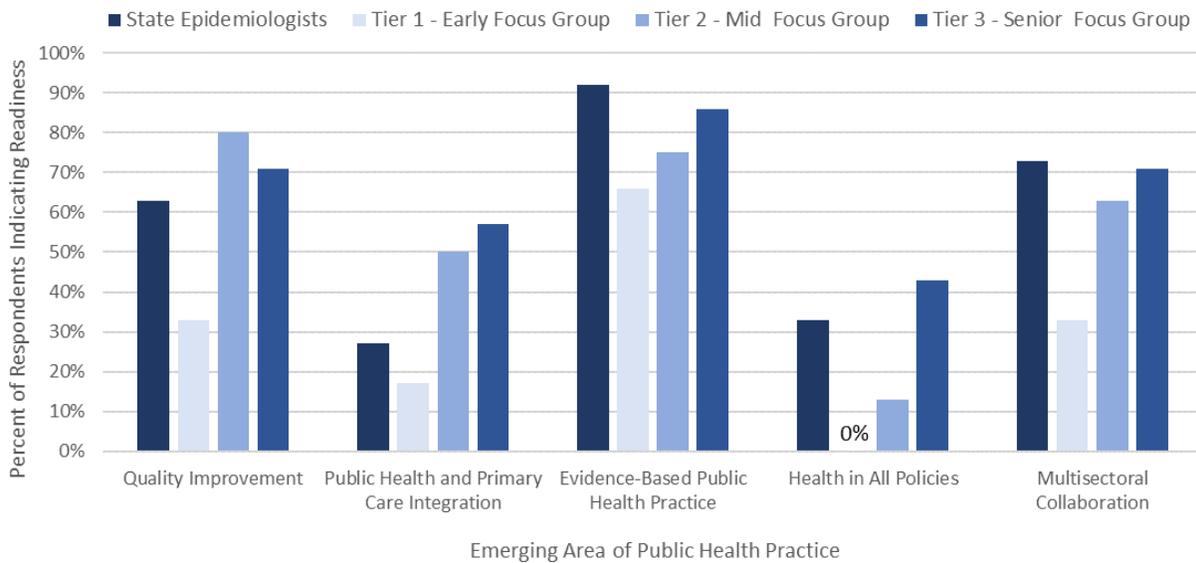


Note: Changes from the initial diagram are italicized in bold.

Aim 2. To assess self-reported competency of state health department epidemiologists and identify differences in self-reported relevancy, competency, and training needs relative to working in emerging areas of public health practice based on "tier" (entry-, mid-, senior-level) of epidemiologist to inform workforce development activities.

In survey data across epidemiologist respondents in PH WINS, the state epidemiologist survey, and all career stages of focus group epidemiologists, the two areas rated lowest in readiness were public health and primary care integration and Health in All Policies, which were also the two areas rated lowest in importance. In general, Tier 1: Early-Career epidemiologists rated readiness to work in emerging areas of public health practice lower than Tier 2: Mid-Career and Tier 3: Senior-Career epidemiologists; State epidemiologists rated readiness generally higher than the focus group participants. Readiness to work in these areas was not assessed in PH WINS. See [Figure 16](#).

Figure 16. Percent of Respondents Reporting that Epidemiologists Are Ready or Very Ready to Work in the Emerging Area of Public Health Practice



Note: PH WINS data are not included because readiness to work in these areas was not assessed in PH WINS 2017. Other respondents were counted if they reported being ready or very ready to work in the area of practice.

While the purpose of this research was to examine emerging areas of public health practice, the National Consortium for Public Health Workforce Development has suggested there are a key set of “strategic skills” that public health professionals need in order to work in all areas of practice (NCPHWD, 2017). These strategic skills include:

- Systems thinking;
- Change management;
- Persuasive communication;
- Data analytics;
- Problem solving;
- Diversity and inclusion;
- Resource management; and
- Policy engagement.

Because many of the emerging areas of practice studied in this research are related, and the roles epidemiologists play in some of the areas are similar, it is true that building skills in key areas would be expected to support epidemiologists’ participation in a number of different practice areas. Therefore, focusing training and development efforts on cross-cutting “strategic” skills is likely an effective approach, though this is an area where future practice-based research would be valuable.

PH WINS allowed for assessing gaps and training needs related to the strategic skills identified by the National Consortium for Public Health Workforce Development. Not surprisingly, the most important skills to epidemiologists working in state health department central offices were the ability to collect and use valid data to drive decision making. The skill gaps assessment, which examined skills reported as high impact but low skill ability, identified the greatest training needs in the areas of systems and strategic thinking and budget and financial management across non-supervisors, supervisors, managers, and executives. This finding may reflect the environment of constrained resources that epidemiologists work in and their appreciation for the need to be strategic in resource

allocation in order to do the work of epidemiology. Analysis of the larger PH WINS dataset of all health department employees identified similar skill gaps and training needs [Bogaert K et al., 2019], suggesting that these needs reach across occupation types in the public health workforce and are not unique to epidemiologists. While the domains with the greatest skill gaps are similar among epidemiologists working in state health department central offices and the larger public health workforce, the estimated percentage of epidemiologists reporting skill gaps in each domain were lower across all domains, which may be a reflection of the high number of epidemiologists with master's and doctoral degrees (94%). In contrast to the larger public health workforce, significant differences in skill gaps by supervisory status among epidemiologists working in state health department central offices were not observed, except for the skill domain of using data for decision-making. This may reflect a true absence of association between supervisory status and skill gaps or it could be attributable to the fact that the majority of skill gap differences identified in the larger public health workforce were between executives and non-supervisors, and executives and supervisors or managers. The subgroup of epidemiologists working in state health department central offices only contained an estimated eight executives, so managers and executives were combined for analyses in this study, which, coupled with the small number of executives, likely limited the ability to detect significant differences between executives and non-executives.

In addition to information on knowledge of emerging areas of public health practice and skill gaps, PH WINS provided other general information on epidemiologists that can be useful to inform workforce development activities. The overall number and general demographic profile of epidemiologists working in state health department central offices in 2017 was similar to those reported in the 2014 PH WINS deployment [Chapple-McGruder et al., 2017]. While epidemiologists working in state health department central offices in the United States are largely academically well-prepared, with 94% having master's and/or doctoral degrees, a number of important areas for further professional development were

identified to address training and workforce gaps to improve epidemiology practice. Overall, job satisfaction and feeling engaged in their work was high (>80%) among epidemiologists working in state health department central offices, although 29% reported that they were considering leaving their job within the next year; while not among the most common reasons, 16% reported lack of training as a reason for considering leaving. As a subgroup, epidemiologists with 16 or more years of work experience reported significant differences in their experience and beliefs around training. These epidemiologists were less likely to report that their training needs were assessed and that their supervisor provides them with opportunities to demonstrate leadership. They were also less likely to be motivated by most of the training motivators listed by epidemiologists with 5 or fewer years of experience. These results suggest that employers may need to better assess the training needs of senior epidemiologists and develop specialized approaches and professional development opportunities to meet the needs of these members of their epidemiology workforce.

In focus groups, participant state health department epidemiologists were able to identify both barriers and facilitators that can be used to improve readiness to work within the studied emerging areas of public health practice. Key findings for action identified from the focus group sessions are reviewed below.

Career Stage Differences

Comments made by focus group participants across the three career stages largely reflected similar perspectives in terms of barriers, and facilitators overall. However, some differences were noted. In general, early-career epidemiologists had a more personalized, or inward, perspective of the various areas, whereas the mid-career and senior-career epidemiologists tended to express a broader, systems, perspective. For example, when barriers were discussed, early-career epidemiologists often spoke of lack of training and barriers within their organization. Mid- and senior-career epidemiologists often spoke of external barriers with partners or from the perspective of their teams and subordinate staff.

The feelings of negativity expressed by mid-career epidemiologists about the bureaucracy and environment they work within was also a difference noted across focus groups. This theme may have emerged due to the influence of one or two participants; however, this finding aligns with some of the observations made from the PH WINS analysis in regards to findings of reduced perception of engagement, motivation, and job satisfaction among epidemiologists with 16 or more years of experience. Employers may need to develop specialized approaches and professional development opportunities to meet the needs of these members of their epidemiology workforce.

Lack of Epidemiologist Engagement

For many emerging areas of practice, focus group participants identified the challenge of not being involved at all (e.g. Health in All Policies) or early enough (e.g. quality improvement, informatics). If these are emerging areas of public health practice that are truly important approaches to improving population health, epidemiologists represent a key part of the public health workforce and should be included on teams working in these areas of practice. In particular, data collection design is one major challenge identified in regards to not being engaged early enough. Participants described numerous experiences with being engaged in a project only after the data were collected when it was too late to improve the quality and utility of the data. Participants emphasized the importance of engaging epidemiologists very early in the process so that their expertise in data collection and analysis can be leveraged to achieve the best result possible and improve the value of the data collected.

Resource Needs

Focus group participants identified key barriers across many of the emerging areas of public health practice related to lack of resources, such as time, staffing, and funding. Some of the work in these areas was described as “extra” or “add-on” responsibilities that are sometimes outside the scope of grant requirements, which dictate much of the activities in state health departments due to heavy reliance on grant-funding. When it is difficult

enough to carry out core public health functions on a day-to-day basis and respond to various public health emergencies when they arise, it is even more challenging to take on the sometimes “extra” work of engaging with healthcare, non-health sector partners, keeping on top of current evidence, creating and publishing new evidence, designing and implementing quality improvement processes, conducting non-required program evaluation activities, and working to address social determinants of health. For any of these areas to be truly institutionalized within public health practice, more resources will be necessary to allow for them to be implemented with high-quality. Furthermore, once resources are available, their use to integrate these practices within the organization will need to be prioritized, which will require a commitment to organizational change.

Training Needs

Focus group participants identified two primary areas for which additional training opportunities would be beneficial: informatics and program evaluation. Both of these areas shared similar features in that most epidemiologists reported that, for the most part, these topics were not adequately addressed in academic training programs. In addition to training in academic programs, participants indicated more on-the-job training was needed, especially for informatics. While there was recognition that some epidemiologist positions require more informatics knowledge than others, most agreed that all epidemiologists need some basic-level understanding of informatics in order to effectively perform their work carrying out surveillance and data analysis functions.

Learning from Others

Focus group participants identified learning from both other people and other programs as facilitators to working in emerging areas of public health practice. For example, more than one participant mentioned learning about program evaluation from a program evaluator contractor or staff member and that having a professional resource to go to for such support was helpful. Participants noted that there is sometimes unequal implementation of these practice areas across epidemiology program areas so the ability to

share and learn from others outside of their own program area is helpful. For example, some federal funding areas emphasize program evaluation (e.g. CDC's STD and tuberculosis prevention cooperative agreements) and provide specialized resources and training that are not offered in other program areas. Creating opportunities within and outside of organizations to enable this learning and sharing was recommended by participants. Such opportunities could come in the form of communities of practice (CoP) aimed at capacity building and sharing of best practice, either within state health departments or more broadly through professional organizations, such as CSTE, which already hosts a number of CoP-like committees and workgroups. Other opportunities could include cross-training within organizations and implementing other capacity building activities specific to the area of practice (see Leveraging Strategy below).

Organizational Support

Focus group participants identified a number of barriers to working in emerging areas of practice related to lack of organizational support, in particular, the importance of having support from the organization's leadership. Comments from participants focused on providing epidemiologists dedicated and protected time to work in these areas as well as time to participate in related training. Additionally, one specific facilitator identified as being helpful was identification of "champions" within the organization's leadership that could promote the importance of, and participation in, the area of practice. This champion could be used internally with state health department staff and externally to engage partners.

Leveraging Strategy

Focus group participants identified some barriers to working in emerging areas of practice related to lack of organizational strategy. Typically, participant comments referenced silos and different programs working in the areas in different ways or with different partners without coordination. There are many evidence-based frameworks that could be useful by state health department leadership in implementing these various areas of practice. Several of the emerging areas of practice have their own frameworks from

which to operate that can be leveraged by state health departments to assure they are operating from a proven strategy.

In regards to quality improvement there are numerous technical tools and methods for carrying out this work. Additionally, there have been a number of initiatives around institutionalizing a culture of quality improvement in public health agencies to learn from since quality improvement was incorporated as one of the 12 domains (Domain 9) in the Public Health Accreditation Board's standards and measures (PHAB, 2013). More recent examples include the Robert Wood Johnson Foundation's Communities of Practice for Public Health Improvement and the CDC's National Public Health Improvement Initiative (NPHII) (McLees et al., 2015). The healthcare sector also offers established evidence-based frameworks for quality improvement capacity-building, such as those developed by the Institute for Healthcare Improvement (McGrath et al., 2018).

One of the most well-known frameworks for public health and healthcare integration work is *The Practical Playbook* (Practical Playbook, 2015). *The Practical Playbook* provides guidance on implementing integration projects for healthcare and public health organizations and is based on the core principles that lead to successful integration initiatives identified in the IOM's report *Primary Care and Public Health: Exploring Integration to Improve Population Health* (IOM, 2012). *The Practical Playbook* organizes the process of developing and implementing an integration initiative into five steps: organize and prepare, plan and prioritize, implement, monitor and evaluate, sustain (Practical Playbook, 2015).

In regards to program evaluation, there is a significant existing body of literature available already regarding capacity building and institutionalizing program evaluation within an organization. In general, it is important for organizations to commit to the topic, to identify a "focal point" for evaluation leadership, and to create a "culture of evaluation" by training their workforce and sharing evaluation information throughout the organization (Milstein, 2002; Hoole & Patterson, 2008; Kidder et al., 2018).

The area of multisectoral collaboration also has established frameworks from which to implement population health improvement initiatives. One of the most well-known frameworks in recent use is the collective impact model, which is specifically touted as an approach for collaboration across sectors. The model aims to leverage partners, eliminate duplication of efforts, and benefit from sharing of best practices and lessons learned through strong coordination (Kania & Kramer, 2011). The key components of the model include a common agenda, shared measurement, mutually reinforcing activities, continuous communication, and backbone support (Kania & Kramer, 2011). A 2017 study examining 25 collective impact initiatives documented the effectiveness of this approach on contributing to change in the initiatives' target populations or environments (SPI & ORS Impact, 2018).

While not studied in this research, one emerging area of practice that could offer valuable strategic support to public health practitioners in implementing any initiative is implementation science. Implementation science provides evidence-based information on what factors have been demonstrated in the literature to lead to successful implementation (Durlak & DuPre, 2008). There are a variety of implementation frameworks that provide principles and strategies to support effective implementation and could be useful to applied epidemiologists and state health department leadership as they carry out the work of public health in a number of areas, such as public health and healthcare integration, multisectoral collaboration, informatics, and addressing the social determinants of health. Implementation science is an emerging field, however, and like the other emerging areas of practice, it is likely that significant training and resources would need to be provided in order for state health departments to effectively leverage it.

Finally, while not studied in this research, systems science is another emerging practice area that could be valuable to public health practitioners in strategically engaging in many of the studied emerging areas of public health practice. In particular, systems thinking tools and approaches could be particularly helpful in working in the areas of quality improvement, public health and healthcare integration, multisectoral collaboration,

informatics, and addressing the social determinants of health. Several of these areas have complex interactions between individuals, partners, communities, and their natural, built, and social environments and therefore would benefit from more of a systems-based, coordinated approach.

Data to Action

Focus group participants described the role of epidemiologists in many of the emerging areas of public health practice in ways that are consistent with traditional functions of epidemiologists, such as collecting, analyzing, interpreting, and disseminating data. However, many of these emerging areas of practice call upon the epidemiologist to move beyond the dissemination of data alone to take the next step of “doing” something with the data to improve the health of the population. In academia and among research epidemiologists, there have been calls to make epidemiology more “consequential,” meaning that epidemiologists should move beyond research that describes health conditions, to identify effective interventions and policies that can improve health (Galea S, 2013). Similarly, in public health practice, epidemiologists are being called upon in recent years to engage more fully in “Data to Action” initiatives to use data for public health action to improve health.

Epidemiologists can help to design data collection processes, collect and analyze data, and interpret and disseminate data to support the emerging areas of public health practice studied in this research. Participants reported being the least engaged in Health in All Policies work. Policy development involves analyzing and interpreting relevant data to identify potential policy solutions to address health problems, an activity that aligns with functions that epidemiologists perform. Therefore, this research suggests there may be an underappreciation for the role that epidemiologists can play in policy development.

Aim 3. To understand how epidemiology career ladders are used in state health departments to define the role of epidemiologists, to incorporate applied epidemiology competencies, and to inform workforce development activities.

Most jurisdictions (n=36; 74%) with job classification systems reported having epidemiology career ladders in use. State epidemiologists generally felt that career ladders positively contributed to recruitment and retention of epidemiologists in their agency. Most of the career ladders were not developed based on the AECs and only 10 (29%) jurisdictions reported using the AECs to develop or revise their jurisdiction's epidemiology career ladder.

The emerging areas of practice most commonly referenced in epidemiology classifications used in state health departments were evidence-based public health practice (90%) and informatics (60%). Program evaluation and quality improvement were referenced in about 1/3 of classifications. Social determinants of health (18%) and engaging in policy work (13%) were less commonly referenced and no classifications included references to public health and healthcare integration, Health in All Policies, or multisectoral collaboration. The lack of reference to public health and healthcare integration and Health in All Policies in epidemiology classifications mirrors the lower perceptions of importance and epidemiologists' reported lack of engagement in these areas. In general, reference to the emerging areas of practice increased as career stage advanced. The only exception was informatics, which was most commonly referenced in mid-career classifications.

Epidemiology career ladders in state health departments are used to allow for a system of career progression that reflects increasing technical expertise, scope of authority, and often increasing supervisory responsibility. There is likely additional opportunity to more clearly incorporate competencies related to emerging areas of public health practice progressively within the AECs. In turn, incorporation of the revised AECs into formal epidemiology classifications within public health agency job classification systems can support hiring, retention, and succession planning efforts that improve the ability of epidemiologists to work in emerging areas of public health practice.

Table 22. Summary of Findings by Stated Aim

Research Question
What is the role and readiness of state health department epidemiologists to work in emerging areas of public health practice?
Aims
Aim 1. To define the role of state health department epidemiologists in emerging areas of public health practice.
<u>Key Findings:</u> <ul style="list-style-type: none">• Participants indicated that all studied emerging areas of public health practice were important to their work and that epidemiologists have some role in them.• Participants identified the role of epidemiologists in many areas of emerging public health practice as collecting, analyzing, interpreting and disseminating data.<ul style="list-style-type: none">◦ Additional roles were identified specific to certain areas of practice.• Participants reported hearing the most about evidence-based public health practice and also reported this area impacted their work the most.• The two areas rated lowest in importance to their day-to-date work were public health and primary care integration and Health in All Policies.
Aim 2. To assess self-reported competency of state health department epidemiologists and identify differences in self-reported relevancy, competency, and training needs relative to working in emerging areas of public health practice based on “tier” (entry-, mid-, senior-level) of epidemiologist to inform workforce development activities.
<u>Key Findings:</u> <ul style="list-style-type: none">• The two areas participants rated lowest in readiness were public health and primary care integration and Health in All Policies, which were also rated lowest in importance.• The most important skills to epidemiologists working in state health department central offices were the ability to collect and use valid data to drive decision-making.• The skill gaps assessment examining skills reported as high impact but low skill ability identified the greatest training needs in the areas of systems and strategic thinking and budget and financial management.• Mid- and senior-career epidemiologists have lower perceptions of engagement, motivation, and job satisfaction.• Leveraging existing frameworks and providing cross-cutting skills development could support epidemiology practice in emerging areas.

Aim 3. To understand how epidemiology career ladders are used in state health departments to define the role of epidemiologists, to incorporate applied epidemiology competencies, and to inform workforce development activities.

Key Findings:

- Most jurisdictions (n=36; 74%) with job classification systems reported having epidemiology career ladders in use.
 - Most of the career ladders were not developed based on the AECs.
- Evidence-based public health practice (90%) and informatics (60%) were most commonly referenced in state health department epidemiology classifications.
- None of the state health department epidemiology classifications reviewed included explicit reference to public health and healthcare integration, Health in All Policies, or multisectoral collaboration.
- State epidemiologists reported that job classification systems that include epidemiology-specific classifications and career ladders support hiring and retention efforts in state health departments.

Limitations of the Findings

This study was subject to several limitations. First, in Phase 1, the PH WINS data set, which serves as the primary source of quantitative data, was collected for a broader purpose than assessing the epidemiology workforce, specifically. As such, what the PH WINS survey has included for emerging areas of public health practice may not be as relevant to epidemiologists, or alternatively, could be missing key emerging areas of practice that would be more relevant to epidemiologists. This limitation was mitigated through the state epidemiologist survey and focus groups in phases 2 and 3 of the research during which participating epidemiologists had the opportunity to provide feedback on the areas listed in PH WINS as well as offer new areas not included in PH WINS. Second, while nationally-representative, the results may not be reflective of the states or employees who did not participate in the survey. Third, there may be public health professionals who function as an epidemiologist but who self-identified as working in a non-epidemiologist job category and are therefore not included in this analysis. For example, we identified 273

respondents working in state health department central offices who reported working in the “Epidemiology and Surveillance” program area but who did not self-identify as an “Epidemiologist.” It may be that these individuals perform other functions in the program, such as performing administrative tasks, although it is also possible that they perform epidemiology functions and are not captured in this analysis. However, the number of epidemiologists working in state health departments estimated in 2017 PH WINS is reasonably consistent with the 2017 enumeration of state health department epidemiologists carried out by CSTE, which identified 3,300 (Arrazola J et al., 2018). A fourth important limitation of the PH WINS survey is that epidemiologists are not categorized specifically according to the AEC career stages. The survey responses regarding highest degree obtained, years’ experience, and supervisory status was used to approximate career stage. Finally, collected data were self-reported and results are subject to the limitations inherent in a cross-sectional survey, namely that cause and effect relationships between variables cannot be clearly established.

In Phase 2, the potential limitation of poor response rate from state epidemiologists was mitigated through CSTE’s support of the research and reminders and follow-up with invited participants. Ultimately, a 100% response rate was achieved. An additional limitation of Phase 2 is that the survey collected information about the jurisdiction from a single individual, which may not be reflective of the perspectives of others within the jurisdiction. The survey was also subject to the limitations of other surveys, such as potential issues with recall, accuracy, and completeness of the data.

The primary potential limitation of focus groups conducted in Phase 3 was that a focus group session can become influenced by one or two vocal participants and not reflect the true opinions of the remaining group members. This potential limitation was mitigated by using best practices to moderate the focus group. An additional limitation in Phase 3 is that focus group participation was recruited through the CSTE membership, which may not be representative of all epidemiologists working in state health departments. This limitation

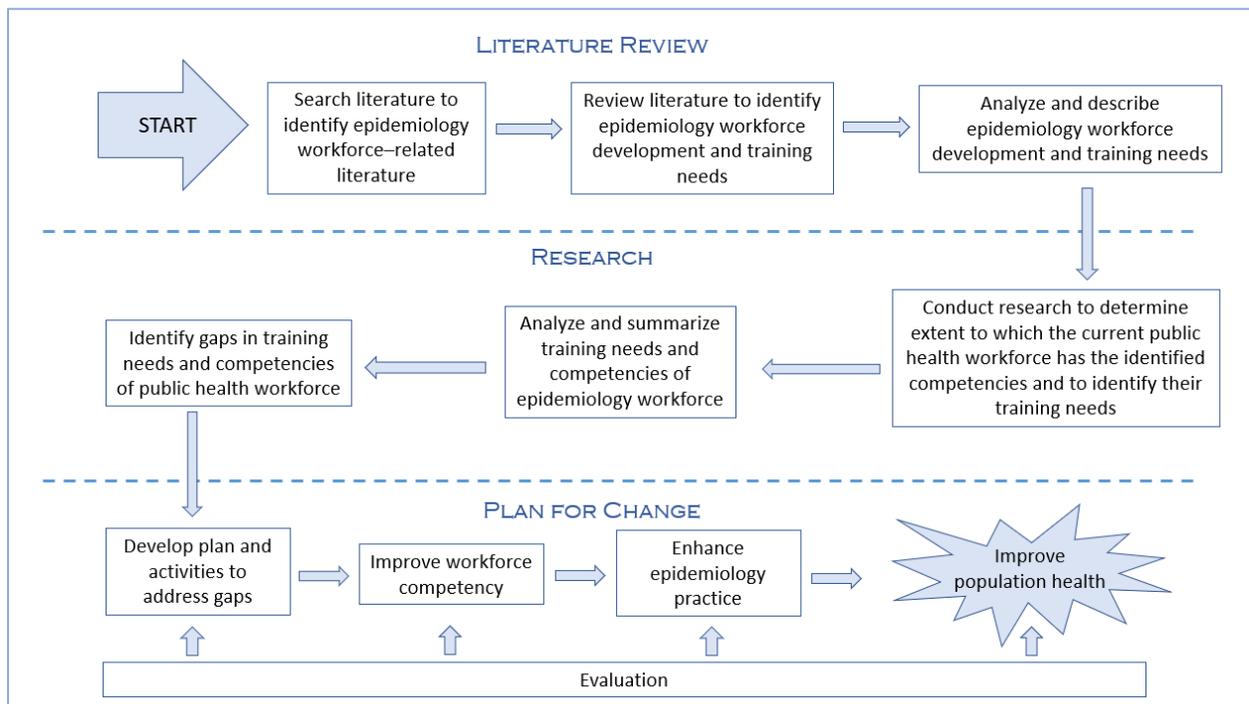
was mitigated by noting in the recruitment email that CSTE membership was not required to participate.

The AECs were used throughout this research and some limitations were noted in their ability to be applied for research purposes. The AECs were not necessarily designed for research purposes and research is not one of the stated intended purposes (CSTE, 2008). As one example, a limitation noted in this research was that the AEC tier descriptions do not account for all possible combinations of education and experience so it was not possible to assign AEC tiers to all participants in this study strictly according to the AECs. The authors of the AECs clearly state that they did not intend for the categories to be rigid definitions, but instead, to serve more as guidelines to describe the typical epidemiologist and their functions at each tier (CSTE, 2008). In this research, the AEC tiers (i.e. function level) were used as proxy for career stage; however, as the research progressed it became clearer that these are different concepts with different workforce implications that could be further clarified within the AECs, depending on their intended purpose. For example, among focus group participants who were asked to self-classify according to the AECs, many of those who classified themselves as mid-career met the AEC criteria for senior-level epidemiologist. The AEC tier descriptions require a relatively low number of years' experience and are more likely reflecting skill-level rather than career stage. If the AECs are not addressing career stage, then there would remain a need for a framework of skills and functions by career stage to guide workforce development activities. Future iterations of the AECs could address this distinction in such a way that they could possibly meet both needs.

CHAPTER 6: PLAN FOR CHANGE

The findings of this research were considered within the larger context of public health practice to formulate a plan for change with the goal of improving population health. This dissertation research aligns with the National Research Agenda for Public Health Services and Systems published in 2012 (PHSSR, 2012). The described research agenda was grouped within four domains: workforce, public health system structure and performance, financing, and information and technology (PHSSR, 2012). Specifically, this research aligns with the recommendations to research the size and composition of the public health workforce, how it changes over time, and how skills and competencies of the workforce impact population health. The ultimate goal of this dissertation research is to improve population health through a competent state health department epidemiology workforce as described by the process depicted in [Figure 17](#). The literature review provided a foundational knowledge of the history and prior and current issues related to the state health department epidemiology workforce. The gaps and areas for future research identified in the literature review led to a specific research question that was pursued through data collection and analysis of workforce survey data and focus groups with epidemiologists. The results of this study were interpreted within the context of existing public health and epidemiology workforce skills and competencies to determine what skills or competencies state health department epidemiologists need to successfully perform within the emerging areas of public health practice. Finally, the following plan for change is proposed to enhance state health department epidemiology practice to ultimately improve population health.

