Burden of Disease and Health Status Among Hurricane Katrina–Displaced Persons in Shelters: A Population-Based Cluster Sample

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Study objective: Anecdotal evidence suggests that the population displaced to shelters from Hurricane Katrina had a significant burden of disease, socioeconomic vulnerability, and marginalized health care access. For agencies charged with providing health care to at-risk displaced populations, knowing the prevalence of acute and chronic disease is critical to direct resources and prevent morbidity and mortality.

Methods: We performed a 2-stage 18-cluster sample survey of 499 evacuees residing in American Red Cross shelters in Louisiana 2 weeks after landfall of Hurricane Katrina. In stage 1, shelters with a population of more than 100 individuals were randomly selected, with probability proportional to size sampling. In stage 2, 30 adult heads of household were randomly chosen within shelters by using a shelter log or a map of the shelter where no log existed. Survey questions focused on demographics, socioeconomic indicators, acute and chronic burden of disease, and health care access.

Results: Two thirds of the sampled population was single, widowed, or divorced; the majority was female (57.6%) and black (76.4%). Socioeconomic indicators of under- and unemployment (52.9%), dependency on benefits or assistance (38.5%), lack of home ownership (66.2%), and lack of health insurance (47.0%) suggested vulnerability. One third lacked a health provider. Among those who arrived at shelters with a chronic disease (55.6%), 48.4% lacked medication. Hypertension, hypercholesterolemia, diabetes, pulmonary disease, and psychiatric illness were the most common chronic conditions. Risk factors for lacking medications included male sex (odds ratio [OR] 1.58; 95% confidence interval [CI] 0.96 to 2.59) and lacking health insurance (OR 2.25; 95% CI 1.21 to 4.20). More than one third (34.5%) arrived at the shelter with symptoms warranting immediate medical intervention, including dehydration (12.0%), dyspnea (11.5%), injury (9.4%), and chest pain (9.7%). Risk factors associated with presenting to shelters with acute symptoms included concurrent chronic disease with medication (OR 2.60; 95% CI 1.98 to 3.43), concurrent disease and lacking medication (OR 2.22; 95% CI 1.36 to 3.63), and lacking health insurance (OR 1.83; 95% CI 1.10 to 3.02).

Conclusion: A population-based understanding of vulnerability, health access, and chronic and acute disease among the displaced will guide disaster health providers in preparation and response. [Ann Emerg Med. 2007;xx:xxx.]

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Editor's Capsule Summary

What is already known on this topic

Little is known about the health status and health needs of those displaced by natural disasters.

What question this study addressed

What were the demographic characteristics and acute and preexisting health problems of 499 displaced persons living in shelters in Louisiana 2 weeks after Hurricane Katrina?

What this study adds to our knowledge

Fifty percent of subjects had no preexisting health insurance and 50% had chronic disease. Thirty percent were in need of acute medical attention.

How this might change clinical practice

Disasters affect the poor and vulnerable disproportionately. The characterization of displaced persons from Hurricane Katrina may aid in planning response to disasters.

INTRODUCTION

Background

Hurricane Katrina struck the Gulf Coast as a category 4 storm on August 29, 2005, killing more than 1600 people, mainly in Louisiana (1,293) and Mississippi (238).[1] The storm affected more than 2.5 million households, left more than 500,000 homeless, and forced the unprecedented displacement of an entire metropolitan area.[2] The 1.3 million residents of metropolitan New Orleans, including New Orleans and the surrounding parishes of Orleans, St. Bernard, St. Charles, St. Tammany, Jefferson, and Plaquesmines, were forced to flee either under mandatory evacuation orders or as a result of the catastrophic storm surge that provoked multiple breaks in the New Orleans levee system. Evacuees traveled to all 50 states where they could find temporary housing with family, friends, or other sheltering venue.

