 **Research Brief**

The WEA Video Platform: Emergency Alerts in Many Formats Allow Access for All

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# Introduction

People with disabilities, an estimated 26% of the United States population, or 61 million people (National Center on Birth Defects and Disabilities - Centers for Disease Control and Prevention, 2020), are more seriously impacted during disasters. People with disabilities experience barriers to communication that impede access to information about impending emergencies and communications with first responders in the immediate aftermath of an emergency (Federal Emergency Management Agency, 2004, 2015). Federal law mandates emergency communications to be inclusive of people with disabilities. Among its other accessibility provisions, the Twenty-first Century Communications and Video Accessibility Act (CVAA) required an advisory committee to be established for "achieving equal access to emergency [communication] services by people with disabilities ("The Twenty-first Century Communications Video Accessibility Act," 2010)," while the Federal Communications Commission (FCC) continues its efforts to ensure emergency communications are accessible and inclusive all people, including those with disabilities. These efforts have taken on considerable importance because of the continued growth in the use of wireless devices by people with disabilities, with 88% of respondents to a Wireless RERC survey indicating that they owned or used at least one wireless device (Moon, Griffiths, LaForce, & Linden, 2020).

The Federal Emergency Management Agency (FEMA) operates the International Public Alert & Warning System (IPAWS) to provide authenticated emergency and life-saving information to the public through mobile phones using Wireless Emergency Alerts (WEAs), the Emergency Alert System (EAS) through radio and television, and on the National Oceanic and Atmospheric Administration's (NOAA) Weather Radio. Because they are delivered to an individual's mobile phone, WEA messages are geotargeted. Only wireless devices in the areas immediately impacted by the emergency event receive the incoming communication. Unfortunately, WEA messages are difficult for people with sensory, cognitive, or learning disabilities to access the information that they need in an emergency. Although the message appears like text, it is frequently not readable by voice output (screen-reader) software. This makes the message inaccessible and easily misunderstood for those with vision, learning, and cognitive disabilities. Emergency information is best understood in one's primary language (National Council on Disability, 2014 ), which for many people who are Deaf is American Sign Language (ASL). Those who are Deaf and primarily rely on ASL for communication have low written English literacy levels (Paul & Jackson, 1993; Strong & Prinz, 1997), which presents barriers to understanding the message content.

This research brief reports on developing a software app that demonstrates the technical feasibility of providing WEA messages in multiple formats, namely text-based messages, spoken messages, symbology, and ASL video with captions, to improve the accessibility of the messages for all receivers. The results of a usability study examining how people who are Deaf understand the emergency messages in multiple formats are also described.

# Development Process

The team produced the Wireless Emergency Alert – Video Platform (WEA-VP), a smartphone application (App). The goal of the WEA-VP was to provide WEA message content in multiple accessible formats to make it accessible to people with a variety of disabilities. The App was developed with Android Studio for the Android Operating System. This platform was selected as it remains significantly more open to development than the Apple IOS (formerly iPhone Operating System).

The ASL video creation process utilized the Common Alerting Protocol (CAP) to streamline message generation. The team recorded and captioned individual videos for 28 events and seven (7) protective actions and event times that represented 15-minute increments throughout a 24-hour day. Each of these videos was trimmed so that they could be assembled and streamed as a single, seamless video. As a result, with the creation of 35 short videos, the WEA-VP could display any of 129 event / protective action combinations that could be sent through the platform.

The WEA-VP was developed to be phone-based rather than a web-based App. The phone-based app has a few critical advantages related to the ability of a phone-based App to trigger from the incoming WEA message. Triggering from the incoming WEA message allows the WEA-VP App to take advantage of WEA geotargeting and initiate a video sequence played from the phone, rather than requiring streaming of video components from a web platform. The videos and symbols need to be stored on the phone, which takes up data space for the user. The team developed a web portal subscription service to develop, test, and demonstrate the technical feasibility of being able to trigger the App from an external signal. The web portal was designed to send a text message to phones subscribed to the App. Upon receiving the text message, the App would decode the event, time, and action codes and display an emergency message using the formats selected by the end-user. The web portal employed a graphical user interface (GUI) to select the CAP components and send the messages.

