

Health of Medicare Advantage Plan Enrollees at 1 Year After Hurricane Katrina

Lynda C. Burton, ScD; Elizabeth A. Skinner, MSW; Lori Uscher-Pines, PhD;
Richard Lieberman, BA; Bruce Leff, MD; Rebecca Clark, BA; Qilu Yu, PhD;
Klaus W. Lemke, PhD; and Jonathan P. Weiner, DrPH

Hurricane Katrina has had profound and ongoing effects on the health of inhabitants of the city of New Orleans, Louisiana, and surrounding areas. Numerous reports on the immediate health effects of Hurricane Katrina have focused on surveillance of the following: mortality, injury, and illness^{1,2}; mental health problems³; health services utilization^{4,5}; disruption to the healthcare delivery system^{4,6,7}; implications for patient care during disasters⁸; and suggestions for health policy change.⁹ Although the disaster literature contains many studies on the immediate health effects of natural disasters, few (including the Hurricane Katrina literature) have tracked health outcomes during the long term or have been able to compare health status before an event versus after an event.^{10,11} Older adults with a heavy burden of chronic conditions require effective care delivery systems¹²; however, few studies to date have focused on the health effects following a major disruption to care delivery such as occurred with Hurricane Katrina.

The first objective of this study was to document mortality associated with Hurricane Katrina in a defined population of older adults. The second objective was to explore the relationship between prehurricane health risk status and the effects of the hurricane on morbidity and health service use in a population of continuously enrolled older persons from a New Orleans-based Medicare Advantage plan.

METHODS

Peoples Health (PH) is a provider-owned managed care organization (MCO) that served approximately 20% of all Medicare beneficiaries 65 years and older in 4 parishes around New Orleans before Hurricane Katrina through its Medicare Advantage plan, with a provider network of 7 independent practice associations representing 1101 participating physicians (160 primary care physicians and 941 specialists). Peoples Health remained operational throughout Hurricane Katrina, moving its administrative operations from New Orleans to Baton Rouge, Louisiana. Through December 2006, PH used mailings, their Web site, and the news media to inform its members that all copayments and deductibles for out-of-area services would be waived as required by the Centers for Medicare & Medicaid Services.¹³ The information system of PH captures all data on outpatient and office encounters.

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Objective: To assess the effects of Hurricane Katrina on mortality, morbidity, disease prevalence, and service utilization during 1 year in a cohort of 20,612 older adults who were living in New Orleans, Louisiana, before the disaster and who were enrolled in a managed care organization (MCO).

Study Design: Observational study comparing mortality, morbidity, and service use for 1 year before and after Hurricane Katrina, augmented by a stratified random sample of 303 enrollees who participated in a telephone survey after Hurricane Katrina.

Methods: Sources of data for health and service use were MCO claims. Mortality was based on reports to the MCO from the Centers for Medicare & Medicaid Services; morbidity was measured using adjusted clinical groups case-mix methods derived from diagnoses in ambulatory and hospital claims data.

Results: Mortality in the year following Hurricane Katrina was not significantly elevated (4.3% before vs 4.9% after the hurricane). However, overall morbidity increased by 12.6% ($P < .001$) compared with a 3.4% increase among a national sample of Medicare managed care enrollees. Nonwhite subjects from Orleans Parish experienced a morbidity increase of 15.9% ($P < .001$). The prevalence of numerous treated medical conditions increased, and emergency department visits and hospitalizations remained significantly elevated during the year.

Conclusions: The enormous health burden experienced by older individuals and the disruptions in service utilization reveal the long-term effects of Hurricane Katrina on this vulnerable population. Although quick rebuilding of the provider network may have attenuated more severe health outcomes for this managed care population, new policies must be introduced to deal with the health consequences of a major disaster.

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For author information and disclosures, see end of text.

ters, hospitalizations, prescriptions filled, out-of-area services, and other covered services. Mental health services were carved out, preventing assessment of diagnoses and utilization by mental health providers. The information system is used to generate encounters and payments. Although there were disruptions to receipt of claims in the months immediately following Hurricane Katrina, claims for the period of the study were received by the time of the data analysis.

