

# Community Assessment for Public Health Emergency Response following Hurricane Ike—Texas, 25–30 September 2008

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#### Abbreviations:

APHT = Applied Public Health Team  
 CASPER = Community Assessments for Public Health Emergency Response  
 CDC = [US] Centers for Disease Control and Prevention  
 DSHS = [Texas] Department of State Health Services

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#### Abstract

**Introduction:** On 13 September 2008, Hurricane Ike made landfall near Galveston, Texas, resulting in an estimated 74 deaths statewide and extensive damage in many counties. The Texas Department of State Health Services, US Public Health Service, and the Centers for Disease Control and Prevention conducted assessments beginning 12 days following hurricane landfall to identify the public health needs of three affected communities. The results of the assessment are presented, and an example of a type of public health epidemiological response to a disaster due to a natural hazard is provided.

**Methods:** A one-page questionnaire that focused on household public health characteristics was developed. Using a two-stage cluster sampling methodology, 30 census blocks were selected randomly in three communities (Galveston, Liberty, and Manvel, Texas). Seven households were selected randomly from each block.

**Results:** The assessments were conducted on 25, 26, and 30 September 2008. At the time of the interview, 45% percent of the households in Galveston had no electricity, and 26% had no regular garbage collection. Forty-six percent reported feeling that their residence was unsafe to inhabit due to mold, roof, and/or structural damage, and lack of electricity. Sixteen percent of households reported at least one member of the household had an injury since the hurricane. In Liberty, only 7% of the household members interviewed had no access to food, 4% had no working toilet, 2% had no running water, and 2% had no electricity. In Manvel, only 5% of the households did not have access to food, 3% had no running water, 2% had no regular garbage collection, and 3% had no electricity.

**Conclusions:** Post-Ike household-level surveys conducted identified the immediate needs and associated risks of the affected communities. Despite the response efforts, a high proportion of households in Galveston still were reportedly lacking electricity and regular garbage pickup 17 days post-storm. The proportion of households with self-reported injury in Galveston suggested the need to enhance public education on how to prevent injuries during hurricane cleanup. Galveston public health officials used the assessment to educate local emergency and elected officials of the health hazards related to lack of basic utilities and medical care in the community. This resulted in the provision of an extensive public health outreach education program throughout the island. The Liberty and Manvel assessment findings suggest that most households in both communities were receiving the basic utilities and that the residents felt “safe”. The assessments reassured local health officials that there were no substantial acute public health needs and provided objective information that services were being restored.

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## Introduction

Disasters due to natural or human-made hazards destroy or damage significant aspects of a community's infrastructure, resulting in acute medical and public health needs.<sup>1</sup> The impact of a disaster on the community may vary by the types and magnitude of post-event hazards. In a weather-attributed events such as a hurricane, flooding, high winds, and heavy rains, cause the majority of property damage and impacts on population in disaster-affected areas.<sup>2</sup> Hurricanes, meteorological depressions, or low pressure systems that develop from atmospheric disturbances over the warm waters of the tropical oceans, produce destructive winds, heavy rains, and storm surges that frequently are accompanied by floods, tornadoes, and landslides.<sup>3</sup>

Each year (1851–2004) during hurricane season (01 June to 30 November), approximately two hurricanes make landfall along the Gulf of Mexico or Atlantic coast of the United States.<sup>4</sup> From 1998 to 2007, hurricanes accounted for approximately 11 deaths and 5 billion [US] dollars in damages to property and infrastructure annually.<sup>5</sup>

