

**Web Accessibility Evaluation for People with Disabilities: Wisconsin County Government
Website Homepages**

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Abstract

Web accessibility is becoming more prevalent in an ever-growing online world. Proper access to digital information is vital, especially for those with disabilities. This research evaluates the web accessibility of all 72 Wisconsin county government website homepages and how the accessibility can affect individuals with disabilities. Homepages are usually first the point of contact for a user and accessibility problems can hinder users from finding essential information. Online accessibility evaluation tools WAVE and TAW were used to find the Web Content Accessibility Guideline (WCAG) errors. The number of specific errors and alerts were recorded for each website. The results indicated that almost every website has WCAG errors that need to be fixed. Common issues were contrast errors, redundancy, missing alternative text, and page organization. Many of the problems could affect those with visual or auditory impairments and the use of assistive technology such as screen readers. The findings show that the Wisconsin county government homepages have accessibility problems that need to be fixed to allow users equal access to information.

Keywords: web accessibility, disabilities, digital information, WCAG, information equity

Introduction

Web accessibility is becoming an integral factor of internet usage and website creation. It allows web content to be accessible to everyone, no matter their age, abilities, or disabilities. One crucial type of web page that requires access to information are government websites.

Government websites are usually the first place and contact point a user goes to find information such as health, disability, transportation, or housing services. If websites have inaccessible web and rhetorical designs, they create a barrier for users with disabilities from accessing services. Poor web design practices can hinder the access of that information. An individual with visual impairments may not see text with high contrast or a person that is deaf would need captions if there is a video. Government websites are also held to a higher standard of accessibility because of laws regarding information accessibility.

In 2024, an update to Title II of the Americans with Disabilities Act (ADA) was made in favor of web accessibility. Title II now requires state and local governments to make sure that their services, programs, and activities are accessible online and through mobile apps to people with disabilities. As of April 20, 2026, the first part of the rule requires state and local government sizes of 50,000 or more persons meet compliance by April 26, 2027, and sizes 0 to 49,999 by April 26, 2028. The web content must meet WCAG 2.1 Level AA. The title helps governments stay more aligned with the ADA guidelines and sets a specific technical standard. Another set of rules that governments can follow is from the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI). W3C WAI creates international standards and strategies for building web pages based on accessibility. W3C publishes a document called the Web Content Accessibility Guidelines (WCAG) which lists ways to make web content more accessible including users with any type, severity and combination of disability. Then there is

Section 508 of the Rehabilitation Act of 1973 (2011) requires that members of the public that have disabilities that are seeking information or services have the same access as those with no disabilities. Governments have multiple laws and guidelines to follow which can become challenging at the county level. Past research has used W3C and the WCAG to review web accessibility in country and region government websites and services, but not in a specific state.

According to the U.S. Census, in 2024, 12.9% of people in Wisconsin reported to have a disability, about 770,130 Wisconsinites. The most common disabilities reported were hearing, vision, cognitive, ambulatory, self-care, and independent living. All those individuals may need access to government information online and face challenges in doing so. The Wisconsin Department of Justice (DOJ) says they are committed to providing accessibility under Section 508 of the Rehabilitation Act but how well do counties comply with it? This study focuses on the 72 Wisconsin county government websites to answer how accessible are they for people with disabilities and what type of accessibility and information design errors are impeding disabled users to potentially not have proper access to information.

Literature Review

There are multiple research articles on web accessibility and those with disabilities and web accessibility for government websites. They express concerns and challenges of implementing accessible features in websites. The article from Jordanski and Nielsen (2023) expressed how most countries they analyzed contained low levels of compliance and can, “continue to be a serious challenge in the lives of all users and the level of digital inclusion, not least persons with disabilities”. Those violations can affect people with sensory disabilities such as visual or hearing impairments who use assistive devices.

The articles also discussed rhetorical accessibility, which is designing information that is not only functional, but also understandable. This is achieved through clear labels, concise wording, non-confusing navigation, and audience centered language (Zdenek, 2019). Some articles noted that users want organized webpage layouts and plain language, especially users that are older adults or have a disability (Chiriboga-Casanova et al., 2025; Souza et al., 2024).

Studies out of Europe have shown that there is a lack of equal access to information. Cantone et al. investigated the compliance of Italian Local Health Authorities with WCAG 2.1 Level AA. The Stanca Law (Legge Stanca) regulates accessibility in Italy which, “promotes the access of people with disabilities to information technology tools and services, particularly public websites” (Catone et al., p. 1). Their conclusion was that compliance was significantly broken and how users with visual and cognitive disabilities are being greatly affected. In the UK, Kuzma (2010) evaluated accessibility design issues in 130 Members of Parliament websites finding that most of them do not meet mandates set by the government and accessibility guidelines. Specific errors across websites hinder the accessibility for people with disabilities and consistency is not being kept.

Another theme throughout the articles is how there can be limitations to using automated tools such as Web Accessibility Evaluation Tool (WAVE) to collect data because they could miss usability issues. One other theme was the need for updated design standards for those with disabilities. Alahmadi and Drew (2017, p.1) argue how, “Understanding the characteristics of users with disabilities, e-learning system features and functions, and then mapping the relationship to state- of-the-art accessibility and usability guidelines and standards using relevant questionnaires (e.g. WCAG 2.0, SUMI, SECTION 508 and IBM) will contribute to a disability-specific accessibility and usability evaluation tool.” Technical communicators and information

designers must acknowledge a disabled users' perspective and experiences. The standards will always be evolving so it is difficult to create one set of rules.

Methods

The study gathered qualitative data from the 72 Wisconsin county websites. The process was automated to find WCAG guideline problems. The list of counties and their website links were taken from Wisconsin Counties Association website. To gather the data, two accessibility evaluation tools, WAVE and Test de Accessibilidad Web (TAW), were used on the websites. The two research questions were used to determine the accessibility of the websites:

- How accessible are Wisconsin county government website homepages for people with disabilities?
- What type of accessibility and information design errors are impeding disabled users to potentially not have proper access to information?

The WCAG offers an approach to evaluating how well websites follow the guidelines called Website Accessibility Conformance Evaluation Methodology (WCAG-EM). The WCAG-EM has five steps which are to (a) define the scope of the evaluation; (b) explore the website; (c) select a representative sample; (d) evaluate the selected sample; (e) report the evaluation findings. This approach was followed when determining the sample of this study.

WCAG-EM Approach

WCAG-EM first says to identify the goal of conformance level. The conformance levels are A, AA, and AAA. The levels check different guidelines based on HTML and CSS. A and AA levels are used to identify the data being recorded because both evaluation tools used them. Next, the homepages of the Wisconsin county government websites were chosen as the sample. The approach suggests selecting a representative sample when it is not feasible to evaluate every

webpage on a website. The home pages are usually the first point of contact for a user. If the homepage has accessibility problems, then it can be assumed that other pages on the website have the same or similar problems.

