Disaster Medicine and Public Health Preparedness

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Original Research

Cite this article: Stone KW, Felkner M, Garza E, Perez-Patron M, Schmit C, McDonald TJ, Horney JA (2022) Epidemiology surveillance and capacity improvement: a characterization of Texas, 2017. *Disaster Med Public Health Prep* **16**: 999–1006. doi: https://doi.org/10.1017/dmp.2020.471.

First published online: 17 March 2021

Keywords:
capacity building; epidemiologic monitoring; public health surveillance

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Epidemiology Surveillance and Capacity Improvement: A Characterization of Texas, 2017

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Abstract

Objectives: In response to increasing caseloads of foodborne illnesses and high consequence infectious disease investigations, the Texas Department of State Health Services (DSHS) requested funding from the Texas Legislature in 2013 and 2015 for a new state-funded epidemiologist (SFE) program.

Methods: Primary cross-sectional survey data were collected from 32 of 40 local health departments (LHDs) via an online instrument and analyzed to quantify roles, responsibilities, and training of epidemiologists in Texas in 2017 and compared to similar state health department assessments.

Results: Sixty-six percent of SFEs had epidemiology-specific training (eg, master's in public health) compared to 45% in state health department estimates. For LHDs included in this study, the mean number of epidemiologists per 100 000 was 0.73 in medium LHDs and 0.46 in large LHDs. SFE positions make up approximately 40% of the LHD epidemiology workforce of all sizes and 56% of medium-sized LHD epidemiology staff in Texas specifically.

Conclusions: Through this program, DSHS increased epidemiology capacity almost twofold from 0.28 to 0.47 epidemiologists per 100 000 people. These findings suggest that capacity funding programs like this improve epidemiology capacity in local jurisdictions and should be considered in other regions to improve general public health preparedness and epidemiology capacity.

Introduction

The Centers for Disease Control and Prevention (CDC) established 15 public health emergency preparedness and response capability standards for state, local, tribal, and territorial public health in 2011 and were updated in 2018.[1] Standard 13 describes functions for public health surveillance (#1), epidemiological investigations (#2), recommend, monitor, and analyze mitigation actions (#3), and improve public health surveillance and epidemiological investigation systems (#4). Each function in Standard 13 has detailed tasks and priorities related to essential public health services (EPHS) tied to epidemiology capacity, a key component in public health preparedness. Since 2001, the Council of State and Territorial Epidemiologists (CSTE) has assessed the epidemiology workforce in state health departments, publishing periodic reports that characterize changes over time.[2-5] Identifying gaps in the epidemiology capacity of state health departments provides the public health system with opportunities to build capacity and support the provision of EPHS. In their 2013 and 2017 Epidemiology Capacity Assessment (ECA), CSTE recommended that state health departments increase funding from state budgets, rather than relying disproportionately on federal funds, to support epidemiology positions.[5,6] Although state health department epidemiology capacity has been well documented by CSTE and others, limited information is available to describe local health department (LHD) epidemiology capacity.

Since 2005, the National Association of County and City Health Officials (NACCHO) profile survey has collected information on a range of topics, including workforce information, from all LHDs in the United States. The NACCHO profile study has demonstrated growth in the number of epidemiologists in LHDs, with 1300 identified in 2005 and 1600 included in the 2016 profile.[7] However, the NACCHO national profile data are limited since it only includes an estimated number of epidemiologists employed without other measures of capacity.

