DISASTER SURVEILLANCE CAPACITY IN THE UNITED STATES:

RESULTS FROM A 2012 CSTE ASSESSMENT

Council of State and Territorial Epidemiologists

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EXECUTIVE SUMMARY

In early 2012, the Disaster Epidemiology Subcommittee of the Council of State and Territorial Epidemiologists (CSTE) assessed the non-infectious disease disaster epidemiology and surveillance practices of state and territorial health departments, along with related projected needs. The assessment covered five broad topic areas: (1) disaster surveillance personnel, (2) past disaster surveillance experience, (3) other disaster epidemiology activities (e.g. rapid needs assessments), (4) disaster surveillance plans and exercises, and (5) lessons learned.

Health officials in 53 jurisdictions completed the assessment (95% response rate). Just over half of respondents (53%) indicated that their health agency has a specific team or unit responsible for disaster surveillance.

Forty-six respondents (87%) indicated that their agency had implemented disaster surveillance activities in the past ten years. In most of these jurisdictions, officials reported use of morbidity, mortality and syndromic surveillance systems after a disaster, although more than half of the systems used required modification. Over half of respondents with previous disaster epidemiology experience (59%) reported using baseline data for comparison when conducting post-disaster analyses and about a quarter (26%) reported tracking behavioral and mental health outcomes post-disaster. Sixty-three percent reported using at least one health-related assessment strategy other than surveillance following a disaster.

Nearly three quarters of respondents (72%) indicated that their agency's emergency response plan described surveillance activities, but only 16% of jurisdictions' plans include evaluation of surveillance activities following disasters. Fifteen respondents (28%) reported that their state health departments had conducted exercises to test disaster surveillance capabilities.

Key lessons learned include the need to have response systems, trained staff and data-sharing agreements in place before a disaster; the need for pre-existing relationships with key partners; the need to share information early and widely; and the need for adaptability.

Results reveal important opportunities to strengthen disaster epidemiology in the U.S., notably by increasing the number of states and territories with formalized disaster surveillance plans that include a post-disaster evaluation component and by increasing the number of jurisdictions that regularly exercise their disaster surveillance plans. As noted by several respondents, adequate, sustained funding for governmental epidemiology programs would abet such efforts. Because of the wide range of disaster surveillance practices among jursidictions, there may be benefits to an exchange of lessons learned, especially between those jurisdictions with more response experience and those with less.

BACKGROUND

The Centers for Disease Control and Prevention (CDC) defines disaster epidemiology as "the use of epidemiology to assess the short- and long-term adverse health effects of disasters and to predict consequences of future disasters." [1] Prior to 2001, few state or local disaster preparedness and response programs existed. [2] The increased emphasis on national disaster preparedness following the September 11, 2001 terrorist attacks and the subsequent anthrax attacks spurred disaster preparedness efforts across the country. One result was a substantial increase in the number of disaster epidemiologists employed at the state and local levels during the early 2000s. Yet, despite this personnel boost, a 2004 CDC assessment indicated that an additional 192 disaster epidemiologists—45% more than the 424 employed in state and territorial health departments in 2004—were needed to reach full disaster preparedness capacity nationwide. [3]

In addition to hiring more disaster epidemiologists, health agencies in the post-9/11 world created or strengthened partnerships with federal agencies that might be involved in disaster response, such as the U.S. Food and Drug Administration, Department of Defense, Department of Health and Human Services, Department of Justice, Department of Transportation, and the United States Postal Service. [4] The post-9/11 focus on national disaster preparedness is reflected in a number of timely assessments of the public health system's disaster response capacity and capabilities, including epidemiological capacity and workforce needs. [5-8]

Such assessments notwithstanding, past and current disaster epidemiology practices in state and local public health departments—particularly for non-infectious disease disasters—are poorly described in the literature. Although it is standard practice for health agencies to assess their methodologies for surveillance of ill or injured individuals, they continue to seek a greater understanding of useful strategies for disaster epidemiology.

Recognizing the need for improved disaster epidemiology, the Council of State and Territorial Epidemiologists (CSTE) formed a Disaster Epidemiology Subcommittee in 2009, with members drawn from state and local health departments and the CDC. A chief Subcommittee aim is to improve coordination of state and federal post-disaster surveillance and other epidemiology activities. In early 2012, the Subcommittee conducted an assessment of state and territorial public health agency disaster programs to compile information on past disaster response experiences, current practices, and projected needs. The assessment was intended to identify both strengths and gaps in state-based disaster surveillance capabilities and capacity. This report summarizes the results of that assessment.