Types of Web Accessibility Evaluation Tools

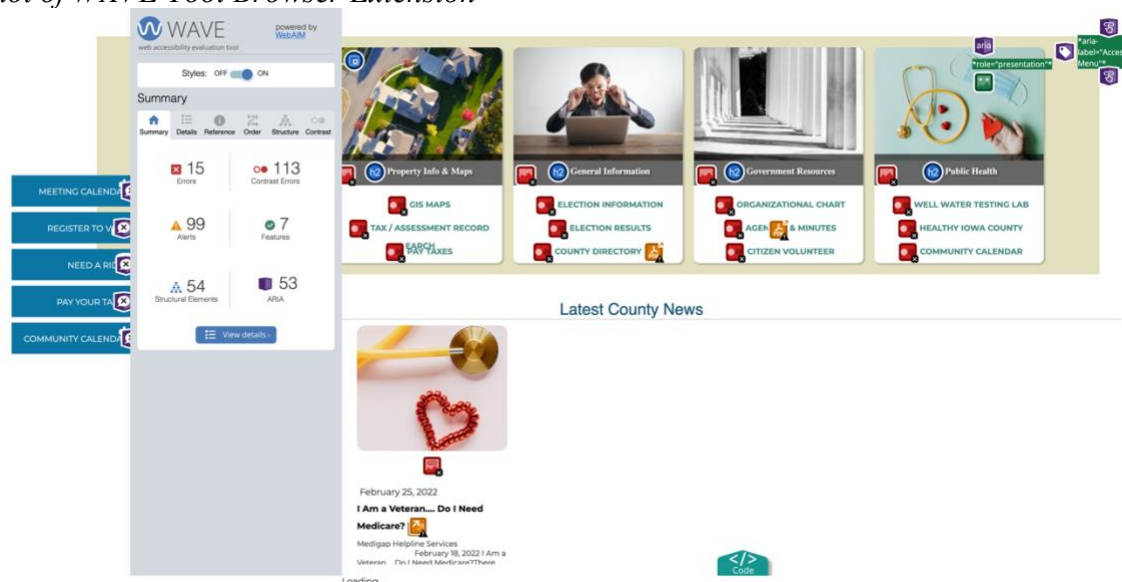
There are two main types of evaluation methods, those being manual and automated. Manual evaluation can be more accurate because an automated tool may miss a problem that would need fixing. Bhatia and Malek (2024, p.61) state how, “manual testing is always required along with automated testing, because many errors are not identified by automated tools and require human intervention and judgement”. Human input will always be needed when evaluating a website for accessibility, but that input could be misguided by bias and personal judgements. Multiple automated tools have been created that are publicly available for use and are faster than manual evaluations. These tools usually create reports based on the WCAG guidelines and help the web creators identify problems. The reports show both the site’s problems and warnings and the content which meets guidelines. Multiple automated tools were used in this study because doing so can, “maximize coverage and completeness and thereby obtain more reliable data” (Inal et al., 2022, p.4). Thus, the WAVE and TAW tools were used because WAVE shows where in the webpage the error or warning occurs and TAW identifies the specific WCAG guideline being broken. Firefox was the browser used for both tools.

WAVE was developed by Utah State University. For this study, the browser extension version was used because since the sample is government websites, they may block website scanners from working. The browser extension bypasses this problem and still produces the same results. One summary piece that the extension misses out on is the AIM score. This score

measures the accessibility of the webpage but does not inherently mean the webpage is fully accessible. Figure 1 below is an example of the interface.

Figure 1

Screenshot of WAVE Tool Browser Extension



Note: This example is from the Iowa County government website homepage. Red icons indicate errors and orange icons indicate alerts.

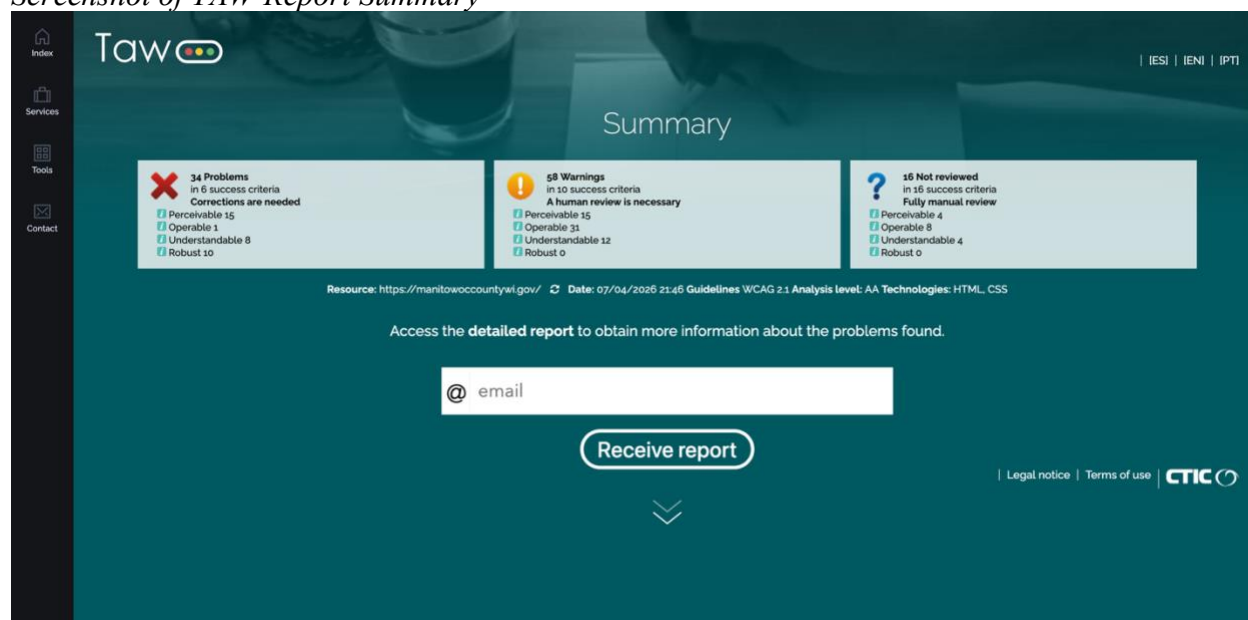
The WAVE panel shows the summary of what it found and gives the number of each item. Users can then click on the “Details” tab to learn about the specific findings. In Figure 1, the icons represent errors, alerts, features, and ARIA. When the icons are clicked, they provide an explanation of the guideline being violated, why it matters, and how to fix it. These icons allow a user analyzing a webpage to learn where the problems are occurring. The CSS styling can also be turned off which can be useful to find underlying problems that can affect assistive devices such as screen readers. The data was taken from the specific type of issue (error or alert) and number of errors, contrast errors, and alerts and put into an Excel file. Contrast errors were grouped with errors since the only type of contrast error found was “Very Low Contrast”.

TAW stands for Test de Accessibilidad Web and was developed by the Spanish organization CTIC. TAW creates a report based on the conformance level the user wants. Level AA was used in this study. One limitation that was encountered with the tool was reports not being generated. 21 websites failed to be analyzed because of this. Either the tool responded with a pop-up warning saying there was an error in the analysis, or the website would time out.

The reports categorized the guidelines into four principles: perceivable, operable, understandable, and robust. The specific guidelines are stated in the report along with an explanation. Examples of the report are below in Figure 2 and 3.

Figure 2

Screenshot of TAW Report Summary



Note: This example is from Manitowoc County government website homepage showing the total problems, warnings, and not reviewed areas.

Figure 3*Screenshot of Detailed TAW Report*

Perceivable

Information and user interface components must be presentable to users in ways they can perceive.

Guideline	Level	Result	Problems	Warnings	Not reviewed
1.1-Text Alternatives			7	7	0
1.1.1 - Non-text Content	A	✖	7	7	0
1.2-Time-based Media			0	0	0
1.2.1 - Audio-only and Video-only (Prerecorded)	A	na			
1.2.2 - Captions (Prerecorded)	A	na			
1.2.3 - Audio Description or Media Alternative (Prerecorded)	A	na			
1.2.4 - Captions (Live)	AA	na			
1.2.5 - Audio Description (Prerecorded)	AA	na			
1.3-Adaptable			8	1	1
1.3.1 - Info and Relationships	A	✖	8		
1.3.2 - Meaningful Sequence	A	!		1	
1.3.3 - Sensory Characteristics	A	?			1
1.4-Distinguishable			0	7	3
1.4.1 - Use of Color	A	?			1
1.4.2 - Audio Control	A	na			
1.4.3 - Contrast (Minimum)	A	?			1
1.4.4 - Resize text	AA	!		7	
1.4.5 - Images of Text	AA	?			1

Operable

User interface components and navigation must be operable.

