ORIGINAL RESEARCH

A Comparison of Patient Needs Following Two Hurricanes

Kevin E. Nufer, MD, Gina Wilson-Ramirez, MD, MPH

Center for Disaster Medicine, Department of Emergency Medicine, University of New Mexico, Albuquerque, New Mexico USA

Correspondence:
Kevin E. Nufer, MD
Emergency Department
MSC10 5560
1 University of New Mexico
Albuquerque, NM 87131-0001 USA
E-mail: knufer@salud.unm.edu

Abbreviations:
CI = confidence interval
DMAT = Disaster Medical Assistance Team
OR = odds ratio
NM-1 DMAT = The New Mexico-1 Disaster Medical Assistance Team
PMH = past medical history
URI = upper respiratory infection

Keywords: deployment; disaster; disaster planning; Disaster Medical Assistance Team (DMAT); hurricane; Hurricane Andrew; Hurricane Iniki

Web publication: 13 August 2004

Abstract

Objectives: The New Mexico-1 Disaster Medical Assistance Team (NM-1 DMAT) has responded to more disasters due to hurricanes than disasters from any other type of event. To assess whether defined patient needs may be applied to future hurricanes, the patient needs after Hurricanes Andrew and Iniki were compared. The study question was, "Did patient medical needs differ after these hurricanes?"

Methods: *Design*: Retrospective cohort review. *Subjects*: All patients evaluated by NM-1 DMAT following Hurricanes Andrew and Iniki. *Observations*: Age, past medical history, chief complaint, diagnosis, diagnostic tests, treatments, triage level, and disposition. Age was analyzed using Student's *t*-test, other data were analyzed using the chi-square test.

Results: A total of 1,056 patients were evaluated. Age distributions did not differ between events. More patients had co-morbidities after Hurricane Andrew. The only difference in chief complaint was that more patients complained of "cold" symptoms following Hurricane Iniki. The only differences in diagnoses were for upper respiratory infections, which were diagnosed more often after Hurricane Iniki. There were no differences in the administration of tetanus toxoid, antibiotics, or analgesics. Patients evaluated after Hurricane Andrew had more diagnostic tests performed and a higher illness/injury acuity. The proportion of the total number of patients conveyed to a hospital did not differ.

Conclusion: Patient needs were similar after Hurricane Andrew and Hurricane Iniki and may be applicable for predicting the needs of patients for future hurricanes.

Nufer KE, Wilson-Ramirez G: A comparison of patient needs following two hurricanes. *Prehosp Disast Med* 2004;19(1):146–149.

Introduction

Disaster planning has taken on a new urgency since the events of 11 September 2001 and the repeated levels of high terrorism alert since. To prepare best for future disasters, we should begin by examining our past experiences. The New Mexico-1 Disaster Medical Assistance Team (NM-1 DMAT) has responded to more disasters related to hurricanes than to disasters related to any other type of event and responded to both Hurricane Andrew and Hurricane Iniki.

Hurricane Andrew was a Category 4 hurricane that made landfall in Florida on 24 August 1992. It contained winds of 145 mph (238 km/hour) with gusts up to 175 mph (287 km/hour). This hurricane killed 41 people and caused [US] $20 billion worth of damage.[1] Hurricane Iniki struck the Hawaiian island of Kauai on 11 September 1992 and contained sustained wind velocities of 150 mph (246

	Andrew n (estimate ±CI)	Iniki n (estimate ±CI)	OR (CI)
Wounds	169 (23.7 ±3.1)	90 (26.2 ±4.6)	0.88 (0.65–1.20)
Musculo-skeletal pain	95 (13.3 ±2.4)	39 (11.3 ±3.1)	1.20 (0.80–1.84)
Medication refill	90 (12.6 ±2.4)	30 (8.7 ±2.8)	1.51 (0.97–2.43)
URI	64 (9.0 ±2.0)	65 (18.9 ±4.0)	0.42 (0.29–0.63)
Rash	49 (6.9 ±1.7)	26 (7.6 ±2.6)	0.90 (0.54–1.54)
Abdominal complaints	41 (5.8 ±1.7)	11 (3.2 ±1.6)	1.85 (0.92–4.04)

