

Trial of a Survey Instrument to Establish the Hurricane Preparedness of and Medical Impact on a Vulnerable, Older Population

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ADL = activity of daily living

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Abstract

Introduction: Millions of vulnerable, elderly individuals live in coastal areas susceptible to hurricanes and are at risk for adverse health outcomes. The purpose of this study was to determine the status of preparedness for and possible health consequences of a hurricane on a vulnerable, but experienced, elderly population. **Problem:** Preparedness guidelines have been published, but it is unclear how well-prepared elderly individuals are for hurricanes, and what impact hurricanes may have on their health.

Methods: Five hundred forty-seven ambulatory patients who attended an urban teaching hospital's geriatrics clinic in Florida were surveyed. A 25-question survey that asked whether subjects followed the American Red Cross guidelines for hurricane preparation was developed. The participants were asked what hurricane supplies they had, and whether they would need to evacuate or utilize storm-proof window shutters. They also were queried about definitions and their understanding of hurricane warnings. Three possible health impacts during the two weeks following Hurricane Wilma in 2005 were asked: (1) falls; (2) missed medication; and (3) missed doctor's appointments. An additional 105 patients in the same clinic were asked about the same three health outcomes one and one-half years after the hurricane struck.

Results: Two-thirds of respondents were missing at least one supply item. A multivariate analysis indicated that there was no relationship between the subjects' demographic characteristics and the possession of the suggested disaster supplies. Although 36% would need to evacuate, only 56% of these 36% had a plan. Only 63% had storm-proof windows or shutters, and of these, only 46% could install them. Gasoline-powered electrical generators can be useful, but also a source of morbidity or mortality following a hurricane. For example, this study found that 28% of respondents had generators, but only 46% knew how to use them. Subjects immediately after the hurricane missed *fewer* doses of medication than at other times (3.4% vs. 6.7%; $p < 0.0001$) and fell slightly *less* often (8.8% vs. 12.9%; $p < 0.0001$). However, there were significantly more missed doctors appointments after the hurricane (11.6% vs. 0.1%, $p < 0.0001$).

Conclusions: The survey indicated that even a well-experienced population lacks adequate hurricane preparation. Most still are vulnerable in at least one aspect of preparation. The elderly may be more likely to miss medical appointments immediately following a hurricane. Interventions to improve hurricane preparedness should be piloted.

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Introduction

At least 45 million people live in the Atlantic and Gulf coastal regions of the United States, which are vulnerable to the effects of hurricanes.¹ Many of those most at risk are the elderly. By 2025, at least 12% of the population of all of the coastal states will be >65 years of age.² Due to rising sea surface temperatures, since 1995, the yearly frequency of hurricanes in the North Atlantic has grown almost 40%.³

Older individuals are more likely to suffer more adversely from hurricanes than younger populations. For example, in 2005, >1,000 people perished in 14 hurricanes.⁴ Seventy-four percent of the deaths in Hurricane Katrina, the deadliest hurricane of that year, occurred in persons >60 years of age.⁵ In 2004, Hurricane Charley passed through southern and central Florida, areas highly populated by elderly individuals. Half of the fatalities caused by this storm were among older persons.⁶ This manuscript describes the pilot application of a survey instrument used to assess storm preparedness and the impact of a hurricane on a well-experienced elderly population.

Few studies have reported the total health impact of hurricanes specifically on the elderly. After Hurricane Charley, 10–15% of all households that contained at least one person \geq 60 years experienced disruption in healthcare services.⁶ In Charlotte County, Florida, one-third of all elderly residents self-reported a worsened chronic health condition, and 28% were unable to access routine medical care.⁷ Increases in trauma, asthma, and cardiovascular disease in the period immediately following a hurricane also have been reported in affected populations.^{8–10} Individuals >75 years of age had an injury rate three times that seen in persons <20 years of age during a typhoon in China.¹¹ However, not all studies observed that the elderly have more health problems after a tropical hurricane. A report on the number of injuries in rural Louisiana after Hurricane Andrew in 1992 found that those in the fourth decade of life had 30% more injuries than those >60 years of age.¹² A study of post-traumatic stress disorder among survivors of a hurricane in Honduras did not find an increased incidence among older persons.¹³

Florida has the highest percentage of elderly individuals per total population, and is most frequently affected by hurricanes of all US states.^{2,14} On 24 October 2005, Hurricane Wilma, the strongest hurricane ever recorded in the Atlantic,¹⁵ hit southeastern Florida, where nearly one million elderly persons live.¹⁶ Hurricane Wilma's highest maximum sustained winds recorded after landfall were 103 miles per hour.¹⁵ At least 25 people died, and six million people lost electrical power for up to three weeks.¹⁷ Transportation was impaired by a gasoline shortage, and there was a rise in toxic exposures to gasoline from siphoning. There were 58 cases of carbon monoxide poisoning from the use of portable, electrical generators following the storm.¹⁸ The results of a survey described here detail several possible health effects of this hurricane on a population of affected elderly.

