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Medication Adherence in Older Clinic Patients with Hypertension after Hurricane Katrina: Implications for Clinical Practice and Disaster Management

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Abstract

Background—In post-disaster situations, additional barriers may reduce antihypertensive medication adherence.

Methods—Between November 2005 and August 2006, 210 hypertensive patients receiving care at a multispecialty group practice in New Orleans completed a structured questionnaire. Antihypertensive medication adherence was measured with the Hill-Bone medication compliance subscale. In a subset of patients, data on difficulties patients encountered with blood pressure medications in the aftermath of Hurricane Katrina were collected.

Results—Seventy-six percent of patients reported damage to their residence and 46 % of patients had less-than-perfect medication adherence. After multivariate adjustment, less than perfect medication adherence post disaster was more common among people age <65 years (prevalence ratio = 1.37; 95% CI: 1.03 – 1.82) and nonwhites (1.32; 95% CI: 1.02– 1.71). Uncontrolled blood pressure (systolic/diastolic $\geq 140/\geq 90$ mm Hg) was more common in those with less-than-perfect adherence than their counterparts with perfect adherence (51% versus 42 %, respectively). In addition, 7% of patients reported not bringing their blood pressure medications when they evacuated, 28% ran out of blood pressure medications, 16% reported difficulties getting medications filled, and 28% reported a blood pressure medication change post-disaster.

Conclusions—Opportunities exist to improve disaster planning and prescription refill processes and increase medication adherence and hypertension control post-disasters.

Keywords

medication adherence; hypertension; disasters; hurricane

Introduction

On August 29, 2005, Hurricane Katrina devastated New Orleans and its surrounding parishes and was classified as the worst natural disaster to impact the United States. Over 500,000 people were evacuated and nearly 90,000 square miles declared a disaster area (1,2). Homes and all possessions were lost, communities were destroyed, and financial and personal losses escalated for thousands of residents. Many people are still displaced from their homes, communities and healthcare providers. Although disaster planners prepared for injuries, infectious diseases, and toxic exposures as leading diagnoses for disaster victims, chronic diseases such as hypertension and diabetes posed challenges in the aftermath of Hurricane Katrina (2–4). Around the time of the Hurricane, over 200,000 adults in the greater New Orleans area had a diagnosis of and were receiving treatment for high blood pressure (3). In post-disaster situations, where the medical infrastructure is in disarray and patients are distracted from their healthcare and lifestyle routines, new barriers to medication adherence can emerge. In the context of patients with hypertension this can lead to uncontrolled hypertension and subsequent cardiovascular complications. There is a need to consider the importance of chronic disease management including access and adherence to medications in disaster planning efforts (2,4).

Understanding patterns of medication adherence post-disaster in patients with chronic diseases may have important implications for planning and disease management in disaster-prone areas. And in these times, what areas are not prone to disasters? In an effort to gain greater insight into medication non-adherence in the aftermath of disaster, we examined non-adherence to antihypertensive medications in a group of patients attending a healthcare clinic in the year following Hurricane Katrina. Additionally, we assessed medication issues patients encountered in the aftermath of Hurricane Katrina.

Methods

Study Population and Study Design

We conducted a cross-sectional survey of community-dwelling patients attending the hypertension section of an established urban multispecialty group practice after Hurricane Katrina. Patients registering for routine appointments with their physician between November 2005 and August 2006 were asked to complete a self-administered core questionnaire, which consisted of questions regarding demographics, medication adherence, and damage to their residence. Additionally, between January and August 2006, a supplemental survey, along with the core survey, was administered that included questions about antihypertensive medication issues and difficulties after the hurricane. After excluding 23 participants who did not complete the full medication adherence subscale, 210 patients were included in the current analysis. Persons who did and did not complete the medication adherence scale were similar with respect to age, gender and race. Of patients who completed the core questionnaire, eighty-six patients also completed the supplemental survey. Those completing the supplemental and core surveys were similar with regards to demographics, blood pressure control, and mean medication adherence scores to those completing the core survey only. Blood pressure measurements, which were taken as part of the patients' routine visits, were provided by their treating physicians who were blinded to the questionnaire responses. Participants were classified as having uncontrolled blood pressure if the average of their systolic/diastolic blood pressure readings were $\geq 140/\geq 90$ mm Hg. The Institutional Review Board determined that this study using anonymous surveys was exempt research.

