ORIGINAL RESEARCH

"Just-in-Time" Personal Preparedness: Downloads and Usage Patterns of the American Red Cross Hurricane Application During Hurricane Sandy

Thomas D. Kirsch, MD, MPH; Ryan Circh, MD; Richard A. Bissell, PhD; Matthew Goldfeder, BA

ABSTRACT

Objective: Personal preparedness is a core activity but has been found to be frequently inadequate. Smart phone applications have many uses for the public, including preparedness. In 2012 the American Red Cross began releasing "disaster" apps for family preparedness and recovery. The Hurricane App was widely used during Hurricane Sandy in 2012.

Methods: Patterns of download of the application were analyzed by using a download tracking tool by the American Red Cross and Google Analytics. Specific variables included date, time, and location of individual downloads; number of page visits and views; and average time spent on pages.

Results: As Hurricane Sandy approached in late October, daily downloads peaked at 152,258 on the day of landfall and by mid-November reached 697,585. Total page views began increasing on October 25 with over 4,000,000 page views during landfall compared to 3.7 million the first 3 weeks of October with a 43,980% increase in views of the "Right Before" page and a 76,275% increase in views of the "During" page.

Conclusions: The Hurricane App offered a new type of "just-in-time" training that reached tens of thousands of families in areas affected by Hurricane Sandy. The app allowed these families to access real-time information before and after the storm to help them prepare and recover. (*Disaster Med Public Health Preparedness*. 2016;10:762-767)

Key Words: computer applications software, disaster medicine, disaster planning, emergency preparedness

Personal and family preparedness is an essential core of community and national preparedness for natural and man-made disasters.[1] Decades of efforts have been made to increase the personal and family preparedness of the American public, including campaigns by the American Red Cross and the Federal Emergency Management Agency's (FEMA's) Ready campaign.[2,3] These efforts have included public outreach through the use of educational websites, pamphlets, billboards, public service announcements, and other mass media techniques. Despite these efforts, the American public remains unprepared. A 2009 National Hurricane Survival Initiative survey of 1100 residents living along the coastline from Maine to Texas found 55% without a disaster plan and 66% without a disaster kit (Joseph Keebler, Wichita State University, personal communication, July 27, 2015). A survey of central Florida residents found only 50% with disaster plans and only 10% with an adequate 3-day disaster supply kit.[4] Even a cohort of public health employees found 33% were "not prepared" (<2 of 21 items) according to the 21-point FEMA checklist, and another 43% were only minimally prepared (<10 of 21 items).[5] All 3 of these studies focused on populations that, by reason of training or risk exposure, would be expected to have better than average levels of preparedness, which may actually be the case. A broad review of the current disaster preparedness research, including data from more than 30 peer-reviewed articles, found that there is a pervasive lack of understanding of the need for personal preparedness actions by a broad swath of the US public, and that the reasons for preparedness-related ignorance and inactivity are multiple and complex.[6] Alternative approaches to helping a disaster-affected population to meet its own needs are required.

As smartphones become increasingly more prevalent in today's society, they have the potential to play an important role in personal disaster preparedness and just-in-time information sharing before, during, and after disasters. Recent surveys of hurricane-vulnerable areas, including a post–Hurricane Sandy survey of New Jersey residents, found anywhere from 84% to 95% of respondents own cell phones.[7,8] Cell phones, text messaging, and smartphone apps are being used for a variety of health care–related topics, including first responder dispatch systems, asthma management,

 DOI: 10.1017/dmp.2016.52

smoking cessation, patient follow-up, teleconsultation, medication compliance, and infectious disease monitoring.[9] Although there has been recent academic interest in the impact of social media in disasters,[10] to date, there have been no studies examining the use of smartphone apps for civilian personal preparedness and response.

The American Red Cross has recently developed smartphone applications, or "apps," to provide information on preparedness and response for a variety of natural disasters and first aid. These apps include Hurricane, Tornado, Flood, Wildfire, Earthquake, Shelter, First Aid, Swim, Pet First Aid, and Team Red Cross. These apps provide emergency information in real time through mobile alerts and provide essential information for people to prepare for natural disasters. The first American Red Cross disaster app to be developed was the Hurricane App, which was launched in August 2012 just before 2 major hurricanes, Isaac and Sandy, hit the United States.