Study Population

The study population consisted of all noninstitutionalized PH enrollees who lived in 4 parishes in the New Orleans metropolitan area served by PH providers (Orleans, Jefferson, St Tammany, and Plaquemines parishes) before Hurricane Katrina. All PH managed care beneficiaries enrolled as of September 1, 2004 (1 year before Hurricane Katrina [$n = 27,871$]) comprised the cohort for the survival analysis. Enrollees who survived and remained continuously enrolled through August 31, 2006 ($n = 20,612$) comprised the cohort for the morbidity and utilization analyses. A subset ($n = 728$) was randomly selected for structured telephone interviews among subjects who had been stratified by health status using prospective adjusted clinical groups (ACGs) (described herein). Half of them were in the highest risk category, a quarter in a moderate risk category, and another quarter in the lowest risk categories. Telephone interviews occurred from December 2006 through February 2007.

Measurements

Age, sex, Medicaid eligibility, and race/ethnicity were obtained from MCO enrollment data. Age was stratified as 65 to 74 years, 75 to 84 years, or 85 years and older. Medicaid eligibility was defined as those qualified for all Medicaid benefits. Race/ethnicity was classified as white or as nonwhite. Mortality information was updated monthly by files received from the Centers for Medicare & Medicaid Services.

Morbidity was measured using ACGs.¹⁴ The ACG method for assigning risk scores is based on overall disease burden derived from *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis codes from ambulatory and hospital claims. Adjusted clinical groups have been used extensively¹⁵⁻¹⁷ and have been validated as a method of differentiating morbidity levels among older populations.¹⁸ The ACG concurrent risk score assesses an individual's health burden during the year of interest. The occurrence of an ICD-9-CM code counts as a condition, regardless of the number of visits. The ACG prospective risk score is calculated to predict health service utilization the following year based on claims in the preceding year. The ACG prospective risk score was used to stratify the telephone survey population. The ACG

concurrent risk score was used to compare health risk before versus after Hurricane Katrina.

Changes in morbidity were measured in 4 ways. First, we measured change by comparing ACG concurrent risk scores before Hurricane Katrina with those after Hurricane Katrina for the overall study population and by subgroup for race/ethnicity (white vs nonwhite), level of disruption (Orleans Parish vs other parish), and displacement out of state for 12 months following Hurricane Katrina. Second, we calculated specific disease prevalence rates before and after Hurricane Katrina, as well as percentage change in prevalence rates of treated morbidities that had a study population prevalence rate of at least 1% (except cardiac arrest) and that the medical disaster literature suggests may be associated with such events.¹⁹⁻²³ We also included several control conditions that would not be expected to change in the setting of a disaster and for which treatment is not optional (and hence not likely to appear in claims data). Third, as summary indicators of prevalence, we used expanded diagnostic clusters, developed as part of the ACG software to describe related conditions using ICD-9-CM codes from ambulatory and hospital visits.¹⁴ Fourth, we categorized self-reports of health status among the telephone-interviewed population as "worse," "the same," or "better" compared with before Hurricane Katrina.

Health services utilization was obtained from claims for physician office visits. These comprised new and established visits and consultations, hospitalizations (including inpatient acute medical and surgical care), and emergency department visits (including visits to an urgent care site).

Several dimensions of disruption were measured. Disruption of the physical environment was measured using Federal Emergency Management Agency classifications,²⁴ which defined disruption on a parish level by the percentage of homes that were moderately to catastrophically damaged (77% in Orleans Parish) compared with the combined parishes in which fewer homes were similarly damaged (49% in Plaquemines Parish, 41% in Jefferson Parish, and 4% in St Tammany Parish). From the telephone survey population, we obtained 2 measures of personal disruption. Early disruption was based on recall of the first 4 months following Hurricane Katrina and was defined by the following 5 events, each scored as 0 or 1: ≥ 3 places lived in since Hurricane Katrina, damage to the home, home unlivable for more than 3 weeks, trouble getting healthcare, and living in Orleans Parish at the time of Hurricane Katrina. Long-term disruption, based on the time from Hurricane Katrina to the telephone interview, was defined by 5 questions, each scored as 0 or 1: the respondents' report that their home remained unlivable at the time of the telephone interview, their financial situation was worse, living arrangements were different, they had no regular source of care, and

they felt “not very” or “not at all” settled. Based on the distribution of the score, early disruption was scored as 3 or more of the 5 possible events; long-term disruption was defined as 1 or more of the 5 possible events. Finally, displacement out of state was determined by an individual’s having a home address with a zip code outside of Louisiana in the year after Hurricane Katrina.