Guideline	Level	Result	Problems	Warnings	Not reviewed
2.1-Keyboard Accessible			0	0	1
2.1.1 - Keyboard	A	?			1
2.1.2 - No Keyboard Trap	A	?			1
2.2-Enough Time			0	0	1
2.2.1 - Timing Adjustable	A	?			1
2.2.2 - Pause, Stop, Hide	A	?			1
2.3-Seizures			0	0	1
2.3.1 - Three Flashes or Below Threshold	A	?			1
2.4-Navigable			1	35	5
2.4.1 - Bypass Blocks	A	!		2	2

Note: The screenshot shows each guideline under the perceivable and operable sections. The red “X” represents problems, and orange exclamation points are warnings.

In Figure 2, the summary first displays total problems, warnings, and not reviewed guidelines. The problems are associated with the red “X” and are deemed corrections that need to be fixed. Warnings are the yellow circles with the exclamation point meaning that the guidelines need a human review and judgement. The Not Reviewed guidelines, indicated by the blue question mark, were not counted in this study but let the user know that those guidelines need a full human review. A more detailed report can be generated upon request as it specifies the line numbers in the code where the issues are. In Figure 3, the guidelines under each principle are viewed and marked as a problem, warning, or not reviewed with the total count of how many times they appear on the webpage. The total counts of each guideline for each website homepage were put into an Excel file. There are also icons next to each guideline, that when clicked,

display information about the guideline. TAW does not show where the problems or warnings occur, unlike WAVE.

Data Processing

R-Studio was used to process that data that was stored in Excel. Simple summary statistical analysis, correlation test, liner regression, and graphs were created including a heat map. Appendix C and Appendix D contain the code used for both WAVE and TAW.

Results

The evaluations conducted using the WAVE and TAW tools produced multiple results that tell different stories. The next sections analyze the data from each tool.

WAVE Tool

Table 1

Total number of errors detected by WAVE

Type of Error	Number of Occurrences	Number of Websites	Percentage of Websites
Very low contrast	669	54	75%
Missing form label	155	33	49%
Linked image missing alternative text	70	18	25%
Broken ARIA menu	68	10	14%
Empty heading	52	28	39%
Missing alternative text	34	6	8%
Empty link	33	17	24%
Spacer image missing alternative text	16	3	4%
Empty button	15	11	15%
Empty table header	15	1	1%
Broken ARIA reference	7	4	6%
Contrast error	5	1	1%
Language missing or invalid	3	3	4%
Empty form label	2	2	3%
Multiple form labels	2	1	1%

Table 1 above shows a summary of the total number of errors that WAVE found and the total number of websites that error occurred on and the percentage of websites affected. There

were 15 unique errors found on all websites. The most common error was “Very low contrast” which had 669 occurrences on 53 websites. This error refers to the very low contrast between text and background colors. This error type corresponds with the WCAG guideline 1.4.3 Contrast (Minimum) at the conformance of Level AA. WAVE notes that to fix this problem, there needs to be an increase of contrast between the foreground text color and the background color. 74% of counties experience this. The Iowa county website had the highest amount of very low contrast errors at 105. Upon further inspection of their website, there are several contrast errors in their important links section and in their calendars for events and board and committee meetings. WAVE allows the user to view the contrast ratio of the identified problems. Text that has a contrast ratio of 4:5:1 or 3:1 for large text, will fail on the WCAG Level AA. All of the text that was marked for very low contrast fail to meet the 4:5:1 ratio.

The second most common error was “Missing form label” with 155 occurrences on 33 websites. The guidelines associated with this are 1.1.1 Non-text Content (Level A), 1.3.1 Info and Relationships (Level A), 2.4.6 Headings and Labels (Level AA), and 3.3.2 Labels or Instructions (Level A). This error matters because if a form does not have a text label associated with it, it can prevent screen readers from seeing that information. An example of this is if a search bar has no label text, then a user with a screen reader may miss it.

The other three errors in the top five are “Linked image missing alternative text”, “Broken ARIA menu”, and “Empty Heading”. These errors can hinder the accessibility when navigating a webpage. Screen readers cannot communicate alt text, help navigate complex apps such as Gmail with menus, and may confuse a user of a webpage’s organization when a heading has no content. Forest, Marquette, Waupaca, and Waushara counties had zero errors.

The number of alerts outnumbered the number of errors by a wide margin. Alerts can cause the same issues that errors can for individuals with disabilities. They should be treated as an occurrence for a web designer to go back and make sure it is complied with and does not cause any problems. There were 39 unique alerts found by WAVE. Table 2 below summarizes the top 15.

Table 2

Top 15 Alerts Detected by WAVE

Type of Alert	Number of Occurrences	Number of Websites	Percentage of Websites
Redundant link	1214	65	90%
Redundant title text	638	26	36%
Layout table	286	22	31%
Link to PDF document	256	32	44%
Underlined text	156	16	22%
Suspicious alternative text	138	17	24%
Redundant alternative text	106	24	33%
Possible heading	95	17	24%
Very small text	91	14	19%
Device dependent event handler	72	7	10%
Suspicious link text	52	22	31%
Noscript element	50	37	51%
A nearby image has the same alternative text	41	9	13%
Skipped heading level	39	24	33%
Missing first level heading	24	24	33%

“Redundant Link” was the most common alert occurring 1134 times in 65 websites. 90% of websites had this alert making it the most prevalent error or alert in the data. This alert is caught by adjacent links going to the same URL. The guideline associated with this alert is 2.4.4 Link Purpose In Content (Level A). The second most common one is “Redundant title text” and it occurred on 32 websites. This alert does not have an associated guideline, but it means that the title attribute text is the same as the text or alternative text. The text should be providing advisory information. WAVE states how, “In most cases the title attribute can be removed, otherwise

modify it to provide advisory, but not redundant information.” The redundancies can be caught by screen readers and provide a harder time for users to understand information.

The alert with the third highest occurrence was “Layout table”. It was found 286 times but was on 58 websites and they help organize content on a webpage. Screen readers may read them as data tables which can cause extra time for a user to go through. An example in a webpage can be a calendar. The calendar would be read by each day of the week and day cell by cell. WAVE says to replace layout tables with other HTML elements and CSS styles. It is important for web designers to ensure the navigation and content are logical. Fourth is “Link to PDF document” occurring 256 times in 25 websites. PDFs must have accessibility in mind because sometimes the links to them create new tabs or require an application to open such as Adobe Acrobat which can cause navigation issues. PDFs should be made natively accessible and WAVE suggests informing the user when a link to one will be opened. Then the fifth most common alert was “Underlined text” as it occurred 156 times in 54% of websites. Underlined text is usually associated with linked text and other styling such as bold or italics can be used instead. Lincoln County was the only one that had no alerts.

When reviewing the combined totals, there are some surprising findings. Eleven counties had over 100 combined errors and alerts. First, the summary statistics in Table 3 for the number of errors and alerts per county is interesting.

