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## Disaster-Related Injuries and Illnesses Treated by American Red Cross Disaster Health Services During Hurricanes Gustav and Ike

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### Abstract

**Objective**—To describe the injuries and illnesses treated by the American Red Cross (Red Cross) during Hurricanes Gustav and Ike disaster relief operations reported on a new Aggregate Morbidity Report Form.

**Methods**—From August 28 to October 18, 2008, 119 Red Cross field service locations in Louisiana, Mississippi, Tennessee, and Texas addressed the healthcare needs of people affected by the hurricanes. From these locations, individual client visit data were retrospectively collated per site onto new 24-hour Aggregate Morbidity Report Forms.

**Results**—A total of 3863 clients were treated. Of the clients, 48% were girls and women and 44% were boys and men; 61% were 19 to 64 years old. Ninety-eight percent of the visits occurred in shelters. The reasons for half of the visits were acute illness and symptoms (eg, pain) and 16% were for routine follow-up care. The majority (65%) of the 2516 visits required treatment at a field location, although 34%, or 1296 visits, required a referral, including 543 healthcare facility transfers.

**Conclusions**—During the hurricanes, a substantial number of displaced evacuees sought care for acute and routine healthcare needs. The capacity of the Red Cross to address the immediate and ongoing health needs of sheltered clients for an extended period of time is a critical resource for local public health agencies, which are often overwhelmed during a disaster. This article highlights the important role that this humanitarian organization fills, to decrease surge to local healthcare systems and to monitor health effects following a disaster. The Aggregate Morbidity Report Form has the potential to assist greatly in this role, and thus its utility for real-time reporting should be evaluated further.

### Keywords

American Red Cross; disasters; Hurricane Ike; postdisaster surveillance; shelter

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During a large-scale disaster, public health surveillance is important to track emerging illnesses and injuries, identify at-risk populations, and assess the effectiveness of the response effort.<sup>1</sup> Since 1987, the Centers for Disease Control and Prevention (CDC) and the American Red Cross (Red Cross) have collaborated in the collection of morbidity and mortality data that are specific to natural and technological disasters. During federally declared disasters, such as large-scale major hurricanes, the Red Cross, in coordination with the Federal Emergency Management Agency and states, establish and manage shelters for displaced populations and provide assessment and care of this population's disaster-related health needs.<sup>2</sup>

During the 2008 Atlantic hurricane season, four tropical cyclones affected the Greater Antilles in rapid succession.<sup>3–5</sup> Hurricanes can cause major property damage and affect human health as wind speeds reach from 74 mph to 155 mph (categories 1–5 based on the Saffir-Simpson Hurricane Wind Scale).<sup>6</sup> On the morning of September 1, Hurricane Gustav made landfall as a category 2 (96–110 mph) hurricane near Cocodrie, Louisiana.<sup>3</sup> More than 2 million residents evacuated the Gulf Coast ahead of Hurricane Gustav, and the cost of the damage within the disaster-affected area was \$4.6 billion.<sup>3,4</sup> Approximately 2 weeks later, on September 13, Hurricane Ike made its final landfall over Galveston, Texas, as a large category 2 hurricane.<sup>6</sup> Damage from Hurricane Ike was estimated at approximately \$29.5 billion, making it the third costliest (after Hurricanes Katrina and Sandy) hurricane to affect the US mainland.<sup>6–8a</sup> As a result of these two hurricanes, between August 29 and October 27, counties across Alabama, Arkansas, Florida, Kentucky, Texas, Louisiana, Mississippi, and Ohio were declared federal disaster areas.<sup>5</sup> The mandatory evacuations and possible severe damage to property caused more than 300 field service locations to be opened by September 2, which increased to almost 900 by September 14 (1 day after Hurricane Ike made landfall).<sup>9</sup> More than 20,000 Red Cross disaster workers and volunteers were deployed to address the needs of the hurricane-affected population in the states of Louisiana and Texas and evacuees who had temporarily relocated to Mississippi and Tennessee.<sup>9</sup>

