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The Epidemiology and Surveillance Workforce Among Local Health Departments in California: Mutual Aid and Surge Capacity for Routine and Emergency Infectious Disease Situations

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ABSTRACT

Objective. Public health surveillance and epidemiologic investigations are critical public health functions for identifying threats to the health of a community. We conducted a survey of local health departments (LHDs) in California to describe the workforce that supports public health surveillance and epidemiologic functions during routine and emergency infectious disease situations.

Methods. The target population consisted of the 61 LHDs in California. The online survey instrument was designed to collect information about the workforce involved in key epidemiologic functions. We also examined how the public health workforce increases its epidemiologic capacity during infectious disease emergencies.

Results. Of 61 LHDs in California, 31 (51%) completed the survey. A wide range of job classifications contribute to epidemiologic functions routinely, and LHDs rely on both internal and external sources of epidemiologic surge capacity during infectious disease emergencies. This study found that while 17 (55%) LHDs reported having a mutual aid agreement with at least one other organization for emergency response, only nine (29%) LHDs have a mutual aid agreement specifically for epidemiology and surveillance functions.

Conclusions. LHDs rely on a diverse workforce to conduct epidemiology and public health surveillance functions, emphasizing the need to identify and describe the types of staff positions that could benefit from public health surveillance and epidemiology training. While some organizations collaborate with external partners to support these functions during an emergency, many LHDs do not rely on mutual aid agreements for epidemiology and surveillance activities.

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Public health surveillance and epidemiologic investigations are critical functions for the control and prevention of infectious diseases. The activities associated with these functions, including case and contact investigations, public health surveillance, and data analysis, are conducted by trained personnel in response to a variety of infectious disease threats, including those with pandemic potential, such as novel influenza.[1–3] According to the 2010 National Profile of Local Health Departments, 92% of local health departments (LHDs) in the United States conduct epidemiology and surveillance for communicable diseases, while 77% conduct these activities for environmental health issues.[4] In 2005, approximately 25% of all LHDs employed one or more epidemiologists, and epidemiologic activities were conducted by individuals with a wide range of backgrounds and training.[5] For many LHDs that do not employ epidemiologists, other public health professionals (e.g., health officers, public health nurses, or environmental health staff) may fulfill epidemiologic functions within the LHD.

To create and maintain sustainable preparedness and response systems, the public health workforce must have the proper skills, capabilities, and adequate staffing levels to respond successfully in a public health emergency.[6] In 2007, the results of a survey of LHDs in California demonstrated that not all disease investigation staff had received basic epidemiology training and not all staff that might supply surge capacity for disease investigations had received formal disease investigation training.[7] In 2005, 12 of 56 (21%) LHDs reported having a formal agreement with neighboring jurisdictions to secure services of qualified epidemiologists in an emergency.[8] From 2006 to 2010, cuts to bioterrorism and emergency response funding resulted in substantial decreases in epidemiology capacity among state health departments nationally.[9] Despite the decrease in preparedness and response funding, public health preparedness and emergency response remains an area of critical importance for LHDs; maintaining the public health capacity to detect, investigate, and respond to infectious disease threats is an essential component of preparedness efforts.[10]

The purpose of this study was to describe the public health workforce involved in public health surveillance and epidemiologic activities among LHDs in California. Other studies such as the Council of State and Territorial Epidemiologists (CSTE) Epidemiology Capacity Assessments (ECAs)[11–15] have attempted to enumerate and assess the epidemiology capacity among LHDs in the United States. Our goals were to describe the functional epidemiology capacity among California LHDs, understand the internal and external networks that are used to support epidemiologic and surveillance functions, and find out how health departments recruit additional epidemiologic support during infectious disease emergency events. For the purposes of this study, we have defined "functional epidemiology capacity" to mean the ability of the organization to conduct epidemiology-related tasks, regardless of the personnel performing them. An in-depth understanding of the sources of epidemiologic support during infectious disease emergencies and ensuring these individuals are trained to meet the functional needs are essential to an effective public health response.

METHODS

Study population

The study focused on the 61 local health jurisdictions (58 county health departments and three city health departments) in California. These local health jurisdictions range in population size from about 1,100 to 9.8 million individuals and include urban, rural, coastal, and inland jurisdictions. We sought to obtain one survey response from each LHD in California.