Figure 17. Process to Improve Population Health Through a Competent Public Health Epidemiology Workforce

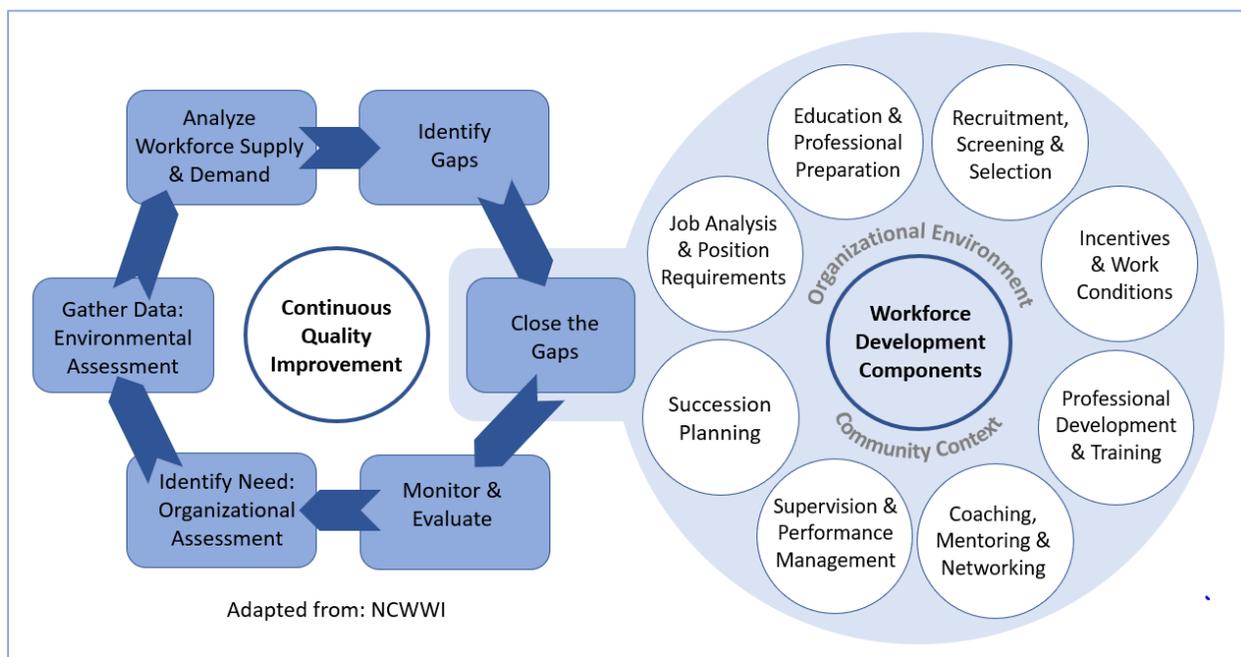


Framework

The workforce development framework developed by the National Child Welfare Workforce Institute (NCWWI) in 2015 (NCWWI, 2015) was used to guide the development of a plan for change to improve the state health department epidemiology workforce’s readiness to work in emerging areas of public health practice, as directed by the findings of this study.

Although NCWWI developed the framework for use in child welfare agencies, it was developed after a comprehensive review of the workforce development literature across multiple sectors (NCWWI, 2015). This framework places emphasis on assessment and monitoring of the workforce and then using workforce development concepts to address the identified gaps (see [Figure 18](#)).

Figure 18. Modified Workforce Development Framework



The left side of [Figure 18](#) reflects the workforce assessment process, some of which was carried out during this study. The right side of [Figure 18](#) reflects the workforce development components that can be used to address workforce gaps and needs. For the purpose of this study, the NCWWI’s framework has been modified to include two additional workforce development components, “succession planning” and “coaching, mentoring, and networking”. Additionally, the framework was designed primarily for use by individual agencies so there was emphasis on leadership and the vision, mission, and values of the organization being considered throughout the workforce development process. Because this study is focused on the epidemiology workforce in the United States and not at one agency, the emphasis on vision, mission, and values was removed and “organizational environment” and “community context” were moved from stand-alone workforce development components to the center where they serve as cross-cutting elements applicable to all workforce development components.

Recommendations

In consideration of all three phases of data collection, recommendations to improve readiness and workforce capacity to work within the studied emerging areas of public health practice are offered below. Not all of these recommendations will be incorporated into the Implementation Plan but they are captured here to help inform potential future activities and research. See [Table 23](#) for an abbreviated summary of recommendations.

1. Increase Resources to Support Delivery of Public Health Services

The top barriers identified to working in emerging areas of public health practice centered around lack of time, staff, and other resources. For epidemiologists, and public health more broadly, to fully engage in these areas with success, more resources will be necessary.

- a. Increase and diversify public health funding. State health departments rely heavily on federal funding. According to the 2017 ECA, more than three quarters (77%) of epidemiology positions and epidemiology activities were reported as federally-funded (Arrazola et al., 2018). This reliance on federal funding not only indicates there is a lack of overall funding to support the public health infrastructure in the United States, but, as participants described in this research, federal funding limits flexibility of health departments to set their own priorities and to engage in activities and areas of practice that are outside the scope of federal grant activities. These challenges are not newly identified in this research. This research confirms these issues continue to be challenges and that they affect epidemiologists' ability to engage in emerging areas of practice. However, the issue of lack of funding is not easy to address, especially given the various governments involved in funding the United States public health infrastructure as a whole. In its 2017 ECA report, CSTE recommended we learn from states that receive the most state funding to support epidemiologic activities to see if there are any useful strategies for how to approach decision-making bodies around funding (CSTE, 2018). Any promising practices could be replicated in other jurisdictions in an attempt

to increase state funding for public health services. Professional organizations, such as CSTE and ASTHO, should also continue to advocate for adequate funding of public health agencies through their advocacy efforts at the national level on behalf of their membership.

- b. Increase number of epidemiology positions. In responding to the ECA, state epidemiologists expressed significant unmet need for epidemiology staffing, reporting that an additional 1,200 epidemiologists are needed to reach full capacity to provide the Essential Public Health Services of monitoring health, investigating health problems and hazards, evaluation, and research (Arrazola et al., 2018). The ECA suggests there are already currently not enough epidemiology positions in state health departments.
- c. Address epidemiologist recruitment and retention challenges. On top of the challenge of insufficient number of epidemiologist positions, participants in this research expressed additional challenges with recruitment and retention for the positions that do exist, compounding the already existing and significant barrier of lack of staffing resources to engage in emerging areas of public health practice. Again, these challenges are not newly identified in this research. This research confirms these issues continue to be challenges and that they affect epidemiologists' ability to engage in emerging areas of practice. Recommendations to address recruitment and retention challenges are addressed below in the section on workforce development strategies.
- d. Continue support for supplemental epidemiology staffing placement programs. Federal funders should continue support for supplemental epidemiology staffing placement programs, such as CDC's Epidemic Intelligence Service, CDC's Career Epidemiology Field Officer Program, CSTE's Applied Epidemiology Fellowship Program, etc.
- e. Increase access to the peer-reviewed literature. As the basic core science of public health, evidence-based practice is central to epidemiology. Epidemiologists must be able to access evidence, and in particular, the peer-reviewed literature. According to the 2017 ECA, only 47% of states can access literature within 24 hours, and 27% have

no access to the literature at all; the remaining 26% can access literature but with a delay of 24 -72 hours or longer (CSTE, 2018). State health departments should look to partner with educational institutions or other entities to gain access to literature for employees. Other options for group discount or purchase may be available through professional associations or other entities. It would be helpful for states with literature access to share with their peers how they have gained such access.

- f. Increase and improve access to information technology resources. As more and more electronic health data becomes available, significant investment in the public health informatics infrastructure will be necessary in order for public health agencies to effectively leverage these data and use them in public health initiatives. Currently, public health data systems are outdated and have significant challenges communicating with one other and with other healthcare data systems (CSTE, 2019). In 2019, CSTE along with the Association of Public Health Laboratories, National Association for Public Health Statistics and Information Systems, and the Healthcare Information & Management Systems Society launched a major data strategy campaign aimed at securing \$1 billion over the next decade to modernize the United States public health surveillance infrastructure (CSTE, n.d.b). The campaign calls for the funds to be used not only to directly support technology, but also to fund public health workforce development initiatives, such as training, fellowships, and student loan repayment programs to help address recruitment and retention challenges.

2. Implement Workforce Development Strategies

In addition to generally increasing resources, the following recommendations are suggested to address workforce gaps and needs and are framed within the workforce development components developed by NCWWI (2015) and depicted in [Figure 18](#).

a. Job analysis and position requirements

Description: Review and analysis of job tasks and responsibilities, and understanding of the knowledge, skills, and abilities required to perform those tasks. This includes

defining minimum and desired qualifications and how the position is classified within an organization's career system (NCWWI, 2015).

Recommendations: Recommendations related to job analysis and position requirements include the following:

1. Implement use of epidemiology-specific job classifications that are based on the AECs. Review of epidemiology job classifications revealed a diverse range of job accountabilities and qualifications for epidemiologists working in state health departments across the United States. There was more consistency among the 19 (37%) jurisdictions that reported using the AECs to create or revise their epidemiology job classifications. While most jurisdictions have epidemiology-specific job classifications (n=44, 90%), there were 7 that reported not having an epidemiology-specific classification. Jurisdictions without epidemiology-specific classifications should consider working with their human resources agency to create one as 37 (84%) of state epidemiologists strongly agreed or agreed that having an epidemiology-specific classification positively contributed to recruitment of epidemiologists in their agency and 29 (66%) strongly agreed or agreed that having one positively contributed to retention.
2. Update the Applied Epidemiology Competencies. The 2006 are recommended for use by employers to develop epidemiology job descriptions and may also be used by academia to develop curricula. Most (n=39, 78%) state epidemiologists reported using the AECs for workforce development activities within their jurisdiction. Given their wide use and important role, the AECs should be updated periodically to ensure they are reflective of current practice. While overall (~85%) state epidemiologists reported that the AECs were relevant to both current and future practice, many (n=18, 33%) felt they should be updated. Specific suggestions made were to incorporate skills related to informatics, "big data" and data science, data visualization, and new analytic tools and to incorporate "non-traditional" functions that epidemiologists perform to support programs. such as evaluation and quality improvement.

The AECs were used throughout this research and some limitations were noted in their application for research purposes. The AECs were not necessarily designed for research purposes, but given the recommendations for ongoing assessment of the public health workforce and existing public health workforce research agendas, the AECs could be revised to improve their ability to support epidemiology workforce research. One specific limitation that affected this research was that the AECs do not provide for every possible combination of education and experience in assigning epidemiologists to career-stage or “Tier”. Specific gaps in the definitions include a lack of how to categorize those with the following:

- Less than a bachelor’s degree;
- Bachelor’s or non-epidemiology professional degree with no epidemiology-specific training and less than 2 years of experience; and
- Master’s or doctoral degrees in a non-epidemiology concentration.

b. *Education and professional preparation*

Description: Examination of the required and desired level of education, as well as partnering with academic institutions to encourage students to enter into the field (NCWWI, 2015).

Recommendations: State health departments should establish strong relationships with academic institutions. These relationships offer numerous benefits to state health departments, including serving as a conduit for improving recruitment of epidemiologists. They also benefit the academic institution by providing potential opportunities for applied practicum experiences, as well as for students to apply classroom learning to a real-life setting. Recommendations related to education and professional preparation include the following:

1. Increase exposure to emerging areas of public health practice in epidemiology programs. The findings from this research can be used to develop epidemiology curricula to improve the readiness of graduates of public health programs to work in emerging

areas of public health practice. Enhancing the applied epidemiologist's preparation during academic training was specifically suggested in the following areas:

- Informatics;
- Program evaluation; and
- Policy.

Schools and programs of public health have many demands placed upon them for content and must comply with accrediting body requirements. However, there may be an opportunity to expose students to multiple topics through a single "Data to Action"-type of course or to otherwise build some of these topics into existing course work.

2. Increase opportunities for epidemiology students to build "strategic skills" within the academic curriculum and related experiences. Strategic skills (systems thinking, change management, data analytics, persuasive communication, problem solving, diversity and inclusion, resource management, and policy engagement) can support epidemiologists' participation in a number of the different emerging areas of practice (NCPHWD, 2017).

Given the increasing complexity of public health practice and the need for more intersectoral approaches, public health professionals will need to have enhanced cross-cutting skills that support multisector work, partner engagement, and policy development (Magaña Valladares et al., 2019).

3. Increase internship opportunities in state health departments as a mechanism to attract graduating students to work in this setting. CSTE has recommended some strategies for addressing epidemiologist recruitment challenges in their report summarizing the 2017 ECA, in particular around improving the pipeline from academic programs to health departments, which includes this recommendation (CSTE, 2018).

4. Increase health department staff teaching in public health programs. In the 2017 ECA report, CSTE also recommends increasing health department staff teaching in public health programs to expose students to real-world applied epidemiology, again with the goal of attracting students to apply for, and accept positions in, governmental public

health agencies (CSTE, 2018). Increasing the connection of practitioners to academia may offer other benefits such as improving access to literature, as already mentioned, and it could also help to improve retention and job satisfaction for mid- and senior-career epidemiologists.

c. *Recruitment, screening, and selection*

Description: This component includes a range of recruitment practices to assure the “right” applicant is selected for the job, such as effective screening of candidates and developing competency-based interviewing processes (NCWWI, 2015).

Recommendations: No additional specific recommendations emerged related to screening and selection of candidates. The greatest barriers around recruitment centered around (1) attracting people with the necessary skill sets to work in governmental public health, and (2) gaps in certain skill sets (e.g. informatics) among those who did apply and/or were hired. Recommendations to address these recruitment challenges are described under “Educational and professional preparation.”

d. *Incentives and work conditions*

Description: Strategic and thoughtful decision-making related to offering incentives (monetary and non-monetary) and working conditions that increase retention of valued employees (NCWWI, 2015).

Recommendations: In terms of specific incentives and work conditions that would facilitate epidemiologists’ ability to work in emerging areas of public health practice, participants indicated that finding time to participate in training was a barrier and that having encouragement and support from their supervisors or organizations to carve out dedicated time to take training was helpful.

e. *Professional development and training*

Description: Appropriate orientation and training for new staff, as well as continuous learning through on-the-job training and opportunities for knowledge and skill development for existing staff (NCWWI, 2015).

Recommendations: Recommendations related to professional development and training include the following:

1. Increase on-the-job training opportunities. Training for the existing epidemiology workforce was suggested in a number of areas. It is likely that training needs within these topics will vary based on specific position job duties and career stage. For example, the Institute of Healthcare Improvement (IHI) promotes the concept of “dosing” in implementing organization-wide quality improvement training programs, whereby certain positions (e.g. quality improvement experts and team leaders) would need higher “doses” of training in more technical areas, while others (e.g. senior managers) might need higher “doses” in broader topics, such as strategy and scale up and spread (Lloyd, 2018). This type of approach would likely apply well to emerging areas of practice in consideration of the varying role of epidemiologists in these areas by career-stage. The approach would also work particularly well for informatics, given that participants identified that there were epidemiologists who specialize in informatics and would therefore require more informatics knowledge and training, and others who were more programmatic and would require less informatics training but would still need a baseline level of knowledge. In consideration of the various barriers to working in emerging areas of public health practice, specific topics that are recommended to facilitate work in these areas include:

- Informatics;
- Quality improvement;
- Program evaluation;
- Collaboration and integration frameworks;
- Policy analysis and the legislative process;
- Leadership and strategic skills training, especially in the areas of systems thinking and strategic planning, budget and financial management,

developing a vision for a healthy community, cultural competency, and change management; and

- Technical methods such as use of the social vulnerabilities index and small area estimation to support work in addressing social determinants of health.

2. Incorporate existing training opportunities related to emerging areas of public health practice into a training inventory resource. Because emerging areas of practice are applicable to many public health professionals and not only epidemiologists, existing training resources may already exist. These existing training resources should be identified and referred to in a resource that is available to state health departments.

f. *Coaching, mentoring, and networking*

Description: Providing opportunities to both receive and provide coaching and mentorship to and from others across the career lifecycle, as well as to network with others in the field to broaden professional perspective and exposure.

Recommendations: Recommendations related to coaching, mentoring, and networking include the following:

1. Health department leadership should support establishment of CoP, or dedicated space and time for sharing best practices, lessons learned, cross-training, and resources across programs within the organization. Defined as groups of people who voluntarily come together to share expertise, best practices, and learn together, CoP are one approach to achieving practice change and learning (Wenger & Snyder, 2000). First growing out of the field of business, CoP have been increasingly used in healthcare (Li et al., 2009). Health department leadership should also support epidemiologists' participation in regional or national CoP for broader sharing outside the organization.
2. Pursue multidisciplinary team training opportunities. Training in multidisciplinary teams will allow epidemiologists to learn and explore their role within emerging areas of practice, which often require multidisciplinary approaches.

3. Implement mentorship programs for mid-career epidemiologists. Much emphasis is placed on development of early-career professionals through fellowship and mentorship programs, but the development needs of mid-career professionals may be overlooked and this research identified a particular need to offer additional support and development opportunities to epidemiologists within this career stage.

g. *Supervision and performance management*

Description: Provision of high-quality supervision to support and retain a competent workforce through regular coaching and feedback (NCWWI, 2015).

Recommendations: Increase leadership and management training for epidemiology supervisors to retain and improve performance of epidemiology staff. Some of the barriers to working in emerging areas of public health practice noted by participants were related directly to their relationships with their supervisors, such as having time and support to do the work and to participate in training. Supervisors can also improve performance of staff by using effective performance management processes, through which they can incorporate the AECs and competency-based evaluation of employees. This includes identifying skill gaps and developing a plan to address them.

h. *Succession planning*

Description: Ensuring continuity in key positions through effective retention, knowledge transfer, and professional development of staff (Rothwell, 2010).

Recommendations: Retention challenges are harder to address at the national level because, according to state epidemiologists, these arise from agency-specific issues related to low salaries, lack of opportunity for promotion, restrictions on merit raises, and loss to the private or government sector (CSTE, 2018). However, some of the recommendations around increasing access to training, leadership development, and CoP could positively impact retention as well. Additional recommendations include:

1. Implement epidemiology-specific career ladders that are based on the AECs. While most jurisdictions have epidemiology-specific career ladders (n=36, 74%) in place, there

were 15 jurisdictions without one. Jurisdictions without epidemiology-specific career ladders should consider working with their human resources agency to create one as 24 (69%) state epidemiologists strongly agreed or agreed that having an epidemiology-specific career ladder positively contributed to recruitment of epidemiologists in their agency and 23 (66%) strongly agreed or agreed that having one positively contributed to retention.

2. Invest in the development of mid- and senior-career epidemiologists. This research found that senior-career epidemiologists reported lower feelings of engagement, motivation, and job satisfaction, and mid-career epidemiologists expressed feelings of negativity about their work environments. Efforts to improve the experience of mid- and senior-career epidemiologists could include offering leadership and management training and engaging them in succession planning activities in recognition of their future potential as senior leaders within public health agencies in the United States.

i. *Organizational environment*

Description: Promotion of a healthy organizational culture that attracts, recruits, and retains a competent and qualified workforce (NCWWI, 2015).

Recommendations: Several recommendations emerged from this research for state health department leadership to improve the organizational environment to support epidemiologists' work in emerging areas of public health practice. Specific recommendations include:

1. Encourage public health program areas to engage epidemiologists earlier during the program/project planning process to fully leverage epidemiology skill sets and improve likelihood of the initiative's success.
2. Implement strategic planning processes with regularity and fidelity, and ensure that program activities are driven by strategy.
3. Identify champions within the organization who can promote work within emerging areas of public health practice.

4. Cultivate strong relationships with the jurisdiction's IT department, advocate for appropriate resources to support public health IT needs, and consider appointing a high-level liaison to the IT department who can support health department staff in navigating approval processes and advocate for public health IT needs.
5. Ensure public health services are carried out using the best available evidence and that evidence-based frameworks and models are used, where available, to guide public health initiatives.

j. *Community context*

Description: Establishing positive community partnerships to (1) attract potential job candidates who reflect the diversity of the populations served, and (2) to increase positive interactions with partners such that the workforce feels valued by the community and supported within a collaborative community network (NCWWI, 2015).

Recommendations: Build and sustain relationships with leadership across the public health, healthcare, and non-health sectors. Health department leadership should invest time and effort in building and sustaining relationships with leadership across the public health and healthcare sectors, as well as throughout non-health sectors, to support multisectoral collaboration work to address population health issues.

Table 23. Summary of Recommendations to Improve State Health Department Epidemiologists’ Ability to Work in Emerging Areas of Public Health Practice

Recommendations	
1. Increase resources to support delivery of public health services	
	<ul style="list-style-type: none"> • Increase and diversify public health funding • Increase number of epidemiologist positions • Address epidemiologist recruitment and retention challenges • Continue support for supplemental epidemiology staffing placement programs • Increase access to peer-reviewed literature • Increase and improve information technology resources
2. Implement epidemiology workforce development strategies	
Job analysis and position requirements	<ul style="list-style-type: none"> • Implement use of AEC-based epidemiology-specific job classifications • Update the Applied Epidemiology Competencies
Education and professional preparation	<ul style="list-style-type: none"> • Increase exposure to emerging areas of practice during academic programs, especially in informatics, program evaluation, and policy • Increase opportunities for epidemiology students to build “strategic skills” • Increase internship opportunities in state health departments • Increase health department staff teaching in public health programs
Recruitment, screening, and selection	<ul style="list-style-type: none"> • Improve retention through implementation of workforce development activities described in other components
Incentives and work conditions	<ul style="list-style-type: none"> • Provide and encourage the use of dedicated time for training
Professional development and training	<ul style="list-style-type: none"> • Increase on-the-job training opportunities, especially in areas of <ul style="list-style-type: none"> ○ Informatics ○ Quality improvement ○ Program evaluation ○ Collaboration and integration frameworks ○ Policy analysis and the legislative process

	<ul style="list-style-type: none"> ○ Leadership and strategic skills training, especially in systems thinking and strategic planning, budget and financial management, developing a vision for a healthy community, cultural competency, and change management ○ Technical methods such as use of the social vulnerabilities index and small area estimation ● Incorporate existing training opportunities related to emerging areas of practice into a training inventory resource
Coaching, mentoring, and networking	<ul style="list-style-type: none"> ● Support the establishment of communities of practice, or dedicated space and time for sharing of best practices, lessons learned, cross-training, and resource sharing across programs within the organization ● Pursue multidisciplinary team training opportunities ● Implement mentorship programs for mid-career epidemiologists
Supervision and performance management	<ul style="list-style-type: none"> ● Increase leadership and management training for epidemiology supervisors
Succession planning	<ul style="list-style-type: none"> ● Implement AEC-based epidemiology-specific career ladders ● Invest in the development of mid-career epidemiologists
Organizational environment	<ul style="list-style-type: none"> ● Encourage public health program areas to engage epidemiologists earlier during the project planning process ● Implement strategic planning processes and ensure that program activities are driven by strategy ● Identify champions within the organization who can promote work within emerging areas of practice ● Cultivate strong relationships with the jurisdiction's information technology department and advocate for appropriate resources to support public health information technology needs ● Ensure public health services are carried out using the best available evidence and that evidence-based frameworks are used, where available, to guide public health initiatives
Community context	<ul style="list-style-type: none"> ● Build and sustain relationships with leadership across the public health, healthcare, and non-health sectors

AEC: Applied Epidemiology Competencies; CDC: Centers for Disease Control and Prevention; CSTE: Council of State and Territorial Epidemiologists

Implementation

The results of this study led to a number of recommendations and proposed actions to improve epidemiologists' ability to work in emerging areas of public health practice. The workforce development framework is extensive and provides a robust opportunity for numerous recommendations. While all recommendations have been outlined for future use and reference, a subset have been selected as strategies for inclusion in the implementation plan for this Plan for Change based on their suitability to be pursued by the researcher. The selected strategies are divided into those with national impact and those with local impact.

National Strategies

Four strategies aimed at national impact to improve epidemiologists' ability to work in emerging areas of public health practice are outlined. Communications strategies will be implemented to inform and engage stakeholders in the proposed activities.

1. Update the Applied Epidemiology Competencies

Purpose: To revise the AECs such that they reflect current and future practice and can be used to improve epidemiology practice.

Principal Components / Activities:

- Engage CSTE leadership to discuss and plan for a future process to update the AECs
- Conduct a roundtable discussion with applied epidemiologists to initiate preliminary discussions around areas for revision within the existing AECs (tentatively planned for the next annual CSTE meeting)
- Participate in the AEC update process via the CSTE Workforce Subcommittee

Financing / Resources Needed: No additional financing is needed to support this strategy initially. Depending on the process selected for formally embarking on the update, it is likely that financial and personnel resources will be necessary.

Crucial Stakeholders: Council of State and Territorial Epidemiologists

Environmental Assessment: The initial version of the AECs was developed by a group convened by CSTE with financial support from CDC. The decision-making around updating the AECs ultimately rests with CSTE.

2. Increase on-the-job training opportunities

Purpose: To increase knowledge of epidemiologists currently working in state health departments relative to the emerging areas of public health practice and related areas.

Principal Components / Activities:

- Identify topics and potential speakers that address emerging areas of practice
- Discuss and select topics as part of the CSTE Workforce Subcommittee
- Schedule and deliver selected training opportunities to the CSTE membership

Financing / Resources Needed: Additional funding could be helpful but training activities can be incorporated into ongoing training plans using existing resources.

Crucial Stakeholders: Council of State and Territorial Epidemiologists

Environmental Assessment: This work would be carried out using the resources of CSTE.

The decision-making around which activities are carried out ultimately rests with CSTE.

3. Incorporate existing training on emerging areas of public health practice into a training inventory resource

Purpose: To increase access to training on emerging areas of public health practice and related topics.

Principal Components / Activities:

- Identify existing trainings that are available that address emerging areas of public health practice
- Incorporate these trainings into the AEC-based training catalogue currently in development by CDC, CSTE, and the Association of Public Health Laboratories.

Financing / Resources Needed: No additional financing is needed to support this strategy.

The training catalogue project that is currently in development is funded by CDC. It is assumed the catalogue will be maintained and updatable over time.

Crucial Stakeholders: Association of Public Health Laboratories, Centers for Disease Control and Prevention, Council of State and Territorial Epidemiologists

Environmental Assessment: This project is owned by the stakeholders listed above so the decision to incorporate specific trainings into the training catalogue is ultimately up to the team overseeing the project.

4. **Invest in the development of mid- and senior-career epidemiologists**

Purpose: To improve the outlook of mid- and senior-career epidemiologists and their ability to work in emerging areas of public health practice and to support subordinate epidemiology staff in their work in emerging areas of public health practice.

Principal Components / Activities:

- Incorporate findings of this research into the CSTE Leadership Program aimed at mid-career epidemiologists that is currently in development
- Incorporate the findings of this research relative to the needs of mid- and senior-career epidemiologists in national workforce development and training plans

Financing / Resources Needed: No additional financing is needed to support this strategy.