Hurricane Sandy became a named storm on October 22 as it was first classified as a tropical depression in the southern Caribbean. The storm strengthened to a category 1 hurricane on October 24 and struck Jamaica and Cuba in the Caribbean Sea. As the storm moved north along the East Coast of the United States, its strength varied but re-intensified to a category 2 hurricane on the 29th with a wind diameter of over 1150 miles (1850 km). The storm made landfall at approximately 8 PM EST near Atlantic City, New Jersey, with sustained winds of 80 mph (130 km/h).[11] This article aimed to describe the scope and use of the Hurricane App had before, during, and immediately after Hurricane Sandy in October 2012.

METHODS

The application was designed to educate and help families prepare for and recover from hurricanes. The app has 6 main tabs or sections: Alerts, Tracker, Quizzes, Info, Toolkit, and Prepare. The Alert function actively monitors and sends warnings and messages that can be set for specific locations or be based on the location of the mobile device. It also has user-directed pages. The Tracker function links to a weather site to allow user-driven monitoring of weather events. Quizzes teach general and hurricane-specific disaster knowledge. The Info function provides background about the app and the Red Cross and links to other useful apps.

Under the Prepare function, 4 sections are available to assist users with planning and response activities: *Right Before* describes important preparedness and safety steps in the 2 to 3 days before landfall, *During* describes personal and family protection activities during landfall, *After* describes recovery and safety activities after the hurricane has passed and includes sections added as more response resources became available, and *Plan Ahead* was for more long-term disaster planning activities.

Additional information pages were added to the After section after Sandy's landfall to continuously address the changing needs and resources. A "Sandy Recovery Center" page was added on October 31 and a "Recovery Checklist and Rebuilding after Flood to Recover from Sandy" page was added to the App on November 1. Additional updates on available resources were added continuously, such as the location of Red Cross Emergency Response Vehicles on November 3, links to the location of available gas stations through GasBuddy.com, Hess, and Exxon oil (November 4), and the location of warming stations, a link for contacting family and friends ("Safe and Well") and links to "FEMA resources to Recover from Sandy" (November 5). Some of these updates, such as Safe and Well, have now become a permanent function of the app.

With a focus on family preparedness and recovery activities, patterns of the application downloads were analyzed by using a combination of a proprietary internal download tracking tool by the American Red Cross and Google Analytics for usage-based data. Specific variables included date, time, and location of individual downloads; number of daily visits; total page views; and average time spent on individual app pages. Our raw data came from the data capture using Google Analytics. This data capture is routine in the online apps industry, and although it is not intended for the kind of pattern research we were conducting, the data capture is considered to be highly accurate and reliable.[12] In recent years, researchers have used several similar databases for the purpose of examining public electronic communications patterns in emergencies and disasters.[13]

Downloads and usage patterns were analyzed for the week before the storm's landfall in the New York City region (October 21-27), during landfall (October 28-29), and for the week after (October 30-November 5). The Red Cross Hurricane App has specific sections that focus on the typical decision-making that its users will be faced with before, during, and after the storm. For example, before the storm users have the option of evacuating to a "safer" place or to shelter in place. If the user decides to shelter in place, what kinds of supplies and equipment should be acquired? If, instead, they decide to evacuate, there are important issues of destination, how to get there under uncertain road conditions, what kinds of possessions to take along, what to do with pets, etc.

Using the FEMA definitions of very-high-impact zip codes, we further quantified download patterns specifically to these zip codes by using Excel (Microsoft Corp, Redmond, WA). These were defined as counties where more than 10,000 people were exposed to the storm surge.[14] We compared download patterns in these very-high-impact areas versus total downloads during the dates surrounding Hurricane Sandy impact on the East Coast from October 12 to November 9, 2012. We used the Statistical Package for the Social Sciences (SPSS; IBM Corp, Armonk, NY) to test for significance at the 95% confidence interval ($P \leq 0.05$) on

https://doi.org/10.1017/dmp.2016.52 Published online by Cambridge University Press

all investigated potential relationships, as noted in the following pages.

The study was exempted by the Hopkins School of Medicine institutional review board.

