The Use of Mobile Applications as Low-Vision Aids: A Pilot Study

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ABSTRACT

OBJECTIVE: To determine the most commonly used and highest-rated mobile applications (apps) for low-vision aids.

METHODS: This was a convenience sample survey. Patients known to use low-vision apps at a nonprofit low-vision center (INSIGHT, Warwick, RI) were contacted by phone between June and September 2019. Inclusion criteria: age 18+, Snellen visual acuity (VA) below 20/70, and the use of low-vision mobile apps for at least one month. A standardized script was used to record survey data and app ratings were evaluated by patients with a scale of one to five, one being the lowest and five being the highest.

RESULTS: Of the sample (n=11), nine patients (81.8%) stated they used an iPhone for low-vision mobile apps. A list of 14 mobile apps was identified: the two most commonly used apps were *Seeing AI* (81.8%) and *Be My Eyes* (63.6%); their average ratings were 4.43/5 and 4.75/5, respectively.

CONCLUSIONS: This survey suggests that *Seeing AI* and *Be My Eyes* are useful apps to help low- vision patients with activities of daily living.

KEYWORDS: low vision, mobile-health applications, activities of daily living

INTRODUCTION

Up to 35% of the world's population is classified as being blind or having moderate to severe visual impairment.[1] In Rhode Island, there is an estimated 22,000 people living with a visual disability as of 2016.[2] Many have trouble performing activities of daily living and rely on the help of caretakers. With the rise of technology, they may utilize mobile apps as low-vision aids to help with daily living and becoming more independent. [3]

A literature review shows a lack of peer-reviewed studies on patient-centered mobile apps as low-vision aids. More information on these apps would be beneficial to physicians and vision rehabilitation facilities to disseminate to patients and their families, including obviating the need to sift through user reviews and find useful apps.

METHODS

Study approval was obtained from Massachusetts Eye and Ear Institutional Review Board and a data use agreement from INSIGHT (Warwick, RI; in-sight.org), a nonprofit vision rehabilitation organization that provides programs, children's camps, and services to the blind and visually impaired. A 12-question phone survey was utilized in place of an online survey given that individuals with moderate visual impairment were the chosen population for this study and they could potentially have difficulties completing an online survey on their own. The survey script was developed by both authors and designed to utilize open-ended questions to capture all apps utilized by patients.

This study conducted a phone survey of patients seen at INSIGHT. Inclusion criteria included patients over the age of 18 who have been using low-vision mobile applications for at least one month with Snellen visual acuity (VA) below 20/70, defined as moderate visual impairment. With the assistance of the Executive Director of INSIGHT, 27 patients who used mobile low-vision apps and who met the study's inclusion criteria were identified and invited to participate in the survey between June and September 2019. After verbal consent was obtained, a phone survey was conducted by one of the authors (DD) using a standardized script.

Subject age, gender and low-vision severity and onset were recorded. Severity of vision loss was determined by asking the participant their current vision for both eyes. They were then grouped into categories based on the International Classification of Diseases (ICD) utilized by the World Health Organization (WHO).[4] Moderate visual impairment (category one) is defined as a Snellen VA of 20/70 to 20/200. Severe visual impairment (category two) is defined as a Snellen VA of 20/200 to 20/400. Blindness consists of three different categories ranging from Snellen VA of 20/400 to no light perception (**Table 1**).

Table 1. WHO Classifications of Visual Impairment

Category	Level of Visual Impairment	Snellen Visual Acuity
1	Moderate	20/70–20/200
2	Severe	20/200–20/400
3	Blindness	20/400–20/1200
4	Blindness	20/1200 to light perception
5	Blindness	No light perception

The type of cell phone (iPhone, Android, Google, or others), length of time since implementing apps and the apps used were recorded. All apps mentioned by patients were verified by research staff via the Internet and app stores. Patients were asked to name their favorite and second favorite app and give a subsequent rating. A scale of one to five, with five being the highest, was applied to determine the apps' overall rating by the individual. They were then queried about their preferred component of all apps using an open-ended question. Answers were recorded using direct quotes and subsequent categorization. Patients were then asked the highest one-time cost they were willing to pay for an app. The data was analyzed using descriptive statistics.