To recruit a representative from each LHD in California to complete the survey, study personnel sent an initial recruitment e-mail on September 13, 2012, to each health officer in the state, using a publicly available contact list maintained by the California Department of Public Health (CDPH). This e-mail contained a short description of the survey goals and was sent from the office of the Principal Investigator of Cal PREPARE, a Centers for Disease Control and Prevention (CDC) Preparedness and Emergency Response Research Center at the University of California at Berkeley. The e-mail was sent using Qualtrics® survey software[16] and provided each health officer with a unique link to the online survey that was specific to his or her jurisdiction. Health officers were asked to provide only one response to the survey from their organization and to identify the most appropriate individual in their organization to complete the survey. Participants were offered a $50 gift card for participating in the survey. A description of the study was also posted to an online Yahoo! group for epidemiologists in California to support study recruitment; a link to the survey was not provided via this announcement. Two e-mail reminders were sent and systematic follow-up telephone calls were made to each health department that did not respond to the initial recruitment efforts. The survey was closed on October 19, 2012.

Survey instrument

Data collection was conducted using Qualtrics survey software. The survey instrument focused on how epidemiologists and public health professionals work

with one another to conduct epidemiologic investigations and public health surveillance among LHDs in California. The online survey included questions about organizational characteristics, such as whether or not the organization had an epidemiologist job classification, if the organization employed any CDC- or CDPH-funded epidemiologists, and if the organization had experienced decreases in staff directly involved with communicable disease control, prevention, or surveillance functions due to decreases in funding from January 1, 2011, to the time of the survey.

In addition, we obtained information on job classifications that were responsible for conducting a series of core epidemiology and surveillance functions (i.e., case and contact investigations, public health surveillance, and data analysis[17]) on a routine basis, job classifications that support these functions in a surge capacity role in an urgent or emergency situation, and sources for surge capacity outside of the organization for these functions. As there is not one standardized definition for "surge capacity,"[18] we defined it as "additional staff who can assist in carrying out the specified function during an urgent or emergency event, when staff who routinely perform that function are in need of extra support." For the purposes of this survey, we omitted tuberculosis (TB), human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), and sexually transmitted diseases (STDs) from our definition of communicable diseases. During a TB outbreak, LHDs may indeed activate their incident command system to coordinate their response or test their response capabilities. However, we wanted to focus on response capabilities for other communicable diseases that are more likely to be considered an urgent or unusual event for which preparedness and response resources may be necessary.

Finally, the survey instrument included questions regarding mutual aid agreements for emergency response, laboratory, and epidemiology and surveillance activities, as well as the sharing of tools, forms, or statistical codes with other organizations. Due to the wide variety of organizations and resources involved in an emergency response, mutual aid agreements for emergency response may include, but are not limited to, activities such as fatality management, mass care, medical surge, and responder safety and health.[17]

Statistical analyses

We analyzed the data using Stata® version 11[19] and Qualtrics survey software. For several summary statistics, the data were stratified according to the size of the population served by the LHDs—small, <50,000 people; medium, 50,000–500,000 people; and large, >500,000 people—to understand systematic differences among LHDs based on population size.

RESULTS

Of the 61 LHDs in California, 31 (51%) completed the survey. The job titles of the 31 respondents included health officer and/or health director (n=14), deputy health officer (n=1), epidemiologist (n=11), and other (n=5). The number of local health jurisdictions according to size of the population served, type of population (urban, rural, or mixed), mutual aid coastal region, and study participation is shown in Table 1.

Table 1. Characteristics of local health departments participating in a study of the epidemiology and surveillance workforce: California, 2012

	Participated in study		
Characteristic	*Yes (n=31)* N	*No (n=30)* N	*Total (n=61)* N
Size of population served			
Small (<50,000 individuals)	6	9	15
Medium (50,000–500,000 individuals)	15	15	30
Large (>500,000 individuals)	10	6	16
Type of population			
Urban	23	19	42
Mixed	5	5	10
Rural	3	6	9
Mutual aid region			
Coastal	11	6	17
Inland	14	17	31
Southern	6	7	13

Organizational characteristics and epidemiologic staffing

Of the 31 responding agencies, 21 (68%) indicated that they maintained an epidemiologist job classification within their organization. All large health departments (n=10) that responded and 11 of 15 (73%) medium-sized health departments that responded reported having an epidemiologist job classification. None of the small health departments reported having an epidemiologist job classification within their agency (Table 2). Of the 10 LHDs that did not have an epidemiologist job classification, seven respondents specifically indicated a lack of funding when asked about the barriers to creating such a classification, while six respondents noted having a small population. Three of the 10 counties described a regional partnership that allowed them to share an epidemiologist through public health emergency preparedness (PHEP) funding. Additionally, one large health department reported employing a California Epidemiologic Investigation Service (Cal EIS) fellow, while a separate large health department reported employing one Cal EIS fellow, one CDC/CSTE applied epidemiology fellow, and one CDC Epidemic Intelligence Service officer (data not shown).