Crucial Stakeholders: Council of State and Territorial Epidemiologists

Environmental Assessment: This work would be carried out using the resources of CSTE. The decision-making around which activities are carried out ultimately rests with CSTE.

Local Strategies

Two strategies aimed at local impact to improve epidemiologists' ability to work in emerging areas of public health practice in New Hampshire are outlined. New Hampshire is one of only seven jurisdictions that does not have an epidemiology-specific job classification within the state personnel classification system. Communications strategies will be implemented to inform and engage stakeholders in the proposed activities.

1. Develop and implement an epidemiology-specific classification and career ladder in the State of New Hampshire personnel classification system

Purpose: To improve recruitment and retention of epidemiologists in New Hampshire.

Principal Components / Activities:

- Engage human resources leadership to discuss recruitment and retention challenges and the justification for epidemiology-specific classifications and a career ladder
- Draft a proposed epidemiology career ladder with job descriptions that incorporate the AECs and emerging areas of public health practice most relevant to applied epidemiology
- Present the proposed epidemiology career ladder to leadership for approval
- If approved, work with agency supervisors to implement the new career ladder including assessment of financial implications
- Share lessons learned with other jurisdictions that lack epidemiology-specific classifications and career-ladders

Financing / Resources Needed: No additional financing is needed to create the classifications and career ladder. There are likely to be financial implications of implementing the career ladder as employees are likely to experience increases in pay, if not initially, then over time as they progress through the career ladder.

Crucial Stakeholders: Health department leadership, human resources leadership, supervisors, epidemiology staff impacted by the new classifications and career ladder

Environmental Assessment: The process of creating new classifications and a career ladder must adhere to state laws and administrative rules relative to the state personnel classification system. Additionally, approval of the proposed career ladder is ultimately up to health department and human resources leadership.

2. Increase on-the-job training opportunities

Purpose: To increase knowledge of epidemiologists currently working in the state health department in New Hampshire relative to the emerging areas of public health practice and related areas.

Principal Components / Activities:

- Identify existing training opportunities to share with New Hampshire's CoP of public health epidemiologists
- Identify topics and potential speakers to bring to New Hampshire's CoP of public health epidemiologists during regularly scheduled monthly meetings

Financing / Resources Needed: Additional funding could be helpful but training activities can be incorporated into ongoing training plans using existing resource.

Crucial Stakeholders: Health department epidemiologists

Environmental Assessment: There are no major barriers anticipated. Usual barriers such as carving out time to dedicate to workforce development topics are expected.

Evaluation

Ongoing monitoring and evaluation of the implementation process is essential. Due to much of the decision-making around national strategies being outside the control of the researcher, the evaluation activities are focused on the local strategy to develop and implement an epidemiology-specific classification and career ladder in the State of New Hampshire personnel classification system. Adequate resources to support monitoring and evaluation will be provided through infrastructure already in place within the agency, such as trained evaluators and quality improvement staff, that can be leveraged to support monitoring and evaluation of the local strategy implementation plan. The overall monitoring and evaluation process will include monitoring key performance indicators, regularly reviewing indicator data, and taking actions to correct problems when identified. The evaluation process will be incorporated into the agency's existing Strategic Planning

Workforce Subcommittee as the goals and activities of the work align with other planned activities within the agency. As milestones are met, “small wins” will be celebrated to maintain enthusiasm for the work and keep focus on the bigger vision of improving epidemiology capacity in New Hampshire to improve population health.

Evaluation Questions

Evaluative Question 1: Does implementation of epidemiology-specific classifications improve epidemiologist recruitment in New Hampshire?

Data Collection Method 1.1: A qualitative data collection approach will be used to evaluate whether epidemiology-specific classifications improve epidemiologist recruitment in New Hampshire. To collect qualitative information, during the orientation process, new epidemiology hires will meet with the deputy state epidemiologist, who coordinates the agency’s CoP for epidemiologists, to discuss the barriers and facilitators to the person’s eventual hire at the agency.

Data Collection Method 1.2: A quantitative data collection approach will be used to evaluate whether an epidemiology-specific career ladder improves epidemiologist retention in New Hampshire. A number of different measures will be collected and monitored to evaluate the impact of the classifications, including the number of days epidemiology positions are vacant, the number of applicants for each vacant position, and the number of applicants for each vacant position that certify for the position and advance to the interview process.

Evaluative Question 2: Does implementation of an epidemiology-specific career ladder improve epidemiologist retention in New Hampshire?

Data Collection Method 2.1: A qualitative data collection approach will be used to evaluate whether an epidemiology-specific career ladder improves epidemiologist retention in New Hampshire. To collect qualitative information, during the exit interview process, departing epidemiology staff will meet with the deputy state epidemiologist, who coordinates the agency’s CoP for epidemiologists, to discuss the reason for the person’s departure from the agency and what role, if any, the career ladder played.

Data Collection Method 2.2: A quantitative data collection approach will be used to evaluate whether an epidemiology-specific career ladder improves epidemiologist retention in New Hampshire. A number of different measures will be collected and monitored to evaluate the impact of the career ladder, including short term measures such as how many people progress and how long it takes to progress, as well as long term measures such as changes in the longevity of epidemiology staff and number of epidemiology position vacancies as a percentage of total epidemiology positions.

Dissemination

The findings of this research and the resulting Plan for Change will be shared with state health departments, epidemiologists working in governmental health agencies, and through contributions to the peer-reviewed literature. Proposed products for dissemination include comprehensive summary reports, conference abstracts and presentations, and peer-reviewed publications.

Comprehensive Summary Reports

- Comprehensive summary of the state epidemiologist survey distributed to state epidemiologists
- Comprehensive summary of focus group findings distributed to focus group participants
- All state epidemiologist survey data, findings, and summary report provided to CSTE for long term storage and retrieval

Conference Abstracts

- Conference presentation summarizing PH WINS analysis relative to training needs
- Conference presentation summarizing PH WINS analysis relative to emerging areas of public health practice
- Conference roundtable to discuss use of, and the need to update, the Applied Epidemiology Competencies

Peer-reviewed Articles

- Peer-reviewed publication summarizing PH WINS analysis relative to training needs and emerging areas of public health practice
- Peer-reviewed publication summarizing state epidemiologist perspectives on training needs, workforce development approaches, including use of career ladders, and challenges
- Peer-reviewed publication summarizing mixed methods exploration of the role and readiness of state health department epidemiologists to work in emerging areas of public health practice
- Peer-reviewed publication and conference presentation summarizing the process of developing the epidemiology career ladder in New Hampshire and the results of the evaluation of their impact

CHAPTER 7: CONCLUSION

This research provided answers to the question of, “what is the role and readiness of state health department epidemiologists in the United States to work in emerging areas of public health practice?” The 2017 deployment of PH WINS provided a robust source of individual-level nationally representative data on epidemiologists working in state health department central offices in the United States. The state epidemiologists survey provided information on state epidemiologists’ perceptions on the importance of the emerging areas of public health practice and whether state health department epidemiologists were ready to work in these areas. Focus groups with epidemiologists working in state health departments provided an opportunity to further explore the role of epidemiologists in emerging areas of public health practice and barriers and facilitators to this work. Participant state health department epidemiologists indicated that the studied emerging areas of public health practice were important to their work and that epidemiologists have some role in them. While there are significant barriers to practicing in these areas, participants were hopeful and offered suggestions for how to overcome these barriers. Taken together, these three assessments identified several areas for future workforce development activities that are outlined in a plan for change to improve applied epidemiology capacity.

As a subgroup of the larger public health workforce, epidemiologists are key professionals that can contribute meaningfully to public health initiatives through collection, analysis, interpretation, and dissemination of data in addition to contributing their unique expertise. As more and more data have become available electronically, epidemiologists can play a central role in using that data for public health action. The outlined plan for change is broad in scope to address many barriers affecting epidemiology practice, which must be

addressed if epidemiologists are to be effectively engaged in emerging areas of public health practice. The advantages of the activities outlined in the plan for change are that they have the potential to improve epidemiologist recruitment, retention, and knowledge, all of which were noted as important barriers to working in emerging areas of public health practice. The primary disadvantage is the realistic capacity to sustain change. Given that one of the major barriers to governmental public health practice in general is that it is significantly and disproportionately underfunded (TFAH, 2019), it is very challenging for health departments to provide core public health services while also sustaining new initiatives over time because resources must shift in order to respond to changing needs and priorities. More resources and a commitment to organizational change will be necessary to sustain these activities.

There is much opportunity for epidemiologists to be more engaged in emerging areas of public health practice. Not only can epidemiologists supply relevant data, but they can also bring skills and expertise to help improve the overall success of the work, with the ultimate goal of improving population health.

APPENDIX 1: CHARACTERISTICS OF STUDIES INCLUDED IN THE LITERATURE REVIEW

Author	Year	Category	Setting	Participants	Study Type	Article Emphasis	Assessment Type
Arrazola	2018	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Arrazola	2019	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Beck	2017	Empiric	United States	Senior leadership in governmental PH agencies	Cross-sectional	Workforce development needs	Survey
Bensyl	2019	Non-empiric	None	None	N/A	Applied Epidemiology Training Needs	N/A
Birkhead	2006	Non-empiric	United States	None	N/A	Establishing AECs	N/A
Birkhead	2008	Non-empiric	United States	None	N/A	Establishing AECs	N/A
Boss	1994	Empiric	United States	Epidemiologists in governmental PH agencies - noninfectious	Cross-sectional	Enumeration	Survey
Boulton	2003	Empiric	United States	Epidemiologists in governmental PH agencies	Cross-sectional	Enumeration	Survey
Boulton	2005	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Boulton	2009	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey

Author	Year	Category	Setting	Participants	Study Type	Article Emphasis	Assessment Type
Boulton	2009	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Boulton	2011	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Boulton	2011	Empiric	United States	Epidemiologists in governmental PH agencies - foodborne	Cross-sectional	Enumeration and competency	Survey
Boulton	2012	Empiric	United States	State and local lead epidemiologists	Cross-sectional	Enumeration and competency	Survey
Brownson	2015	Empiric	United States	Academic and governmental epidemiologists	Cross-sectional	Training needs	Key Informant Interviews
Buss	2011	Empiric	Nebraska	Epidemiologists in governmental PH agencies	Cross-sectional	Enumeration and competency	Survey
Carter-Pokras	2009	Empiric	United States International	ACE members	Cross-sectional	Enumeration and competency	Survey
Chapple-McGruder	2017	Empiric	United States	Epidemiologists in governmental PH agencies	Cross-sectional	Enumeration and competency	Survey
Chung	2017	Empiric	United States International	Epidemiologists in governmental PH agencies	Secondary data analysis	Increasing workforce capacity	Survey
Detels	1979	Empiric	United States	Epidemiologists	Cross-sectional	Enumeration of needs	Survey

Author	Year	Category	Setting	Participants	Study Type	Article Emphasis	Assessment Type
Dick	2014	Empiric	United States	Epidemiology Fellows in governmental PH agencies	Cross-sectional	Increasing workforce capacity	N/A
Duffy	2009	Empiric	Ohio	Epidemiologists in governmental PH agencies - chronic disease	Case report	Increasing workforce capacity	N/A
Gunn	1989	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration	Survey
Hadler	2015	Empiric	United States	State epidemiologists	Cross-sectional	Enumeration and competency	Survey
Hopfer	2009	Empiric	United States	State Cancer Control Program Directors	Cross-sectional	GIS training needs	Survey
Kogan	2014	Non-empiric	United States	None	N/A	Role of leadership and change	N/A
Koo	2010	Non-Empiric	United States	None	N/A	Proposed model for workforce development	N/A
Kuller	2019	Non-Empiric	None	None	N/A	Epidemiologists of the future	N/A
Leider	2019	Empiric	United States	Public health managers in governmental PH agencies	Cross-sectional	Executive perspectives on workforce needs	Survey
Lengerich	2003	Empiric	United States	Epidemiologists in governmental PH agencies - chronic disease	Case report	Increasing workforce capacity	N/A

Author	Year	Category	Setting	Participants	Study Type	Article Emphasis	Assessment Type
Lichtveld	2008	Empiric	United States	State epidemiologists	Cross-sectional	Competency	Survey
McGinty	2019	Empiric	Large Urban Health Departments	Single designated person within agency	Cross-sectional	Enumeration and competency	Survey
Orchard	1980	Non-empiric	United States	None	N/A	Future of epidemiology	N/A
Patel	2008	Empiric	Virginia	Epidemiologists in governmental PH agencies	Cross-sectional	Enumeration and competency	Survey
Phillips	2012	Non-empiric	United States	None	N/A	Proposed strategies to increase workforce capacity	N/A
Pourshaban	2015	Empiric	United States	Public Health professionals in governmental PH agencies	Cross-sectional	Determinants of workforce turnover	Survey
Rankin	2012	Empiric	United States	Epidemiologists in governmental PH agencies - MCH	Case report	Increasing workforce capacity	N/A
Rogawski	2016	Non-empiric	United States	None	N/A	Distinction between public health epidemiology and medical epidemiology	N/A
Rosenberg	2011	Empiric	United States	State MCH Program Directors	Cross-sectional	Functioning	Telephone Interviews

Author	Year	Category	Setting	Participants	Study Type	Article Emphasis	Assessment Type
Rosenberg	2012	Non-empiric	None	None	N/A	Call for leadership training in MCH epidemiology	N/A
Samet	2019	Non-empiric	None	None	N/A	The role of epidemiologists	N/A
Savitz	1999	Non-empiric	United States	None	N/A	Call for epidemiology to be more applied	N/A
Smith	2013	Non-empiric	United States	None	N/A	Future of surveillance epidemiology	N/A
Thacker	2001	Non-empiric	United States International	None	N/A	Applied epidemiology training programs	N/A
Thacker	2008	Non-empiric	United States International	None	N/A	How competent are applied epidemiologists	N/A
Thacker	2011	Empiric	United States	Epidemiologists in governmental PH agencies	Cross-sectional	Increasing workforce capacity	Secondary Data
Williams	1988	Empiric	United States	Mailing list recipients, trainees in graduate programs, experts, review of job announcements	Secondary data analysis	Enumeration	Secondary Data
Woernle	1991	Empiric	12 Southern US States	Epidemiologists in governmental PH agencies	Cross-sectional	Enumeration	Survey

AECs: Applied Epidemiology Competencies; MCH: Maternal and child health; PH: Public health

APPENDIX 2: PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS SURVEY

2017 PH WINS

Public Health Workforce Interests and Needs Survey (PH WINS)

About the Survey

You have been selected to participate in the Public Health Workforce Interests and Needs Survey (PH WINS). The purpose of this survey is to inform future public health workforce development initiatives. The survey is being conducted by the Association of State and Territorial Health Officials (ASTHO) with support from the de Beaumont Foundation. This survey should take approximately 15-20 minutes of your time. Your participation is voluntary and your responses will be confidential. We hope you will participate. Your feedback is important and will help determine opportunities for future workforce development efforts.

Instructions for Completing the Survey

If you start the questionnaire and need to complete it at a later time, you may do so, but your responses will not be saved. The survey must be completed in one sitting. The survey is intended for you personally; please do not delegate it. Clicking "continue" will be interpreted as your informed consent to participate and that you affirm that you are at least 18 years of age.

Need Help?

If you have questions about the survey, please email PHWINS@astho.org or call (571) 318-5418. If you have any questions about your rights as a participant, you may contact the NORC Institutional Review Board at (773) 256-6000.

Defining Terms

Throughout the survey, the terms agency, department, or organization are used interchangeably to refer to independent state or local public health agencies or a unit/division of public health within a larger agency, often referred to as an umbrella agency or super-agency. In this survey, we will use several terms specific to public health practice. In several questions, you will see these terms displayed in blue. If you hover your mouse over them, the definition of that term will appear (pictured below).



EXAMPLE

Q11. How important are the following areas to public health?

	Not at all important	Not very important	Somewhat important	Very important	I am not familiar with this
Cross-jurisdictional sharing of public health services	<input type="radio"/>				
Fostering a culture of quality improvement (QI)	<input type="radio"/>				
Public health and primary care integration	<input type="radio"/>				
Evidence-based public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health. (Michener and Wellik, 2012)	<input type="radio"/>				
Multi-sectoral collaboration	<input type="radio"/>				

Section I: Workplace Environment

1. Please rate your level of agreement with the following items:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I know how my work relates to the agency's goals and priorities.					
The work I do is important.					
Creativity and innovation are rewarded.					
Communication between senior leadership and employees is good in my organization.					
Supervisors work well with employees of different backgrounds.					
Supervisors in my work unit support employee development.					
My training needs are assessed.					
Employees have sufficient training to fully utilize technology needed for their work.					
Employees learn from one another as they do their work.					

My supervisor provides me with opportunities to demonstrate my leadership skills.					
I have had opportunities to learn and grow in my position over the past year.					
I feel completely involved in my work.					
I am determined to give my best effort at work every day.					
I am satisfied that I have the opportunities to apply my talents and expertise.					
My supervisor and I have a good working relationship.					
My supervisor treats me with respect.					
I recommend my organization as a good place to work.					

2. Considering everything, how satisfied are you with:

	Very dissatisfied	Somewhat dissatisfied	Neither dissatisfied nor satisfied	Somewhat satisfied	Very satisfied
Your job?					
Your organization?					
Your pay?					
Your job security?					

- If you wish, you may provide comments below about your workplace environment or level of job satisfaction.
- The following statements refer to your feelings and attitudes during work. Please indicate to what extent you agree with each of the following statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I always find new and interesting aspects in my work.					
There are days when I feel tired before I arrive at work.					
More and more often I find that I am distancing myself from my job.					
After work, I tend to need more time than in the past to relax and recover.					
I can tolerate the pressure of my work very well.					
Lately, I tend to think less at work and do my job almost mechanically.					
I find my work to be a real challenge.					
During my work, I often feel emotionally drained.					
Over time I've lost my personal engagement with my work.					
After working, I have enough energy for my leisure activities.					
Sometimes I feel fed up by my work tasks.					
After my work, I usually feel worn out and weary.					
Usually I can manage my workload well.					
This is the only type of work that I can imagine myself doing.					
When I work, I usually feel energized.					
I feel more and more engaged with my work.					

5. Are you considering leaving your organization within the next year, and if so, why?

- No
- Yes, to retire
- Yes, to take another governmental job (in public health)
- Yes, to take another governmental job (not in public health)
- Yes, to take a non-governmental job (in public health)
- Yes, to take a non-governmental job (not in public health)
- Yes, other _____

[If yes, display:]

5a. For approximately how long have you been considering leaving your organization?

- Less than 3 months
- 3-6 months
- More than 6 months

[If yes for another job, display:]

5b.1 Have you recently taken any steps towards leaving your organization, such as applying or interviewing for a new position outside your organization?

- Yes
- No

[If yes to retire, display:]

5b.2 Have you recently taken any steps towards retiring, such as meeting with HR or submitting relevant paperwork?

- Yes
- No

[Display for those leaving for another job]:

5c. Please select the most important reason(s) why you are considering leaving your organization.

- Lack of acknowledgement/recognition
- Job satisfaction
- Lack of opportunities for advancement
- Lack of training
- Leadership changeover
- Other opportunities outside agency
- Pay
- Retirement
- Satisfaction with your supervisor
- Stress
- Lack of flexibility (flex hours/telework)
- Weakening of benefits (e.g., retirement contributions/pensions, health insurance)
- Work overload / burnout
- Workplace environment
- Lack of support
- Other (Please Specify)

6. I am planning to retire in:

- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- I am not planning to retire before 2023

Section II: Training Needs Assessment

7. What is your supervisory status? Please note, supervisory levels are defined as follows:

- Non-supervisor: you do not supervise other employees;
- Supervisor: you are responsible for employees' performance appraisals and approval of their leave, but you do not supervise other supervisors;
- Manager: you are in a management position and supervise one or more supervisors; and
- Executive: member of Senior Executive Service or equivalent.

- Non-supervisor
- Supervisor
- Manager
- Executive

8. Please rate the following items in terms of importance to your current position and your current skill level. These items have been adapted from the Core Competencies for public health professionals.

Please note, skill levels are defined as follows:

- Not applicable: current position does not require performing this item
- Unable to perform: lacking the necessary skills to perform
- Beginner: able to perform with assistance
- Proficient: able to perform independently
- Expert: able to assist or teach others

TIER 1: NON-SUPERVISORS

Item	How important is this item in your day-to-day work?				What is your current skill level for this item?				
	Not important	Somewhat unimportant	Somewhat important	Very important	Not applicable	Unable to perform	Beginner	Proficient	Expert
Effectively target communications to different audiences (e.g., the public, community organizations, external partners, the scientific community, etc.)									
Communicate in a way that persuades others to act									
Identify appropriate sources of data and information to assess the health of a community									
Collect valid data for use in decision making									
Identify evidence-based approaches to address public health issues									
Describe the value of a diverse public health workforce (e.g., diverse in terms of race, ethnicity, gender, age, sexual orientation)									

diversity of individuals and populations in a community									
Use financial analysis methods in making decisions about programs and services across the agency									
Leverage funding mechanisms and procedures to develop sustainable funding models for the agency (e.g., categorical grants, state general funds, fees, thirdparty reimbursement, tobacco taxes, value-based purchasing, budget approval process)									
Design a business plan for the agency (e.g., tool for analyzing and planning for a product or service that will meet a community need, will generate revenue, and be sustainable)									

programs) to improve health in a community									
Build collaborations within the public health system among traditional and non-traditional partners to improve the health of a community									
Advocate for needed population health services and programs									

Q8.1 Items shown are those you identified as "Very Important" to your current position from the last three pages. Select the most important item for your current position.

[Populated with items from training needs assessment deemed "Very Important" by the respondent]

9. What would motivate you to seek out training? Select all that apply.

- Maintenance of licensure
- Taken into account during performance reviews
- Requirement for promotion
- Peers were taking it
- Expectation from my supervisor
- Mandated by agency supervisor/management/leadership

- Covered time for training
- Paid travel for training
- Availability of applicable in-person training opportunities
- Availability of applicable online training opportunities
- Personal growth/interest
- None of the above
- Other

Section III: Emerging Issues in Public Health

Please use the following definitions for Q10.

Cross-jurisdictional sharing of public health services-

Cross-jurisdictional sharing refers to the sharing of resources, such as equipment or personnel, to provide essential public health services. Sharing may take place across state boundaries (such as between state health agencies) or within a state (such as between a state and local health department or two local health departments.)

Fostering a culture of quality improvement (QI)-

"QI is an integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization. The intent is to improve the level of performance of key processes and outcomes within an organization." (ASTHO)

Public health and primary care integration-

The linking of public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health. (Michener and Wellik, 2012)

Evidence-Based Public Health Practice (EBPH)-

"Key components of EBPH include making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned."(Brownson et al., 2009)"

Health in All Policies (HiAP)-

HiAP is a collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people.

Multisectoral collaboration-

Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest.

10. How much, if anything, have you heard about the following concepts in public health?

	Nothing at all	Not much	A little	A lot
Cross- jurisdictional sharing of public health services				
Fostering a culture of quality improvement (QI)				
Public health and primary care integration				
Evidence-Based Public Health Practice (EBPH)				
Health in All Policies (HiAP)				
Multisectoral collaboration				

11. To what extent do each of the following areas impact your day-to-day work?
 a. [carryforward all items not identified as "nothing at all"]

12. To what extent do you believe your agency should be involved in:

	Not all involved	Not very involved	Somewhat involved	Very involved
Affecting the K-12 education system in your jurisdiction?				
Affecting the economy in your jurisdiction?				
Affecting the built environment (roads, parks, greenways, walking and biking trails, etc.) in your jurisdiction?				
Affecting the quality of housing in your jurisdiction?				
Affecting the quality of transportation in your jurisdiction?				
Affecting the quality of social support systems for individuals in your jurisdiction?				
Affecting health equity in your jurisdiction?				

Section IV: Demographics

Please remember that your responses will remain confidential.

13. What is your gender?

- Male
- Female
- Non-binary/Other

14. Are you Hispanic or Latino?

- No
- Yes

15. Please select the racial category or categories with which you most identify.

- White
- Black or African American
- Native Hawaiian or other Pacific Islander
- Asian
- American Indian or Alaska Native
- Two or more races

16. What is your age in years? Please round to the nearest whole year.
[dropdown list]

17. Please move the sliders to indicate how long you have been in each of the following (in years). Please round to the nearest year.

___In your current position

___With your current agency in total (in any position)

___In public health practice in total (in any agency, in any position)

[Display if supervisory status of manager or executive is selected]

In years, please indicate how long you have been in public health management in total (in any agency, in any public health Manager or Executive position). Please round to the nearest year. _____

18. Which of the following better describes your employment status?

- Contractor employed by third party rendering services to the health department
- Permanent staff employed directly by the health department
- Intern employed directly by the health department
- Temporary staff employed directly by the health department

19. Is your position a bargaining unit (union) position?

- Yes
- No

20. Are you currently employed full-time at the public health department?

- Yes
- No

[if no]: Please indicate what percent time you are working at the public health department. (e.g., 50% for half-time [.5 FTE], 100% for full-time [1.0 FTE])

____ Part-time percentage

21. Is your pay based on an annual salary or hourly wage?

- Annual salary
- Hourly wage

[if annual]: What is your current annual salary?

- Less than \$25,000
- \$25,000 - \$35,000
- \$35,000.01 - \$45,000
- \$45,000.01 - \$55,000
- \$55,000.01 - \$65,000
- \$65,000.01 - \$75,000
- \$75,000.01 - \$85,000
- \$85,000.01 - \$95,000
- \$95,000.01 - \$105,000
- \$105,000.01 - \$115,000
- \$115,000.01 - \$125,000
- \$125,000.01 - \$135,000
- \$135,000.01 - \$145,000
- More than \$145,000

[if hourly] What is your current hourly wage?

