

# Emergency Preparedness and Disaster Response: There's an App for That 2.0

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**Conflicts of interest/funding:** None declared.

**Keywords:** disaster planning; mobile health care technology; smartphone applications

## Abbreviations:

ARC: American Red Cross  
CDC: Centers for Disease Control and Prevention  
CPR: cardiopulmonary resuscitation  
EMT: emergency medical technician  
FEMA: Federal Emergency Management Agency  
GPS: Global Positioning System  
NOAA: National Oceanic and Atmospheric Administration  
NREMT: National Registry of Emergency Medical Technicians  
PFA: psychological first aid  
TCCC: Tactical Combat Casualty Care

**Received:** June 30, 2021

**Revised:** August 24, 2021

**Accepted:** September 8, 2021

doi:[10.1017/S1049023X21001321](https://doi.org/10.1017/S1049023X21001321)

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## Abstract

**Introduction:** In disaster response, smartphone applications (or apps) are being used by the layperson, emergency first responders, and health care providers to aid in everything from incident reporting to clinical decision making. However, quality apps are often diluted by the overwhelming number of apps that exist for both the lay public and first responders in the Apple iTunes (Apple Inc.; Cupertino, California USA) and Google Play (Google LLC; Mountain View, California USA) stores.

**Hypothesis/Problem:** A systematic review of disaster response apps was originally completed in 2015; a follow-up review was completed here to evaluate trends and explore novel apps.

**Methods:** A search of the Apple iTunes and Google Play stores was performed using the following terms obtained from PubMed (National Center for Biotechnology Information; Bethesda, Maryland USA) Medical Subject Headings Database: Emergency Preparedness; Emergency Responders; Disaster; Disaster Planning; Disaster Medicine; Bioterrorism; Chemical Terrorism; Hazardous Materials; and the Federal Emergency Management Agency (FEMA [Washington, DC USA]). After excluding any unrelated apps, a working list of apps was formed and categorized based on topics. Apps were categorized by intended user (first responders or the public) and sub-categorized by topic for discussion. Sub-categories included News/Information, Reference/Education, Weather/Natural Disasters, Travel/Navigation, and Communication/Reunification.

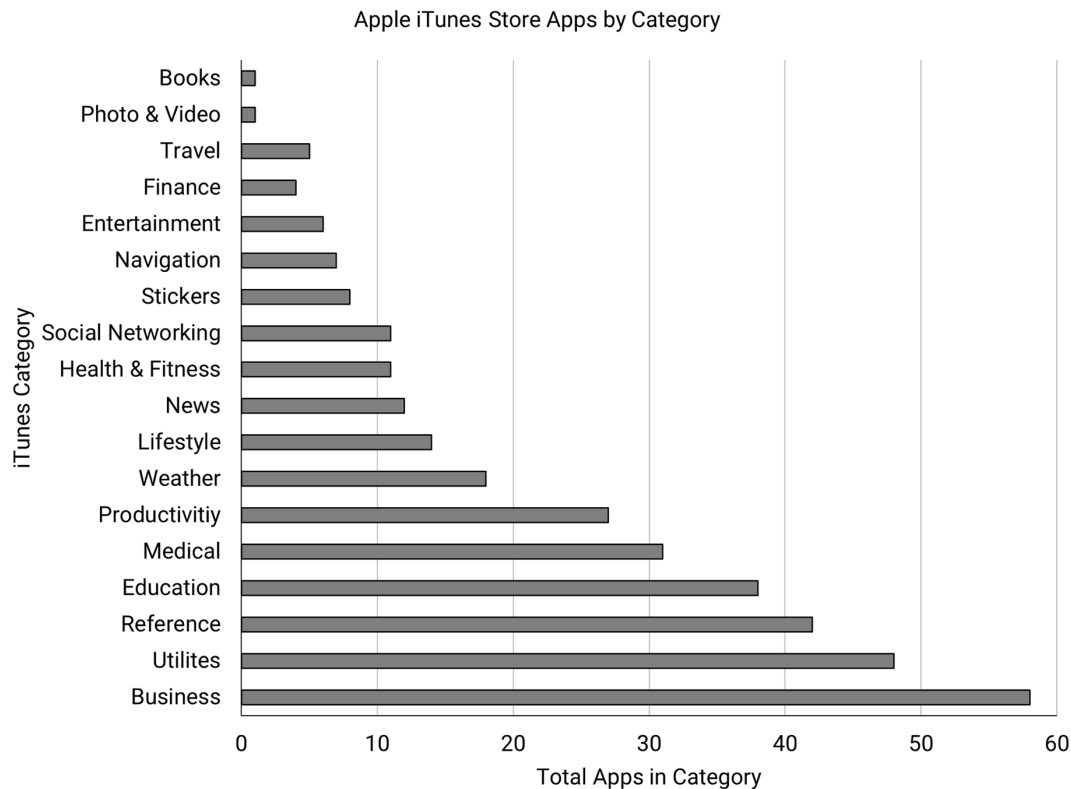
**Results:** A search of the Apple iTunes store revealed 394 unique apps and was narrowed to 342 based on relevance to the field and availability on the iPhone. A search of the Google Play store yielded 645 unique applications and was narrowed to 634 based on relevance. Of note, 49 apps appeared in both app stores using the search terms. An aggregate 927 apps from the Apple iTunes and Google Play stores were then critically reviewed by the authors. Apps were sub-categorized based on intended audience, layperson or first responder, and sorted into one of five disaster response categories. Two apps were chosen for discussion from each of the five sub-categories. The highest quality apps were determined from each group based on relevance to emergency preparedness and disaster response, rating, and number of reviews.