A large proportion of the surveyed organizations reported decreases in communicable disease staffing since January 1, 2011. These decreases included 15 LHDs (48%) eliminating vacant positions, six LHDs conducting layoffs, and seven LHDs offering early retirement to staff. Seven LHDs had other types of decreases that consisted of staff reassignments to other divisions outside of communicable disease control, vacant positions, reduction in health officer time, reduction in staff due to medical or personal leave, and staff departures from the LHD for new positions. The proportion of LHDs that reported no decreases in communicable disease staff varied by size of the population served (17%, 33%, and 40% among small, medium, and large LHDs, respectively) (Table 2).

Staffing for epidemiology and surveillance functions

The routine job titles and sources for surge capacity for case and contact investigations, communicable disease surveillance, and data analysis are shown in Tables 3, 4, and 5, respectively. In addition to routine staffing for epidemiology functions, respondents were also asked to identify staff who provided surge capacity during an urgent or emergency situation. There was substantial variation in the type of staff performing each epidemiologic activity among LHDs. In addition to health officers, public health nurses, disease control investigators, HIV and TB program staff and epidemiologists (who were all common staff in performing these functions on a routine basis), environmental health staff, health educators, and preparedness staff were often cited as sources for surge capacity. For case and contact investigations, public health or registered nurses (58%), environmental health specialists/sanitarians (48%), and TB program staff (45%) were the most frequently cited sources for surge capacity (Table 3). For communicable disease surveillance, emergency preparedness coordinators/staff (39%), public health

Table 2. Epidemiology job classifications and decreases in communicable disease staffing by size of the population served by the local health department: California, 2012

	Size of population served			
Characteristic	*Small*[a] *(n=6)* N	*Medium*[b] *(n=15)* N	*Large*[c] *(n=10)* N	*Total (n=31)* N
Epidemiology job classification				
Yes	0	11	10	21
No	6	4	0	10
Decreases in communicable disease staffing since January 1, 2011[d]				
Layoffs	0	3	3	6
Early retirement	0	4	3	7
Elimination of vacant positions	3	7	5	15
Other decreases	2	3	2	7
No decreases in communicable disease staff	1	5	4	10

[a]A small population consisted of <50,000 people.

[b]A medium population consisted of 50,000 to 500,000 people.

[c]A large population consisted of >500,000 people.

[d]Respondents could select more than one option.

Table 3. Job titles involved with case and contact investigations among local health departments: California, 2012[a]

Job title	*Routine case and contact investigations (n=31)* N *(percent)*	*Source for surge capacity (n=31)* N *(percent)*
Public health nurse or registered nurse	28 (90)	18 (58)
CD control investigator	15 (48)	5 (16)
CD epidemiologist	11 (36)	7 (23)
Health officer	7 (23)	11 (36)
Tuberculosis program staff	6 (19)	14 (45)
HIV/AIDS and/or STD program staff	5 (16)	12 (39)
Physician	4 (13)	2 (7)
Environmental health specialist/sanitarian	3 (10)	15 (48)
Emergency preparedness coordinator/staff	3 (10)	12 (39)
Health service manager/administrator	2 (7)	5 (16)
Other	2 (7)	4 (13)
Health educator	1 (3)	11 (36)
Behavioral health professional	1 (3)	3 (10)
Health director	0 (0)	1 (3)
Non-CD epidemiologist	0 (0)	5 (16)

[a]Respondents could select more than one option.

CD = communicable disease

HIV = human immunodeficiency virus

AIDS = acquired immunodeficiency syndrome

STD = sexually transmitted disease

or registered nurses (36%), health officers (29%), and non-communicable disease epidemiologists (29%) were the most frequently reported sources for surge capacity (Table 4). Four LHDs did not indicate any staff positions as potential sources for surveillance surge capacity. For data analysis, non-communicable disease epidemiologist (32%) was the most frequently reported job classification as a source for surge capacity, followed by health service manager/administrator (13%), communicable disease epidemiologist (13%), and emergency preparedness coordinator/staff personnel (13%). Four LHDs (three medium LHDs and one large LHD) specifically noted that they had no internal surge capacity for data analysis (Table 5).

The sources of surge capacity for the three epidemiology and surveillance functions outside of the organization included staff from other LHDs, CDPH, nursing, public health or medical students, and volunteers. The study found that CDPH staff was most heavily relied upon, with staff from other LHDs as an additional source for external surge capacity. Five LHDs reported making use of external staff for epidemiologic surge capacity from January 1, 2011, until the time the survey was conducted. Events included a multijurisdictional salmonella outbreak, a rabies investigation, a mumps outbreak, a foodborne outbreak, and consultation for unusual disease outbreaks such as brucellosis and Hantavirus. The type of organizations called on for external surge capacity included, but was not limited to, CDPH staff, other LHDs, nursing students, and public health graduate students (data not shown).

