
Measuring Changes in Local Surveillance and Investigation Capacity

ABSTRACT

Background: The outbreak of Ebola virus disease in West Africa and confirmation of the first cases in the United States highlight the need for robust and responsive public health surveillance system. With a 25% decline in funding since 2007, the impact on local surveillance capacities has not previously been described.

Purpose: The *Surveillance & Investigation* domain of the *Local Health Department Preparedness Capacities Survey* (PCAS) was reweighted to reflect the national profile of LHDs. Changes in subdomain performance of capacities and the effect of population size on subdomain capacity performance were examined over time.

Methods: Participating LHDs ($n=208$) from the PCAS sample were reweighted according to characteristics from the 2010 National Association of County and City Health Officials (NACCHO) Profile. Overall changes in preparedness capacity across four subdomains from 2010 to 2012 were tested for significant differences using a weighted t-test. A series of weighted least squares regression models were used to determine whether population size may have modified the temporal changes in preparedness capacity.

Results: Significant declines *were observed* in the preparedness capacity in three of the four subdomains of *Surveillance & Investigation*. Results suggest that surveillance inputs from various sources, including hospitals, urgent care, poison control, pharmacies, and schools absentee reporting, especially for larger LHDs, may be more sensitive to changes or shifts over time versus others.

Implications: Declines in preparedness capacity may have affected the ability of LHDs, particularly larger ones, to effectively respond to community preparedness needs and, specifically, the detection of highly communicable and novel disease events.

Keywords

preparedness capacity, public health surveillance, local health departments, panel data

Cover Page Footnote

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The outbreak of Ebola virus disease in West Africa and confirmation of the first cases in the United States highlight the need for robust and responsive public health surveillance system. Local health departments (LHDs) stand at the front lines of this defense, having a statutory authority to perform key functions including epidemiologic investigations, enforcement of health laws and regulations, and coordination of the local public health system.¹ Despite the recognized importance of emergency preparedness, funding has declined more than 25% since 2007 (<http://nacchopreparedness.org/?p=1199>). The potential effects of the ever-changing fiscal and political funding climate on local surveillance capacities have not previously been described. Previous findings suggest that those jurisdictions serving larger populations (>50,000) would be more likely to demonstrate (and therefore maintain) higher levels of performance, based on a range of performance indicators and measures.² As a result, it is expected that the preparedness capacity of LHDs serving larger populations would decrease less, offering a potential “protective effect” to larger jurisdictions as they weathered the changing times.

Previous findings of a survey sample found significant decreases in LHD capacity across a subset of five of eight preparedness domains, including *Surveillance & Investigation, Plans & Protocols, Communication, Incident Command*, and *Legal Preparedness*.² The extent to which the observed decreases in capacities extend across jurisdictions is of concern. Significant decreases in *Surveillance and Investigation* (see Table 1 for subdomains and measures) were observed for all survey participant groups and represented the greatest level of decline for capacities in all groups. This analysis further explores the *Surveillance & Investigation* domain using a reweighted sample to reflect the national profile of LHDs. Changes in preparedness capacities in the four *Surveillance & Investigation* subdomains are examined as well as the effect of population size on these preparedness capacities over time.

METHODS

In 2010 and 2012, 333 local health departments, distributed across 40 states, including all 85 LHDs in North Carolina, were invited to participate in the *Local Health Department Preparedness Capacities Survey* (PCAS).² The PCAS sample was selected using a propensity score matching methodology, based on a set of representative public health agency and system characteristics obtained from the *National Association of County and City Health Officials 2010 Profile* ($n=2151$) and *Area Health Resource File* (ARF) Department of Health and Human Services, Bureau of Health Professions, Office of Research and Planning ($n=3225$).³ The PCAS instrument assessed LHD preparedness capacity across eight domains, with subsets of preparedness capacities within each domain equally weighted into an aggregate value. The response rate for both 2010 and 2012 was 62.4%, yielding a set of 208 LHDs for these analyses.