From 2005 to August 2008, two tropical storms (Erin, Edouardo) and four hurricanes (Rita, Humberto, Dolly, Gustav) made landfall in Texas.<sup>6</sup> On 13 September 2008, Hurricane Ike (Ike), a Category-2 storm with sustained winds of 110 mph (180 km/hr), made landfall near Galveston, Texas, resulting in an estimated 74 hurricane-related deaths statewide.<sup>7</sup> Ike produced a damaging, destructive, and deadly storm surge across the upper Texas and southwest Louisiana coasts, and likely will end up being the third costliest disaster due to a natural hazard in the US behind Hurricanes Katrina and Andrew.<sup>7</sup> Thirty-four Texas counties were declared disaster areas by the Federal Emergency Management Agency;<sup>8</sup> 15 counties were under mandatory evacuation orders. Extensive damage occurred in many areas, including Liberty, Brazoria, and Galveston counties. Based on the information from local public health, elected, and emergency management officials, the Texas Department of State Health Services (DSHS) identified the cities of Galveston (Galveston County: population—57,247),<sup>9</sup> Liberty (Liberty County: population—8,033), and Manvel (Brazoria County: population—3,046) as highly impacted areas (Figure 1). The DSHS requested assistance from the US Public Health Service Applied Public Health Team (APHT) and the Centers for Disease Control and Prevention (CDC) for assistance in assessing the public health needs in Galveston and the two rural communities (Liberty and Manvel). In response, on 22 September 2009, the APHT and CDC deployed with DSHS public health preparedness staff to conduct the Community Assessments for Public Health Emergency Response (CASPER), a methodological approach designed to rapidly determine the household-level of needs of a disaster-affected community. The objectives of the assessment were to: (1) collect information about the public health impact of the hurricane; (2) identify the current public health needs of the affected community; and (3) estimate the effects of the hurricane on households in order to assist response and recovery activities.

## Methods

### *Sample Selection*

Since the cities differed in demographics, socio-economic status, and geographical location in relation to the storm

track, a separate CASPER was conducted in each city. In each of the three cities, a two-stage cluster sampling methodology (30 clusters, seven households) was used. Using probability-proportionate-to-size, 30 census blocks (clusters) were randomly selected in each community, and then, seven households were selected randomly from each cluster to interview. A household was defined as all persons living in the same dwelling. Printed street maps of clusters showing geographical identifiers were created using Environmental Systems Research Institute (ESRI) ArcMap 9.3 and provided to 10 two-person teams, which consisted of one member of DSHS and one member of APHT personnel. The first household to be assessed in each cluster was selected using a random number generator sheet. Teams moved sequentially down the street and attempted to complete seven interviews per cluster for a goal of 210 interviews. One adult person ( $\geq 18$  years old) was interviewed for each household.