Table 1—Chief complaints (If 5% or more of patients had a specific chief complaint, it was included for analysis. CI = 95% confidence interval; n = number of patients; OR = odds ratio; URI = upper respiratory infection)

km/hour). It killed five people, injured 100 persons, and caused [US] $2 billion of damage.[2]

Previous reports have described the responses to and the effects of single disasters on local Emergency Departments.[3–6] There is one previous study that found that flood and hurricane victims had different medical needs.[7] The hypothesis for the current study is that, despite being affected by the same type of event, disasters are so unpredictable that victims still will have different medical needs. The study question is: Did patient needs differ following Hurricanes Andrew and Iniki? This is the first study that compares the patient medical needs following a disaster from the same type of event.

Methods

Study Design: This study was a retrospective, cohort analysis of victims of Hurricanes Andrew and Iniki.

Study Setting and Population: All patients evaluated by the NM-1 DMAT following Hurricanes Andrew in Florida and Iniki in Hawaii were included for analysis.

Study Protocol: The charts of all the patients affected by Hurricanes Andrew and Iniki that were evaluated by NM-1 DMAT were reviewed. This study was deemed exempt from review by the University of New Mexico Institutional Review Board.

Assessments: A database was established that included the following variables: age, past medical history (PMH), chief complaint, diagnosis, diagnostic tests, treatments, triage level acuity (green/yellow/red), and disposition for patients following each hurricane. Chief complaint, diagnosis, and treatment were included if they represented at least five percent of the total for either disaster.

Data Analysis: The outcome measures were the comparisons of the above variables between the victims of Hurricane Andrew and Hurricane Iniki. Age was analyzed using Student's *t*-test, the remaining data were analyzed using the chi-square test. Differences were considered significant at the $p = 0.05$ level.

	Andrew n (estimate ±CI)	Iniki n (estimate ±CI)	OR (CI)
Wounds	140 (19.5 ±2.8)	75 (19.0 ±3.8)	1.03 (0.75–1.43)
Musculo-skeletal pain	62 (8.6 ±2.0)	35 (8.9 ±2.6)	0.97 (0.62–1.54)
Cellulitis	29 (4.0 ±1.3)	22 (5.6 ±2.1)	0.71 (0.39–1.32)
URI	19 (2.6 ±1.0)	22 (5.6 ±2.1)	0.46 (0.23–0.90)

Table 2—Diagnoses (If a specific diagnosis was assigned 5% or more of the time, it was included for analysis. Denominator is the total number of diagnoses given: Andrew = 718, Iniki = 393. CI = 95% confidence interval; n = number of patients; OR = odds ratio; URI = upper respiratory infection)

Results

There was a total 1,056 patients evaluated, 712 after Hurricane Andrew and 344 after Hurricane Iniki. The ages of the patients were similar for the two events (mean values 33.3 years versus 35.1 years, difference 1.55 ±2.7 years, $p = 0.19$). More patients reported positive past medical histories following Hurricane Andrew than Hurricane Iniki (29.1% versus 20.9%, odds ratio (OR) = 1.55, 95% confidence interval (CI) = 1.13–2.14, $p < 0.01$). Of the patients that did have co-morbidities, 33.3% and 19.0% had hypertension, 23.8% and 12.7% had diabetes, and 12.7% and 11.4% had asthma following Hurricanes Andrew and Iniki, respectively.

The two most common chief complaints of physical wounds and musculoskeletal pain occurred with similar frequency. Also, there were no differences between the proportion of the total number of patients who sought care for medication refills, rashes, and abdominal complaints (abdominal pain, vomiting, and/or diarrhea). The only difference in chief complaints between the two groups was the presence of upper respiratory infection (URI) symptoms (cough, cold, sore throat, congestion, ear pain, and/or fever) (Table 1).

