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Ready.gov

Who's Ready, Really? Examining Principles of Inclusivity and Universal Design in Emergency Management and Disaster Preparedness Public Information Websites

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Abstract: Nearly 20 years ago, the U.S. Department of Homeland Security launched Ready.gov, a national public service advertising campaign designed to educate and empower Americans to prepare for and respond to emergencies such as natural and technological disasters. To date, little is known about the accessibility and adaptability of this information for vulnerable populations including persons with disabilities (PwDs) and those with limited English proficiency (LEP). This computer-automated analysis seeks (1) to determine the general web, mobile and language accessibility of state websites which extend and/or amplify the Ready.gov national campaign goals, (2) to evaluate the document accessibility of

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downloadable emergency preparedness information, and, based on findings, (3) reflect upon improvement opportunities for disaster and emergency management preparedness messaging processes to vulnerable populations. An exploratory, quantitative content analysis relying on computer-automated software is used to assess the web, language, mobile and document accessibility of Ready.gov state-affiliated websites dedicated to providing public information for emergency preparedness and disaster response. Additional factors such as the use of CAPTCHA, adherence to the Matterhorn Protocol, disclosure of accessibility policy statements, and the presence of tailored information are evaluated. No significant differences among FEMA regions were found. The most frequent errors were likely to impact the POUR dimensions of perceivability and operability. In all, 76% of the Ready.gov state-affiliated websites had WCAG Level AA detectable accessibility failures on the home pages. Furthermore, 62% of the sites offered translational language formats for LEP users, while only 6% ($n = 3$) explicitly provided PwDs an option to report accessibility-related user experiences to the agency. Document accessibility was deemed to be poor with 80% of the websites disseminating downloadable .pdfs such as emergency planning guides and preparedness kits in inaccessible digital formats. These findings identify opportunities for improvement specifically, in the web, mobile and document accessibility of information associated with the Ready.gov national campaign. We argue that improvement and compliance is expected to reduce the likelihood of litigation, increase the resilience of vulnerable populations, and improve user experiences.

Keywords: Crisis; emergency and disaster communication; web accessibility; public information campaigns; disabilities; Matterhorn protocol.

In the context of public safety fomenting, a state of readiness and resiliency to potential emergencies and disasters is a fundamental goal of government agencies. Within communication studies, emergency and disaster management research often explores ways to pragmatically inform the public about how to respond to crises, emergencies and/or disasters that have an enhanced likelihood of occurrence in specific regions. Realizing the need to bolster efficacy in the U.S. population, the U.S. Department of Homeland Security (DHS)[1] launched the Ready.gov in February 2003 as a national public service campaign effort designed to educate and empower

Americans to prepare for and respond to a range of crises and emergencies, including natural disasters and technological crises (i.e., cybersecurity). The campaign asks the public to do four things: (1) To stay informed about the types of emergencies that could occur and appropriate responses, (2) to make a family emergency plan, (3) to build an emergency supply kit, and (4) to be involved in community preparedness efforts.

For the past 19 years Ready.gov has been educating the American public about disaster and emergency preparedness. During this time $1.6 billion in earned media has enabled the campaign to reach millions of Americans resulting in 100 million visits to the campaign's website, Ready.gov.[2] Since the campaign's inception, additional efforts have focused on tailoring the campaign message content. For example, Ready.gov/Business focuses on specific information for the commercial sector. In September 2019, FEMA launched a Ready.gov information campaign for minors, focusing on youth emergency and disaster preparedness. Still, to date, little is known about the inclusivity and accessibility of this public information to persons with disabilities (PwDs) and those with limited English proficiency (LEP). As a result, this study seeks to determine the (1) general web, mobile, and language accessibility of websites that amplify and integrate the Ready.gov national campaign information into state-level public information initiatives, (2) to further evaluate the document accessibility of supplemental, downloadable preparedness information delivered via state-affiliated Ready.gov websites, and based on these findings (3) to reflect upon opportunities to improve diversity, equity and inclusivity for PwDs and those with LEP in the emergency management and preparedness process.

To achieve these aims, we first review the literature related to emergency management and PwDs followed by an overview of web, mobile, language, and document accessibility concepts. Finally, a description of the methods and measures is used to evaluate this digital preparedness content, followed by a report of findings.

