ORIGINAL ARTICLES

Hurricane Katrina's Impact on the Care of Survivors with Chronic Medical Conditions

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BACKGROUND: Hurricane Katrina affected a population with significant levels of chronic disease.

OBJECTIVE: The extent to which Hurricane Katrina disrupted treatments is not known but would be useful information for future disaster planning.

PARTICIPANTS: 1,043 displaced and nondisplaced English-speaking Katrina survivors ages 18 and older who resided in affected areas before the hurricane.

DESIGN AND SETTING: A geographically representative telephone survey conducted between January 19 and March 31, 2006.

MEASUREMENTS AND MAIN RESULTS: The proportions of survivors with chronic illnesses in the 12 months before the hurricane and the extent to which those with chronic illnesses cut back or terminated treatments because of the disaster. Correlates and reasons given by survivors for disrupted treatment were identified. Most (73.9%) Katrina survivors had 1 or more chronic conditions in the year before the hurricane; of these, 20.6% cut back or terminated their treatment because of the disaster. Disruptions in treatment were significantly more common among the non-elderly, uninsured, socially isolated, those with housing needs, or for conditions remaining relatively asymptomatic but still dangerous if untreated. Frequent reasons for disrupted care included problems accessing physicians (41.1%), medications (32.5%), insurance/financial means (29.3%), transportation (23.2%), or competing demands on time (10.9%).

CONCLUSIONS: Many Katrina survivors burdened by chronic disease had their treatments disrupted by the disaster. Future disaster management plans should anticipate and address such chronic care needs, with timely reestablishment of primary care services, access to medications, and means to address financial and structural barriers to treatment.

KEY WORDS: hurricane Katrina; chronic medical conditions; disrupted treatment.

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In late August 2005, Hurricane Katrina and subsequent levee breaches devastated 1.5 million inhabitants of an area the size of Great Britain; with over 1,600 killed, hundreds of thousands displaced, and more than \$100 billion in federal aid already allocated or requested, it has become the costliest natural disaster in U.S. history.^{1,2} Emergency responses to such disasters typically address immediate health needs, storm-related injuries, and acute illness in the aftermath.^{3,4} Katrina has been no exception, with initial efforts focused on providing shelter, food, water, and mitigation of injuries from environmental hazards, infectious diseases, or other acute conditions.^{5–11}

Unfortunately, the disaster response has been much less robust for survivors with chronic illnesses.^{12,13} This large and frail group might be expected to suffer disproportionately from all aspects of the disaster, including: initial pre-storm evacuation and post-storm displacement; loss of access to health care providers, facilities, or treatments; and a relief response criticized for being slow and poorly coordinated.^{14,15} Anecdotal evidence^{16–19} suggests that patients with a wide range of chronic diseases—such as cardiovascular conditions, diabetes, cancer, respiratory illness, HIV/AIDS, renal disease, dementia, and mental disorders—had their treatment disrupted. However, there is a paucity of systematically collected data on Katrina's survivors with chronic illness to truly ascertain how their care was impacted by the disaster.

In this report, we describe the prevalence of chronic medical conditions in a geographically representative survey of Katrina survivors, and the extent to which those with chronic illnesses cut back or terminated treatments because of the disaster. We then identify correlates and reasons for disrupted care. Our goal in doing so is to help inform the design and targeting of future relief efforts that better ensure the health of disaster survivors with chronic disease.

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METHODS

The Sample

Our study's target sample was English-speaking adults, 18 years of age and over, who resided before the hurricane in a parish or county that Federal Emergency Management Agency (FEMA) subsequently defined as eligible for assistance after Hurricane Katrina,¹ and who were reachable using 1 of 2 telephone sampling frames. The first sampling frame was through a random-digit dial (RDD) of households listed in telephone banks from eligible parishes or counties before the hurricane. It is worth noting that many displaced people were traceable because they were able to forward calls made to their pre-hurricane numbers. The second sampling frame was through cellular and land-based telephone numbers on approximately 1.4 million families throughout the country that applied for American Red Cross (ARC) assistance after Hurricane Katrina. We oversampled individuals in both frames living in the New Orleans Metropolitan Area before the hurricane. Between January 19 and March 31, 2006, a total of 1,043 respondents participated in the survey. The percentage of eligible households that could be reached by telephone (the estimated contact rate) of 64.9% was lower than in some household surveys. This was primarily owing to the massive geographic dislocation of the post-geographic post-Katrina population and the attendant difficulties tracing and contacting people in it.