The only difference in diagnoses identified was in the proportion of patients diagnosed with an upper respiratory infection. Patients received the most common diagnoses of physical wounds, musculoskeletal pain, and cellulitis with similar frequency (Table 2). More patients had diagnostic testing after Hurricane Andrew than after Iniki (20.5% versus 1.7%, OR = 14.53, CI 6.41–40.63, $p < 0.001$).

The proportion of the total number of patients receiving tetanus vaccinations, antibiotics, and/or analgesics was not different between the two hurricanes. However, wound care occurred more frequently following Hurricane Iniki and medication refills occurred more frequently following Hurricane Andrew (Table 3).

	Andrew n (estimate ±CI)	Iniki n (estimate ±CI)	OR (CI)
Tetanus vaccination	138 (16.1 ±2.4)	81 (18.8 ±3.5)	0.83 (0.61–1.14)
Wound care	135 (15.8 ±2.4)	89 (20.6 ±3.7)	0.72 (0.53–0.98)
Antibiotics	133 (15.5 ±2.4)	77 (17.9 ±3.5)	0.84 (0.61–1.17)
Pain reliever	91 (10.6 ±2.0)	39 (9.0 ±2.5)	1.19 (0.79–1.82)
Medications refilled	57 (6.7 ±1.6)	15 (3.5 ±1.5)	1.98 (1.09–3.80)

Table 3—Treatment provided: If a specific treatment was used 5% or more of the time, it was included for analysis. The denominator is the total number of treatments provided: Andrew = 852, Iniki = 437 (CI = 95% confidence interval; n = number of patients; OR = odds ratio)

Patients had a higher acuity following Hurricane Andrew as measured by assigned triage category. A lower proportion of the total number of patients were triaged as green and a higher percentage were triaged as yellow and red following Hurricane Andrew as compared to Iniki (Table 4). Despite this, patients were conveyed to a hospital with similar frequency. Following Hurricane Andrew, 6.3% of patients were sent to a hospital and 4.9% were sent following Hurricane Iniki (OR = 1.30, CI = 0.72–2.46, p = 0.37) (Table 5).

Discussion

Despite occurring in very different locations with different population densities, Hurricanes Andrew and Iniki created similar medical needs in the patients who presented to the NM-1 DMAT clinics as assessed by the variables listed above. Five of the six most common complaints (wounds, musculoskeletal pain, medication refill, rash, and abdominal complaints) occurred with similar frequency. The only difference identified was in the higher proportion of patients with upper respiratory symptoms following Hurricane Iniki. Similarly, the only statistically significant differences in diagnoses was the higher proportion of URIs following Hurricane Iniki. This difference is likely to be clinically insignificant when planning for a disaster response in that URIs generally do not require any specific treatment.

Interestingly, the frequency of wound care, as a treatment, seemed to be higher after Hurricane Iniki than after Hurricane Andrew. In contrast, the proportion of patients receiving tetanus toxoid was similar. The reason for the disparity in wound care is unclear given the similar proportion of patients seeking care for and being diagnosed with wounds. One possible explanation is a difference in documentation as data collection was not uniform or controlled. In addition, as wound care was one of the top two treatments rendered after each of the hurricanes, this difference probably is not significant clinically. The DMATs should be well stocked with wound care supplies when responding to hurricanes.

	Andrew n (estimate ±CI)	Iniki n (estimate ±CI)	OR (CI)
Green	436 (61.2 ±3.7)	236 (68.6 ±5.2)	0.74 (0.54–0.96)
Yellow	126 (17.7 ±2.7)	8.0 (2.3 ±1.3)	9.03 (4.36–21.61)
Red	30 (4.2 ±1.4)	5.0 (1.5 ±1.0)	2.98 (1.13–9.93)

Table 4—Triage category (Triage categories are defined as: green–"walking wounded," reassess after critical patients are cared for; yellow–delayed care; red–immediate care. CI = confidence interval, OR = odds ratio)