The telephone survey included the K6, a 6-item screening scale that assesses psychological distress.²⁵ The scale covers the occurrence of symptoms related to depression and anxiety in the past 30 days.

Statistical Analysis

We compared the following characteristics of several subgroups of the study population using χ^2 test or *t* test as appropriate: (1) those who lived in heavily disrupted Orleans Parish (*n* = 7242) with those in more moderately disrupted parishes (*n* = 13,120) and (2) those surveyed by telephone who completed interviews (*n* = 303) with those who refused to participate in interviews (*n* = 425). To assess the generalizability of the total study population to the total population of New Orleans 65 years and older, recently published data on age and sex from US Census 2000²⁶ and from the 2005 American Community Survey, New Orleans,²⁷ were used. To assess generalizability of the total study population to a national sample, ACG weights were benchmarked to a nationally representative random sample of Medicare beneficiaries.²⁸

Monthly counts of mortality for 1 year before and 1 year after Hurricane Katrina were compared in survival analysis, controlling for age, sex, and race/ethnicity, and were evaluated using χ^2 test. A Cox proportional hazards regression model was developed. Different relative risk parameters were allowed for death happening before versus after Hurricane Katrina, with a change point for the time of the hurricane.

Alternative explanations for the increase in ACG scores during each year were tested. “Coding creep” was ruled out by ascertaining that the direction and amount of change in the score moved in parallel with service utilization. We compared summary morbidity scores before and after Hurricane Katrina by parish and by race/ethnicity using *t* test to determine statistically significant differences.

To assess the effect of aging alone, we used a data set of enrollees 65 years and older (*n* = 77,603) from several MCOs that did not experience Hurricane Katrina.²⁹ Using propensity scoring techniques, we created a comparison population matched to the study population by age, sex, and ACG score before Hurricane Katrina. Several weighting schemes were tested, with the goal of showing a similar percentage change from the preyear to the prediction year. At the outset, the

ACG score of the unmatched comparison population was 0.80 compared with the study population score of 1.05. Propensity scoring matching for age and sex yielded a comparison group that had a 3.1% change in summary health scores from preyear to postyear compared with the study population change of 12.6% from preyear to postyear. Adding the ACG scores before Hurricane Katrina to the propensity scoring resulted in a smaller change in summary health scores from preyear to postyear for the comparison population.

We evaluated differences in prevalences of diseases using McNemar test. The mean preyear and postyear utilizations were compared using paired *t* test. For the telephone survey population, we defined *disruption* as positive responses to questions related to events that occurred early or in the long term at the thresholds already defined. Logistic regression analysis was used to determine the odds of self-reported physical health decline given short-term, long-term, and both short-term and long-term disruption, controlling for age, sex, race/ethnicity, Medicaid eligibility, and health status before Hurricane Katrina health status as measured by the ACG concurrent risk score.

Study Approval

The study was approved by the institutional review board of Johns Hopkins University Bloomberg School of Public Health. Informed consent for participation was obtained from all telephone-interviewed subjects.

RESULTS

Study Population Characteristics

Table 1 gives characteristics of the study population who were continuously enrolled in PH and of the telephone survey subset. Comparing characteristics of enrollees who lived in the heavily disrupted Orleans Parish with those in the moderately disrupted 3 other parishes revealed several statistically significant differences. Orleans Parish residents were more likely to be older, female, Medicaid eligible, and nonwhite. Nonwhite subjects were overwhelmingly black (94.2%) and did not differ from other nonwhite subjects by Medicaid eligibility or by health risk before Hurricane Katrina.

For the telephone survey, 728 persons were selected in the stratified sample: 303 (41.6%) completed interviews. The 425 persons (58.4%) who did not complete the telephone survey included 23.4% refusals, 13.3% who could not be located, 10.3% ineligible or physically or mentally unable to respond, and 11.4% who were locatable but could not be reached.

Health status of the telephone survey population sampled differed from that of the total study population, reflecting the intentional oversampling of the sickest population.

