A Comparative Analysis of Two External Health Care Disaster Responses Following Hurricane Katrina

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Abstract

Objective. Hurricane Katrina severely disrupted the health services in the U.S. Gulf Coast, necessitating an external health care response. The types and needs of patients following such an extensive event have not been well described. The objective of this study was to analyze the types of patients treated in two temporary clinics and to identify differences between them. **Methods.** Two temporary sites were established: a disaster medical assistance team–based site in Mississippi and a volunteer-based site near New Orleans. Data were abstracted from patient charts for the two days of simultaneous operation: September 11 and 12, 2005. Each patient's age group, disposition, and primary discharge diagnosis was categorized and analyzed with descriptive and comparative statistics. **Results.** There were a total of 501 patient encounters. The most common presentation overall was for chronic health conditions such as medication refills (20.6%), immunizations (11.0%), obtaining community resources (6.0%). and management of acute exacerbation of chronic hypertension (4.6%). There were important differences; the Mississippi site treated more acute conditions than the Louisiana site, including lacerations (13.7% vs. 0%; $p < 0.001$), musculosketal injuries (9.4% vs. 2.6%; $p < 0.001$), and other nonspecified injuries (3.0% vs. 0.4%; $p = 0.020$). **Conclusions.** With extensive damage to a health care system, these temporary clinics staffed by out-of-state volunteers provided needed health care. The most common health problems were related to chronic disease, primary health care, and routine emergency care, not to the direct impact of the hurricane. In addition to treating minor injuries, disaster planners should prepare to provide primary health care, administer vaccinations, and provide missing long-term medications.
Key words: disaster medicine; emergency medicine; emergency medical services; public health.

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Introduction

On August 29, 2005, the Gulf Coast of the United States was hit by Hurricane Katrina. Katrina made landfall in Plaquemines Parish, south of New Orleans, with maximum sustained winds of 140 mph (category 4). A second landfall occurred four hours later near the Louisiana/Mississippi boarder, with maximum sustained winds of 125 mph (category 3).[1] As the hurricane passed through the area, rising waters broke through the levee system protecting the New Orleans metropolitan area, causing massive flooding.

This hurricane is a unique disaster for the United States in that it forced the long-term evacuation of a large city and essentially shut down an entire metropolitan health care system. In the immediate aftermath of the hurricane, only three acute care hospitals in the New Orleans metropolitan area remained functional.[2,3] An estimated 5,944 physicians in the flood-affected areas, which included six Louisiana and four Mississippi counties or parishes, were temporarily or permanently displaced.[4] Wind and water damage in the total gulf region from the hurricane is expected to exceed $34.4 billion.[5]

Mounting an emergency response to natural disasters is not a new phenomenon for the U.S. health care system. In the first four days after Hurricane Ivan hit the Florida panhandle in 2004, federal disaster medical assistance teams (DMATs) treated nearly 300 people.[6] There are clear patterns in the health impact of different types of natural disasters. In a meta-analysis of the medical impact of tornados in North America from 1962 to 1994, Bohonos reported on 1,394 cases with only 0.4% due to medical illnesses and the rest due to trauma.[7] Wylie et al. reported on the impact on their emergency department in the 72 hours following the passing of Hurricane Georges in Key West in 1998. In contrast to the findings of Bohonos, with almost all of the cases following a tornado being traumatic, Wylie et al. found that of the 86 patients who presented to their emergency department, 52% had general medical conditions, 42% were seen for minor trauma, 3% were seen for surgical problems, and 2% were seen for psychiatric illnesses.[8]

Planning for the management of chronic illness after a catastrophic disaster has also been suggested. Fernandez et al. reported on management strategies for frail elderly as disaster victims. They wrote that, "... when disasters compromise health resources,

patients may find it difficult to effectively manage their own illnesses or chronic conditions."[9]

Despite the findings from previous natural disasters, in general, health care systems are not adequately prepared for natural disasters. While hospitals are required by the Joint Commission on Accreditation of Health care Organizations to have disaster plans, few communities have planned for the possibility that the majority of health care agencies in a given metropolitan area would be shut down due to a disaster.

In an attempt to compare geographic variations in the health response following this large-scale disaster, we report on the findings of two temporary clinics that were established in the immediate aftermath of the storm. The first site, located just outside of New Orleans, was a volunteer-run clinic as part of a program organized by the state of Maryland. The second site, located in Gulfort, MS, was organized through the federal DMAT program.