**Conclusion:** After comparisons with the 2015 article, many new apps have been developed and previously described apps have been updated, highlighting that this is a constantly changing field deserving of continued analysis and research.

McAtee KJ, Bedenbaugh R, Lakis D, Bachmann DJ, Kman NE. Emergency preparedness and disaster response: there's an app for that 2.0. *Prehosp Disaster Med.* 2022;37(1):117–123.

## Introduction

Mobile technology, wearable technology, and social media have become pervasive in the personal health and health care sectors. This is apparent at both the individual level, with the use of health tracking on mobile devices, and at the population level, with real-time postings about various disasters and emergency events. Additionally, smartphone applications (or apps) are being used by emergency first responders and health care providers to aid in everything from incident reporting to clinical decision making to weather tracking. A study conducted by Scheller, et al concluded that emergency responders would like to increase their mobile phone use during a response but are often limited by a dearth in quality and vetted applications.<sup>1</sup> There are thousands of medical apps currently available, ranging from basic reference and education to medical calculators and medication databases. A study



**Figure 1.** Emergency Preparedness and Disaster Response Apps by Apple iTunes Store Categories After Targeted Search.

conducted by Wiechmann, et al found that only 6.9% of the apps within the “Medical” category were clinically relevant.<sup>2</sup> This highlights the necessity for a review of these apps by persons with real-life experience in emergency preparedness and disaster response. A review of apps relating to emergency preparedness and disaster response was completed in 2015.<sup>3</sup> Here, an updated review of available apps, with inclusion of an additional app store, was completed with trends and changes noted as applicable. Additionally, a limited literature review was completed on the use of disaster apps in the field, yielding minimal current research on the topic.

### Methods

A search of the Apple iTunes (Version 12.1.4; Apple Inc.; Cupertino, California USA) and Google Play (Google LLC; Mountain View, California USA) stores<sup>4</sup> was performed using the following terms obtained from PubMed (National Center for Biotechnology Information; Bethesda, Maryland USA) Medical Subject Headings Database: Emergency Preparedness; Emergency Responders; Disaster; Disaster Planning; Disaster Medicine; Bioterrorism; Chemical Terrorism; Hazardous Materials; and the Federal Emergency Management Agency (FEMA [Washington, DC USA]).

The search for these terms was conducted in January 2019 and was continually updated until December 21, 2020 yielding 394 iPhone apps and 645 Android apps. Relevant apps belonged to various application store-specific categories. The Apple iTunes store categorized apps by: Books, Business, Education, Entertainment, Finance, Health and Fitness, Lifestyle, Medical, Navigation, News, Photo and Video, Productivity, Reference, Social Networking, Travel, Utilities, and Weather (Figure 1). The Google Play store categorized apps by: Books and

