MMWR Weekly
January 20, 2006 / 55(02);32-35

Surveillance in Hurricane Evacuation Centers --- Louisiana, September--October 2005

On August 29, 2005, Hurricane Katrina made landfall southeast of New Orleans, Louisiana. Before the arrival of Katrina, New Orleans and surrounding parishes were under a mandatory evacuation order (*1*). Because of this order and subsequent flooding, approximately 400,000 residents became displaced (*2*). On August 28, approximately 50,000 persons began moving into evacuation centers (ECs) throughout the state of Louisiana (American Red Cross, unpublished data, 2005). The Louisiana Department of Health and Hospitals, Office of Public Health (LAOPH) recognized the need for communicable disease surveillance in the ECs. Although the LAOPH Internet-based Reportable Disease Database was intact and never stopped functioning after the hurricane, LAOPH determined that the large number of ECs warranted active surveillance. On September 8, LAOPH, with the cooperation of the American Red Cross (ARC) and the U.S. Public Health Service, initiated statewide daily syndromic surveillance for communicable diseases in the ECs. In addition to collecting and analyzing data on communicable disease syndromes, data were collected on chronic medical conditions, injuries, and mental health conditions. This report summarizes the develop ment and implementation of this surveillance system in the ECs, the types of data collected and how they were used, and the limitations of the data.

ARC, local governments, faith-based groups, and others established and sponsored ECs. Any facility that housed displaced persons overnight was considered an EC. ARC disaster headquarters in Baton Rouge, Louisiana, maintained a comprehensive list of ECs in Louisiana that was updated at least twice daily. This list included the name, location, contact information, and population of each EC. Approximately 500 ECs were identified. Individual EC populations ranged from fewer than 10 to as many as 7,000 persons.

A one-page surveillance form was designed to record the number of patient encounters at an EC for selected communicable disease signs and syndromes, including fever only (>100.4°F [>38°C]); watery diarrhea (three or more watery bowel movements per day); vomiting; bloody diarrhea; influenza-like illness or other severe respiratory infection; rash; scabies, lice, or other infestation; conjunctivitis; other potentially communicable diseases; injury (e.g., self-inflicted injury, intentional injury, unintentional injury, dehydration, or heat-related injury); mental health disorders (e.g., preexisting psychiatric disorder, new psychiatric disorder since hurricane, or alcohol/substance abuse or withdrawal); and chronic medical conditions (e.g., diabetes mellitus, high blood pressure and other cardiovascular disease, and asthma or chronic obstructive pulmonary disorder). The form was designed to record the number of patient encounters during a 24-hour period at an individual EC, including residents who were evaluated in health clinics set up inside the EC and those who were referred to an offsite medical facility. Instructions for recording and returning the completed forms were distributed along with the forms to all identified ECs. Health-care personnel were asked to complete the forms whenever possible.

Completed forms were reported by fax, e-mail, or telephone to the ARC disaster headquarters in Baton Rouge, where the Louisiana EC surveillance program was housed. To maximize reporting and the proportion of EC population under surveillance, the surveillance staff attempted to call ECs that had not reported by 11:00

a.m. each day, with higher-census ECs called first. Individual forms were reviewed; if the reviewing medical epidemiologist identified a case or clusters of cases that indicated a possible outbreak, the file was flagged for further investigation.

Data were entered into a database. Initially, communicable disease data were analyzed by comparing daily results with a 3-day moving average. Beginning September 14, data were analyzed in statistical software using the Early Aberration Reporting System (EARS), a program developed by CDC to calculate cumulative sum (CUSUM) scores for each syndromic category (*3*). An elevated CUSUM score suggests a potential outbreak. Elevated CUSUM scores and suspicious cases and clusters identified were investigated by telephone. Those cases that could not be reconciled by telephone were referred to LAOPH for investigation.

The EC surveillance system operated during September 8--October 26. Some ECs had been collecting patient data before the system started and provided these data retrospectively from as early as September 4. The surveillance team received 2,975 surveillance forms reporting on 39,217 patient encounters during its 49 days of operations. At least one surveillance form was received from 297 (61%) of the 489 identified ECs. On average, 33% (range: 4%--64%) of the EC population was under surveillance each day (Figure 1). On average, reports were received from 23% (range: 3%--49%) of the ECs daily.