■ **Table 1.** Characteristics of the Study Population

Characteristic	Study Population				Telephone Survey Subset		
	Total (N = 20,362) ^a	Orleans Parish (n = 7242)	Jefferson, Plaquemines, and St Tammany Parishes (n = 13,120)	Benchmarks From Several Sources	Total (N = 728)	Respondents (n = 303)	Non- respondents (n = 425)
Age, y, %							
65-74	54.4	52.8	55.2	57 ^b	48.6	51.8	46.4
75-84	37.4	37.2	37.5	35 ^b	41.6	42.6	40.9
≥85	8.3	9.9 ^c	7.3	8 ^b	9.8	5.6 ^d	12.7
Female sex, %	58.3	60.1 ^c	57.3	69 ^b	52.9	59.4 ^d	48.2
Nonwhite race/ethnicity, %	33.8	66.4 ^c	15.9	63 ^b	33.4	35.3	32.0
Medicaid eligible, %	8.9	11.9 ^c	7.3	15.4 ^e	7.6	8.9	6.6
Health risk score before Hurricane Katrina^f	1.04	0.97 ^c	1.08	1.00	1.77	1.80	1.75

^aMissing values for 250 persons among the total population of 20,612.

^bUS Census Bureau.²⁷

^cSignificant difference between Orleans Parish and other parishes ($P < .001$).

^dSignificant difference between respondents and nonrespondents for age ($P = .006$) and sex ($P = .003$).

^eAdapted from Holohan and Ghosh.³⁰ State estimate reduced by 19% to reflect dual eligibles with any institutional care.

^fCalculated using adjusted clinical group method.¹⁴ Standardized to a national 5% sample of Medicare beneficiaries 65 years and older in fee-for-service populations.²⁸ Higher scores indicate greater health burden.

Table 1 gives the concurrent health risk scores before Hurricane Katrina standardized to persons 65 years and older from a national fee-for-service Medicare sample.²⁸ The score of 1.08 indicates that the total study population had an 8% greater health burden during that year than the average Medicare beneficiary. Orleans Parish enrollees showed less disease burden before Hurricane Katrina than enrollees in the other parishes. For the telephone survey population, disease burden was considerably higher, reflecting the sampling strategy.

However, there was little difference between telephone survey respondents and nonrespondents in the health risk scores before Hurricane Katrina (1.80 and 1.75, respectively). There were sex and age differences. Respondents were more likely to be female (59.4% vs 48.2%) ($P = .003$) and were younger: 51.8% versus 46.4% were aged 65 to 74 years, 42.6% versus 40.9% were aged 75 to 84 years, and 5.6% versus 12.7% were 85 years and older ($P = .006$). There were no differences in the proportions of respondents versus nonrespondents who lived in Orleans Parish before Hurricane Katrina.

Disenrollment for the year before Hurricane Katrina was 4.2% and rose to 11.3% ($n = 3072$) in the year after Hurricane Katrina. Those who disenrolled were older (mean age, 75.6 vs 74.8 years) and had higher summary health risk scores in the years before Hurricane Katrina (7.1 vs 6.5), and greater proportions were female (64.6% vs 58.4%), nonwhite (50.6% vs 33.8%), Medicaid eligible (15.0% vs 8.9%), and residents

of Orleans Parish (57.6% vs 35.6%); all differences were significant at $P < .001$.

Mortality

The mortality per month for the years before and after Hurricane Katrina showed little change in the months before Hurricane Katrina, a spike in September during and immediately after the hurricane, and then a return to levels before the hurricane. Adjusted for age and sex, the annual mortality rate for the year before Hurricane Katrina was 4.3% compared with 4.9% for the year after the hurricane, which was not statistically different. The relative risks relating a 1-year increase in age to the incidence of death are estimated at 1.11 (95% confidence interval [CI], 1.10-1.11) for subjects who died before Hurricane Katrina and 1.02 (95% CI, 1.02-1.03) for those who died after Hurricane Katrina, suggesting that the relative risk of mortality because of age alone was slightly lower following Hurricane Katrina after adjusting for sex and race/ethnicity. The relative risk of mortality for women compared with men was 0.63 (95% CI, 0.57-0.70). The relative risk of mortality was not significantly different by race/ethnicity or by parish. Cause of death was not available.

