COVID Vaccine Locator Accessibility for Users who are Blind and Visually Impaired

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As the COVID-19 vaccine became available, national and local governments directed people to websites to find information about vaccine locations and appointments. People who are blind access websites with screen readers, which often skip over data visualizations like maps, charts, and graphs. Due to this, people who are blind have difficulty accessing critical information about COVID-19. We conducted remote and in-person usability tests on the Chicago COVID-19 vaccine locator website with eight participants, four people who were blind and four who were sighted. In this paper, we uncover and analyze usability and accessibility problems, including indirect pathways to information, lack of clear and concise language, and lack of user control and freedom. Implications for future website design iterations include prioritizing information, reducing reliance on recall, consistency, and appropriate use of elements, alt tags, and ARIA.

CCS CONCEPTS • Accessibility • Usability • COVID-19

Additional Keywords and Phrases: Blind Users, Visual Impairment, Human-Computer Interaction, Design

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1 INTRODUCTION

People who are visually impaired and blind regularly use screen readers to access online information. Unfortunately, screen readers often skip over data visualizations like maps, charts, and graphs [2]. Research indicates screen-reader users spend 211% more time interacting with online data visualizations, yet extract information 61% less accurately than non-screen-reader users [4]. Often, entire categories of information are inaccessible to screen reader users. This became particularly dangerous during the global COVID-19 pandemic in 2020, when agencies responsible for administering important information started relying heavily on online data visualizations. Fan et al. [1] studied COVID-19 data visualization accessibility during the pandemic. They observed a lack of a “systematic and detailed understanding of specific accessibility gaps in current, highly-encountered visualizations" [1]. In our project, we explore the City of Chicago's vaccine locator website and identify accessibility gaps for people who are blind or visually impaired.

The inaccessibility of online COVID information sources for users who are disabled has been well documented. In January 2021, a review of U.S. COVID information websites discovered accessibility violations in almost all 94 web pages surveyed [7]. Jo et al. [4] compiled accessibility scores for COVID-19 information and vaccine registration web pages from 56 states. Based on WAI standards, they reported median scores of 259/536 for information pages and 146/281 for registration pages. Sebring et al. [6] conducted a focus group exploring the accessibility of COVID information dissemination in Canada. The researchers asked participants about their experiences with various provincial government COVID vaccine websites. Participants cited several barriers, and some users with vision impairments found online vaccine registration practically impossible due to intrusive pop-ups and disorganized information architecture.

Limited workarounds exist for inaccessible web pages. Though sites commonly offer a phone number alternative, participants in Sebring et al.'s study reported long wait times and limited hours of availability that hindered their experience [6]. Due to these obstacles, many people with vision impairments experienced delays in obtaining COVID vaccinations [10]. Heavy reliance on data visualizations further complicated the process of gathering information about COVID for people with visual impairments.

Students from the University of Washington developed an open-source code called "VoxLens" to address issues with data visualization accessibility [8]. VoxLens provided screen readers with a summary of data visualizations and allowed for user interaction via voice-activated commands. The researchers studied the accessibility of geospatial visualizations using VoxLens, arguing that geospatial images were among the top ten most popular interactive data visualizations. They found that the multimodal presentation of information using VoxLens improved the accuracy of information extraction and interaction time for screen reader users by 122% and 36%, respectively. The researchers determined the need for future task-based usability testing to compare the experiences of users with vision impairments to a control group of users without vision impairments.

As Fan et al. observed, we have little information about whether existing data visualization accessibility solutions actually meet the needs of blind and visually impaired users [1]. Our project explores this knowledge gap. We focused on the City of Chicago's vaccine locator website with four participants who were blind and four who were sighted, to compare their experiences. In the following sections, we discuss our methods and findings, as well as the implications for future website design iterations.

2 METHODS

In the following section, we present our participants, data collection, and data analysis methods.

2.1 Participants

We recruited eight participants, four people who were blind and four people who were sighted, through personal and professional connections. The average age of participants who were blind was 68.75 years. Three participants who were blind resided in the Chicago area, while one resided outside the Chicago area. All the participants who were blind used JAWS as their primary screen reader. The average age of participants who were sighted was 29.3 years. Two participants who were sighted resided in the Chicago area, while two resided outside the Chicago area. All participants had an interest in improving access to COVID-19 vaccine locations online. See Table 1.