1. Emergency Management & Persons with Disabilities (PwDs)

According to the Americans with Disabilities Act (ADA), a disability is "a physical or mental impairment that substantially limits one or more of the major life activities".[3] Individuals may experience one or more disabilities

categorized as *visual* (e.g., macular degeneration, color blindness, light sensitivity), *motor/mobility* (e.g., physical limitations), *auditory* (deaf, hard of hearing (HOH)), or *neurological/learning/cognitive* (e.g., ADHD, dyslexia).[4] Overcoming these challenges can be difficult in digital information environments. The Centers for Disease Control and Prevention estimates 61 million or 26% of the U.S. population lives with some form of disability, and the number of Americans with disabilities is anticipated to increase as the U.S. population ages.[5] Notably, the U.S. Census Bureau projects the number of Americans aged 65 and older will nearly double from 52 million in 2018 to 95 million by 2060.

PwDs are considered a vulnerable population in emergency management and disaster preparation education and outreach. These populations are more pronounced and concentrated in certain geographic regions with known and novel hazards. A 2014 Federal Emergency Management profile "Preparedness in America" revealed that PwDs, compared to caregivers and the general U.S. population, report increased perceived risk severity toward a variety of hazards. For example, 48% believed they are at risk for natural disasters (i.e., tornados, earthquakes, wildfires, floods, others), and 59% believed these disasters would be severe. Additionally, 27% believed they were at risk of disease outbreaks while 46% believed these outbreaks would be severe. Elevated risk perceptions were documented in additional categories (i.e., hazardous material accidents, terrorist acts). FEMA also found that PwDs, compared to caregivers and the general U.S. population, were less likely to (1) participate in home evacuations or shelter in place drills, (2) participate in disaster preparedness training, and (3) develop a household plan and discuss it with other family members — many of the goals of the Ready.gov campaign. PwDs reported the lowest level of response efficacy belief in preparedness efforts to confront a range of hazards (i.e., 69% weather emergencies, 64% natural disasters, 53% wildfires, 48% disease outbreaks, 47% hazard materials accidents, and 43% terrorist acts). These individuals also reported a low level of self-efficacy to respond to these events — in that less than half (47%) believe they could respond to natural disasters, 41% to wildfires, 33% disease outbreak, and 25% to terrorist acts.[6]

These findings reinforce the need for effective and accessible emergency risk and disaster preparedness messages to address knowledge gaps and efficacy in vulnerable populations. Efforts to address these issues align

with FEMA's goals and aims. An ODIC report details FEMA's key accessibility principles outlined as follows.[7]

There are additional legal and regulatory rationales for ensuring that emergency response and disaster preparedness content is both accessible and adaptive to public needs. The Americans with Disabilities Act applies to state and local governments (Title II) and businesses that are open to the public (Title III). Title II of the ADA "prohibits discrimination against people with disabilities in all services, programs, and activities of state and local governments".[8] The U.S. Department of Justice Guidance to State and Local Governments details the Americans with Disabilities Act and other laws apply to a variety of emergency and disaster response phases including: (1) Preparation, (2) notification, (3) evacuation and transportation, (4) sheltering, (5) first aid and medical services (6) temporary lodging and housing, (7) transitions back to the community, (8) clean up and recovery,

Table 1. FEMA Key Accessibility Principles.

Equal Access	People with disabilities must be able to access the same programs and services as the general population. Access may include modifications to programs, policies, procedures, architecture, equipment, services, supplies, and communication methods.
Physical Access	People with disabilities must be able to access locations where emergency programs and services are provided.
Access to Effective Communication	People with disabilities must be given the same information provided to the general population using methods that are understandable and timely.
Inclusion	People with disabilities have the right to participate in and receive the benefits of emergency programs, services, and activities provided by governments, private businesses, and nonprofit organizations.
Integration	Emergency programs, services, and activities typically must be provided in an integrated setting.
Program Modifications	People with disabilities must have equal access to emergency programs and services, which may entail modifications to rules, policies, practices, and procedures.
No charge	People with disabilities may not be charged to cover the costs of measures necessary to ensure equal access and nondiscriminatory treatment

Notes: See Ref. 7. *Planning for the Whole Community: Integrating and Coordinating the Access and Functional Needs of Children and Adults with Disabilities in Preparedness, Response, Recovery and Mitigation.* Federal Emergency Management Agency Office of Disability Integration and Coordination. Retrieved June 30, 2022, from http://www.fema.gov/pdf/about/odic/all_hands_0411.pdf.

and (9) ancillary emergency- and disaster-related programs, services, and activities.[7]

The U.S. regulatory system helps to ensure accessible information is made available to the public. By being proactive on universal design and accessibility concerns government agencies reduce exposure to litigation. This is a timely matter as rates of litigation for failure to provide accessible online public information are impacting U.S. colleges and universities[9] and government institutions.[10] Since 2018, website and mobile app accessibility lawsuits have comprised one-fifth of all ADA Title III filings in federal courts, which are currently estimated to exceed 10,000 lawsuits annually.[11]