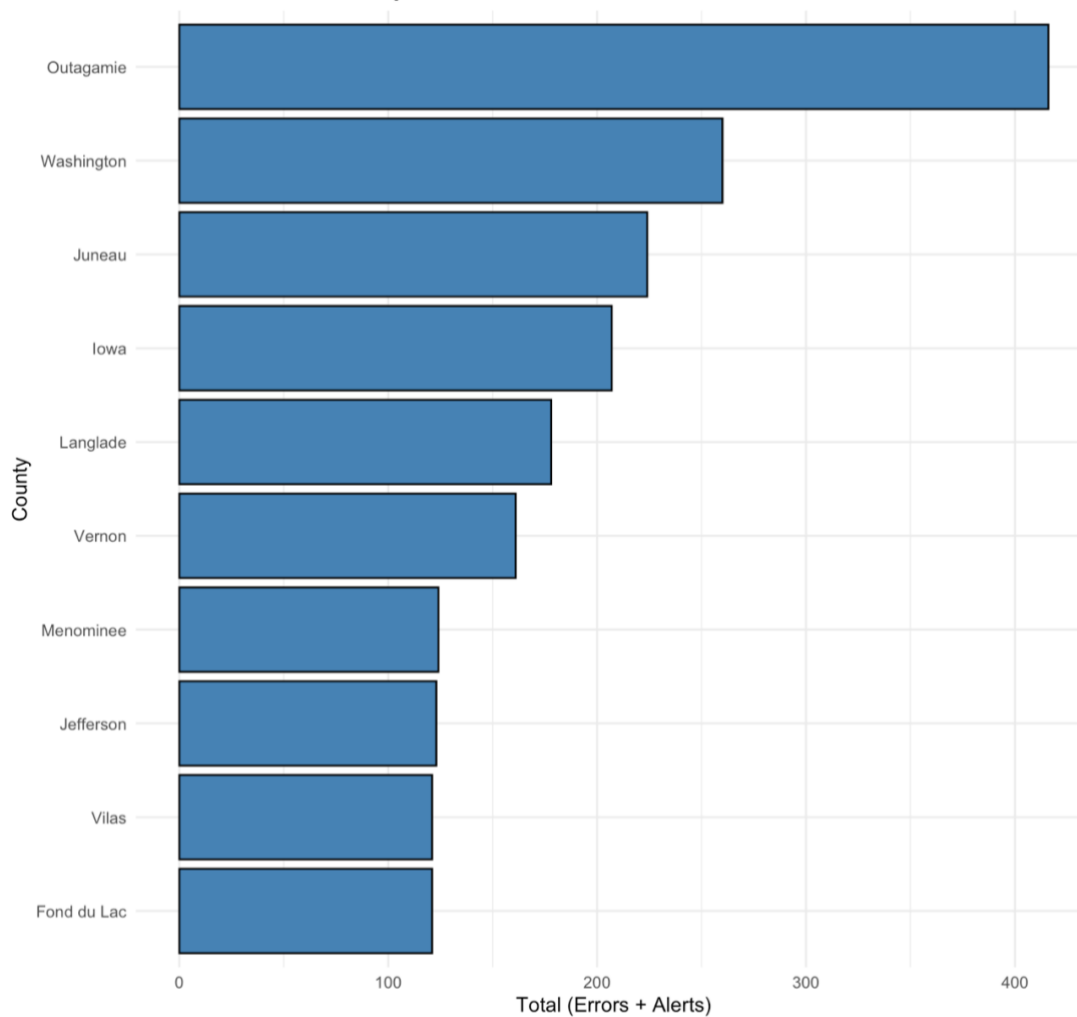
Table 3

Summary Statistics for the Number of Errors and Alerts from WAVE per County

	Mean	Median	Q1	Q3	IQR	Range	Min	Max	SD
Errors	16	9	4	19	15	117	0	117	19.70
Alerts	46	27	14	50	36	411	0	411	61.97

First, the alerts had higher numbers. The county average was 46 alerts. The middle 50% of the data falls between 14 and 36. There is a very high range of 411 because some webpages had zero alerts. The standard deviation of 61.97 indicates that there is high variability since it is larger than the average. This could be from the jump of Q3 being 50 to the max of 411.

The average amount of errors on a webpage was 16 while the middle 50% of data was between 4 and 19. Errors also have a very high range with it being 117 because some webpages had zero errors. The errors have a large spread with a standard deviation of 19.70 to the mean of 16. Figure 4 below highlights the top 10. One interesting note in Figure 4 is Outagamie County having a total of 416.

Figure 4*Top 10 Counties with the Most Total Issues*

Note: Outagamie County had the highest count at 416. See Appendix A for full totals of each county.

Outagamie had 411 alerts for redundant title text. As stated above, this alert happens because the title attribute text is the same as text or alternative text. When investigating the webpage for this problem, it is found that links in their “popular services” tab have the same name as the text on the page. An example is that the link that goes to their recreation page has the title attribute of “Recreation”. The text “Recreation” is under that link. Most of the alerts are hidden behind the webpage styles. The redundancies in link title text and the webpage text can

become confusing for someone using a screen reader. Washington had the second highest totals with 260. 254 alerts come from redundant links. When removing the styles, it was revealed that the links came from the translate feature on the website. There is a translate button that when clicked, shows a drop-down list of 243 languages that the webpage can be translated with. Those links are to each language Google Translate has. All the links can add inconvenience to someone using a screen reader because screen readers ignore the CSS and only look at the HTML, especially since the translate button is in the navigation bar. The alerts and errors identified can greatly impact those with disabilities when accessing information from the home webpages.

TAW Tool

Tables 4 and 5 below show the total numbers for problems and warnings found by the TAW tool. It is important to note that TAW could not process 21 webpages due to an error in analysis or the tool timing out and resulting in a web error. Below is a list of county websites that were not analyzed.

- | | | |
|--------------|-------------|---------------|
| • Burnett | • Lincoln | • Racine |
| • Dane | • Marathon | • Rock |
| • Eau Claire | • Marquette | • Sauk |
| • Fon du Lac | • Milwaukee | • Trempealeau |
| • Jefferson | • Monroe | • Vilas |
| • Juneau | • Outagamie | • Waupaca |
| • Lafayette | • Polk | • Waushara |

The statistics provided in Tables 4, 5 and 6 are based on the 51 websites that were successfully analyzed. WCAG Levels A and AA were analyzed. The problems and warnings found were based on the WCAG four principles of perceivable, operable, understandable, and robust. The totals for each principle were 236, 228, 174, and 18 respectively. Problems indicated that corrections are needed, and warnings indicate that a human review is necessary. Some guidelines had both problems and warnings appearing at the same time per webpage.

Table 4*Total Number of Problems Found by TAW*

Guideline	Number of Occurrences	Number of Websites	Percentage of Websites
Non-text Content	309	32	63%
Info and Relationships	249	42	82%
Name, Role, Value	121	20	39%
Link Purpose (In Context)	92	26	51%
Labels or Instructions	87	19	37%
On Input	37	26	51%
Language of Page	10	10	20%

Table 4 shows all the problems found by TAW. Only seven guidelines were detected as problems. The top problem found was “1.1.1 Non-text Content”. This guideline falls under the perceivable principle which is how information and the UI components are presented in ways users can perceive. It is to make sure that non-text content such as data charts, videos, CAPTCHA, and audio recordings has alternative text present. 63% of websites had this issue. It is alarming that this guideline has the greatest number of problems because of the importance of alternative text for those with disabilities. If no alternative text is present, users may miss out on important information.

The second most common problem was “1.3.1 Info and Relationships”. This guideline again is in the perceivable principle, and it is to help give visual or audio cues for information and relationships. A visual cue may be defined headings that organize a page, the color of a textbox in a form that indicates a required field, an asterisk indicating a required field, and colors of cells in a table that share relationships. Audio cues could be changes in tone of voice or sounds playing in a video to indicate new sections. The WCAG 2.1 document says how implementing cues can, “help people with different disabilities by allowing user agents to adapt content according to the needs of individual users.” Users will not be confused when the cues are

in place. Again, it is alarming that this guideline is present on 82% of webpages, significantly affecting users with disabilities. Table 5 gives a summary of all the warnings found by TAW. 15 guidelines contained warnings and are more prevalent than problems.