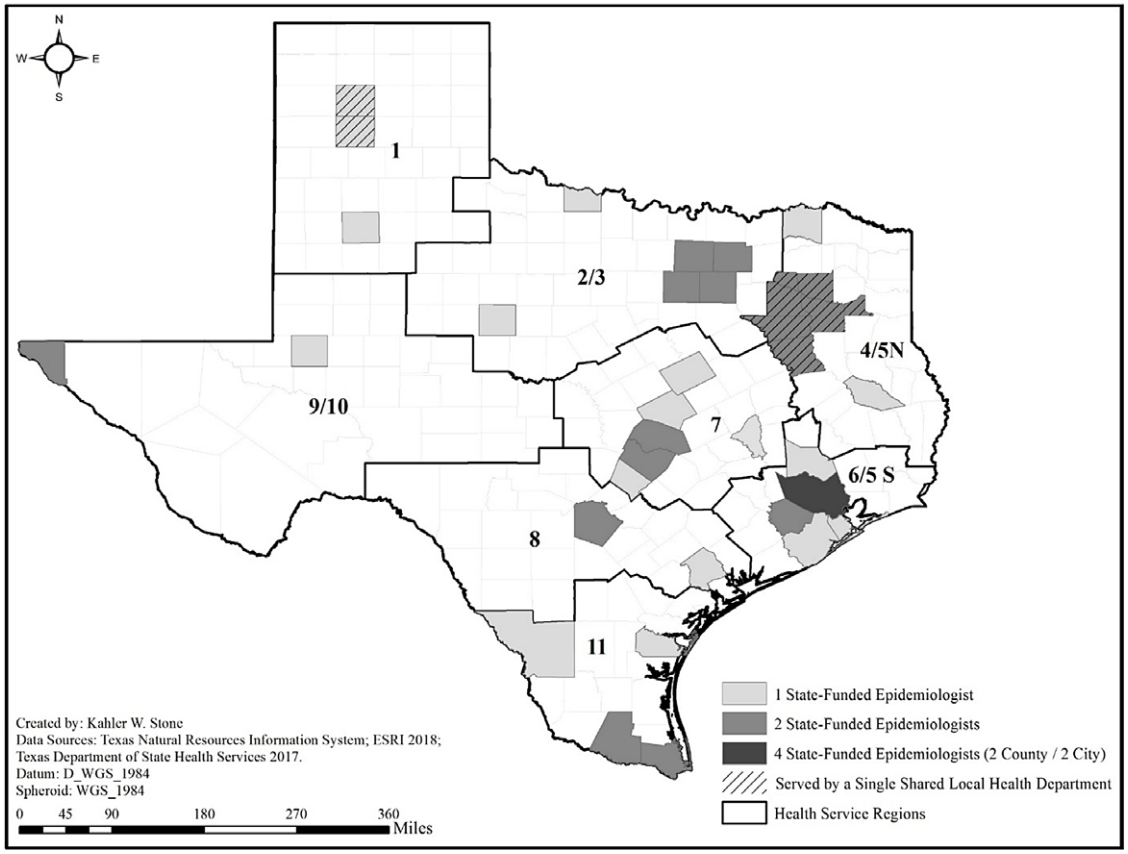

Figure 1. Distribution of state-funded epidemiologist positions in Texas, 2017.

No information regarding program area, competency, training needs, or experience is captured. This is partially due to the intricacies of LHDs. Recently, CSTE partnered with the Big Cities Health Coalition and modified the state-level ECA to better understand epidemiologic workforce capacity in US large health departments.[8] This study found similar workforce trends with the state health department studies; however, this accounts for only large health departments in the United States. While the CDC, NACCHO, and CSTE have long been documenting the inadequacy of public personnel responsible for responding to public health disasters, coronavirus disease (COVID-19) has brought this to the attention of the lay public via the media.[9-12]

Texas has 254 counties, 71 local public health departments/districts, and a state health department that operates as a largely decentralized public health system with 11 Health Service Regions that are functionally condensed to eight. According to the Association of State and Territorial Health Officials (ASTHO), Texas is 1 of 2 states that has a largely decentralized public health system where LHDs provide public health services for the majority of residents.[13] In response to increasing caseloads of foodborne illnesses and high consequence infectious disease investigations in Texas, the Texas Department of State Health Services (DSHS) requested funding for a state-funded epidemiologist (SFE) program. The Texas Legislature, in its 83rd and 84th legislative sessions (2013 and 2015, respectively), funded 45 epidemiology positions to be assigned to LHDs/districts in Texas to increase epidemiology capacity in the state, in general, and specifically to improve response to infectious disease threats (Figure 1). DSHS provides funds to LHDs through contracts, and the LHD is responsible for hiring and managing the SFE position. The majority of contract epidemiology work in US health departments come from federal funding through the CDC's Epidemiology and Laboratory Capacity Cooperative Agreement that helps local, state, and territorial health departments, a portion of which comes from the Prevention and Public Health Fund, a mandated fund that is part of the Affordable Care Act.[14] The SFE program is unique in its approach to increasing the epidemiology workforce in Texas by providing state funds to LHDs across the state, specifically for new epidemiology positions.