- Less than \$12.50
- \$12.51 - \$17.50
- \$17.51 - \$22.50
- \$22.51 - \$27.50
- \$27.51 - \$32.50

- \$32.51 - \$37.50
- \$37.51 - \$42.50
- \$42.51 - \$47.50
- \$47.51 - \$52.50
- \$52.51 - \$57.50
- \$57.51 - \$62.50
- \$62.51 - \$67.50
- \$67.51 - \$72.50
- More than \$72.50

22. Please identify the classification that best represents your role in the organization.

- Animal Control Worker
- Attorney or Legal Counsel
- Behavioral Health Professional
- Business Support - Accountant/Fiscal
- Business Support services – Administrator
- Business Support services - Coordinator
- Clerical Personnel - Administrative Assistant
- Clerical Personnel - Secretary
- Community Health Worker
- Custodian
- Disease Intervention Specialist
- Department/Bureau Director
- Deputy Director
- Economist
- Emergency Medical Services Worker
- Emergency Medical Technician/Advanced Emergency Medical Technician/Paramedic
- Emergency Preparedness/Management Worker
- Engineer
- Environmental Health Worker
- Epidemiologist
- Grants or Contracts Specialist
- Health Educator
- Health Navigator
- Health Officer
- Human Resources Personnel
- Implementation Specialist
- Information Systems Manager/Information Technology Specialist
- Laboratory Aide or Assistant
- Laboratory Technician
- Laboratory Quality Control Worker
- Laboratory Scientist/Medical Technologist

- Licensure/Regulation/Enforcement Worker
- Medical Examiner
- Nursing and Home Health Aide
- Nutritionist or Dietitian
- Other
- Other Business Support Services
- Other Facilities or Operations Worker
- Other Oral Health Professional
- Other Registered Nurse – Clinical Services
- Peer Counselor
- Pharmacist
- Physician Assistant
- Policy Analyst
- Population Health Specialist
- Program Director
- Program Evaluator
- Public Health Agency Director
- Public Health Dentist
- Public Health Manager or Program Manager
- Public Health/Preventive Medicine Physician
- Public Health Veterinarian
- Public Health Informatics Specialist
- Public Information Specialist
- Quality Improvement Worker
- Registered Nurse – Public Health or Community Health Nurse
- Registered Nurse - Unspecified
- Sanitarian or Inspector
- Social Worker/Social Services Professional
- Statistician
- Student, Professional or Scientific

23. Please specify your setting.

- City/Town Health Agency
- County Health Agency
- Other Public Health Local Agency
- Multi-city Health Agency
- Multi-county Health Agency
- State Health Agency - Central Office
- State Health Agency - Local or Regional Office
- Other State Agency, not Health Agency
- Hospital or Primary Care Clinic
- Inpatient or Outpatient Clinical Setting
- Other [please specify]

24. Please specify your employer.

- Local government
- State government
- Federal government
- Non-governmental

25. Please indicate which degrees you have attained. Check all that apply.

- High school or equivalent
- Associate's degree in nursing
- Other associate degree
- BS/BA
- BSN
- BSPH
- Other baccalaureate degree
- MA/MS
- MBA
- MHSA
- MPA
- MPP
- MPH
- MSN
- MSW
- Other masters degree
- DDS/DMD
- DrPH/PhD/ScD/other public health doctorate
- DNP
- DVM/VMD
- JD
- MD/DO, or international equivalent
- PharmD
- PhD/ScD/other non-public health doctorate

[Display all selected above high school or equivalent]

25a. Please indicate the primary major/concentration associated with your degrees, "eg BA Biology, MPH Health Policy, MD Internal Medicine". Write "N/A" if this is not applicable.

26. Please indicate which credentials you have attained. Check all that apply.

- Physician board certification
- Nurse certification
- Physician Assistant – Certified (PA-C)
- Certified in Public Health
- Certified Health Education Specialist (CHES or Master CHES)

- Laboratory certification
- Dental Public Health – Board Certification (DPH)
- Breastfeeding/Lactation Certification (CLC, CLE, CLS, or IBCLC)
- Diabetes Educator Certification (CDE)
- Physical Activity in Public Health Specialist (PAPHS)
- Infection Control Certification (CIC)
- Registered Dietitian (RD)
- Other Certification _____
- Not formally certified

27. Please specify your primary program area.

- Administration/Administrative Support
- Animal Control
- Clinical Services (excluding TB, STD, family planning)
- Clinical Services – Immunizations
- Communicable Disease – HIV
- Communicable Disease – STD
- Communicable Disease – Tuberculosis
- Other Communicable Disease
- Community Health Assessment/Planning
- Emergency Medical Services
- Emergency Preparedness
- Environmental Health
- Epidemiology Surveillance
- Global Health
- Health Education
- Health Promotion/Wellness
- Informatics
- Injury/Violence Prevention
- Maternal and Child Health
- Maternal and Child Health – Family Planning
- Maternal and Child Health - WIC
- Medical Examiner
- Mental Health
- Non-Communicable Disease
- Oral Health/Clinical Dental Services
- Program Evaluation
- Public Health Genetics
- Public health laboratory
- Substance Abuse, including tobacco control programs
- Training/Workforce Development
- Vital Records
- Other Program Area (specify)
- I work equally in multiple programs

[Display if "Other Program Area (specify)" is selected]
27a. Please specify your primary program area

[Display if "I work equally in multiple programs" is selected] 27b. Please select your program areas.

- Administration/Administrative Support
- Animal Control
- Clinical Services (excluding TB, STD, family planning)
- Clinical Services - Immunizations
- Communicable Disease - HIV
- Communicable Disease - STD
- Communicable Disease - Tuberculosis
- Other Communicable Disease
- Community Health Assessment/Planning
- Emergency Medical Services
- Emergency Preparedness
- Environmental Health
- Epidemiology Surveillance
- Global Health
- Health Education
- Health Promotion/Wellness
- Informatics
- Injury/Violence Prevention
- Maternal and Child Health
- Maternal and Child Health – Family Planning
- Maternal and Child Health - WIC
- Medical Examiner
- Mental Health
- Non-Communicable Disease
- Oral Health/Clinical Dental Services
- Program Evaluation
- Public Health Genetics
- Public Health Laboratory
- Substance Abuse, including tobacco control programs
- Training/Workforce Development
- Vital Records
- Other Program Area (specify) _____

Q28a. Please indicate where you work by answering the following questions (Alaska-Louisiana). For other states, please scroll to the corresponding question. As a reminder, your responses are confidential and individual responses will never be shared with your agency.

What state do you work in?

What agency do you work in?

What division or bureau do you work in?

Q28b. Please indicate where you work by answering the following questions (Massachusetts-New York). For other states, please scroll to the corresponding question. As a reminder, your responses are confidential and individual responses will never be shared with your agency.

What state do you work in?

What agency do you work in?

What division or bureau do you work in?

Q28c. Please indicate where you work by answering the following questions (Ohio-Wyoming). As a reminder, your responses are confidential and individual responses will never be shared with your agency. What state do you work in?

What agency do you work in?

What division or bureau do you work in?

[Display if "Other (please specify)" is selected]

Q28d. If you selected "Other" above, please specify. Otherwise, please leave this blank or write "N/A"

Thank you for participating in the survey.

ASTHO will be analyzing and disseminating the results of PH WINS. Aggregated results will be provided to your agency in 2018. For more information about PH WINS, please visit: <http://www.astho.org/PH WINS/>

If you would like to review any of your answers, please hit the "Back" button at the bottom of this page. Otherwise, click submit.

APPENDIX 3: PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS SURVEY VARIABLE LIST

Variable	Description	Values
Original Variables		
Setting2	Setting - State CO vs All Local	1 = SHA-CO; 2 = LHD
HighestDegree	Highest Degree attained	0 = No college degree; 1 = Associates; 2 = Bachelors; 3 = Masters; 4 = Doctoral
Q127_19	Please select the most important reason(s) why you are considering leaving your organization. Job satisfaction	0 = No; 1 = Yes
Q127_21	Please select the most important reason(s) why you are considering leaving your organization. Lack of training	0 = No; 1 = Yes
Q133_3	What would motivate you to seek out training? Other	0 = No; 1 = Yes
Q133_4	What would motivate you to seek out training? Maintenance of licensure	0 = No; 1 = Yes
Q133_5	What would motivate you to seek out training? Taken into account during performance reviews	0 = No; 1 = Yes
Q133_6	What would motivate you to seek out training? Requirement for promotion	0 = No; 1 = Yes
Q133_7	What would motivate you to seek out training? Peers were taking it	0 = No; 1 = Yes
Q133_8	What would motivate you to seek out training? Expectation from my supervisor	0 = No; 1 = Yes
Q133_10	What would motivate you to seek out training? Mandated by agency supervisor/management/leadership	0 = No; 1 = Yes
Q133_11	What would motivate you to seek out training? Covered time for training	0 = No; 1 = Yes
Q133_12	What would motivate you to seek out training? Paid travel for training	0 = No; 1 = Yes
Q133_18	What would motivate you to seek out training? Availability of applicable in-person training opportunities	0 = No; 1 = Yes

Q133_19	What would motivate you to seek out training? Availability of applicable online training opportunities	0 = No; 1 = Yes
Q133_20	What would motivate you to seek out training? Personal growth/interest	0 = No; 1 = Yes
Q133_21	What would motivate you to seek out training? None of the above	0 = No; 1 = Yes
Q135_x2	Of those concepts that you have heard not much/a little/a lot about, to what extent do each of the following areas impact your day-to-day work? Fostering a culture of quality improvement (QI)	1 = Not at all; 2 = Not too much; 3 = Impact fair amount; 4 = Impact great deal
Q135_x5	Of those concepts that you have heard not much/a little/a lot about, to what extent do each of the following areas impact your day-to-day work? Public health and primary care integration	1 = Not at all; 2 = Not too much; 3 = Impact fair amount; 4 = Impact great deal
Q135_x6	Of those concepts that you have heard not much/a little/a lot about, to what extent do each of the following areas impact your day-to-day work? Evidence-Based Public Health Practice	1 = Not at all; 2 = Not too much; 3 = Impact fair amount; 4 = Impact great deal
Q135_x7	Of those concepts that you have heard not much/a little/a lot about, to what extent do each of the following areas impact your day-to-day work? Health in All Policies (HiAP)	1 = Not at all; 2 = Not too much; 3 = Impact fair amount; 4 = Impact great deal
Q135_x15	Of those concepts that you have heard not much/a little/a lot about, to what extent do each of the following areas impact your day-to-day work? Multisectoral collaboration	1 = Not at all; 2 = Not too much; 3 = Impact fair amount; 4 = Impact great deal
Q2_3_50	My training needs are assessed	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4= Agree; 5 = Strongly agree
Q2_3_51	Employees have sufficient training to fully utilize technology needed for their	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4= Agree; 5 = Strongly agree
Q2_3_52	Employees learn from one another as they do their work	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4= Agree; 5 = Strongly agree

Q2_3_53	My supervisor provides me with opportunities to demonstrate my leadership skills	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree
Q2_3_68	I feel completely involved in my work	1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree
Q2_6_1	Considering everything, how satisfied are you with your job?	1 = Very dissatisfied; 2 = Somewhat dissatisfied; 3 = Neither dissatisfied nor satisfied; 4 = Somewhat satisfied; 5 = Very satisfied
Q3_T1	T1. Of skills identified as very important, which is most important skill for cu	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2	T2. Of skills identified as very important, which is most important skill for cu	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3	T3. Of skills identified as very important, which is most important skill for cu	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_10a	T1. Imp. Describe how public health funding mechanisms support agency programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_10b	T1. Skill. Describe how public health funding mechanisms support agency programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_10c	T1. Skill Gap. Describe how public health funding mechanisms support agency programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_11a	T1. Imp. Describe the value of an agency business plan	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_11b	T1. Skill. Describe the value of an agency business plan	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T1_11c	T1. Skill Gap. Describe the value of an agency business plan	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_12a	T1. Imp. Describe the influence of internal changes on organizational practices	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_12b	T1. Skill. Describe the influence of internal changes on organizational practice	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_12c	T1. Skill Gap. Describe the influence of internal changes on organizational practices	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_13a	T1. Imp. Assess the external drivers in your environment that may influence your work	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_13b	T1. Skill. Assess the external drivers in your environment that may influence your work	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_13c	T1. Skill Gap. Assess the external drivers in your environment that may influence your work	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_14a	T1. Imp. Describe how social determinants of health impact the health of individuals, families, and the overall community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_14b	T1. Skill. Describe how social determinants of health impact the health of individuals, families, and the overall community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_14c	T1. Skill Gap. Describe how social determinants of health impact the health of individuals, families, and the overall community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_15a	T1. Imp. Participate in quality improvement processes for agency programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important

Q3_T1_15b	T1. Skill. Participate in quality improvement processes for agency programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_15c	T1. Skill Gap. Participate in quality improvement processes for agency programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_16a	T1. Imp. Describe the value of community strategic planning that results in a community health assessment or community health improvement plan	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_16b	T1. Skill. Describe the value of community strategic planning that results in a community health assessment or community health improvement plan	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_16c	T1. Skill Gap. Describe the value of community strategic planning that results in a community health assessment or community health improvement plan	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_17a	T1. Imp. Describe your agency's strategic priorities, mission, and vision	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_17b	T1. Skill. Describe your agency's strategic priorities, mission, and vision	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_17c	T1. Skill Gap. Describe your agency's strategic priorities, mission, and vision	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_18a	T1. Imp. Describe the importance of engaging community members in the design and implementation of programs to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_18b	T1. Skill. Describe the importance of engaging community members in the design and implementation of programs to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T1_18c	T1. Skill Gap. Describe the importance of engaging community members in the design and implementation of programs to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_19a	T1. Imp. Engage community assets and resources to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_19b	T1. Skill. Engage community assets and resources to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_19c	T1. Skill Gap. Engage community assets and resources to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_1a	T1. Imp. Effectively target communications to different audiences	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_1b	T1. Skill. Effectively target communications to different audiences	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_1c	T1. Skill Gap. Effectively target communications to different audiences	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_20a	T1. Imp. Collaborate with public health personnel across the agency to improve the health of the community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_20b	T1. Skill. Collaborate with public health personnel across the agency to improve the health of the community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_20c	T1. Skill Gap. Collaborate with public health personnel across the agency to improve the health of the community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_21a	T1. Imp. Describe your role in improving the health of the community served by the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important

Q3_T1_21b	T1. Skill. Describe your role in improving the health of the community served by the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_21c	T1. Skill Gap. Describe your role in improving the health of the community served by the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_2a	T1. Imp. Communicate in a way that persuades others to act	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_2b	T1. Skill. Communicate in a way that persuades others to act	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_2c	T1. Skill Gap. Communicate in a way that persuades others to act	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_3a	T1. Imp. Identify appropriate sources of data and information to assess the health of a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_3b	T1. Skill. Identify appropriate sources of data and information to assess the health of a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_3c	T1. Skill Gap. Identify appropriate sources of data and information to assess the health of a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_4a	T1. Imp. Collect valid data for use in decision making	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_4b	T1. Skill. Collect valid data for use in decision making	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_4c	T1. Skill Gap. Collect valid data for use in decision making	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T1_5a	T1. Imp. Identify evidence-based approaches to address public health issues	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_5b	T1. Skill. Identify evidence-based approaches to address public health issues	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_5c	T1. Skill Gap. Identify evidence-based approaches to address public health issues	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_6a	T1. Imp. Describe the value of a diverse public health workforce	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_6b	T1. Skill. Describe the value of a diverse public health workforce	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_6c	T1.Skill Gap. Describe the value of a diverse public health workforce	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_7a	T1. Imp. Support inclusion of health equity and social justice principles into planning for program and service delivery	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_7b	T1. Skill. Support inclusion of health equity and social justice principles into planning for program and service delivery	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_7c	T1. Skill Gap. Support inclusion of health equity and social justice principles into planning for program and service delivery	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_8a	T1. Imp. Deliver socially, culturally, and linguistically appropriate programs and customer service	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_8b	T1. Skill. Deliver socially, culturally, and linguistically appropriate programs and customer service	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T1_8c	T1. Skill Gap. Deliver socially, culturally, and linguistically appropriate programs and customer service	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T1_9a	T1. Imp. Describe financial analysis methods applicable to program and service delivery	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T1_9b	T1. Skill. Describe financial analysis methods applicable to program and service delivery	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T1_9c	T1. Skill Gap. Describe financial analysis methods applicable to program and service delivery	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_10a	T2. Imp. Identify funding mechanisms and procedures to develop sustainable funding models for programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_10b	T2. Skill. Identify funding mechanisms and procedures to develop sustainable funding models for programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_10c	T2. Skill Gap. Identify funding mechanisms and procedures to develop sustainable funding models for programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_11a	T2. Imp. Implement a business plan for agency programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_11b	T2. Skill. Implement a business plan for agency programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_11c	T2. Skill Gap. Implement a business plan for agency programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_12a	T2. Imp. Modify programmatic practices in consideration of internal and external changes	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important

Q3_T2_12b	T2. Skill. Modify programmatic practices in consideration of internal and external changes	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_12c	T2. Skill Gap. Modify programmatic practices in consideration of internal and external changes	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_13a	T2. Imp. Assess the drivers in your environment that may influence public health programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_13b	T2. Skill. Assess the drivers in your environment that may influence public health programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_13c	T2. Skill Gap. Assess the drivers in your environment that may influence public health programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_14a	T2. Imp. Integrate current and projected trends into strategic planning for programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_14b	T2. Skill. Integrate current and projected trends into strategic planning for programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_14c	T2. Skill Gap. Integrate current and projected trends into strategic planning for programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_15a	T2. Imp. Build cross-sector partnerships to address social determinants of health	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_15b	T2. Skill. Build cross-sector partnerships to address social determinants of health	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_15c	T2. Skill Gapp. Build cross-sector partnerships to address social determinants of health	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T2_16a	T2. Imp. Apply quality improvement processes to improve agency programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_16b	T2. Skill. Apply quality improvement processes to improve agency programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_16c	T2. Skill Gap. Apply quality improvement processes to improve agency programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_17a	T2. Imp. Apply findings from a community health assessment or community health improvement plan to agency programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_17b	T2. Skill. Apply findings from a community health assessment or community health improvement plan to agency programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_17c	T2. Skill Gap. Apply findings from a community health assessment or community health improvement plan to agency programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_18a	T2. Imp. Implement an organizational strategic plan	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_18b	T2. Skill. Implement an organizational strategic plan	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_18c	T2. Skill Gap. Implement an organizational strategic plan	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_19a	T2. Imp. Engage community members in the design and implementation of programs to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_19b	T2. Skill. Engage community members in the design and implementation of programs to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T2_19c	T2. Skill Gap. Engage community members in the design and implementation of programs to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_1a	T2. Imp. Communicate in a way that different audiences can understand	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_1b	T2. Skill. Communicate in a way that different audiences can understand	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_1c	T2. Skill Gap. Communicate in a way that different audiences can understand	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_20a	T2. Imp. Identify and engage assets and resources that can be used to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_20b	T2. Skill. Identify and engage assets and resources that can be used to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_20c	T2. Skill Gap. Identify and engage assets and resources that can be used to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_21a	T2. Imp. Engage in collaborations within the public health system, including traditional and non-traditional partners, to improve the health of a community.	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_21b	T2. Skill. Engage in collaborations within the public health system, including traditional and non-traditional partners, to improve the health of a community.	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_21c	T2. Skill Gap. Engage in collaborations within the public health system, including traditional and non-traditional partners, to improve the health of a community.	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T2_22a	T2. Imp. Assess how agency policies, programs, and services advance population health	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_22b	T2. Skill. Assess how agency policies, programs, and services advance population health	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_22c	T2. Skill Gap. Assess how agency policies, programs, and services advance population health	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_2a	T2. Imp. Communicate in a way that persuades others to act	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_2b	T2. Skill. Communicate in a way that persuades others to act	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_2c	T2. Skill Gap. Communicate in a way that persuades others to act	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_3a	T2. Imp. Identify appropriate sources of data and information to assess the health of a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_3b	T2. Skill. Identify appropriate sources of data and information to assess the health of a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_3c	T2. Skill Gap. Identify appropriate sources of data and information to assess the health of a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_4a	T2. Imp. Use valid data to drive decision making	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_4b	T2. Skill. Use valid data to drive decision making	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T2_4c	T2. Skill Gap. Use valid data to drive decision making	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_5a	T2. Imp. Apply evidence-based approaches to address public health issues	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_5b	T2. Skill. Apply evidence-based approaches to address public health issues	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_5c	T2. Skill Gap. Apply evidence-based approaches to address public health issues	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_6a	T2. Imp. Support development of a diverse public health workforce	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_6b	T2. Skill. Support development of a diverse public health workforce	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_6c	T2. Skill Gap. Support development of a diverse public health workforce	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_7a	T2. Imp. Incorporate health equity and social justice principles into planning for programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_7b	T2. Skill. Incorporate health equity and social justice principles into planning for programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_7c	T2. Skill Gap. Incorporate health equity and social justice principles into planning for programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_8a	T2. Imp. Implement socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important

Q3_T2_8b	T2. Skill. Implement socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_8c	T2. Skill Gap. Implement socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T2_9a	T2. Imp. Use financial analysis methods in managing programs and services	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T2_9b	T2. Skill. Use financial analysis methods in managing programs and services	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T2_9c	T2. Skill Gap. Use financial analysis methods in managing programs and services	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_10a	T3. Imp. Leverage funding mechanisms and procedures to develop sustainable funding models for the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_10b	T3. Skill. Leverage funding mechanisms and procedures to develop sustainable funding models for the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_10c	T3. Skill Gap. Leverage funding mechanisms and procedures to develop sustainable funding models for the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_11a	T3. Imp. Design a business plan for the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_11b	T3. Skill. Design a business plan for the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_11c	T3. Skill Gap. Design a business plan for the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T3_12a	T3. Imp. Manage organizational change in response to evolving internal and external circumstances	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_12b	T3. Skill. Manage organizational change in response to evolving internal and external circumstances	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_12c	T3. Skill Gap. Manage organizational change in response to evolving internal and external circumstances	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_13a	T3. Imp. Assess the drivers in your environment that may influence public health programs and services across the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_13b	T3. Skill. Assess the drivers in your environment that may influence public health programs and services across the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_13c	T3. Skill Gap. Assess the drivers in your environment that may influence public health programs and services across the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_14a	T3. Imp. Integrate current and projected trends into organizational strategic planning	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_14b	T3. Skill. Integrate current and projected trends into organizational strategic planning	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_14c	T3. Skill Gap. Integrate current and projected trends into organizational strategic planning	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_15a	T3. Imp. Influence policies external to the organization that address social determinants of health	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_15b	T3. Skill. Influence policies external to the organization that address social determinants of health	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T3_15c	T3. Skill Gap. Influence policies external to the organization that address social determinants of health	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_16a	T3. Imp. Create a culture of quality improvement at the agency or division level	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_16b	T3. Skill. Create a culture of quality improvement at the agency or division level	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_16c	T3. Skill Gap. Create a culture of quality improvement at the agency or division level	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_17a	T3. Imp. Ensure health department representation in a collaborative process resulting in a community health assessment or community health improvement plan.	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_17b	T3. Skill. Ensure health department representation in a collaborative process resulting in a community health assessment or community health improvement plan.	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_17c	T3. Skill Gap. Ensure health department representation in a collaborative process resulting in a community health assessment or community health improvement plan.	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_18a	T3. Imp. Ensure the successful implementation of an organizational strategic plan	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_18b	T3. Skill. Ensure the successful implementation of an organizational strategic plan	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_18c	T3. Skill Gap. Ensure the successful implementation of an organizational strategic plan	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T3_19a	T3. Imp. Ensure community member engagement in the design and implementation of programs to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_19b	T3. Skill. Ensure community member engagement in the design and implementation of programs to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_19c	T3. Skill Gap. Ensure community member engagement in the design and implementation of programs to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_1a	T3. Imp. Communicate in a way that different audiences can understand	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_1b	T3. Skill. Communicate in a way that different audiences can understand	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_1c	T3. Skill Gap. Communicate in a way that different audiences can understand	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_20a	T3. Imp. Negotiate with multiple partners for the use of assets and resources to improve health in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_20b	T3. Skill. Negotiate with multiple partners for the use of assets and resources to improve health in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_20c	T3. Skill Gap. Negotiate with multiple partners for the use of assets and resources to improve health in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_21a	T3. Imp. Build collaborations within the public health system among traditional partners to improve the health of a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_21b	T3. Skill. Build collaborations within the public health system among traditional partners to improve the health of a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert

Q3_T3_21c	T3. Skill Gap. Build collaborations within the public health system among traditional partners to improve the health of a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_22a	T3. Imp. Advocate for needed population health services and programs	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_22b	T3. Skill. Advocate for needed population health services and programs	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_22c	T3. Skill Gap. Advocate for needed population health services and programs	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_2a	T3. Imp. Communicate in a way that persuades others to act	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_2b	T3. Skill. Communicate in a way that persuades others to act	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_2c	T3. Skill Gap. Communicate in a way that persuades others to act	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_3a	T3. Imp. Ensure the use of appropriate sources of data and information to assess the health of a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_3b	T3. Skill. Ensure the use of appropriate sources of data and information to assess the health of a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_3c	T3. Skill Gap. Ensure the use of appropriate sources of data and information to assess the health of a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_4a	T3. Imp. Use valid data to drive decision making	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important

Q3_T3_4b	T3. Skill. Use valid data to drive decision making	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_4c	T3. Skill Gap. Use valid data to drive decision making	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_5a	T3. Imp. Ensure the application of evidence-based approaches to address public health issues	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_5b	T3. Skill. Ensure the application of evidence-based approaches to address public health issues	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_5c	T3. Skill Gap. Ensure the application of evidence-based approaches to address public health issues	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_6a	T3. Imp. Develop a diverse public health workforce	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_6b	T3. Skill. Develop a diverse public health workforce	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_6c	T3. Skill Gap. Develop a diverse public health workforce	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_7a	T3. Imp. Incorporate health equity and social justice principles into planning across the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_7b	T3. Skill. Incorporate health equity and social justice principles into planning across the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_7c	T3. Skill Gap. Incorporate health equity and social justice principles into planning across the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill

Q3_T3_8a	T3. Imp. Ensure the implementation of socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_8b	T3. Skill. Ensure the implementation of socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_8c	T3. Skill Gap. Ensure the implementation of socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q3_T3_9a	T3. Imp. Use financial analysis methods in making decisions about programs and services across the agency	1 = Not important; 2 = Somewhat unimportant; 3 = Somewhat important; 4 = Very important
Q3_T3_9b	T3. Skill. Use financial analysis methods in making decisions about programs and services across the agency	1 = Not applicable; 2 = Unable to perform; 3 = Beginner; 4 = Proficient; 5 = Expert
Q3_T3_9c	T3. Skill Gap. Use financial analysis methods in making decisions about programs and services across the agency	1 = Low Imp/Low Skill; 2 = Low Imp/High Skill; 3 = High Imp/Low Skill; 4 = High Imp/High Skill
Q4_3_Q4_3_5	How much, if anything, have you heard about the following concepts in public health? Public health and primary care integration	2= Nothing at all; 3 = Not much; 4 = A little; 5 = A lot
Q4_3_Q4_3_6	How much, if anything, have you heard about the following concepts in public health? Evidence-Based Public Health Practice (EBPH)	2= Nothing at all; 3 = Not much; 4 = A little; 5 = A lot
Q4_3_Q4_3_7	How much, if anything, have you heard about the following concepts in public health? Health in All Policies (HiAP)	2= Nothing at all; 3 = Not much; 4 = A little; 5 = A lot
Q4_3_Q4_3_15	How much, if anything, have you heard about the following concepts in public health? Multisectoral collaboration	2= Nothing at all; 3 = Not much; 4 = A little; 5 = A lot

Q4_3_Q7_2	How much, if anything, have you heard about the following concepts in public health? Fostering a culture of quality improvement (QI)	2= Nothing at all; 3 = Not much; 4 = A little; 5 = A lot
Q5_3	Supervisory status	1 = Non-supervisor; 3 = Supervisor; 4 = Manager, 5 = Executive
Q5_8	Gender	1 = Male; 2 = Female; 3 = Non-binary/Other
Q5_16	Are you considering leaving your organization within the next year?	1 = No; 2 = Yes, to retire; 3 = Yes, to take another governmental job (in public health); 4 = Yes, to take another governmental job (not in public health); 5 = Yes, to take a nongovernmental job (in public health); 6 = Yes, to take a nongovernmental job (not in public health); 7 = Yes, other
Q5_25	Job classification	156 = Epidemiologist; many others
Q5_10XC	Race / Ethnicity collapsed	1 = American Indian or Alaska Native; 2 = Asian; 3 = Black or African American; 4 = Hispanic or Latino; 5 =Native Hawaiian or other Pacific Islander; 6 = White; 7 = 2 or more races
Q5_11X	Age in years (categories)	1 = 20 or below; 2 = 21-25; 3 = 26-30; 4 = 31-35; 5 = 36-40; 6 = 41-45; 7 = 46-50; 8 = 51-55; 9 = 56-60; 10 = 61-65; 11 = 66-70; 12 = 71-75; 13 = 76 or above
Q5_12_1X	Tenure in Current Position (categories)	1 = 0-5 years; 2 = 6-10 years; 3 = 11-15 years; 4 = 16-20 years; 5 = 21 or above
Q5_12_3X	Tenure in Public Health Practice (categories)	1 = 0-5 years; 2 = 6-10 years; 3 = 11-15 years; 4 = 16-20 years; 5 = 21 or above