Influenza-like illness and rash were the most commonly reported communicable disease syndromes, and skin infestation was the largest reported cluster (Table). However, the majority of large clusters were attributed to overreporting. For example, after telephone investigation, a skin infestation cluster of 60 cases was determined to be four confirmed cases of scabies, with the remainder being EC residents treated prophylactically.

Review of individual EC surveillance forms led to 86 follow-up investigations by telephone; of these, 67 (74%) led to further investigation by LAOPH. During September 15--October 26, the EARS syndromic surveillance system produced 194 CUSUM scores that warranted telephone investigation; 46 (15%) were referred for follow-up by LAOPH. Of 56 investigations referred to LAOPH after implementation of EARS, 42 (75%) were identified by both an elevated CUSUM score and epidemiologist review of surveillance forms, 10 (18%) were identified by epidemiologist review only, and four (7%) were identified by an elevated CUSUM score only.

Chronic medical conditions accounted for 31% of encounters (Figure 2). Anecdotal reports suggested that many of these encounters involved replacing medications lost during evacuation or reestablishing medical treatments that were interrupted after Katrina. Patient encounters for mental health conditions, either previously diagnosed (e.g., depression) or newly recognized (e.g., anxiety), accounted for 9% of patient encounters.

Reported by: *A Toprani, MD, Tulane Univ, New Orleans; R Ratard, MD, S Straif-Bourgeois, PhD, T Sokol, MPH, Louisiana Dept of Health and Hospitals, Office of Public Health. F Averhoff, MD, J Brady MD, D Staten, MPH, M Sullivan, MPH, US Public Health Svc. JT Brooks, MD, National Center for HIV, STD, and TB Prevention; AK Rowe, MD, National Center for Infectious Diseases; K Johnson, DVM; T Chester, MD, National Center for Health Marketing; P Vranken, MBA, E Sergienko, MD, EIS officers, CDC.*

Editorial Note:

This report describes the rapid development and implementation of an active surveillance system established in ECs located throughout Louisiana in the aftermath of Hurricane Katrina. This surveillance system directed limited public health resources to investigate and control potential communicable disease outbreaks and monitor health-care needs for selected injuries, mental health conditions, and chronic medical conditions.

Public health responses after hurricanes have previously focused on populations other than those in ECs and have emphasized needs assessments, injury and carbon monoxide poisoning surveillance, and emergency department surveillance (*4*,*5*). After Hurricane Hugo, needs assessments were conducted in all identified

ECs in Puerto Rico, and communicable diseases were identified; however, no ongoing surveillance was conducted (*6*). Active surveillance in a large and changing number of ECs during an extended period has not been described previously. Concurrent with establishing the surveillance system in Louisiana, a needs assessment was conducted in all known ECs.

An existing program designed to conduct routine, active surveillance for disease and injury among military personnel was adapted to conduct surveillance of ECs (*7*). Syndromic surveillance has been implemented to provide early recognition of a bioterrorist attack and in other settings in which an epidemic potential exists (*8*). The surveillance system described in this report represents the first instance of EARS being used to monitor ECs after a natural disaster.

The system enabled surveillance of nearly 64% of the EC population; however, the average daily proportion under surveillance was lower. To maximize the number of ECs contributing data, active follow-up (e.g., telephone calls) of larger-population ECs was conducted with some success, as evidenced by the proportion of the EC population under surveillance (33%), which was consistently higher than the proportion of ECs under surveillance (23%). Several factors might have contributed to the limited surveillance coverage. First, reporting was encouraged but not mandatory. Second, no training was provided to EC staff regarding the recognition or definition of syndromes included in the system. Third, rapid turnover occurred among EC staff. Fourth, many EC personnel staff did not have health-care backgrounds or training. Fifth, at an unknown number of ECs, especially those with a small population, delivery of health-care was not provided or the care was offered offsite. Sixth, the number and location of ECs changed daily, and communication was often difficult in the post-hurricane environment (i.e., telephone lines damaged, cellular telephone systems overloaded, and Internet servers offline). Finally, the system conducted surveillance of patient encounters, which might have overrepresented the prevalence of chronic diseases, such as hypertension and diabetes, for which persons might have multiple visits for monitoring and control. These limitations might have resulted in underreporting, overreporting, and poor quality of reported data. However, the primary purpose of the system was to detect potential outbreaks and to measure the burden of selected chronic conditions among the EC population on the health-care system. The daily incidence of patient encounters with the identified syndromes and conditions provided a useful indicator for these purposes.