Table 1: Participant Information

Participant	Non-Sighted/Sighted	Age	City of Residence	Browser	Screen Reader
Participant 1	Non-Sighted	73	Chicago, IL	Chrome	JAWS
Participant 2	Non-Sighted	74	Columbia, MO	Chrome	JAWS
Participant 3	Non-Sighted	68	Arlington Heights, IL	Edge	JAWS
Participant 4	Non-Sighted	60	Schaumburg, IL	Chrome	JAWS
Participant 5	Sighted	30	Raleigh, NC	Chrome	N/A
Participant 6	Sighted	31	San Juan, PR	Chrome	N/A
Participant 7	Sighted	30	Chicago, IL	Chrome	N/A
Participant 8	Sighted	26	Chicago, IL	Safari	N/A

2.2 Data Collection

We conducted usability tests remotely and in person. Each session lasted 30 to 45 minutes and had a moderator and notetaker. We began each session by reading the consent form to all participants, and we allowed for participants to ask questions and verbally consent to the study. Then, we asked participants about their experience finding information about COVID-19 vaccine locations, setting up an appointment, and commuting to a medical appointment.

We instructed participants to share their screens and navigate to the Chicago COVID-19 vaccine locator website. We asked participants to browse the website's homepage and describe their first impressions. We instructed participants who were blind to use their screen reader at their typical speed. Next, we asked participants to complete the following four tasks:

- Task 1: Imagine you want to find a place to get the COVID-19 vaccine. Using this website, please show me how to find a COVID-19 vaccine location near you?
- Task 2: You've heard that pharmacies such as CVS and Walgreens also offer vaccines. Please walk me through how you would find which pharmacies offer COVID-19 vaccines?
- Task 3: You received your first and second dose of the COVID vaccine about three months ago. You are looking to see if you can schedule your first booster (third shot). How would you go about figuring this out?
- Task 4: You've heard that Chicago is offering in-home vaccinations. Where would you find information about this, and how would you schedule an appointment?

Due to time constraints, we did not present Task 3 to one participant (P2), nor Task 4 to three participants (P2, P3, P5). After each task, we asked all participants to rate the task on a Likert scale of one to five, with one being easy and five being difficult. Additionally, we recorded whether participants experienced failure or success on each task.

To conclude, we asked all participants to rate the likelihood that they would use a website like the Chicago COVID-19 vaccine locator on a Likert scale of one to five, with one being unlikely and five being extremely likely. Finally, we asked open-ended questions to solicit additional feedback about their experience with the website.

2.3 Data Analysis

The team uploaded notes and recordings to a shared Google folder. We then transcribed the recordings and transferred our data to FigJam, a collaborative work tool. Next, we conducted an affinity mapping exercise to organize the participant's answers and our observations by task. We also summarized the task success in a table. Finally, we identified three overarching themes described in the following section.

3 FINDINGS

We organized our findings into two sections to reflect the two categories of data collected: quantitative and qualitative measures.

3.1 Quantitative Findings

The following sections contain quantitative data gathered during user testing sessions, including task success. Please note: any result marked “N/A” indicates when a task was not included during a testing session due to time constraints.

3.1.1 Task Success

Sighted participants experienced greater success with task completion than non-sighted participants. On average, sighted participants successfully completed 93% of the tasks presented to them. On the other hand, non-sighted participants only completed 33% of the tasks presented to them.

Table 2: Participant Task Success

Name	Non-Sighted/Sighted	Task 1	Task 2	Task 3	Task 4
Participant 1	Non-Sighted	Failure	Failure	Failure	Success
Participant 2	Non-Sighted	Failure	Failure	N/A	N/A
Participant 3	Non-Sighted	Failure	Success	Failure	N/A
Participant 4	Non-Sighted	Failure	Success	Success	Success
Participant 5	Sighted	Success	Success	Success	N/A
Participant 6	Sighted	Success	Success	Success	Success
Participant 7	Sighted	Success	Success	Failure	Success
Participant 8	Sighted	Success	Success	Success	Success

3.2 Qualitative Findings

The following sections summarize our findings based on qualitative data gathered during user testing sessions, including observations of participant behavior and direct quotes from participants. We divided our qualitative findings into three themes according to the types of issues we observed participants encounter while interacting with the Chicago COVID-19 vaccine locator site. These themes are as follows: (1) indirect pathways to information, (2) lack of clear and concise language, and (3) lack of user control and freedom.