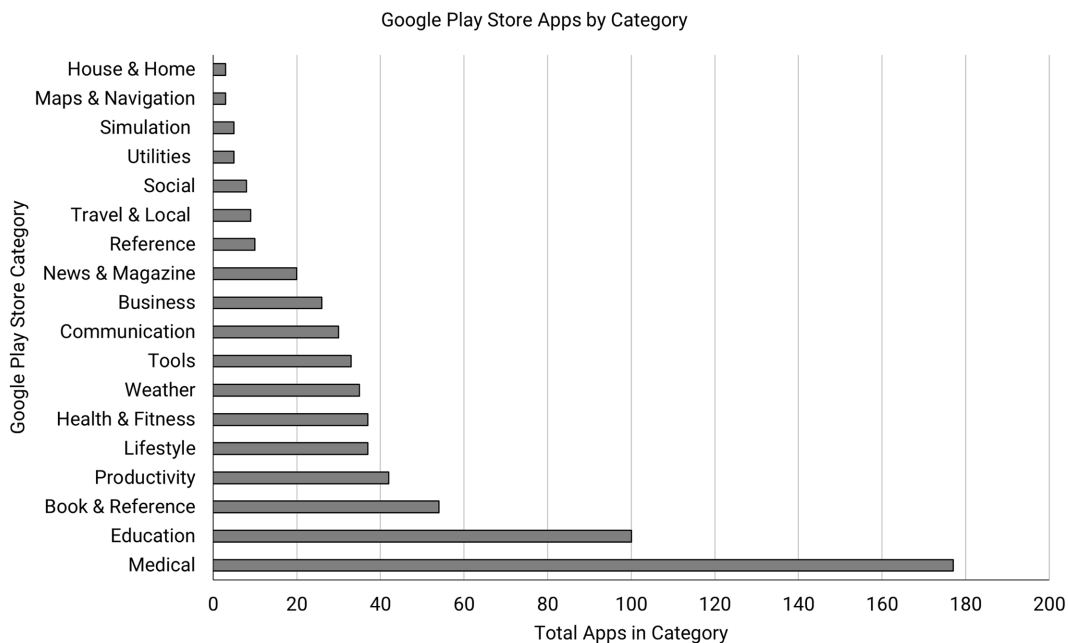
Reference, Business, Communication, Education, Health and Fitness, House and Home, Lifestyle, Maps and Navigation, Medical, News and Magazine, Productivity, Reference, Simulation, Social, Tools, Travel and Local, Utilities, and Weather (Figure 2).

Apps were excluded if they were games, music, shopping, tablet only, or otherwise deemed not applicable to disaster response by the authors. The author team included members with current and past military (DB, KM); FEMA Urban Search and Rescue (DB, NK); and hospital emergency preparedness experience (DB, DL, KM, NK, RB). Each of the selected apps was downloaded and explored for content, use, and applicability to emergency preparedness. Apps were categorized by intended user (first responders or the public) and sub-categorized by topic for discussion. Sub-categories included: News/Information, Reference/Education, Weather/Natural Disasters, Travel/Navigation, and Communication/Reunification.

### Results

The search of the Apple iTunes store revealed 394 unique applications and was narrowed to 342 based on relevance to the field. The search of the Google Play store yielded 645 unique applications and was narrowed to 634 based on similar criteria. Forty-nine apps appeared in both app stores, resulting in an aggregate of 927 apps from both stores.

Apps from the Apple iTunes store were sub-categorized based on intended audience, layperson or first responder, and sorted into one of five disaster response categories. In an effort to highlight differences between apps geared towards the layperson and first responder, apps were chosen for discussion from each of the two categories. “CitizenAID,” “Medical ID Record,” and “Pet First



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**Figure 2.** Emergency Preparedness and Disaster Response Apps by Google Play Store Categories After Targeted Search.

Aid: ARC [American Red Cross; Washington, DC USA]” were selected to highlight apps for the layperson, whereas “NREMT [National Registry of Emergency Medical Technicians]” and “PFA [psychological first aid] Mobile” highlighted apps intended for first responders. Apps were chosen for discussion from each of the five sub-categories of News/Information, Reference/Education, Weather/Natural Disasters, Travel/Navigation, and Communication/Reunification. The highest quality apps were determined from each group based on relevance to emergency preparedness and disaster response, rating, and number of reviews. Each app was then cross-referenced with the Google Play store to determine if it, or an equivocal alternative, was available for Android devices. As discussed above, this review primarily focused on apps not discussed in the 2015 review of apps relating to emergency preparedness and disaster response.<sup>3</sup> Instead, novel apps were explored, and selected apps from the 2015 review were discussed briefly to reiterate their utility. Notable selected apps from the 2015 review include “FEMA,” “FloodWatch,” “Centers for Disease Control and Prevention (CDC [Atlanta, Georgia USA]),” “American Red Cross (ARC),” “Hurricane Tracker,” “Pulse Point,” and “NOAA [National Oceanic and Atmospheric Administration; Washington, DC USA] World Radar” (Table 1).

### Discussion

Apps for disaster responders and medical providers in general are becoming increasingly popular. That said, other studies have shown that relevant apps are a small percentage of the apps that are found while searching.<sup>3</sup> Without direction, it may be difficult for first responders to find apps relevant to them. Based on this search, as well as the experiences of first responders, the following are some applications that have been rated highly in the app store and in the field.

Smartphone applications can be categorized by the intended audience: layperson or first responder.