A short screening questionnaire was administered to a random respondent in each of the households that we contacted in the screening sample to determine eligibility. This screening questionnaire included questions about location of pre-hurricane residence, extent of exposure to the hurricane, current mental health, and basic demographics. Once these screening survey questions were answered, respondents determined to be eligible by virtue of their pre-hurricane residence were introduced to the purposes and goals of the full study and informed that agreement to participate required a commitment to participate in a number of follow-up surveys over a period of several years and to provide tracing information that would allow us to follow them if they changed residences over the study period. We asked respondents to consider these requirements carefully before agreeing to participate, as we wanted to include only respondents who would participate on an ongoing basis in the repeated tracking surveys.

Because of these stringent requirements, the percentage of contacted eligible households in which the randomly selected household member was ultimately interviewed was 41.9%. This was also lower than in typical one-time telephone surveys, but considerably higher than in more conventional consumer panel surveys. It is worth noting that responses to the screening questionnaire were quite similar among those who agreed to participate compared to those who declined. Nevertheless, a weight was applied to the sample to adjust for observed differences between respondents and non-respondents in terms of screening questionnaire reports (primarily reflecting the somewhat lower level of trauma exposure and hurricane-related psychological distress among participants versus non-participants).

Three other sampling frames were considered but abandoned: those on internet "safe lists" because of high overlap with the ARC frame; all hotel rooms in high-density areas

where FEMA housed evacuees, because only 20 families were estimated to be needed to represent this segment and all were recruited from an initial probability sample of 100 hotels; and a random digit dialing (RDD) of all telephone numbers in the continental US, because an initial screen of 20,000 households found only a handful of displaced families, almost all in the primary sampling frames.

Measures

A standard checklist of chronic conditions drawn from the National Health Interview Survey²⁰ was used to assess chronic medical conditions. Eighteen conditions were included: cancer, cardiovascular (heart attack or stroke, heart disease, hypertension), diabetes, digestive conditions (ulcer and a summary question about other serious stomach problems), kidney disease, migraine headaches, other severe or persistent headaches, musculoskeletal conditions (arthritis, chronic back/neck problems), respiratory conditions (asthma, emphysema, and a summary question about chronic obstructive pulmonary disease [COPD], tuberculosis [TB], and other serious lung diseases), and psychiatric problems (depression, alcohol or drug problems, and a summary question about other serious emotional problems). Such checklists have been shown to yield more complete and accurate reports than open-ended questions²¹ and have good concordance with medical records.²²

Respondents who reported having 1 or more chronic conditions were asked if events surrounding the hurricane led them either to stop getting treatment or to cut back on treatment of each condition, and if so, why. Five broad classes of reasons were found in the open-ended responses: lack of access to physicians, lack of access to medications, financial/insurance difficulties, transportation difficulties, and competing demands.

Correlates of terminating or cutting back on treatment were assessed including: demographic (age; sex; race; education; household income in the year before interview; and current insurance coverage), residential (number of other adults living with respondent; number of residential moves since the hurricane; and distance of current residence from pre-hurricane home), and social network variables (numbers of relatives who lived inside and outside the hurricane area; and numbers of people with whom the respondent had a confiding relationship who lived inside and outside the hurricane area).

Analysis Methods

The potential overlap of the 2 primary sampling frames was dealt with in 3 ways: by confining numbers selected from the ARC frame to those outside the area affected by the hurricane (i.e., not in the RDD frame); down-weighting respondents in the RDD frame if they reported asking for ARC assistance and had a primary phone number other than the landline number called to reach them; and by adjusting the weighted proportion of sample households in the ARC frame to their estimated population proportion (based on the proportion of all ARC numbers outside the RDD frame and the proportion of RDD respondents who reported asking for ARC assistance). Respondents obtained from the hotel frame were included without a household weight to represent those living in hotels at the time of sample selection. Additional weights were applied to adjust for the over-sampling of Metropolitan New Orleans residents, within-household probabilities of being randomly selected as

the focal respondent (with no substitution for refusal or not being interviewed), differences between respondents and non-respondents in terms of trauma exposure and psychological distress, and residual discrepancies between the sample and the population from affected areas on a range of demographic and geographic variables from the 2000 US Census. Final consolidated weights were trimmed to increase design efficiency after observing that this did not materially affect estimates of interest.

Prevalences of conditions and condition-specific probabilities of treatment termination or cutback were estimated with frequency distributions and cross-tabulations. Correlates of condition-specific treatment cutback and, among respondents who reported cutback, correlates of self-reported reasons for cutback, were examined with logistic regression analysis. Continuous predictor variables were converted to categorical ones, using thresholds that optimized the ability to predict treatment disruption. Because the data were weighted, the Taylor series linearization method²³ was used to calculate design-based significance tests. Multivariate significance in logistic regression equations was estimated using Wald χ^2 tests based on design-corrected coefficient variance-covariance matrices. Statistical significance was evaluated using 2-sided .05 level tests.