Although hurricanes cannot be prevented, individuals can take advance measures to mitigate the deleterious effects of hurricanes. The American Red Cross has established a series of guidelines that individuals should follow to protect themselves.¹⁹ These include: (1) learning the warning terminology used by the National Weather Service to describe approaching storms; (2) paying attention to warning notifications passed through the media; (3) preparing and locating needed supplies; (4) securing one's residence; and (5) if necessary, evacuating.¹⁹ The survey instrument discussed in this manuscript also was designed to help understand how readily a well-experienced population of elderly

individuals follows hurricane preparation guidelines. This study was approved by the Investigation Review Board of the Miami Veteran's Affairs Healthcare System.

Methods

Population

A written questionnaire was administered by investigators to a convenience sample of 547 ambulatory, geriatric subjects in 2006 and 2007. They were at least 65 years of age and patients of geriatric clinics at the Miami Veterans Affairs Healthcare System, a teaching hospital on the campus of the University of Miami Miller School of Medicine. An additional 100 subjects in the same clinic were asked several health questions that were part of the survey, a year and a half after the hurricane.

Questionnaire

A 25-question survey was developed (Appendix) that asked whether subjects followed the American Red Cross guidelines for hurricane preparedness. It took approximately 15 minutes to complete the survey. Participants were asked to state what hurricane supplies they had, whether they would need to evacuate, and whether they could put up storm-proof shutters for windows or clear objects from their yard. They were asked to provide definitions used to indicate impending hurricanes. In addition, they were asked if they had experienced any of three possible health impacts during the two weeks following the most recent hurricane: (1) falls; (2) missed doses of medication(s); and (3) missed doctor's appointments. In order to validate the consistency of the information gathered in the survey (i.e., to determine if there was a significant difference in the incidence of adverse health outcomes during the period of time after the hurricane than at other times), a second convenience sample of 105 elderly subjects was surveyed informally as part of regular geriatric clinic visits. These subjects were asked about the presence of the three health impacts during the two weeks prior to their visits. This second sample only was asked about these health impacts, one and one-half years after the hurricane; no further information was collected from them. The survey also asked basic demographic information (age, education, income, number of hurricanes experienced, number of years living in hurricane-prone region). It also inquired as to the subjects' housing and ability to perform activities of daily living (ADLs): both basic (i.e., feeding, dressing, bathing, using the toilet, and transfers out of bed), as well as instrumental activities (i.e., shopping, cooking, cleaning, using the telephone, handling finances, using transportation), and their means for obtaining information about approaching hurricanes.

Data Processing

Frequencies of responses were calculated for the questions on the survey and logistic regression analyses were obtained to determine correlations between the demographic characteristics, functional status of the patients, and steps in hurricane preparation. The independent variables were age, race, income, ADLs, and prior hurricane experience. The dependent variable was lack of at least one supply item.

	%
Age (years)	
65–70	9.5
71–79	41.9
80 or above	48.6
Race	
White	58.8
Black	31.1
Hispanic	8.2
Other	1.9
Education	
Never went to school	1.9
Grade 1–6	3.5
Grade 7–11	17.3
High school graduate	21.5
Any college or vocational school	28.6
College graduate	16.0
Post-graduate	11.2
Income (US \$)	
<\$6,000	8.4
\$6,000–\$25,000	45.1
\$25,001–\$50,000	23.8
\$50,001–\$100,000	12.7
>\$100,000	10.0
At least one deficit in	
Basic activities of daily living	21.6
Instrumental activities of daily living	33.0
Any activities of daily living	36.4
Years living in hurricane-prone areas	
<1	1
1–4	6.8
5–10	8.5
>10	83.7
Hurricanes experienced	
<1	1.7
1–4	30.8
5–10	30.8
>10	36.7

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Table 1—Demographic characteristics of the subjects (n = 547)

A chi-square test was used to identify the statistically significant differences in frequencies for the three possible adverse health consequences of hurricanes between the initial sample of 547 subjects and the second sample of 105 subjects.