Importance

Never in US history had an urban population this large been displaced by a natural disaster. By September 14, an estimated 41,000 people evacuated to 133 American Red Cross shelters in Louisiana.[3] Although evacuating to temporary shelter is not unusual for populations during a hurricane, those who seek Red Cross shelters are typically the most vulnerable among the displaced. Often lacking the social networks or the financial means to secure private temporary housing, the marginalized rely on the Red Cross as their shelter safety net. Disaster experts quickly realized that in addition to these more traditional indicators of vulnerability, this displaced population was also at increased risk for public health problems unlike any other previous disaster-affected domestic population. During their flight, they had been exposed to sewage, environmental toxins, heat and humidity, and physical violence and in many instances had become weakened from lack of food and water. Their access to health care before the hurricane was suspect; whatever access they may have had was now thoroughly disrupted.

Once these people were displaced, the glaring concern was the potential for significant comorbidities, with coincident acute exacerbations and inability to access care. Stress-related cardiac death during and immediately after natural disasters is a well-known example.[4,5] The implications for infectious disease outbreaks, injury, and acute exacerbations of chronic diseases were enormous. Coupled with the prospect that because of the level of devastation, the evacuees would need to remain in shelters for a prolonged period, there was a need for health care providers at shelters and at local health facilities near shelters to understand the burden of acute and chronic disease within the population.

Goals of This Investigation

Our intent was to describe the demographics and burden of disease in the displaced population living in shelters after Hurricane Katrina and analyze the association of sociodemographic and health factors to the prevalence of acute and chronic disease within the population. In the past, most health data on populations affected by disasters in the United States were generated by health facilities or disaster medical assistance teams.[6,7] However, these data sets cannot provide an analysis of true disease prevalence or characterize the demographic of the displaced population, because many may not seek care or have access to these resources. By applying a population-based method to determine disease prevalence and the effects of sociodemographic factors, this study can guide disaster planners and disaster medicine specialists in addressing the health care limitations of a large population displaced by future natural disasters. Densely populated areas in the United States are at significant risk for natural disasters; in the future, disaster managers and health providers will need to prepare for potentially large numbers of displaced individuals who may have limited resources. A population-based epidemiologic approach will be necessary to avert catastrophic public health sequelae in the future.

MATERIALS AND METHODS

Study Design

From September 14 to 23, 2005, a team of emergency physicians from Harvard and Johns Hopkins Schools of Public Health, with extensive experience in population-based sampling in complex emergencies, working under the auspices of the American Red Cross, conducted a statewide cluster sample of Louisiana American Red Cross shelters as a component of the first-ever American Red Cross public health response for populations displaced in a disaster. The American Red Cross sheltered approximately 70% of evacuees displaced from Hurricane Katrina.

We used a randomized, 2-stage, modified cluster study design. Random cluster sampling has been previously used in displaced and highly mobile populations where the only information available to construct a sampling frame was a list of settlements and their population sizes.[8-10] The total Louisiana

American Red Cross shelter population of 38,804 on September 14, 2005, was housed in 103 shelters of at least 100 persons each.

Sample size was calculated as for a simple random sample to estimate disease prevalence of 0.5, with a 95% confidence interval (CI) of 0.425 to 0.575, and then multiplied by a conservative design effect of 3.0 to render a sample size of 512. Design effect accounts for the increase in intracluster and intercluster variances that are inherent in cluster sampling as opposed to simple random sampling.

All 103 American Red Cross shelters in Louisiana with a population of more than 100 individuals on September 14, 2005, were selected for inclusion. In the first stage, 20 clusters were randomly selected from an alphabetized shelter list according to probability proportional to size sampling methods. Probability proportional to size sampling is an approach to selecting clusters in such a way that more populous study areas (shelters) are proportionally allocated more clusters, allowing for the variability in population size across shelters.[11] We chose this method because the shelters across Louisiana varied in size from 100 to several thousand. To minimize disease prevalence bias, no special needs shelters were included in the sample.