Access to local and state services are increasingly managed online, including: Applying for absentee ballots, filing police reports, and applying for state benefit programs. Beyond providing educational and prepatory information about hazards, state-affiliated Ready.gov websites also serve as gateways to resources and services needed by impacted populations such as disaster relief assistance applications and requests for government supplies and materials (i.e., potassium iodine pills for nuclear hazards). *In lieu* of the regulatory, legal, and communicative importance of Ready.gov public information a review of the inclusivity and accessibility of this information is warranted.

1.1. *Crisis, Emergency, & Disaster Communication & Web Accessibility*

The web accessibility of Ready.gov state-affiliated websites is consequential. In general, crisis communication reflects the process of emergency management by concentrating on key stages such as (1) Mitigation, (2) preparedness, (3) response, and (4) recovery.[12,13] Communicating throughout the stages is necessary to ensure public readiness and resilience. When disseminating public information about myriad emergencies and disasters government agencies frequently rely on key messaging strategies — to distribute (1) *instructing information* about how to cope physically with a crisis, emergency or disaster, and (2) *psychologically adjusting information* on how to cope psychologically with the crisis, emergency or disaster.[14] These messaging strategies provide preparation and planning information, convey how to receive warning and risk messages, offer safety information (i.e., how to use a generator in a power outage), and inform

the public with sheltering and evacuation instructions for a variety of threats including: Weather-related hazards (i.e., floods, tsunamis, tornadoes, wildfires, earthquakes), technological hazards (i.e., cybersecurity); and, novel hazards (i.e., active shooter events, pandemics, bio terrorism-terrorism, among others). Ready.gov state-affiliated websites also commonly provide community-based tools and widgets to users such as Evacuation zone look-ups, preparedness calendars, training exercises and videos, and downloadable mobile applications.

Heath and Palenchar reason that because "concern remains high that risk events are likely to occur and harm community safety, citizens are willing to become knowledgeable of emergency response measures," (p. 131).[15] This knowledge in turn "gives citizens a greater sense of control, which may translate into trust for industry and city emergency response efforts" (p. 131). Prior studies have investigated how people respond to emergency information (e.g., Ref. 15) and the need for instructing information.[16] Additionally, Coombs and Holladay reasoned that if an organization fails to provide instructing information stakeholders and the organizations suffer dual effects, the first resulting from damages caused by the event itself and the second-level effects involving the reputational damage resulting from public perception of a lack of care and concern for stakeholders.[17] This is especially true in emergency and disaster events involving vulnerable populations. Crisis, emergency, and disaster communications consisting of instructing and psychologically adjusting information delivered through national campaigns such as Ready.gov are designed to empower the public with information in order to cultivate a sense of agency for their personal protection, thus facilitating readiness and resilience among the U.S. population.

To date, little is known about the accessibility attributes of Ready.gov information. To explore the general web accessibility of this content we rely on the World Wide Web Consortium (W3C) standards. W3C.org is an international organization that oversees the standardization and operation of the web and develops the globally recognized Web Content Accessibility Guidelines.[18] W3C posits four general principles for evaluating the content of web accessibility: Perceivable, operable, understandable, and robust; together these elements are known as the POUR framework. W3C advances three priority levels: A (lowest), AA, and AAA (highest). The U.S. government adopted WCAG 2.0 Level AA as the national web accessibility

standards in January 2017. In alignment, we use the Level AA guidelines to evaluate the online information provided by Ready.gov state-affiliated websites.

A key objective of this study is to evaluate the general web, language, and mobile accessibility of U.S. state-affiliated Ready.gov disaster preparedness information using W3G WCAG 2.0 AA guidelines, therefore we ask:

RQ1: What is the general web accessibility of state-affiliated Ready.gov emergency management and disaster preparedness websites?

Emergency management and disaster information providers have a regulatory and legal responsibility to ensure accessible public information. To remain safe before, during, and through a crisis, emergency or disaster PwDs and those with LEP need adaptive and accessible content. Adaptive content can be accessed by a variety of mobile and desktop devices, while remaining accessible to a variety of visual, auditory, language proficiencies, and cognitive needs. Because state-affiliated Ready.gov websites have autonomy on message development and design, it remains unknown if there will be regional differences in the degree of accessibility across FEMA regions, therefore the below research question is offered.

RQ2: Are there regional differences among FEMA regions in the frequency of web accessibility errors reflected by the (a) total alerts and (b) overall error density?