# Usability Testing

The App seeks to provide increased message comprehension through accessibility enhancements. Two of these accessibility enhancements (symbology and ASL WEA videos) would potentially increase comprehension for those who are Deaf and use ASL for communication. Upon completion of the development of the App, a study was conducted to determine whether and how accessibility enhancements impacted message comprehension for those who are Deaf.

Participants who were Deaf and primarily used ASL for communication were recruited to participate from the greater San Antonio Metropolitan area. The message content and formats were randomly selected for each trial. A pool of twenty were randomly selected to be viewed during testing. We selected four message formats – Text Only (TO), Text with Symbology (TWS), Text with ASL Video (TWA), and ASL Video Only (AVO) – to allow us to compare the standard WEA Message Format to the symbology and ASL Video enhancements.

After viewing each message, participants were asked two questions: 1) What did the message say? And 2) What would they do if they received that message? The answers were recorded by video, transcribed, and coded for analysis. Answers were coded to determine if the participants correctly understood what emergency event was happening and identified the correct action to take. Quantitative analysis was completed to determine if certain message components created confusion or if certain symbols were better understood than others. Chi-Squared Analysis was employed to examine the impact of the message format, the event occurring, and the recommended protective action on the participants' understanding of events or actions. The Chi-Square analysis employed Yates Continuity Correction.

# Results

A total of 96 messages were viewed. The distribution of events, actions, and message formats for the viewed messages are shown below. It should be noted that not all events held associated protective actions.

**Table 1: Message Formats viewed with percentage of events and protective actions that the participant understood.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Format** | **Count** | **% of understood Events** | **% of understood protective actions** |
| Text Only (TO) | 23 | 30% | 40% |
| Text with Symbology (TWS) | 22 | 45% | 29% |
| Text with ASL Video (TWA) | 24 | 74% | 52% |
| ASL Video Only (AVO) | 27 | 67% | 48% |

There were 23 viewed TO messages, and 20 of them recommended protective actions. Participants correctly identify seven (30%) of the events and eight (40%) of the actions. The addition of symbology had mixed results. There were 22 viewed TWS messages, and all but one of them recommended protective actions. Participants correctly identified 10 (45%) of the events and 6 (28%) of the actions. Of the 27 viewed TWA messages, 23 recommended protective actions. Participants correctly identified 20 (74%) of the events and 12 (52%) of the actions. Finally, the 24 AVO messages recommended 21 protective actions. Participants correctly identified 16 (67%) of the events and 10 (48%) of the actions.

Chi-squared distribution analysis shows that the presence of ASL videos (TWA and AVO formats) resulted in participants being almost four times more likely to understand the description of the emergency event in the message (p< 0.01). However, distribution analysis did not show a statistically significant increase in the understanding of protective action recommended with the presence of ASL video. Further, the presence of symbology did not improve the participants understanding of either the event or the recommended protective action. Of the 80 viewed messages that recommended protective actions, participants understood both message components (event and protective action) in one-third (27) of them. Of these messages that included ASL, participants understood both components of 17 (41%) of them while understanding 10 (25%) of the viewed TO and TWS messages.

Across all message formats, participants understood 17% - 100% of the messages for each event type (Table 2). All participants understood the tropical storm warning, while 80% of them understood the hurricane warning. Messages calling for immediate evacuation were the least understood, with only 17% of these events identified correctly. The presence of the symbology for this event seemed to be confusing; three out of the four times that this symbology was viewed, participants stated that it indicated they should "go slow" or "walk don't run." Five participants who understood that the event was asking them to evacuate explained that they didn't know where to go, one clarifying, "I don't know where the safe places are." The Hazardous Materials event was only understood by the person who saw the message in TWS format. He stated that the presence of the "chemicals" in the symbol helped him understand the word Hazardous. Chi-squared distribution analysis did not show statistically significant differences in understanding events based on what events were occurring.