In the initial round of hiring, the SFEs were to focus on foodborne illness because of the perpetual nature of foodborne outbreaks. Foodborne investigations were usually the ones abandoned when staffing shortages required prioritizing investigation of foodborne versus a less frequently encountered disease or one of greater public concern. Infectious disease staff selected LHDs to receive SFEs based on turn-around-time for foodborne illness questionnaires, granting SFEs to LHDs with the longest response times. These contracts did not stipulate experience or education requirements on the assumption that the LHDs would select properly qualified individuals. The 2015 legislature funded additional capacity in reaction to the Texas Ebola virus disease event that had stressed LHD capacity to exhaustion. The 2013 SFE experience informed changes in the 2015 contracts. Specifying that the SFEs work on a specific type of infectious disease had proved less than optimal in both large and small health departments. Small health departments did not have enough foodborne illness surveillance and investigations to occupy a full-time position; some larger health departments allocated responsibility by geographic sector rather than the type of infectious disease. Health departments improved efficiency, given greater flexibility in SFE job duties.

https://doi.org/10.1017/dmp.2020.471 Published online by Cambridge University Press

Because some health departments had simply promoted from within or for other reasons hired without regard to adequate qualifications in the first round, 2015 SFEs were required to have at least 2 years of epidemiologic experience or a master's of public health. The selections were essentially population-based with large population counties receiving 2 epidemiologists.

The purpose of this study was to describe and evaluate the impact of the epidemiology surge capacity program established by the DSHS and funded by the Texas Legislature beginning in 2013. Evaluating the SFE program requires quantifying and characterizing epidemiologists in LHDs to identify areas of unmet need and gaps in capacity.[14-16] For example, describing the roles and responsibilities and competency levels of epidemiologists in LHDs can help in identifying areas where EPHS are not being met. Understanding the number and function of epidemiologists in LHDs is the first step to improving public health services associated with epidemiology in local jurisdictions.

Methods

Study Population

The SFE program in Texas provides contracts for 45 positions in 31 LHDs of varying sizes. At the time of this study, 40 of the 45 positions were filled, thus the target sample was 40 (representing 29 health departments) for the online survey. The SFE program coordinator at DSHS provided a contact list for epidemiologists in the SFE program and their corresponding LHDs. Each SFE received an e-mail with a link to an individual assessment, along with instructions, frequently asked questions, and other study information.

Assessment Tool

A cross-sectional survey was implemented to describe and quantify LHD contracted epidemiologists in the SFE program, their general roles, and their epidemiology training. The CSTE ECA tool was used to characterize the competency and training needs of health department epidemiologists. This tool is described in detail on the CSTE website, http://www.cste.org/group/ECA. The tool has had only minor changes and adjustments since its creation in 2001 to maintain the integrity of the tool and to provide data on trends over time related to the nature and makeup of the epidemiologist workforce in state health departments.

The ECA tool assessed Applied Epidemiology Competencies (AECs) to allow individual respondents to self-identify their competency level and classify their skill level and training needs. The AECs were developed in a collaborative effort by CSTE and the CDC to describe the roles and skills needed for applied epidemiologists working in the field as part of the Core Competencies for Public Health Professionals.[17] A descriptive cross-sectional study, conducted an assessment of epidemiology capacity in LHDs nationwide, using this tool previously.[18] In this study, the authors modified the individual assessment tool from CSTE's 2013 assessment to address study-specific questions related to perceived LHD capacity from the epidemiologist and public health director perspectives. Similarly, we added 2 questions to the ECA tool to gather information specific to SFE tasks and logistics specific to the Texas SFE program.

Data Collection

The individual assessment was designed in 2017 and conducted using Qualtrics (Provo, UT), a secure online survey management system that offers tools for dissemination and response tracking. Two weeks prior to distributing the individual assessment to all SFE positions, the individual assessment was pilot tested with 2 SFEs in different LHDs. Each SFE position was given a unique access link to the assessment and specific instructions for completing the assessment. Following the pilot test, a letter was sent to each SFE from the DSHS SFE program coordinator to explain the study, validate the collaboration between DSHS and Texas A&M University on this project, and encourage response from LHD epidemiologists. A recruitment e-mail was then sent to each SFE. Participants were given 6 weeks to complete the online individual assessment. Each potential participant was contacted 3 times before considering him or her a non-response. E-mail reminders were sent periodically to encourage the completion of the assessment for those who agreed but did not finish the assessment immediately. Multiple contacts were made to encourage response because LHD epidemiologists have demanding schedules, and the prior nationwide study yielded a low response rate (27% in the O'Keefe et al. study[18]).