Q5_34	Primary program area	573 = Administration/Administrative Support; 574 = Animal Control; 575 = Clinical Services (excluding TB, STD, family planning); 576 = Clinical Services - Immunizations; 577 = Communicable Disease - HIV; 578 = Communicable Disease - STD; 579 = Communicable Disease - Tuberculosis; 580 = Other Communicable Disease; 581 = Community Health Assessment/Planning; 582 = Emergency Medical Services; 583 = Emergency Preparedness; 584 = Environmental Health; 585 = Epidemiology Surveillance; 586 = Global Health; 587 = Health Education; 588 = Health Promotion/Wellness; 589 = Informatics; 590 = Injury/Violence Prevention; 591 = Maternal and Child Health; 592 = Maternal and Child Health - Family Planning; 593 = Maternal and Child Health - WIC; 594 = Medical Examiner; 595 = Mental Health; 596 = Non-Communicable Disease; 597 = Oral Health/Clinical Dental Services; 598 = Program Evaluation; 599 = Public Health Genetics; 600 = Public Health Laboratory; 601 = Substance Abuse, including tobacco control programs; 602 = Training/Workforce Development; 603 = Vital Records; 604 = Other Program Area (specify)
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New Variables		
TenureCat	Tenure in Public Health Practice (variable Q5_12_3X) recoded	1 = 5 years or less; 2 = 6-15 years; 3 = 16 or more years
budfinman	Used for skill gap analysis. Composite variable that combines Budget and Financial Management skills: Skill Gap Variables: Q3_T1_9c, Q3_T1_10c, Q3_T1_11c, Q3_T2_9c, Q3_T2_10c, Q3_T2_11c, Q3_T3_9c, Q3_T3_10c, Q3_T3_11c	If any subvariable was reported as a skill gap, then budfinman = 1, else budfinman = 0.
changeman	Used for skill gap analysis. Composite variable that combines Change Management skills: Skill Gap Variables: Q3_T1_12c, Q3_T1_13c, Q3_T2_12c, Q3_T2_13c, Q3_T3_12c, Q3_T3_13c	If any subvariable was reported as a skill gap, then changeman = 1, else changeman = 0.
crosssectpart	Used for skill gap analysis. Composite variable that combines Cross Sector Partnership skills:	If any subvariable was reported as a skill gap, then crosssectpart = 1, else crosssectpart = 0
cultcomp	Used for skill gap analysis. Composite variable that combines Cultural Competency skills: Skill Gap Variables: Q3_T1_6c, Q3_T1_7c, Q3_T1_8c, Q3_T2_6c, Q3_T2_7c, Q3_T2_8c, Q3_T3_6c, Q3_T3_7c, Q3_T3_8c	If any subvariable was reported as a skill gap, then cultcomp = 1, else cultcomp = 0.
datadec	Used for skill gap analysis. Composite variable that combines Data for Decision-Making skills: Skill Gap Variables: Q3_T1_3c, Q3_T1_4c, Q3_T1_5c, Q3_T2_3c, Q3_T2_4c, Q3_T2_5c, Q3_T3_3c, Q3_T3_4c, Q3_T3_5c	If any subvariable was reported as a skill gap, then datadec = 1, else datadec = 0.
docdeg	Highest Degree attained variable recorded	If doctoral degree then docdeg=1, else docdeg = 0
ebphheard	Evidence-Based Public Health Practice (EBPH) Q135_x6	0 = Nothing at all or Not much; 1 = A little or A lot
ebphimpact	Evidence-Based Public Health Practice (EBPH) Q4_3_Q4_3_6	0 = Not at all or Not too much; 1 = Impact fair amount or Impact great deal
effcomm	Used for skill gap analysis. Composite variable that combines Effective Communication skills: Skill Gap Variables: Q3_T1_1c, Q3_T1_2c,	If any subvariable was reported as a skill gap, then

	Q3_T2_1c, Q3_T2_2c, Q3_T3_1c, Q3_T3_2c	effcomm = 1, else effcomm = 0.
empinvolved	Recoded: Q2_3_68 I feel completely involved in my work	1 = strongly agree or agree; 0 = neither agree or disagree, disagree, or strongly disagree
emplearn	Recoded: Q2_3_52 Employees learn from one another as they do their work	1 = strongly agree or agree; 0 = neither agree or disagree, disagree, or strongly disagree
hiapheard	Health in All Policies (HiAP) (variable Q135_x7) recoded to be dichotomous.	0 = Nothing at all or Not much; 1 = A little or A lot
hiapimpact	Health in All Policies (HiAP) (variable Q4_3_Q4_3_7) recoded to be dichotomous.	0 = Not at all or Not too much; 1 = Impact fair amount or Impact great deal
integrationheard	Public health and primary care integration (variable Q135_x5) recoded to be dichotomous.	0 = Nothing at all or Not much; 1 = A little or A lot
integrationimpact	Public health and primary care integration (variable Q4_3_Q4_3_5) recoded to be dichotomous.	0 = Not at all or Not too much; 1 = Impact fair amount or Impact great deal
intentiontoleave	Recoded intent to leave variable (Q5_16) to be dichotomous	0 = no, else =1
jobsat	Job satisfaction (variable Q2_6_1) recoded to be dichotomous.	0 = Very dissatisfied, Somewhat dissatisfied, or Neither dissatisfied nor satisfied; 1 = Somewhat satisfied or Very satisfied
leavelacktrain	Intent to leave due to lack of training (variable Q127_21) recoded to be dichotomous.	0 = No; 1 = Yes
male	Gender (variable Q5_8) recoded to be dichotomous.	1 = male; else = 0
manager	Recoded Supervisory Status variable	0 = Non-supervisor or Supervisor; 1 = Manager or Executive
mastdocdeg	Recoded HighestDegree variable	0 = Bachelor's degree or less; 1 = Master's degree or Doctoral degree
mscollabheard	Multisectoral collaboration (variable Q135_x15) recoded to be dichotomous.	0 = Nothing at all or Not much; 1 = A little or A lot

mcollabimpact	Multisectoral collaboration (Q4_3_Q4_3_15) recoded to be dichotomous.	0 = Not at all or Not too much; 1 = Impact fair amount or Impact great deal
qiheard	Fostering a culture of quality improvement (QI) (variable Q135_x2) recoded to be dichotomous.	0 = Nothing at all or Not much; 1 = A little or A lot
qiimpact	Fostering a culture of quality improvement (QI) (variable Q4_3_Q7_2) recoded to be dichotomous.	0 = Not at all or Not too much; 1 = Impact fair amount or Impact great deal
racecat	Race / Ethnicity collapsed (variable Q5_10XC) recoded to....	0 = white, non-hispanic, else racecat = 1
supervisor	Recoded Supervisory Status variable	1 = Non-supervisor; 2 = Supervisor; 3 = Manager or Executive
supervisor2	Recoded Supervisory Status variable	0 = Non-supervisor; 1 = Supervisor, Manager or Executive
supopp	Recoded: My supervisor provides me with opportunities to demonstrate my leadership skills	1 = strongly agree or agree; 0 = neither agree or disagree, disagree, or strongly disagree
systhink	Used for skill gap analysis. Composite variable that combines Systems and Strategic Thinking skills: Skill Gap Variables: Q3_T1_14c, Q3_T1_15c, Q3_T1_17c, Q3_T2_14c, Q3_T2_15c, Q3_T2_16c, Q3_T2_18c, Q3_T3_14c, Q3_T3_15c, Q3_T3_16c, Q3_T3_18c	If any subvariable was reported as a skill gap, then systhink = 1, else systhink = 0.
techtraining	Recoded: Employees have sufficient training to fully utilize technology needed for their work	1 = strongly agree or agree; 0 = neither agree or disagree, disagree, or strongly disagree
tenure16ormore	Tenure in Public Health Practice (variable Q5_12_3X) recoded	1 = 16 years or more; 0 = less than 16 years
tenure6ormore	Tenure in Public Health Practice (variable Q5_12_3X) recoded	1 = 6 years or more; 0 = less than 6 years
trainingneeds	Recoded: My training needs are assessed	1 = strongly agree or agree; 0 = neither agree or disagree, disagree, or strongly disagree
trainmotavailiptrain	Recoded: Training Motivator - Availability of applicable in-person training opportunities	0 = No; 1 = Yes

trainmotavailoltrain	Recoded: Training Motivator - Availability of applicable online training opportunities	0 = No; 1 = Yes
trainmotcovtime	Recoded: Training Motivator - Covered time for training	0 = No; 1 = Yes
trainmotlic	Recoded: Training Motivator - Maintenance of licensure	0 = No; 1 = Yes
trainmotmandate	Recoded: Training Motivator - Mandated by agency supervisor/management/leadership	0 = No; 1 = Yes
trainmotnone	Recoded: Training Motivator - None of the above	0 = No; 1 = Yes
trainmotother	Recoded: Training Motivator - Other	0 = No; 1 = Yes
trainmotpaidtravel	Recoded: Training Motivator - Paid travel for training	0 = No; 1 = Yes
trainmotpeers	Recoded: Training Motivator - Peers were taking it	0 = No; 1 = Yes
trainmotperfrev	Recoded: Training Motivator - Taken into account during performance reviews	0 = No; 1 = Yes
trainmotpgrowth	Recoded: Training Motivator - Personal growth/interest	0 = No; 1 = Yes
trainmotprom	Recoded: Training Motivator - Requirement for promotion	0 = No; 1 = Yes
trainmotsupexp	Recoded: Training Motivator - Expectation from my supervisor	0 = No; 1 = Yes
under30	Recoded Age in years (categories) variable Q5_11X	1 = age less than 30 years; 0 = age 30 years or greater
AgeCat	Recoded Age in years (categories) variable Q5_11X	1=30 or under; 2=31-40; 3=41-50; 4=51-60; 5=61 and over
DevVis	Used for skill gap analysis. Composite variable that combines Developing a Vision for a Healthy Community skills:Skill Gap Variables: Q3_T1_16c, Q3_T1_18c, Q3_T1_21c, Q3_T2_17c, Q3_T2_19c, Q3_T2_22c, Q3_T3_17c, Q3_T3_19c, Q3_T3_22c	If any subvariable was reported as a skill gap, then DevVis = 1, else DevVis = 0.
HighestDegree2	Recoded HighestDegree variable	1= Bachelors degree or less; 2= Masters degree; 3= Doctoral degree

Note: Variables used to apply the national sample weights are not included in this table. These variables are SHA/LOCAL NATWTS and BRR REPWT1 through BRR REPWT40, which were used to apply the balanced repeated replicates weighting.

APPENDIX 4: STATE EPIDEMIOLOGIST SURVEY RECRUITMENT AND REMINDER EMAILS

Email #1: Sent August 29, 2019, one week prior to survey deployment by the Council of State and Territorial Epidemiologists

Subject: Upcoming Applied Epidemiology Workforce Assessment

Sent to State Epidemiologists

In early September, you will be sent an applied epidemiology workforce assessment from Beth Daly, CSTE's Workforce Subcommittee co-chair and Deputy State Epidemiologist in New Hampshire. We are writing to encourage you to complete this assessment. In addition to her roles at CSTE and in New Hampshire, Beth is also a doctoral student at UNC Chapel Hill. Data from her assessment will be shared with CSTE to complement the Epidemiology Capacity Assessment and to inform future CSTE workforce development activities. As such, we hope Beth's assessment will achieve CSTE's customary 100% response rate from all jurisdictions.

If you have any questions about this survey, you can contact Beth at erdaly@unc.edu or Jessica Arrazola at jarrazola@cste.org or 770-458-3811.

Sincerely,

Jeffrey Engel, MD

Executive Director

Email #2: Survey deployment sent Via Qualtrics on September 4, 2019

Subject: State Epidemiologist Applied Epidemiology Workforce Assessment: Response Requested by September 30, 2019

Hello-

You are receiving this email because you are listed as a State Epidemiologist by the Council of State and Territorial Epidemiologists (CSTE). I am writing to you as a doctoral student at the University of North Carolina at Chapel Hill. I am conducting my dissertation research on the role and readiness of state health department epidemiologists to work in emerging areas of public health practice (UNC IRB#18-2687).

Please complete this electronic survey by Monday, September 30th, 2019.

To participate, follow this link to the survey:

A pdf Survey Preview is attached here for your reference.

The purpose of this survey is to collect information on emerging areas of public health practice, epidemiology career ladders, and the use of the [Applied Epidemiology Competencies](#) in state public health agencies. The District of Columbia and the territories are also invited to participate. The data will be used for my dissertation and will be shared with CSTE to inform future CSTE workforce development activities.

Participation in this survey is voluntary and should take approximately 20 minutes or less. Your responses will be kept confidential and will not be shared with the exception of with CSTE National Office Staff. All responses will be reported in aggregate except to generate a list of states with epidemiology-specific job classifications and epidemiology-specific career ladders. If you have any questions about this survey, please contact me at erdaly@unc.edu.

Sincerely,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Student

Gillings School of Global Public Health

University of North Carolina, Chapel Hill, NC

erdaly@unc.edu

Emails #2 and #3: Reminder emails sent Via Qualtrics on September 13, 2019 and September 23, 2019

Subject: REMINDER: State Epidemiologist Applied Epidemiology Workforce Survey:

Response Requested by September 30th

Hello-

This is a reminder to participate in the Applied Epidemiology Workforce Survey. You are receiving this email because you are listed as a State Epidemiologist by the Council of State and Territorial Epidemiologists (CSTE). The data will be shared with CSTE to inform future CSTE workforce development activities and will be used for my dissertation research at the University of North Carolina at Chapel Hill on the role and readiness of state health department epidemiologists to work in emerging areas of public health practice (UNC IRB#18-2687).

Please complete this electronic survey by Monday, September 30th, 2019.

To participate, follow this link to the survey:

A pdf Survey Preview is attached here for your reference.

Participation in this survey is voluntary and should take approximately 20 minutes or less. Your responses will be kept confidential and will not be shared with the exception of with CSTE National Office Staff. All responses will be reported in aggregate except to generate a list of states with epidemiology-specific job classifications and epidemiology-specific career ladders. If you have any questions about this survey, please contact me at erdaly@unc.edu.

Sincerely,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Student

Gillings School of Global Public Health

University of North Carolina at Chapel Hill

erdaly@unc.edu

**Email #4: Reminder email with deadline extension sent Via Qualtrics on
September 30, 2019**

Subject: DEADLINE EXTENDED: Applied Epidemiology Workforce Assessment now due
October 18, 2019

Hello -

In consideration of the ongoing national public health responses and our desire to achieve a 100% response rate from all jurisdictions, the deadline for completing the State Epidemiologist Applied Epidemiology Workforce Assessment has been extended to October 18, 2019.

Please complete this electronic survey by Friday, October 18th, 2019.

To participate, follow this link to the survey:

A pdf Survey Preview is attached here for your reference. The survey works best when completed in a single setting, which takes approximately 20 minutes or less, depending on if your jurisdiction has epidemiology-specific job classifications.

Additional information about the survey has been sent in earlier emails and is also available when you click on the survey link. If you have any questions about this survey, please contact me at erdaly@unc.edu.

Thank you,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Candidate

Gillings School of Global Public Health

University of North Carolina, Chapel Hill, NC

erdaly@unc.edu

Email #5: Reminder email sent Via Qualtrics on October 9, 2019

Subject: REMINDER: Applied Epidemiology Workforce Assessment due October 18, 2019

Hello -

This is a reminder to participate in the State Epidemiologist Applied Epidemiology Workforce Survey. We hope to achieve a 100% response rate from all jurisdictions.

Please complete this electronic survey by Friday, October 18th, 2019.

To participate, follow this link to the survey:

A pdf Survey Preview is attached here for your reference. The survey works best when completed in a single setting, which takes approximately 20 minutes or less, depending on if your jurisdiction has epidemiology-specific job classifications.

Additional information about the survey has been sent in earlier emails and is also available when you click on the survey link. If you have any questions about this survey, please contact me at erdaly@unc.edu.

Thank you,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Candidate

Gillings School of Global Public Health

University of North Carolina, Chapel Hill, NC

erdaly@unc.edu

Email #6: Final reminder email sent Via Qualtrics on October 16, 2019

Subject: FINAL REMINDER: Applied Epidemiology Workforce Assessment due October 18, 2019

Hello -

We hope you will be able to complete the State Epidemiologist Applied Epidemiology Workforce Assessment in the final days the survey is open. We would very much like to achieve a 100% response rate from all jurisdictions.

Please complete this electronic survey by Friday, October 18th, 2019.

To participate, follow this link to the survey:

A pdf Survey Preview is attached here for your reference. The survey works best when completed in a single setting, which takes approximately 20 minutes or less, depending on if your jurisdiction has epidemiology-specific job classifications.

Additional information about the survey has been sent in earlier emails and is also available when you click on the survey link. If you have any questions about this survey, please contact me at erdaly@unc.edu.

Thank you,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Candidate

Gillings School of Global Public Health

University of North Carolina, Chapel Hill, NC

erdaly@unc.edu

APPENDIX 5: STATE EPIDEMIOLOGIST SURVEY CONSENT FORM

**University of North Carolina at Chapel Hill
Consent to Participate in a Research Study
Electronic Survey Consent for Adult Participants**

Consent Form Version Date: 07/28/2019

IRB Study # 18-2687

Title of Study: Exploring the Role and Readiness of State Health Department Epidemiologists to work in Emerging Areas of Public Health Practice in the United States

Principal Investigator: Elizabeth Daly

Principal Investigator Department: Health Policy and Management Operations

Principal Investigator Phone number: 603-661-0553

Principal Investigator Email Address: erdaly@unc.edu

Faculty Advisor: Leah Devlin

Faculty Advisor Contact Information: 919-696-7095

The purpose of this survey research is to better understand the role and readiness of state health department epidemiologists to work in emerging areas of public health practice to identify training needs and options to promote epidemiology practice in the changing landscape of public health. Additionally, this survey will collect information on use of career ladders and the Applied Epidemiology Competencies in your jurisdiction.

Completion of this survey is expected to take 20 minutes. Your responses are voluntary and will be kept confidential, except that a list of states with epidemiology-specific job classifications and epidemiology-specific career ladders will be generated. Otherwise, all responses will not be identified by individual, but rather compiled together and analyzed as a group. Your individual data will be shared with the Council of State and Territorial Epidemiologists (CSTE) National Office Staff, who will only report data in aggregate.

There are no significant risks anticipated from your participation in this study. A potential benefit of participation is your opportunity to contribute to our understanding of current and future epidemiology practice that can lead to future training and other opportunities to advance applied epidemiology practice in the United States.

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may choose not to participate, or you may withdraw your consent to be in the study, for any reason, without penalty. Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies. Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

This study will seek to better understand the role and readiness of state health department epidemiologists to work in emerging areas of public health practice. Specifically, this study aims to define the role of state health department epidemiologists in emerging areas of public health practice, to assess self-reported competency of state health department epidemiologists, and understand how epidemiology career ladders are used in state health departments to support epidemiology competency and practice. **The survey will explore this topic and collect information that would be useful to improving state epidemiologists' practice in emerging areas of public health practice.**

You are being asked to be in the study because **you are the designated State Epidemiologist for your jurisdiction.**

Are there any reasons you should not be in this study?

You should not be in this study if you do not want information you provide included in this study or shared with the Council of State and Territorial Epidemiologists.

How many people will take part in this study?

There will be approximately 1,075 people in this research study, of which 51 are participating in the State Epidemiologist survey component of the study.

How long will your part in this study last?

Your participation in this survey will last approximately 20 minutes plus the time it takes to gather and submit your jurisdictions' epidemiology job descriptions, if applicable.

What will happen if you take part in the study?

You will be asked to complete an electronic survey.

What are the possible benefits from being in this study?

A potential benefit of participation is your opportunity to contribute to our understanding of current and future epidemiology practice that can lead to future training and other opportunities to advance applied epidemiology practice in the United States.

What are the possible risks or discomforts involved from being in this study?

We do not anticipate any risks or discomfort to you from being in this study.

How will information about you be protected?

Every effort will be taken to protect your identity as a participant in this study. You will not be identified in any report or publication of this study or its results. We may use de-identified data from this study in future research without additional consent.

What if you want to stop before your part in the study is complete?

You can withdraw from this study at any time, without penalty. The investigators also have the right to stop your participation, or the entire study, at any time.

Will you receive anything for being in this study?

No compensation will be provided for your participation in this study.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions about the study (including payments), complaints, concerns, or if a research-related injury occurs, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject, or if you would like to obtain information or offer input, you may contact the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above and I indicate my voluntarily agreement to participate in this research study by clicking "Next".

APPENDIX 6: STATE EPIDEMIOLOGIST SURVEY

State Epidemiologist Applied Epidemiology Workforce Survey

Start of Block: Introduction

PURPOSE: The purpose of this survey is to collect information on emerging areas of public health practice, epidemiology career ladders, and the use of the Applied Epidemiology Competencies in state public health agencies. The District of Columbia and the territories are also invited to participate.

This survey is being conducted as part of dissertation research and has been approved by the University of North Carolina at Chapel Hill Institutional Review Board (UNC IRB#18-2687). Please read the consent to participate in this research [here](#). You consent to participate in this study by clicking the “Next” button at the bottom of this screen.

CONFIDENTIALITY: Your responses are voluntary and will be kept confidential, except that a list of states with epidemiology-specific job classifications and epidemiology-specific career ladders will be generated. Otherwise, all responses will not be identified by individual, but rather compiled together and analyzed as a group. Your individual data will be shared with the Council of State and Territorial Epidemiologists (CSTE) National Office Staff, who will only report data in aggregate.

RESPONSE: Participation in this survey should take approximately 20 minutes or less. If there is more than one designated State Epidemiologist in your jurisdiction, please coordinate to provide one response for your jurisdiction.

Please complete this survey by Monday, September 30, 2019.

Documents available for your reference while participating in this survey:

[Survey Preview](#) (pdf)

[Definitions of Emerging Areas of Public Health Practice](#) (pdf)

[Applied Epidemiology Competencies](#) (website)

If you have any questions about this survey, please contact Elizabeth Daly, principal investigator, at erdaly@unc.edu.

End of Block: Introduction

Start of Block: The Jurisdiction's Designated State Epidemiologist Position

This section collects information about the jurisdiction's designated "State Epidemiologist" position, which is generally the most senior epidemiology position found in state health departments.

How many years have you served as the designated State Epidemiologist in this jurisdiction?

01234567891011121314151617181920212223242526272829303132333435

Years	
-------	--

Is the State Epidemiologist position in your jurisdiction an appointed position (i.e. appointed by the governor, agency head, or similar political office)?

- Yes
- No

Display This Question:

If Is the State Epidemiologist position in your jurisdiction an appointed position = Yes

Who appoints the State Epidemiologist?

- Governor
- Agency Head
- Other _____

Display This Question:

If Is the State Epidemiologist position in your jurisdiction an appointed position = Yes

Does this appointment require additional confirmation by a political body?

- Yes
- No

Does the State Epidemiologist in your jurisdiction participate as a member of your public health agency's senior management/leadership/executive team?

- Yes
 - No
 - Other _____
-

What is the minimum educational requirement for the State Epidemiologist position in your jurisdiction?

- Medical Doctor, Doctor of Osteopathic Medicine only
 - Any doctoral degree (MD, PhD, DrPH, DVM, DDS, etc.) Note: If only certain types of doctoral degrees are permissible, select "Other" and list the specific types.
 - Master's degree or higher
 - Bachelor's degree or higher
 - No minimum educational requirement
 - Other _____
-

Is your jurisdiction's delivery of public health epidemiology services considered:

- Centralized
- Decentralized
- Mixed or Other _____

End of Block: The Jurisdiction's Designated State Epidemiologist Position

Start of Block: Emerging Areas of Public Health Practice

The following questions ask about the role and readiness of epidemiologists for working in emerging areas of public health practice.

For this assessment, epidemiologists are people working in your agency who study 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. This is the same definition used by the CSTE Epidemiology Capacity Assessment.

The emerging areas of public health practice listed here are those that are included in the national Public Health Workforce Interests and Needs Survey; however, we are interested in collecting additional areas you think are relevant to epidemiologists and there is a place for you to provide those.

For reference, we provide operational definitions of emerging areas of public health practice here, and we recommend you refer to them before answering.

Fostering a culture of quality improvement: An integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization (PH WINS).

Public health and primary care integration: The linking of public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health (IOM, 2012).

Evidence-Based Public Health Practice: Making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned (Brownson et al., 2009).

Health in All Policies: A collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people (PH WINS).

Multisectoral collaboration: Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest (PH WINS).

How ***important*** do you feel the following emerging areas of public health practice are to the role of epidemiologists working within your agency?

	Not important	Slightly important	Important	Very important
Fostering a culture of quality improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public health and primary care integration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evidence-Based Public Health Practice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health in All Policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multisectoral collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How would you rate the ***overall readiness*** of epidemiologists working within your agency for working in the emerging areas of public health practice listed below?

	Not ready	Slightly ready	Ready	Very ready
Fostering a culture of quality improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public health and primary care integration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evidence-Based Public Health Practice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health in All Policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multisectoral collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are there any additional emerging areas of public health practice that you feel are important to the role of epidemiologists within your agency?

Yes

No

Display This Question:

If Are there any additional emerging areas of public health practice that you feel are important = Yes

List additional emerging areas of public health practice and provide information on their importance and epidemiologists' readiness for working in these areas. If there are more than five areas you would like to list, list the five you think are most important.

	Additional Areas	Overall <u>importance</u> of this area to the role of epidemiologists working in your agency.				Overall <u>readiness</u> of epidemiologists working in your agency to work in this area.			
		Please List	Not important	Slightly important	Important	Very important	Not ready	Slightly ready	Ready
Area 1		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 2		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 3		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 4		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 5		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Emerging Areas of Public Health Practice

Start of Block: Epidemiologist Classifications

The purpose of this section is to understand the use of epidemiology job classifications in state health departments.

A job classification system uses a process to classify jobs in a standardized way based on accountabilities, educational and experience requirements, knowledge, skill, and abilities, or other areas.

Does your agency use a job classification system for purposes such as structuring or assigning job descriptions and pay grades?

- Yes
- No
- I don't know _____

Skip To: Next Question If Does your agency use a job classification system = Yes

Skip To: End of Block If Does your agency use a job classification system = No

Skip To: End of Block If Does your agency use a job classification system = I don't know

Does your agency have epidemiology-specific job classifications? Epidemiology-specific job classifications are classifications that are only used for epidemiologists and not for non-epidemiology positions. The word "epidemiologist" may not necessarily be in the title of the classification.