Beyond solely considering the general accessibility of the content, this study further seeks to understand the language accessibility, content readability, and mobile accessibility of this digital information. *Language accessibility* refers to language that accommodates people of all ages and abilities, including those with cognitive disabilities, persons with low literacy skills, and those with LEP.[19] *Mobile accessibility* closely aligns to the POUR principles of operability and robustness due to the proliferation of personal mobile devices such as smartphones and tablets and the rise in mobile based applications.[20] *Content readability* indices such as the Flesch–Kincaid Reading Ease (FK-RE) Index, the Flesch–Kincaid Grade Level (FK-GL), and the Automated Readability Index (ARI) are commonly used to

evaluate the complexity of digital content. Because there are no research studies that evaluate these U.S. government emergency management and disaster preparation websites using the accessibility attributes described above, we offer the following research question.

RQ3: What is the degree of (a) language accessibility (b) mobile accessibility, and (c) content readability level of state-affiliated Ready.gov affiliated websites?

Digital information within state-affiliated Ready.gov websites may take a variety of forms including: Print, video, audio, social/digital and hotlines, each with varying levels of richness and appeal to diverse audiences. Because there are an array of messaging options, a strategic mix of information channels is necessary to ensure the accessibility of disaster preparedness public information. For a review of the advantages and disadvantages of specific mediums in crises and disasters, see Ref. 21. A popular method for disseminating supplemental Ready.gov campaign information is through downloadable .pdfs. Campaign-related .pdfs often include guide books for emergency and disaster preparedness, and checklists and kits for bolstering response efficacy. *Document accessibility* is increasingly a focal point for universal design and inclusivity technology advocates.[22] Founded in 2021, the PDF/UA Foundation is a non-profit organization that publishes the *Matterhorn Protocol*. The Matterhorn Protocol is a list of criteria that .pdf documents must satisfy in order to be considered universally accessible (UA). The Matterhorn Protocol is composed of 31 checkpoints involving 136 failure conditions specified in PDF/UA guidelines. Currently, there are no studies which evaluate the accessibility of document downloads from Ready.gov state-affiliated websites, therefore we ask:

RQ4: Will the document accessibility of public information provided via state-affiliated Ready.gov emergency management websites meet Matterhorn Protocol — PDF/UA criteria?

The following section of this paper details the strategies for sampling the units of analysis, explains the variables of the analysis, describes the computer-automated tools used to assess the variables presented, and documents the process by which intercoder reliability was obtained.

2. Method

The units of analysis for this study are governmental (.gov) websites providing disaster and emergency preparedness information. State-affiliated Ready.gov websites were identified through FEMA.gov and the Google browser. FEMA territories (i.e., Guam, Puerto Rico, U.S. Virgin Islands, Marshall Islands, Federation of Micronesia among others) are omitted from this study as no identifiable participation in the Ready.gov public information campaign programs were noted at the local level. The main author conducted the computer-automated analysis of the web content. Following the completion of the initial analysis, an independent secondary review was conducted by the second author in order to establish reliability using 20% of the sample ($n = 10$). Scott's Pi was used to establish intercoder reliability. Reliability scores ranged from $\alpha = 0.92$ to $\alpha = 0.96$ for all factors.

2.1. *Measures*

Website Characteristics. Each state-affiliated Ready.gov website was coded for categorical and descriptive data. These factors include (1) FEMA Region location (1–10), (2) inclusion of tailored content for PwDs and LEP, (3) user design control (i.e., adjustments to font size and color contrasts), (4) presence of accessibility policy statements, and (5) forms or instructions to report accessibility issues impacting users. Each website was calculated for a composite accessibility score including features 2–5 outlined above.

Web Accessibility. Web AIM WAVE® software assessed the general accessibility of state-affiliated Ready.gov websites included in this sample. WAVE determines whether a website is WCAG-compliant by identifying critical accessibility failures most likely to undermine POUR web accessibility principles.[23]

Language accessibility. WCAG Guideline 3.1 (2019) posits language accessibility is directly related to broader web accessibility principles. Poor language accessibility may act as a barrier to informational messages and emergency and disaster management resources.[24,25] Ready.gov state-affiliated websites were evaluated to determine if the information was automatically translatable and/or offered in at least one other language.