#### *Selected Layperson-Specific Apps*

*CitizenAID USA*—Unfortunately, mass-casualty incidents are becoming more prevalent in the United States. Events like the nightclub shooting in Orlando (2016) and the school shootings in Columbine (1999), Parkland (2018), and Sandy Hook (2012) have shown the importance of early first aid and hemorrhage control. This app gives a step-by-step approach to mass-casualty response. It features sections on Active Shooter, Knife Attacker, Bombings, and Vehicle as a Weapon, with a detailed section on Stop the Bleed. It is free to use and has a 4.3/5.0 rating. An equivalent app named *CitizenAID North America* is available in the Google Play store with the same capabilities and functions.

*Medical ID Record*—In disaster response, victims are often separated from their possessions, including their identification and medical records. This app provides a single space to store personal medical data, medical conditions, allergies and reactions, medications, and emergency contacts. It is accessible from the lock screen in case the individual is unable to communicate or is otherwise incapacitated. Additionally, photos and files can be easily incorporated into the record. This app has a 4.6-star rating in the Apple iTunes store with 86 reviews. Costing US\$3.99, it is in its fifth version undergoing monthly updates. This app is not available in the Google Play store. Instead, an alternative app called *Medical ID (Free): In Case of Emergency* can be found in the Google Play Store. This app has the same capabilities and functions as *Medical ID Record*. It is free-to-use with a 4.5-star rating and 7,946 reviews.

*Pet First Aid: ARC*—Pet rescue and pet reunification are an ever-present component of disaster response. First responders and lay rescuers are often called upon to take care of animals during disasters. Furthermore, in FEMA Urban Search and Rescue, medical responders are often responsible for the K9 team. This app contains an information storage component and an education component.

<p><b>“FEMA”</b> (Developer: Federal Emergency Management Agency)</p> <p>The FEMA mobile app contains disaster safety tips, an interactive emergency kit list, storable emergency meeting locations, and a map with open shelters and open FEMA Disaster Recovery Centers (DRCs). The app also has a Disaster Reporter feature, allowing users to take and submit GPS photo reports of disasters so they can be displayed on a public map for others to view. This app contains additional features such as preparedness information for different types of disasters, an interactive checklist for emergency kits, a section to plan emergency meeting locations, guides on how to stay safe/recover after a disaster, a map with FEMA-DRC locations/shelters, a link to a FEMA blog, and a link to FEMA’s social media pages. This app is free for all users.</p>
<p><b>“FloodWatch”</b> (Developer: D5G Technology, LLC)</p> <p>This is a free weather app that allows users to monitor rivers/streams throughout the United States with data from the US Geological Survey and National Weather Service (Silver Spring, Maryland USA). It provides the most recent historical river heights, precipitation totals, and flood stage data. The authors, with training in Urban Search and Rescue, have utilized this app in the field. This app is only available in the Apple iTunes store.</p>
<p><b>“CDC”</b> (Developer: Centers for Disease Control and Prevention)</p> <p>This free app features sections on news, outbreaks (with a special section devoted to COVID-19), travel notices, articles, data, facts, links to journals (Emerging Infectious Diseases [EID], Morbidity and Mortality Weekly Report [MMWR], and Preventing Chronic Disease [PCD]), photos, podcasts, and videos.</p>
<p><b>American Red Cross Apps for Natural Disasters</b> (includes “Flood,” “Hurricane,” “Wildfire,” “Earthquake,” and “Tornado;” Developer: American Red Cross)</p> <p>These free, weather-related apps are ideal for both the public and for responders and are available in both English and Spanish. The tornado app, for example, alerts users when the National Oceanic and Atmospheric Administration (NOAA; Washington, DC USA) issues a tornado warning for pre-set monitored locations and gives instructions on what to do before and during a tornado. The hurricane app allows users to track the path of current hurricanes, while the earthquake app sends earthquake and tsunami warnings. All of these apps also have Red Cross location-based shelter maps.</p>
<p><b>“Hurricane Tracker”</b> (Developer: EZ Apps, Inc.)</p> <p>For US\$2.99, this is a popular and well-reviewed hurricane tracking app. Features include daily audio updates, long-range threat graphics, a model watch product to see possible future developments, graphics with alert level, and impact-potential maps and others.</p>
<p><b>“Pulse Point”</b> (Developer: PulsePoint Foundation)</p> <p>This free app is able to notify those trained in CPR when someone nearby is having a cardiac emergency. The app also shows locations of nearby public access automated external defibrillators (AEDs). Additionally, users can choose to receive incident notifications when they are dispatched from local response organizations, like fire departments, which allows this app to serve as a modern version of a traditional fire scanner. These notifications can be displayed in a live feed or geographically. There is also a “Pulse Point AED” app which only shows nearby public access AEDs.</p>
<p><b>“NOAA Weather Radar Live”</b> (Developer: Weather or Not Apps)</p> <p>This well-reviewed and popular free weather app from the NOAA has one hour radar forecast, hurricane development and path prediction, and weather warnings displayed geographically on maps. It also includes information about tornados, flooding, fog warnings, and tropical storms.</p>