3.2.1 Indirect Pathways to Information

Almost all users started with the same task flow in Task 1 (Find a Vaccine > Vaccine Finder), one of the first available options in the homepage navigation. All four participants who were sighted successfully completed Task 1 by using this task flow followed by the map feature. Despite using a similar initial task flow, none of the participants who were blind completed Task 1 successfully (see Table 2 in Section 3.1.1). One participant who was blind tried to use Ctrl+F to search directly for information, but this function was not available on the website. Four out of eight total users mentioned a desire to directly search for a vaccine site using a ZIP code. One user who was blind expressed frustration that the search bar was not available closer to the top of the page navigation order. Both participants who were blind and sighted made navigation choices in later tasks based on recall instead of recognition.

3.2.2 Lack of Clear and Concise Language

Both participants who were blind and participants who were sighted experienced difficulty with the language on the site. The website uses the term “bivalent” multiple times, but more than one participant expressed confusion over what the term means. One user pointed out that the word “provider” was used on the site in two separate contexts, with completely different meanings. Participants who were blind had to repeatedly hear alt tags read out for images irrelevant to the content of the site. For example, the screen reader called out every single red star in the Chicago flag-style section divider used throughout the website.

3.2.3 Lack of Control and Freedom

Six of the nine total primary navigation menu items are dropdown menus. Participants who were blind got stuck in a repeating loop within the main menu navigation. They were unable to Tab out of the main menu and into other sections of the website. During the second task, one participant who was blind (P1) clicked on a decision matrix image that opened in a pop-up window, then could not find a way to exit. During the same task, P1 reached the page with vaccine booster information, but stated, “There isn’t any information here I can get to.” Participants who were blind also struggled to identify and interact with the rotating image carousel on the homepage.

4 DISCUSSION

The goal of our study was to evaluate the usability and accessibility of the City of Chicago’s vaccine locator website for people who were blind and visually impaired. Through usability testing, we found that users who were blind experienced more difficulty with completing tasks as compared to users who were sighted.

Our usability tests showed that participants who were blind struggled with indirect pathways to information while navigating the website. Similar to the challenges Hewiit and He [3] referenced, screen readers did not read vital data visualizations, they skipped over the vaccine locator map without offering a suitable alternative. As a result, participants who were blind could not find a vaccination location. Therefore, they could not complete the online appointment process. They stated that they would have to book their appointments by phone instead. Booking an appointment by phone is not an equitable alternative, due to long wait times and limited hours of availability [6]. This added obstacle causes many people who are blind or visually impaired to experience delays in obtaining the COVID-19 vaccine [10].

Additionally, participants encountered accessibility problems similar to the copious accessibility violations for COVID-19 vaccine dashboard websites cited by Joe et al. [4] and Weber and Recht [10]. One such finding was the lack of clear and concise language across the website. For example, the Chicago COVID-19 vaccine locator website used unfamiliar terms, such as “bivalent,” without explaining their meaning. Therefore, we conducted a quick cognitive level test by running the City of Chicago's vaccine locator's homepage through the Readable online toolkit. The average readability score of the website's homepage was 8.2, slightly above the WCAG standards for website reading levels.

Further, participants who were blind and used a screen reader found their flow of information disrupted by excessive alt tags for decorative elements on the website. These participants also missed out on vital sources of information due to missing alt text and ARIA tags for essential images and graphics. Much like the findings from Sharif et al. [7], the participants who were blind extracted less information from the website and spent more time navigating than our participants who were sighted.

The participants who were blind were hindered by a lack of control and freedom while using the City of Chicago's vaccine locator website. Zong et al. [11] explain how targeted navigation is vital for those who use screen readers. Instead of relying on a mental model of a website, users can use keyboard commands with their screen readers to display a page's heading structure or links list. When our participants attempted to utilize keyboard commands to conduct target navigation, they were met with empty records or lack of feedback. For example, participants using screen readers could not use “H” to scan by headings and would sometimes get stuck within a section, unable to “Tab” to other areas of the page.

4.1 Implications for Design

Based on our findings, we identified six design implications that, if implemented, would make the City of Chicago’s vaccine locator website more accessible and usable for both its sighted and non-sighted users.

4.1.1 Important Information First

User behavior between both sighted and non-sighted users indicates a desire for direct pathways to information. However, the Chicago vaccine locator website does not always prioritize important information. We recommend structuring the information architecture of the website so that vital information is displayed first.

4.1.2 Reduce Reliance on Recall

Both sighted and non-sighted participants made navigation choices based on remembering something they saw earlier, rather than the information on the current page. We recommend making essential information and links visible or easily retrievable when needed in order to reduce reliance on recall and make pathways to important information more direct.

4.1.3 Provide Accelerators

Both sighted and non-sighted participants expressed a preference for a search option while navigating through the website. We recommend providing accelerators like this early and often, such as making the “Ctrl + F” keyboard shortcut available. This technique creates more direct pathways to important information and provides more control to users.