Morbidity Change

Table 2 gives morbidity scores by race/ethnicity and by parish standardized to the total study population before Hurricane Katrina (adjusted for age and sex) and by whether individuals were displaced out of state at any time in the

Table 2. Health Risk Scores Among the Study Population Before and After Hurricane Katrina by Race/Ethnicity and Parish and Whether Displaced Out of State^a

Race/Ethnicity and Parish	No.	Health Risk Score		% Change	P ^b
		12 mo Before Hurricane Katrina	12 mo After Hurricane Katrina		
Total	20,544^c	1.00	1.13	13	<.001
White race/ethnicity					
All 4 parishes	13,597	1.07	1.21	13	<.001
Orleans Parish	2452	1.04	1.18	13	<.001
Not displaced	2263	1.04	1.15	11	<.001
Displaced	177	1.02	1.49	46	<.001
Other 3 parishes	11,145	1.07	1.22	14	<.001
Not displaced	10,943	1.06	1.20	13	<.001
Displaced	169	1.56	1.64	5	.65
Nonwhite race/ethnicity					
All 4 parishes	6947	0.87	0.98	13	<.001
Orleans Parish	4847	0.88	1.02	16	<.001
Not displaced	3779	0.88	0.99	13	<.001
Displaced	1049	0.86	1.13	31	<.001
Other 3 parishes	2100	0.84	0.88	5	.20
Not displaced	2037	0.84	0.88	5	.26
Displaced	61	0.83	1.03	24	.36

^aAdjusted clinical group concurrent risk scores (higher scores indicate greater disease burden) adjusted for age and sex using a regression-based age-sex adjustment with 5-year age groups for men and women. Displaced persons had a home address with a zip code outside of Louisiana in the year after Hurricane Katrina. Not displaced and displaced persons do not add to totals because of missing zip codes at 1 year.
^bPaired *t* test for difference in the mean clinical group concurrent risk scores before and after Hurricane Katrina.
^cPersons with nonmissing race/ethnicity and parish codes.

year following Hurricane Katrina. The pattern of the scores indicates that morbidity increased after Hurricane Katrina for all race/ethnicity and parish groups, with a 12.6% increase overall but with a 15.9% increase for nonwhite subjects in Orleans Parish. This change contrasts with a 3.4% increase in morbidity in 1 year among the matched sample of Medicare managed care enrollees. Nonwhite subjects in Orleans Parish had scores indicating less morbidity before Hurricane Katrina than white subjects in the same parish and maintained lower scores, despite a greater morbidity increase from before the hurricane to after the hurricane. The smallest increase was for nonwhite subjects in the other 3 parishes (4.8%). For all subgroups, those displaced experienced greater increases in morbidity compared with those not displaced.

Among the continuously enrolled population, **Table 3** gives the prevalences of treated morbidities per 1000 members and the percentage changes from before the hurricane to after the hurricane. Although the absolute numbers are small, the change in prevalence of cardiac arrest was highest (135.3%) among the conditions hypothesized to increase.

Other conditions such as acute myocardial infarction and sleep problems also demonstrated significant increases in prevalence. Several conditions hypothesized a priori not to increase in prevalence (the control conditions) experienced nonsignificant change.