RESULTS

The response rate was eleven subjects of the initial 27 patients who were identified in this study (**Table 2**). The mean age of the patients was 54 years (range 29–70); most were male (n=8; 72.7%). Participants' education levels ranged from high school equivalent to a master's degree; four patients had high school equivalents, four had associate degrees, two had bachelor's degrees and one had his master's degree. Based on the above ICD classifications, eight patients were categorized as being blind and the remaining three were categorized as having severe visual impairment. Three

participants had low vision since birth and the remaining had a wide range of onset of low vision of three to 68 years.

The majority of patients used an iPhone for use of low-vision mobile apps (81.8%); the remaining two used an Android or state-issued phone by the Rhode Island Office of Rehabilitation Services. The mean length of use for mobile apps as low-vision aids was 38.2 months and the average participant utilized four apps regularly (range one to eight apps). Six subjects stated they had occasional help setting up, navigating or managing their low-vision apps from immediate or extended family or friends. The mean age of these family members or friends was 40.25 years, with a range from 15 to 69 years old.

Patient input yielded a list of 14 mobile apps: *Seeing AI*, *Be My Eyes*, *KNFB Reader*, *AIRA*, *Money Reader*, *Soundscape*, *BARD*, *Seeing Eye GPS*, *Digit-Eyes*, *TapTap See*, *Document Scanner*, *Card Identifier*, *Podcasts*, and *Newsline NFB*. The two most commonly used apps were *Seeing AI* (81.8%) and *Be My Eyes* (63.6%); their average patient ratings were 4.43 and 4.75 out of five, respectively. When asked what their favorite components of these apps were, participants most frequently stated navigation, person-to-person interaction, help with reading documents, and voice settings (n=2 for each). In particular, patients who utilized *Be My Eyes* stated that the app was "comprehensive and helps with daily activities on the go" and voiced that they "love that [they are]

Table 2. Survey questions and responses

Question	Average Response or Counts
How many years have you had low vision in both eyes?	Avg 22.5 years (range 3–68) 3 since birth
What is your visual acuity?	3 category two 4 category three 3 category four 1 category five
What type of cell phone do you currently use: iPhone, Android or another smartphone?	9 iPhone 1 Android 1 State phone
What current low-vision apps do you use?	See Table 3
How long have you been using low-vision apps for?	38.2 months
What is your favorite low-vision app and what would you rate it on a scale of 1 to 5 (5 being the best)?	See Table 3
What is your second favorite low-vision app and what would you rate it on a scale of 1 to 5 (5 being the best)?	See Table 3
What are your favorite components or features of all the apps you use which you find most helpful?	Navigation (2) Personal interaction (2) Help with documents (2)
What is the highest cost you would be willing to pay for an app?	Avg $49.50 (range $0-$150)
What is your age and gender?	Avg 54 years, 8 males
What is your highest level of education?	4 high school/GED 4 associates 2 bachelors' 1 master's
Do you have other people in your household or family who help you navigate your mobile apps? If so, what are their approximate ages and their relationship to you?	6 yes 67% from immediate family Average age 40.25