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**Table 1.** Update on Previously Reviewed Apps<sup>3</sup>

Abbreviations: FEMA, Federal Emergency Management Agency; DRC, Disaster Recovery Center; GPS, Global Positioning System; NOAA, National Oceanic and Atmospheric Administration; CPR, cardiopulmonary resuscitation; AED, automated external defibrillator.

Pet profiles can be created with information about each pet in a family, including medications, medical problems, and upcoming veterinary appointments. The app also provides education on 25 common pet emergency situations including identification of toxic substances and pet cardiopulmonary resuscitation (CPR). Step-by-step instructions and videos are included. In the Apple iTunes store, this app has a rating of 4.4 stars with 40 ratings and is free-to-use. It is updated yearly and is in its second version. This app is available in the Google Play store with identical capabilities and features.

*Applications for First Responders*

*NREMT (The National Registry of Emergency Medical Technicians)*—In disaster response, providers are often asked to practice in environments unfamiliar to them. They may be practicing outside of their hospital or typical jurisdiction. The ability to reference their certifications and scope of practice is paramount. With over 5,900 reviews, earning 4.7 stars, in the Apple iTunes store this free app is the official app of the NREMT. It allows Emergency Medical Service personnel to track education and renew certifications easily in one location. The app also allows medical directors and training officers to manage and track their respective agencies and providers, providing an easy way to keep track of recertifications deadlines and to sign off on skills and education. This app is currently in its second version and is updated on

a monthly basis. This app is available for download in the Google Play store with identical capabilities and features.

*PFA Mobile*—This app contains resources and information to help those responders who provide PFA to families, adults, and children after an emergency or disaster event. Summaries of PFA fundamentals and various interventions are provided, along with a provider readiness tool. Field assessment forms for survivors are included to help tailor interventions towards specific needs and track any care given. In the Apple iTunes store, this is a free-to-use app, rated at 5.0 stars with seven user ratings. It is updated yearly and is in its first version. This app is also available in the Google Play store with identical capabilities and features.

*Apps Relevant to Both First Responders and the Lay Public*

*News/Information*—These apps ranged from distributing news and information at the national level down to the level of an individual university. There were apps for various counties, states, and cities. Some examples include: Maryland Prepares (Maryland USA), Alberta Emergency Alert (Alberta, Canada), Sedgewick County Government (Sedgewick County, Kansas USA), Ready NYC (New York City, New York USA), Owl Ready (Florida Atlantic University, Florida USA), A Safer Ohio (Ohio USA), and Landau Emergency Preparedness (Landau Coal Mine, South Africa). Two apps that were rated highly included:

*Emergency: Alerts*—This app, published by the ARC, offers real-time local alerts for severe weather and hazards including tornadoes, hurricanes, floods, earthquakes, extreme heat, and wildfires. It includes a map with open ARC shelters, instructions on how to make a family emergency plan, and a toolkit with a strobe light and an alarm function. The app also has preloaded preparedness and emergency content, allowing access without mobile connectivity. In the Apple iTunes store, this app has a user rating of 3.6 stars with over 260 reviews. It is free to use and has been updated monthly since it was first released. Currently, the app is in its third version. This app is not available in the Google Play store. Instead, the ARC offers the equivocal *Emergency - American Red Cross* for Android devices with similar features and capabilities as its Apple counterpart. In the Google Play store, this app has a 4.2-star rating with 830 reviews. It is free to use and is in its third version.

*SaskAlert*—This app, currently in its second version, is published by the Government of Saskatchewan (Canada). It provides critical information on emergencies in real time. Alerts can come from the national and province levels. Event alerts include tornadoes, winter weather, train derailments, drinking water advisories, road closures, and evacuation recommendations. This free-to-use app has a 4.6-star rating, over 6,900 reviews, and undergoes monthly updates. This identical app is available under the name *Saskatchewan Emergency Alert* in the Google Play store.