Mutual aid and sharing epidemiologic tools and resources

Mutual aid agreements among LHDs were most common for emergency response activities (n=17, 55%) and less common for laboratory (n=10, 32%) and epidemiologic (n=9, 29%) activities. A number of LHD respondents were unsure if their LHD maintained agreements for emergency response (n=7, 23%) or laboratory (n=8, 26%) mutual aid; only one organization was unsure if it maintained an agreement related to epidemiology and surveillance (3%) (data not shown).

Twenty-five LHDs (81%) surveyed indicated that they shared epidemiologic tools and resources (e.g., forms, analysis plans, or statistical codes) with other organizations. Twenty-three LHDs (74%) shared epidemiologic tools and resources with other LHDs in California, and 21 LHDs (84%) shared epidemiologic tools and resources with CDPH (data not shown).

DISCUSSION

To our knowledge, this study is the first to examine mutual aid and sources for surge capacity within and external to LHDs for epidemiology and surveillance

functions in California. The results of the study demonstrate that LHDs rely on a diverse workforce to conduct epidemiology and public health surveillance functions in response to communicable disease emergencies. This study builds on previous evaluations of the epidemiology workforce among LHDs in California.[7,8,20] In our study sample of LHDs, we found that support for epidemiology and surveillance functions extends well beyond the traditional epidemiologist title or position. Small LHDs relied more on individuals with non-epidemiologist job titles or epidemiologists external to their organization to conduct epidemiologic functions. Mutual aid agreements may be one method to improve both routine and emergency epidemiology capacity for LHDs that employ few to no epidemiologists.

Furthermore, the study results showed that less than one-third (29%) of responding LHDs had mutual aid agreements with other organizations for epidemiology and surveillance activities. Previous findings from California surveys conducted in 2005[8] and 2011[21] reported that 21% (2005) and 12% (2011) of California LHDs had mutual aid agreements related to epidemiologic activities. In our study, many respondents were unsure if their LHD maintained laboratory or emergency response mutual aid agreements. This finding may be explained in part by the fact that survey respondents were chosen by their health officer or health director because of their familiarity with the epidemiology and surveillance activities of their organization; however, they may have been less familiar with laboratory or emergency response activities. In contrast with the limited number of mutual aid agreements, the majority of LHDs shared epidemiologic tools and resources with other LHDs and with CDPH. Existing relationships based on the sharing of epidemiologic resources may serve as an effective starting point for the development of more comprehensive epidemiologic mutual aid agreements and surge capacity planning. The existence of three LHDs having a regional partnership that allowed them to share an epidemiologist through PHEP funding is evidence of regionalization of epidemiologic capacity, which has been shown to improve networking and coordination.[22,23] Such partnerships could serve as a model for other LHDs in the state.

We have learned a great deal about the epidemiology capacity of state health departments and LHDs, including how it is changing over time from the ECAs conducted by CSTE.[11–15] The ECA surveys have characterized the state-level epidemiology workforce by program area, including a count of the current epidemiology capacity overall. A pilot study extended the work of previous CSTE studies and described the

Table 4. Job titles involved with communicable disease surveillance among local health departments: California, 2012[a]

Job title	*Routine communicable disease surveillance (n=31)* N *(percent)*	*Source for surge capacity (n=31)* N *(percent)*
Public health nurse or registered nurse	19 (61)	11 (36)
CD epidemiologist	18 (58)	3 (10)
CD control investigator	9 (29)	3 (10)
Health officer	6 (19)	9 (29)
Environmental health specialist/sanitarian	5 (16)	7 (23)
Health service manager/administrator	4 (13)	5 (16)
Tuberculosis program staff	4 (13)	7 (23)
HIV/AIDS and/or STD program staff	4 (13)	6 (19)
Physician	4 (13)	2 (7)
Emergency preparedness coordinator/staff	4 (13)	12 (39)
Other	4 (13)	3 (10)
Non-CD epidemiologist	3 (10)	9 (29)
Health educator	2 (7)	4 (13)
Statistician	1 (3)	1 (3)
Behavioral health professional	1 (3)	3 (10)
Health director	0 (0)	2 (7)
Missing	0 (0)	4 (13)

[a]Respondents could select more than one option.