Content readability. The WebFX® Readability analysis tool was used to assess the understandability of messages within the websites. Three indices

were selected: The FK-RE, the FK-GL, and the ARI. The ARI is used as secondary index to the FK-GL for comparability. Unlike the FK-GL, the ARI formula does not require analysis of the characters that create the words, such as syllable counts, but rather the length in characters. The FK-RE uses a ranking of 0–100 with higher scores indicating more reading ease.[26] FK-GL scores with an average grade level of 7 means that the website should be understood by persons in the age group of 12–13 years. The ARI estimates the U.S. grade level necessary to comprehend a passage of text; scores between 7–9 are considered acceptable.[27]

Mobile accessibility. Think With Google® Test My Site platform allows users to measure a website's performance across devices, from mobile to desktop and speaks to the POUR principle of robustness. Website URLs were processed through the Test My Site software which provides feedback about current website speed. Site and page speed are critical indices of the likely quality of a user's experiences related to content exposure and engagement. *Page speed* is the speed of an individual page within a website and *site speed* is the speed of all pages contained in a website. Websites are considered *good* if they load in less than 2.5 s, *needs improvement* if between 2.5–4 s, and *poor* if loading requires longer than 4 s.[28]

Document accessibility. PDF/Universal Accessibility (PDF/UA) is the term for requirements related to PDF documents. Adherence to PDF/UA guidelines helps to ensure that these file formats are properly supported for accessibility needs. In this study, document accessibility was evaluated using PDF Accessibility Checker (PAC) software. PAC® was the first automated PDF/UA compliance validation tool and has been in use since 2010. Each PAC report provides an analysis of three categories of accessibility features: Logical structure (i.e., elements, tree, mapping and alternatives), basic requirements (i.e., PDF syntax, content, fonts, embedded files, natural language), and metadata and settings.[29]

Use of CAPTCHA. CAPTCHA are challenges in websites asking users to prove they're human by compelling users to solve visual puzzles, or by identifying a collection of images or letters which may or may not be obscured by lines and other distortions. These tools are mainly required when submitting information or requesting information from an agency or organization. CAPTCHA may be difficult to use via the keyboard, impossible to use if a user is vision-impaired, and serve as a barrier if the audio is hard to listen to.[18,30]

2.2. *Report of Findings*

In order to answer the research questions posed in this exploratory, using quantitative content analysis a variety of descriptive an univariate statistical tests were computed using ISM SPSS 26 software. The below section provides a general description of the websites included in this sample and answers the research questions posed. The W3C POUR framework is used to describe our approach and to interpret and discuss findings.

To begin, general web accessibility characteristics of state-affiliated Ready.gov websites were explored. The results show that 20% of Ready.gov websites ($n = 10$) offer tailored information for PwDs on the home pages, and 70% ($n = 35$) provide an accessibility policy statement on the website. The use of CAPTCHA for contact forms and inquiries was minimal ($n = 5$) while 62% ($n = 31$) offered translational language options for LEP users. Adaptive user features such as adjusting font sizes ($n = 2$) and adapting color contrasts ($n = 3$) were not popular design features. Based on these attributes, a composite score was calculated for each of the websites. The presence of features such as tailored information on the main page, inclusion of an accessibility policy statement for the website, options for translational language for LEP web users, and the ability to report accessibility issues to the agency or webmaster were assigned a value of 1, if present. These features were summed to create an overall composite score. To determine if there were regional differences in these composite scores, a univariate analysis of variance was calculated and no significant differences were found between FEMA regions $F(2, 41) = 0.67$, $p = 0.52$. The overall sample average was $M = 1.95$, suggesting most websites include 1 or 2 of these features, and only a small portion ($n = 7$, 15%) offer none of these features.

RQ1 sought to understand the general web accessibility of state-affiliated Ready.gov emergency management websites. Using WAVE computer-automated software, error scores were calculated. The analysis revealed 76% of Ready.gov state-affiliated websites had recognizable W3C Level AA accessibility failures on the home page. A total of 326 accessibility errors were noted in this sample with an average error rate of 3.7 occurrences per website home page. Furthermore, a majority of the sample (66%) reported contrast errors on the home page. Further review of the critical errors presented in Figure 1 reveals the most frequent accessibility error