### *Questionnaire Development*

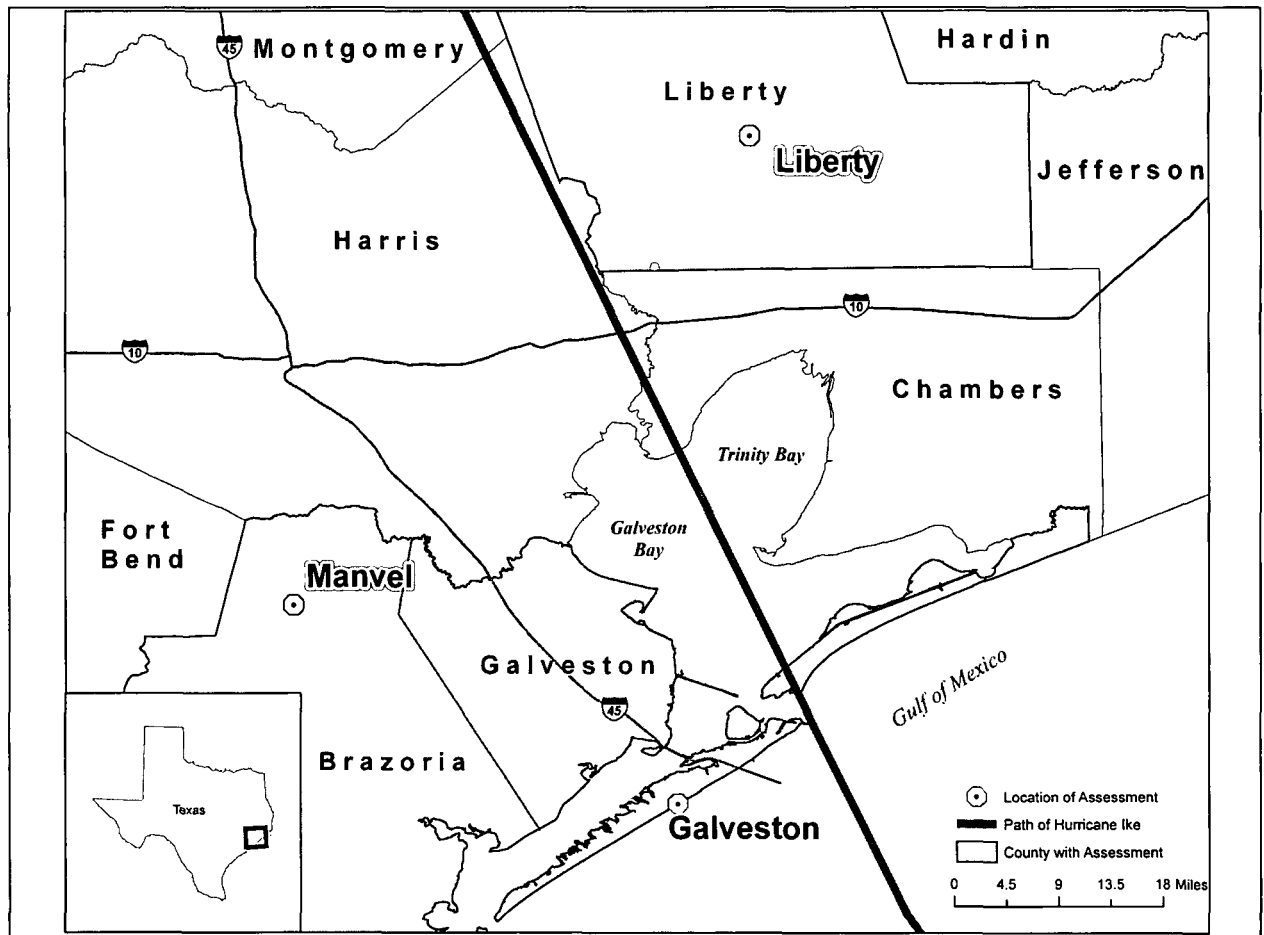
A one-page, data-collection instrument was developed on site by state and local health officials. It was modeled after previous disaster surveys developed by other states and the CDC.<sup>10–12</sup> The questionnaire included general demographic, household type, and extent of damage questions regarding hurricane-related, self-reported injuries and illness, medication availability, generator and gas/charcoal grill use, and access to basic utilities (e.g., electricity, water). At a local health authority or state government's request, questions on tetanus vaccination status (due to potential increase in injuries during relief and recovery) and vector control were added to the questionnaire. The survey tool used in Galveston is provided in Appendix 1.

### *Questionnaire Administration*

Interviews were conducted during the day and only one interview attempt was made per household. Log sheets were kept by the interviewers to track the number of households approached and recorded as either interviewed or inaccessible due to the following: (1) refused to participate; (2) unsafe environment; (3) language barrier; (4) evacuated; (5) vacant; (6) seasonal occupant; (7) dwelling destroyed; or (8) unknown. Assessment teams, trained by CDC personnel on CASPER's methodology, interviewing, and tracking form administration, conducted the assessment in Liberty on 25 September, Manvel on 26 September, and Galveston on 30 September 2008. In addition to collecting information on household needs, assessment teams distributed public health and relief agency telephone numbers and educational materials regarding mold, carbon monoxide poisoning, mosquitoes, and other hurricane-related health concerns. When immediate needs pertaining to public health and general assistance were identified, assessment teams completed confidential referral forms, which were forwarded to local public health or emergency management officials for appropriate response.

### *Data Processing*

The data-entry form and database were created in Epi Info 3.5.1 (US Department of Health and Human Services,



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**Figure 1**—Map of the assessment area (Liberty, Manvel, and Galveston counties) and the Hurricane Ike path, 13 September 2008

Source: Texas Department of State Health Services and the National Oceanic and Atmospheric Administration, National Hurricane Center, November 2008

Centers for Disease Control and Prevention, Atlanta, GA). Data entry was conducted by four people using designated computers. Microsoft Excel 2003 (Microsoft Corporation, Redmond, WA) was used for data cleaning and the Excel file was imported into Epi Info for analysis. The percentage and estimate, or projected, number of households for selected variables were calculated and reported. For each community, response rates were calculated using the following formula: number of completed interviews divided by the number of all houses where contact was attempted.