RESULTS

Prevalence of Chronic Conditions and Probability of Treatment Disruption

The majority (73.9%) of respondents reported having 1 or more chronic medical conditions in the year before the hurricane (see Table 1). The 1,043 respondents reported a total of 2,117 such conditions. Over one-fifth (20.6%) of respondents reported disrupted treatment of at least 1 condition after the hurricane, with a weighted (by condition prevalence) average across conditions of 20.8%. Reductions in care were smallest for respiratory illnesses, heart disease, and musculoskeletal conditions, intermediate for conditions such as diabetes and cancer, and greatest for conditions such as other mental disorders.

Predictors of Treatment Disruption

Controlling for the number and type of condition in bivariate models, treatment disruption was 3.5 times (odds ratio [OR] 3.5; 95% CI 1.1–11.9) more likely among those less than 65 versus those older (see Table 2). Those who lacked health insurance after Katrina were 2.7 times (OR 2.7; 95% CI 1.2–6.0) more likely to cut back on treatment than those with insurance. Those having no relatives in the hurricane area were 2.6 times (OR 2.6; 95% CI 1.2–5.8) more likely to experience treatment disruptions; and those having no relatives in unaffected areas were 3.4 times (OR 3.4; 95% CI 1.8–6.5) more likely. Katrina survivors with no confidants in the hurricane area were 3.6 times (OR 3.6; 95% CI 1.6–8.4) more likely to cut back. Treatment disruption was 3 times (OR 3.0; 95% CI 1.4–6.2) more likely among survivors experiencing residential instability after the hurricane. We then constructed a multivariable model containing variables found to be significantly associated with treatment cutback in bivariate models. In this multivariable model adjusted for the number and type of condition, treatment

Table 1. Prevalence of Chronic Conditions in the Year Before the Hurricane and Condition-Specific Probability of Treatment Cutback Subsequent to the Hurricane

	Prevalence % (SE)	Probability of treatment cutback % (SE)
A. Cardiovascular conditions		
Heart attack or stroke	5.0 (1.3)	15.3 (9.3)
Heart disease	5.1 (1.1)	11.2 (4.4)
Hypertension	31.2 (2.5)	21.7 (4.1)
Any cardiovascular condition	32.8 (2.5)	21.9 (3.9)
B. Digestive conditions		
Ulcer	8.7 (1.5)	25.8 (8.6)
Other stomach problems	6.6 (1.4)	23.4 (9.4)
Any digestive condition	13.4 (1.8)	21.1 (6.1)
C. Musculoskeletal conditions		
Arthritis	29.8 (2.5)	18.5 (3.9)
Back/neck problems	33.6 (2.6)	19.0 (3.7)
Any musculoskeletal condition	43.4 (2.7)	16.6 (3.0)
D. Respiratory conditions		
Asthma	11.7 (1.8)	9.6 (4.4)
Emphysema	1.5 (0.6)	21.5 (12.9)
COPD, TB, and other lung problems	1.5 (0.6)	10.2 (9.9)
Any respiratory condition	13.5 (1.9)	9.6 (3.9)
E. Psychiatric problems		
Depression	18.9 (2.1)	21.3 (5.3)
Alcohol or drug problems	1.6 (0.6)	19.0 (12.2)
Other mental disorders	3.4 (1.0)	42.4 (15.3)
Any psychiatric problem	21.3 (2.2)	22.9 (5.1)
F. Other		
Cancer	3.7 (1.1)	32.6 (15.2)
Diabetes	11.2 (1.7)	30.6 (7.6)
Kidney disease	1.2 (0.3)	24.4 (11.9)
Migraine headaches	22.1 (2.3)	19.7 (5.0)
Other frequent headaches	14.3 (2.0)	25.1 (6.8)
G. Any		
Any condition	73.9 (2.3)	20.6 (2.5)

disruption remained significantly associated with age less than 65, having fewer relatives and confidants inside or outside the hurricane area, and residential instability since the hurricane (see Table 2).