Table 5

Total Number of Warnings Found by TAW

Guideline	Number of Occurrences	Number of Websites	Percentage of Websites
Info and Relationships	1597	38	75%
Resize text	1552	41	80%
Non-text Content	1321	43	84%
Link Purpose (In Context)	743	37	73%
Headings and Labels	741	46	90%
Meaningful Sequence	259	33	65%
Error Prevention (Legal, Financial, Data)	239	39	76%
Error Identification	160	39	76%
Bypass Blocks	102	40	78%
Error Suggestion	80	39	76%
Keyboard	79	8	16%
Page Titled	50	50	98%
Focus Order	16	12	24%
Focus Visible	15	9	18%
Contrast (Minimum)	7	7	14%

Guideline “1.3.1” Info and Relationships” appears again with the highest number of occurrences. It is on 75% of websites. Guideline “1.1.1 Non-text Content” also has a high amount of warning occurrences, appearing on 84% of websites. The second highest was “1.4.4 Resize Text” and it falls under the perceivable principle. This guideline ensures that all text can be easily read by people with visual impairments and without the use of assistive technology. It is important that users can change the scale of text on a page. WCAG states that content satisfies the guideline if, “it can be scaled up to 200% using at least one text scaling mechanism supported by user agents.” Web authors are responsible for providing the types of scaling mechanism to ensure it works with their users. If no zoom is available on the webpage, there needs to be a way

for the user to increase the text size. Users of the government webpages are heavily affected by the small size of text. It is essential that the webpages have compatibility with screen magnifiers and the ability to change the scale of text.

The fourth most common guideline was “2.4.4 Link Purpose (In Context)” and is under the operable principle. The operable principle represents how usable the UI components and navigation are. The guideline’s intent is to help the user understand the purpose on a link and if they want to follow it. An example is “Read more” text followed by a link. Having defined links helps users with visual impairments learn the purpose of the link and it limits the number of clicks and navigation to their desired content.

The operable principal guideline “2.4.2 Page Titled” appears on 98% of websites. It is present once on each webpage except for one. The guidelines ensures that the page has a descriptive title and identifies the location the user is at without the need for knowing the content. The page title usually appears on the browser tab. It is worrisome that this is caught on almost every webpage because it means that the webpages may not be giving users the information they need about the page they are on. This can affect those with cognitive and reading disabilities because it does not let them retain or quickly learn the type of content on the page. Website authors would need to review that their page titles are accurately reflecting the content on the page. Table 6 below shows the summary statistics of the counties combined.

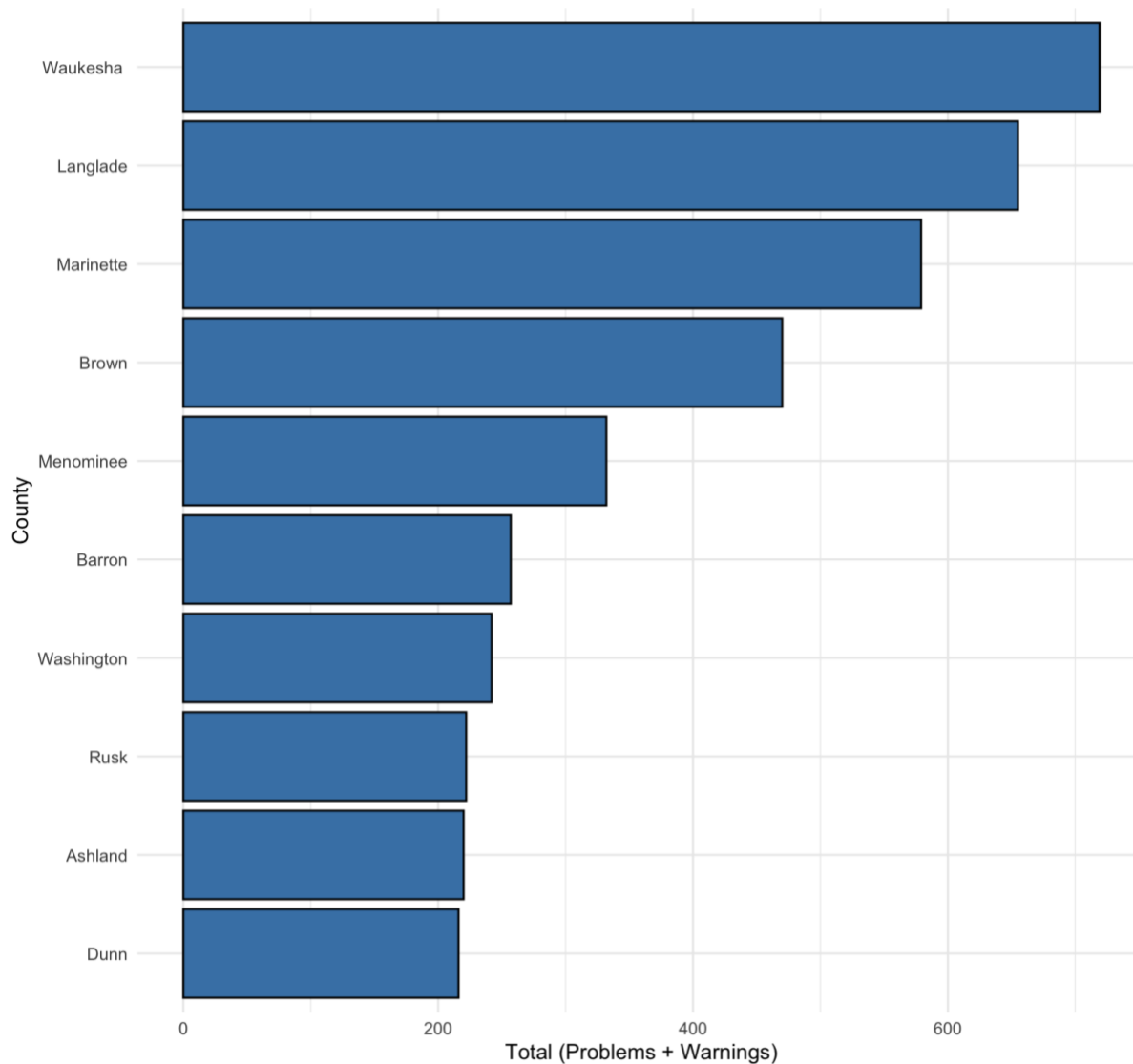
Table 6

Summary Statistics for the Number of Errors and Alerts from TAW per County

	Mean	Median	Q1	Q3	IQR	Range	Min	Max	SD
Problems	18	9	4	32	28	110	1	111	20.19
Warnings	137	99	64	155	91	700	3	703	149.20

The totals for each issue type are drastically different but the summary statistics for both are still important to highlight. For the problems issue type, there was an average of 18. 50% of the data was between 4 and 32. There is a very high range because some websites had low amounts of problems. The standard deviation indicates there is high variability and that is because of outliers.

The warnings issue type had a mean of 137 and 50% of the data is between 64 and 155. Most of the data is clustered lower than the mean. There is a very wide range of 700 because Waukesha County had 703 warnings. Again, the standard deviation shows a high variability due to very high outlier data points from Waukesha, Langlade, Marinette, and Brown counties. Figure 5 below shows those outliers.

Figure 5*Top 10 Counties with the Most Total Issues Detected by TAW*

Note: Waukesha county had the highest total of 719. See Appendix B for full totals of each county.