Survey Instrument

Hill-Bone Compliance to High Blood Pressure Therapy Scale—Designed as a simple tool for clinicians to evaluate patients' self-reported adherence levels, the Hill-Bone Compliance to High Blood Pressure Therapy Scale assesses three behavioral domains of high blood pressure treatment: medication taking, appointment keeping and reduced sodium intake. Written at a high fifth grade reading level and designed for self- or interviewer-assisted administration, the scale consists of 14 items, each with a four-point Likert response format. For example, for the question 'How often do you decide not to take your high blood pressure medicine?' the responses are: none of the time =1, some of the time =2, most of the time =3, and all of the time =4. Prior research has demonstrated the Hill Bone Compliance Scale to have adequate reliability, construct validity, and predictive validity in several independent populations. The validity and reliability of the scale in two urban samples of African-American adults with hypertension (5) and reliability in a sample of predominantly Caucasian hypertensive clinic patients similar to the current study population (but prior to the hurricane) have been previously described (6). Specifically, in a previous study of treated hypertensive adults who completed the Hill Bone medication taking subscale, higher compliance scale scores were associated with blood pressure control ($p < 0.01$); the total compliance scale was reliable (Cronbach's alpha 0.84) (5). In urban hypertensive black American men, the reliability for the medication taking subscale was 0.77 (7). In our previous study to assess reliability of this subscale in a sample of community dwelling, primarily white hypertensive adults, the Cronbach's alpha was 0.68 (6). We report herein the results of the nine-item medication adherence subscale in a sample of hypertensive clinic patients following the hurricane. The items in the sub-scale are additive with a range from 9 to 36 with higher scale score reflecting poorer compliance to antihypertensive therapy. Additionally, we divided this sub-scale into two domains, reflecting intentional and unintentional non-adherence. Six of the nine items reflect intentional (i.e. deliberately not taking medication) behavior and three items reflect unintentional (i.e.; forgetfulness) behavior towards medication non-adherence (Appendix).

Disaster-related Survey Items—The core and supplemental surveys included disaster-related questions. In the core questionnaire, participants were asked about damage to their residence through the following question: 'How much damage did you have to your residence?' Response options were: no damage, able to be inhabited with some repairs (i.e. damaged minimally), damaged or burned (hardly able to be inhabited; i.e. damaged moderately); and completely damaged or burned (8). The supplemental questionnaire included items on medication issues following Hurricane Katrina: whether participants ran out of blood pressure medications, had problems getting prescriptions filled and changed medications after the hurricane. A comment section was available for participants to explain medication changes and difficulties getting prescription filled.

Statistical Analyses—Given the high percentage of persons reporting perfect adherence, participants' response to the overall medication adherence subscale was dichotomized as being perfect (subscale score = 9) or not perfect (subscale score >9) (6). A multivariable binomial regression model that included age, gender, race, education, marital status and damage to residence as independent variables, simultaneously, was used to determine the prevalence ratios of less-than-perfect medication adherence associated with these characteristics. Prevalence ratios are recommended, in lieu of odds ratios, for use in cross-sectional studies with common outcomes. Additionally, the prevalence ratio of uncontrolled blood pressure associated with less-than-perfect adherence was determined. Less-than-perfect intentional and unintentional adherence were calculated by different demographic characteristics and damage to residence with differences across sub-groups assessed by chi-square tests. In addition, differences in medication issues encountered after Hurricane Katrina by participant

characteristics were assessed with chi square tests. All statistical analyses were performed using SAS version 9.1.3 (Cary, NC).

Results

Study Population Characteristics and Prevalence of Damage to Residence

The mean age of the 210 participants was 63.6 years; 46% were men; 69% were white; 89% had at least a high school education; and 66% were married. Seventy-eight percent of participants reported at least some damage to their residence with 16% reporting complete damage (Figure 1).

Prevalence of Less-than-perfect Medication Adherence and Blood Pressure Control

With the Hill Bone medication-taking subscale, 46 percent of the patients had less-than-perfect adherence to antihypertensive medications in the year following Hurricane Katrina. After multivariate adjustment, age <65 years was associated with less-than-perfect medication adherence (prevalence ratio [PR] 1.37; 95% CI: 1.03– 1.82). In this same model, less-than-perfect antihypertensive medication adherence was more common in nonwhites versus whites (PR=1.32; 95% CI 1.02– 1.71). Although men, those who were not married, had less than a high school education and had complete damage to their residence were more likely to have less-than-perfect medication adherence, these factors did not achieve statistical significance (each $p>0.05$).