Utilization

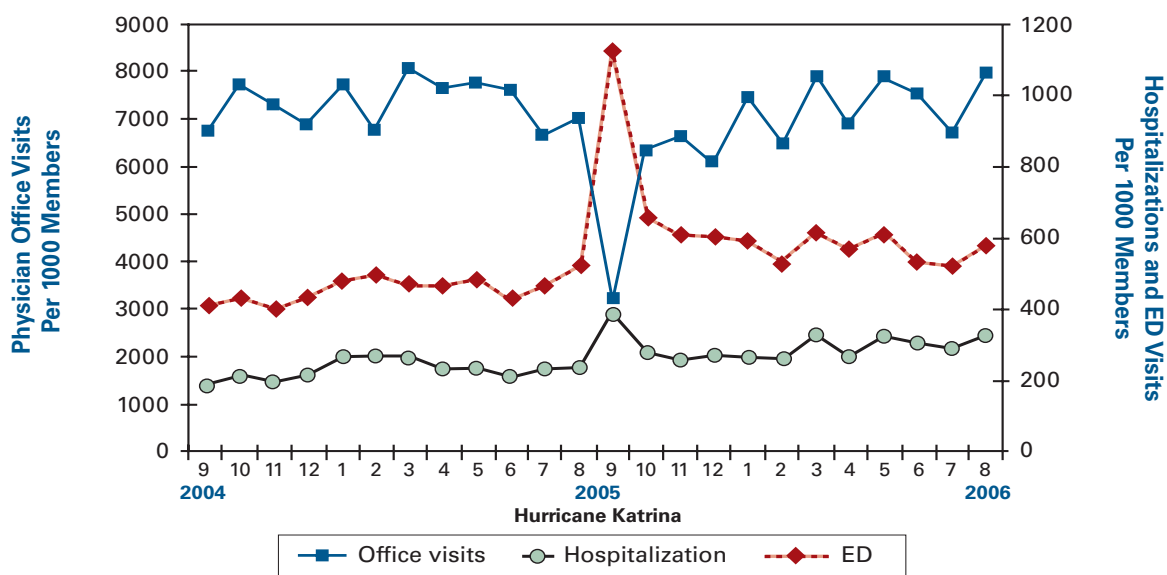
The **Figure** shows annualized monthly rates of physician office visits, hospitalizations, and emergency department visits per 1000 members. Rates of physician visits immediately following Hurricane Katrina were 57% lower compared with the mean number 11 months before the hurricane of 7373 but recovered to near prehurricane levels in the 11 months after the hurricane, a nonsignificant difference (*P* = .13). Rates of emergency department visits spiked 100.0% in the month after Hurricane Katrina and reached a plateau at a significantly higher level (21%) than that before Hurricane Katrina (*P* <.001). Emergency department visits had an increasing linear trend before Hurricane Katrina and had a decreasing linear trend after Hurricane Katrina. Hospitalization rates increased 66% in the first month after Hurricane

■ **Table 3.** Prevalences of Selected Treated Morbidities Before and After Hurricane Katrina Among the Study Population

Treated Morbidity ^a	Prevalence Per 1000 Members (N = 20,612)		Change, %	P
	12 mo Before Hurricane Katrina	12 mo After Hurricane Katrina		
Disaster-affected conditions				
Cardiac arrest	1.7	4.0	135.3	<.001
Acute myocardial infarction	11.6	15.8	36.2	.001
Congestive heart failure	88.7	110.3	24.4	<.001
Hypertension without major complications	663.6	684.1	3.1	<.001
Hypertension with major complications	121.1	147.3	21.6	<.001
Cerebrovascular disease	78.0	83.6	7.2	.007
Sleep problems	25.6	37.0	44.5	<.001
Headaches	39.0	41.4	6.2	.18
Control conditions				
Appendicitis	0.9	0.5	-44.4	.12
Cholecystitis	15.0	14.6	-2.6	.70
Allergic rhinitis	97.5	95.4	-2.2	.41
Otitis externa	13.4	13.0	-3.0	.64

^aBased on Johns Hopkins expanded diagnostic categories.¹⁴

■ **Figure.** Physician Office Visits, Hospitalizations, and Emergency Department (ED) Visits per 1000 Members (Annualized) for the Months Before and After Hurricane Katrina



Katrina and maintained an increase of 23% in the ensuing 11 months compared with the 11 months prior ($P < .001$).

Disruption and Health

In response to questions regarding disruption in the first

4 months following Hurricane Katrina, the greatest concern reported was damage to the home, with 68.6% reporting a house moderately or severely damaged or destroyed. Just over half (52.1%) reported that their house was unlivable for more than 3 weeks. Only 5.9% reported having trouble

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getting healthcare in the first 4 months after Hurricane Katrina. Fewer respondents reported that disruption remained at 1 year. Approximately 28% said that their house remained unlivable or destroyed or that their financial situation was worse. Few respondents (5.6%) reported early or long-term problems getting healthcare.

Table 4 gives telephone survey responses to questions regarding early and long-term personal disruption. The most common early effect was damage to respondents' homes. Markers of long-term disruption were less frequently reported. Survey respondents who experienced short-term and long-term disruption had more than 3 times greater odds of reporting worse health (odds ratio [OR], 3.6; 95% CI, 1.4-9.5). Higher K6 scores, which are indicative of distress, were also significant (OR, 1.1; 95% CI, 1.1-1.2). Other control variables (age, sex, race/ethnicity, Medicaid eligibility, and health risk before Hurricane Katrina) were not significant.