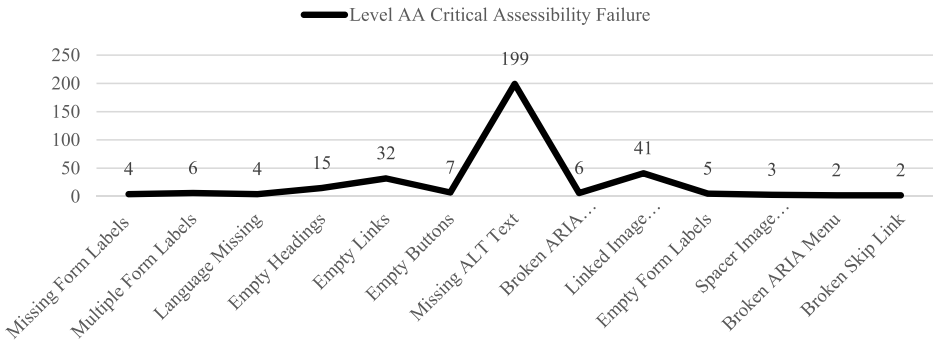

Figure 1. Common Level AA Critical Accessibility Failures.

types include: *Missing ALT text*, *empty links*, and *linked images missing alternative text.* The impacts of these errors on user experiences will be addressed in Sec. 3.

Because of public needs for tailored information related to local hazards and considerate of individual differences, *RQ2* sought to understand if there would be differences among FEMA regions in the frequency of web accessibility elements represented by the *total alerts*, which indicate elements in need of review, and *contrast errors* which refer to the contrast between web copy and background colors. A series of univariate analyses were computed and no regional differences were found to be statistically significant on the factors of error rate $F(2, 48) = 1.42$, $p = 0.25$, total alerts $F(2, 49) = 0.88$, $p = 0.42$, nor contrast error rate $F(2, 46) = 0.48$, $p = 0.62$.[a]

Results in Table 2 show that across the FEMA regions, state-affiliated Ready.gov websites averaged $4+$ contrast errors per website, with an average alert rate exceeding 19 occurrences per website, suggesting intra-agency reviews and updates to the digital information content are needed.

RQ3 sought to understand additional accessibility attributes including the content readability, mobile accessibility, and language accessibility of Ready.gov emergency management and preparedness information. To determine the content readability the FK-RE, Flesch–Kincaid Grade Level (FK-GL), and ARI indices were processed. A series of univariate analyses were

[a]Following an outlier analysis, the State of Louisiana was dropped from the error rate calculations as it was found to have 161 errors on the home page by WebAIM[23]; Florida $n = 145$, Kentucky $n = 68$, and Mississippi $n = 66$ were dropped from the contrast error calculations as they were found to be outliers on this factor.

Table 2. Regional Web and Mobile Accessibility.

	Web Accessibility			Mobile Accessibility	
	Error Rate Mean/SD	Contrast Errors Mean/SD	Alerts Mean/SD	Site Speed Mean/SD	Page Speed Mean/SD
Region 1	3.09/4.28	3.36/6.13	16.86/17.07	2.64/1.47	3.54/1.97
Region 2	3.00/5.11	5.40/7.12	19.46/16.13	2.35/0.54	3.10/1.92
Region 3	5.66/4.69	5.00/5.84	25.16/19.53	2.70/0.81	3.47/0.63
	3.70/4.68	4.45/6.33	19.69/17.38	2.55/0.90	3.39/1.59

Notes: For comparability the 10 FEMA regions were collapsed into three. FEMA regions 1–4 are represented as region 1, FEMA regions 5–7 are represented as region 2 above, and FEMA regions 8–10 are represented as region 3 above. For a map of FEMA regions, see https://www.fema.gov/about/organization/regions.

computed and no significant differences were noted among the FEMA regions. Overall, the content readability falls within acceptable ranges for the indices; however, there were a few notable exceptions. Approximately, 20% ($n = 10$) of the state-affiliated Ready.gov affiliated websites presented information that exceeds a 10th grade reading level indicating there may be barriers or challenges to understanding the information disseminated, within certain populations.

Google's Test My Site computer-automated analysis software was used to evaluate the digital performance of state-affiliated Ready.gov