Results

The demographic characteristics of the 547 subjects are listed in Table 1. The study included an ethnically, educationally, and financially diverse population with a great deal of experience with hurricanes. More than two-thirds had lived through at least five hurricanes.

In the two weeks after the hurricane subjects who:	%
Experienced a fall ^a	8.8
Missed doses of medication ^b	3.4
Missed doctor's appointments ^c	11.6

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Table 2—Impact of Hurricane Wilma among subjects
^an = 502; ^bn = 471; ^cn = 416

The percentages of subjects who reported that they had experienced one of the three possible adverse health outcomes during the two weeks after Hurricane Wilma are in Table 2. When the percentages of positive responses were compared with those in the second sample, subjects after the hurricane missed fewer doses of medication (3.4% vs. 6.7%; $p < 0.0001$) and fell slightly, but statistically less often (8.8% vs. 12.9%; $p < 0.0001$) than those when no hurricane was present. However, there were significantly more missed doctors appointments during the weeks after the hurricane (11.6% vs. 0.1%; $p < 0.0001$).

Different aspects of the disaster preparation among subjects are in Table 3. A multivariate analysis indicated that there was no correlation between the subjects' demographic characteristics (age, race, income, education, prior experience with hurricanes) and their possession of the suggested disaster supplies. Although many subjects appeared to have taken many of the necessary steps to prepare, 67.6% had not performed at least one of the recommended steps. Thirty-six percent believed they would need to evacuate; many of them had ADL deficits, such as inability to take their own medicines. Information was not collected that would verify, based on the subjects' home addresses, whether this belief was correct. Sixty-three percent of the elderly had storm-proof shutters or windows, but only 46% of these respondents believed they could put them up. Twenty-eight percent owned an electrical generator, but only 46% knew how to operate one.

Responses about what information source they used to find out about hurricanes are in Table 4. Television was the most popular source, followed by radio and newspapers.

Knowledge of the terminology used in disaster warnings is described in Table 5. Many of the subjects' knowledge of the meaning of the terms "hurricane watch" and "hurricane warning" and the steps that are necessary to take when one of them is declared was found to be deficient.

Discussion

Despite the potential large public health implications of hurricanes on the elderly, the effect of storms and the preparedness of the elderly have not been studied extensively. This study is a preliminary effort to address these issues.

However, there are several major limitations to this study. The subject population was composed of ambulatory subjects who were veterans attending only one clinic in a hurricane-vulnerable region, and therefore, may not be representative of larger populations at-risk. Data are not available for the elderly individuals in the population-at-

Items subjects possess	%
A 3-day supply of water	86
A 3-day supply of canned food	88
A 3-day supply of medicines	95
A can opener	96
A first-aid kit	79
A battery-powered or hand-cranked flashlight	92
A battery-powered or hand-cranked radio or TV	81
Extra batteries	82
Rainwear or other protective clothing for working outside	74
Sleeping bag or extra bedding	57
Knowledge of or written instructions on how to turn off the utilities (gas, electricity, and water)	70
Percentage of subjects missing any item above	68
Need to leave their home if a warning was declared	36
With at least one deficit in basic ADLs	10
With at least one deficit in instrumental ADLs	14
Have an evacuation plan	56
Home has storm shutters for windows or storm-proof windows	63
Ability to put up storm shutters on windows	46
An electric generator	28
Knowledge of how to use an electric generator	46

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Table 3—Disaster preparations among subjects (n = 510)
(ADL = activity of daily living; TV = television) ...

large in Miami-Dade County, where the clinic is located. The population of Miami-Dade County is 60.6% Hispanic, 19.2% non-Hispanic whites, 20.5% blacks, and 1.5% Asians, and the mean household income in 2004 was US \$34,682.²⁰ Thus, the sample in this study is not representative of the general population.

Furthermore, these elderly individuals were asked to recall possible adverse events, which in some cases were one to two years in the past. The recorded frequencies of these events probably are underestimates, so the significance of differences in the rates of falls and missed doses of medications after the hurricane and at other times is uncertain. Alternatively, if the differences in rates are accurate, it is possible that, since most patients stockpiled supplies of their medications before the hurricanes, they were less likely to run out. Additionally, since they were less likely to travel outside the home after a storm, they may have been less likely to fall.