	Andrew n (estimate ±CI)	Iniki n (estimate ±CI)
Home	611 (85.8 ±2.8)	325 (94.5 ±3.0)
Hospital	45 (6.3 ±1.7)	17 (4.9 ±2.0)
Left without being evaluated	25 (3.5 ±1.2)	2 (0.6 ±0.5)

Table 5—Disposition (CI = 95% confidence interval; OR = odds ratio)

Patients seemed to have a higher level of acuity following Hurricane Andrew than after Hurricane Iniki. However, there was no difference in the proportion of the total number of patients sent to a hospital. This may be due to the fact that there was more diagnostic testing available and used after Andrew. The NM-1 DMAT staffed two sites after Hurricane Andrew; one of them was an Urgent Care Center that had radiography and laboratory testing available.[8] This increased capability may have resulted in a decreased number of patients sent to a hospital.

The only other study that compared disasters found a difference between the medical needs of flood and hurricane victims.[7] The results of these studies may mean that different kinds of precipitating events create different patient medical needs, but those needs may be predicable based on the kind of precipitating event.

Examinations into disaster medicine such as these are becoming more important with Emergency Physicians taking on increasing roles with DMATs and as disaster planners.

Limitations

This is a retrospective review. Data abstraction of the patients' charts was not uniform. Some charts had data elements missing. Also, the hurricanes affected areas with different population densities and caused different numbers of

casualties and amounts of damage. Further, deployment dates and lengths were not uniform. Deployment to Hurricane Andrew occurred four days after the event and lasted 10 days, while deployment to Hurricane Iniki occurred eight days after the event and lasted six days. These variables are difficult, and almost impossible to control for, yet important similarities still existed.

Future work should include a prospective validation of these findings in a future deployment following a hurricane. In addition, prospective evaluation of diagnostic testing in a future deployment also should be done.

This unique study of hurricane victims demonstrated that the medical needs of the victims following Hurricanes Andrew and Iniki were similar despite the fact that one hurricane struck Florida and the other struck Hawaii. This has important implications for disaster planners in that the medical needs of hurricane victims may be predictable. Based on the findings of this study, the DMATs should be equipped adequately with wound-care supplies, tetanus toxoid, antibiotics, and analgesics when responding to hurricanes.

References

1. Rappaport E: National Hurricane Center: Preliminary report Hurricane Andrew, 16-28 August 1992. Available at http://www.nhc.noaa.gov/1992andrew.html. Accessed 03 November 2002.
2. Reyes BJ: Hurricane Iniki stuns Hawaiian island in 1992, 11 September 2002. The Associated Press. Available at http://www.weather.com. Accessed 03 November 2002.
3. Henderson AK, Lilllibridge SR, Salinas C, *et al*: Disaster medical assistance teams: Providing health care to a community struck by Hurricane Iniki. *Ann Emerg Med* 1994;23:726–730.
4. Brewer RD, Morris PD, Cole TB: Hurricane-related emergency department visits in an inland area: An analysis of the public health impact on Hurricane Hugo in North Carolina. *Ann Emerg Med* 1994;23:731–736.
5. Quinn B, Baker R, Pratt J: Hurricane Andrew and a pediatric emergency department. *Ann Emerg Med* 1994;23:737–741.
6. Alson R, Alexander D, Leonard RB, *et al*: Analysis of medical treatment at a field hospital following Hurricane Andrew. *Ann Emerg Med* 1993;22:1721–1728.
7. Nufer KE, Wilson-Ramirez G, Crandall CS: Different medical needs between hurricane and flood victims. *Wilderness & Environmental Med* 2003;14:89–93.
8. Gaffney JK, Schodorf L, Jones G: DMATs respond to Andrew and Iniki. *J Emerg Med Serv* 1992;Nov:76–79.
9. Schultz CH, Koenig KL, Noji EK: Disaster Preparedness. In: Marx JA (ed): *Rosen's Emergency Medicine, Concepts and Clinical Practice*. St. Louis, MO: Mosby, Inc. 2002: pp 2631–2640.