*Reference/Education*—This category is very diverse, ranging from information about blast injuries to how to prepare your home disaster kit. Apps range from those geared towards children to those created specifically with the first responder in mind. There were numerous apps relating to first responder education and preparation for certification exams. Two applications that were highly rated include:

*Deployed Medicine*—A product of Allogy Interactive (Denver, Colorado USA), this app is primarily meant for United States military personnel to supplement their medical education and training in the deployed setting. The app was created in close collaboration with United States military experts and approved by the Committee on Tactical Combat Casualty Care (TCCC). The medical content focuses on TCCC training for combat medical personnel. This app has a useful search function where users can look up current clinical practice guidelines. It is a multi-modal app with reference texts, videos, and podcasts. The app can work online and offline to accommodate use in austere environments. This free-to-use app currently has a 4.1-star rating in the Apple iTunes store with 31 reviews. It is in its first version with monthly updates. This app is also available in the Google Play Store.

*EMT [Emergency Medical Technician] Tutor Study Guide*—This app contains review material for the EMT Basic certification. There are quiz questions, flashcards, and scenarios to help EMTs study and prepare for their initial certifications and recertifications. Although it costs US\$4.99, it is highly rated at 4.7 stars with 57 reviews. The app is updated yearly to keep up-to-date with any changes made to the EMT curriculum. It is in its third version. This app can be found on the Google Play store under the name *EMT Tutor NREMT-B Study Guide* at a cost of US\$3.99.

*Weather/Natural Disasters*—When deploying to natural disasters, it is imperative that responders have an understanding of the weather expected. Although more predictable than tornadoes, hurricane responders must understand the strength of the storm, the expected impact zone, and the expected storm surge. Several of

these were discussed in the 2015 publication, but there are some additional weather and natural disaster apps that have interesting features. This category explores some of these apps:

*Earthquake + Alert, Map, & Info*—With a 4.7-star rating and over 14,000 reviews, this app sets itself apart from other earthquake monitoring apps. This app offers real-time seismic and tsunami data from 21 global data sources, volcanic activity provided by the Smithsonian Institution (Washington, DC USA), and six years of earthquake history. Users of this app can customize alerts, filters, lists, and maps to create a more personalized and relevant experience. Some features such as map styles, 3D maps, damage radius rings, and map time-lapse require a monthly subscription of US \$0.99. This app is in its third version with updates occurring as frequently as every other week. Unfortunately, an app by this publisher is not available in the Google Play store. There are, however, several apps with similar functionality. One such app is *My Earthquake Alerts-US and Worldwide Earthquakes*. This free-to-use app offers a live earthquake map with the ability to set custom alerts. It has a search feature allowing users to find earthquake history back to 1970. This Android app has a 4.6-star rating and over 32,000 reviews. It is currently in its third version and is updated monthly.

*Disaster Alert (PDC [Pacific Disaster Center; Hawaii USA])*—This app provides maps for weather, earthquakes, and tsunamis compiled from the NOAA, the United States Geological Survey (USGS; Reston, Virginia USA), the Pacific Tsunami Warning Center (PTWC; Ewa Beach, Hawaii USA), and the National Aeronautics and Space Administration (NASA; Washington, DC USA). This app overlays a satellite map with several interchangeable map layers that include Doppler radar, cloud coverage, precipitation accumulation, hurricanes, typhoons, tectonic plates, volcanoes, and nuclear reactors. Map overlays are updated anywhere from every ten minutes to every three hours. Additionally, real-time temperature, humidity, wind speed/direction, and forecast information are provided in one convenient location. In the Apple iTunes store, this app is free-to-use with 4.1 stars and 346 ratings. This is the sixth version of the app. This app is available in the Google Play store with identical features.

*Travel/Navigation*—Travel and navigation was revolutionized in 1999 when the first Global Positioning System (GPS) was introduced in cell phones. Today, there is an entire category devoted to navigation in the App Store. The challenge these authors faced was finding apps with features that could be utilized in disaster or emergency situations, including real-time updates and availability of navigation in the absence of reliable internet connection.

*Waze Navigation & Live Traffic*—This is a unique navigation app that relies on community-edited maps for updated traffic information. With a 4.9-star rating and over 2.7 million reviews, this app has developed a robust following. Community-edited information regarding traffic patterns, location of law enforcement, and hazards (ie, potholes, stopped vehicles, and debris) set this app apart from other navigation apps. Additionally, practical information such as location of gas stations, food locations, and estimated arrival time makes this app functional for all drivers. This free-to-use app is on its fourth version with updates occurring weekly. This identical app is available for download in the Google Play store.

*HERE WeGo - City Navigation*—In the search and rescue arena of disaster response, it is very important to have good navigation and to be able to operate in a signal poor environment. This app allows users to download maps in advance so they can be used in the absence of internet connection or cell service. This feature,

while marketed towards city travel, can be used for any location with a downloadable map; it is possible to download a map of the entire United States within the app. This is an ideal app for travel scenarios where a reliable internet connection is not guaranteed. It is free to use and has a 4.1-star rating with over 775 reviews. The app is currently on its second version and is updated monthly. This app is also available in the Google Play store.