METHODS

Description of Sites

Operation Lifeline and the Johns Hopkins Site

In a response to a request for humanitarian and medical assistance from the president of Jefferson Parish, Louisiana, to the governor of the state of Maryland, the Maryland Department of Health and Mental Hygiene along with the Maryland Institute for Emergency Medical Services Systems (MIEMSS), the Maryland Emergency Management Agency, and the Maryland Defense Force sent a multi disciplinary team of volunteers to assist in filling the gap in health care resources that resulted from the storm.

The mission of the volunteers from the state of Maryland was to develop that which became known as Operation Lifeline: the formation of six temporary clinics within Jefferson Parish. All six clinics were strategically located within impoverished areas in the parish as identified by the local officials.

By order of eminent domain, the president of Jefferson Parish authorized the Maryland medical volunteers to utilize as a base of operations a hospital that had earlier been evacuated within Jefferson Parish. In the beginning of the operation, pharmaceuticals and supplies from the hospital were used at the six clinic sites. These supplies were eventually augmented through DMAT supplies and private donations.

Three physicians and 10 nurses from the Johns Hopkins Healthcare System were organized by the Johns Hopkins Office of Critical Event Preparedness and Response to join the Maryland relief effort. This group was augmented and supported by six emergency medical services providers with one transport vehicle. The entire contingent of 19 health care professionals was assigned to staff one of the six temporary clinics (Figure 1). The clinic was located in the cafeteria of Westwego Elementary School in Westwego, LA.

Clinic hours were from 10 AM to 4 PM. The clinic did not have laboratory or radiology services or the capacity to manage critical care patients. Any patient with a high level of acuity was therefore stabilized at the site and then transported to West Jefferson Medical Center. The clinic was open from September 10, 2005, to September 19, 2005.

Gulfport NJ-1 DMAT Team Site

The NJ-1 DMAT, within the National Disaster Medical System (NDMS), is administered by U.S. Department of Homeland Security's Federal Emergency Management Agency. The team generally deploys with 35 personnel and extensive equipment and supplies with the purpose to set up a self-supporting field hospital.

NJ-1 DMAT responded to the gulf region on September 4, 2005. The DMAT team consisted of three physicians, one nurse practitioner, one physician assistant, nurses, pharmacists, and communications and logistics personnel. The team spent approximately one week working at shelter clinics and performing outreach during the day and returning to a nearby military base at night. During this time, patient care was provided and medical supplies were dispensed.

On September 11 and 12, the NJ-1 DMAT operated at a base of operations in the parking lot of a hospital in Gulfport, MS (Figure 2). This hospital had sustained minor flooding of approximately 1 foot of water and wind damage. The hospital was operating at partial capacity. All patients presenting to the emergency department and urgent care were routed to the DMAT medical tents. Patients deemed to require further medical care were transported to the hospital's emergency department or transported to outside facilities. Patients treated in the medical tents came by foot, personal vehicle, ambulance, and helicopter.

Data Collection

Patients who presented to the Louisiana clinic site had data collected on the standardized MIEMSS triage card. All patients in the clinic for a reason other than to receive immunizations or community resources were seen by one of the three physicians. At the time of discharge, the physician marked on the chart the primary diagnosis as well as any secondary diagnosis. At the end of each day, two of the nurses collected the triage sheets and recorded the diagnosis on a standardized form. Data were abstracted for the clinic days of September 11 and 12.

Patients who presented to the Mississippi DMAT site had data collected on the standardized NDMS patient

care chart. Data were then abstracted from these charts into the same diagnosis categories as the Louisiana clinic site. Data were abstracted for the clinic days of September 11 and 12.

During the data abstraction process, the same information was collected for each group. This information consisted of recording one of 23 primary discharge diagnoses, adult versus pediatric patient (pediatric defined as younger than 18 years), and number of patients transported to an acute care emergency department.

Data Analysis

Data from the two abstraction tables were entered into SPSS statistical software version 11.0 LSPSS Inc., Chicago, IL). Data were analyzed with descriptive statistics. Nominal data from the two sites were compared with Pearson chi-square test or fisher's exact test as indicated.

Study Approval

The Johns Hopkins University Institutional Review Board approved the study.