4.1.4 Define Essential Terminology and Use it Consistently

Some participants encountered words like “providers” used multiple times in different contexts, which they found misleading. The word “bivalent,” while important to the content on the site, also caused confusion among participants unfamiliar with its meaning. We recommend using clear and concise language for site content and defining essential terminology.

4.1.5 Use ALT Tags and ARIA with Discretion

We noticed that the screen reader recited irrelevant image callouts multiple times. For example, the screen reader read “Chicago star graphic” aloud four times at every section break. This contributes to a lack of concise language on the website for screen reader users and causes user fatigue. We recommend revising alt tags and ARIA usage to eliminate extraneous image callouts.

4.1.6 Choose Appropriate Elements

Dropdown menus in primary navigation impeded multiple users from navigating. The website also presents important information using image carousels, which cannot be read by screen readers. We recommend using elements recognized by screen readers in order to enhance screen reader users’ control and freedom over website navigation.

4.2 Limitations

We encountered a few limitations while conducting this study:

- We, as researchers, did not have native proficiency with JAWS like the participants who were visually impaired or blind. During the tests, the participants who were blind used keyboard shortcuts to view links and headings, but our lack of knowledge limited our ability to ask follow-up questions.
- We had difficulty recruiting participants for this study, so we had a small sample size of sighted and non-sighted participants.
- Not all of our participants were Chicago residents, which may have impacted their ability to locate nearby vaccination centers since they were unfamiliar with Chicago areas and zip codes.

4.3 Future Work

Our future research will explore the problems identified in this study in greater depth. We will recruit more participants with varied demographics from within Chicago to gather comprehensive data and insights through interviews and usability testing.

REFERENCES

[1] Danyang Fan et al. 2022. The accessibility of data visualizations on the web for screen reader users: Practices and experiences during COVID-19. ACM Transactions on Accessible Computing (2022). DOI:http://dx.doi.org/10.1145/3557899

[2] Dylan H. Hewitt and Yingchen He. (2021). Internet Accessibility for Blind and Visually-Impaired Users: An Evaluation of Official U.S. State and Territory COVID-19 Websites. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 65,1 (Nov. 2021), 154–158. DOI: https://doi.org/10.1177/1071181321651051

[3] Grace Jo, Daniel Habib, Varshini Varadaraj, Jared Smith, Sabrina Epstein, Jiafeng Zhu, Gayane Yenokyan, Kara Ayers, and Bonnielin K. Swenor. 2022. COVID-19 vaccine website accessibility dashboard. Disability and Health Journal, 15,3 (Apr. 2022). DOI: https://doi.org/10.1016/j.dhjo.2022.101325

[4] Jennifer Sebring, Gabriela Capurro, Christine Kelly, Cynthia Jardine, and Jordan Tustin. 2022. “None of it was especially easy”: improving COVID-19 vaccine equity for people with disabilities. Can J Public Health (Apr. 2022). DOI: https://doi.org/10.17269/s41997-022-00621-z

[5] Ather Sharif, Sanjana Shivani Chintalapati, Jacob O. Wobbrock, and Katharina Reinecke. 2021. Understanding screen-reader users’ experiences with online data visualizations. The 23rd International ACM SIGACCESS Conference on Computers and Accessibility (2021). DOI: http://dx.doi.org/10.1145/3441852.3471202

[6] Ather Sharif, Olivia H. Wang, Alida T. Muongchan, Katharina Reinecke, and Jacob O. Wobbrock. 2022. VoxLens: Making Online Data Visualizations Accessible with an Interactive JavaScript Plug-In. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22). Association for Computing Machinery, Article 478, 1–19. DOI: https://doi-org.ezproxy.depaul.edu/10.1145/3491102.3517431

[7] Lauren Weber and Hannah Recht. (2021.) Covid Vaccine Websites Violate Disability Laws, Create Inequity for the Blind. (Feb. 2020). Retrieved October 20, 2022 from https://www.latimes.com/california/story/2021-02-25/covid-19-vaccine-websites-violate-disability-laws-create-inequity-for-the-blind

[8] Jonathan Zong, Crystal Lee, Alan Lundgard, Ji Woong Jang, Daniel Hajas, and Arvind Satyanarayan. 2022. Rich screen reader experiences for accessible data visualization. Computer Graphics Forum 41, 3 (2022), 15–27. DOI: http://dx.doi.org/10.1111/cgf.14519