For this analysis, the responding LHDs are reweighted according to a set of characteristics from the 2010 NACCHO Profile, using population size, full-time equivalent staff (FTE), and FTE per capita to account for variation in jurisdiction size and staffing resources. The dependent variable, preparedness capacity, was calculated from the weighted mean of the overall preparedness capacity scores for each of the four subdomains of *Surveillance & Investigation*, based on the proportion of reported measures within each of the subdomains. The resulting scores, ranging from 0 to 1, represent the extent to which an LHD reports

having all the capacity measured in that subdomain (score of 1). The overall change in preparedness capacity from 2010 to 2012 were examined, testing for statistically significant differences using a weighted t-test.

Table 1. Surveillance and Investigation Subdomains

Subdomain	Description of Measures
Access to a public health surveillance system <i>11 measures</i>	▪ Access to real-time syndromic surveillance to accessing, either directly or indirectly, a system maintained by another agency or organization ▪ Ability to view multiple types of data sources (8) in a public health surveillance system
Ability to manage urgent case reports <i>4 measures</i>	▪ Responsibility to receive urgent case reports ▪ Ability to receive urgent case reports 24/7 ▪ Ability to confirm receipt of urgent case reports 24/7 ▪ Tested its ability to receive urgent case reports during the past 12 months
Electronic storage of local case report data <i>2 measures</i>	▪ Maintenance of an electronic system for compiling and analyzing local data from: ▪ <i>Case reports</i> ▪ <i>Case investigations</i>
Access to a specimen transportation system <i>2 measures</i>	▪ Use of a transport system ▪ Real-time electronic tracking of specimens

A series of weighted least square regression models were created to determine the extent to which population size may have modified the temporal changes in preparedness capacity for each of the four *Surveillance & Investigation* subdomains. As a baseline, the continuous variable of population size in 2010 was selected (start of the PCAS). Population size is relatively independent of federal, state, and local funding levels, and, unlike total FTE or FTE per capita, does not vary significantly over the time period of interest. Among LHDs in our sample, population size averaged 106,009, with lower and upper 95% confidence limits of 89,479 to 122,538; similarly, across the U.S. in the *Profile Study*, LHDs serve populations, on average, of 130,875, with lower and upper 95% confidence limits of 113,450 to 148,301.

All analyses were conducted in R version 2.14.0, using the *weights* and *matrixStats* packages.

RESULTS

Between 2010 and 2012, the total aggregate measure of *Surveillance & Investigation* domain capacity decreased, on average (weighted), from 0.443 to 0.387, which represents a 22% decrease in preparedness capacity (Figure 1). More specifically, the ability for LHDs to *access and view multiple types of data in a public health surveillance system* declined by 6% from 0.242 to 0.185. The capacity for local agencies to *manage urgent case reports*, including the handing and testing of urgent cases, significantly declined by 19%, from 0.662 to 0.536. The capacity of LHDs to manage the *electronic storage of local case report data* declined from 0.450 to 0.399 (11%). Lastly, a 20% (0.602 to 0.480) decline in LHD's

utilization of a specimen transportation system was observed. All declines were statistically significant at the 0.05 level.