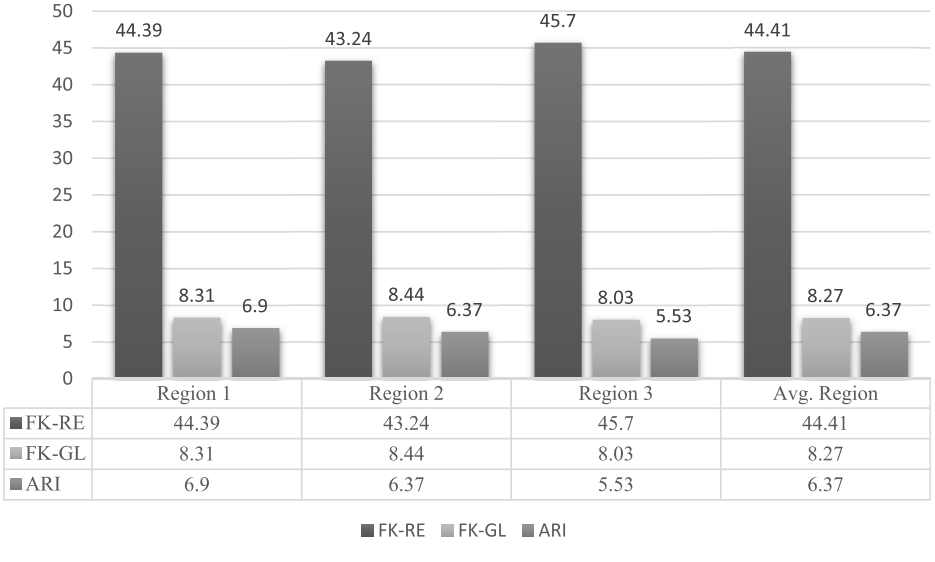

Figure 2. FEMA Regional Content Readability.

public information platforms. No significant differences were found in the regions on the factors of *page speed* $F(2, 19) = 0.25$, $p = 0.78$ and *site speed* $F(2, 19) = 0.10$, $p = 0.89$. The mean averages of the websites indicate a majority of these websites need improvement. Each unit of analysis was given a performance rating of either *good, needs improvement* or *poor*. Of the Ready.gov state-affiliated websites included in this study 33% of the sample were performing good ($n = 12$), while 41.7% are performing poorly ($n = 36$), with the remainder of the websites needing improvement. There was little notable change in the processing speeds as 15% ($n = 3$) were found to be speeding up, 15% ($n = 3$) slowing down and 63% ($n = 12$) indicating no recent changes to processing rates in the preceding months.

Finally, *RQ4* questioned whether Ready.gov state-affiliated emergency management websites distribute downloadable .pdfs that meet Matterhorn Protocol accessibility criteria.This variable was evaluated on a random subset of the states included in this analysis. PAC was used to analyze emergency management and disaster preparation public information planning guides ($n = 9$) and kits ($n = 7$) available as a downloadable .pdf from Ready.gov websites. For this subsequent analysis, only the items with reported document accessibility failures were recorded. PAC provides a score for each factor indicating the number of passes versus fails for the items analyzed. A % ratio of accuracy is computed for each identified

Table 3. PAC Document Accessibility Results.

	Planning Documents ($n = 9$)			Kits/Checklists ($n = 7$)		
	Passed ($n =$)	Failed ($n =$)	% Accuracy	Passed ($n =$)	Failed ($n =$)	% Accuracy
Logical Structure						
Elements	30	101	29%			
Alternatives	2962	12	99%	728	8	91%
Basic Features						
Content	4971	9206	53.9%	4755	6851	69%
Natural Language				0	3346	0%
MD & Settings						
Metadata	4	13	31%	3	18	16%
Settings	8	13	62%	8	13	61%

Notes: A random subset of downloadable .pdf information was gathered from state-affiliated Ready.gov websites and processed using PAC software. This data is used to gauge adherence to Matterhorn Protocol criteria.

accessibility failure. The reports indicate that .pdfs used to support the Ready.gov national campaign have a low level of accessibility in regard to the elements, content, metadata and settings of the .pdfs. These findings suggest this supplemental information offers little value to PwDs or those with LEP who may attempt to access the materials online.

3. Discussion, Limitations, and Conclusions

Accessibility of web and digital content was considered in this study. Duplaga notes that too often, PwDs continue to experience a `digital divide', a gap between digital resources for PwDs and persons without disabilities.[31] Given the exploratory nature of this approach to examining the messages from Ready.gov state-affiliated campaign websites, this study offers an atheoretical analysis of an applied communication campaign spanning nearly two decades. Our findings draw attention to matters of inclusivity and accessibility in emergency and disaster management information campaigns and highlights the varying degrees of accessibility within public information strategies designed to aid vulnerable populations including PwDs and those with LEP.

Several strengths of Ready.gov website characteristics were discovered. For example, there was minimal integration of CAPTCHA within state-affiliated Ready.gov websites, and 80% of these websites deliver message content at a reading level appropriate for the U.S. general population. The lack of significant regional differences in accessibility content supports the position these that findings speaks to the Ready.gov campaign accessibility efficacy as a whole, not a specific U.S. region or a specific state.

