

# An Evaluation of Smartphone Applications for Ophthalmology

Dr. Sarita Aggarwal<sup>1</sup>, Dr. Shikha Pawaiya<sup>2\*</sup>, Dr. Somesh Ranjan<sup>3</sup>, Dr. Sukriti Gupta<sup>4</sup>, Dr. Sagarika Rao<sup>5</sup>

<sup>1</sup>Professor, Department of Ophthalmology, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad.

<sup>2\*</sup>Associate Professor, Department of Ophthalmology, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad.

<sup>3</sup>Assistant Professor, Department of Ophthalmology, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad.

<sup>4</sup>PG Final Year Student, Department of Ophthalmology, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad.

<sup>5</sup>PG Final Year Student, Department of Ophthalmology, Santosh Medical College & Hospital, Santosh Deemed to be University, Ghaziabad.

Corresponding Author: <sup>2\*</sup>Dr. Shikha Pawaiya

## ABSTRACT

The scope and usefulness of smartphone applications (Apps) in ophthalmology are topics that are not well covered in the literature. As a result, eye care professionals are dubious about the advantages of smartphone apps and hesitant to incorporate them into their daily work. This study's objective was to present an updated overview of all ophthalmology-specific Apps. Methods: For this study, smartphone apps that are just intended for ophthalmic care were quantitatively analyzed. Apps with an eye care theme were looked for in the Apple iPhone and Google Play stores. The study includes all eye-related apps, including those for visual acuity testing, eye education, calculators, eBooks, and low vision aids. Data regarding the apps' goals, intended end users, validation, app usage, user reviews, and app developers' credentials were recorded. Results: A total of 140 Apps that are only focused on eye care have been found as of March 2020. 55% of the 140 accessible apps were compatible with iPhones, 45% with Android smartphones, and 4% with both. 30% (42/140) of the Apps were created for visual acuity (VA) testing, 13% (18/140) for eye relaxation exercises, 12% (17/140) for professional development, and the rest Apps were created for color blindness detection, low vision aids, patient education, and assistance. Six (4.2%) of the 140 Apps claim to be validated, according to the developers. This study reveals a variety of smartphone apps that are specific to ophthalmology and offers advice on how to pick the best ones. The study also emphasizes how crucial interdisciplinary cooperation is to the conception, creation, and evaluation of these Apps.

**Keywords:** Apps in Ophthalmology, eye care apps, ophthalmic apps, smartphone applications

## 1. INTRODUCTION

The future of telemedicine is probably going to involve mobile-based technology. Instead of the community, the home would be the focal point of outreach operations. [1-3] Visual field and visual acuity testing Before a healthcare practitioner notices any vision impairment, apps on the App Store can be used to identify it (HCP). Apps may also increase a patient's sense of engagement and treatment compliance. In this way, smartphone applications (Apps) can enhance the course of sickness.

The use of cellphones is on the rise across the globe. According to a poll conducted by the American Society of Cataract and Refractive Surgeons in 2010, 83% of its members use smartphones to carry out work-related tasks. [4] According to forecasts, 36% of Indians who currently use mobile phones will do so by 2022. [5] Thus, widespread smartphone use may increase mHealth's potential for the early detection and treatment of ocular illnesses. In the past ten years, several Apps have been released. Ophthalmologists still struggle, nevertheless, to integrate a suitable app into their routine practice. [6] It has been more than ten years since Apps were created solely for ophthalmic use. Since then, other studies have demonstrated the upcoming potential of apps. [1–5] Numerous studies have provided a qualitative study of apps that were chosen at random. [6,7] The reliability and utility of these Apps are rarely questioned.

Therefore, it is also the duty of HCPs to assist patients in selecting an appropriate App. This study's objective was to present a current review of all ophthalmology-specific Apps that were readily available on the market as of March 2020. The study also examines the most recent developments in these Apps' usability and validation.