Based on lessons learned from Hurricane Katrina, the CDC developed and subsequently piloted disaster mortality and morbidity surveillance forms.<sup>10–12</sup> These forms are a public health resource if ad hoc surveillance is needed during a disaster if regular reporting mechanisms are disrupted or a location needing surveillance is not part of the existing surveillance system (eg, megashelter).<sup>13–15</sup> Based on this work, the reporting process of the existing CDC and Red Cross disaster morbidity surveillance system was converted from an individual format to an aggregate format. Changes arose from experience with large numbers of individual surveillance forms generated during an event, which burdened volunteers' time and the logistical challenges of collecting and sending these data to the CDC. An aggregate form was developed to replace the individual report form, the Red Cross Disaster Health Services (DHS) Aggregate Morbidity Report Form (Fig.). The new aggregate form tallies daily individual health records from one field service location (ie, shelter) onto a single form and every 24 hours can be e-mailed or faxed to the CDC or the local public health department. This new form was piloted as an aggregate data collection tool for data from the individual health records generated during the disaster relief operations of Hurricanes Gustav and Ike.

This article summarizes retrospective health data from this large mass-care event, which were collated on the new aggregate form. We characterized the disaster-associated injuries and illnesses using the aggregated data and examined whether this new reporting format would allow the Red Cross to identify immediate public health concerns and determine healthcare delivery needs during a disaster relief operation.

## Methods

### Data Source

We used data collected at 119 Red Cross field service locations in 39 counties across Louisiana, Mississippi, Tennessee, and Texas between August 28 and October 18, 2008. Field service locations included shelters (eg, evacuation, emergency), outreach teams (ie, teams that conduct community door-to-door outreach or specific home visits for disaster-affected families), service centers (ie, first aid stations at a Red Cross feeding station or a bulk supply distribution center), hospitals (ie, patients referred from a shelter), and other types of sites (eg, first aid at a local chapter).

### Data Collection Methods and Analysis

Red Cross DHS volunteers were primarily registered nurses (or in some instances an emergency medical technician or physician) assigned from Red Cross's Disaster Human Resources System, the official system of trained preregistered volunteers. All client visits for healthcare assistance were documented, per protocol, on a standardized confidential client health record. The record captures the client's demographics, reason for visit, treatment, and disposition. Typical health services available to clients are health assessment, healthcare maintenance (eg, blood pressure checks), assistance with medication refills, eyeglass replacement vouchers, and medical casework (eg, coordination of home health care). If a higher level of care were needed (eg, emergency department evaluation), clients were transferred to the local healthcare system and this event would be documented in the client's health record.

Following Hurricanes Gustav and Ike, all of the individual client health records were retrospectively tallied onto a Red Cross DHS Aggregate Morbidity Report Form by a cadre of DHS volunteers deployed during the event. A single aggregate form for every 24-hour period was generated for each field location (except for Texas, which provided tallies with varied reporting periods); the form reported totals for demographics, reasons for visits, treatments, and dispositions. Because only five forms were reported from Mississippi, they were combined with those from Louisiana because Hurricane Gustav affected both states and they are contiguous geographically.<sup>3</sup> During the data-cleaning process by the CDC, missing information such as city, state, and county was obtained, if possible. For example, if Houston was indicated as the city but the state was missing, Texas would be added as the state. Data were analyzed in EpiInfo 3.5.3 (CDC, Atlanta, GA)

We described the demographics of the client visits (medical care visits), reporting date, and location; the clinical presentation or reason for visit(s) for five main categories: injuries, mental health, acute illness/symptoms, follow-up care, and exacerbation of chronic illness;

and client visit disposition and referrals (Fig.). If a person accessed care more than once, then each visit would be counted as a different client visit and would be included in the total number of client visits. Reason for visit refers to the medical complaints with which a person presented, such as cough, fever, and/or congestion. Multiple reasons for the visit could be listed for each client visit; therefore, the actual client visits is less than the total number of reasons for visit recorded.