Analysis

Data were exported from Qualtrics (Provo, UT) to Microsoft Excel (Redmond, WA) and Stata 14 (StataCorp, College Station, TX) for analysis. LHDs were categorized as small (< 50 000), medium 000 500–000 50)), or large (> 500 000), based on the population served according to July 1, 2015, US Census estimates. The proportion of epidemiologists per 100 000 people served, tier level, gender, experience, skill level, and training needs were then cross-tabulated and compared to the 2013 CSTE ECA report. Though CSTE has released their 2017 ECA report, individual epidemiologist characteristics were not collected, and therefore the data collected in this study can be compared only to the 2013 CSTE assessment for most variables. The mean ratio of epidemiologists per 100 000 population was calculated by LHD size and overall for comparison to CSTE ECA reports and other literature. Confidence intervals at the 95% level were calculated for percentage estimates.

This study and all aspects of data collection, analysis, and reporting were reviewed and approved by the Texas A&M Institutional Review Board (IRB2017-0366M).

Results

Between November 29, 2017, and January 8, 2018, 34 online surveys were collected, 2 of which were not included in the analysis due to being largely incomplete, leaving an overall response rate of 80% (32 of 40). All non-respondents were employed in medium and large LHDs; however, no other information on the non-respondents was captured. The 32 participants represented 26 of the 29 LHDs that currently had an SFE position filled. Of these 26 LHDs, 7 have only 1 epidemiologist position, which is filled with an SFE.

Of SFE respondents, 41% (N = 13) were male, 56% (N = 18) were female, and 3% (N = 1) preferred not to say (Table 1). Nine percent (N = 3) identified as Asian, 16% (N = 5) as black, 19% (N = 6) as Hispanic, 41% (N = 13) as non-Hispanic white, and 15% (N = 5) as other or unknown. The median age of all SFE respondents was 31 years (range, 24 – 64). Race, gender, and median age all differed from the national state health department epidemiology workforce as reported by CSTE, including a larger percentage of SFEs who were Hispanic (19% compared

https://doi.org/10.1017/dmp.2020.471 Published online by Cambridge University Press

Table 1. Texas state-funded epidemiologist characteristics in comparison to a national sample of state health department epidemiologists

Characteristics	SFE (N = 32)			Reference (CSTE Report)
	% (No.)	95% LCL	95%UCL	%
Median Age	31 years (range, 24-64)			40 years (range, 22-88)
Gender				
Male	41 (13)	24	58	29
Female	56 (18)	39	73	71
Unknown/prefer to not answer	3 (1)	0	9	0
Race/Ethnicity				
Asian	9 (3)	0	19	9
Black	16 (5)	3	29	8
Hispanic	19 (6)	5	33	4
White	41 (13)	24	58	76
Other	12 (4)	1	23	3
Unknown	3 (1)	0	9	0
Tier level				
Entry level epidemiologist (Tier 1)	28 (9)	12	44	25
Mid-level epidemiologist (Tier 2)	47 (15)	30	64	41
Senior-level epidemiologist (Tier 3a)	22 (7)	8	36	23
Senior scientist/subject matter expert (Tier 3b)	0 (0)	0	0	11
Unknown	3 (1)	0	9	0
Academic Education				
Professional degree (MD, DMD, DVM, etc.)	12 (4)	1	23	11
PhD or DrPH	3 (1)	0	9	16
Master's degree	72 (23)	56	88	61
Registered nurse	3 (1)	0	9	2
Bachelor's degree or lower	9 (3)	0	19	10
Epidemiology-Specific Training				
PhD, DrPH, other doctoral degree in epidemiology	3 (1)	0	9	9
Professional background (MD, DO, DVM, DDS) with dual degree in epidemiology	3 (1)	0	9	6
MPH, MSPH, other master's degree in epidemiology	66 (21)	50	82	45
BA, BS, other bachelor's degree in epidemiology	0 (0)	0	0	1
Completed formal training program in epidemiology (eg, EIS, CSTE)	9 (3)	0	19	4
Completed some coursework in epidemiology	9 (3)	0	19	23
Received on-the-job training in epidemiology	9 (3)	0	19	10
No formal training in epidemiology	0 (0)	0	0	2

CSTE = Council for State and Territorial Epidemiologists; DDS = Doctor of Dental Surgery; DMD = Doctor of Dental Medicine; DO = Doctor of Osteopathic Medicine; DVM = Doctor of Veterinary Medicine; EIS = Epidemic Intelligence Service; LCL = lower confidence limit; MD = medical doctor; SFE = state-funded epidemiologist; UCL = upper confidence limit; totals may not sum to 100% because of rounding.

to 4%), male (41% compared to 29%), and lower median age (31 years old versus 40 years old).