Results

During the two days that the two sites had an overlap in operational activities, there were a total of 501 patient encounters: 267 from the Louisiana site and 234 from the Mississippi site. Overall, the most common discharge diagnoses were related to chronic health conditions, with medication refills the most frequent between the two sites (20.6% of all visits). While presentation to both sites for medication refills was common, there were relatively more patients at the Louisiana site than the Mississippi site ($p < 0.001$). Other common reasons for presenting at the two sites included requests for immunizations (11.0%), obtaining community resources (6.0%), and management of acute exacerbation of chronic hypertension (4.6%).

There were important differences between the two sites; in general, the Mississippi site treated more acute medical problems than the Louisiana site. The Mississippi site also treated more injuries than the Louisiana site, including lacerations (13.7% vs. 0%; $p < 0.001$), musculoskeletal injuries (9.4% vs. 2.6%; $p < 0.001$), and other nonspecified injuries (3.0% vs. 0.4%; $p = 0.020$).

The top five discharge diagnoses from the Louisiana site were as follows: 1) to receive medication refills (26.6%), 2) to receive immunizations (18.0%), 3) to obtain community resources (10.5%), 4) for management of acute exacerbation of chronic hypertension (8.2%), and 5) for treatment of respiratory illnesses (7.5%). This is in contrast to the top five discharge diagnoses from the DMAT site, which were as follows: 1) to receive medication refills (13.7%), 2) for management of lacerations and irrigation and drainage of cutaneous abscesses (13.7%), 3) for treatment of infections (9.4%), 4) for treatment of acute musculoskeletal disorders (9.4%), and 5) for treatment of acute respiratory illnesses (9.4%). Complete comparative analysis of all patients seen at both clinic sites is shown in Table 1.

The Mississippi site had a higher percentage of pediatric patients than the Louisiana site (17.1% vs. 4.7%; $p < 0.001$). The distribution of pediatric cases was generally more acute than the adult cases. The top three discharge diagnoses in the pediatric group were as follows: 1) respiratory illness, 2) infections, and 3) dermatologic conditions. Analysis of pediatric patients is shown in Table 2.

The Mississippi site also had a higher percentage of patients who were transported to an acute care emergency department (13.7% vs. 1.5%; $p < 0.001$). The most common reason overall for transportation to an acute care hospital between the two sites was for cardiac conditions. Analysis of transported patients is shown in Table 2.

Discussion

In this study, data were compared from two sites that were established in the aftermath of Hurricane Katrina by two out-of-state health care teams. While both sites were open for more days than studied, data were only analyzed for the two days that both sites were simultaneously fully operational. This was done to help minimize the possible confounding nature of temporality to the date of the hurricane.

Except in uncommon circumstances, it is usually not possible for an out-of-state or out-of-country medical response team to begin delivery of scene care within the first 72 hours of the disaster. It is, therefore, necessary for outside responders to plan for external care to be focused on managing those illnesses that may occur after the initial phase of the disaster response. Our experience supports this; the Mississippi team was functioning five days after the event and the Louisiana team 11 days after the event. The two teams managed a combination of primary health care, preventive services, minor injury, and infectious disease.

A common expectation after any disaster is that most patients would be seen for acute illness directly related to the event, such as traumatic injuries from falling debris, and infectious diseases, particularly diarrhea from contaminated water. Contrary to these expectations, more than 40% of the health problems treated at the two sites were related to chronic conditions and the lack of access to routine care. The largest single group of patients coming to both sites was for medication refills, and many patients were seen for other