DISCUSSION

To our knowledge, this is the first study to examine the 1-year health effects of Hurricane Katrina in an older population with a heavy burden of chronic disease. In contrast to reports by the news media of elevated mortality in the months after Hurricane Katrina,³¹ mortality rates were not elevated among our study cohort of approximately 20% of older persons in the parishes directly affected by the storm. Our finding is supported by the Louisiana Department of Health and Hos-

pitals,¹ which used basic statistical techniques to track deaths through October 2006. However, this optimistic finding did not extend to morbidity, for which large declines in health beyond those expected from aging alone were documented. The heavy burden on health was validated by the increase in disease prevalence for selected conditions that were hypothesized a priori to be affected by a disaster, by self-reports of increased health burden directly associated with disruption from Hurricane Katrina, and by benchmarking our data to standard populations. Persons who disenrolled during the year and were not included in the study population were sicker before Hurricane Katrina. Had they been included in the study population, the health decline may have been greater.

The adverse effect on morbidity was strongest for non-white subjects in Orleans Parish. Although there was difficulty delineating the effect of disruption experienced, the effect of race/ethnicity, and the higher level of Medicaid eligibility, we found that the health decline of nonwhite subjects was greater than that of white subjects. What seems to be less morbidity in the predominantly black population in Orleans Parish before Hurricane Katrina may reflect underutilization and reliance on sporadic emergency care. It was acknowledged by health providers and administrators of the MCO that enrollees from this parish traditionally received most of their medical care from Charity Hospital, eschewing care in a private primary care setting, where there was greater opportunity for preventive services and follow-up care (C.S. Solomon, oral communication; April 2007). All

Table 4. Early and Long-term Disruption Indicators After Hurricane Katrina Among the Telephone Survey Subset Respondents

Measure	No. (%) (n = 303)
Early disruption^a	
Damage to house was moderate or severe or house was destroyed	208 (68.6)
House unlivable for >3 wk after Hurricane Katrina	158 (52.1)
Lived in ≥3 places after Hurricane Katrina	134 (44.2)
Had trouble getting healthcare in first 4 mo after Hurricane Katrina	18 (5.9)
Lived in highly disrupted Orleans Parish	102 (33.7)
No. with ≥3 early disruption indicators (n = 303)	251 (82.8)
Long-term disruption^b	
House remains unlivable or destroyed	85 (28.1)
Financial situation worse than before Hurricane Katrina	85 (28.1)
Living arrangements different than before Hurricane Katrina	60 (19.8)
No regular source of healthcare	17 (5.6)
Feels "not very" or "not at all" settled	44 (14.5)
N with ≥1 long-term disruption indicators (n = 303)	171 (64.4)

^aIn the first 4 months after Hurricane Katrina.

^bUp to the time of the telephone interview (range, 1 year to 17 months after Hurricane Katrina).

Take-away Points

Continuity of care for persons with chronic conditions may be critical in a postdisaster environment. Efforts to maintain continuity of care may have attenuated the outcomes of Hurricane Katrina because of the dedication of health providers who remained in the area and the diligence of the health plan in facilitating continuity of care. Specific lessons for policy makers and managed care organizations involve having systems in place to perform the following:

- Notify beneficiaries of benefit changes during a disaster to facilitate continued care.
- Make prescription medications available to beneficiaries.
- Identify, monitor, and stay in contact with the most vulnerable beneficiaries.

patients who were displaced out of state, particularly those from Orleans Parish, had dramatic increases in morbidity scores compared with those who were not nondisplaced. This may be an artifact of the morbidity measure, which depended in part on utilization, and may indicate greater access to healthcare or more thorough diagnostic workups after the disaster. It may also reflect differences in practice patterns between physicians seeing patients known to them in the setting of a Medicare managed care plan versus physicians seeing newly displaced older patients with multiple chronic conditions previously unknown to them in a fee-for-service encounter.