SFEs were asked to quantify the total number of epidemiologist positions in their LHDs. Based on their responses, a total of 25 epidemiologists work in medium LHDs that have an SFE, and 67 epidemiologists work in large LHDs that have an SFE (Table 2). In medium LHDs, SFE positions account for 56% of epidemiologist positions, while in large LHDs, SFEs account for 34% of epidemiologist positions. For LHDs included in this study, the mean number of epidemiologists per 100 000 population served in medium LHDs was 0.73 and 0.46 in large LHDs.

Of SFE respondents, 47% (N = 15) reported being a mid-level epidemiologist, whereas 28% (N = 9) and 22% (N = 7) reported being entry-level and senior-level, respectively. No respondents reported meeting the epidemiologist tier level of a senior scientist/subject matter expert according to the CSTE AEC. Most SFEs had advanced academic training, with 87% (N = 28) having a master's degree or higher. Compared to state health department epidemiologists nationwide, more SFEs have a master's degree of any concentration (72%; N = 23) as their highest level of academic training, whereas fewer SFEs have a PhD or DrPH (3%; N = 1), though neither was significantly different statistically. Respondents who reported having a doctoral degree (12%; N = 4), being a registered nurse (3%; N = 1), or having a bachelor's degree or lower (9%; N = 3) were similar to national estimates. In terms of epidemiology-specific training, 66% (N = 21) of respondents reported having an MPH or other master's degree with a concentration in epidemiology, well above the national estimate of 45% and statistically significant. All SFEs reported having some type of formal training in epidemiology or a bachelor's degree that included specialized training in epidemiology.

Most SFEs are relatively new to their positions, with 3/4 (75%; N = 24) of SFEs having 4 or fewer years of experience and 16% (N = 5) having 10 or more years (Figure 2). When SFEs were

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Table 2. Local health department epidemiologist distribution in Texas by health department size and population served

	LHD Size			
	Small	Medium	Large	Unknown
Tier Level	*% (CI)*	*% (CI)*	*% (CI)*	*% (CI)*
Entry-level epidemiologist (Tier 1)	0 (0-0)	44 (12-76)	44 (12-76)	12 (0-31)
Mid-level epidemiologist (Tier 2)	0 (0-0)	27 (5-50)	67 (43-91)	6 (0-18)
Senior-level epidemiologist (Tier 3a)	0 (0-0)	71 (37-100)	29 (0-63)	0 (0-0)
All tiers	0 (0-0)	41 (23-59)	53 (36-70)	6 (0-14)
No. Epidemiologists	*No. (%)*	*No. (%)*	*No. (%)*	*No. (%)*
Reported total no. epidemiologists	0	25	67	3
% SFE*	0 (0)	(56)	(34)	0 (0)
Mean epidemiologist per 100 000	0	0.73	0.46	-
Mean epidemiologist per 100 000 in absence of SFE positions	0	0.32	0.27	-

Notes: CI = 95% confidence interval; LHD = local health department; small LHD (< 50 000); medium LHD (50 000–500 000); large LHD (> 500 000)
*Multiple LHDs have > 1 SFE on staff; these additional positions were considered in the calculations.