TABLE 1. Discharge Diagnosis From the Two Clinic Sites

Diagnoses	Total No. (%) (n = 501)	No. in Louisiana (%) (n = 267)	No. in Gulfport (%) (n = 234)	p-value/Odds Ratio (95% confidence interval)
Chronic conditions				
Access community resources	28 (6.0)	28 (10.5)	0 (0)	<0.001 0.895 (0.859–0.933)
Immunizations	55 (11.0)	48 (18.0)	7 (3.0)	<0.001 7.108 (3.148–16.04)
Medication refills	103 (20.6)	71 (26.6)	32 (13.7)	<0.001 2.287 (1.442–3.627)
Supplies	11 (2.2)	10 (3.7)	1 (0.4)	0.007 10.01 (1.283–78.14)
Hypertension	23 (4.6)	22 (8.2)	1 (0.4)	<0.001 20.92 (2.798–156.5)
Diabetes mellitus/metabolic	5 (1.0)	3 (1.1)	2 (0.9)	0.763 1.318 (0.218–7.958)
Acute conditions				
Allergy	5 (1.0)	2 (0.7)	3 (1.3)	0.549 0.581 (0.096–3.508)
Burns	3 (0.6)	0 (0)	3 (1.3)	0.101 1.013 (0.998–1.028)
Cardiac	8 (1.6)	4 (1.5)	4 (1.7)	0.851 0.875 (0.216–3.536)
Dermatology	28 (6.0)	7 (2.6)	21 (9.0)	<0.001 0.233 (0.092–0.588)
Hydration	1 (0.2)	1 (0.4)	0 (0)	0.533 0.996 (0.989–1.004)
Gastrointestiral	18 (3.6)	3 (1.1)	15 (6.4)	0.002 0.166 (0.047–0.581)
Genitourinary	14 (2.8)	6 (2.2)	8 (3.4)	0.427 0.649 (0.222–1.900)
Infections	37 (7.4)	15 (5.6)	22 (9.4)	0.106 0.574 (0.290–1.134)
Lacerations/irrigation and drainage	32 (6.4)	0 (0)	32 (13.7)	<0.001 1.158 (1.101–1.219)
Musculoskeletal	29 (5.8)	7 (2.6)	22 (9.4)	<0.001 0.259 (0.109–0.619)
Neurologic	12 (2.4)	3 (1.1)	9 (3.8)	0.047 0.284 (0.076–1.062)
Obstetric-gynecologic	2 (0.4)	1 (0.4)	1 (0.4)	0.920 0.876 (0.040–14.08)
Psychiatric	10 (2.0)	10 (3.7)	0 (0)	0.003 0.963 (0.940–0.986)
Respiratory	42 (8.4)	20 (7.5)	22 (9.4)	0.411 0.780 (0.414–1.469)
Injury, not otherwise specified	8 (1.6)	1 (0.4)	7 (3.0)	0.020 0.122 (0.015–0.998)
Wound care	18 (3.6)	5 (1.9)	13 (5.6)	0.027 0.324 (0.114–0.924)
Other	9 (1.8)	0 (0)	9 (3.8)	<0.001 1.04 (1.014–1.067)

chronic conditions such as hypertension and diabetes and procurement of medical supplies.

This points out a major shortcoming of traditional disaster health care planning. Despite previous reports of the importance of primary care after disasters, seldom have disaster planners prepared for the management of chronic disorders, and little attention has been paid to resupplying lost routine medications for chronic diseases.[10,11] While medication dispensing was available on a limited basis for both clinic sites, much improvement could be made for disaster planning of medication dispensing. It is nearly impossible for most patients to get prescriptions refilled in an environment with few open pharmacies and most accepting only cash because of the lack of telephone lines for insurance and credit transactions. In the future, disaster planning should account for the need to provide medical care to patients with chronic diseases. Therefore, disaster planners should consider the stockpiling of medications to manage chronic diseases such as hypertension, diabetes, and cardiovascular disorders.

The second highest number of patients presenting to the Louisiana site was for immunizations. The Louisiana site actively immunized members of the local community against tetanus and provided hepatitis A vaccine to those at high risk, such as public utilities workers exposed to standing water. By direction of the medical director of MIEMSS, emergency medical technician-paramedics were trained and then extended the ability to give immunizations to the public under medical direction. This use of these personnel was efficient and effective. In developing disaster management plans, communities should consider temporary clinics as an appropriate site for mass vaccination by using emergency medical services personnel. Furthermore, the vaccination status of the community and the type of disaster should be considered to ensure the best use of resources.

There were differences between the two sites. In gerneral, the Mississippi site treated more acute medical problems and managed far more patients with injuries such as lacerations, infections, and general wound care. In Mississippi, 81.6% of patients presented with an acute medical problem; in Louisiana, only 31.9% of patients presented with an acute medical problem. This may have been a function of the different impact of the

TABLE 2. Pediatric Patients Seen in the Clinic and Patients Transported to the Emergency Department

	Total No. (%) (n = 501)	No. in Louisiana (%) (n = 267)	No. in Mississippi (%) (n = 234)	p-value/Odds Ratio (95% confidence interval)
Pediatrics	53 (10.6)	13 (4.7)	40 (17.1)	<0.001/0.256 (0.133, 0.493)
Transport	36 (7.2)	4 (1.5)	32 (13.7)	<0.001/0.100 (0.035, 0.287)

hurricane on the health care system in Louisiana compared with Mississippi or may be related to the nature of the teams themselves. The Mississippi site opened directly outside of a partially functioning emergency department, and patients were referred there from the DMAT site. Perhaps this location served as an advertisement for the community and could explain why the Mississippi site saw more acutely ill patients. Furthermore, in New Orleans, the health care system was essentially destroyed for an extended period, while in Mississippi the few hospitals that were evacuated were reopened within one week.