## Results

### *Galveston (Galveston County)*

Seventeen days after hurricane landfall, 384 dwellings were approached; 146 assessments were completed (response rate 38%). Most of the housing units visited were single family units (56%) (Table 1). When asked, "Since the hurricane, do you feel your house is safe to live in?" 76 (46%) of those interviewed felt the residence was unsafe. Among those feeling unsafe in their homes, mold (48; 63%), roof and structural damage of the house (17; 22%), and lack of electricity (7; 9%) were the main reasons for not feeling safe in their home. Similarly, when asked, "Since the hurricane, do you feel secure

in your area?", 40 (27%) of those interviewed reported feeling insecure. Sixty-five (45%) households had no electricity and 38 (26%) had no regular garbage collection.

Thirty-nine (27%) of those interviewed reported at least one household member had gastrointestinal or upper respiratory illness since the hurricane. Of the households reporting an illness, 19 households (49%) reported at least one person with symptoms of nausea/stomachache/diarrhea, 12 (31%) at least one person with a sore throat/cold, and six (15%) with a person having worsened chronic illness. Twenty-three (16%) households reported at least one household member had sustained an injury since the hurricane. Of those households reporting an injury, 11 (47%) reported cuts/abrasion/puncture wound, four (17%) strain/sprain, and four (17%) minor head injuries. Thirty-nine (27%) households reported at least one adult household member not having a tetanus shot within the last 10 years. When asked, "Since the hurricane, has there been any increase in insect bites/stings?" 93 (64%) of those interviewed reported an increase in mosquito bites.

### *Liberty (Liberty County)*

Twelve days after hurricane landfall, assessment teams approached 337 dwellings in Liberty and completed 157

Characteristic	Galveston (Galveston County)			Liberty (Liberty County)			Manvel (Brazoria County)		
	Households Interviewed (n = 146)		Estimated* number of households	Households Interviewed (n = 157)		Estimated* number of households	Households Interviewed (n = 151)		Estimated* number of households
	n	%		n	%		n	%	
<b>Household structure type</b>									
Single-family house	82	56	17,724	91	65	1,514	112	74	960
Multiple unit	64	44	9,023	27	19	246	2	1	5
Mobile home	0	00	00	22	16	230	37	25	167
<b>Perceptions of safety</b>									
Feel home unsafe to live†	76	52	12,331	25	16	317	11	7	113
Do not feel secure†	40	27	5,918	9	6	147	18	12	85
<b>Household utilities</b>									
No electricity	65	45	9,612	3	2	24	4	3	11
No working telephone	40	28	8,349	17	11	266	3	2	8
No regular garbage collection	38	26	6,637	7	5	113	3	2	22
No working toilet	11	8	1,637	5	4	54	2	1	4
No running water	9	6	1,344	3	2	80	4	3	20
<b>Food and water</b>									
Do not have safe drinking water	11	8	2,452	0	00	00	2	1	11
Do not have food for three days	9	6	2,345	11	7	114	7	5	30
<b>Health care</b>									
With illness since hurricane†	39	27	5,684	39	25	567	30	20	182
With injury since hurricane†	23	16	3,815	8	5	143	13	9	90
Not able to get medication they need	19	13	3,754	15	10	171	4	3	12
Require medical care now	19	13	2,880	16	10	341	21	14	146
Adult in household without tetanus shot	39	27	6,432	56	36	811	66	44	517
<b>Other</b>									
Increase in mosquito bites†	93	64	16,843	138	89	2,047	117	78	765

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**Table 1**—Number of households interviewed and estimates reporting selected characteristics after Hurricane Ike, by community (county), Texas, 25–30 September 2008 (12–17 days after hurricane landfall)