Uncontrolled blood pressure was more common in patients with less-than-perfect adherence (51%) than those with perfect adherence (42%). After adjusting for age, race, education, and complete damage to residence, patients with less-than-perfect medication adherence were non-significantly more likely to have uncontrolled blood pressure than participants who reported perfect adherence (PR = 1.30; 95% CI 0.94, 1.81).

Unintentional versus Intentional Non-adherence

Unintentional non-adherence was more common (39%) than intentional non-adherence (28%). Patients younger than 65 years and non-whites were more likely to have less-than-perfect unintentional adherence when compared to their counterparts older than 65 years and whites. Also, those younger than 65 years, nonwhites, and those not married were more likely to have less-than-perfect intentional adherence (Table 1). Although less-than-perfect intentional and unintentional adherence was more common among patients reporting complete damage to their residence, versus less than complete damage, the differences did not achieve statistical significance.

Post-disaster Medication Issues (supplemental survey)

Several issues were identified regarding antihypertensive medications in the post-disaster period: patients not bringing medications with them when they evacuated; running out of medications; difficulties getting medications filled; and medication change post-disaster (Figure 2). The distribution of post-Katrina medication issues by socio-demographic characteristics including education, and marital status is presented in Table 2. Patients with less than a high school education were significantly more likely to report difficulties getting prescriptions filled after Hurricane Katrina and were more likely to have had their medications changed after the hurricane (Table 2). For those reporting difficulties filling prescriptions after the hurricane ($n=14$), the following reasons were cited: the medication was not available at the pharmacy where they evacuated and they had to travel out of town to get prescriptions filled; the pharmacy was not open; there were problems with insurance; the local pharmacy in New Orleans flooded and there were no records of their prescription; the pharmacy had delays in

receiving medications. For patients who reported a change in the antihypertensive medications (n=24), reasons included that they received a new prescription, an increased dose, or they discontinued a drug.

Discussion

Uncontrolled hypertension remains a significant public health challenge (9–11) with a potential major contributor being patient non-adherence to prescribed antihypertensive medication therapy (12). Survivors of a disaster who are burdened with chronic diseases such as hypertension may experience disruptions in treatment. In a sample of adult displaced and non-displaced Katrina survivors, Kessler and others found 31.2% had hypertension with 21.7% of these adults reported cutting back on antihypertensive treatment in the post-disaster period (2). Patients in that study also reported the most common reasons for cutting back on treatment were limited access to physicians, limited access to medications, and financial/insurance problems (2). In our study, hypertensive patients reported problems with access to prescribed medications and a high rate of less-than-perfect medication adherence in the year following Hurricane Katrina. The rate of less-than-perfect medication adherence was higher in the current study (46%) when compared to a similar hypertensive clinic population surveyed prior to Hurricane Katrina (40%) (6). In post-disaster situations, when the healthcare infrastructure is in disarray and personal and financial losses escalate, additional barriers to medication adherence may exist, further compromising blood pressure control and health. There is a continued need to strengthen local disaster plans and public health messages for populations with chronic medical conditions such as hypertension (13).

Although medication adherence has traditionally been defined as an overall concept, prior work has suggested that unintentional and intentional non-adherence are different phenomena (14, 15). Unintentional non-adherence is considered a passive process in which patients may be forgetful or careless about proper adherence to prescribed therapies, whereas intentional non-adherence is an active process in which patients decide to deviate from their prescribed therapy (14). Given the high prevalence of unintentional non-adherence (i.e. forgetfulness) in this study after Hurricane Katrina, physicians and other healthcare providers may recommend reminder systems, engagement of a family member or friend in the patient's care, or weekly medication pill boxes as part of their patients' disaster planning efforts. For patients with intentional non-adherence, efforts should be tailored to educate patients about the importance of continuing medical treatment for hypertension even in post-disaster time periods and reporting potential side effects of the medications to their providers. In assisting patients living in disaster-prone areas, it remains incumbent on physicians and other healthcare providers to consider poor adherence as a factor contributing to poor blood pressure control in the aftermath of catastrophes, to communicate the importance of medication adherence while taking into account patient-specific barriers (e.g. forgetfulness, side effects) with their patients, to consider approaches a priori that might lessen the effect of barriers on medication adherence and to actively engage the patient in selecting adherence-enhancing strategies (16,17). Tailoring interventions to improve patient adherence to therapy may be particularly important in managing patients with chronic diseases post-disasters.