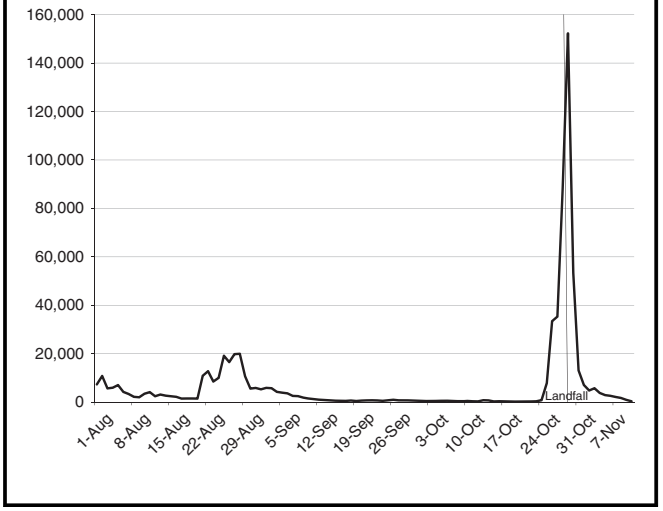
RESULTS

The American Red Cross Hurricane App was made public in Apple's App Store and Android's Google Play store in August 2012. There was no paid advertising, but the app was featured by Apple's App Store and it received high initial ratings. Initial downloads in the United States averaged 3763 daily and then briefly reached 19,978 downloads on August 28, 2012, as Hurricane Isaac moved into the Caribbean, for a total of over 216,188 downloads by the end of August. Downloads dropped to an average of 443 daily between October 1 and 24. As Hurricane Sandy approached the United States in late October, daily downloads sharply increased, reaching a peak of 152,258 on October 29 and then regressing to pre-hurricane numbers by November 9 (Figure 1). By November 15 the application had been downloaded to 697,585 devices, with the majority in the last week of October and the first week of November.

We further analyzed download trends in the 864 zip codes in the FEMA very-high-impact area spanning coastal New Jersey, metro New York, Long Island, and southwestern Connecticut.[14] Daily downloads in these zip codes peaked in a similar fashion to the total national downloads, reaching 31,183 on October 29 (Figure 2), but rapidly increased as a portion of total downloads. Between October 25 and 28, the percentage of very-high-impact area downloads in relation to total downloads spiked from less than 5% to a peak of 25% of the total.

FIGURE 1

Daily Hurricane App Downloads From First Release, August 12 through November 9, 2012.



In addition to the number of downloads, the usage patterns of the application can be described by the pages visited. We analyzed the page views for specific app pages of the app prior to, during, and after the storm (Table 1). The number of total pages viewed began spiking on October 25 and had a dramatic increase the day before storm impact on October 28-29 with just over 4 million total page views during these 2 days compared to a 3.7 million during the first 3 weeks of October before the storm (Figure 3). There was a dramatic rise in views of the Right Before and During pages surrounding the hurricane's impact (October 28-29), peaking at nearly 73,000 and 64,000 views, respectively, representing a 43,980% increase over baseline for those who were viewing the Right Before page and a 76,275% from baseline for the During page (Figure 4). There was less of a rise in views of the After and Plan Ahead pages leading up to and after the storm, peaking at over 17,000 and 14,700 respectively. However, this still represents a 36,374% increase in the After and 20,724% increase in the Plan Ahead pages. This smaller rise in views of the After page is most likely explained by a smaller population of those actually affected by the hurricane compared to those threatened before landfall. For the Plan Ahead

FIGURE 2

Daily Hurricane App Downloads in Very-High-Impact Zip Codes, October 10 Through November 9, 2012.

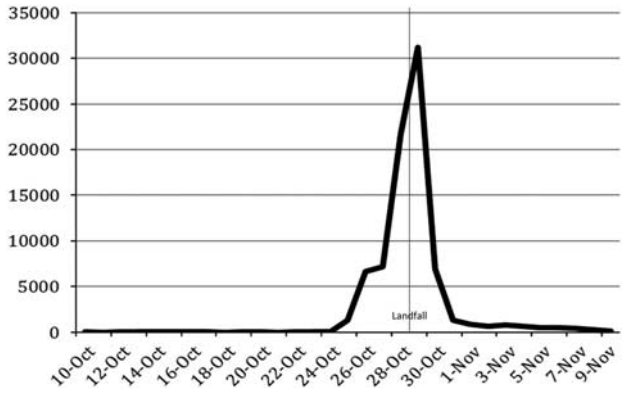


TABLE 1

Average Number of Page Views on the Hurricane App at Baseline and Before, During, and After Hurricane Sandy Landfall