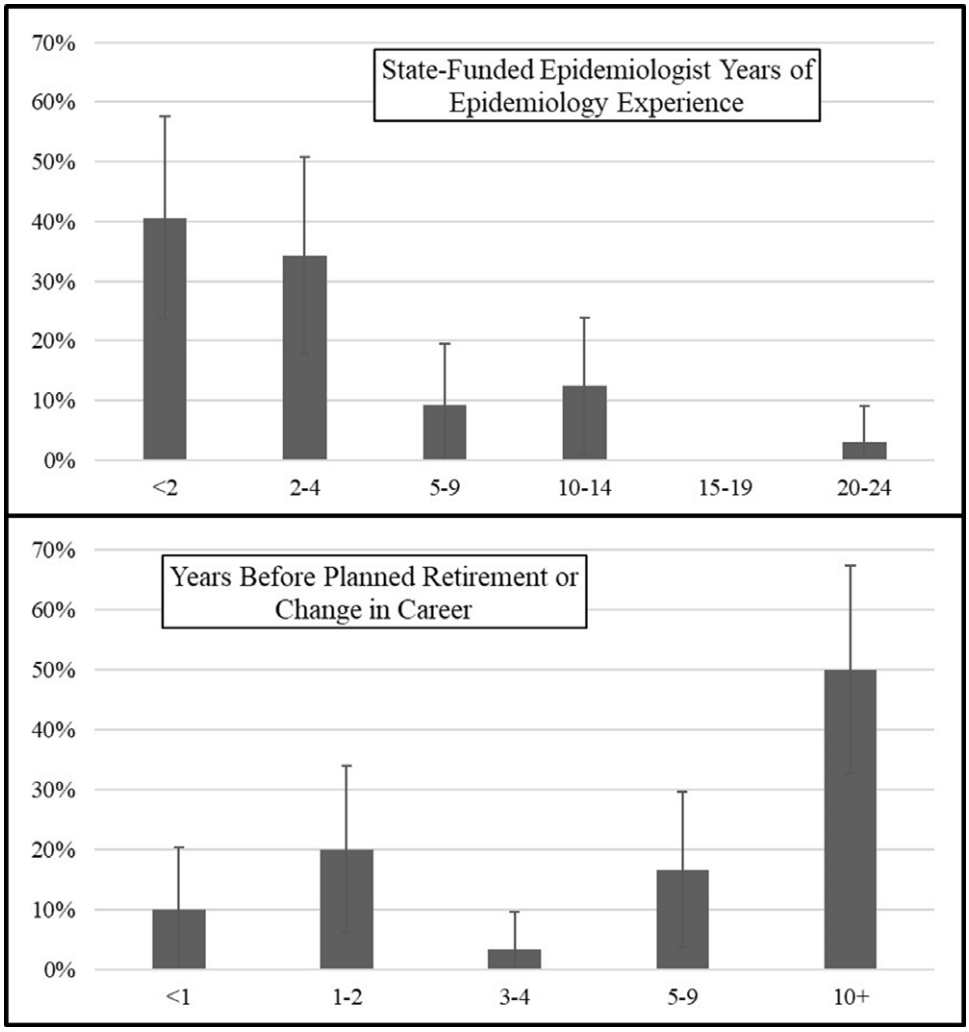

Figure 2. State-funded epidemiologist experience and future retirement or career change estimates.

asked about the number of years before they had planned to retire or change careers, 50% (N = 16) reported less than 10 years, 20% (N = 6) reported a planned retirement in the next 3–9 years, and 30% (N = 10) reported a planned retirement in less than 2 years.

The majority of SFEs' time (86%, 82%, and 87% for Tiers 1, 2, and 3a, respectively) is allocated to infectious disease control program areas (eg, foodborne, waterborne, vaccine-preventable disease, high consequence infectious disease, invasive

https://doi.org/10.1017/dmp.2020.471 Published online by Cambridge University Press

Table 3. State-funded epidemiologist cumulative competencies by tier level (N = 31)

			Report at Least Intermediate Competency		Report Advanced-Expert Competency		Report Needing More Training	
Tier Level	N	No. Competencies	Mean, %	Range, %	Mean, %	Range, %	Mean, %	Range, %
Tier 1	9	30	98	71–100	18	0–42	26	13–63
Tier 2	15	31	99	75–100	54	13–88	29	14–50
Tier 3a	7	32	100	100–100	73	25–100	40	14–57

Notes: Each competency was reported as minimal or none, basic, intermediate, advanced, or expert by each SFE in their respective tier. Training was reported as minimal or none to needs significant training by using a scale of 1-5 with 5 needing the most training (4 & 5 were combined to indicate more training needed in a similar fashion to CSTE AEC). Tier 1 = entry-level epidemiologist; Tier 2 = mid-level epidemiologist; Tier 3a = senior-level epidemiologist.

and respiratory disease, and healthcare-associated infection). The program area second to infectious disease was bioterrorism/emergency response, where across all tiers, 8% of the time was allocated. The remaining time was allocated to environmental health (4%) and other program areas (3%). Respondents reported that the majority of the time they spend working on infectious disease control was spent on case investigation (53%). Other major duties related to infectious disease control included data entry (18%), outbreak control (15%), and public health communication about infectious diseases (13%).