Nevertheless, the results of this investigation suggest that even a well-experienced elderly population may be insufficiently prepared for a disaster. Approximately two-thirds of subjects had at least one of the recommended supplies suggested for hurricanes. Many subjects appeared not

Source	% who use
Television	95
Radio	80
Newspapers	72
Other People	42
Internet	24
Other Methods	7

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Table 4—Source of information about hurricanes

Warning	%
Hurricane Watch—correctly named time until storm is expected ^a	8
Hurricane Watch—correctly named at least one preparation step ^b	67
Hurricane Warning—correctly named time until storm is expected ^c	4
Hurricane Warning—correctly named at least one preparation step ^d	38

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Table 5—Knowledge of disaster warnings

^an = 410; ^bn = 312; ^cn = 431; ^dn = 290

to understand the meanings of the storm warnings properly. Evacuation efforts could be complicated by the number of those evacuees who might have difficulty performing ADLs. While incidents of carbon monoxide poisonings have occurred from the use of gasoline-powered electrical generators after hurricanes, 38% of the elderly have these generators, but only 46% understand how to use them.

Lack of preparation among experienced populations has been found in two recent telephone surveys of 1,100 individuals in the Atlantic and Gulf coastal states; and a May 2007 survey of 625 people in Florida conducted by the also confirmed this lack of preparation. Among coastal residents, 61% had no survival kit, and 82% of those who did have a kit, packed it with items that were fire hazards (candles and kerosene lamps). Sixteen percent would not evacuate if they were ordered to do so.²⁰ While the 625 Floridians were more likely to have had a family disaster plan (69%), 89% had candles in their survival kits, 10% did not know whether they ought to evacuate or not, and 11% would not leave under any circumstances.²¹

There are many reasons healthcare providers must be aware of the growing danger to vulnerable populations from the increasing number of hurricanes. In order to prevent a disaster-related health crisis, public health officials must plan for the increasing health needs of a growing number of vulnerable individuals. Just as primary care providers safeguard the health of their patients with other forms of preventive medicine, they also might make a valu-

able contribution to the health of their patients by educating them (perhaps by reinforcing disaster preparation recommendations) and helping them plan for emergencies in which transportation may be problematic or impossible once the storm hits, as occurred when Hurricane Katrina struck New Orleans. Since elderly patients often have sensory, cognitive, and physical deficits, extra effort will be needed to help them prepare. Further research should examine the preparedness of the frail elderly, and pilot the efficacy of interventions to educate healthcare profession-

als and the elderly themselves to meet the challenge of safeguarding the health of older individuals before future hurricanes threaten their safety.

Conclusions

The survey proved indicated that even a well-experienced population lacks adequate hurricane preparation. Most still are vulnerable in at least one aspect of preparation. The elderly may be more likely to miss medical appointments immediately following a hurricane. Interventions to improve hurricane preparedness should be piloted.

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Appendix—Hurricane awareness survey

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Thank you for agreeing to complete this Hurricane Awareness Survey. The purpose of this survey is to learn about how elderly veterans get ready for hurricanes. This may help the VA be more prepared to provide services to veterans in South Florida during future hurricane seasons.

This survey asks 25 questions. When you answer the questions, most of the time, you will be asked to "circle your answer" or "circle Yes or No." There are a few questions that ask you to fill in the blank. Please try to answer all the questions. You do not need to answer questions that make you feel uncomfortable.

Again, thank you very much for taking the time to do to this survey.

-
1. How old are you? (circle your answer)
 - A. 65–70
 - B. 71–79
 - C. 80 or older

 2. How would you describe your race? (circle your answer)
 - A. White
 - B. Black
 - C. Hispanic
 - D. Other

 3. Circle the answer that includes the highest grade you finished in school.
 - A. I never went to school
 - B. Grade 1–6
 - C. Grade 7–11
 - D. High school graduate
 - E. Any college or vocational school
 - F. College graduate
 - G. Post graduate

 4. What is your yearly income from all sources? (circle your answer)
 - A. Less than \$6,000
 - B. \$6,000 to \$25,000
 - C. \$25,001 to \$50,000
 - D. \$50,001 to \$100,000
 - E. More than \$100,000