## Results

### Client Visits

A total of 3863 client visits occurred in 119 field service locations, including 102 Red Cross shelters, 13 outreach services, 1 service delivery site, 1 hospital, and 2 other locations in at least 39 counties. The majority of client visits occurred in Texas (79%, n = 3042); 36% were in the affected counties of Harris (n = 584, 15%), Galveston (n = 583, 15%), and Cameron (n = 242, 6%). Most client visits occurred among people in shelters (Table 1).

### Demographic Characteristics

Overall, 48% of the client visits were by girls and women (n = 1871) and 44% (n = 1693) were boys and men, although in Tennessee, 64% (n = 84) were boys and men. Sixty-one percent (n = 2352) of client visits were among people 19 to 64 years old. Only a few clients seen were younger than 2 years old (5%) or 65 years old and older (9%; Table 1).

### Reason for Visit

A total of 5602 reasons for visit were reported for the 3863 client visits. More than half (52%) of the visits were for acute illnesses/symptoms, such as respiratory symptoms, pain, gastrointestinal illnesses, and skin conditions (Table 2). Routine follow-up care accounted for 16% of reasons for visit, followed by exacerbation of chronic disease (14%) and injury (14%). Mental health accounted for 5% of the total reasons for visit (Table 2).

**Acute Illness and Routine Follow-up Care**—Acute illness visits (n = 2898) were the most common medical complaint across the states and overall (Table 2). Approximately 60% of the acute visits were for complaints of pain (n = 949) and respiratory (n = 885) symptoms. Visits for pain included headache or migraine (n = 301), muscle or joint pain (n = 291), and abdominal pain (n = 113). Respiratory conditions included congestion, cough and sore throat. Of the 410 gastrointestinal conditions, 38% of client visits were for nausea and vomiting and 34% were for diarrhea. Only 1% of the visits indicated a fever (Table 2).

The second most common reason for seeking treatment was for follow-up care (n = 894, 16%) and the majority of these visits were for blood pressure checks (32%, n = 284), medication refills (32%, n = 282), and blood glucose checks (12%, n = 104).

**Exacerbation of Chronic Illness and Mental Health**—Visits for exacerbation of a chronic condition(s) were mainly for hypertension (28%, n = 220), diabetes (22%, n = 174), and asthma (10%, n = 74). In addition, approximately 5% of the overall visits were for

mental health issues (n = 305), most commonly for agitated behavior (48%, n = 145) and depressed mood (23%, n = 70; Table 2).

## Injury

Two mutually exclusive variables on the aggregate form provided data on injuries: type of injury and mechanism of injury. Therefore, for a single injury visit, type of injury and mechanism of injury should have been recorded; however, this did not always occur. There were 359 different types of injuries recorded; lacerations/cuts represented the largest percentage (63%, n = 227). The remainder of the injuries included those that likely required referral to a higher level of care, such as fractures (6%, n = 22), avulsions (1%, n = 4), and concussions (1%, n = 2). Mechanism of injury was selected 410 times and the most frequently reported mechanisms of injury were fall, slip, or trip (27%, n = 112) and bites/stings (26%, n = 106).

## Disposition

Of the 3863 client visits triaged, the majority (n = 2516, 65%) were treated onsite at a field location. Approximately 35% (n = 1296) of the client visits resulted in a referral to a higher level of care. Of these 1296 referrals, 42% were hospital/emergency department/clinic referrals, 24% were pharmacy referrals, and 23% were physician referrals.

## Discussion

During a 6-week period, Red Cross DHS volunteers mounted a massive and impressive physical and mental healthcare disaster services effort in response to this catastrophic event.<sup>16</sup> Nearly 4000 Gustav and Ike evacuees across 4 states were treated by the Red Cross and of these, 69% were adults and an almost equal number of male and female evacuees sought care. More than half (52%) of the visits were for an acute complaint, especially pain (ie, headache), respiratory, and gastrointestinal symptoms, and 16% required assistance with routine monitoring of chronic conditions. Almost all of the client visits occurred in the shelters and approximately one-third required referral care, the majority transferred to a higher level of care. The timeliness and temporal analyses of the aggregate data were not assessed because of the retrospective nature of the data collection and irregularities in the reporting periods.