Study Limitations and Strengths

Results of the current study should be interpreted with the following limitations in mind. The sample size was relatively small and participation rates were not captured. Data were not available on the socioeconomic and clinical make-up of those who attended the clinic pre and post hurricane Katrina; thus, we could not determine if the sample was representative of the entire clinic population. The survey included mostly insured patients returning for a clinic visit in a healthcare facility in the New Orleans metropolitan area that suffered minimal structural

damage and had access to electronic medical records. Therefore, the results may under-represent the most disadvantaged and seriously ill patients who were unable to return to New Orleans for clinic visits and patients who were displaced from their healthcare providers, facilities, and medical records because of structural damage to the facilities. These patients may have experienced greater difficulties in filling prescriptions, accessing appropriate medical care, and adhering to prescribed therapies. It is possible that rates of less-than-perfect adherence could be different in the patients unable or unwilling to participate in this study; thus, there may be some selection bias inherent to those who participated in this study. The cross-sectional nature of the study and the lack of detailed information on clinical outcomes prevent conclusions regarding any causal relationship related to less-than-perfect adherence. Despite the advantages of assessing medication adherence by self report (e.g., simplicity, speed, and viability of use) there are potential shortcomings of self-report medication adherence including reliance on recall and social desirability with a tendency to overestimate adherence [16]. More work is required to validate the Hill Bone medication-taking subscale in demographically diverse populations.

With these limitations in mind, there are public health and clinical implications of our findings. Access to adequate supplies of prescribed medications for hypertension is critical to successful disaster relief efforts in economically developed countries such as the United States (2). Even in the New Orleans metropolitan region facilities minimally damaged by Hurricane Katrina, hypertensive patients experienced difficulties with prescribed treatment for their disease, which possibly lead to higher rates of less-than-perfect medication adherence in the population after, compared to a similar population before, Hurricane Katrina (6). In planning for disasters, patients, healthcare providers, healthcare systems, and local communities should work together to identify strategies to ensure access to care and chronic disease medications (4). Patients should work with their physicians and pharmacies to ensure they have access to at least a one month's supply of medication when evacuating from disaster prone areas and a plan for refilling prescriptions in the event that displacement is extended beyond one month. In addition, patients should evacuate with up-to-date lists of their diseases and the current medications they take. Healthcare systems in disaster prone areas should consider ways to ensure access to patients' prior medical records (e.g. electronic medical and prescription records), which may facilitate record keeping and prescription refills (2).