METHODS

The CSTE Disaster Epidemiology Assessment instrument was developed by the CSTE Disaster Epidemiology Subcommittee in early 2012 and was piloted by three jurisdictions. The final assessment instrument included 33 questions covering five topic areas related to disaster epidemiology in state and territorial health departments: (1) disaster surveillance personnel, (2) past disaster surveillance experience, (3) other disaster epidemiology activities (e.g., rapid needs assessments), (4) disaster surveillance plans and exercises, and (5) lessons learned. In this assessment, "disaster" refers to both and manmade disasters, encompassing everything from hurricanes and flooding to chemical spills or radiation releases. Large-scale infectious disease outbreaks such as the 2009 H1N1 influenza pandemic were explicitly excluded from the definition of "disaster" for the purpose of this assessment.

A web-based assessment tool was made available to all 50 U.S. states, Washington D.C., and five U.S. territories in late February 2012 and remained open for completion for one month. The State Epidemiologist or equivalent lead epidemiologist in each jurisdiction was contacted as the primary informant. Primary informants were asked to refer the assessment to the person within their

department deemed most appropriate to complete it if necessary. Non-responders were contacted by e-mail and telephone at least three times.

RESULTS

Fifty-three of the 56 jurisdictions invited to complete the assessment did so, giving a 95% response rate.

Just over two-thirds of respondents (n=36, 68%) self-identified as epidemiologists, with the remaining respondents identifying themselves as administrators or managers. Among the 36 epidemiologists who responded, 27 were State Epidemiologists.

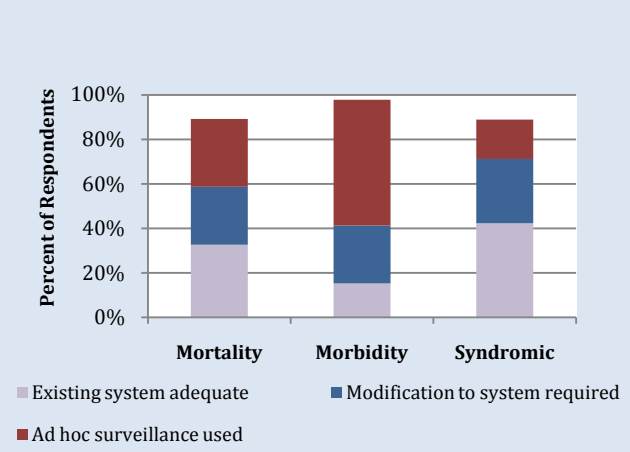
DISASTER SURVEILLANCE PERSONNEL: Just over half of respondents (n=28, 53%) indicated that their health agency has a specific team or unit responsible for disaster surveillance. Among these 28 health agencies, 46% include *epidemiology* in the title of the organizational unit identified as the lead for disaster surveillance activities, 29% include *emergency preparedness* in the title and 14% include *environmental*.

PAST DISASTER SURVEILLANCE EXPERIENCE: Forty-six respondents (87%) indicated that their agency has implemented disaster surveillance activities in the past ten years, most often in response to floods (59%), hurricanes (57%), and winter storms (41%) (See Table 1). Most respondents reported use of morbidity (98%), mortality (89%), and syndromic (87%) surveillance systems after a disaster event, although more than half of these systems required modification to address disaster-specific needs (See Figure 1). Use of ad hoc systems varied across surveillance types; 57% of morbidity surveillance systems were completely ad hoc while only 18% of syndromic surveillance systems were completely ad hoc.

Table 1. Type(s) of disasters during which states with prior disaster surveillance experience reported implementing surveillance (n=46).

Type(s) of Disasters	Count (%)
Flood	27 (59)
Hurricane	26 (57)
Winter storm	19 (41)
Chemical releases	14 (30)
Tornado	14 (30)
Fire/wildfire	10 (22)
Radiation	7 (15)
Earthquake	4 (9)
Other	18 (39)

Figure 1. Use of existing and/or ad hoc surveillance systems by type of surveillance, among states with previous disaster surveillance experience (n=46).



Among jurisdictions with previous disaster surveillance experience, the most commonly used surveillance data sources included emergency departments (87%), hospitals (83%), poison centers (65%), and shelters (65%). Surveillance among all sources was most frequently performed on a daily basis, as opposed to a weekly or one-time survey. Thirty-three percent of jurisdictions with previous disaster surveillance experience reported that they had used electronic technologies, such as scannable forms, electronic lab reports, or handheld devices, for data collection.