Waukesha County had the most total issues detected by TAW. The webpage contained 602 warnings of resizing text. Next was Langlade County with a total of 655. Their website had 362 info and relationships warnings and 172 non-text content warnings. Third was Marinette

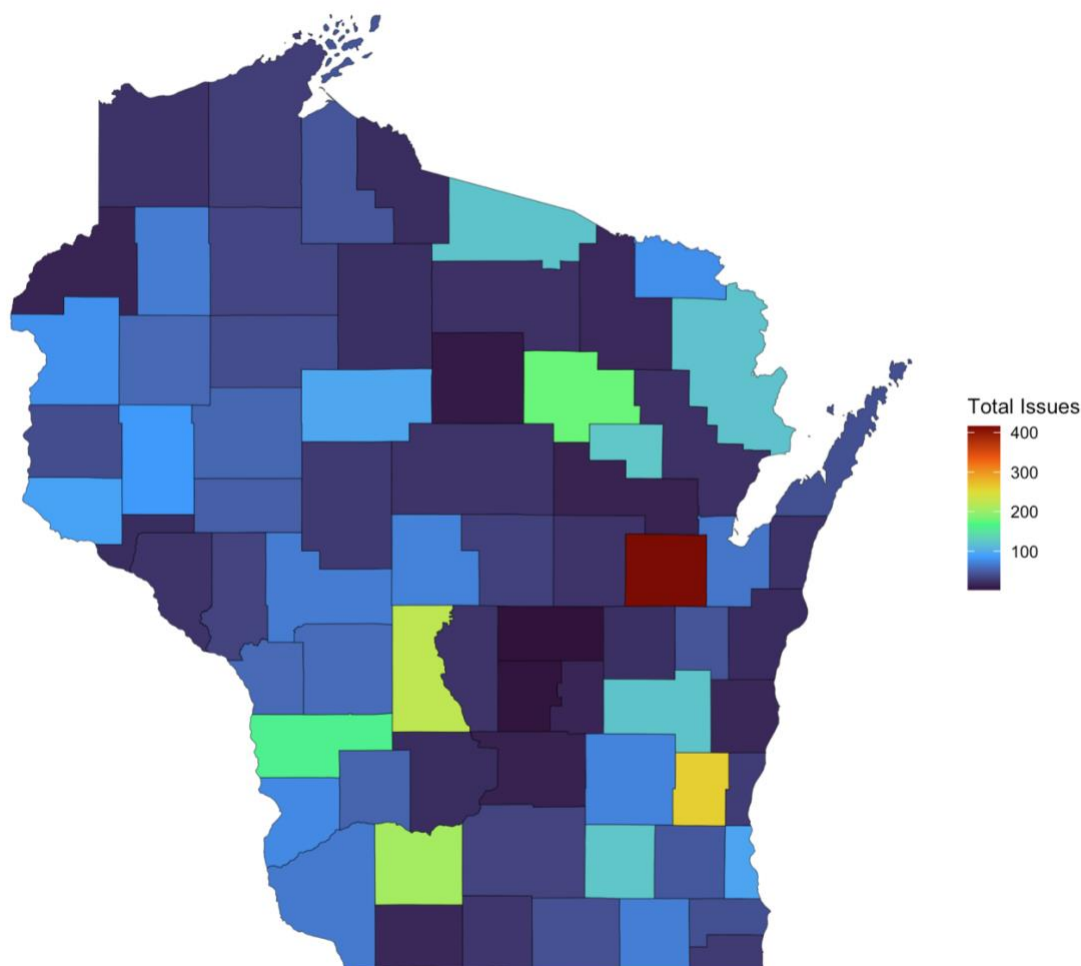
with 579. Their two main warnings were also info and relationships with a total of 323 and non-text content with a total of 157. Errors per website did not contribute much to the total amounts.

Web Accessibility Heat Map of Wisconsin and Correlation Analysis

The total issues from WAVE for each county were taken to give an overall view of accessibility in the state. 4492 issues were found with an average of 62 issues per webpage. Many webpages have below the average, but it is still important to limit the number of issues.

Figure 4

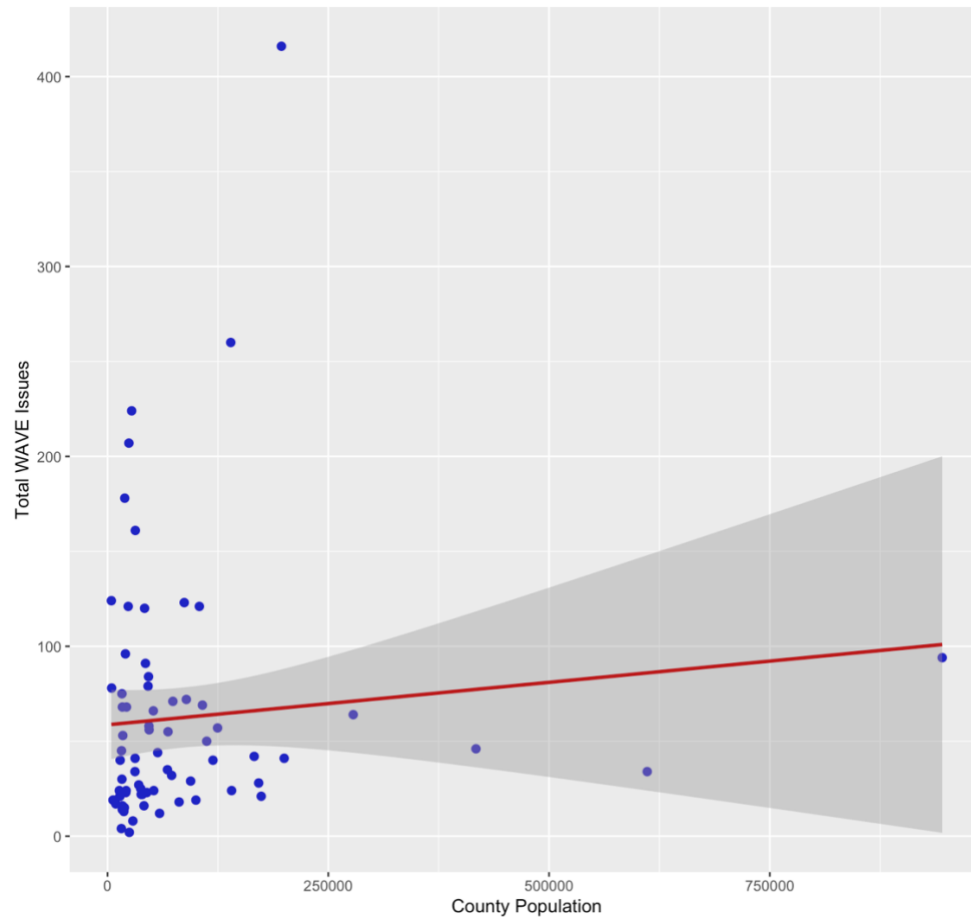
Wisconsin Counties by Total Issues Detected by WAVE.



Note: Blue hues are lower values while red hues are higher values. Outagamie County has the highest number of total issues.

Figure 6 shows a summary of the number of total issues per county detected by WAVE. Outagamie has the highest amount followed by Washington, Juneau, Iowa, and Langlade. The counties with the fewest are Waushara, Marquette, Lincoln, Columbia, and Shawano.

Since there is a wide range of data, it is important to see if there is any correlation. A Pearson product-moment correlation test can be done to find if there is correlation between county population and the number of issues. Counties with larger populations may serve more people with disabilities which can cause more users to be impacted by accessibility issues. A weak positive correlation, $r = .093$, was observed which initially means that counties with higher populations have more accessibility issues. The probability value that the results occurred by random chance is $p = .435$. This high of a p-value means the data is not significant. A scatterplot with a linear regression line was used to further analyze the validity of the positive correlation within the model.