We computed a multivariable treatment disruption risk profile score by summing each respondent's status in each of the domains significantly associated with treatment cutback (see Table 2). Two points were assigned for the risk domains most strongly associated with cutback (i.e., having no relatives and no confidants in affected areas and no relatives in unaffected areas; as well as age less than 65) and 1 point was assigned for all other domains. It was not uncommon for respondents to score 4 or more (15.4%) and the vast majority scored at least 1 (92.2%); nearly 1 of 2 of respondents scored 3 or more (see Table 3). There was a strong, nearly exponential relationship between the risk profile score and probability of disrupted treatment, ranging from 55.3% among those with 4 or more to 2.7% among those with none. More than half (55.3%) of all condition-specific treatment disruptions occurred in instances where respondents had risk profile scores of 4 or more.

Table 2. Correlates of Condition-Specific Treatment Cutback*

	Bivariate OR (95% CI)	Multivariable OR (95% CI)
I. Demographics		
18–64 years of age	3.5† (1.1–11.9)	3.9† (1.0–14.6)
Male gender	0.9 (0.4–2.1)	
Non-white race/ethnicity	1.1 (0.5–2.5)	
0–12 years of education	0.7 (0.3–1.4)	
Low income	1.2 (0.6–2.3)	
No health insurance	2.7† (1.2–6.0)	1.7 (0.8–3.5)
II. Social networks		
a. 0 relatives in same county/parish	2.6† (1.2–5.8)	
b. 0–4 relatives outside affected area	3.4† (1.8–6.5)	
c. 0 confidants in county/parish	3.6† (1.6–8.4)	
d. 0 confidants outside county/parish	1.1 (0.4–3.0)	
e. 0 on all 3 a, b, c above		15.0* (3.8–59.4)
f. 0 on 2 of a, b, c above		2.2* (1.0–4.7)
g. 0 on 0–1 of a, b, c above		1.0 –
III. Residential		
Different state	4.2 (0.8–21.4)	
Same state/different county	1.9 (0.5–6.3)	
Same county/same town	1.5 (0.7–3.3)	
Same home	1.0 –	
1–2 adults in household	1.5 (0.6–3.8)	
2+ moves	3.0† (1.4–6.2)	3.8† (1.7–8.4)

*Based on a person-condition data array of 2,117 observations (one observation for each condition reported by each respondent)

†Significant at the .05 level, 2-sided test

Table 4. Weighted Prevalence of Reasons for Cutting on Treatment*

	% (se)
Lack of access to physicians	41.1 (6.3)
Lack of access to medication	32.5 (5.9)
Financial/insurance problems	29.3 (5.7)
Transportation problems	23.2 (5.8)
Competing demands on time	10.9 (4.1)

*Among the subsample of those who said they cut back on treatment (unweighted n=198)

Louisiana parishes showing the majority of households have 1 or more members with chronic illnesses.⁵ Even before the disaster, populations in Katrina's path were the most chronically ill in the nation.²⁴ They contained many impoverished and minority residents, with poverty and minority status being strongly linked to poor health.²⁵

Disruptions in treatments from Katrina were common, occurring in over 1 of 5 of survivors with chronic illnesses. These results confirm an assessment of evacuees in Houston shelters that found 1 of 4 went without needed medical care.²⁶ This should not be surprising in light of the widespread loss of health care facilities and personnel, as well as employment, financial resources, and insurance to pay for care even if available; the continued displacement of the majority of New Orleans' residents and even larger proportions of some coastal communities continues to cut many evacuees off from their usual sources of treatment and support.^{15,27}

The smallest reductions in care appeared to be for conditions that quickly become symptomatic if treatment is reduced (e.g., respiratory, cardiovascular, and musculoskeletal conditions). Cutbacks were more common for conditions that can be temporarily asymptomatic, but no less life-threatening, if treatment is disrupted (e.g., diabetes and cancer). The greatest reductions appeared to occur for conditions that may not be immediately life-threatening or those potentially associated with stigma and low perceived needs for treatment (e.g., other mental health problem).²⁸ The negative consequences of these disruptions remain uncertain. However, some prior studies have shown delayed increases in mortality after disasters, with lack of access to routine health care being a leading cause of such deaths.^{3,29–31}

The association between lack of insurance and disrupted treatments confirms accounts that many survivors without coverage had no access to primary care services after Katrina; this is particularly troubling given that 20% of the non-elderly in Louisiana and Mississippi were uninsured before Katrina and this proportion may have swelled after the disaster owing to job losses.¹⁵ Nearly 1 of 3 of survey respondents who cut back on treatments reported lack of insurance or means for financing care as a factor.