Over half (59%) of the jurisdictions with disaster epidemiology experience reported using baseline data for comparison when conducting analyses, but only 14% indicated that use of baseline comparison data is included in their emergency response plans. Respondents using baseline data indicated that baseline numbers were typically derived from non-disaster syndromic surveillance data, hospital records, and poison control center data.

Twenty-six percent of respondents with previous disaster epidemiology experience indicated that past disaster activities in their jurisdiction included tracking behavioral and mental health outcomes. Methods for collecting behavioral health data included the Community Assessment for Public Health Emergency Response (CASPER), crisis call center surveillance, ad hoc community surveys, and shelter surveillance. One respondent noted use of a county-wide Behavioral Risk Factor Surveillance (BRFS) survey that happened to be concurrent with a very large disaster in their state.

The majority of respondents with disaster epidemiology experience (89%) reported that the information collected from their disaster surveillance activities was useful. Twenty-nine of these respondents identified one or more ways that disaster surveillance information had been useful in an open-ended follow-up question. Fifteen of the 29 (48%) said it was useful for situational awareness. Other responses ranged from public communication to rumor control and targeting of public health response activities) (Table 2).

Table 2. Reported uses of disaster surveillance (n=29).

Type of use	Count (%)*
Situational awareness	15 (52)
Communication with the public/rumor control	6 (21)
Assessment of needs/ targeting responses	6 (21)
Responding to questions from officials	4 (14)
Informing policies and procedures	2 (7)
Exposure assessment	1 (3)
Determining effectiveness of response	1(3)

*Totals add up to >100%; some respondents identified more than one use

Surveillance data collected during disasters were most commonly shared with State Epidemiologists (89%), emergency operations centers (87%), and local public health officials (85%) (See Table 3).

Table 3. Agencies and persons with whom states reported sharing surveillance data during disasters, among states with previous disaster surveillance experience (n=46).

Agency/Persons	Count (%)
State Epidemiologist	41 (89)
Emergency operation center(s)	40 (87)
Local public health officials	39 (85)
Centers for Disease Control and Prevention	27 (59)
The public	25 (54)
Other federal partners (e.g., FEMA)	21 (46)
Other	14 (30)

OTHER DISASTER EPIDEMIOLOGY ACTIVITIES: Thirty-one of 53 respondents (63%) reported use of at least one disaster health-related assessment strategy other than on-going morbidity/mortality or syndromic surveillance. Fifteen respondents (33%) had used line lists or rosters, 14 (30%) had conducted rapid needs assessments in communities, and 12 (26%) had used other strategies such as damage needs assessments or surveys of pharmacy operations. Two respondents (4%) had established long-term registries in response to a disaster.

DISASTER EPIDEMIOLOGY PLANS AND EXERCISES: Fifteen respondents (28%) indicated that their state health departments had conducted exercises to test surveillance capabilities in a disaster scenario. Thirty-eight respondents (72%) reported that their agency's emergency response plan described surveillance activities. Some plans addressed specific disaster scenarios, such as tornados, but the majority (68%) was all-hazard plans, with specific hazards unidentified (See Table 4). Most disaster epidemiology plans included morbidity (89%), mortality (79%), and syndromic (79%) surveillance, and

almost all noted that data would come from typical surveillance data sources like hospitals and emergency departments (See Table 5). Some respondents' plans also referenced the use of rosters of impacted people (54%), rapid needs assessments (50%), and long-term registries (35%). Twenty-two percent of the plans included or reference specific surveillance case definitions (e.g. carbon monoxide poisoning). Thirty percent of the surveillance plans specified use of electronic technologies for data collection, such as scannable forms or electronic syndromic disease surveillance systems.

Table 4. Types of disasters covered by state emergency response plans, among states whose plans describe surveillance activities (n=38).

Type(s) of Disasters	Count (%)
All/Type not specified	25 (68)
Flood	9 (24)
Radiation	8 (22)
Chemical releases	8 (22)
Hurricane	7 (19)
Other	7 (19)
Winter storm	6 (16)
Tornado	6 (16)
Earthquake	4 (11)
Fire/wildfire	4 (11)

Table 5. Most common surveillance data sources specified by state emergency response plans, among states whose plans describe surveillance activities (n=38).