CD = communicable disease

HIV = human immunodeficiency virus

AIDS = acquired immunodeficiency syndrome

STD = sexually transmitted disease

Table 5. Job titles involved with data analysis among local health departments: California, 2012[a]

Job title	*Routine data analysis (n=31)* N *(percent)*	*Source for surge capacity (n=31)* N *(percent)*
CD epidemiologist	20 (65)	4 (13)
Health officer	7 (23)	3 (10)
Non-CD epidemiologist	7 (23)	10 (32)
Public health nurse or registered nurse	6 (19)	2 (7)
Health service manager/administrator	4 (13)	4 (13)
Other	4 (13)	3 (10)
Physician	2 (7)	0 (0)
Statistician	2 (7)	2 (7)
CD control investigator	1 (3)	0 (0)
Tuberculosis program staff	1 (3)	2 (7)
HIV/AIDS and/or STD program staff	1 (3)	2 (7)
Environmental health specialist/sanitarian	1 (3)	0 (0)
Information technologist	1 (3)	1 (3)
Emergency preparedness coordinator/staff	1 (3)	4 (13)
Health director	0 (0)	2 (7)
Health educator	0 (0)	1 (3)
Do not conduct this activity	1 (3)	4 (13)
Missing	0 (0)	7 (23)

[a]Respondents could select more than one option.

CD = communicable disease

HIV = human immunodeficiency virus

AIDS = acquired immunodeficiency syndrome

STD = sexually transmitted disease

composition, training, and competency level of LHD staff functioning in an epidemiologic role within their organization.[24] However, previous ECA surveys have not described how the epidemiology capacity within an LHD is used during routine vs. emergency situations, where the roles and responsibilities may shift due to staff availability, competence, and response needs. Understanding the role of nontraditional sources of epidemiologic support and ensuring that these sources are adequately trained and have the resources to meet the epidemiologic needs is essential to an effective public health response during infectious disease emergencies. In addition, not all sources of epidemiology support can be anticipated in advance of an event, emphasizing the importance of just-in-time epidemiology training to provide the skills and knowledge to individuals who lack the necessary education, training, and experience.

Study limitations

This study was subject to several limitations. Although an evaluation of the workforce is an important area of research in surge capacity, workforce requirements are complex, involving issues of credentialing, activation, mobilization, education, training, and evaluation.[25] These complex issues require in-depth measurement at the local level and exceeded that which our research staff could achieve via an online survey with one respondent per jurisdiction. Thus, we focused on surge capacity related to staff only, rather than focusing on the four S's of surge capacity (i.e., staff, stuff, structure, and systems) for routine and emergency situations.[18] As a result, we presented a basic examination of the use of staff for different aspects of epidemiologic investigations and public health surveillance at the local level during routine and emergency situations.

Second, our survey instrument focused on job classifications that fill epidemiology roles during routine and emergency situations. It may be difficult to classify one person into one job title because a public health nurse could be involved with TB, HIV/AIDS, and STD activities in addition to public health preparedness and response activities. Also, the job classifications alone do not suggest anything about the individuals' skills and capabilities; the survey instrument was not designed to collect specific information on the level of education, training, and skills of the LHD workforce.

Third, the survey instrument was designed to collect essential information to understand a few key aspects of the epidemiology and surveillance workforce capacity in a short amount of the respondent's time (approximately 20 minutes), requiring one person

to complete the survey rather than relying on several people with extensive documents. Even with a short survey instrument, we only achieved a 51% response rate. As a result, the study sample may not constitute a representative sample of LHDs in California, and the results might be different with additional data from nonrespondent LHDs. Furthermore, we did not have the sample size to describe sources for surge capacity by size of the population served by the jurisdiction. Finally, sources of surge capacity used in a future event may differ from past experiences depending on the needs and availability of staff of the organization in the future incident and the actual threat posed. In this study, we inquired about broad activities for epidemiology and surveillance activities. A more refined set of activities could be used in a future survey.

Further research activities involving sources of surge for functional epidemiology capacity could include an examination of how these sources actually accommodate the demand for resources[18] during infectious disease emergencies, as well as determine the sufficient number of staff (with specific education, training, and skills) necessary to manage the public health needs[24] of an emergency, including epidemiology. Further exploration of surge capacity for epidemiologic and public health surveillance activities both within and external to the LHD could identify barriers for successful surge capabilities and opportunities for additional education and just-in-time training.

CONCLUSION

Many non-epidemiologists perform and/or contribute to epidemiologic activities in LHDs in California. Continued efforts should be made to comprehensively identify and describe the types of staff positions that could benefit from public health surveillance and epidemiology training. Further training would enhance the performance of routine functions and enable increased epidemiologic surge capacity to help mitigate infectious disease threats.

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