\*Estimates based on 2000 US Census

†Verbatim Question asked: “Since the hurricane, do you feel your home is safe to live in?”; “Since the hurricane, do you feel secure in your area?”; “Have any house members become ill due to/since the hurricane?”; “Was anyone in this house injured due to or since the hurricane?”; “Since the hurricane, has there been any increase in insect bites/stings?”

household assessments (response rate 47%). Most (91; 65%) of the housing units visited were single family units. Twenty-five (16%) of the households reported their residence was unsafe to inhabit and nine (6%) felt insecure in the area (Table 1). Reasons given for not feeling safe included roof damage (8; 33%) and mold (4; 14%). Only 11 (7%) of those interviewed indicated no access to food for household members, five (4%) had no working toilet, three (2%) had no running water, and three (2%) had no electricity. Thirty-nine (25%) of those interviewed reported household members becoming ill since the hurricane; half reported upper respiratory symptoms such as sore throat, acute sinusitis, and allergies. Eight (5%) of the households interviewed reported at least one household member had an injury due to or since the hurricane with cuts and abrasions most frequently reported from four (50%) households. Fifty-six (36%) of the households reported an adult not having a tetanus shot within the last 10 years, and 138 (89%) households reported an increase in the number of mosquito bites.

#### *Manvel (Brazoria County)*

Thirteen days after hurricane landfall, teams approached 273 dwellings in Manvel and completed 151 assessments (response rate 55%). Thirty-seven (25%) of households surveyed were mobile homes (Table 1). Eleven (7%) of all households reported feeling that their residence was unsafe to inhabit. Roof damage (5; 44%) was the main concern for those (11) who did not feel safe in their home. Despite the initial hardship in the hurricane's aftermath, seven (5%) of the households reported no access to food for household members, four (3%) had no running water, three (2%) had no regular garbage collection, and four (3%) had no electricity at the time of the interview. Thirty (20%) of households surveyed reported that at least one member of the household had become ill since the hurricane. Among those reporting illness, 10 (33%) reported upper respiratory illness such as sore throat and acute sinusitis, and 10 (33%) reported gastrointestinal symptoms such as stomachache. Thirteen (9%) of those interviewed reported a household member being injured due to or since the hurricane; among those reporting an injury (13), two (15%) of these were cuts and abrasions sustained during clean-up activities. Sixty-six (44%) of the households reported an adult not having a tetanus shot within the last 10 years, and 117 (78%) of the households reported an increase in mosquito bites.

#### **Discussion**

Events that result in disasters generally cause significant infrastructure damage and devastating financial losses. They also can pose a variety of health risks, including physical injuries, illnesses, potential disease outbreaks, and short- and long-term psychological effects. The destruction of homes and the damage to local infrastructure, such as disruptions in safe drinking water and electricity, access to health facilities, and the interruption of services such as garbage pickup and social support affect the well-being of a community.<sup>13</sup> The CASPER, also referred to as Rapid Need Assessment (RNA), Rapid Epidemiologic Assessment (REA), and Rapid Health Assessment (RHA), assist pub-

lic health practitioners and emergency management officials in determining the health status and basic needs of the affected community. Gathering information about health and basic needs by using valid statistical methods allows public health and emergency managers to prioritize their responses and to rationalize the distribution of resources.<sup>14</sup>

Post-Ike household level assessment conducted in Galveston, Liberty, and Manvel using a CASPER methodology identified the immediate needs and associated risks of the hurricane-affected communities. Many of these findings were precursors for public health issues. Despite the response effort, a high proportion of households in Galveston reportedly still were lacking electricity and regular garbage pickup 17 days post-storm. The lack of utilities may create conditions conducive to the development of an outbreak of acute respiratory or gastrointestinal illness, which may require immediate public health interventions.<sup>15</sup> In addition, the proportion of households with self-reported injury in Galveston suggested the need to enhance public education on how to prevent injuries during hurricane cleanup.