Figure 5*County Population vs Total WAVE Issues.*

Note: Blue dots represent an individual county. The red regression line shows a slight positive trend. The gray area around the line is the 95% confidence interval 95% CI [-0.14, 0.32].

Figure 7 illustrates the relationship between the county population size and total number of WAVE issues. Each data point represents a county, and the red regression line is the trend. The regression line shows the weak positive correlation as previously stated. Most of the data is clustered to the left. There are also a few outliers at moderate populations but have a high number of WAVE issues, which is pulling the regression line upward.

The confidence interval is the gray area around the regression line. From the Pearson product-moment correlation test, the interval is 95% CI [-0.14, 0.32] and because the interval

includes zero, the relationship is not statistically significant. The extreme width of the interval in Figure 7 suggests high uncertainty of the predictions in the model. Based on the statistical test and scatter plot, there is no consistency of data points at higher populations to conclude that population size consistently affects the total number of issues and that potentially more disabled users in a larger county are being positively, negatively, or not effected at all.

Discussion

This study provides insight into the accessibility of Wisconsin county government website homepages. The purpose was to understand if there are any accessibility barriers that hinder the access of information for individuals with disabilities. All 72 counties have issues that do not meet the WCAG guidelines and the new rule of the Title II from the ADA. The 29 counties with populations of 50,000 or more must meet the expectations by April 26, 2027. The ADA states how, “This rule will help make sure people with disabilities have access to state and local governments’ services, programs, and activities available on websites and mobile apps. This rule will also provide state and local governments with more clarity about what they have to do to comply with the ADA.” Having a standard set of rules and guidelines increases the chances of a webpage being accessible. It keeps developers from guessing what follows compliance and what does not. The ADA does have a way to handle state and local governments from failing to meet the guidelines in a minor way. They say how web content that does not meet the guidelines could be displayed on webpage, “in a way that is so minor that would not change a person with a disability’s access to the content or mobile app.” The state or local government would need to show that they are not violating anything. Each county has the time to fix their individuals problems, but currently a majority have accessibility issues that are hindering users with disabilities.

Based on the results, websites contain multiple accessibility problems. Very low contrast errors detected by WAVE are on 75% of websites which can affect individuals with visual disabilities. The other major errors found from WAVE such as missing form labels, linked images missing alt text, empty headings, and empty links can create missing information issues. Screen readers will not properly organize the information and can leave users confused. The total amount of warning redundancies found is alarming. Redundancies again can cause screen reader issues.

Each county had an average of 16 errors and 46 alerts. These averages are high, as the expectations are they include minimal. The averages could be skewed due to Outagamie having over 400 issues and three other counties having over 200. Some counties had very minimal or zero errors or warnings. Waushara only had two alerts and zero errors, making it the most accessible website based on WAVE.

TAW found how alternative text and visual and audio cues issues are scattered across websites. 63% had non-text content issues and 82% did not have cues for information and relationships. These issues can restrict users from accessing information they miss out on and struggle with relating information on screen. The same issues were also detected as warnings, making reviews of websites for them essential. One glaring statistic was the guideline “Page Titled” being detected as a warning on 98% of websites. Developers would need to go back to ensure the text on the tab makes sense for what the webpage is displaying. Another meaningful warning was the “Headings and Labels” guideline. This warning can indicate that headings and labels on a webpage are not clear and descriptive enough. Descriptive ones help users follow the organization, especially those that use screen readers. Waukesha, Marinette, Langlade, and Brown counties had over 400 total issues from TAW. Errors did not contribute a lot to the totals.

Developers have a lot of issues to review based on the TAW findings as they would need to start soon to meet the April 26, 2027, deadline.

Figures 6 and 7 aimed to find correlation between county population size and total number of WAVE issues. If larger counties had more issues, it would be worrisome because they potentially serve more of a disabled population. A weak positive correlation, $r = 0.93$, was found but a non-statistical significance of $p = .435$ to deny the relationship. Further analysis using the Pearson product-moment correlation test and linear regression found that the outliers most likely are pulling the trend line upward, resulting in a positive correlation. It cannot be safely stated that there is a positive, negative, or no relationship between county population size and total number of issues. The relationship was most likely due to random chance.

Three limitations were present in this study. The first was that the WAVE browser extension was used instead of the main WAVE website due to government websites blocking website scanners. Second, TAW failed to analyze 21 out of 72 county websites. The data from TAW cannot be accurately compared with the data from every county analyzed by WAVE. Lastly, as efficient online automated evaluation tools are, there still needs to be manual evaluations done. Automated ones do not catch everything.

With all the accessibility problems found from this study, it is important to outline a few recommendations. The creation of accessibility training or resources can be distributed to developers to outline guidelines and standards set by the ADA, WCAG, or Wisconsin DOJ. The ADA states in a document titled “Nondiscrimination on the Basis of Disability; Accessibility of Web Information and Services of State and Local Government Entities” that, “The Department will issue a small entity compliance guide and will continue to consider what additional guidance or training it can provide that will assist public entities in complying with their obligations.”

(p.284) The ADA is open to letting public entities decide what type of tools and contractors they use to evaluate their websites. Once the new rule is in place, the Wisconsin DOJ can be stricter on enforcing accessibility to meet the AA level. They have taken considerations from the public on how to handle compliance of websites. One suggestion in the same document was for the ADA to, “require public entities to hire an ADA Coordinator devoted specifically to web accessibility, similar to the requirement in the existing title II regulation at § 35.107(a).” (p.289). This current regulation requires public entities that have 50 or more employees to hire one employee to coordinate the ADA title II compliance and handle complaints. The ADA is in favor of public entities going with this option if it suits them the best to ensure compliance. There then needs to be a combination of automated and manual reviews to be as thorough as possible when correcting issues.

Conclusion

In this study, an accessibility evaluation was conducted on all 72 Wisconsin county government website homepages. County homepages are usually the first point residents go to find information on health, disability, transportation, or housing services. WCAG guidelines were recorded to see how online automated evaluation tools WAVE and TAW were used to answer how accessible they are and potential barriers that hinder access to information for people with disabilities. The study found that all counties contain issues that require attention. Very low contrast, redundancy, missing alternative text, and cues for information and relationships are the most critical issues found. These issues can negatively affect someone with vision, hearing, or cognitive disabilities that may use screen readers, screen magnifiers, closed captions, or text to speech. A correlation between county population size and total issues detected by WAVE is unidentifiable because of outliers.

The results show that much work is needed for all counties to meet the compliance of the new Title II rule by April 2027 or 2028. Webpages are missing important accessibility needs and individuals with disabilities could be facing the consequences. The ADA is working on how compliance of the new rule will be monitored for individual public entities. This study hopes to add insights on why evaluating accessibility consistently is important for those accessing vital information. Everyone deserves the right to access information.

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Appendix A

Data Totals Collected from WAVE for Each County

Table A1 below contains every count of alert and error for each county. The grand total for is displayed next to them. The counties are in alphabetical order.