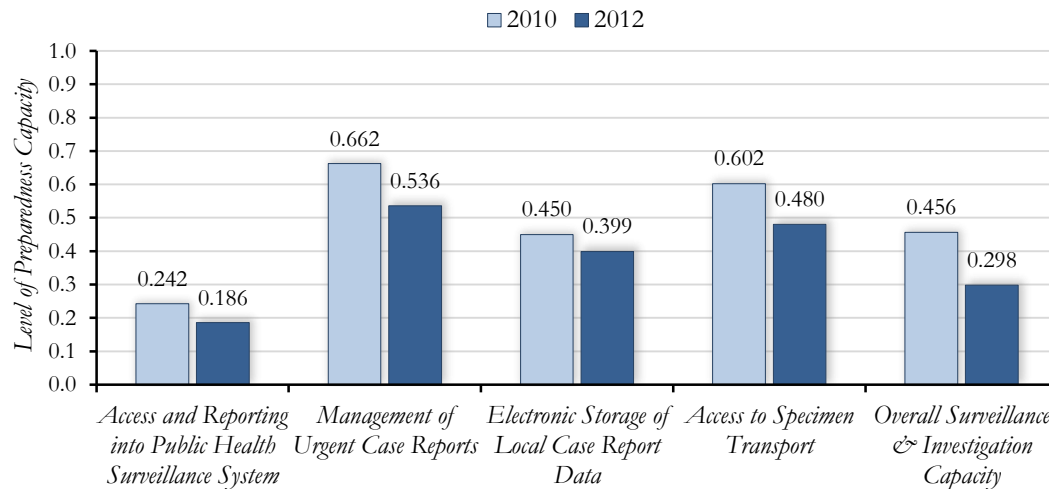


Figure 1. Change in Local Surveillance & Investigation Capacities, 2010–2012 (n=208)

In the weighted least squares analysis, population size was not found to be significant for *Surveillance & Investigation's* total domain score change. Population size, however, was found to significantly influence the ability of LHDs to *access and view multiple types of data in a public health surveillance system* ($\beta = -1.692 \times 10^{-7}$; $p < 0.05$) and the *electronic storage of local case report data* ($\beta = -3.727 \times 10^{-7}$; $p < 0.05$). In other words, for a LHD serving a population of 25,000, the effect on change associated with access to a public health surveillance system would be approximately -0.004 versus a larger health department serving 100,000 that would experience an effect of -0.017, more than four times greater the smaller LHD. With respect to LHD's *utilization of a specimen transportation system*, this was found to be positively influenced by population size ($\beta = 5.448 \times 10^{-7}$; $p < 0.05$), where larger LHDs were able to better mitigate changes over time. However, local capacity to *manage urgent case reports* was not found to be significantly affected by population size ($\beta = -1.835 \times 10^{-7}$; $p > 0.05$), such that decreases in ability to respond to immediately notifiable conditions were consistent, regardless of populations served. These results are inconsistent with the hypothesis that larger LHDs would universally fare better, where preparedness capacity of larger LHDs should have decreased less.

IMPLICATIONS

Overall, significant declines in preparedness capacity were observed in three of the four subdomains of *Surveillance & Investigation* for all LHDs (n=208) between 2010 and 2012. This reflects decreased LHD capacity to quickly manage and respond to urgent case reports, regardless of size, with subsequent effects on investigation times. In cases of highly communicable and novel diseases with high mortality rates, i.e., Ebola virus disease,

response time and ability are critical to mitigate the potential emergency. In order to detect these events, it is also important to maintain access and ability to review data within the broader public health surveillance system. Further compromising this ability, decreases in system event inputs from various sources were observed, including hospitals, urgent care, poison control, pharmacies, and schools absentee reporting, which subsequently reduces the amount and range of data that informs LHD surveillance. These results indicate that surveillance inputs, especially for LHDs serving larger populations, may be more sensitive to changes or shifts over time versus those serving smaller populations. This variation in findings is more consistent with similar findings by Erwin and colleagues, that showed the recession impacted LHDs of different population sizes in different ways with no single explanatory model across population sizes.^{4,5}

SUMMARY BOX

What is already known about this topic? Preparedness funding declined considerably since 2007. Previous studies of a survey sample indicated that preparedness capacities, particularly in *Surveillance and Investigation*, declined from 2010 to 2012.

What is added by this report? This report extends the survey sample findings to the national profile of LHDs. Results indicate that *Surveillance & Investigation* capacity declined by 22% between 2010 and 2012.

What are the implications for public health practice, policy, and research? Observed declines in *Surveillance & Investigation* capacity may affect the ability of LHDs to meet community preparedness needs, particularly the ability to effectively respond to and manage urgent case reports.

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