**Communication/Reunification**—Communication during a disaster scenario is essential, but is often overlooked. The challenge was to find apps that allowed reliable communication in scenarios where mobile data and internet are limited. It was also essential to ensure these messenger apps were reliable and user friendly, so emphasis was placed on finding apps with high ratings and reviews.

**WhatsApp Messenger**—Created by WhatsApp Inc (Menlo Park, California USA), this app is a free-to-use messenger app that uses your phone's internet connection to send messages. Traditional messenger apps utilize mobile data to send messages, which can limit communication in international and emergency settings. WhatsApp allows users to make phone calls, create group chats, and send/receive multi-media such as photos, videos, and voice messages. This application was successfully used by Ohio's urban search and rescue team (Ohio Task Force 1; Vandalia, Ohio USA) during times of natural disaster (Figure 3). WhatsApp is currently ranked as the fifth Social Networking app in the Apple iTunes store with 4.7 stars and 7.9 million ratings. This app is currently in its second edition and is updated multiple times each month. This app is available for download in the Google Play store.

**Bridgefy**—This free-to-use messaging app allows for instant messaging without mobile data or internet connection. This app belongs to an expanding group of messenger apps that creates a mesh network for sending and receiving messages using Bluetooth alone. This app enables persons within 330 feet to send and receive end-to-end encrypted messages. This app is ideal in scenarios where internet or mobile data may be limited or unavailable. In the Apple iTunes store, it is free to use, has a 3.9-star rating with 261 reviews. It is in its third version and receives monthly updates. This app is also available on the Google Play store and allows for communication between Apple and Android devices.

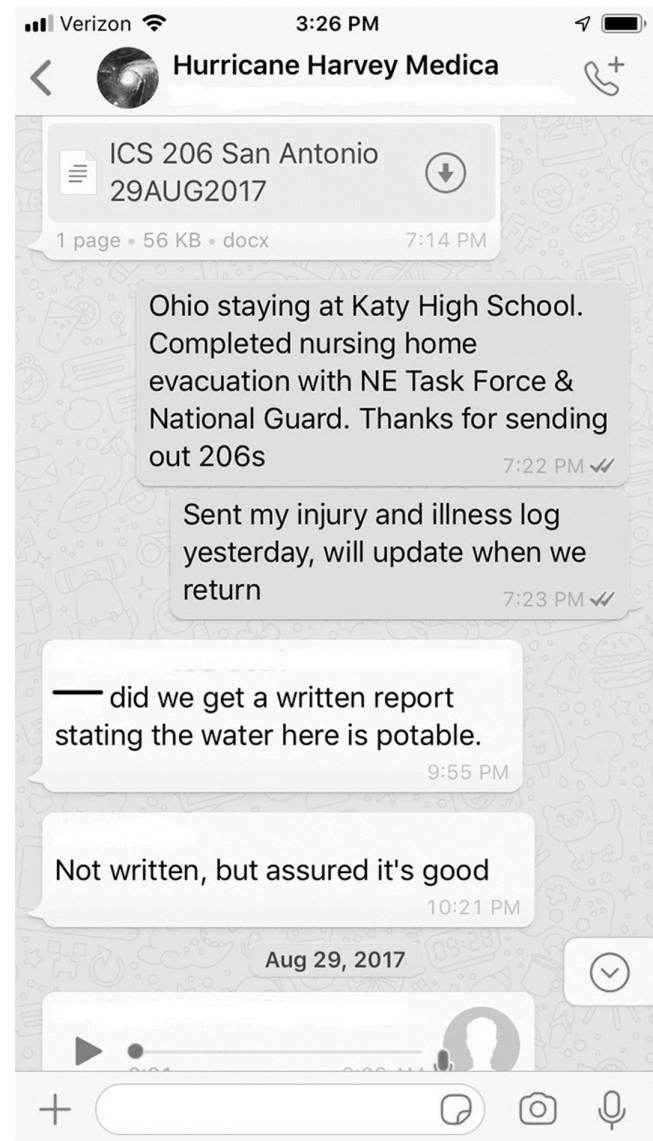
#### Updates

In their 2015 discussion of disaster apps, Bachmann, et al touched on several highly rated disaster applications: *FEMA*, *FloodWatch*, *CDC*, *ARC*, *Hurricane Tracker*, *Pulse Point*, and *NOAA Weather Radar* (Table 1).<sup>3</sup> With the exception of *FloodWatch*, each app is also available in the Google Play store.