## **2. METHODS**

In this study, smartphone applications specifically created for ophthalmic care were quantitatively analyzed. Between January 2020 and March 2020, searches were made for apps with an eye-care theme on the Apple iPhone and Google Play store. There were other keywords used, including "eye," "vision," "visual acuity," "sight," "ophthalmology," and "optics." By keeping track of related Apps, developers, and healthcare products, semantic searches on apps were also conducted manually. One researcher manually examined each App, gathering information from the App description posted by the creators in the App store. The study includes any App designed to carry out preliminary ophthalmic evaluations such visual acuity screening, color vision screening, and support management including eye education, calculators, eBooks, and LVAs. General medical apps and non-English apps (with no available translation) were not included. Applications that need for add-ons like slit light adaptors were also eliminated.

The year the app was published, the app's goal, the audience it was intended for, whether it was free or not, the expected number of downloads, the average user rating, validation reports, and the verified involvement of competent professionals were all included in the data gathering. Pie charts, bars, and line diagrams were used to represent the results of a descriptive quantitative study.

## **3. RESULTS**

Using search terms related to eye care, our initial search revealed more than 750 Apps for both Android and iPhone. After following the inclusion and exclusion criteria outlined in the

approach, 265 Apps were chosen as of March 2020. After excluding general healthcare Apps and Apps that call for specialist equipment, the researcher then chose 140 Apps that are only pertinent for ophthalmic practice.

33% (46/140) of the Apps, or ophthalmologists and optometrists, were made specifically for Eye Care Professionals (ECP). 62 percent (86/140) of the Apps were created for anyone other than eye care professionals (non-ECPs). Eye-care health workers, HCPs who may not be eye-care professionals, community outreach workers in the healthcare field, volunteers, and members of the general public are examples of non-ECPs. The majority of color blindness testing apps are made for taxi and truck drivers to test their own color vision. 2 out of 140 apps, or 9%, are specifically designed for ECPs and non-ECPs.

Among the 140 apps, 77 (55%) were available for iPhones, 63 (45%) for Android smartphones, and 4% for both. Only 30% (42/140) of the tests were intended for Visual Acuity (VA) screening. 18 out of 140 apps, or 13%, were created for eye relaxing exercises. 17 out of the 140 apps (or 12%) were devoted to professional development. These consist of emergency manuals, movies, and eBooks. The calculators for intraocular lens (IOL) power and contact lenses (CL) accounted for 9% (13/140) of the total. 100 out of the 140 apps are free, or 75% of them. 30/140 people, or about 21%, require a yearly or monthly payment of between 6 and 24 dollars.

In 2009, the first four ophthalmology-specific apps were released. Since then, the range of ophthalmology-related apps has grown to include data gathering, amblyopia treatment, and low vision support in addition to vision screening. 25 apps were made available for download by the general public in 2018, and 20 more in 2019.

Android phones had easy access to download history. 46/140 apps had downloads that exceeded 10,000. Three of these apps—Eye Exam, Eye Care Plus, and Eye Test—have received more than one million downloads. All three of the apps were made with the general public in mind.

More than 540 people reviewed 15 apps. Which were all created for non-ECPs. The app with the most positive reviews was the Eye Test, which was created for the general public. Thirty of the 44 apps created for ECPs have review ratings of less than 50.

The makers of 6% of the apps say that those apps have undergone validation tests. 40 out of the 140 of these apps, claim to have had ECP involvement. Three apps were created by ECPs without the assistance of developers. A total of 12 apps received the support of ECPs and healthcare organizations.

### **Professional Education and Decision Support Apps**

Twenty-eight of the 140 apps were devoted to ophthalmology education and decision-support tools like calculators. No HCP organizations validated any of the apps. Three were approved, and they were all created by organizations. A large percentage of HCPs did not include reviewer ratings. For the Ophthalmology and Optometry Guide App, which had a download rate of 10,000, the maximum number of reviewers was 140. One of the most downloaded eyecare instructional apps, Eye-hand Book (EHB), has received up to one million downloads. The App has received an overall rating from users of 3.8 stars on Android devices and 4 stars on iPhones.