Selection of Participants

In the second stage, 30 heads of household respondents older than 18 years in each cluster shelter were randomly selected by either using shelter registration lists or, when those were unavailable or outdated, by mapping cots in the shelters. When shelter registration lists were available, the sampling interval was defined by dividing the number of residents by 30. A number, *n*, between 1 and the sampling interval was chosen, and sampling began with the *n*th name on the registration list. Sampling continued according to the interval until all 30 interviewees were selected. If a selected respondent was not at his or her cot, an attempt was made to locate him or her in the shelter. For those unavailable at sampling, a second attempt was made either later in the day or the following morning. If that person was still unavailable, a replacement respondent was selected by moving 7 names down the list. If that person, too, was unavailable, another respondent was chosen by again moving 7 names down the list. If a person was found to be younger than 18 years or no longer living at the shelter, a replacement respondent was chosen by moving 7 names down the registration list.

More frequently, updated registration lists did not exist, and respondents were selected through a process that involved mapping all cots present in the designated shelter. The number of cots was then counted and divided by 30 to establish the sampling interval. A number, *n*, between 1 and the sampling interval was chosen, and sampling began by picking a cot in the shelter and counting in any direction from there to the *n*th cot and then seeking the person who occupied that cot. Sampling continued according to the interval until all 30 respondents were selected. Parameters for selecting replacement respondents were identical to the method described above, with the exception that they were chosen by moving ahead 7 cots rather than 7 names.

Data Collection and Processing

A population-based demographic and health assessment tool was designed to assess the characteristics and health care status of the sheltered population. Key questions elicited information on household sociodemographics, including benefits, home ownership, and employment status; acute symptoms on arrival to the shelter; chronic health problems; unaddressed health-care-related needs; and ability to access health care before evacuation. The recall period was less than 3 weeks. Teams of American Red Cross volunteer health care workers (physicians and nurses with public health backgrounds) and non–health care workers administered the survey. All team members received interview and survey method training on site in Louisiana, and non–health care personnel were overseen by health care personnel on the survey teams. The survey instrument was reviewed and approved by the Louisiana Red Cross branch and American Red Cross's Disaster Health Services at their national headquarters in Washington, DC.

Primary Data Analysis

Data were coded and checked for errors by 2 field epidemiologists at the end of each day. Data were entered into an EPI INFO 6.0 database by an information technology specialist under the supervision of the field epidemiologist. Proportions of demographic characteristics for each specific category of respondents, along with prevalences of chronic medical conditions and acute symptoms on shelter arrival, were estimated by using SAS PROC SURVEYFREQ (version 9.1; SAS Institute, Inc., Cary, NC). Design effect, defined as the ratio of the variance, taking into account the cluster sample design, and variance of a simple random sample design with the same number of observations, was calculated using an intraclass correlation coefficient by the formula design effect= $1+(m-1)\times ICC$, where m is the average number of units per cluster.[12] Bivariate analyses between sociodemographic factors and outcome variables were first performed to select potential variables with $P<.2$ to be incorporated into the full model for the multivariate logistic regression analysis. Multivariate logistic regression analysis was then performed by SAS PROC SURVEYLOGISTIC to assess the association between potential variables and outcome variables. For the model describing lack of prescribed medication when arriving at a shelter, the variables "receiving assistance/benefits prior to hurricane" and "gender" were forced into the final model because it was suspected to be a strong confounder. For the model describing presence of acute symptoms when arriving at a shelter, a composite variable integrating the information of presence of known chronic disease and medication on arrival to a shelter was