Although there was extensive hurricane damage to 2 key network hospitals, PH had signed 3 new local hospital agreements, which brought the number of contracted facilities up to 6 in the original service area within 1 year. For those displaced outside of the New Orleans area, the efforts made by PH to contact enrollees after Hurricane Katrina and to assure out-of-network providers of payment may have attenuated worse health consequences. The increased utilization suggests that the decision by the Centers for Medicare & Medicaid Services to require Medicare Advantage plans to continue payments without out-of-service area penalties was an important factor in providing ongoing access to care in the face of high and unexpected relocation following the disaster.

Our findings about the effect of Hurricane Katrina on chronically ill patients add a valuable perspective to that reported earlier by Kessler and colleagues,⁵ whose focus was on a population of persons who had contacted the American Red Cross or were defined as eligible for assistance from the Federal Emergency Management Agency. Many (30%-40%) reported that they had no health insurance, and there were few older persons (245 responses from those ≥ 60 years) in that population. Diseases and service utilization were self-reported. Our study population originally lived in several parishes, one third in the hardest hit parish of Orleans, affording a comparison of the health effect between those most heavily affected by the disaster and those less affected. All had health insurance through the MCO. Documented service utilization remained high after the first month.

Results from the small sample of telephone-interviewed PH enrollees mirrored the morbidity finding in the larger study population and provided a link between self-reports of heavy disruption and health decline. However, the low response rate to the telephone survey introduced the possibility of selection bias yielding reports of health outcomes and disruption effects that

did not represent those of the larger population. This possibility is somewhat attenuated by the fact that respondents and nonrespondents had similar health status before Hurricane Katrina, as well as that similar proportions came from Orleans Parish, presumably experiencing similar disruption. Locating persons after a disaster is a well-known problem. That only 13.3% could not be located is positive and testifies to the close contact maintained between enrollees and the health plan. The low proportion that reported having trouble getting healthcare in the first 4 months following Hurricane Katrina or in the longer term may be unique to the telephone survey respondents. Alternatively, it may relate to the fact that housing issues were so overwhelming or may be a tribute to the efforts made by the MCO to keep their medical system intact and to notify patients displaced from the New Orleans area that the costs of care would be covered by PH.

The study has several major strengths. First, the study focused on a continuously enrolled population with health data available on all subjects before and after Hurricane Katrina. Second, we utilized ACG methods, which provided a rigorous and well-established summary measure of health status, enabling comparisons before and after the event. The MCO continued operating with only minor interruption throughout the period following Hurricane Katrina, lending credibility to the complete capture of claims data. Third, unlike most studies in the disaster literature, this study focused on older adults and had 1 year of follow-up. Fourth, the mortality measure was reliable and accurate.

Several limitations prevent us from generalizing our findings to the entire area affected. We did not have a comparison Medicare population from New Orleans. In lieu of health data on the general population of New Orleans, we used benchmarking to a national older population and a propensity scoring technique to estimate year-to-year health decline in an unaffected population. Differences in outcomes may have been related to the uniqueness of this managed care population. There is some evidence in the literature that Medicare Advantage plan enrollees are healthier.³² In addition, voluntary disenrollment of patients from the MCO may have skewed the findings because more of those who disenrolled were from Orleans Parish and

more likely to be nonwhite, female, and enrolled in Medicaid. Both of these phenomena would have led to the study population's appearing healthier, suggesting that the total population may have had even greater decline in health.

Diagnostic codes, on which the ACG method is based, depend in part on utilization and access to care and on diagnostic coding habits of health service providers. However, several methods were used to assess alternative explanations for increases in morbidity and the effects of aging in this continuously observed cohort.

Other problems experienced by the study population such as mental health issues documented elsewhere³ and disruption to social networks and living arrangements—all of which may have an effect on the health of older individuals who rely on others for assistance—were beyond the scope of this analysis. However, these issues need to be considered in understanding the long-term effects of a disaster on the health of older persons.

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Author Affiliations: Johns Hopkins University Bloomberg School of Public Health (LCB, EAS, LU-P, BL, RC, KWL, JPW), Baltimore, MD; Health Data Services, Inc (RL), Baltimore, MD; and Johns Hopkins University School of Medicine (BL, QY), Baltimore, MD.

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Address correspondence to: Lynda C. Burton, ScD, Johns Hopkins University Bloomberg School of Public Health, 624 N Broadway, Baltimore, MD 21205. E-mail: lburton@jhsph.edu.

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