	Baseline (Oct. 14-23)	Before (Oct. 21-27)	During (Oct. 28-29)	After (Oct. 30-Nov. 5)
"Right Before" page	166	14,332	72,888	3359
"During" page	84	7191	64,071	2809
"After" page	47	2441	17,096	2863
"Plan Ahead" page	71	3754	14,714	1255
"Recovery from Sandy" page				2250

https://doi.org/10.1017/dmp.2016.52 Published online by Cambridge University Press

FIGURE 3

Total Page Views Within the Hurricane App, October 10 Through November 6, 2012.

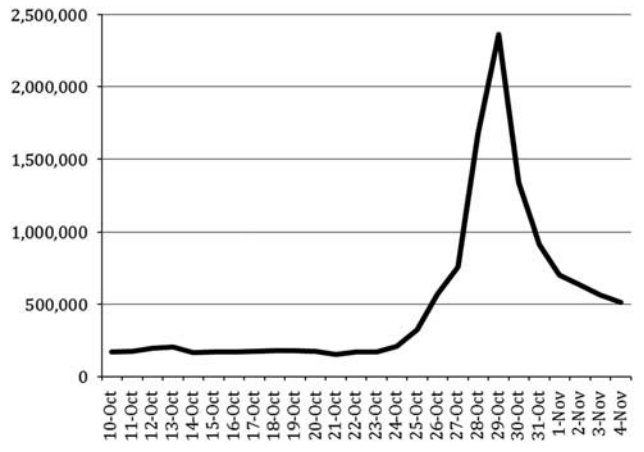
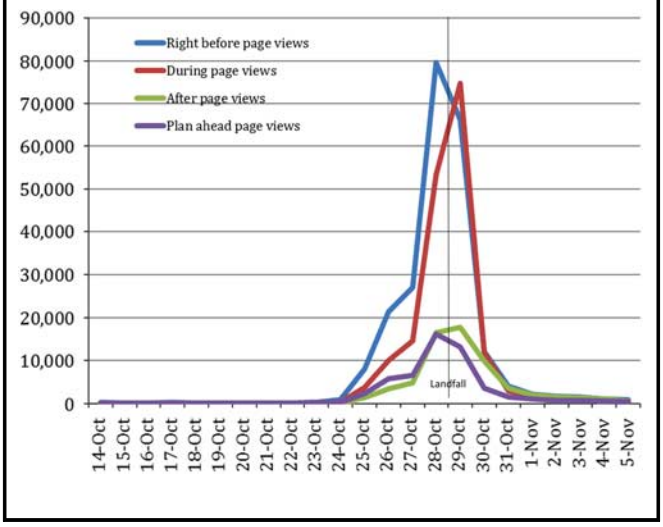


FIGURE 4

Daily Hurricane App Page Views by Specific Content, October 14 Through November 6, 2012.



page, most of the activities were for longer term rather than immediate hurricane preparedness.

DISCUSSION

Despite decades of efforts, the American public remains poorly prepared for disasters in terms of personal and family preparedness. Most literature regarding personal preparedness has evaluated trusted resources, demographic predictors of preparedness, supplies stored, and barriers to preparedness.[6] It appears the only study examining the impact of interventions on civilian preparedness is a 2007 social marketing intervention through educational pamphlets that found 10% of the target population changed their preparedness behaviors.[10] A number of factors are known to increase the level of preparedness. For example, Basolo et al found information exposure increased both perceived and actual preparedness.[15] As well, Hurnen et al found greater preparation when individuals had greater knowledge of earthquake-response measures.[16] Preparedness activities are much more likely when a threat is recognized and more immediate.[17]

A less studied aspect of preparedness in the US public may be termed "just-in-time preparedness," that is, preparedness that is engaged in when the immediate threat risk is rapidly climbing. This would include all activities done by individuals or families to enhance their own protection prior to the time that the destructive event (hurricane, tornado, tsunami) impacts where they live. Activities engaged in as the disaster is hitting, and afterwards, may be termed "response." The US military, numerous first-response agencies, NASA, and humanitarian assistance organizations around the world have adopted just-in-time training for their personnel deploying into new environments or functions. Just-in-time training is useful because not all personnel can have working knowledge of crucial task-related skills covering all potential, but uncommon scenarios, but can quickly gain enough information with just-in-time programs to allow them to be effective when needed. For example, NASA has just-in-time modules for astronauts to use in addressing unforeseen but potential in-space medical emergencies (Joseph Keebler, Wichita State University, personnel communication, July 27, 2015). The Red Cross hurricane and other applications provide just-in-time training for families at risk from an impending event.