Conclusions

Nearly half of patients participating in the current study had less than perfect adherence to antihypertensive medications in the year following Hurricane Katrina. In addition, many patients encountered difficulties with respect to their antihypertensive medication in the post-disaster period. In areas prone to natural and other disasters, preparation efforts should include a plan to ensure appropriate and timely access to medications and consideration of tailored approaches to address intentional versus unintentional non-adherence for patients with chronic diseases.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Hurricane Katrina Advisory Group, Harvard Medical School, Department of Health Care Policy. Overview of Baseline Survey Results. 2006 August 29 [Accessed on June 26, 2007]. Available from: <http://www.hurricanekatrina.med.harvard.edu/reports.php>
http://hurricanekatrina.med.harvard.edu/pdf/baseline_report%208-25-06.pdf
2. Kessler RC. The Hurricane Katrina Community Advisory Group. Hurricane Katrina's Impact on the Care of Survivors with Chronic Medical Conditions. *J Gen Intern Med* 2007;22:1225–1230. [PubMed: 17657545]
3. Ford, ES.; Mokdad, AH.; Link, MW., et al. Chronic Disease in Health Emergencies: In the Eye of the Hurricane; *Prev Chronic Disease* [serial online]. 2006 Apr. p. 3 Available from URL: http://www.cdc.gov/pcd/issues/2006/apr/05_0235.htm
4. Mokdad, AH.; Mensah, GA.; Posner, SF., et al. When chronic conditions become acute: prevention and control of chronic diseases and adverse health outcomes during natural disasters. *Prev Chronic Dis* [serial online]. 2005. Available from: URL: http://www.cdc.gov/pcd/issues/2005/nov/05_0201.htm
5. Kim MT, Hill MN, Bone LR, et al. Development and Testing of the Hill-Bone Compliance to High Blood Pressure Therapy Scale. *Prog Cardiovasc Nurs* 2000;15:90–96. [PubMed: 10951950]
6. Krousel-Wood MA, Muntner P, Jannu A, et al. Reliability of a Medication Adherence Measure in an Outpatient Setting. *Am J Med Sci* 2005;330:128–133. [PubMed: 16174996]
7. Kim MT, Han H, Hill MN, Rose L, Roary M. Depression, substance use, adherence behaviors, and blood pressure in urban hypertensive black men. *Ann Behav Med* 2003;26:24–31. [PubMed: 12867351]
8. Inui A, Kitaoka H, Majima M, et al. Effect of the Kobe Earthquake on Stress and Glycemic Control in Patients with Diabetes Mellitus. *Arch Intern Med* 1998;158:274–278. [PubMed: 9472208]
9. Ong KL, Cheung BM, Man YB, et al. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999–2004. *Hypertension* 2007;49:69–75. [PubMed: 17159087]
10. Fields LE, Burt VL, Cutler JA, et al. The burden of adult hypertension in the United States 1999 to 2000: a rising tide. *Hypertension* 2004;44:398–404. [PubMed: 15326093]
11. Kearney PM, Whelton M, Reynolds K, et al. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005;365:217–23. [PubMed: 15652604]
12. Burnier M, Santschi V, Favrat B, et al. Monitoring compliance in resistant hypertension: an important step in patient management. *J Hypertens Suppl* 2003;21:S37–S42. [PubMed: 12929906]
13. Preliminary medical examiner reports of mortality associated with Hurricane Charley---Florida 2004. *MMWR Morbidity Mortality Weekly Report* 2004;43:835–7.
14. Lowry KP, Dudley RK, Oddone EZ, et al. Intentional and unintentional nonadherence to antihypertensive medication. *Ann Pharmacother* 2005;39:1198–203. [PubMed: 15956238]
15. Wroe AL. Intentional and Unintentional nonadherence. A study of decision-making. *J Behav Med* 2002;25:355–72. [PubMed: 12136497]
16. Krousel-Wood MA, Hyre A, Muntner P, et al. Methods to improve medication adherence in hypertensive patients: current status and future directions. *Curr Opin Cardiol* 2005;20:296–300. [PubMed: 15956826]
17. Hawkshead J, Krousel-Wood MA. Techniques for Measuring Medication Adherence in Hypertensive Patients in Outpatient Settings: Advantages and Limitations. *Disease Management and Health Outcomes* 2007;15:109–118.

Figure 1. Report of Damage to Residence in Sample of Patients (n= 210) in a New Orleans metropolitan area clinic from November 2005 to August 2006

Damaged Minimally = able to be inhabited with some repairs; Damaged Moderately = Hardly able to be inhabited

Figure 2.
Post-Disaster Medication Issues in Sample of Patients (n=86) in a New Orleans metropolitan area clinic from November 2005 to August 2006

Table 1

Distribution of Less-than-perfect Intentional and Unintentional Medication Adherence by Socio-Demographic Characteristics and Damage to Residence in Sample of Patients (n= 210) in a New Orleans metropolitan area clinic from November 2005 to August 2006

	Prevalence of less-than-perfect adherence			
	%	Intentional <i>p</i> -value	%	Unintentional <i>p</i> -value
Age, yrs				
<65	39	<0.001	50	<0.01
≥65	18		30	
Gender				
Male	28	0.94	40	0.75
Female	28		38	
Race				
White	20	<0.01	35	0.06
Non-white	46		49	
Education				
< High school	42	0.12	46	0.47
≥ High school	26		38	
Marital status				
Married	24	<0.05	39	0.93
Not married	37		39	
Complete damage of residence				
Yes	36	0.25	49	0.23
No	27		37	

Table 2
 Distribution of Post-Katrina Medication Issues by Socio-Demographic Characteristics in Sample of Patients (n= 86) in a New Orleans metropolitan area clinic from November 2005 to August 2006
Post-Katrina Medication Issues

	Did not bring Medications %	Ran out of medications %	Difficulties getting medications filled %	Changed medications %
Age				
<65 yrs	7.5	35.0	22.5	35.0
≥65 yrs	6.5	21.7	10.9	22.2
Gender				
Male	5.4	32.4	24.3	27.0
Female	8.2	24.5	10.2	29.2
Race				
White	6.5	24.2	21.0	32.8
Non-white	8.3	37.5	4.2	16.7
Education				
< High school	18.2	36.4	45.5*	54.6*
≥ High school	5.3	26.7	12.0	24.3
Marital status				
Married	8.6	25.9	13.8	24.6
Not married	3.6	32.1	21.4	35.7

*

p< 0.05