The percentage of SFEs reporting at least intermediate competency increased as tier levels increased (Table 3). Tier 3a epidemiologists reported at least an intermediate level of competency in 100% of the competencies specific to Tier 3a. As tier level increased, the mean percentage increased for those reporting advanced or expert competency. For example, Tier 1 epidemiologists reported advanced or expert competency in 18% of the competencies specific to Tier 1 while Tier 3a epidemiologists reported advanced or expert competency in 73% of their competency categories.

Discussion

This cross-sectional survey used the CSTE ECA and was designed to quantify the number of LHD epidemiologists who were part of the SFE program and to describe their general roles, epidemiology competency, and training needs. Findings from this survey of SFEs provide data on the characteristics of the epidemiology workforce in Texas and allow for the comparison of the SFE workforce to national averages in state health departments.

In 2017, an estimated 3370 epidemiologists worked in state health departments in the United States, a ratio of 1.04 epidemiologists per 100 000 population.[5] In its report, CSTE calls for hiring additional epidemiologists to meet the optimal capacity of 1.4 epidemiologists per 100 000. In a similar study, large LHDs in the Big Cities Health Coalition reported having an estimated 1.4 epidemiologists per 100 000, indicating large LHDs better meet optimal capacity.[8] However, in the large health department study, the number of epidemiologists per 100 000 needed to reach optimal capacity was higher, 1.9 epidemiologists per 100 000 compared to 1.4 per 100 000 reported in the state-level study. This discrepancy highlights the intricacies and differences in state and local-level epidemiology work. In LHDs who have SFE contracts in Texas, medium LHDs have 0.73 epidemiologists per 100 000 people and large LHDs have 0.46 per 100 000, both lower than the national state health department mean and the large LHD study means. Since SFE positions make up approximately 40% of the overall LHD epidemiology workforce (and 56% of medium-sized LHD epidemiology staff) without the SFE program, the LHDs in this study would only have 0.28 per 100 000, far below the national estimates in state health departments and below CSTE ECA reported need for increased ratios to meet the demand of epidemiology services required. The epidemiology capacity increase found in this study from the SFE program indicates that medium-sized LHDs saw a greater improvement in epidemiologists per 100 000 people, especially in those who had no epidemiologist before the program.

The COVID-19 pandemic has made these estimates look overly conservative. In a letter dated April 27, 2020, numerous public health leaders from government, non-profit, and academic entities explained to congressional leaders that, while traditional public health activities – contact tracing and self-isolation – could be effective in controlling the COVID-19 pandemic, they could only be successful with a massive infusion of personnel, estimating a need for 180 000 additional public health workers in this capacity.[19] Widely variant estimations[20] emerged concurrently with the bipartisan public health leaders' letter. While both the press[21] and professional papers[22] tout that persons can become contact tracers with little training, the need for trainers and supervisors still poses another daunting labor force challenge with Johns Hopkins suggesting just-in-time training and supervision can be handled by existing public health staff[22] management structure while George Washington's Contact Tracing Workforce Estimator has 1 supervisor for each 10 contact tracers as the default.[23]

By supplying LHDs with state funding to hire additional epidemiologists with training at the MPH level, the SFE program allowed LHD epidemiology and surveillance programs to benefit from obtaining more specialized epidemiology capacity. The majority of respondents with epidemiology-specific academic training reported having a master's of public health with a concentration or specialization in epidemiology. The SFEs reported higher levels of epidemiology-specific training compared to national estimates, particularly when considering the number of SFEs with an MPH. Having formal training, such as an MPH with a concentration in epidemiology from an accredited graduate education program, can build epidemiology capacity.[24] For example, an SFE who completed a master's degree in public health with an emphasis in epidemiology will meet most of the Tier-1-epidemiologist competency recommendations by CSTE AECs. A core competency of an MPH graduate is how to recognize and interpret public health data for surveillance activities.[24] These curriculum-based competencies align with the Tier-1-epidemiologist AECs.[17] However, comparative national data collected by CSTE in 2004 found that 29% of epidemiologists had no formal training. These SFE positions supply LHDs with greater epidemiology capacity by adding predominantly graduate-level trained individuals in these positions. In addition to AECs, these positions link directly to the Preparedness and Response Capability 13 Functions 1–4 through the conduction, evaluation, and reporting of public health surveillance systems.