However, it is difficult to evaluate the effectiveness of any just-in-time program. One of the challenging aspects of evaluating impact is the dynamic conditions that make just-in-time training worthwhile in the first place: the users are often scattered and hard to reach after conditions have stabilized and there are no data recorders to observe and assess the effectiveness of participants. Indeed, defining and measuring "effectiveness" is difficult in situations in which pre-post study and control study groups cannot be logistically or ethically constructed. We are not even very adept at defining and measuring effectiveness in emergency and disaster responses in which there are known goals and objectives and personnel who are well trained prior the event.[18] There is a significant volume of research on training effectiveness in programs that have known personnel who will need to accomplish predicted tasks in stable situations. There is a need to build a methodology for evaluating just-in-time training programs in the emergency response field, including cases in which the affected population becomes both the responders and the potential victims.

One of the interesting aspects of the Red Cross apps is that they can provide both static and real-time information prior

https://doi.org/10.1017/dmp.2016.52 Published online by Cambridge University Press

to and even during a specific disaster event. In addition, the hurricane application was also able to provide real-time and rapidly changing information regarding access to power, water, shelter, food, and gasoline in the immediate aftermath. Equally important is the fact that programs that provide good quality preparedness, response, and recovery information using the just-in-time capabilities afforded by smartphone apps significantly lower the barrier of entry to useful information when and where they needed.

This study showed a dramatic increase in smartphone app usage surrounding Hurricane Sandy. Although actual impact and lives saved cannot be determined from these usage patterns, it is clear that users were getting information regarding what to do right before and during "just-in-time." As well, there was extremely heavy use in the weather alerts and shelters pages, likely improving outcomes in many lives with this information. In the case of Hurricane Sandy in the New York/New Jersey corridor, the number of unique hits ranged from a few thousand to over 400,000, depending on the stage of the storm and its effects. It appears that tens of thousands of users were able to access critical information designed to limit their suffering and the pressure on response agencies due to the availability of timely information from this app on their smartphones. As other organizations move into the practice of providing this kind of just-in-time information and training to the general public, it is highly important that researchers and practitioners alike work on developing methods of accurately and reliably assessing the effectiveness of such programs.

The American Red Cross has come out with other smartphone apps for specific disasters (Tornado, Hurricane, Flood, etc) and has created an all-encompassing app called Emergency to bring information regarding all types of disasters into one location. Other disaster-related apps have been released in the past 5 years, including those released by FEMA and the Asia-Pacific Disaster Center. Lists of these apps can be found at https://www.disasterready.org/blog/top-mobile-apps-disaster-preparedness-and-response#.Vtilmo9Fz0Z. Facebook has even added a feature to allow its members to notify their family and friends that they are safe after a disaster event. While it is still yet to be determined how these apps change behavior and affect individual outcomes, the usage before and during Hurricane Sandy in the New York and New Jersey region is remarkable and encouraging. Smartphones have changed the way people live in many ways. With appropriately designed and vetted disaster apps, we may have found a way to positively impact countless lives with just-in-time disaster information like no other disaster preparedness intervention has accomplished before.

The study had some limitations. It only described evidence of usage of the application but could not demonstrate actual changes in behavior of those using the app. The actual number and location of the phone using the app was blinded so that directly attributing use to an individual or location was not possible.

About the Authors

Department of Emergency Medicine, Johns Hopkins School of Medicine, Baltimore, Maryland (Drs Kirsch, Circh); Department of Emergency Health Services, University of Maryland, Baltimore County, Baltimore, Maryland (Dr Bissell); and American Red Cross, Washington, DC (Mr Goldfeder).

Correspondence and reprint requests to Thomas Kirsch, Department of Emergency Medicine, Johns Hopkins School of Medicine, 1830 E Monument St, Baltimore, MD 21286 (e-mail: tkirsh1@jhmi.edu).

Published online: June 28, 2016.

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https://doi.org/10.1017/dmp.2016.52 Published online by Cambridge University Press

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