 5. What is your occupation or what was your occupation before you retired? (fill in the blank)

 6. Do you need help doing any of the following? (circle "Yes" or "No")

A. Using the toilet?	Yes	No
B. Feeding yourself?	Yes	No
C. Getting dressed?	Yes	No
D. Grooming (for example: brushing teeth, combing hair, clipping nails, shaving, or putting on make-up)?	Yes	No
E. Walking?	Yes	No
F. Taking a shower or bath?	Yes	No
G. Using the telephone?	Yes	No
H. Shopping for groceries?	Yes	No
I. Cooking or preparing food for a meal?	Yes	No
J. Cleaning the house?	Yes	No
K. Doing your laundry?	Yes	No
L. Using public transportation (bus, taxi, train)?	Yes	No
M. Taking your medicines?	Yes	No
N. Paying bills or writing checks or banking?	Yes	No

 7. What kind of house or home do you live in? (circle your answer)
 - A. Single family home
 - B. Townhouse or row house (a house attached to at least one other family's house)
 - C. Apartment/condominium (up to 4 stories)
 - D. High-rise condominium (higher than 4 stories)
 - E. Mobile home

 8. Who do you live with? (circle your answer)
 - A. I live alone
 - B. I live with my spouse
 - C. I live with my spouse and other people
 - D. I live with one or more people other than a spouse

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9. How long have you been living in an area that has a "hurricane season"? (circle your answer)
 A. Less than 1 year
 B. 1–4 years
 C. 5–10 years
 D. More than 10 years
10. How many hurricanes have you been in? (circle your answer)
 A. 0
 B. 1–4
 C. 5–10
 D. More than 10
11. In the two weeks after Hurricane Wilma... (circle "Yes" or "No")
 A. Did you trip and fall, or fall even without tripping? Yes No
 B. Did you miss taking any of your medicines because you were unable to get them? (Check here if you were taking NO medication, then go to the next question) Yes No
 C. Did you miss any doctors' appointments because they were cancelled or you could not get there? (Check here if you had NO doctor's appointments then go to the next question)
12. Do you have the following supplies ready for use in case of a hurricane: (circle "Yes" or "No")
 A. A 3-day supply of water? Yes No
 B. A 3-day supply of canned food? Yes No
 C. A 3-day supply of medicines? Yes No
 D. A can opener? Yes No
 E. A first-aid kit? Yes No
 F. A battery-powered or hand-cranked flashlight? Yes No
 G. A battery-powered or hand-cranked radio or TV? Yes No
 H. Extra batteries? Yes No
 I. Rainwear or other protective clothing for working outside? Yes No
 J. Sleeping bag or extra bedding? Yes No
 K. Do you know how or do you have written instructions on how to turn off the utilities (gas, electricity, and water)?
 Yes No
13. In case of a hurricane warning, would city or county officials ask you to leave your home? (circle "Yes" or "No")
 Yes No
14. If you decide to leave your home before a hurricane comes, do you have an evacuation plan? (circle "Yes" or "No")
 Yes No
15. Does your house or home have hurricane shutters or storm-proof windows? (circle "Yes" or "No")
 Yes No
16. If you had to, can you put up storm shutters by yourself? (circle "Yes" or "No")
 Yes No
17. Do you have a portable or built-in electrical generator? (circle "Yes" or "No")
 Yes No
18. If you have to use a generator, do you know how operate it? (circle "Yes" or "No")
 Yes No
19. Circle ALL of the methods below you use to learn about an approaching tropical storm or hurricane.
 A. TV
 B. Radio
 C. Newspapers
 D. Hear from other people
 E. The Internet
 F. Other methods (write other methods here _____)
20. Circle the one method below you use THE MOST to learn about an approaching tropical storm or hurricane.
 A. TV
 B. Radio
 C. Newspapers
 D. Hear from other people
 E. The Internet
 F. Other methods (write other methods here _____)
21. As a tropical storm or hurricane approaches, would you be able to clear small objects from the yard if you needed to?
 (circle "Yes" or "No")
 Yes No

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Appendix—Hurricane awareness survey

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On the line below, describe what "HURRICANE WATCH" means.

22. On the lines below, make a list of the things you would do if a "HURRICANE WATCH" is declared? (fill in as many as you can)

23. On the line below, describe what "HURRICANE WARNING" means.

25. On the lines below, make a list of the things you would do if a "HURRICANE WARNING" is declared? (fill in as many as you can)

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