SFE respondents reported relatively few years of experience, with 41% reporting less than 2 years of experience, compared to

https://doi.org/10.1017/dmp.2020.471 Published online by Cambridge University Press

the national estimates of 18%.[6] Only 3% of SFEs had at least 20 years of experience, significantly less than the national estimate of 13%. However, although the SFEs reported relatively few years of experience, 30% of SFEs indicated that they would either retire or change careers in the next 2 years, a turnover rate of 15%. According to the 2013 CSTE national report, state health department epidemiologists with at least a master's degree had an 11% turnover rate. This indicates a potential higher turnover in SFEs who have worked only 2 years. This may be in part due to these positions being contract-based.[8] However, it has also been shown that recruitment and retention of health care workers are more difficult in rural settings compared to urban settings.[25]

Tier-based competencies were also assessed among SFEs. Similar to national estimates, as the tier-level of the epidemiologist increased, the reported competency also increased. However, the finding of this study contradicts national estimates related to reported training needs. As their tier-level and level of competency increased, SFEs reported needing more training, as opposed to the national estimates, where training needs decreased as competency level increased. This phenomenon could be due to self-efficacy attribution and the complexity of higher tier competencies where, in this case, as tier levels increase, the desire for more knowledge and training also increases.[26,27]

This study has several limitations. Not all LHDs in Texas that received an SFE were represented in this study, with a marked absence of small LHDs, leaving the potential for selection bias. The sample size of SFEs in this study was small and the sampling frame included only 1 state, limiting the generalizability of the reported SFEs findings. Because the number of SFEs was only 45 at the time of data collection, multiple attempts to recruit participants were made, yielding a response rate of 80%. This study documented the epidemiology capacity improvement in LHDs using a standardized tool, the ECA, which has limitations as well. Participants in this study were asked to quantify the number of epidemiologists in their respective LHDs using a broad definition of epidemiology-related work. This quantification of epidemiologists may not capture the true epidemiology capacity of an LHD as other studies have suggested.[18,28,29] The evaluation of timeliness and response to outbreak investigations in LHDs that received SFEs would provide more information on the true impact of the program. Further research into LHD epidemiology capacity is needed to better estimate needs to meet the EPHS.

The funding and support of the SFE program have allowed DSHS to increase epidemiology capacity almost twofold from 0.28 to 0.47 epidemiologists per 100 000 people. Increasing capacity in this way supports LHDs in providing EPHS, particularly 1, 2, 9, and 10, which are closely related to epidemiology and surveillance. EPHS 1 and 2 are directly impacted in LHDs with SFE since our study shows that 70% of all SFEs spend their time investigating cases and controlling outbreaks. This program has also supplied 7 LHDs with their 1 epidemiologist, providing capacity where there was none, to begin with, and supporting the Public Health Infrastructure Improvement Goals in Healthy People 2020, which include the need to increase the proportion of tribal, state, and local public health agencies offering comprehensive epidemiology services.[30]

Conclusions

Funding epidemiologists in LHDs in decentralized public health systems improve public health surveillance and capacity locally and statewide, providing workforce capacity to prevent and control disease outbreaks. The retention of trained epidemiologists in LHDs is difficult. Offering further training and discipline-specific career-building opportunities, such as fellowships and workgroups with national organizations, along with competitive salaries, are potential ways to retain epidemiologists. Despite the capacity improvement from such funding in Texas, the optimal threshold for epidemiologic capacity is still not met in the United States, according to estimates, and has demonstrably failed to meet the needs posed by a true public health emergency. These data offer a call for increased public health funding from all levels to improve epidemiologic capacity, preparedness and response capabilities, and public health.

Author Contributions. KWS contributed to the project conceptualization, study design, data collection, data analysis, manuscript writing, and manuscript editing; MF contributed to the project conceptualization, study design, manuscript review, and editing; EG contributed to the project conceptualization, data collection, subject matter expertise, and manuscript review; MP-P contributed in the study design, data analysis, and manuscript review; CS contributed in the study design, manuscript writing, editing, and review; TM contributed in the study design, manuscript writing, editing, and review; and JAH contributed in the project conceptualization, study design, data analysis, manuscript writing, editing, and review.

Conflict(s) of Interest. The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

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https://doi.org/10.1017/dmp.2020.471 Published online by Cambridge University Press