Acute and routine care remains an important Red Cross DHS activity in shelters. A sample of approximately 30,000 patient visits during Hurricane Katrina treated in Red Cross shelters found a similarly large proportion (60%) needing both acute and routine care.<sup>17</sup> Providing routine health maintenance care, including blood pressure checks, blood glucose checks, and prescription medication replacement are critical to the well-being of vulnerable populations most often affected by disasters, such as older adults, people with chronic disease(s), and people who are socioeconomically disadvantaged.<sup>17-20</sup> Similar to clients during Hurricane Katrina, many clients were referred to a higher level of care, including pharmacies, which suggests there are complex illnesses and needs seen in shelters, especially during mass care disasters.<sup>17,18,21</sup> For example, during this response, an evacuee from Louisiana with active tuberculosis was identified in triage (before entering a shelter) at

a Mississippi shelter and was correctly referred to Louisiana public health for continuity of care.<sup>22</sup> Clearly, it is important that the Red Cross and other disaster response agencies (eg, Medical Reserve Corps) continue to roster qualified health services shelter personnel with triage and public health experience so that clients are properly assessed, treated, and referred.<sup>17,21–23</sup>

The Red Cross is building its internal capacity to care for clients in its general population shelter through an increase in nursing practice scope and better integration of external health partners. An increase in shelter capacity to meet client health needs postdisaster would mean a decrease in surge on the community healthcare system, which is likely to be stressed after a disaster incident. A result of this pilot is the establishment of a surveillance committee with members from the Red Cross's field staff and CDC. The main efforts of the committee are to address data quality and timeliness issues through revisions of surveillance protocols and training, prioritize surveillance in certain locations (eg, large shelters), explore electronic data collection and transmission solutions, capture denominator data, and enhance data dissemination to volunteers to increase their awareness and understanding of public health surveillance reporting.

This retrospective pilot identified limitations of the aggregate form. The client visit data (eg, demographics, dispositions) are a daily aggregate of all visits; therefore, it is not possible to identify repeat visits and data cannot be stratified across the demographic, illness/injury category, and outcome variables. Without stratifying, it is not possible to identify at-risk age groups for particular injuries or illnesses or the referral patterns by reason of visits (eg, pharmacy referrals by specific chronic diseases). Also, the "other" categories on the form are not text fields but are recorded as a total (Fig.); therefore, specifics for the "other" categories cannot be determined. In addition, the lack of denominators (shelter population, daily numbers of clients treated per site) and variations in reporting period (eg, start/stop dates, length of reporting period) restricted our ability to perform rate calculations and temporal analysis. The discrepancies in the reporting periods and types of missing data likely indicate a lack of resources in the field (eg, staff, connectivity to print and report forms), misunderstanding of the form's instructions, or a lack of understanding of the usefulness of daily counts as a measure of surge.

Despite these limitations, this aggregate form does have several potential advantages. First, the one-page tally format of the new form is a tool that rapidly enumerates and categorizes client encounters every 24 hours per field service location. The capability of visualizing the 24-hour data aggregately is important because potential disease clusters can be identified, especially in a mega-shelter setting, where a large number of clients are being seen. If regular daily reporting occurs, then Red Cross leadership could examine the healthcare delivery and resource allocation needs across the different service locations throughout the entire disaster area. Subsequently, these data could be shared with local public health departments that may be collecting surveillance data from other sources, such as state-based emergency department and hospital discharge surveillance systems.



## Conclusions

A large population was displaced into shelters because of these hurricanes; many stayed for an extended period of time as a result of extensive damage to their residences.<sup>8,9</sup> As the nation's co-lead for the mass care component of Emergency Support Function-6 during nationally declared disasters, the Red Cross is in a unique position to collect information to assess the impact of disasters on affected populations.<sup>23a</sup> To our knowledge, the present study is the only description in the literature of the immediate medical needs of the large number of evacuees from Hurricanes Gustav and Ike who were displaced into shelters.<sup>24–26</sup> Using a new tool, we described the frequency of reasons for visit, age groups, and number of hospital referrals, which provided an overall summary of the health needs experienced by a sizable number of sheltered hurricane evacuees. Finally, we anticipate our findings will be used for future disaster health and public health preparedness planning for the care of vulnerable shelter populations.<sup>1,17</sup>

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**Key Points**

- A total of 3863 clients were treated during the 6-week disaster response to Hurricanes Gustav and Ike; 98% of these client visits occurred in shelters.
- The reason for half of the visits was acute illness; 16% of the visits were for routine follow-up care.
- Of the 1296 client visits requiring a referral, 42% were referred to a healthcare facility.