In preparation for large-scale disasters that result in numerous displaced persons being housed in crowded conditions, coordinated planning by federal, state, and volunteer agencies for surveillance in ECs is needed. Standard operating procedures for EC surveillance should be developed that include easily adaptable surveillance forms and software to analyze and report data. Disease surveillance should be incorporated into the training offered to persons involved in managing and providing health care in ECs.

The EC surveillance system provided a timely reporting mechanism for EC staff to alert LAOPH about potential outbreaks and concerns related to communicable diseases and other health conditions. The use of similar surveillance in other large-scale disasters that require the sheltering of a large population should be incorporated into state and national response plans.

Acknowledgments

The report is based, in part, on contributions by E Feigenbaum, MD, J Jaekle, T Carville, M Bormet, MPH, W Osterholm, and other members of the Louisiana Katrina Response, American Red Cross; S Auerbach, MD, D Sniadack, MD, D Kim, MD, US Public Health Service; and S Thomas, MPH, National Center for Injury Prevention and Control, R Kamadjeu, MD, National Immunization Program, D Jarman, DVM, V Sneller, PhD, EIS officers, CDC.

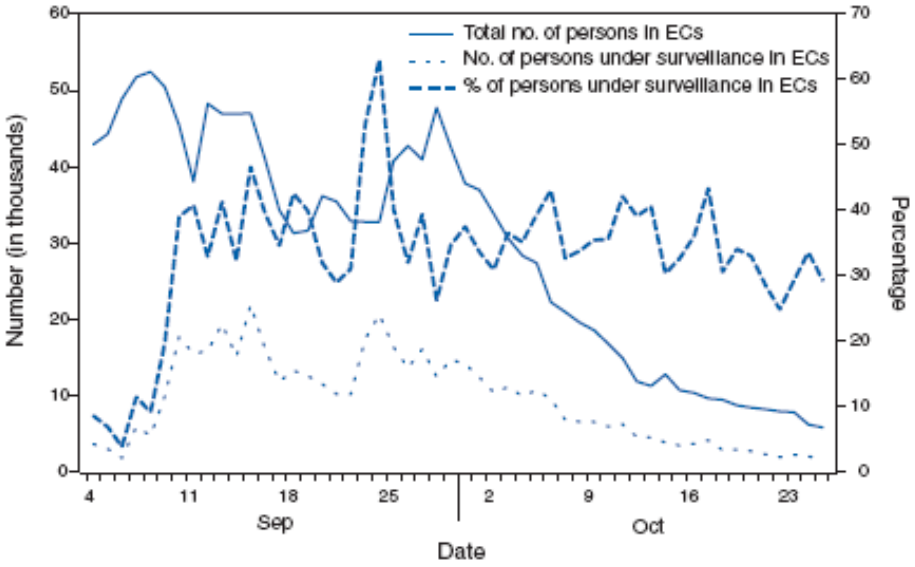
References

1. Nagin R. Promulgation of emergency orders. New Orleans, LA: City of New Orleans; 2005. Available at http://www.cityofno.com/portal.aspx?portal=1&tabid=43.
2. US Department of Homeland Security, Federal Emergency Management Agency. By the numbers: FEMA recovery update in Louisiana. Available at http://