- Yes
- No
- I don't know _____

Skip To: Next Question If Does your agency have epidemiology-specific job classifications = Yes

Skip To: End of Block If Does your agency have epidemiology-specific job classifications = No

Skip To: End of Block If Does your agency have epidemiology-specific job classifications = I don't know

What is the title(s) of the job classification(s) that is **only** used for epidemiologists in your agency's job classification system?

Note: We are looking for the title of job classifications used within your jurisdiction's job classification system (e.g. Epidemiologist I, Epidemiologist II, etc.) and not the title of individual positions (e.g. HIV Epidemiologist, Chronic Disease Epidemiology Manager, etc.).

If you have more than 10 epidemiology-specific job classifications in use in your jurisdiction, please email erdaly@unc.edu.

	List of Titles	To the best of your knowledge, have the Applied Epidemiology Competencies ever been used to create or update this classification?		
		Yes	Yes	I don't know
Title 1		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 2		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 3		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 4		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 5		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 6		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 7		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 8		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 9		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Title 10		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To what extent do you agree with the statement: Having an epidemiology-specific job **classification** has positively contributed to recruitment and retention of epidemiologists in my agency.

Use the following definitions when answering this question:

Recruitment: The process of attracting, selecting, and appointing qualified candidates for epidemiology positions within your organization.

Retention: Your ability to keep qualified epidemiologists employed within your organization.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Recruitment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Retention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Epidemiologist Classifications

Start of Block: Epidemiologist Career Ladders

The purpose of this section is to understand the use of epidemiology-specific career ladders in state health departments.

A career ladder within a job classification system is a formal pathway that allows for progression from an entry level position to higher level positions of pay, skill, responsibility, and/or authority.

The career ladder may allow for automatic progression once an individual meets minimum criteria and satisfactory job performance to move to the next level, or it may require a reclassification, hiring, or promotion process to advance to the next level.

Does your agency have a formal career ladder (i.e. progressive job classifications) for epidemiologists, such as Epidemiologist I, Epidemiologist II, Epidemiologist III, etc.?

- Yes
- No
- I don't know _____

Skip To: Next Question If Does your agency have a formal career ladder = Yes

Skip To: End of Block If Does your agency have a formal career ladder = No

Skip To: End of Block If Does your agency have a formal career ladder = I don't know

Which of the following factors is your career ladder's steps based on? (check all that apply)

- Increasing supervisory responsibility
 - Year's work experience
 - Completion of formal education
 - Increases in technical ability or developing new skills
 - Demonstrating mastery of epidemiology competencies
 - Other _____
 - I don't know
-

How do individuals advance to the next level of the career ladder?

- Automatic advancement to next level once an individual meets minimum criteria and satisfactory job performance
- Advancement to next level is not automatic and instead requires a reclassification, hiring, or promotion process
- Other _____

To what extent do you agree with the statement: Having an epidemiology-specific ***career ladder*** has positively contributed to recruitment and retention of epidemiologists in my agency.

Use the following definitions when answering this question:

Recruitment: The process of attracting, selecting, and appointing qualified candidates for epidemiology positions within your organization.

Retention: Your ability to keep qualified epidemiologists employed within your organization.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Recruitment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Retention	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To the best of your knowledge, have the [Applied Epidemiology Competencies](#) ever been used to create or update this career ladder?

- Yes
- No
- I don't know _____

End of Block: Epidemiologist Career Ladders

Start of Block: Closing

This section asks about your jurisdiction's experience with the [Applied Epidemiology Competencies](#) and about the challenges you face in regards to epidemiology workforce development.

Has your agency used the [Applied Epidemiology Competencies](#) in any of the following ways? (check all that apply)

- To create / update job descriptions
- To evaluate epidemiology employee performance
- To assess epidemiology training needs
- To develop epidemiology training plans
- Other _____
- We have never used the Applied Epidemiology Competencies as far as I know

What, if any, comments would you would like to share regarding your agency's use of the [Applied Epidemiology Competencies](#)?

How ***useful*** are the [Applied Epidemiology Competencies](#) to your management of epidemiologists working in your agency?

- Extremely useful
 - Very useful
 - Moderately useful
 - Slightly useful
 - Not at all useful
 - I do not have experience using the Applied Epidemiology Competencies in my agency
-

How ***relevant*** are the [Applied Epidemiology Competencies](#) to the ***current work*** of epidemiologists working in your agency?

- Extremely relevant
 - Very relevant
 - Moderately relevant
 - Slightly relevant
 - Not at all relevant
 - I do not feel familiar enough with the Applied Epidemiology Competencies to answer this question
-

How ***relevant*** are the [Applied Epidemiology Competencies](#) to the ***future work*** of epidemiologists working in your agency?

- Extremely relevant
 - Very relevant
 - Moderately relevant
 - Slightly relevant
 - Not at all relevant
 - I do not feel familiar enough with the Applied Epidemiology Competencies to answer this question
-

Do you think the [Applied Epidemiology Competencies](#) need to be updated?

- Yes, comments: _____
- No, comments: _____
- I don't know, comments: _____

Rank, in order, the challenges your organization faces in regards to epidemiology workforce development, with number 1 representing the biggest challenge. To rank, drag the items above and below one another until they are listed in order from the biggest challenge to the smallest challenge.

- _____ Lack of funding to pay for training
- _____ Lack of appropriate training opportunities
- _____ Lack of information on training needs
- _____ Lack of organizational support to approve travel or training
- _____ Lack of time due to competing priorities
- _____ Lack of qualified epidemiology staff due to recruitment challenges
- _____ Lack of qualified epidemiology staff due to retention challenges
- _____ Other

In the space below, you may enter any additional comments you would like to share about the topics of the role and readiness of epidemiologists in emerging areas of public health practice, epidemiology-specific job classifications, epidemiology career ladders, or the Applied Epidemiology Competencies.

Display This Question:

If Does your agency have epidemiology-specific job classifications = Yes

Please upload or link to your organization's epidemiology-specific job classification(s) below. If you do not have these available now, you can complete the survey and email them to erdaly@unc.edu or you will be contacted later to collect them.

Important: Only provide classifications that are used only for epidemiologists and not for non-epidemiology positions. We are interested in collecting job classifications and not individual position or job descriptions.

Display This Question:

If Does your agency have epidemiology-specific job classifications = Yes

Option to upload epidemiology-specific job classifications. You can upload one file at a time in each space provided. Alternatively, you can email these files to erdaly@unc.edu. If you have more than five files to upload, please email the files to erdaly@unc.edu.

Options to upload additional files.

End of Block: Closing

Submit button.

Post-survey message with option to export survey responses will appear after submitting.
"Thank you for your time spent taking this survey. Your response has been recorded."

APPENDIX 7: EMERGING AREAS OF PUBLIC HEALTH PRACTICE DEFINITIONS FOR JOB CLASSIFICATION CONTENT ANALYSIS

Practice Area	Explicit Reference	Implicit Reference
Quality Improvement	Refers specifically to quality improvement, continuous quality improvement, continuous improvement	Refers generally to monitoring program performance to identify problems and recommend /making changes to improve the program. Does not include reference to quality assurance activities only, for example of data, without also referencing improvement activities.
Public Health and Healthcare Integration	Refers specifically to integrating public health and healthcare through activities aimed at improving population health	Refers generally to collaborating with healthcare systems or providers through activities to address public health problems.
Evidence-Based Public Health Practice	Refers specifically to "evidence-based" or "science-based" accountabilities	Refers generally to creating or using scientific information or evidence, reviewing literature, or being knowledgeable in content, science, or methods of the field to inform practice.
Health in All Policies	Refers specifically to Health in All Policies	Refers generally to policy-making that involves collaboration across health and non-health sectors to improve population health.
Policy-Making	Refers specifically to being engaged or informing any type of legislative policy-making process	Not applicable
Multisectoral Collaboration	Refers specifically to multisectoral collaboration	Refers generally to collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) aimed at improving population health.
Informatics	Refers specifically to informatics	Refers to effective use of information technology or developing or maintaining surveillance or data collection information technology systems or databases.
Social Determinants of Health and Health Disparities	Refers specifically to social determinants of health, health disparities, health inequities, or health equity	Refers to the social environment, physical environment, health services, and structural and societal factors that can lead to differences in health status.
Program Evaluation	Refers specifically to program evaluation or evaluating programs	Refers to collection of information about programs to make judgments about program effectiveness. Does not include general use of the world evaluation.

APPENDIX 8: FOCUS GROUP RECRUITMENT EMAIL

TO: All CSTE Members

DATE: September 19, 2019

SUBJECT: Request for Focus Group Participants from State Health Departments

The Council of State and Territorial Epidemiologists Workforce Subcommittee Co-Chair (New Hampshire Deputy State Epidemiologist Beth Daly) is seeking focus group volunteers to discuss the role and readiness of state health department epidemiologists to work in emerging areas of public health practice. The data collected will inform CSTE's workforce development activities and be used for her dissertation studies at the University of North Carolina at Chapel Hill.

Epidemiologists of all career stages (early, mid, senior) working as a paid employee or contractor at a state health department or the District of Columbia are encouraged to participate in the focus group. The focus group will explore and collect information that would be useful to improving our ability to work in emerging areas of public health practice. The focus group will occur one time for 90 minutes and will be carried out online virtually in October or November 2019. Compensation is not available for participants. CSTE membership is not required to participate.

If you are interested in volunteering to participate, please complete a brief form to indicate your interest by Friday, September 27, 2019:

https://unc.az1.qualtrics.com/jfe/form/SV_ehPV7952uRZ9ULH

Participants will be selected randomly and contacted to schedule the focus groups. If you have any questions about this project, please contact Beth at erdaly@unc.edu. Thank you very much for your interest.

Sincerely,

Jessica Arrazola, DrPH, MPH, CHES

Senior Program Analyst



Council of State and Territorial Epidemiologists

"Using the power of epidemiology to improve the public's health"
CSTE.org • [Membership](#) • [Facebook](#) • [Twitter](#) • [Instagram](#)

2635 Century Parkway NE, Suite 700, Atlanta, GA 30345
Tel: 770.458.3811 | Fax: 770.458.8516

APPENDIX 9: FOCUS GROUP RECRUITMENT FORM

Epidemiologist Focus Group Recruitment Form

Start of Block: Interest Form

Q1 Thank you for your interest in participating in research on the role and readiness of state health department epidemiologists to work in emerging areas of public health practice (UNC IRB#18-2687).

We are seeking epidemiologists of all career stages (early, mid, senior) working as a paid employee or contractor of a state health department or the District of Columbia to participate in a focus group. The focus group will collect information that would be useful to improving epidemiologists' ability to work in emerging areas of public health practice. The focus group will occur one time for 90 minutes and will be carried out online virtually in October or November 2019. Participants will not be compensated for their time. You do not have to be a CSTE member to participate so please feel free to share this invitation with your colleagues.

If you are interested in volunteering to participate, please provide the information below by 11:59pm ET on Friday, September 27, 2019.

Participants will be selected randomly and contacted by October 4, 2019 to schedule the focus groups. If you have any questions about this survey, please contact Elizabeth Daly, principal investigator, at erdaly@unc.edu. Thank you very much for your interest!

Q2 Are you a paid employee or contractor of a state health department or the District of Columbia? Federal assignees or fellowship assignees/fellows assigned to state health departments should select "no" and are not eligible for participation.

- Yes (1)
- No (2)

Skip To: End of Survey If Eligibility = No

Q3 For which state health department / jurisdiction do you work?

▼ Alabama (1) ... Wyoming (52)

Q4 Contact Information

- First Name (1) _____
- Last Name (2) _____
- Position Title (3) _____
- Email (4) _____
- Phone Number (5) _____



Q5 How many years have you been working as an epidemiologist at your current agency (in years)?



Q6 How many years in total have you been working as an epidemiologist during your career (in years)?

Q7

What is your supervisory status?

Please note, supervisory levels are defined as follows:

- Non-supervisor: you do not supervise other employees;
- Supervisor: you are responsible for employees' performance appraisals and approval of their leave, but you do not supervise other supervisors;
- Manager: you are in a management position and supervise one or more supervisors;

- Non-supervisor (1)
- Supervisor (2)
- Manager (3)

Q8 What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree (1)
- High school graduate (high school diploma or equivalent including GED) (2)
- Some college but no degree (3)
- Associate degree in college (2-year) (4)
- Bachelor's degree in college (4-year) (5)
- Master's degree (6)
- Doctoral degree (PhD, DrPH, etc.) or professional degree (e.g. MD, DO, DVM, DDS, JD, etc.) (7)

Display This Question:

If HighestDegree = Bachelor's degree in college (4-year)

Or HighestDegree = Master's degree

Or HighestDegree = Doctoral degree (PhD, DrPH, etc.) or professional degree (e.g. MD, DO, DVM, DDS, JD, etc.)

Q9 Provide the information requested for each Bachelor's, Master's, Doctoral (PhD, DrPH, etc.), and professional degree (e.g. MD, DO, DVM, DDS, JD, etc.) you have earned.

	Type of Degree	Is the degree or concentration in <u>public health</u> ?			Is the degree or concentration specifically in <u>epidemiology</u> ?		
		Yes (1)	No (2)	Not Applicable (3)	Yes (1)	No (2)	Not Applicable (3)
Degree 1 (1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 2 (2)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 3 (3)	▼ Bachelor's Degree (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 4 (5)	Master's Degree (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 5 (6)	Doctoral Degree (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 6 (7)	Professional Degree (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 7 (10)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Degree 8 (11)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q10 What program area do you currently primarily work in?

- Chronic Disease (371)
 - Environmental Health (372)
 - Genomics (373)
 - Infectious Disease (374)
 - Informatics (375)
 - Injury (376)
 - Maternal and Child Health (377)
 - Mental Health (378)
 - Occupational Health (379)
 - Oral Health (380)
 - Preparedness (381)
 - Substance Use (382)
 - Vital Statistics (383)
 - Other (384)
-

Q11

Review this [one-page overview](#) of the Applied Epidemiology Competencies Career Stages.

How would you classify yourself in terms of your own career stage according to the Applied Epidemiology Competencies Career Stages?

- Tier 1 - Entry-Level (1)
 - Tier 2 - Mid-Level (2)
 - Tier 3 - Senior-Level (3)
-

Q12 In a few sentences, what do you hope to gain from participating?

End of Block: Interest Form

Start of Block: Block 1

Q13 If you are selected to participate in a focus group session, please check the dates/times you are available to participate (check all that apply).

- Tuesday, October 15, 2019, 2:00 - 3:30pm ET (2)
- Wednesday, October 16, 2019, 2:00 - 3:30pm ET (3)
- Friday, October 25, 2019, 2:00 - 3:30pm ET (11)
- Tuesday, October 29, 2019, 2:00 - 3:30pm ET (5)
- Wednesday, October 30, 2019, 2:00 - 3:30pm ET (6)
- Thursday, October 31, 2019, 2:00 - 3:30pm ET (7)
- Friday, November 1, 2019, 2:00 - 3:30pm ET (9)
- Friday, November 15, 2019, 2:00 - 3:30pm ET (10)
- I am not available for any of these times (8)

Q14 Please read the participant consent form [here](#) . If selected to participate in a focus group, do you voluntarily offer your consent to participate?

- Yes, I consent. (1)
- No, I do not consent. (2)

End of Block: Block 1

APPENDIX 10: FOCUS GROUP CONSENT FORM

University of North Carolina at Chapel Hill Consent to Participate in a Research Study Focus Group for Adult Participants

Consent Form Version Date: 09/04/2019

IRB Study # 18-2687

Title of Study: Exploring the Role and Readiness of State Health Department Epidemiologists to work in Emerging Areas of Public Health Practice in the United States

Principal Investigator: Elizabeth Daly

Principal Investigator Department: Health Policy and Management Operations

Principal Investigator Phone number: 603-661-0553

Principal Investigator Email Address: erdaly@unc.edu

Faculty Advisor: Leah Devlin

Faculty Advisor Contact Information: 919-696-7095

The purpose of this focus group research is to talk about your experience and thoughts about working as an epidemiologist in a state health department. Specifically, we will be talking about emerging areas of public health practice, what the role of epidemiologists is in these areas, and whether epidemiologists are prepared to work in these areas. The information collected will be used to better understand the role and readiness of state health department epidemiologists to work in emerging areas of public health practice to identify training needs and options to promote epidemiology practice in the changing landscape of public health.

The focus group session will take 90 minutes. I will be recording the session so that information can be transcribed and analyzed, but the recordings will be destroyed after the transcriptions are complete. I will keep all information you share confidential and no statements or comments will be attributed to any specific individual.

There are no significant risks anticipated from your participation in this study. A potential benefit of participation is your opportunity to contribute to important conversations about current and future epidemiology practice that can lead to future training and other opportunities to advance applied epidemiology practice in the United States.

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may choose not to participate, or you may withdraw your consent to be in the study, for any reason, without penalty. Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies. Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

This study will seek to better understand the role and readiness of state health department epidemiologists to work in emerging areas of public health practice. Specifically, this study aims to define the role of state health department epidemiologists in emerging areas of public health practice, to assess self-reported competency of state health department epidemiologists, and understand what factors support epidemiology competency and practice. **The focus group will explore this topic and collect information that would be useful to improving your ability to work in emerging areas of public health practice.**

You are being asked to be in the study because **you are an epidemiologist working as a paid employee or a contractor of a state health department or the District of Columbia.**

Are there any reasons you should not be in this study?

You should not be in this study if you do not feel you can fully participate in the focus group discussion for any reason.

How many people will take part in this study?

There will be approximately 1,075 people in this research study, of which 24 - 30 are participating in the focus group component of the study.

How long will your part in this study last?

Your participation in this focus group will last approximately 90 minutes plus the time it takes to schedule a time for the focus groups.

What will happen if you take part in the study?

The group will be asked to talk about your experience and thoughts about working as an epidemiologist in a state health department. Specifically, we will be talking about emerging areas of public health practice, what the role of epidemiologists is in these areas, and whether epidemiologists are prepared to work in these areas. No questions will be directed to you individually, but instead will be posed to the group. You may choose to respond or not respond at any point during the discussion. The focus group discussion will be recorded so we can capture comments in a transcript for analysis.

What are the possible benefits from being in this study?

A potential benefit of participation is your opportunity to contribute to important conversations about current and future epidemiology practice that can lead to future training and other opportunities to advance applied epidemiology practice in the United States.

What are the possible risks or discomforts involved from being in this study?

We do not anticipate any risks or discomfort to you from being in this study. Even though we will emphasize to all participants that comments made during the focus group session should be kept confidential, it is possible that participants may repeat comments outside of the group at some time in the future. Therefore, we encourage you to be as honest and open as you can, but remain aware of our limits in protecting confidentiality.

How will information about you be protected?

Every effort will be taken to protect your identity as a participant in this study. You will not be identified in any report or publication of this study or its results. Your name will not appear on any transcripts. After the focus group recording has been transcribed, the recording will be destroyed. We may use de-identified data from this study in future research without additional consent.

What if you want to stop before your part in the study is complete?

You can withdraw from this study at any time, without penalty. The investigators also have the right to stop your participation, or the entire study, at any time.

Will you receive anything for being in this study?

No compensation will be provided for your participation in this study.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions about the study (including payments), complaints, concerns, or if a research-related injury occurs, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject, or if you would like to obtain information or offer input, you may contact the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study and indicate so by selecting "yes, I consent" in the Qualtrics Focus Group Recruitment Form.

APPENDIX 11: FOCUS GROUP SELECTION NOTIFICATIONS

Email to Focus Group Participants Sent on October 4, 2019

SUBJECT: State Health Department Epidemiologists Focus Group Participant Selection

Hello-

You have been selected to participate in the Tier X / X-career focus group aimed at discussing the role and readiness of state health department epidemiologists to work in emerging areas of public health practice.

The focus group is scheduled for Day, Month Date, 2019 from 2:00 – 3:30pm ET via Zoom video conference. A calendar invitation will be emailed to you with login information.

Please respond to this email upon receipt to confirm your availability. If you are no longer available at this time, please let me know immediately.

In preparation for the focus group session, please provide input on the areas of emerging public health practice that we should discuss during the focus group by answering three questions by Month Date, 2019: Take Survey Link

Or copy and paste the URL below into your internet browser:

`{I://SurveyURL}`

Thank you very much for your interest and willingness to participate! You will receive additional information one week before the scheduled focus group session. If you have any questions in the meantime, please contact me.

Sincerely,

Elizabeth R. Daly, MPH

Doctor of Public Health (DrPH) Candidate

Gillings School of Global Public Health

University of North Carolina, Chapel Hill, NC

erdaly@unc.edu

Calendar Invite Sent to Focus Group Participants Sent on October 7, 2019

SUBJECT: State Health Department Epidemiologists Focus Group

Thank you for agreeing to participate. The focus group will be held virtually via Zoom video conference. Please log in 5-10 minutes early to make sure that all technology is working correctly.

In advance of the meeting you can use this link to learn about joining a meeting in Zoom and to test your ability to join a test meeting: <https://support.zoom.us/hc/en-us/articles/201362193-Joining-a-Meeting>

Zoom conferencing login information

Sincerely,

Elizabeth R. Daly, MPH
Doctor of Public Health (DrPH) Candidate
Gillings School of Global Public Health
University of North Carolina, Chapel Hill, NC
erdaly@unc.edu

Email Sent to Non-Selected Potential Participants Sent on October 6, 2019

SUBJECT: Epidemiology Workforce Focus Groups

Hello-

Thank you for registering your interest in participating in the Epidemiology Workforce Focus Groups to explore emerging areas of public health practice.

I am writing to let you know that your name was not randomly selected to participate in this study. I do appreciate your interest and willingness to engage and I will share the results of this work when they become available.

Feel free to reach out to me to share any information or ask questions if this area is a particular interest of yours.

Sincerely,

Elizabeth R. Daly, MPH
Doctor of Public Health (DrPH) Candidate
Gillings School of Global Public Health
University of North Carolina, Chapel Hill, NC
erdaly@unc.edu

APPENDIX 12: FOCUS GROUP PRE-SESSION QUESTIONNAIRE

SHD Epidemiologists Focus Group Questionnaire

Start of Block: Introduction

Q1 **PURPOSE:** The purpose of this form is to collect information on emerging areas of public health practice from participants of the State Health Department Epidemiologists Focus Groups prior to the Focus Group event in order to more efficiently use our time together. This focus group research has been approved by the University of North Carolina at Chapel Hill Institutional Review Board (UNC IRB#18-2687).

CONFIDENTIALITY: Your responses are voluntary and will be kept confidential. You indicate you voluntary consent to provide this information by clicking the submit button at the end of this survey. Please refer to the consent document you were provided during the focus group registration process for complete information on all of the risk and benefits of participation.

RESPONSE: Participation in this survey should take approximately 10 minutes or less.

If you have any questions about this form, please contact Elizabeth Daly, principal investigator, at erdaly@unc.edu.

Q2 The following questions ask about the role and readiness of epidemiologists for working in emerging areas of public health practice.

The emerging areas of public health practice listed here are those that are included in the national Public Health Workforce Interests and Needs Survey; however, **we are interested in collecting additional areas you think are relevant to epidemiologists like you and there is a place for you to provide those.**

For reference, we provide operational definitions of emerging areas of public health practice here, and we recommend you refer to them before answering.

Fostering a culture of quality improvement: An integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization (PHWINS).

Public health and primary care integration: The linking of public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health (IOM, 2012).

Evidence-Based Public Health Practice: Making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-

planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned (Brownson et al., 2009).

Health in All Policies: A collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people (PHWINS).

Multisectoral collaboration: Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest (PHWINS).

Q3 How ***important*** do you feel the following emerging areas of public health practice are to you in your day to day work as an epidemiologist working in a state health department?

	Not important	Slightly important	Important	Very important
Fostering a culture of quality improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public health and primary care integration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evidence-Based Public Health Practice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health in All Policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multisectoral collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q4 How would you rate your ***overall readiness*** for working in the emerging areas of public health practice listed below?

	Not ready	Slightly ready	Ready	Very ready
Fostering a culture of quality improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public health and primary care integration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evidence-Based Public Health Practice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Health in All Policies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Multisectoral collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q5 Emerging areas of public health practice are areas of public health practice that are new or are growing in interest and use. Are there any additional emerging areas of public health practice that you feel are important to your role and the role of epidemiologists like you working in state health departments?

- Yes
- No

Display This Question:
 If Emerging areas of public health practice are areas of public health practice that are new or are... = Yes

Q6 List additional emerging areas of public health practice and provide information on their importance and your readiness for working in these areas. If there are more than five areas you would like to list, list the five you think are most important.

	Additional Areas	Overall <i>importance</i> of this area to the role of epidemiologists working in your agency.				Overall <i>readiness</i> of epidemiologists working in your agency to work in this area.			
		Please List	Not important	Slightly important	Important	Very important	Not ready	Slightly ready	Ready
Area 1		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 2		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 3		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 4		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Area 5		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q7 For the sole purpose of describing the general demographic make-up of the focus group, please provide your age group, gender, and race/ethnicity. Data will be aggregated and not presented in any cross tabulations.

Q8 Age Group

- less than 30 years
 - 31 to 40 years
 - 41 to 50 years
 - 51 years or greater
-

Q9 Gender

- Female
 - Male
 - Non-binary or other
-

Q10 Choose one or more races that you consider yourself to be:

- White
- Black or African American
- Native Hawaiian or Pacific Islander
- American Indian or Alaska Native
- Other or more than one

Q11 Are you Spanish, Hispanic, or Latino or none of these?

- Yes
- None of these

End of Block: Introduction

APPENDIX 13: FOCUS GROUP PRE-SESSION INFORMATION

TO: Focus Group Participants

FROM: Elizabeth R. Daly

DATE: One week before scheduled focus group

SUBJECT: REMINDER: X-Career Epidemiology Workforce Focus Group Session on Month Date, 2019

Hello –

This is a reminder that the epidemiology workforce focus group session you have been selected to participate in is scheduled for Month Date, 2019 from 2:00 – 3:30 pm ET via Zoom video conference. You should have received a calendar invitation with Zoom login information.

Please let me know immediately if you did not receive the Zoom login information or if you are no longer available to participate.

Prior to the session, you should use this [link](#) to make sure that your computer equipment (camera/audio) will work appropriately with the Zoom software. Please also log in 5-10 minutes early to make sure that all technology is working correctly.

Agenda for the focus group session:

- Introductions - You will be asked to provide information on who you are, where you work, and what you do.
- Emerging Areas of Public Health Practice Discussion – Based on the feedback you all provided, the areas we will discuss are:
 - Quality improvement
 - Public health and healthcare integration
 - Evidence-based public health practice

- Health in all policies
- Multisectoral collaboration
- Informatics
- Social determinants of health and health disparities
- Program evaluation

For each area of practice, you will be asked for feedback on:

- The role of epidemiologists in this area
- Factors that hinder you in working in this area and what would help you overcome these barriers

I have attached some brief definitions of the emerging areas of practice we will be discussing. It would be helpful for you to have these available to refer to prior to and during the focus group session.

Thank you very much for your interest and willingness to participate! If you have any questions before the session, please contact me.

Beth

Elizabeth R. Daly, MPH
Doctor of Public Health (DrPH) Candidate
Gillings School of Global Public Health
University of North Carolina, Chapel Hill, NC
erdaly@unc.edu

APPENDIX 14: EMERGING AREAS OF PUBLIC HEALTH PRACTICE DEFINITIONS FOR FOCUS GROUPS

Fostering a Culture of Quality Improvement: An integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization (PHWINS).