 **Disaster Health Services Aggregate Morbidity Report Form**

Part I: Site and Clients Demographic Information					
1. Disaster Operation Relief Name & #:				Tally (NJ)	Total (#)
2. Reporting Date:		Gender	Male		
3. Reporting Timeframe:			Female		
4. Name of Site:					
County:		State:			
5. Service Delivery Site: <input type="checkbox"/> Shelter <input type="checkbox"/> Outreach		Age	≤ 2		
<input type="checkbox"/> Hospital/Clinic <input type="checkbox"/> Emergency Aid Station <input type="checkbox"/> Other			3 to 18		
			19 to 64		
6. Total # of Clients Seen:				≥ 65	
Part II: Reason for Visit (For each client visit, place a tick mark for all reason(s). Add up tallies & place # in the Total # column.)					
Categories		Tally (NJ)	Total (#)	Categories	
<b>Injury</b>				<b>Influenza-like-illness (ILI)</b>	
Abrasion/laceration/cut				Skin (includes all skin conditions)	
Avulsion/amputation				OBGYN (includes all OBGYN)	
Bruise/contusion				Neurological	
Concussion				Behavior: agitated/disruptive	
Fracture				Anxiety/stress	
Sprain/strain				Depressed mood	
<b>Mechanism of Injury</b>				Psychotic symptoms	
Bite insect				Suicidal/homicidal thoughts	
Bite snake				Drug/alcohol intoxication	
Bite dog				Other	
Bite human				<b>Follow-up Care</b>	
Bum (thermal or chemical)				Blood pressure check	
Non-fatal drowning/submersion				Blood sugar check	
Foreign body				Dressing change/wound care	
Fall/slip/trip				Immunization/vaccination	
Hit by or against object				Medication refill (please mark one tick for each medication refill)	
Carbon monoxide exposure				Pregnancy check-up	
Ingestion of poison				Other	
Motor vehicle crash				<b>Exacerbation of Chronic Illness</b>	
Use of machinery/tools/equipment				Asthma	
Recreational/playing sports				Cerebrovascular disease/stroke	
Assault				Chronic joint pain	
Sexual assault/rape				Congestive heart failure	
Other				Coronary heart disease	
<b>Acute Illness/Symptoms</b>				Diabetes	
Fever (>100.4°F or 38°C)				Epilepsy	
Conjunctivitis/pink eye/eye irritation				Hypertension	
Extreme fatigue/overexertion				Obstructive pulmonary disease	
Dehydration				Previous mental health diagnosis	
Heat stress/heat exhaustion				Other	
Cold-related conditions				<b>Disposition</b>	
Pain - not specified				Treated by Red Cross	
Pain - abdominal, stomach ache				Not treated	
Pain - chest, angina, cardiac arrest				Refused treatment	
Pain - ear pain or earache				<b>Referred to:</b>	
Pain - headache or migraine				Hospital/clinic	
Pain - muscle or joint				Pharmacy	
Gastrointestinal - diarrhea				Physician	
Gastrointestinal - nausea/vomiting				Other	
Respiratory (include all resp.)					

Complete one form per service location per 24 hrs. Email, fax or call completed form to DRO headquarters by 9 am.