Data source	Count (%)
Hospital	36 (95)
Emergency departments	36 (95)
Poison centers	33 (87)
Shelters	30 (79)
Laboratories	30 (79)
Clinics	27 (71)
Funeral homes, coroners	19 (50)
Doctors' offices	12 (32)
Other site	6 (16)

Sixteen percent of jurisdictions' plans included evaluation of surveillance activities following disasters. The type of evaluations included in the plans varied, ranging from formal in-depth evaluations of certain portions of surveillance activities (e.g., emergency department or shelter surveillance) to less formal discussions or reports, such as a so-called *hot wash* or after action report.

LESSONS LEARNED: Thirty-six respondents answered an open-ended question about lessons learned from disaster epidemiology and surveillance. Among the most oft-repeated lessons learned were the need for adequate and sustainable funding for disaster response, the need to have response systems and appropriately trained staff in place before a disaster event, the need for pre-existing relationships with key partners to enhance data collection during an event, the need to share information early and widely, and the need to be adaptable (See Table 6).

Table 6. Summary of lessons learned, reported by respondents from states with previous disaster surveillance experience (n=36).

Disaster epidemiology/surveillance plans and exercises • Formalize informal surveillance plans and exercise them. • Identify what surveillance is needed and who is going to be responsible for it, and conduct exercises before an event. • Include surveillance in all disaster preparedness exercises. • Have clear policies/procedures about who does what. • Know what injuries and illnesses can be expected, depending upon the disaster type. • Be mindful that detailed surveillance may not be possible until the emergency phase of any disaster is over.
Staffing and resources • Have the right people at the table to verify health-related information. • Cross-train staff from other programs; staff should be able to support public health activities outside their usual area of expertise. • Assure surveillance staff has appropriate language skills (e.g., Spanish). • Be prepared to supply additional data entry support. • Address potential problems resulting from uneven distribution of resources and staff for disaster epidemiology response throughout the agency. • Identify needs for additional resources and staff.

- Expect disaster response to be resource-intensive; sustainable funding and staffing are required.
- The state health department and outside programs that assist in disaster surveillance need stable and adequate funding.
- Have clear goals for disaster epidemiology to improve competition for scarce resources.
- Get training in rapid needs assessment (e.g., CASPER).
- Assure chronic disease epidemiologists are trained in disaster epidemiology, incident command and emergency response.
- Keep the surveillance period as short as possible.
- Develop surveillance forms and train surveillance staff in advance of a disaster.

Tools and data sources

- CASPERs and EPIAIDs provide rapid assessment and expert staff; however, for some situations, CASPER may have limited utility in the post-disaster setting.
- Utilize as much automated reporting as possible.
- Use existing data systems.
- Make use of less widely-used resources (e.g., electronic chief complaint data).
- Be sure new uses of data (e.g. syndromic surveillance data) are acceptable to facilities that provide the data.
- Be flexible and maintain capacity to institute ad hoc surveillance activities.
- Have surveillance systems that are flexible and easily adaptable.
- Use data for situational awareness.
- Recognize that long-term surveillance will be a challenge because it is resource intensive.
- Identify tools and procedures prior to an event.
- Know that active surveillance for injury and illness morbidity using paper-based forms is not useful.
- Use electronic syndromic surveillance, if available, as the foundation for disaster surveillance.
- Recognize that shelter-based surveillance is more cost effective when it functions as a passive reporting system compared with active data collection.
- Do not build a surveillance system dependent on electronic tools. Paper forms, pencils, clipboards, and phones must be the cornerstone, since electricity can be compromised. Conversely, if electricity is not a concern, consider new technologies for surveillance activities: smartphones, digital pen technology, Facebook, internet news alerts, and electronic death registration.
- Know that it is critical to have early buy-in from and coordination with data reporters and stakeholders to get quality data.
- Use GIS in data and spatial analyses.

Organization of response

- Adapt "normal" structure for epidemiology and surveillance to the needs of disaster.
- Start epidemiology and surveillance activities early.
- Keep epidemiology and surveillance activities connected to emergency response activities.
- Determine what data elements to collect upfront.
- Use an Incident command structure, if possible.
- Put epidemiologists in charge of epidemiologic activities.
- Establish collaborative relationships with key partners pre-event.
- Coordinate with others performing similar activities (e.g. American Red Cross, FEMA) as early as possible.
- Be flexible and have pre-existing relationships with hospitals and other response partners.
- Create an epidemiology surveillance group in the operations section for efficient and accurate communications.
- Build linkages between preparedness programs and other public health programs.