**Table 2: The type of event viewed with a percentage of times the participant understood the message event.**

|  |  |  |
| --- | --- | --- |
| **Event** | **Count** | **% of understood messages** |
| Blizzard | 3 | 67% |
| Civil Danger | 5 | 20% |
| Dust Storm | 4 | 75% |
| Earthquake | 4 | 50% |
| Evacuation Immediate | 5 | 40% |
| Evacuation to Shelter | 6 | 17% |
| Fire | 4 | 50% |
| Flash Flood | 4 | 75% |
| Hazardous Material | 4 | 25% |
| High Wind | 7 | 71% |
| Hurricane | 5 | 80% |
| Law Enforcement | 5 | 60% |
| 911 Outage | 7 | 43% |
| Nuclear Power Plant | 4 | 50% |
| Shelter in Place | 5 | 60% |
| Tornado | 5 | 60% |
| Tropical Storm | 6 | 100% |
| Tsunami | 5 | 40% |
| Winter Storm | 4 | 50% |
| Test Message ("This is a test …") | 4 | 75% |

For each protective action, participants understood 27% - 57% of each recommended action across all message formats (Table 3). Almost two-thirds of the participants who viewed a message that contained an "All Clear" indicating that the event was over did not accurately understand the message. Chi-squared distribution analysis did not show statistical differences in understanding based on the protective action.

**Table 3: The type of protective action recommended with the percentage of times the participant understood the protective action.**

|  |  |  |
| --- | --- | --- |
| **Protective Action** | **Count** | **% of Understood Messages** |
| All Clear | 15 | 27% |
| Avoid Hazard | 9 | 56% |
| Evacuate Now | 10 | 40% |
| Evacuate to Shelter | 11 | 36% |
| Monitor Radio | 12 | 33% |
| Monitor TV | 7 | 57% |
| Take Shelter | 16 | 50% |

# Discussion, Recommendations, and Future Work

Participants generally understood messages that contained events they commonly experienced, regardless of the message format. For example, since people in the San Antonio Metropolitan area commonly experience hurricane and tropical storm events, the words and symbology used to describe these events were more familiar to our participants than those for other activities that were not common to their area. Particularly "Winter Storm Warning." This should carry forward to other messages not included in the study, such as warnings for avalanches. **As a result, future studies should include individuals in other geographic areas of the country.**

The usability study results showed that people who are Deaf were four times more likely to understand the event contained in the message when the message format contained ASL. TWS messages showed higher rates of understanding of the event and lower rates of understanding the recommended protective action over TO messages, although these differences are not statistically significant. This mixed result could stem from the fact that, per NAPSGF guidelines, only one symbol was included in each message. The proposed symbology set reflected the events rather than the recommended protective actions, keeping in mind that WEA "events" included "Shelter in Place" and "Evacuation Immediate." As a result, participants either understood what was happening but not what protective action to take, or they understood they were to shelter in place or evacuate but not why that was necessary. Even though these are related, the relation would appear not to be strong enough for one symbol to convey the entire content of the message. For people to take the recommended action, they need to know why it is necessary and that the message applies to them. **As a result, if symbology is used to improve message comprehension, symbols should be used to convey both the event and the protective action.**

The usability study results show that continued education about WEA is important. For example, participants did not understand that "All Clear" meant the emergency was over, even when they saw that message in ASL. Also, most participants did not understand what a "Civil Danger" alert might entail and, as a result, stated that they would not follow the protective action recommendation. **These results indicate that people who are Deaf would benefit from further education about specific terms and geotargeting for WEA messages to be most effective.**

More broadly, FEMA and IPAWS should consult with ASL users and test both the text-based language and symbols used in messaging to improve comprehension of critical information for the population of people who are Deaf. A similar approach would benefit those with cognitive disabilities, including the growing population of older adults with mild cognitive impairment. **Further work should include other populations of people with disabilities targeted by the App Development.**

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