Reported by: \_\_\_\_\_ Signature: \_\_\_\_\_  
 Disaster Health Services Aggregate Morbidity Report Form Rev. 01/2011

**Fig.**  
 American Red Cross Disaster Health Services Aggregate Morbidity Report Form.

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Demographics of client visits and number and type of American Red Cross field service locations by state, Hurricanes Gustav and Ike, August 28–October 18, 2008

**Table 1**

	Louisiana and Mississippi n (%)	Tennessee n (%)	Texas n (%)	Total n (%)
Total no. clients	657 (17.0)	130 (3.4)	3076 (79.6)	3863 (100)
Sex				
Male	253	84	1356	1693 (43.8)
Female	344	42	1485	1871 (48.4)
Missing	60	4	235	299 (7.7)
Age group, y				
2	21	2	162	185 (4.8)
3–18	106	13	399	518 (13.4)
19–64	360	81	1911	2352 (60.9)
65	57	21	251	329 (8.5)
Missing	113	13	353	479 (12.4)
Total no. service locations	46 (38.7)	2 (1.7)	71 (59.7)	119 (100)
No. clients per location				
Shelter	638	130	3042	3810 (98.6)
Outreach team	19	0	25	44 (1.1)
Service center	0	0	6	6 (0.2)
Other (eg, clinic/hospital)	0	0	3	3 (0.1)

Reasons for visits to American Red Cross field service locations by states, Hurricanes ustav and Ike, August 28–October 18, 2008

Table 2

Reason for visit	Louisiana/Mississippi (n = 1006) n	%	Tennessee (n = 382) n	%	Texas (n = 4214) n	%	Variable total n	Percent total visit reasons (N = 5602)
Acute illnesses and symptoms, n = 2898								
Pain	113	11.2	35	9.2	801	19.0	949	16.9
Respiratory disease	105	10.4	58	15.2	722	17.1	885	15.8
Gastrointestinal	118	11.7	18	4.7	274	6.5	410	7.3
Skin	36	3.6	5	1.3	230	5.5	271	4.8
Fever	15	1.5	1	0.3	38	0.9	54	1.0
Acute illness	95	9.4	43	11.3	191	4.5	329	5.9
Follow-up/routine medical care, n = 894								
Blood pressure check	56	5.6	18	4.7	210	5.0	284	5.1
Medication refill	54	5.4	27	7.1	201	4.8	282	5.0
Blood glucose check	16	1.6	6	1.6	82	1.9	104	1.9
Dressing change/wound care	18	1.8	3	0.8	63	1.5	84	1.5
Pregnancy checkup	1	0.1	0	0.0	17	0.4	18	0.3
Follow-up care	35	3.5	5	1.3	82	1.9	122	2.2
Exacerbation of chronic disease, n = 736								
Hypertension	49	4.9	22	5.8	149	3.5	220	3.9
Diabetes	26	2.6	12	3.1	136	3.2	174	3.1
Asthma	19	1.9	5	1.3	50	1.2	74	1.3
Chronic joint pain	6	0.6	0	0.0	30	0.7	36	0.6
Epilepsy	5	0.5	4	1.1	25	0.6	34	0.6
Chronic disease	14	1.4	26	6.8	158	3.8	198	3.5
Injury (type and mechanism), n = 769								
Abrasion, laceration, cut	46	4.6	16	4.2	165	3.9	227	4.1
Fall, slip, trip	28	2.8	6	1.6	78	1.9	112	2.0
Bite/sting	15	1.5	2	0.5	89	2.1	106	1.9
Bruise, contusion	21	2.1	3	0.8	37	0.9	61	1.1
Sprain, strain	8	0.8	1	0.3	38	0.9	47	0.8
Injury–other	55	5.5	25	6.5	136	3.2	216	3.9

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Reason for visit <sup>Y</sup> categories and variables	Louisiana/Mississippi (n = 1006) n		Tennessee (n = 382) n		Texas (n = 4214) n		Variable total n	Percent total visit reasons (N = 5602)
	n	%	n	%	n	%		
Mental Health n = 305								
Agitated behavior	28	2.8	18	4.7	99	2.4	145	2.6
Depressed mood	14	1.4	7	1.8	49	1.2	70	1.3
Drug/alcohol intoxication/withdrawal	0	0.0	6	1.6	12	0.3	18	0.3
Suicidal thoughts or attempts	2	0.2	2	0.5	11	0.3	15	0.3
Mental health—other	8	0.8	8	2.1	41	1.0	57	1.1