Overall, the number of disaster apps available in the Apple iTunes store has increased in the interval since the assessment completed for the article in 2015. The 2015 search yielded 219 apps, whereas the updated search yielded 342 apps after narrowing for utility and applicability. Many of the top-rated apps are still widely in use and have undergone continuous updates, rebranding, and in some cases, new ownership.

One notable trend in the updated search was the rapid increase in the number of regional or locality specific apps available. The 2015 article search yielded approximately ten location-specific apps, whereas the current search yielded more than 30. This highlights the increased interest in emergency response and disaster preparedness at the community level.

Comparing search results from the Apple iTunes and Google Play stores lead to some interesting observations. First, it was



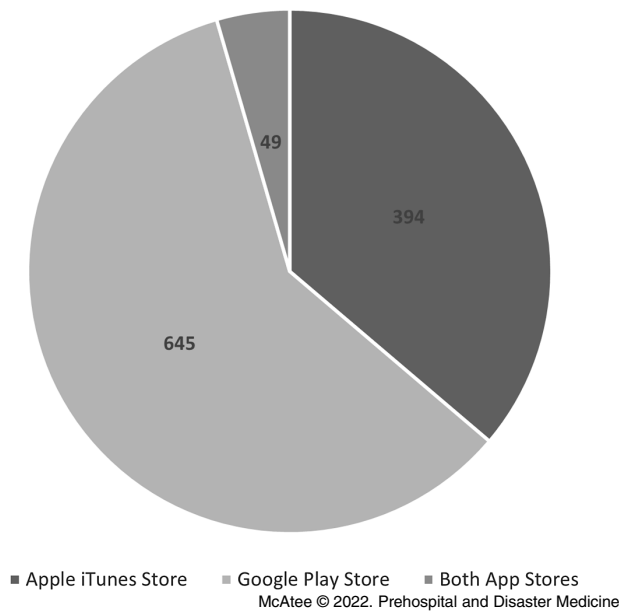
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**Figure 3.** Utilization of WhatsApp by Ohio Task Force One during Response to Hurricane Harvey.

originally anticipated that there would be considerable overlap in apps between platforms when using these search terms. However, after completion of both searches, there was only overlap in 49 apps (Figure 4). This may be a product of the fact that many apps are not available on both platforms. Second, the number of search results for each term was different between the Apple iTunes and Google Play stores. The number of apps that resulted for each term in the Apple iTunes store ranged from 0 to 166, whereas searches in the Google Play store always resulted in 250 apps. It would seem that the search algorithm used by Apple does a better job at selecting relevant search results than the Google Play store. That being said, both platforms had a considerable number of unrelated and inapplicable apps.

A few apps highlighted in the 2015 paper were no longer available: *ReUnite*, *Disaster Preparedness for the Family*, *Quick Start*, and *START Review*. Additionally, the app *FireChat*, which was initially discussed in this publication, has since been discontinued.

## Total Apps: Apple iTunes and Google Play Stores



**Figure 4.** Comparison of Total Resulted Apps between App Stores using Pre-Described Search Terms.

*FireChat* was one of the original offline Bluetooth mesh-network messenger apps available for both Apple and Android devices, and was even featured by *CNN*, *BBC*, *Wall Street Journal*, *New York Times*, and *USA Today*. While it is unclear why this app is no longer

available, its sudden removal illustrates just how volatile the app store can be.

### Limitations

It is first important to acknowledge that cellular and Wi-Fi capability are limited in disasters. Although these capabilities have improved with the advent of FirstNet (powered by AT&T; Dallas, Texas USA) and the capability of companies like Verizon (New York, New York USA) to deploy cell towers, working cellular and Wi-Fi data are necessary for many of these apps.<sup>5</sup> Other limitations of this research arise primarily from the volatility of the Apple iTunes and Google Play stores. While continual searches were completed during the writing of this article, app listings changed frequently with apps being added or removed regularly. Actual real-world utility and viability of use in the field requires in-depth review of each app as well as surveys of first responders and medical providers. The same search criteria were utilized as in the 2015 paper in an attempt to allow for comparison, but app keyword tags were occasionally inconsistent, requiring manual sorting. Additionally, searches yielded apps that were clearly unrelated to emergency response and disaster preparedness, including games and sticker packs.

### Conclusions

Like the search from 2015, many useful apps were found targeting various populations including the lay person and the first responder. One key finding is that high-quality apps do not necessarily need to be associated with a fee. After comparisons with the 2015 article, many new apps have been developed and previously described apps have been updated, highlighting that this is a constantly changing field deserving of continued analysis and research.

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