Katrina survivors also face enormous structural barriers, with lack of access to physicians, medications, or transportation all being common reasons given for interrupted treatment. Perceived or actual lower disease severity and lack of portable insurance such as Medicare may explain why non-elderly patients tend to curtail treatments relative to elderly patients. Katrina survivors also had other acute needs in addition to those for chronic disease treatments; in fact, many who were cutting back on chronic disease treatments reported compet-

Reasons for Disrupted Treatment

Limited access to physicians was the most commonly cited reason for disrupted treatment (cited by 41.1% who cut back on treatment), followed by limited access to medication (32.5%), and financial/insurance problems (29.3%; see Table 4). Problems with transportation (23.2%) and competing demands on time (10.9%) were also frequent.

DISCUSSION

This large survey reveals the burdens from chronic disease borne by nearly 3 of 4 of Katrina survivors. These findings are consistent with a focal assessment after the hurricane in 2

Table 3. The Association Between Number of Risk Factor Domains and Condition-Specific Probability of Treatment Cutback*

Number of risk factor domains	Distribution of number of risk factor domains		Probability of treatment cutback	Distribution of treatment cutback
	% (SE)	(n)	% (SE)	% (SE)
4+	15.4 (3.0)	347	55.3 (8.3)	41.1 (9.4)
3	30.9 (3.4)	784	21.4 (5.5)	31.7 (8.3)
2	39.1 (4.0)	617	12.0 (4.2)	22.6 (7.7)
1	6.8 (1.8)	170	11.2 (9.2)	3.6 (3.2)
0	7.8 (1.7)	199	2.7 (1.6)	1.0 (0.7)

*Based on a person-condition data array of 2,117 observations (one observation for each condition reported by each respondent)

ing demands on their time as a reason. Likewise, making multiple domiciliary moves was related to disrupted care, suggesting the importance and potential benefits of providing survivors with permanent housing. Finally, having relatives and confidants was related to maintaining treatment, confirming anecdotal evidence that social networks allowed some survivors to relocate and/or cope with the structural and financial barriers to care.³²

These results should be interpreted with the following 5 limitations in mind. First, the survey excluded people unreachable by telephone and unwilling to participate. These exclusions are likely to have led to the underrepresentation in this study of the most disadvantaged and possibly most seriously ill people. For example, Katrina survivors without phones may have been more likely to experience difficulties scheduling or maintaining routines; likewise, people refusing to participate in the survey may also have been reluctant to pursue or access needed care. Second, not all chronic conditions were assessed and some with chronic illnesses may underreport or never have been diagnosed, all resulting in underestimation of illness burdens. Third, some with chronic conditions may never have been treated or underreport terminating or cutting back, leading again to underestimation of unmet needs for care. Fourth, lack of information on condition severity and the survey's cross-sectional nature prevent us from concluding that the observed predictors and reasons given by respondents were causally related to disruptions in treatment. Finally, we lacked detailed information on length and extent of treatment cutbacks and are unable to examine the clinical outcomes that resulted from them.

With these limitations in mind, 2 broad sets of implications are suggested by these results. First, Katrina challenges fundamental notions concerning the nature and magnitude of disasters that are possible in the United States.³³ Before Katrina, complex humanitarian disasters—defined as acute situations affecting large populations caused by multiple factors such as food shortages and population displacement, and resulting in significant excess mortality—were thought to mainly afflict developing countries.³⁴ Katrina reveals these can strike any concentrated population in the United States and exact a heavy toll on those with chronic disease.

Furthermore, older disaster management plans—consisting of a few specialized rescue workers dealing with acute illness, agencies providing only temporary shelter or food, and the disaster being over within weeks—are clearly inadequate for the many survivors of complex humanitarian crises who have chronic disease.³³ Even current initiatives, such as the Strategic National Stockpile of emergency medications³⁵ and short-term deployments of emergency medical personnel in the Public Health Security and Bioterrorism Preparedness and Response Act,² fail to anticipate and address chronic care needs. Response models from international refugee relief that assume destruction of an area's infrastructure, widespread displacements, and long-lasting recovery and rehabilitation needs, may be far more relevant.³⁶ A critical component of such response models must be timely reestablishment of a primary health care system.¹³ Ensuring health care personnel's access to patients' prior medical records (e.g., through electronic medical charts) is one important piece of continuing prior treatment regimens. Further attention to other "supply side" problems that hampered Katrina relief efforts is also sorely needed³⁷; for example, portable emergency insurance

coverage, such as the Medicaid waiver programs enacted after the World Trade Center attacks and by 17 states for Katrina survivors, may be crucial to obtain primary care and medications in the United States.^{26,38} Models for local health sector preparedness that incorporate knowledge of local chronic care needs and build the capacity of community members to participate in planning and response may also be necessary to ensure the health of the many vulnerable and underserved survivors with chronic disease.³⁹

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