The Mississippi site also had a higher percentage of pediatric patients and patients requiring transportation to an acute care emergency department. The higher percentage of patients requiring transport from the Mississippi site further reflects the greater percentage of patients with acute illnesses at the Mississippi site compared with the Louisiana site. However, this was also probably related to the close proximity of the Mississippi site to the emergency department compared with the Louisiana site, which was 3.5 miles from the nearest open hospital.

The differences in pediatric patients may be due to more children being evacuated from the New Orleans area compared with Mississippi. Despite this difference, just more than 10% of the patients seen overall between the two sites were in this age group. These patients traditionally receive little attention in disaster management. In the future, disaster planners may want to consider the stockpiling of supplies and pharmacies to manage pediatric patients. Planners may also consider including emergency clinicians with dual training in emergency medicine and pediatrics in disaster response activities.

Some of the intrinsic differences in the two teams may have influenced the types of patients that they treated. DMATs are designed to be independently functioning units with a well-integrated function in the Federal Disaster Response Plan. They receive specific training and are deployed with almost $1 million of supplies and equipment. The Maryland team in Louisiana was an ad hoc group responding to a request from the local parish government. They were deployed with no supplies or equipment but were lucky enough to secure them from a closed hospital. They initially operated outside the federal response but gradually integrated into it. The clinicians at the Louisiana site, however, did recognize the need for more "preventive" services and actively provided immunizations and referral to local community social services.

Just more than 10% of the patients presenting to the Louisiana site were primarily in need of community and social services resources. This may be due to the high percentage of people in this community who did not evacuate the area and sheltered from the storm in their own homes. Identifying this as a need, the clinicians at the Louisiana site collected available resources and developed a community resource document that was distributed to the patient population. The DMAT site also encountered a number of community members requesting assistance. However, these numbers were not isolated from the total number of patients seen in the site. A handout developed by NDMS was distributed, and the team worked with local shelters to redistribute both donated and federal medical supplies. Communities may want to consider developing a list of resources prior to a catastrophic disaster such that these resources can be quickly identified and distributed as needed after an event.

Limitations

The most important limitation is related to the use of disaster health care records for the analysis. In general, these records are sparse, if not nonexistent, given the disruptions of power, personnel, equipment, and supplies. Both of these sites did collect health records associated with each patient visit. The record keeping for social services and psychiatric problems was less rigorous. This could lead to an underreporting of these patient encounters. The clinical records of the two sites were also not identical, and the data collection tool for the Louisiana site was developed after the clinic opened. There is, therefore, potential for reporting bias in the data collected from the Louisiana site.

The lack of details in the medical records also made it difficult to separate acute medical conditions from chronic medical conditions. This made the identification of patients with chronic conditions difficult. Therefore, there is the potential for selection bias in the disease categories, which could have falsely elevated the acute category numbers.

Disaster management planners should develop a universal data collection tool for use during a disaster. This tool should be easy to use, such that data can be collected by treating clinicians without compromising patient care. It is important that data collected in future disasters accurately capture patients presenting for management of chronic disorders. This information will help future planners have a comprehensive assessment of the nature of this problem.

Conclusions

This study further identifies the need for chronic and primary health services following a disaster with widespread devastation. It also demonstrates the serious need for emergency pharmaceutical stockpiles and delivery systems in these situations. There were important differences noted between the two

sites, probably related to both the variable impact of the event in New Orleans and Mississippi and the composition and location of the health care teams. Despite these differences, both sites primarily treated minor injuries and illnesses, provided primary health care, and managed chronic disease problems.

In addition to treating minor injuries and illnesses, disaster planners should prepare for the ability to refill medications for chronic health conditions, provide primary health care, administer vaccinations, and organize other community resources.

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