Apps for eye workouts and eye training routines are available. These apps are all free to download. But they haven't yet received approval or validation. More than 40 exercises, 15 eye tests to monitor vision improvement, and a training calendar are all included in the Eye

Exercises & Eye Training Plans - Eye Care Plus App. The app has received over two million downloads and has a 27000 review count with a reviewer rating of 4.7.

Low vision assistance and low vision aids through apps (LVAsst) The "BE My Eyes" app relies on audio-visual communication between blind people and a large network of volunteers who offer remote assistance over a live video feed. The app has won numerous accolades, despite not being recognized, including Global Innovator at the 2020 Dubai Expo, Best Accessibility Experience Winner at the 2018 Google Play Awards, and AbilityNet Accessibility Award Winner at the 2018 Tech4 Good Awards. [8,9]

#### **4. DISCUSSION**

The goal of the study is to provide a thorough analysis of all currently accessible Apps, their applications in eye care, and their intricate interconnections. In 2009, the first eye care-specific apps were made available. By 2013, 340 apps with eye care-related themes have been made available for both Android and iPhone. [10] There aren't many research in the literature about apps specific to ophthalmology. [11-14] We made an effort to broadly classify the apps based on user requirements and qualitatively describe a few apps used in ophthalmic practice from the perspective of physicians. Smartphone LVA-specific apps were qualitatively examined in a study by Akkara and Kuriakose. [14] Apps for smartphones used in ophthalmology have been quantitatively assessed in two publications. [6,16] In 2015, the first thorough quantitative examination of ophthalmology apps was released. About 172 Apps were found in this investigation, all from the iPhone. [6] The second discussed how to use these apps in an emergency. [15]

This study presents a comprehensive quantitative analysis of all Apps that are currently made just for ophthalmic practice. In order to avoid cluttering the study, certain search terms with ophthalmological themes but not intended for medical use were deleted. According to their ophthalmology-related scope of practice, the 140 Apps that were thus discovered in the study were divided into 10 categories. Depending on its intended usage, each category is further broken down into subcategories. Each App foundation was created to support one or more applications, each of which is connected to the others. A wide range of ECP needs are catered for by apps like EHB, starting with tools for vision screening, IOL power calculators, and educational materials to promote evidence-based decision making.

The number of downloads and reviewer ratings reveal how prepared the ECPs are to use the Apps. Download rates are a proximate indicator of end users' knowledge of an app's existence and willingness to test it out. Despite the creation of hundreds of Apps, download statistics show very little usage in daily practice, especially among HCPs. The fact that HCPs are not aware of the advantages of Apps is one of the key causes of this. Many others are perplexed about selecting the appropriate App. HCPs have concerns regarding the dependability of such Apps as well. [2,6] One approach to assess an app's usability is through reviewer ratings. The ratings given to apps serve as a gauge of their quality. Poor review scores may be attributable to these Apps' lack of usability and validity tests. Only 2 apps have received FDA approval for use in ophthalmology so far. [12,13]

Due to the fact that describing and evaluating each App requires a separate study, the study was unable to give a qualitative analysis of each App. The authors do, however, intend to

evaluate and suggest specific apps in the future. Since they are outside the purview of this paper, the study did not include general Apps that might be used in ophthalmology practice. Apps made for LVA and LV Assistance, managing amblyopia, eyedrops reminders, visual simulators, etc., are a separate field that requires specific consideration.

Institutions and/or people may recommend and offer suggestions for professional educational Apps like the EHB and Eye Emergency Manual App. Peer review is required for apps intended for professional usage, much like it is for research papers. To comprehend the preparedness and concerns of ECPs in implementing mhealth, more research is required.

## 5. CONCLUSION

A variety of smartphone apps that are specific to ophthalmology are revealed by our analysis. Guidelines for selecting the right app are offered. We also stress how crucial interdisciplinary cooperation is to the conception, creation, and approval of such Apps.

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