www.fema.gov/news/newsrelease.fema?id=22403.
3. CDC. Early Aberration Reporting System. Atlanta, GA: US Department of Health and Human Services, CDC; 2005. Available at http://www.bt.cdc.gov/surveillance/ears.
4. CDC. Epidemiologic assessment of the impact of four hurricanes---Florida, 2004. MMWR 2005;54:693--7.
5. CDC. Rapid assessment of the needs and health status of older adults after hurricane Charley---Charlotte, Desoto, and Hardee counties, Florida, August 27--31, 2004. MMWR 2004; 53:837--40.
6. CDC. Surveillance of shelters after Hurricane Hugo---Puerto Rico, January 26, 1990. MMWR 1990;39:41--2,47.
7. Office of the Chairman, Joint Chiefs of Staff. Updated procedures for deployment health surveillance and readiness. Joint Staff memorandum. MCM-0006-02. Washington, DC: US Department of Defense; 2002. Available at http://amsa.army.mil/documents/jcs_pdfs/20020201%20mcm-00006-02%20dep%20hlth%20surv%20and%20readiness.pdf.
8. Mandl KD, Overhage JM, Wagner MM, et al. Implementing syndromic surveillance: a practical guide informed by the early experience. J Am Med Inform Assoc 2004;11:141--50.

Figure 1

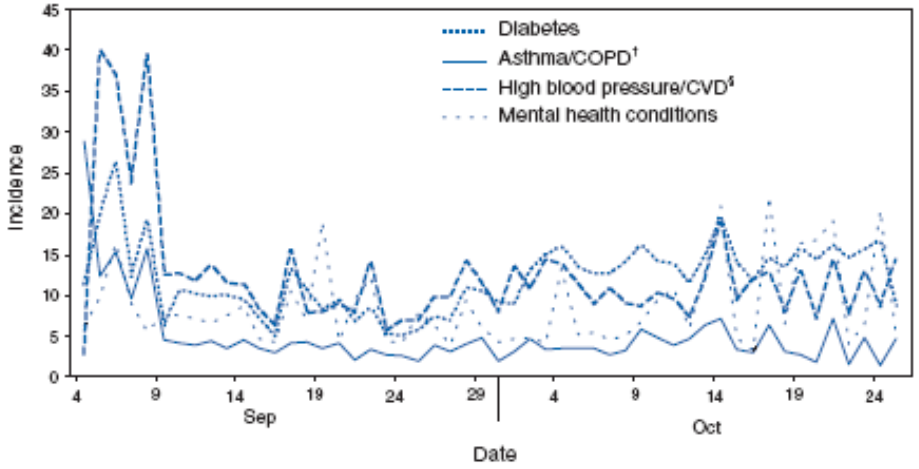
FIGURE 1. Number and percentage of persons under surveillance in hurricane evacuation centers (ECs), by date — Louisiana, September–October 2005



Return to top.

Figure 2

FIGURE 2. Incidence* of patient encounters in hurricane evacuation centers, by date and selected conditions — Louisiana, September–October 2005



*Per 1,000 persons.
†Chronic obstructive pulmonary disease.
§Cardiovascular disease.

Return to top.

Table

TABLE. Average daily incidence* of communicable disease signs and syndromes among persons in hurricane evacuation centers (ECs), by selected conditions — Louisiana, September–October 2005

Condition	Average daily incidence	Range	Largest reported cluster (no. of cases)
Fever only (>100.4°F [>38°C])	0.5	(0–1.9)	10
Bloody diarrhea	0.1	(0–0.7)	6
Watery diarrhea with or without vomiting	1.8	(0–4.0)	22
Vomiting only (one episode or more)	1.3	(0–6.0)	13
Influenza-like illness	4.7	(0–8.8)	47
Rash	2.7	(0–13.8)	35
Scabies, lice, or other infestation	0.6	(0–3.8)	60
Wound infection	1.6	(0–8.5)	34
Conjunctivitis	0.4	(0–1.8)	10

* Per 1,000 persons.

Return to top.

SAFER·HEALTHIER·PEOPLE™
Morbidity and Mortality Weekly Report
Centers for Disease Control and Prevention
1600 Clifton Rd, MailStop E-90, Atlanta, GA 30333, U.S.A