Public Health and Primary Care Integration: The linking of public health and primary care programs and activities to promote overall efficiency and effectiveness and achieve gains in population health (IOM, 2012).

Evidence-Based Public Health Practice: Making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned (Brownson et al., 2009).

Health in All Policies: A collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people (PHWINS).

Multisectoral Collaboration: Deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest (PHWINS).

Informatics: The effective use of information and information technology to improve population health outcomes (PHII).

Social Determinants of Health and Health Disparities: The complex, integrated, and overlapping social structures and economic systems that are responsible for most health inequities. This includes the social environment, physical environment, health services, and structural and societal factors, which can lead to differences in health status (WHO).

Program Evaluation: The systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future program development (CDC).

APPENDIX 15: FOCUS GROUP GUIDE

Introduction (10 mins)

- Hello. My name is Beth Daly. I am a graduate student at the University of North Carolina at Chapel Hill pursuing a Doctor of Public Health Degree.
- Thank you for coming. We are here today to talk about your experience and thoughts about working as an epidemiologist in a state health department. Specifically, we will be talking about the role and readiness of epidemiologists to work in emerging areas of public health practice.
- A focus group is a relaxed discussion to better understand how people think or feel about a topic. This focus group is being conducted as part of my doctoral dissertation research and the results will be shared with CSTE to inform workforce development activities.
- I will be taking notes and recording the discussion so that I don't miss anything you have to say. I will keep all information confidential and no statements will be attributed to any specific individual.
- I am not here to share information or give you my opinions. Your opinions are what matter. There are no right or wrong answers. You can disagree with each other and you can change your mind. It's important that you feel comfortable saying what you really think and feel.
- This is a virtual focus group so it may be a little more challenging to identify when people want to speak so feel free to just go ahead and speak. This will be a group discussion so feel free to respond to me and others without waiting to be called on. However, it's important for only one person to talk at a time.
- I'd like to hear from everyone at different points during the conversation. Some people will naturally be more interested in some parts of the discussion than others and that's okay. Don't feel like you have to respond to every question. Also, some people naturally talk more and others like to listen first before speaking. I am hoping you can all help me

with making sure the conversation is well balanced by thinking about how much you are contributing to the conversation and trying not to repeat information that has already been shared.

- The discussion will last approximately 90 minutes. There is a lot I want to discuss, so at times I may move us along a bit. Feel free to use the chat box feature to provide additional comments for any reason, but especially if a topic has passed that you wanted to say more about.
- Finally, I'd like you to turn your video on if you are able to do that. Also, please mute your line when not speaking to reduce background noise and please don't put the line on hold.
- Participant introduction: (Opening Question) Now, let's start by everyone sharing who you are, where you work, and what you do.

Discussion (70 mins)

- As you know, we're going to be sharing our opinions on working in emerging areas of public health practice as an epidemiologist. Emerging areas of public health practice are areas of practice that are new or are growing in interest and use. Prior to today's session, I asked all of you for feedback on the areas of practice we will be discussing today.
 - Today we will talk about five topics that have been previously identified as emerging areas of practice in public health: quality improvement, public health and healthcare integration, evidence-based public health practice, Health in All Policies, and multisectoral collaboration.
 - Additionally, based on the feedback you provided and a recent survey of state epidemiologists, we will also talk about three additional topics: informatics, social determinants of health and health disparities, and program evaluation.
1. First, we will talk about quality improvement, by which I mean a systematic, formal approach to the analysis of practice performance and efforts to improve performance.

- a. X of you felt this area was important or very important to your day-to-day work.

What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. X of you felt that epidemiologists like you (early career, mid, senior) are ready or very ready to work in this area of practice. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

2. Next, we will talk about public health and healthcare integration, by which I mean the linking of public health and healthcare programs and activities to promote overall efficiency and effectiveness and achieve gains in population health. Examples might include public health and clinical care collaboratives aimed at improving diabetes care, preventing falls, or preventing antimicrobial resistance.

- a. X of you felt this area was important or very important to your day-to-day work.

What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. X of you felt that epidemiologists like you (early career, mid, senior) are ready or very ready to work in this area of practice. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

3. Next, we will talk about evidence-based public health practice, by which I mean making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned.

- a. X of you felt this area was important or very important to your day-to-day work.
What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. X of you felt that epidemiologists like you (early career, mid, senior) are ready or very ready to work in this area of practice. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

4. Next, we will talk about Health in All Policies, by which I mean a collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of the population.

- a. X of you felt this area was important or very important to your day-to-day work.
What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. X of you felt that epidemiologists like you (early career, mid, senior) are ready or very ready to work in this area of practice. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

5. Next, we will talk about multisectoral collaboration, by which I mean the deliberate collaboration among various stakeholder groups and sectors (e.g., health, environment, economy) to jointly achieve a shared goal. Examples might include schools, grocers, and public health working together to increase access to healthy foods for school children or public health, the medical community, schools, businesses, the faith community, and other nonprofits working together to prevent teen pregnancy.

- a. X of you felt this area was important or very important to your day-to-day work.
What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. X of you felt that epidemiologists like you (early career, mid, senior) are ready or very ready to work in this area of practice. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

6. Next, we will talk about informatics, by which I mean the effective use of information and information technology to improve population health outcomes.

- a. X of you wrote this area in as an important emerging area of practice affecting your day-to-day work. What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

7. Next, we will talk about the area of Social Determinants of Health and health disparities, by which I mean the complex, integrated, and overlapping social structures and economic systems that are responsible for most health inequities. This includes the social environment, physical environment, health services, and structural and societal factors, which can lead to differences in health status.

- a. X of you wrote this area in as an important emerging area of practice affecting your day-to-day work; however, state epidemiologists identified this an important emerging area of practice for their epidemiology staff. What do you think the role

is of epidemiologists in this area? What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

8. Next, we will talk about program evaluation, by which I mean the systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future program development.

- a. X of you wrote this area in as an important emerging area of practice affecting your day-to-day work; however, state epidemiologists identified this an important emerging area of practice for their epidemiology staff. What do you think the role is of epidemiologists in this area?

Probes: How do you think epidemiologists should be involved in this area?

- b. What factors hinder your ability to work in this area and what would help you overcome these barriers?

Probes: What has already helped you work in this area?

Probes: What would be needed in order to improve your ability?

Additional Probes Used Throughout the Discussion	
Probes Used to Elicit Elaboration	Probes Used to Elicit Input from Others
<ul style="list-style-type: none"> • Tell me more about that. • Why do you say that? • Would you explain further? • Can you give an example? 	<ul style="list-style-type: none"> • What do others think? • Does anyone see it differently? • Has anyone had a different experience? • Does anyone else wants to add anything?

Closure (10 mins)

- Today we discussed several emerging areas of public health practice and the role and readiness of epidemiologists to work in these areas.
- Final Question: Is there anything else you want to share or anything we should have talked about but didn't?
- Thank you very much for attending. Your time is very much appreciated and your comments have been very helpful.
- If you think of anything else you would like to tell me or if you have any follow-up questions after today, you have my contact information.
- Next, I will summarize the themes and suggestions that came up during the focus groups and will share them with all of you and ask for any additional feedback.

APPENDIX 16: CODEBOOK FOR FOCUS GROUP INDEXING

Code ID	Code Name	Description / Instructions
STE	Structural - Topic Codes – Emerging Areas of Public Health Practice	
STE-1	Quality Improvement	Use when a participant is discussing quality improvement, defined as an integrative process that links knowledge, structures, processes, and outcomes to enhance quality throughout an organization (PHWINS).
STE-2	Public Health and Healthcare Integration	Use when a participant is discussing public health and healthcare integration, defined as the linking of public health and healthcare programs and activities to promote overall efficiency and effectiveness and achieve gains in population health (IOM, 2012).
STE-3	Evidence-Based Public Health Practice	Use when a participant is discussing evidence-based public health practice, defined as making decisions on the basis of the best available scientific evidence, using data and information systems systematically, applying program-planning frameworks, engaging the community in decision making, conducting sound evaluation, and disseminating what is learned (Brownson et al., 2009).
STE-4	Health in All Policies	Use when a participant is discussing Health in All Policies, defined as a collaborative approach that considers health as a factor when making policy decisions about sectors such as education, housing, transportation, and neighborhood safety to improve the health of all communities and people (PHWINS).
STE-5	Multisectoral Collaboration	Use when a participant is discussing multisectoral collaboration, defined as deliberate collaboration among various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy) to jointly achieve a shared goal or outcome of interest (PHWINS).
STE-6	Informatics	Use when a participant is discussing informatics, defined as the effective use of information and information technology to improve population health outcomes (PHII).
STE-7	Social Determinants of Health and Health Disparities	Use when a participant is discussing Social Determinants of Health and health disparities, defined as the complex, integrated, and overlapping social structures and economic systems that are responsible for most health inequities. This includes the social environment, physical environment, health services, and structural and societal factors, which can lead to differences in health status (WHO).
STE-8	Program Evaluation	Use when a participant is discussing program evaluation, defined as the systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future program development (CDC).

STE-9	Other Topic	Use when a participant is discussing a topic other than quality improvement, public health and healthcare integration, evidence-based public health practice, Health in All Policies, multisectoral collaboration, informatics, Social Determinants of Health and health disparities, or program evaluation.
R	Reporting Codes	
R-10	Quote	Use to highlight phrases in the text that represent a particular emerging theme well and could be used later in the reporting process as a direct quote.
R-11	Example	Use to highlight examples provided by participants of the various emerging areas of practice. It can sometimes be challenging to differentiate between a role and an example. A role is intended to be a function. For example, when asked about the role of epidemiologists in quality improvement, one participant listed “conducting data quality assurance.” This is an example of a quality improvement activity.
R-11A	Consensus	Use to indicate when there is some agreement among participants. Agreement or consensus may be indicated when participants say, “I agree with PARTICIPANT X...” or “I would like to echo what PARTICIPANT X just said...”. This code should not be used simply when a participant says they have nothing else to add, or when there are no additional comments, unless it is preceded by a statement that the participant agrees with everything that has already been said.
TDR	Thematic – Deductive Codes – Role	
TDR-12	Collect Data	Use when a participant describes the process of gathering data, conducting surveillance, establishing data feeds to data systems, etc.
TDR-13	Analyze Data	Use when a participant describes the process of looking at data to identify and describe trends in the occurrence of diseases or health conditions, risk factors, or other health-related data. Includes linking data sources and other data linkage activities.
TDR-14	Interpret Data	Use when a participant describes the process of translating, or describing the meaning of, results of data analyses for partners and the public. Interpretation includes assessing the signification of data analysis findings and their implications.
TDR-15	Disseminate Data	Use when a participant describes the process of sharing the results of data analyses with others or otherwise providing data to an entity. Includes data sharing activities.
TDR-16	Conduct Investigations	Use when a participant describes the process of conducting public health investigations, typically in response to reportable diseases, clusters, or outbreaks.

TDR-17	Develop and Implement Prevention and Control Activities	Use when a participant describes the process of using data or evidence to develop and implement prevention and control activities.
TDR-18	Other Role	Use when a participant describes a role (i.e. a function) within an area of practice that is not otherwise captured by one of inductive or deductive role codes listed in the code book.
TIR	Thematic – Inductive Codes – Role	
TIR-19	Unclear Role	Use when a participant states that the role of epidemiologists / their role is not clear.
TIR-20	Educate Healthcare Community	Use when a participant describes the role of epidemiologists / their role as educating healthcare providers or other healthcare partners. Includes providing clinical recommendations such as testing or treatment recommendations.
TIR-21	Linkage to Care	Use when a participant describes the role of epidemiologists / their role as linking individuals to healthcare services.
TIR-22	Create Evidence	Use when a participant describes the role of epidemiologists / their role as generating evidence through contribution to the evidence-based practice literature by publishing work conducted at their agency. Do not use when a participant describes the process of collecting, analyzing, and interpreting data.
TIR-23	Find Evidence	Use when a participant describes the role of epidemiologists / their role as going to the literature or other high-quality reputable sources of information to identify the best available scientific evidence.
TIR-24	Communicate Evidence	Use when a participant describes the role of epidemiologists / their role as translating, explaining, or otherwise communicating what they have learned from the literature in regards to the evidence-base to others.
TIR-25	Use Evidence	Use when a participant describes the role of epidemiologists / their role as using what they have learned from the literature in regards to the evidence-base to inform public health practice.
TIR-26	Provide Subject Matter Expertise	Use when a participant describes the role of epidemiologists / their role as providing subject matter expertise to others in an emerging area of practice.
TIR-27	Use Data to Inform Policy	Use when a participant describes the role of epidemiologists / their role as using data to inform policy-making activities.
TIR-28	Policy Analysis	Use when a participant describes the role of epidemiologists / their role as considering various policy options to make policy recommendations and considering the health implications of proposed or implemented policies.
TIR-29	Engage and Connect Partners	Use when a participant describes the role of epidemiologists / their role as engaging partners or connecting partners to one another.

TIR-30	Data Collection Design	Use when a participant describes the role of epidemiologists / their role as designing data collection processes and systems. This includes defining variables and measures / metrics.
TIR-31	Liaison Between Program and IT	Use when a participant describes the role of epidemiologists / their role as acting as a liaison, or serving as a bridge, between IT and public health programs. This includes translating the needs of public health programs (the business) to IT staff and vice versa.
TDB	Thematic – Deductive Codes – Barriers	
TDB-32	Staffing Challenges - Unspecified	Use when a participant describes barriers related to not having enough staff to do work, or do work well, in the area of practice. Use the codes specific to retention and recruitment challenges if these factors were specifically mentioned as the reason for the lack of staffing.
TDB-33	Staffing Challenges Due to Retention	Use when a participant describes barriers related to not having enough staff to do the work, or do work well, due to retention challenges in the area of practice.
TDB-34	Staffing Challenges Due to Recruitment	Use when a participant describes barriers related to not having enough staff to do the work, or do work well, due to recruitment challenges in the area of practice.
TDB-35	Time - Unspecified	Use when a participant describes barriers related to not having enough time for the area of practice. Use the codes specific to not having enough time to do the work or to take related training if these activities were specifically mentioned as activity for which there was not enough time.
TDB-36	Time to Do the Work	Use when a participant describes barriers related to not having enough time to do work, or do work well, in the area of practice.
TDB-37	Time for Training	Use when a participant describes barriers related to not having enough time to take training related to the area of practice.
TDB-38	Organizational Support - Unspecified	Use when a participant describes barriers related to not having organizational support for the area of practice. Use the codes specific to not having organizational support to do the work or to take related training if these activities were specifically mentioned as activity for which there was not organizational support.
TDB-39	Organizational Support - To Do the Work	Use when a participant describes barriers related to not having organizational support to do work, or do work well, in the area of practice.
TDB-40	Organizational Support - For Training	Use when a participant describes barriers related to having organizational support to take training related to the area of practice.

TDB-41	Training Opportunities - Unspecified	Use when a participant describes barriers related to there not being training opportunities relevant to, or that support work in, the area of practice. Use the codes specific to there not being training relevant to the area of practice on the job or outside of a formal academic program or there not being training relevant to the area of practice within the participants formal academic training program if these types of training were specifically mentioned as types for which there was not training relevant to the area of practice.
TDB-42	Training Opportunities - On the Job	Use when a participant describes barriers related to there not being training opportunities relevant to, or that support work in, the area of practice on the job or outside of a formal academic program.
TDB-43	Training Opportunities - During Academic Program	Use when a participant describes barriers related to there not being training opportunities relevant to, or that support work in, the area of practice within the participants formal academic training program.
TDB-44	Funding to Do the Work	Use when a participant describes barriers related to there not being enough funding to do work, or do work well, in the area of practice. Includes limitations of funding restrictions.
TDB-45	Funding for Training	Use when a participant describes barriers related to there not being enough funding to take training related to the area of practice.
TDB-46	Other Barrier	Use when a participant describes a barrier to working within an area of practice that is not otherwise captured by one of inductive or deductive barrier codes listed in the code book.
TIB	Thematic – Inductive Codes – Barriers	
TIB-47	Not Involved at All	Use when a participant describes barriers related to epidemiologists in general, or personally, not being involved at all, or nearly at all, in the area of practice.
TIB-48	Not Involved Early Enough	Use when a participant describes barriers related to not being involved early enough when work is being done related to the area of practice in their organization.
TIB-49	Clarity in Partner Roles	Use when a participant describes barriers related to there being a lack of understanding among partners regarding the role of each partner, including the role of public health, when working within one of the areas of practice.
TIB-50	No Established Process or Policy	Use when a participant describes barriers related to not having available established policies, protocols, or processes within their organization for how to work in an area of practice.

TIB-51	Access to Literature	Use when a participant describes barriers related to not having access to journals or the peer-reviewed literature in order to find evidence or to stay a subject matter expert in their field to work in an area of practice.
TIB-52	Competing Priorities	Use when a participant describes barriers related to not being able to do work, or do work well, in the area of practice due to competing priorities, or other work that needs to be completed.
TIB-53	Interest	Use when a participant describes barriers related to challenges working in an area of practice due to lack of interest in working in the area either on the part of the epidemiologist or on the part of a partner necessary to perform the work.
TIB-54	Knowledge	Use when a participant describes barriers related to lack of the epidemiologist's knowledge, expertise, or experience in the area of practice or in a skill or other topic necessary to support working in the area of practice.
TIB-55	Political Barriers	Use when a participant describes barriers related to lack of support for working in an area of practice due to decision-making that is driven by reasons that are described by participants as "political" and typically reflective of not being driven by science or availability of resources.
TIB-56	Silos	Use when a participant describes barriers related to lack of sharing knowledge, processes, methods, best practices, and information across programs, organizations, or sectors to support an area of practice.
TIB-57	IT Department Challenges	Use when a participant describes barriers related to implementing technological solutions, systems, software, or hardware to support work in an area of practice due to challenging interactions and relationships with their jurisdiction's information technology department.
TIB-58	Relevant Data	Use when a participant describes barriers related to lack of relevant data to support work in an area of practice.
TIB-59	Inaccurate Data	Use when a participant describes barriers related to working in an area of practice due to missing data, unknowns, stigma issues as well
TIB-60	Usability of Healthcare Data	Use when a participant describes barriers related to challenges with the usability of healthcare data that their jurisdiction has access to support working in an area of practice.
TIB-61	Data Linkage Challenges	Use when a participant describes barriers related to challenges linking data or linking disparate data sources and systems to support working in an area of practice.

TIB-62	Data Sharing Concerns	Use when a participant describes barriers related to challenges sharing data across programs or organizations, typically related to privacy or legal concerns, to support working in an area of practice.
TDF	Thematic – Deductive Codes – Facilitators	
TDF-63	Staffing	Use when a participant describes facilitators related to having, or needing to have, enough staff to do work, or do work well, in the area of practice.
TDF-64	Time to Do Work	Use when a participant describes facilitators related to having, or needing to have, enough time to do work, or do work well, in the area of practice.
TDF-65	Time for Training	Use when a participant describes facilitators related to having, or needing to have, enough time to take training related to the area of practice.
TDF-66	Organizational Support	Use when a participant describes facilitators related to having, or needing to have, organizational support for the area of practice.
TDF-67	Training - Unspecified	Use when a participant describes facilitators related to there being, or needing to be, training opportunities relevant to, or that support work in, the area of practice. Use the codes specific to needing training relevant to the area of practice on the job or outside of a formal academic program or needing training relevant to the area of practice within formal academic training programs if these types of training were specifically mentioned as types for which more training was needed relevant to the area of practice.
TDF-68	Training on the Job	Use when a participant describes facilitators related to there being, or needing to be, training opportunities relevant to, or that support work in, the area of practice, specifically on the job or outside a formal academic program.
TDF-69	Training During Academic Program	Use when a participant describes facilitators related to there being, or needing to be, training opportunities relevant to, or that support work in, the area of practice within formal academic training programs.
TDF-70	Funding	Use when a participant describes facilitators related to there being, or needing to be, increased funding to support the area of practice within formal academic training programs.
TDF-71	Other Facilitator	Use when a participant describes a facilitator to working within an area of practice that is not otherwise captured by one of inductive or deductive facilitator codes listed in the code book.
TIF	Thematic – Inductive Codes – Facilitators	
TIF-72	Learning from Other Programs	Use when a participant describes facilitators related to learning from the experience, methods, tools, or knowledge of other program areas within public health to support working in an area of practice.

TIF-73	Learning from Other People	Use when a participant describes facilitators related to sharing expertise, being mentored, or having someone more knowledgeable teach or train them about the area of practice to support working in an area of practice.
TIF-74	Best Practices	Use when a participant describes facilitators related to having available best practices or lessons learned for how to work in an area of practice.
TIF-75	Organizational Strategy for the Work	Use when a participant describes facilitators related to having available established policies, protocols, or processes within their organization for how to work in an area of practice.
TIF-76	Supplemental Epi Staffing Programs	Use when a participant describes facilitators related to having supplemental epidemiology staffing to support work in emerging areas of practice through placement programs such as CDC's Epidemic Intelligence Service, CDC's Career Epidemiology Field Officer Program, CSTE's Applied Epidemiology Fellowship Program.
TIO	Thematic – Inductive Codes – Other	
TIO-77	State vs Local Role	Use when a participant differentiates between the role of epidemiologists in state health departments vs the role of epidemiologist in local jurisdictions.
TIO-78	Informatics vs Program Epis	Use when a participant differentiates between epidemiologists who work primarily in informatics versus those who work doing traditional epidemiology work in programs, such as outbreak response and disease control.
TIO-79	Negativity	Use when a participant describes feelings of negativity about their work environment. Examples include, criticizing bureaucracy, feeling overworked or underpaid, being "told what to do" by supervisors, or not having access to basic needed equipment like a working computer, etc.
TIO-80	Actual vs Theoretical Role	Use when a participant indicates there is a difference between the actual role an epidemiologist fills within an area of practice and what the epidemiologist's role could or should be in the area of practice. For example, "I don't work in this area of practice but I think I should be more involved."
TIO-81	Importance	Use when a participant expresses their opinion on the perceived importance of a particular area of practice on the daily work of epidemiologists. The expression could be positive or negative, for example, "I think it's extremely important for epidemiologists to be engaged in X..." or "I don't think this area is important to epidemiologists at all."
TIO-82	Role Differs by Program Area	Use when a participant indicates that the role of epidemiologists within an area of practice may differ depending on the program area in which they work. An example is, "In my program, epidemiologist don't work in this area of practice but I know my colleagues in program X do this work."

**APPENDIX 17: SUPPLEMENTAL DATA TABLES AND FIGURES FOR
PHASE 1 PUBLIC HEALTH WORKFORCE INTEREST AND NEEDS
SURVEY ANALYSIS**

Table 17-1. Estimated Percentage of Self-Reported Primary Program Area Among State Health Department Epidemiologists

Characteristic	Level	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Primary Program Area	Epidemiology and Surveillance	1101	36.75%	31.50%	42.01%
	Communicable Disease	708	23.65%	21.03%	26.27%
	Maternal and Child Health	266	8.88%	7.00%	10.76%
	Environmental Health	170	5.66%	3.51%	7.81%
	Chronic Disease	135	4.51%	2.51%	6.50%
	Injury	80	2.66%	1.54%	3.79%
	Informatics	74	2.48%	1.28%	3.67%
	Program Evaluation	41	1.37%	0.42%	2.32%
	Emergency Preparedness	17	0.55%	0.07%	1.04%
	Substance Abuse	16	0.53%	0.04%	1.02%
	Oral Health	11	0.38%	0.00%	0.78%
	Public Health Genetics	10	0.33%	0.11%	0.55%
	Mental Health	5	0.17%	0.00%	0.51%
	Multiple Programs	70	2.35%	1.41%	3.29%
Other	292	9.74%	8.08%	11.40%	

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Table 17-2. Estimated Percentage of Self-Reported Job Satisfaction and Intention to Leave Among State Health Department Epidemiologists

Response	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Considering everything, how satisfied are you with your job?				
Very dissatisfied	64	2.13%	0.94%	3.33%
Somewhat dissatisfied	255	8.51%	6.36%	10.65%
Neither dissatisfied nor satisfied	171	5.72%	4.42%	7.02%
Somewhat satisfied	1174	39.21%	35.77%	42.64%
Very satisfied	1330	44.44%	40.23%	48.65%
Are you considering leaving your organization within the next year?				
No	2121	71.19%	68.52%	73.86%
Yes, to retire	70	2.35%	1.19%	3.51%
Yes, to take another governmental job (in public health)	325	10.90%	9.23%	12.56%
Yes, to take another governmental job (not in public health)	28	0.93%	0.29%	1.56%
Yes, to take a non-governmental job (in public health)	121	4.06%	2.36%	5.76%
Yes, to take a non-governmental job (not in public health)	58	1.94%	0.78%	3.09%
Yes, other	257	8.63%	5.87%	11.40%
Lack of training of training selected as top reason for why	133	15.60%	10.18%	21.03%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Table 17-3. Estimated Percentage of Self-Reported Level of Agreement with Statements Related to Training and Development Among State Health Department Epidemiologists

Training and Development Statements	Level	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
My training needs are assessed	Strongly disagree	137	4.59%	2.54%	6.63%
	Disagree	602	20.22%	14.63%	25.80%
	Neither agree nor disagree	711	23.86%	20.49%	27.24%
	Agree	1171	39.30%	34.85%	43.75%
	Strongly agree	359	12.03%	10.47%	13.59%
Employees have sufficient training to fully utilize technology needed for their work	Strongly disagree	122	4.10%	2.47%	5.73%
	Disagree	623	20.92%	17.65%	24.18%
	Neither agree nor disagree	601	20.18%	15.35%	25.01%
	Agree	1247	41.83%	38.87%	44.78%
	Strongly agree	387	12.97%	9.04%	16.90%
Employees learn from one another as they do their work	Strongly disagree	49	1.66%	0.68%	2.63%
	Disagree	121	4.07%	2.35%	5.79%
	Neither agree nor disagree	252	8.45%	6.32%	10.58%
	Agree	1500	50.32%	44.33%	56.31%
	Strongly agree	1058	35.50%	28.85%	42.15%
My supervisor provides me with opportunities to demonstrate my leadership skills	Strongly disagree	117	3.93%	2.69%	5.18%
	Disagree	265	8.89%	6.40%	11.38%
	Neither agree nor disagree	429	14.37%	11.86%	16.88%
	Agree	1103	36.96%	34.47%	39.45%
	Strongly agree	1070	35.84%	31.53%	40.15%
I feel completely involved in my work	Strongly disagree	56	1.88%	0.30%	3.47%
	Disagree	178	5.95%	4.25%	7.65%
	Neither agree nor disagree	315	10.54%	8.68%	12.40%
	Agree	1248	41.71%	36.48%	46.93%
	Strongly agree	1194	39.92%	32.80%	47.04%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Table 17-4. Estimated Percentage of Self-Reported Training Motivators Among State Health Department Epidemiologists