Local officials used the assessment findings to assist in the disaster response. For example, post-Ike, Galveston Island lost medical and public health infrastructure, which disrupted the routine public health information flow. The assessment was valuable to Galveston County Health District officials because it provided quantifiable information that was used to educate local emergency and elected officials of the health hazards related to lack of basic utilities and medical care in the community following the hurricane. The results assisted the Health District to gain local and state support for needed public health outreach activities. In addition, the personal interaction between assessment teams and household respondents during the interviews may have reassured residents that they were not being forgotten.<sup>16</sup> The face-to-face communication with the household respondents and the distribution of educational materials, such as carbon monoxide poisoning during the assessments, also elevated the visibility of public health in the community. Further, the assessment provided insight to citizens' concerns, which the Health District used in answering questions received at the local phone bank, as well as the development of a one-page flyer to address community issues. The flyer consisted of quick reference information (which included contact numbers) such as medical care sources, utilities, vaccination sites, transportation, mosquito prevention techniques, garbage collection, mold prevention, safety guidelines for use of a generator or charcoal/gas grills, and local municipality services. Volunteers disseminated 6,000 flyers door-to-door and at the points of dispensing sites throughout the island. The volunteers reported that residents were appreciative of the outreach conducted because they were not aware of the services available to them, and it provided helpful health information.

The Liberty and Manvel assessment findings suggest that most of the households in both communities were getting the basic utilities and that the residents felt safe. The assessments in these two rural communities were very useful to local health officials because it reassured them that there were no substantial acute public health needs and provided objective information that services were being restored.

The type of information obtained from community assessments varies according to the time of administration. An assessment conducted for potential impact areas prior to the disaster provides information regarding public health and community readiness. Assessments completed within days immediately following a disaster event provide information to community leaders and first responders for directing (or redirecting) response resources. The assessments also reflect continued ability of those who sheltered in place to remain within the community to begin the recovery process. Texas benefited from assessments conducted two weeks following Hurricane Ike. The data obtained from the affected communities correlated with their geographic proximity to the path of Hurricane Ike (Figure 1).

Variables such as response rates may be affected not only by storm damage, but also by those who had been allowed to return to a community. It is not surprising that Galveston had the lowest response rate (38%) of the three cities surveyed; many individuals continued to be evacuated from the island during the days immediately following the landfall of Hurricane Ike. Community leaders discouraged individuals to return to Galveston too quickly for reasons of personal safety, and lack of basic public health and community-level critical infrastructure to address the needs of residents immediately following the storm. The timeliness of post-hurricane assessments proved beneficial to local public health even when the assessment was not immediately conducted after hurricane landfall.

#### Limitations

The findings are subject to at least three limitations. First, residents of destroyed homes were unavailable for inclusion in the assessment, which caused an underestimation of unknown magnitude in overall public health needs. Second, the estimated number of households was reported using sample weights and US Census 2000 data. However, the weighted analysis does not account for the changes (e.g., growth or decline) in the number of housing units between the time of the census (2000) and the time of the survey

(2008). Third, the survey was conducted 12–17 days after the hurricane; if the assessments had been performed earlier (e.g., 3–5 days), the results might have been more useful in guiding deployment decisions involving medical responders and mental health counselors.

#### Conclusions

Following a disaster-producing event, conducting a CASPER may identify the critical needs and health concerns of the affected community.<sup>17</sup> Information obtained through these household level assessments is used by decision-makers to identify where to provide immediate services and for planning for future disaster relief services.<sup>10,11,18</sup> A modified cluster-sampling method used in CASPER, estimates the number of households with a particular need in the affected area.<sup>19,20</sup> The CASPER conducted following Ike provided information to local and state authorities about the types and magnitude (i.e., estimated or projected number of households) of needs and the health status of the affected communities. Follow-up assessments should be performed weeks or months after a storm to ensure that identified public health needs have been addressed and to measure restoration of services and effectiveness of response efforts.<sup>21,22</sup> The Department of State Health Services will use the experience gained during Ike to identify staff to serve on future teams, develop standardized tools, and increase the awareness among local health authorities about conducting CASPER in future disasters.