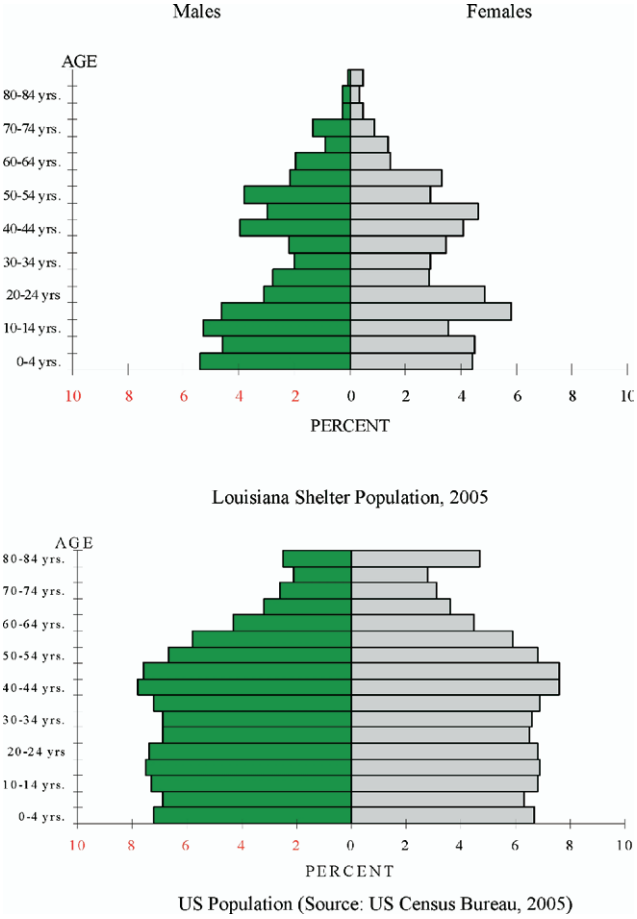

Figure. Age-sex population pyramid of 1,455 shelter residents compared to US population.

Table 1. Characteristics of 499 respondents.

Characteristics	Categories	No. (%)	Design Effect
Sex	Female	291 (57.6)	3.49
	Male	198 (39.1)	2.68
	Not answered	10 (3.2)	2.78
Race	Black	360 (76.4)	4.11
	White	90 (15.2)	5.03
	Hispanic	25 (4.8)	1.68
	Asian	6 (1.4)	1.13
	Other	8 (1.2)	1.21
	Not answered	10 (1.0)	0.84
Marital status	Single	259 (52.5)	0.62
	Married	148 (28.9)	0.78
	Divorced	61 (12.7)	1.03
	Widowed	26 (5.6)	1.91
	Not answered	5 (0.4)	0.82
Employment	Full time	229 (46.6)	1.04
	Part time	54 (12.0)	1.00
	Retired	58 (9.2)	2.54
	Unemployed	155 (31.7)	0.39
	Not answered	3 (0.5)	1.38
Health insurance before hurricane	No	224 (47.0)	2.27
	Yes	269 (51.9)	2.29
	Not answered	6 (1.0)	2.58
Health care provider before hurricane	No	158 (33.2)	3.90
	Yes	337 (65.9)	3.45
	Not answered	4 (0.9)	1.34
Receiving assistance/benefits before hurricane	No	267 (56.9)	1.90
	Yes	209 (38.5)	2.49
	Not answered	23 (4.5)	0.76
Type of assistance/benefits	WIC	32 (6.0)	1.31
	Medicaid	117 (23.2)	0.52
	Medicare	64 (12.0)	0.69
	AFDC welfare	18 (2.4)	2.21
	SSDI disability	64 (11.5)	3.77

In a cluster sample (as opposed to a simple random sample), the respondents may be more similar to each other for a given variable or outcome measure than if they had been independently selected in a simple random sample. The design effect is a statistic that accounts for this level of intracluster correlation and is calculated for each variable or outcome measure. The statistical formula is the ratio of the variance in the cluster sample to the variance that would have been obtained from a simple random sample of the same size. This ratio is then multiplied by the sample size of a simple random sample to obtain the sample size for a cluster sample. A higher intracluster correlation results in a higher design effect and thus a larger sample size.

created for modeling. The final regression model included all variables with corresponding $P<.05$, as well as the forced-in confounders. A generalized R^2 measure to the fitted model was provided for each final multivariate logistic regression model.

This study was granted an exemption by the Harvard School of Public Health Human Subjects Committee.

RESULTS

Two clusters had inadequate sample size and had to be excluded from the data analysis. The resulting 18 clusters yielded 549 head-of-household respondents. Among these, 50 (10.4%; design effect=3.12) declined to participate, leaving 499 adult respondents, who as heads of household represented 1,455 individuals. The age distribution of the sheltered evacuee population (Figure) tended to be less uniform than the US population distribution, with peaks at young and middle-age groups. Table 1 describes the demographic of the sample, with the percentages reflecting the calculated influence of design effect and not simple percentages. The majority was female, and more than two thirds of the sheltered residents were single, widowed, or divorced. The racial mix of the sample matched the racial profile of the city of New Orleans.[13] Nearly 40% were receiving some form of benefits; of those, nearly one quarter were Medicaid recipients. More than half (52.9%) were unemployed or underemployed, and 66.2% (design effect=2.18) rented rather than owned their homes (inversely proportional to a national home ownership percentage of 68.9%).[14] The percentage of the sample without health insurance was more than 3 times that of the national average (47.0% versus 15.7%),[15] and nearly one third lacked a regular health care provider.