Response	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Personal growth/interest	2707	90.66%	88.72%	92.60%
Availability of applicable in-person training opportunities	2005	67.14%	63.26%	71.03%
Covered time for training	1872	62.68%	58.52%	66.84%
Paid travel for training	1838	61.55%	58.19%	64.91%
Availability of applicable online training opportunities	1797	60.17%	56.88%	63.45%
Mandated by agency supervisor/management/leadership	1413	47.32%	43.33%	51.32%
Requirement for promotion	1353	45.30%	40.11%	50.50%
Expectation from my supervisor	1352	45.28%	40.33%	50.24%
Taken into account during performance reviews	1233	41.30%	31.58%	51.02%
Peers were taking it	699	23.41%	20.59%	26.24%
Maintenance of licensure	401	13.43%	11.26%	15.60%
Other	219	7.33%	5.47%	9.20%
None of the above	14	0.45%	0.02%	0.89%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Table 17-5. Estimated Percentage of Self-Reported Skill Gaps (High Importance / Low Skill) Among State Health Department Epidemiologists by Workforce Tier

Skill	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Tier 1: Non-Supervisors				
Systems and Strategic Thinking				
Participate in quality improvement processes for agency programs and services	503	30.19%	25.93%	34.46%
Describe how social determinants of health impact the health of individuals	332	18.49%	14.19%	22.78%
Describe your agency’s strategic priorities, mission, and vision	388	21.45%	17.72%	25.18%
Budget and Financial Management				
Describe financial analysis methods applicable to program and service delivery	453	42.72%	36.82%	48.62%
Describe how public health funding mechanisms support agency programs and services	600	41.87%	35.13%	48.61%
Describe the value of an agency business plan	457	41.80%	36.19%	47.40%
Develop a Vision for a Healthy Community				
Describe the value of community strategic planning that results in a community health assessment or community health improvement plan	453	32.64%	26.87%	38.41%
Describe the importance of engaging community members in the design and implementation of programs to improve health in a community	410	26.63%	22.19%	31.08%
Describe your role in improving the health of the community served by the agency	239	13.02%	10.03%	16.00%
Cross-Sectoral Partnerships				
Engage community assets and resources to improve health in a community	526	33.74%	26.53%	40.95%
Collaborate with public health personnel across the agency to improve the health of the community	299	15.38%	11.27%	19.48%

Cultural Competency				
Support inclusion of health equity and social justice principles into planning for program and service delivery	435	26.68%	22.70%	30.65%
Deliver socially, culturally, and linguistically appropriate programs and customer service	342	20.20%	17.00%	23.40%
Describe the value of a diverse public health workforce	217	13.89%	9.97%	17.80%
Change Management				
Describe the influence of internal changes on organizational practices	493	37.40%	32.64%	42.16%
Assess the external drivers in your environment that may influence your work	481	29.89%	25.68%	34.09%
Effective Communication				
Communicate in a way that persuades others to act	375	19.28%	16.24%	22.31%
Effectively target communications to different audiences	360	18.04%	14.93%	21.14%
Data for Decision-Making				
Identify evidence-based approaches to address public health issues	192	9.94%	7.81%	12.08%
Identify appropriate sources of data and information to assess the health of communities	160	8.12%	5.14%	11.09%
Collect valid data for use in decision making	85	4.17%	2.52%	5.82%
Tier 2: Supervisors and Managers				
Systems and Strategic Thinking				
Build cross-sector partnerships to address social determinants of health	264	34.09%	22.98%	45.20%
Implement an organizational strategic plan	216	30.17%	21.81%	38.53%
Apply quality improvement processes to improve agency programs and services	205	25.54%	15.09%	35.99%
Integrate current and projected trends into strategic planning for programs	185	24.68%	17.10%	32.26%

Budget and Financial Management				
Identify funding mechanisms and procedures to develop sustainable funding models for programs and services	277	39.22%	34.44%	44.00%
Use financial analysis methods in managing programs and services	226	37.52%	27.86%	47.18%
Implement a business plan for agency programs and services	170	28.84%	19.51%	38.18%
Develop a Vision for a Healthy Community				
Engage community members in the design and implementation of programs to improve health in a community	222	32.67%	19.59%	45.74%
Assess how agency policies, programs, and services advance population health	203	28.77%	15.80%	41.73%
Apply findings from a community health assessment or community health improvement plan to agency programs and services	123	19.09%	12.53%	25.66%
Cross-Sectoral Partnerships				
Identify and engage assets and resources that can be used to improve health of a community	237	34.09%	20.95%	47.23%
Engage in collaborations within the public health system, including traditional and non-traditional partners, to improve the health of a community	192	24.21%	17.54%	30.89%
Cultural Competency				
Incorporate health equity and social justice principles into planning for programs and services	244	32.14%	17.56%	46.72%
Implement socially, culturally, and linguistically appropriate policies, programs, and services that reflect the diversity of individuals and populations in a community	225	30.86%	17.03%	44.69%
Support development of a diverse public health workforce	188	25.13%	18.83%	31.43%
Change Management				
Assess the drivers in your environment that may influence public health programs and services	207	28.25%	13.05%	43.44%

Modify programmatic practices in consideration of internal and external changes	203	25.77%	15.25%	36.29%
Effective Communication				
Communicate in a way that persuades others to act	127	14.76%	6.57%	22.94%
Communicate in a way that different audiences can understand	44	4.99%	1.83%	8.14%
Data for Decision-Making				
Apply evidence-based approaches to address public health issues	34	3.91%	2.42%	5.40%
Identify appropriate sources of data and information to assess the health of a community	28	3.21%	0.39%	6.04%
Use valid data to drive decision making	20	2.28%	0.32%	4.24%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Note: Tier 3: Executives were not included because there were fewer than 5 respondents that self-identified in this category.

Table 17-6. Estimated Percentage of Self-Reported Skill Importance* Among State Health Department Epidemiologists by Workforce Tier

* Respondents were asked, of skills identified as very important, which is the most important skill?

Skill	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Tier 1: Non-Supervisors				
Collect valid data for use in decision making	919	45.70%	38.88%	52.53%
Identify appropriate sources of data and information to assess the health of a community	343	17.07%	14.45%	19.69%
Identify evidence-based approaches to address public health issues	212	10.55%	2.40%	18.70%
Collaborate with public health personnel across the agency to improve the health of the community	136	6.77%	4.30%	9.24%
Communicate in a way that persuades others to act	132	6.58%	4.15%	9.00%
Tier 2: Supervisors and Managers				
Use valid data to drive decision making	410	46.67%	38.37%	54.97%
Apply evidence-based approaches to address public health issues	126	14.33%	6.81%	21.85%
Identify appropriate sources of data and information to assess the health of a community	82	9.35%	4.04%	14.66%
Communicate in a way that different audiences can understand	81	9.24%	4.85%	13.64%
Communicate in a way that persuades others to act	37	4.26%	0.00%	9.86%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Note: Tier 3: Executives were not included because there were fewer than 5 respondents that self-identified in this category.

Table 17-7. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Awareness Among State Health Department Epidemiologists

Emerging Area	Level	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Fostering a culture of quality improvement	Nothing at all	218	7.33%	5.42%	9.25%
	Not much	388	13.02%	9.12%	16.92%
	A little	1004	33.71%	30.74%	36.68%
	A lot	1367	45.93%	41.65%	50.21%
Public health and primary care integration	Nothing at all	319	10.70%	7.74%	13.66%
	Not much	534	17.91%	15.03%	20.79%
	A little	1127	37.76%	28.64%	46.88%
	A lot	1004	33.63%	24.34%	42.92%
Evidence-based public health practice	Nothing at all	109	3.65%	1.72%	5.57%
	Not much	170	5.71%	3.58%	7.83%
	A little	712	23.90%	20.66%	27.13%
	A lot	1990	66.75%	62.77%	70.72%
Health in All Policies	Nothing at all	1214	40.79%	30.35%	51.23%
	Not much	719	24.16%	18.21%	30.12%
	A little	612	20.56%	15.43%	25.69%
	A lot	431	14.48%	12.49%	16.48%
Multisectoral collaboration	Nothing at all	511	17.14%	13.03%	21.25%
	Not much	547	18.34%	14.95%	21.74%
	A little	972	32.62%	29.29%	35.94%
	A lot	950	31.90%	25.07%	38.72%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Table 17-8. Estimated Percentage of Self-Reported Emerging Areas of Public Health Practice Impact Among State Health Department Epidemiologists

Emerging Area	Level	Weighted Count	Weighted Proportion	95%CI LB	95%CI UB
Fostering a culture of quality improvement	Not at all	199	7.23%	3.69%	10.77%
	Not too much	867	31.49%	26.18%	36.79%
	Impact fair amount	1000	36.32%	33.38%	39.25%
	Impact great deal	687	24.97%	17.36%	32.57%
Public health and primary care integration	Not at all	425	16.05%	11.32%	20.77%
	Not too much	923	34.84%	28.42%	41.25%
	Impact fair amount	814	30.73%	27.71%	33.75%
	Impact great deal	487	18.39%	8.99%	27.79%
Evidence-based public health practice	Not at all	167	5.82%	3.37%	8.26%
	Not too much	441	15.41%	12.91%	17.91%
	Impact fair amount	983	34.33%	30.65%	38.01%
	Impact great deal	1273	44.44%	40.41%	48.48%
Health in All Policies	Not at all	393	22.59%	18.72%	26.46%
	Not too much	733	42.13%	37.07%	47.20%
	Impact fair amount	439	25.22%	21.80%	28.65%
	Impact great deal	175	10.06%	7.84%	12.27%
Multisectoral collaboration	Not at all	156	6.36%	3.56%	9.15%
	Not too much	639	26.00%	23.28%	28.73%
	Impact fair amount	927	37.71%	32.43%	43.00%
	Impact great deal	736	29.92%	22.35%	37.50%

CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Figure 17-1. Estimated Percentage of Self-Reported Age Group Among State Health Department Epidemiologists

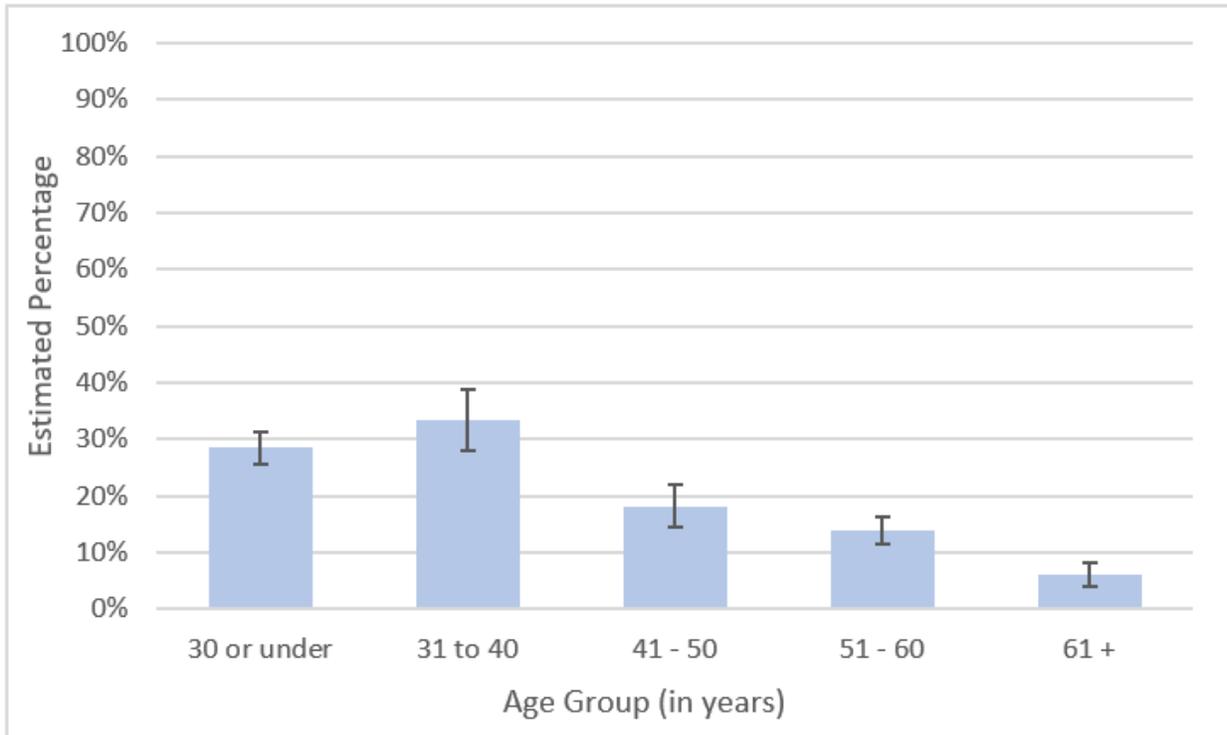
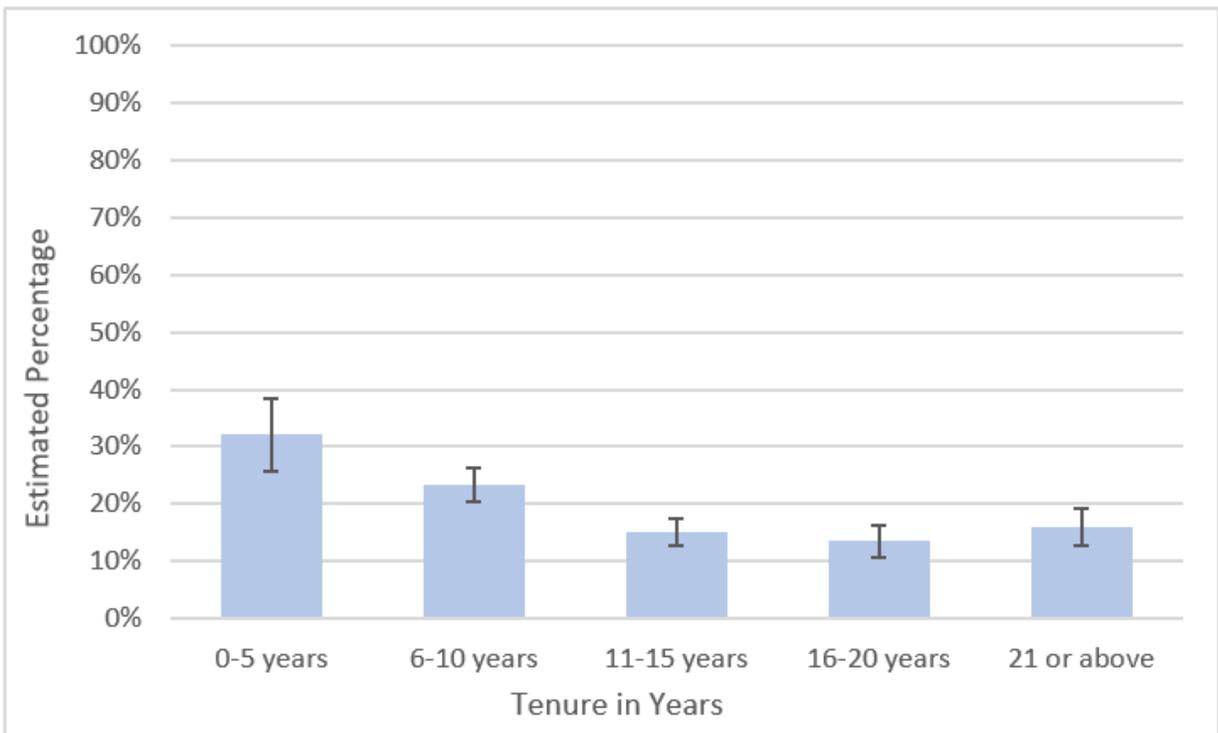


Figure 17-2. Estimated Percentage of Self-Reported Tenure in Public Health Practice Among State Health Department Epidemiologists



**APPENDIX 18: SUPPLEMENTAL DATA TABLES AND FIGURES FOR
PHASE 2 STATE EPIDEMIOLOGIST SURVEY ANALYSIS**

Table 18-1. Importance of Emerging Areas of Public Health Practice in Day-to-Day Work of Epidemiologists Working in State Health Departments as Reported by State Epidemiologists (n=51)

Emerging Area	Level	Count	Proportion	SE	95%CI LB	95%CI UB
Fostering a culture of quality improvement	Not important	0	0%	0.0	0.0	7.0
	Slightly important	5	9.8	4.2	3.3	21.4
	Important	16	31.4	6.6	19.1	45.9
	Very important	30	58.8	7.0	44.2	72.4
Public health and primary care integration	Not important	0	0%	0.0	0.0	7.0
	Slightly important	14	27.5	6.3	15.9	41.7
	Important	20	39.2	6.9	25.8	53.9
	Very important	17	33.3	6.7	20.8	47.9
Evidence-based public health practice	Not important	0	0%	0.0	0.0	7.0
	Slightly important	1	2.0	2.0	0.0	10.4
	Important	5	9.8	4.2	3.3	21.4
	Very important	45	88.2	4.6	76.1	95.6
Health in All Policies	Not important	0	0%	0.0	0.0	7.0
	Slightly important	11	21.6	5.8	11.3	35.3
	Important	23	45.1	7.0	31.1	59.7
	Very important	17	33.3	6.7	20.8	47.9
Multisectoral collaboration	Not important	0	0%	0.0	0.0	7.0
	Slightly important	3	5.9	3.3	1.2	16.2
	Important	17	33.3	6.7	20.8	47.9
	Very important	31	60.8	6.9	46.1	74.2
Listed some other emerging area of practice	Yes	27	52.9	7.1	38.5	67.1
	No	24	47.1	7.1	32.9	61.5

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound
Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

Table 18-2. Readiness of Epidemiologists Working in State Health Departments to Work in Emerging Areas of Public Health Practice as Reported by State Epidemiologists (n=51)

Emerging Area	Level	Count	Proportion	SE	95%CI LB	95%CI UB
Fostering a culture of quality improvement	Not ready	2	3.9	2.7	0.5	13.5
	Slightly ready	17	33.3	6.7	20.8	47.9
	Ready	27	52.9	7.1	38.5	67.1
	Very ready	5	9.8	4.2	3.3	21.4
Public health and primary care integration	Not ready	8	15.7	5.1	7.0	28.6
	Slightly ready	29	56.9	7.0	42.2	70.7
	Ready	9	17.6	5.4	8.4	30.9
	Very ready	5	9.8	4.2	3.3	21.4
Evidence-based public health practice	Not Ready	0	0%	0.0	0.0	7.0
	Slightly ready	4	7.8	3.8	2.2	18.9
	Ready	27	52.9	7.1	38.5	67.1
	Very ready	20	39.2	6.9	25.8	53.9
Health in All Policies	Not ready	8	15.7	5.1	7.0	28.6
	Slightly ready	26	51.0	7.1	36.6	65.2
	Ready	14	27.5	6.3	15.9	41.7
	Very ready	3	5.9	3.3	1.2	16.2
Multisectoral collaboration	Not ready	2	3.9	2.7	0.5	13.5
	Slightly ready	12	23.5	6.0	12.8	37.5
	Ready	26	51.0	7.1	36.6	65.2
	Very ready	11	21.6	5.8	11.3	35.3

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

Table 18-3. Use of Job Classification Systems and Epidemiology-Specific Job Classifications in State Health Departments and the District of Columbia (n=51)

Survey Question	Level	Count	Proportion	SE	95%CI LB	95%CI UB
Job Classification System in Use in Jurisdiction	Yes	49	96.1	2.7	86.5	99.5
	Epidemiology-Specific Job Classification Available	43	87.8	4.7	75.2	95.4
	No Epidemiology-Specific Job Classification Available	6	12.2	4.7	4.6	24.8
	No	2	3.9	2.7	0.5	13.5
Epidemiology-Specific Job Classification Positively Contributes to Recruitment of Epidemiologists*	Strongly agree	20	47.6	7.8	32.0	63.6
	Agree	17	40.5	7.7	25.6	56.7
	Neither agree nor disagree	2	4.8	3.3	0.6	16.2
	Disagree	2	4.8	3.3	0.6	16.2
	Strongly disagree	1	2.4	2.4	0.1	12.6
Epidemiology-Specific Job Classification Positively Contributes to Retention of Epidemiologists*	Strongly agree	15	35.7	7.5	21.6	52.0
	Agree	14	33.3	7.4	19.6	49.5
	Neither agree nor disagree	5	11.9	5.1	4.0	25.6
	Disagree	6	14.3	5.5	5.4	28.5
	Strongly disagree	2	4.8	3.3	0.6	16.2

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound

Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

* The denominator for these proportions is 42 as one state epidemiologist with an epidemiology-specific job classification in place did not provide a response to the questions about impact on recruitment and retention.

Table 18-4. Minimum Education and Experience Requirements Specified in Epidemiology-Specific Job Classifications in State Health Departments (n=157)

Requirement	Degree	Career Stage			Total (n=157)
		Entry (n=35)	Mid (n=43)	Senior (n=79)	
Education	Less than Bachelor's	3 (9%)	7 (16%)	12 (15%)	22 (14%)
	Bachelor's	18 (51%)	16 (37%)	8 (10%)	42 (27%)
	Master's	13 (37%)	19 (44%)	42 (53%)	74 (47%)
	Doctoral	1 (3%)	1 (2%)	17 (22%)	19 (12%)
Experience* [in years, range (median)]	Less than Bachelor's (n=15)	3 - 5 (4)	0 - 9 (5)	0 - 9 (6)	0 - 9 (5)
	Bachelor's (n=56)	0 - 4 (1)	0 - 5 (3)	0 - 6 (4.5)	0 - 6 (2)
	Master's (n=115)	0 - 2 (0)	0 - 6 (2)	0 - 12 (3)	0 - 12 (2)
	Doctoral (n=98)	0 - 1 (0)	0 - 2 (0)	0 - 6 (2)	0 - 6 (1)
Assigned AEC Tier	Not included in AECs	13 (37%)	9 (21%)	12 (15%)	34 (22%)
	Early	20 (57%)	23 (53%)	15 (19%)	58 (37%)
	Mid	2 (6%)	6 (14%)	23 (29%)	31 (20%)
	Senior	0 (0%)	5 (12%)	26 (33%)	31 (20%)
	Not enough information to assign	0 (0%)	0 (0%)	3 (4%)	3 (19%)

* The number noted after each degree is the number of classifications that specified minimum experience requirements and are the basis of the ranges and medians presented.

AEC: Applied Epidemiology Competencies. The reason for the minimum required education not being included in the AECs was because less than a bachelor's degree was required or because a master's or doctoral degree was required but not specifically in epidemiology.

Table 18-5. Use of Epidemiology Career Ladders in State Health Departments and the District of Columbia (n=49)

Survey Question	Level	Count	Proportion	SE	95% CI LB	95% CI UB
Epidemiology Career Ladder in Place	Yes	36	73.5	6.4	58.9	85.1
	No	12	24.5	6.2	13.3	38.9
	Respondent was unsure	1	2.0	2.0	0.1	10.9
Career Ladder Progression Factors	Increasing supervision	26	72.2	7.6	54.8	85.8
	Increasing experience	29	80.6	6.7	64.0	91.8
	Completion of formal education	17	47.2	8.4	30.4	64.5
	New Skills	23	63.9	8.1	46.2	79.2
	Demonstrating epidemiology competencies	19	52.8	8.4	35.5	69.6
	Other	9	25.0	7.3	12.1	42.2
Career Ladder Advancement Mechanism	Advancement not automatic and requires reclassification, hiring, or promotion process	34	94.4	3.9	81.3	99.3
	Other	2	5.6	3.9	0.7	18.7
Career Ladder Positively Contributes to Recruitment of Epidemiologists*	Strongly agree	9	25.7	7.5	12.5	43.3
	Agree	15	42.9	8.5	26.3	60.6
	Neither agree nor disagree	5	14.3	6.0	4.8	30.3
	Disagree	4	11.4	5.5	3.2	26.7
	Strongly disagree	2	5.7	4.0	0.7	19.2
Career Ladder Positively Contributes to Retention of Epidemiologists*	Strongly agree	10	28.6	7.7	14.6	46.3
	Agree	13	37.1	8.3	21.5	55.1
	Neither agree nor disagree	4	11.4	5.5	3.2	26.7
	Disagree	6	17.1	6.5	6.6	33.6
	Strongly disagree	2	5.7	4.0	0.7	19.2
AECs Used to Develop or Revise Career Ladder*	Yes	10	28.6	7.7	14.6	46.3
	No	20	57.1	8.5	39.4	73.7
	Respondent was unsure	5	14.3	6.0	4.8	30.3

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound; AECs: Applied Epidemiology Competences

Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

* The denominator for these proportions is 35 as one participant did not provide a response.

Table 18-6. Perceptions and Use of the Applied Epidemiology Competencies for Workforce Development Activities in State Health Departments and the District of Columbia (n=50)

Survey Question	Level	Count	Proportion	SE	95% CI LB	95% CI UB
Experience Using AECs for Workforce Development Activities	Never used	11	22.0	5.9	11.5	36.0
	Ever used	39	78.0	5.9	64.0	88.5
	To assess training needs	25	50.0	7.1	35.5	64.5
	To create or revise job descriptions	24	48.0	7.1	33.7	62.6
	To evaluate epidemiologists' performance	17	34.0	6.8	21.2	48.8
	To develop training plans	16	32.0	6.7	19.5	46.7
	Other	8	16.0	5.2	7.2	29.1
Usefulness of AECs to Manage Epidemiologists	Extremely useful	7	14.0	5.0	5.8	26.7
	Very useful	13	26.0	6.3	14.6	40.3
	Moderately useful	13	26.0	6.3	14.6	40.3
	Slightly useful	6	12.0	4.6	4.5	24.3
	Not at all useful	1	2.0	2.0	0.1	10.6
	I do not have experience using the AECs in my agency	10	20.0	5.7	10.0	33.7
Relevance of AECs to Current Epidemiology Practice	Extremely relevant	10	20.0	5.7	10.0	33.7
	Very relevant	23	46.0	7.1	31.8	60.7
	Moderately relevant	10	20.0	5.7	10.0	33.7
	Slightly relevant	4	8.0	3.9	2.2	19.2
	Not at all relevant	1	2.0	2.0	0.1	10.6
	I do not feel familiar enough with the AECs to answer this question	2	4.0	2.8	0.5	13.7

Relevance of AECs to Future Epidemiology Practice	Extremely relevant	14	28.0	6.4	16.2	42.5
	Very relevant	23	46.0	7.1	31.8	60.7
	Moderately relevant	5	10.0	4.3	3.3	21.8
	Slightly relevant	5	10.0	4.3	3.3	21.8
	Not at all relevant	0	0%	0.0	0.0	7.1
	I do not feel familiar enough with the AECs to answer this question	3	6.0	3.4	1.3	16.5
Do the AECs Need to be Updated*	I don't know	16	33.3	6.9	20.4	48.4
	No	14	29.2	6.6	17.0	44.1
	Yes	18	37.5	7.1	24.0	52.6

SE: Standard Error; CI: Confidence Interval; LB: Lower Bound; UB: Upper Bound; AECs: Applied Epidemiology Competences

Notes: Clopper-Pearson (exact) confidence limits are presented for proportions.

* The denominator for these proportions is 48 rather than 50.

Table 18-7. Ranked Order of Barriers for Epidemiologist Participation in Training in State Health Departments and the District of Columbia (n=49)

Barriers	Rank	Score	Mean	Median	Mode
Lack of time	1	303	2.8	2	2
Lack of staff due to recruitment challenges	2	272	3.4	3	1
Lack of staff due to retention challenges	3	262	3.7	3	2
Lack of funding for training	4	260	3.7	4	3
Lack of organizational support to attend training	5	214	4.6	5	6
Lack of information on training needs	6	187	5.2	5	6
Lack of training opportunities	7	159	5.8	7	7
Other challenge	8	107	6.8	8	8

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