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Appendix—Hurricane Ike assessment for public health emergency reponse questionnaire—Galveston, Texas, 2008

Date: 09/30/2008	Cluster:	No of HUs in Cluster:	Survey No:	Interviewer Initials:
<b>Address:</b>			<b>Key:</b> Y = Yes D/K = Don't Know N = No N/H = Never Had	
1. Type of Structure: <input type="checkbox"/> Single family home <input type="checkbox"/> Multiple unit (e.g., duplex, apartment) <input type="checkbox"/> Mobile home <input type="checkbox"/> Other _____			10. Since the hurricane, is everybody in this house getting the medication they need? Y N D/K  If no, why? _____	
2. Since the hurricane, do you feel your home is safe to live in? Y N D/K  If no, why? _____			11. Is there anyone in the home who needs special care (e.g., oxygen supply, dialysis, or home health care)? Y N D/K  If yes, what? _____	
3. Since the hurricane, do you feel secure in your area? Y N DK  If no, why? _____			12. Does anyone in the home currently require medical care? Y N D/K	
4. How many people lived in this house before the hurricane? _____			13. Do you have running water? Y N N/K  If yes, source: <input type="checkbox"/> Public <input type="checkbox"/> Private <input type="checkbox"/> Well <input type="checkbox"/> D/K	
5. How many people slept here last night? _____ a. How many are over 18 years of age? _____ b. How many are 2 years or younger? _____ c. How many are 65 years or older? _____			14. Do you have safe drinking water? Y N D/K N/H If yes, source: <input type="checkbox"/> Well <input type="checkbox"/> Public <input type="checkbox"/> Bottled <input type="checkbox"/> No drinking water	
6. Was anyone in this house injured due to or since the hurricane? Y N D/K If yes, what was the injury:			15. Do you have access to enough food for everyone in the house for the next three days? Y N D/K N/H	
a. Cuts, abrasions, puncture wounds requiring medical attention? Y N D/K			16. Do you have a working toilet? Y N D/K N/H	
b. Strain/sprain			17. Do you currently have electric power from the utility company? Y N D/K N/H	
c. Broken bones Y N D/K			18. Are you using a generator? Y N D/K N/H If using a <b>GENERATOR</b> , where and how do you use it? <input type="checkbox"/> Indoors <input type="checkbox"/> Outside, but near an open door/window <input type="checkbox"/> Using open flame as a sources of light when fueling <input type="checkbox"/> Other risky behavior: _____	
d. Head injury Y N D/K			19. Are you cooking on a charcoal or gas grill/camp stove? Y N D/K N/H If using a <b>GRILL/STOVE</b> , where and how do you use it? <input type="checkbox"/> Indoors <input type="checkbox"/> Outside, but near an open door/window <input type="checkbox"/> Using open flame as source of light when fueling <input type="checkbox"/> Other risky behavior: _____	
e. Animal bites Y N D/K				
f. Other _____				
7. Has every adult in the house had a tetanus shot in the last 10 years? Y N D/K				
8. Since the hurricane, has there been any increase in insect bites/stings from any of the following? a. Mosquitos Y N D/K b. Ants Y N D/K c. Bees or wasps Y N D/K d. Other: _____ Y N D/K			20. Do you have a working telephone? Y N D/K	
9. Have any house members become ill due to/since the hurricane? Y N D/K If yes, what did they have?			21. Do you currently have regular garbage pick-up? Y N D/K N/H	
a. Nausea/stomach ache/diarrhea Y N D/K			22. How did you get warning or other information before the hurricane? <input type="checkbox"/> TV <input type="checkbox"/> Neighbor, word of mouth <input type="checkbox"/> Radio <input type="checkbox"/> Internet <input type="checkbox"/> Newspaper <input type="checkbox"/> Other: _____	
b. Sore throat/cold Y N D/K			23. How did you get health advice or other information before the hurricane? <input type="checkbox"/> TV <input type="checkbox"/> Neighbor, word of mouth <input type="checkbox"/> Radio <input type="checkbox"/> Internet <input type="checkbox"/> Newspaper <input type="checkbox"/> Other: _____	
c. Worsened chronic illness Y N D/K			24. Finally, what is your greatest need at this moment?	
d. Other: _____				

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