Reflecting upon the data, it was revelatory that only 20% of the sample offered tailored information to PwDs on the main page of these websites, especially given that vulnerable populations are disproportionately impacted by the effects of crises, emergencies and disasters.[32] Three-quarters (76%) of the state-affiliated Ready.gov websites were found to have WCAG Level AA Critical Accessibility failures on the home pages. The prevalence of frequent failures such as missing ALT text failures, empty links, and linked images missing ALT text are likely to negatively impact user experiences. For example, when added to an image, alternative text conveys meaning about what the image is to those who cannot see it, aligning to the

POUR principle of perceivability. Conversely, the linked text is important because it informs the user what will happen if they click on a link with their mouse or select a link with their screen reader, which relates to the POUR principle of operability. If the text describing the functionality is missing, those relying on screen readers will not know where the link will guide them and thus they are less likely to click on or select it. Empty links undermine the navigation of information dissemination efforts in digital environments. In this sample, 80% (14 of 16) of the websites evaluated for the document accessibility of downloadable emergency management and disaster preparedness kits, guides and planning documents were deemed inaccessible using Matterhorn Protocol PDF/UA attributes (i.e., elements, logical structure, metadata, and settings).

Ready.gov state-affiliated websites often tailored information to specific hazards in specific regions. For example, hazards such as damaging earthquakes are more prone to FEMA region 9, while tornadoes are more prone to FEMA regions 4–7. These findings indicate further message tailoring, with accessibility in mind, will bolster the campaign's effectiveness by extending the reach of Ready.gov campaign messages to PwDs and those with LEP.

These findings are limited in generalizability. All automated tools, including WAVE, have limitation with some estimating only 25–35% of possible conformance failures can be automatically detected.[33] The computer-aided software used for this analysis serves as an indicator of potential accessibility errors, and does not mean the content is necessarily inaccessible to the end user, as they may have adaptative or assistive technologies that aid in understanding and comprehending the content provided. Still the goal of organizations should be to have low-to-no WCAG Level AA-accessibility failures. These findings are additionally limited to the time period in which the analyses were processed. Should there be changes, upgrades, and improvements, the overall number of errors and types of errors would be augmented, thus reducing the opportunity for replication.

Future studies may offer additional insights by using a guiding theoretical framework such as organizational legitimacy, stakeholder management theory, or framing theory to inform the research model, design and variables of consideration. Further consideration of population specific campaign effects is needed. Considerations of additional variables such as

(a) public trust in organizations, (b) response efficacy beliefs, (c) message recall, and (d) information sufficiency may help to further explore issues of readiness and resiliency in at-risk, and vulnerable populations. As noted, our analysis is limited to the accuracy and compatibility of the computer-automated software utilized. Although computer-automated analysis is a popular method for evaluating web accessibility,[34,35] it is one of the three common methodological approaches. Alternative methods involve expert analyses and user-evaluations. Expert evaluation methods involve information evaluation by a group of highly trained experts,[36] while user evaluations involve studies whereby PwDs individually evaluate web accessibility offering first-person user experiences.[37] By integrating theoretical frames, expanding the variables of consideration, and using alternative methods, future studies may gather additional data that more richly describes and explains the effects of these accessibility-errors at the individual-level user experience. This data may further help strategic communicators who engage in the emergency and disaster message production and distribution processes.

Adherence to web accessibility guidelines and principles of universal design is anticipated to have beneficial impacts across the general U.S. population, not only PwDs and those with LEP. Schmutz, Sonderegger and Sauer have previously found that a website's conformance to WCAG 2.0 guidelines leads to higher task completion rates and lower task completion time in non-disabled populations.[38] Furthermore, participants using websites meeting Level AA Guidelines reported higher ratings of usability, aesthetics, and trustworthiness and lower ratings in workload than participants in the other conditions. This led Mason *et al.*[39] to conclude that addressing web accessibility "helps to close the gap of the digital divide . . .. making communication environments better for everyone," not just vulnerable papulations (p. 273). Digital accessibility improvement may also help additional under-represented and marginalized groups such as newly arrived immigrants and refugees as they adapt to new geographic, media, and information environments. WCAG Level AA compliance and adherence to the Matterhorn Protocol is anticipated to reduce the likelihood of litigation, increase the resilience of vulnerable populations, and improve user experiences for all.

These findings add to a body of literature made salient by advocates and Communication scholars who argue for heightened awareness of and

sensitivity to the needs of at-risk, vulnerable U.S. populations in the emergency and disaster preparedness context. It is incumbent on government agencies to provide adaptive and accessible information on matters of public safety with localized relevance to vulnerable populations. *In lieu* of these findings, governmental and intra-agency reviews of Ready.gov campaign materials are advisable so as to more inclusively prepare the U.S. populations for crisis, emergencies, and disasters.

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