The prevalence of sheltered evacuees with known chronic disease is listed in order of frequency (Table 2). Hypertension, hypercholesterolemia, diabetes, and lung diseases were the most commonly identified chronic diseases. The prevalence of

Table 2. Prevalence of medical problems in 499 respondents, in order of frequency.

Medical Problems	No.	Prevalence, % (95% CI)	Design Effect
High blood pressure	170	34.8 (30.4–39.2)	0.96
High cholesterol	86	16.8 (12.0–21.6)	1.87
Diabetes	69	14.3 (12.5–16.1)	0.29
Psychiatric/emotional	70	13.5 (10.4–16.6)	0.94
Lung disease (including asthma)	66	12.9 (8.1–17.8)	2.32
Gastrointestinal or liver	50	11.6 (6.5–16.7)	2.84
Heart disease	48	10.4 (6.9–14.0)	1.53
Substance abuse	18	4.3 (2.9–5.7)	0.54
Dialysis	6	1.6 (0.5–2.6)	0.83
Sickle cell disease	5	0.8 (0–1.9)	1.79
Tuberculosis	3	0.6 (0–1.4)	1.27
HIV/AIDS	2	0.5 (0–1.3)	1.42
Any medical problems listed above	276	55.6 (51.9–59.4)	0.63

Table 3. Lack of prescribed medication when arriving at the shelter and at survey by chronic medical disease in 224 respondents who took medicine for their medical problems.

Medical Problems	No.	No., (%, Design Effect) of Lack of Medicine When Arriving at the Shelter	No., (%, Design Effect) of Lack of Medicine at Survey
High blood pressure	151	61 (47.3, 0.65)	29 (22.7, 1.27)
High cholesterol	76	25 (42.2, 0.64)	15 (19.5, 1.37)
Diabetes	65	25 (43.6, 0.83)	8 (11.1, 1.36)
Psychiatric/emotional	59	23 (42.4, 0.80)	11 (19.2, 1.54)
Lung disease (including asthma)	55	28 (58.8, 1.28)	14 (30.5, 0.28)
Heart disease	45	18 (47.0, 2.14)	6 (12.2, 0.49)
Gastrointestinal or liver	43	22 (55.2, 1.42)	10 (27.0, 2.46)
Any medical problems*	224	95 (48.4, 1.04)	39 (19.8, 1.29)

*See Table 2 for a list.

Table 4. Factors associated with lack of prescribed medication when arriving at shelter, adjusting for receiving benefits or assistance among 206* subjects with prescribed medication.†

Variables	Categories	OR (95% CI)
Sex	Male	1.58 (0.96–2.59)
	Female	1.00
Receiving assistance/benefits	No	1.50 (0.71–3.19)
Before hurricane	Yes	1.00
Having health insurance	No	2.25 (1.21–4.20)
	Yes	1.00
Employment	Unemployed	0.68 (0.37–1.24)
	Retired	0.35 (0.16–0.78)
	Full time or part time	1.00

OR, Odds ratio.
*Eighteen subjects were excluded because of lack of information on sex, assistance/benefits, health insurance, and employment.
†R^2=0.95.

Table 5. Prevalence of symptoms in 499 respondents when arriving at the shelter, in order of frequency.