Communications

- Communicate regularly and clearly with all partners.
- Be able to disseminate information quickly to decision makers.
- Have well-established systems for sharing data, including the development of memoranda of understanding.
- Share information collected as soon as possible, and share it widely.
- Document what public health actions are taken apart from surveillance activities.
- Publish disaster epidemiology methods and outcomes in peer-reviewed journals.
- Be aware that leadership expects data even when the data are hard to interpret.

CONCLUSIONS AND RECOMMENDATIONS

Disaster epidemiology activities have been planned and conducted in many states and territories in response to a variety of situations, ranging from hurricanes and floods to unintended releases of chemicals.

Overall, however, results show substantial differences in the extent of disaster surveillance activities implemented across states and also highlight opportunities to strengthen disaster

epidemiology programs and enhance preparedness. CDC's *Public Health Preparedness Capabilities: National Standards for State and Local Planning* calls for both "demonstrations of [response] capabilities" through exercises, planned events and possibly real incidents and "after action reports and improvement plans." [9] In this assessment, 15 state epidemiology programs (28%) met this benchmark, with respondents reporting that the states have performed surveillance in response to an actual disaster in the past ten years, have tested surveillance capabilities through exercises, and have included a surveillance component in the jurisdiction's emergency response plan.

In contrast, five respondents (9%) reported that their jurisdiction either has not carried out any of these three activities or they "don't know" if their jurisdiction has carried out any of these activities. Seven respondents (13%) indicated that their health agency has no or unknown previous disaster response experience within the past decade and also has not performed exercises to test the jurisdiction's disaster epidemiology capabilities. Altogether, only 16% of responding jurisdictions' disaster plans includes formal or informal evaluations of surveillance activities following a disaster. These issues point towards a need for evaluating the effectiveness and quality of the data from ad hoc systems commonly used exploring the robustness of the non-disaster existing surveillance systems currently being used. Further information on types of partnerships that could assist with data collection and other aspects of disaster epidemiology response would be useful for the development of a "best practices" set of recommendations.

Only about a quarter (26%) of the 46 respondents whose states have responded to disasters within the past decade reported tracking mental and behavioral health outcomes as part of their disaster surveillance activities. Yet, mental health-related comorbidities are a concern for both victims and responders in the disaster setting. [10-11]

Assessment results suggest it may be beneficial for jurisdictions to share their disaster response lessons learned. In particular, jurisdictions with less experience responding to disasters may find it useful to know what more experienced jurisdictions consider their "best practices."

The lessons learned and recommendations from respondents' provide useful guidance for jurisdictions with less developed disaster epidemiology capacity to meet the CDC's Public Health Emergency Preparedness Capability for surveillance. Key recommendations include maintaining formal disaster surveillance plans, which have clear goals for data collection; establishing partnerships and data-sharing agreements prior to a disaster; and using data collection protocols that are as simple and adaptable as possible. Regular exercising of disaster epidemiology plans combined with meaningful after-action evaluation is essential.

Disaster surveillance can be labor intensive and time consuming; therefore, additional resources as well as trained and exercised personnel would be beneficial. Surveillance data collected during a disaster may come with many circumstantial caveats and limitations with regard to how the data were gathered and classified; therefore, it is imperative that well-trained personnel familiar with the data are responsible for explaining surveillance findings to the public and policy makers.

One of the goals of this assessment was to identify programs willing to share resources and lessons learned. Thirty-eight respondents (73%) indicated a willingness to share their disaster epidemiology tools to enable similar data collection across jurisdictions during multi-state responses. The CDC has developed a website for tool sharing available for governmental epidemiologists at: https://partner.cdc.gov/SiteDirectory/DECoP/default.aspx. [To obtain a login ID and password to gain access to the website, email Amy Schnall at aschnall@cdc.gov.]

This assessment has several limitations. First, some respondents may have included large infectious outbreaks like the 2009 H1N1 outbreak in their response, despite the written instructions. Second, the post-disaster timeframe was undefined in this assessment; some respondents may have

considered longer-term surveillance activities in their responses while other respondents did not. It should also be noted that the wide range of disaster surveillance experiences reported here may reflect differences in geographic proximity to disaster-prone areas (e.g. flood-prone coastal areas), rather than greater or lesser capacity to perform needed disaster epidemiology activities. However, it was beyond the scope of this assessment to make such determinations.

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