Table 3. Mobile Applications Used as Low-Vision Aids

App Name	Cost	Description	Patient Comments	# of patients who use	Overall Average Rank	# of Times Ranked
Seeing AI	Free	Uses AI to describe nearby people, text and objects	Comprehensive, can take screenshots and use pictures, some trouble using camera, steep learning curve	9	4.4375	8
Be My Eyes	Free	Connects to a volunteer to help the user see	Comprehensive, use when alone, helps with daily activities on the go, right there for you to talk to	7	4.75	5
KNFB Reader	$99.99	Uses photos and text-to-speech capability for reading	Many variables, not user friendly	6	3.33	6
AIRA	$29/mo & up	Connected with trained rep to help the user see	Subscription is too expensive, similar to free *Be My Eyes*	4	5	1
Money Reader	Free	Scan currency with camera and told amount	Helps with money management	2	5	1
Soundscape	Free	Uses audio to place cues to describe surroundings	Great with navigation	2	4	2
BARD	Free*	Books in audio and braille formats	*Requires National Library Service enrollment	2	5	2
Seeing Eye GPS	Free	Turn-by-turn directions with features for blind users	—	2	3.25	2
Digit-Eyes	$9.99	Barcode maker and reader to identify unique items	Use to label clothes	1	5	1
TapTap See	Free	Tap anywhere on screen to take picture which is then described	—	1	—	—
Document Scanner	Free	Take picture of document which is then read	—	1	5	1
Card Identifier	Free	Take picture of ID/card which is then described	—	1	—	—
Podcasts	Free	Audio podcasts	Not just for visually impaired but utilize often	1	—	—
Newsline NFB	Free	Free service to read news and newspapers for the blind	—	1	—	—

talking to a live person and it is not expensive like *AIRA*." Another patient stated they prefer to use *Be My Eyes* when he is alone or in an unfamiliar territory without his family or friends as the app makes it so "someone is right there to help if needed and [he] can do things on [his] own." The mean maximum cost one was willing to spend on an initial, one-time app purchase was $49.50, with a range of $0.00 to $150.00, although many patients commonly listed free apps as their most-used (**Table 3**).

LIMITATIONS

The small response rate (11 of 27) is the major limitation of this study and may not provide representative data for the visually impaired population. As estimated by the INSIGHT Executive Director, the organization serves 950 adult patients per year, including one-time consults, and approximately 10% of these patients use cellular devices and low-vision apps. Of this population, not all patients were willing to participate or were able to be reached via phone after multiple attempts. In addition, many patients used apps that were not specifically designed for low-vision

use, yielding the low sample size. Furthermore, this was a convenience sample, which results in selection bias, as all of the patients in this study were identified as frequent users of mobile apps by the INSIGHT Executive Director.

DISCUSSION

Our study can serve as a resource for physicians, low-vision specialists, or other providers consulting with the visually impaired. All patients spoke strongly about the apps they used with one participant stating apps had become "part of [their] complete toolbox to go back to normal functioning." To help maintain autonomy and independence in daily life, it is important to connect patients with a new or existing visual impairment to low-vision apps.

The two most commonly used and highest-rated apps in this study are *Seeing AI* and *Be My Eyes*. These apps are free to users on both iPhone and Android app stores, which may contribute to their popularity given that competitors, like *AIRA,* require subscriptions. *Seeing AI* uses artificial intelligence and voice settings to help describe the user's environment. Features of this app include reading short

text, reading documents, scanning barcodes to be informed of what a product is, recognizing people's faces or scenes and identifying colors or lighting, among others. *Be My Eyes* functions as a video call between a person with low vision and a sighted volunteer. The volunteer is then able to help the requests of the visually impaired in almost any capacity with object identification, document reading, navigation, etc. These apps are two well-rated, free options that can be utilized in diverse ways, such as navigating an unknown space, reading the mail or going grocery shopping.

We recognize that many patients who are new to these apps may be apprehensive to use a cell phone with their visual diagnosis given the logistics of maneuvering a screen or camera. However, all of the participants had severe vision loss or blindness and roughly half navigated the apps on their own. Although some patients did emphasize there was "a steep learning curve, particularly with the camera function," these apps can deeply impact the daily lives of patients living with a low-vision diagnosis.

CONCLUSION

This survey suggests that *Seeing AI* and *Be My Eyes* are particularly useful apps that can be utilized for help with activities of daily living for visually impaired individuals. These apps are free, comprehensive, and versatile, making them good options for patients beginning to incorporate low-vision tools.

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Disclosures

Magdalena Krzystolik, MD, serves on the Board of Directors at INSIGHT but has no related financial disclosures.

Disclaimer

The views expressed herein are those of the authors and do not necessarily reflect the views of Massachusetts Eye and Ear Infirmary or INSIGHT.

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