Symptoms	No.	Prevalence, % (95% CI)	Design Effect
Dehydration or general weakness	59	12.0 (9.9–14.2)	0.49
Shortness of breath	61	11.5 (9.4–13.7)	0.51
Chest pain	46	9.7 (7.8–11.6)	0.46
Injury	48	9.4 (6.1–12.8)	1.48
Any fever	40	8.0 (5.2–10.7)	1.15
Fever with cough	25	5.1 (2.7–7.5)	1.35
Fever with stiff neck/headache	21	4.2 (2.5–5.9)	0.81
Fever with rash	5	1.8 (0.3–3.4)	1.53
Diarrhea	34	6.9 (5.6–8.1)	0.26
Thoughts of self-harm	16	3.7 (2.1–5.3)	0.80
Thoughts of harming others	4	1.3 (0.3–2.4)	0.96
Infected wounds	7	1.1 (0.2–1.9)	0.76
Any symptoms listed above	170	33.4 (27.0–39.8)	2.05

psychiatric and mental health illness was notably high as well. Among the sampled population, those reporting a medical history of stroke, HIV, dialysis dependence, or seizure disorder were rare.

Of the 276 respondents with diagnosed chronic disease, 224 (81.4%; design effect=0.19) were taking prescribed medications. The concern that displacement would interrupt their care prompted us to investigate whether the 224 diagnosed with chronic disease had arrived at the shelters with their medications (Table 3); at least 95 (48.4%) had not. However, when the survey concluded more than 2 weeks later, the percentage without medications had improved to 19.8%. Lack of a primary care provider was the sole factor associated with lacking medications at the survey (odds ratio 5.62; 95% CI 1.91 to 16.55; P=.002). In the multivariate regression adjusting for health benefits and assistance, male sex and lacking health insurance were risk factors associated with lacking medications for chronic disease on arrival at the shelter (Table 4).

Given the degree to which the evacuee population was exposed to environmental hazards during flight, a focus of disaster health services during the Hurricane Katrina response was assessment of their condition on arrival to the shelters. One third of the arriving evacuees had symptoms that would prompt immediate treatment interventions (Table 5). Among these, dehydration and generalized weakness, shortness of breath, chest pain, and injury were the most common presenting complaints of evacuees on arrival to the shelter. Nearly 1 in 10 evacuees arrived with chest pain. Approximately 15% of evacuees arrived with symptoms of communicable disease potential (fever, diarrhea) that might prompt shelter managers to segregate them from the general shelter population or to initiate infectious control mechanisms. Arriving evacuees with fever (87.9% versus

Table 6. Factors associated with acute symptoms when arriving at shelter in 493* respondents, multivariate regression.†

Variables	Categories	OR (95% CI)
Having health insurance	No	1.83 (1.10–3.02)
	Yes	1.00
Known chronic disease ± medication on arrival to shelter	Has medication	2.60 (1.98–3.43)
	Lacks medication	2.22 (1.36–3.63)
	Not prescribed medication	1.25 (0.64–2.43)
	No known chronic disease	1.00

OR, odds ratio.
*Six individuals were excluded because of lack of information on health insurance status.
†R^2=0.8691.

59.3%; $P<.001$; design effect=0.77), shortness of breath (76.8% versus 60.3%; $P=0.031$; design effect=0.77), and infected wounds (93.8% versus 65.1%; $P=0.003$; design effect=0.77) were more likely than others to seek immediate medical care for their symptoms. Evacuees without health insurance or those afflicted with chronic disease requiring medications (whether they had them or not) were nearly twice as likely to present with acute symptoms on arrival to shelters (Table 6). Those with comorbidities were also 3 times more likely to be acutely ill on arrival compared with those with no other conditions.

LIMITATIONS

We acknowledge limitations of the study to represent the larger displaced population that had no need for shelters or was displaced to shelters in other states. The shelter population is arguably unique and more vulnerable, representing the level of safety net that must be in place to maintain the health of the population as a whole. Cluster samples by their design have a tendency to select for respondents who have similar experiences and demographic profiles. This tendency is not a significant concern for this study, because the population and outcome measures of interest assume a similar health profile and demographic and similar experiences during the displacement; outcome measures chosen do not depend on specific comparisons. Our inability to analyze 2 clusters could enhance this design effect and miss unintended variability; they were not in the same locations. Our study had a short recall period that allowed for more precision. The sample does not reflect the evacuee population with special needs who have higher acuity and more labor-intensive long-term health problems.