Table A1

Total Alert and Error Counts Detected by WAVE for Each County

County	Alerts	Errors	Grand Total
Adams	6	18	24
Ashland	42	3	45
Barron	55	1	56
Bayfield	27	3	30
Brown	59	5	64
Buffalo	23	1	24
Burnett	8	6	14
Calumet	27	17	44
Chippewa	26	29	55
Clark	24	3	27
Columbia	11	1	12
Crawford	38	37	75
Dane	23	11	34
Dodge	66	6	72
Door	12	29	41
Douglas	20	3	23
Dunn	83	1	84
Eau Claire	31	19	50
Florence	22	56	78
Fond du Lac	106	15	121
Forest	17	0	17
Grant	48	18	66
Green	16	9	25
Green Lake	6	9	15
Iowa	90	117	207
Iron	8	11	19
Jackson	49	19	68

Jefferson	101	22	123
Juneau	207	17	224
Kenosha	22	6	28
Kewaunee	19	4	23
La Crosse	53	4	57
Lafayette	7	9	16
Langlade	115	63	178
Lincoln	0	8	8
Manitowoc	7	11	18
Marathon	11	13	24
Marinette	71	49	120
Marquette	4	0	4
Menominee	122	2	124
Milwaukee	33	61	94
Monroe	39	19	58
Oconto	10	12	22
Oneida	19	3	22
Outagamie	411	5	416
Ozaukee	23	6	29
Pepin	18	1	19
Pierce	39	52	91
Polk	32	47	79
Portage	15	17	32
Price	14	7	21
Racine	24	17	41
Richland	33	20	53
Rock	34	8	42
Rusk	39	1	40
Sauk	13	6	19
Sawyer	24	11	35
Shawano	12	1	13
Sheboygan	10	6	16
St. Croix	31	9	40
Taylor	91	5	96
Trempealeau	14	20	34
Vernon	115	46	161
Vilas	89	32	121
Walworth	46	23	69
Washburn	36	32	68
Washington	254	6	260

Waukesha	43	3	46
Waupaca	24	0	24
Waushara	2	0	2
Winnebago	12	9	21
Wood	65	6	71

Appendix B

Data Totals Collected from TAW for 51 Counties

Table B1 below contains every count of alert and error for each county. The grand total for is displayed next to them. The counties are in alphabetical order.

Table B1

Total Count of Problems and Warnings by TAW in 51 Counties

County	Problem	Warning	Grand Total
Adams	41	7	48
Ashland	4	216	220
Barron	9	248	257
Bayfield	3	129	132
Brown	26	444	470
Buffalo	34	75	109
Calumet	36	110	146
Chippewa	32	114	146
Clark	9	122	131
Columbia	1	3	4
Crawford	34	80	114
Dodge	34	158	192
Door	35	99	134
Douglas	4	75	79
Dunn	9	207	216
Florence	2	152	154
Forest	3	11	14
Grant	28	70	98
Green	4	82	86
Green Lake	12	60	72
Iowa	5	12	17
Iron	5	63	68
Jackson	7	195	202
Kenosha	3	74	77
Kewaunee	5	77	82
La Crosse	1	3	4
Langlade	7	648	655
Manitowoc	34	58	92

Marinette	41	538	579
Menominee	111	221	332
Oconto	6	52	58
Oneida	18	122	140
Ozaukee	4	65	69
Pepin	6	187	193
Pierce	1	3	4
Portage	31	81	112
Price	6	92	98
Richland	11	148	159
Rusk	8	214	222
Sawyer	7	100	107
Shawano	13	75	88
Sheboygan	1	3	4
St. Croix	7	110	117
Taylor	18	79	97
Vernon	1	3	4
Walworth	57	119	176
Washburn	22	117	139
Washington	52	190	242
Waukesha	16	703	719
Winnebago	40	144	184
Wood	1	3	4

Appendix C

R Studio Code Used in Study for WAVE Data

```
#Load data
WAVEtotals<-read.csv('/Users/davidkeefer/Documents/TC Profesional
Practice/WaveCountyTotals1.csv')

#Summary stats for alerts
summary(WAVEtotals$Alert)
IQR(WAVEtotals$Alert)
range(WAVEtotals$Alert)
sd(WAVEtotals$Alert)

#Summary stats for errors
summary(WAVEtotals$Error)
IQR(WAVEtotals$Error)
range(WAVEtotals$Error)
sd(WAVEtotals$Error)

#Summary stats for totals
summary(WAVEtotals$Grand_Total)
IQR(WAVEtotals$Grand_Total)
range(WAVEtotals$Grand_Total)
sd(WAVEtotals$Grand_Total)

#Generate Heat Map
library(tidyverse)
library(sf)
library(tigris)

WAVEtotals$County <- tolower(WAVEtotals$County)

wi_counties <- counties(state = "WI", cb = TRUE)

wi_counties$County <- tolower(gsub("County","", wi_counties$NAME))

map_data <- left_join(wi_counties, WAVEtotals, by = "County")

ggplot(map_data) +
  geom_sf(aes(fill = Grand_Total)) +
  scale_fill_viridis_c(option = "turbo") +
  labs(
    title = "Detected WAVE Accessibility Issues by Wisconsin County",
    fill = "Total Issues"
  ) +
```

```
theme_void()

#bar graph of top 10 county totals
library(dplyr)
library(ggplot2)

colnames(WAVEtotals) <- c("County", "Alert", "Error", "Grand_Total")
WAVEtotals$Grand_Total <- as.numeric(WAVEtotals$Grand_Total)

top10 <- WAVEtotals %>%
  arrange(desc(Grand_Total)) %>%
  slice_head(n = 10)

ggplot(top10, aes(x = reorder(County, Grand_Total), y = Grand_Total)) +
  geom_col(fill = "steelblue", color = "black") +
  coord_flip() +
  labs(
    title = "Top 10 Counties with the Most Total Issues Detected by WAVE",
    x = "County", y = "Total (Errors + Alerts)"
  ) +
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5, face = "bold"))

#Find correlation between population size and total issues
pop<- read.csv('/Users/davidkeefer/Documents/TC Profesional Practice/CountyPopulation.csv')
cor.test(WAVEtotals$Grand_Total,pop$Population)

#combine pop to WAVE totals
library(dplyr)
combined <- left_join(WAVEtotals, pop, by = "County")

#Scatter plot with linear regression
library(ggplot2)
ggplot(combined, aes(x = Population, y = Grand_Total)) +
  geom_point(size = 2, color = "#1f0bc4") +
  geom_smooth(method = "lm", color = "#bb1919") +
  labs(
    title = "County Population vs Total WAVE Issues",
    x = "County Population",
    y = "Total WAVE Issues"
  )
)
```

Appendix D

R Studio Code Used in Study for TAW Data

```
#Load Data
TAWtotals<-read.csv('/Users/davidkeefer/Documents/TC Profesional
Practice/TAWcountytotals.csv')
view(TAWtotals)

#Summary stats for warnings
summary(TAWtotals$Warning)
IQR(TAWtotals$Warning)
range(TAWtotals$Warning)
sd(TAWtotals$Warning)

#Summary stats for problems
summary(TAWtotals$Problem)
IQR(TAWtotals$Problem)
range(TAWtotals$Problem)
sd(TAWtotals$Problem)

#bar graph of top 10 county totals
library(dplyr)
library(ggplot2)

colnames(TAWtotals) <- c("County", "Problem", "Warning", "Grand_Total")
TAWtotals$Grand_Total <- as.numeric(TAWtotals$Grand_Total)

top10 <- TAWtotals %>%
  arrange(desc(Grand_Total)) %>%
  slice_head(n = 10)

ggplot(top10, aes(x = reorder(County, Grand_Total), y = Grand_Total)) +
  geom_col(fill = "steelblue", color = "black") +
  coord_flip() +
  labs(
    title = "Top 10 Counties with the Most Total Issues Detected by TAW",
    x = "County", y = "Total (Problems + Warnings)"
  ) +
  theme_minimal() +
  theme(plot.title = element_text(hjust = 0.5, face = "bold"))
```