DISCUSSION

There is a consensus among disaster medical personnel and epidemiologists that natural and human-generated disasters will become more frequent and intense and will affect greater numbers of people because of increased geographic vulnerability, climate change, poverty, and urbanization.[16] Having a population-based understanding of the disaster displaced, including social and economic demographics, burden of disease, and baseline level of health care, is critical for a society to prepare and respond effectively. Anecdotal reports from the media and existing or ad hoc medical facility records are not sufficient to make intelligent focused decisions on the broader public health issues in acutely displaced populations. This epidemiologic study attempts to characterize the largest population ever displaced to shelters by a natural disaster in the United States.

Disasters affect the poor and vulnerable disproportionately; Hurricane Katrina's effect on the Mississippi delta and the city of New Orleans unmasked the lack of reserve the less fortunate members of society have when facing a disaster of this magnitude. Our sample was representative of the larger displaced population because it closely resembled that of New Orleans: the majority was black (76.4%), with single heads of households that fell well below the national average for health care access (insurance, regular health care provider, having medications) and socioeconomic indicators (home ownership, limited income-generating activity, and reliance on benefits/assistance). For instance, home ownership of the sheltered evacuee population was 33.8% compared with 68.9% for the United States and 70.6% for Louisiana; 31.7% of the sheltered evacuee population were unemployed compared to national and Louisiana unemployment rates of 5.1% and 5.6%, respectively.[17,18]

Also representative was the prevalence of chronic disease in the sample. The prevalence of hypertension among the sheltered evacuees (34.8%), although above the national average of 25.6%, was in line with the national average for that of blacks (36.9% men, 39.5% women); the prevalence of diabetes in our sample (14.3%) was similarly above the national average (9.4%) but more representative of the US black prevalence for diabetes (11.2%).[19]

The baseline lack of health care access and the burden of acute and chronic disease in displaced populations are critical issues to the effective delivery of health care during disaster response efforts. That nearly half our sampled population with known chronic disease was lacking treatment at arrival to shelters represents the kind of vital information that directly affects how disaster health providers prepare for and implement a health response. Stockpiled common medications for chronic disease can be readily available for shelter residents if this requirement is realized early in the response phase. In addition, the prevalence of known psychiatric illness further complicated by a recent stress event will necessitate access to early mental health services either in the shelter or in the local community. A network of skilled local providers can be in place in advance to address the needs of the recently displaced.

A population with a significant burden of chronic disease that has limited health care access at baseline and is lacking medications will be at risk for acute exacerbations of those diseases. In addition, the risk of communicable diseases significantly increases when living quarters become more densely populated. Shelter managers would benefit from instituting a registration mechanism that has both a medical intake (for chronic disease) and a screening triage (for acute disease) component. Real-time information on the health of the shelter population would allow the shelter health providers to implement communicable disease prevention strategies, manage resources for diagnostic and treatment interventions more effectively, and plan for contingencies. In the international arena, humanitarian relief agencies are following evidence-based, consensus-driven guidelines that rely on applied epidemiology, such as this study, to respond to displaced populations in emergencies.[20]

In summary, the challenges to meeting the health needs of marginalized displaced populations are immense. A population-based approach that provides an evidence base for preparation and response will help ensure adequate access for a given burden of disease and address the level of disease acuity as it arises in the immediate postdisaster period.

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Author contributions: PGG designed the study and developed the sampling frame. PGG, MDL, EBH, SF, and TDK developed the questionnaire. PGG deployed the teams. PGG, MDL, and EBH designed the data analysis. PGG, MDL, EBH, and SF helped write the article. MDL and SF helped coordinate field activity. MDL coordinated data collection. MDL and SF oversaw field management of data. SF trained and coordinated field teams on the questionnaire and sampling frame. Y-HH, AV, and CH conducted cleaning of the data set. Y-HH conducted all statistical analysis and designed graphs, the figure, and tables. AV conducted data entry. CH developed the field database. TDK coordinated Red Cross activity and logistics. PGG takes responsibility for the paper as a whole.

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