

Current Practices in Ophthalmology

*Series Editor:* Parul Ichhpujani

Parul Ichhpujani

Sahil Thakur

# Smart Resources in Ophthalmology

Applications and Social Networking

 Springer

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# Current Practices in Ophthalmology

## Series Editor

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Department of Ophthalmology  
Government Medical College and Hospital  
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This series of highly organized and uniform handbooks aims to cover the latest clinically relevant developments in ophthalmology. In the wake of rapidly evolving innovations in the field of basic research, pharmacology, surgical techniques and imaging devices for the management of ophthalmic disorders, it is extremely important to invest in books that help you stay updated. These handbooks are designed to bridge the gap between journals and standard texts providing reviews on advances that are now part of mainstream clinical practice. Meant for residents, fellows-in-training, generalist ophthalmologists and specialists alike, each volume under this series covers current perspectives on relevant topics and meets the CME requirements as a go-to reference guide. Supervised and reviewed by a subject expert(s), chapters in each volume provide leading-edge information most relevant and useful for clinical ophthalmologists. This series is also useful for residents and fellows training in various subspecialties of ophthalmology, who can read these books while at work or during emergency duties. Additionally, these handbooks can aid in preparing for clinical case discussions at various forums and examinations.

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## Preface

*“A poem begins with a lump in the throat... It is a reaching-out toward expression; an effort to find fulfilment. A complete poem is one where an emotion has found its thought and the thought has found words.”*

Robert Frost’s lines can be easily adopted as our own. This book is an expression of emotions that we have felt everyday while seeing the patients in the hospital. Can we do something innovative that makes their and our life easier? Mobile technology was the quickest avenue that gave us answers. As mobile data search applications on the Android/iOS platforms are fast replacing all the libraries of the world, it is imperative that we capitalize on this ‘app’ boom. We tried to find resources that could guide us in this massive conundrum of countless applications but sadly couldn’t find one that could aid us in this journey. We sincerely hope none of you have to feel that way when you look at the treasure trove of applications currently available on your mobile devices. The book can additionally help you streamline and optimize your current practice. We have also included user-friendly applications like drug/revisit reminders that you can suggest to your patients and in turn make sure that they come back to you for future referrals. We have also included useful social media and website links which we feel can add to this connected experience. After all who doesn’t want a doctor who is just a few clicks away? We specifically added the QR codes for each application to make this experience a truly interactive one. It is most emphatically not a substitute for a detailed clinical examination. This book is a humble attempt to guide you, inspire you and above all to help you download the application that you always wanted but never knew existed.

Best wishes and Happy Downloading!!

Chandigarh, India

Parul Ichhpujani  
Sahil Thakur

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**Sahil Thakur** is a budding ophthalmologist who, apart from pursuing clinical aspects of ophthalmology, has a keen interest in affordable medical technology and clinical photography. His presentations at various scientific fora were evidence-based studies done using smartphone apps or online tools for ophthalmic investigations. He is currently involved in research and development of digital software for faster and more efficient diagnosis of common ophthalmic disorders. He is following his mentor Dr Parul Ichhpujani’s footsteps into the field of medical books.



# What Is a “Smart” Device?

# 1

A smart device is an electronic device, connected to other devices or networks via different wireless protocols such as Bluetooth, near-field communication (NFC), Wi-Fi, 3G, 4G, etc. that have the ability to operate interactively and autonomously. Currently available smart devices include smartphones, tablets and phablets, smart bands, smart watches and smart key chains. Most commonly used among the smart devices are the smartphones.

On April 3, 1973, Martin Cooper, a Motorola employee, made the first mobile handheld cellular telephone call in New York City. Since then cellular phones have evolved into small wireless computers with Bluetooth and Internet connectivity, thus appropriately labelled as *smartphones*. The smartphones have virtually invaded our personal and professional space.

There are a few key components necessary for a mobile phone handset to be a *smartphone*:

- It should be designed for personal use rather than designed for business or commercial use.
- It should have the ability to connect to the Internet in a constant, unrestricted way.
- It should have the ability to install a range of applications (apps) from an external source, such as an ‘app store’.
- It should have a high-resolution screen and a high-definition camera to facilitate high-quality video conferencing and image acquisition capability [1].

Smartphones have taken the world by storm primarily due to the ease of wireless mobile computing that they offer. Every day the technology behind smart devices gets even smarter making them an indispensable part of our lives. The number of smartphone users is predicted to grow from 3.2 billion in 2015 to around 6.3 billion in 2021, with smartphone penetration rates increasing exponentially as well [2].

## Tablets and Phablets

A **tablet computer** or “**tablet**” is a mobile personal computer. The hardware and software that make the tablet work are housed in a single thin flat package. Ever since Issac Assimov described a fictional prototype in his novel *Foundation*, mobile computing has today come a long way. Based on operating systems like iOS, Android, Ubuntu Touch and Windows, tablets bring the easy accessibility of smartphones and powerful processing/screen size of desktop computers together in a functional and versatile package. With the ability to add accessories like keyboard, stylus and VR devices to the tablet platform, we today have a device that has potentially limitless flexibility. This is why tablets are so popular devices for medical use [3–5]. Recently, a new generation of devices have made the mobile computing market even more interesting. Smartphones with screen sizes between 5.5 in. (140 mm) and 7 in. (180 mm) and an aspect ratio of 16:9 have blurred the borders between tablets and smartphones. These ‘phablet’ devices offer app developers more screen size to work with while maintaining the easy accessibility of the smartphone form factor.

---

## Smart Device Use by Doctors: Pros and Cons

The usage of smart devices by doctors has also been increasing day by day. A survey in Ireland showed that 94.4% of junior doctors own a smartphone and on at least a daily basis used it for the purposes of work, 83.3% made or received phone calls, 87.2% sent or received texts, 52.9% used their smartphone to take work-related pictures, and 41.2% sent or received emails on their smartphone [6]. Similarly high percentage of smartphone usage has been reported elsewhere [7, 8].

Ophthalmological applications are today widely available across operating systems and can turn smartphones into sophisticated medical devices. They are useful tools for the practice of evidence-based medicine, professional and patient education, mobile clinical communication, disease self-management, remote patient monitoring or as powerful administrative tools [9]. There are also several applications that are available for different ophthalmological examinations that can assess visual acuity, colour vision, astigmatism, pupil size, Amsler grid test and more [10]. Smartphones in conjunction with a +20D lens or external attachments can be used for taking images of anterior and posterior eye segment that are comparable to those taken with expensive fundus/anterior segment cameras [11, 12].

Many physicians have raised concerns about the inappropriate use of the cell phones/smartphones in letters to the editors of various academic journals and online surveys. In a 2015 survey, vast majority of the doctors (95.2%) endorsed use of smartphone. Nearly all (97.1%) carried a cell phone with them at work. While at work, only 6.3% kept their phones in silent mode, while 72.1% and 21.6% left their phones on vibrate and ring mode, respectively. Approximately half of them (56.7%) password protected their cell phone. Participants were also asked to rate how much they relied on their phones on a scale from 1 (not at all) to 5 (can’t leave home

without it). Most individuals (91.9%) rated their reliance a 4 (31.3%) or 5 (60.6%). The study further showed how doctors don't consider their usage unprofessional but find patient usage of phone during an interaction highly irritable [13].

With the increased utility of social networking applications like WhatsApp for professional interaction, ethical issues of ownership of data, security of confidential information and need of patient consent for transmission over Internet via these applications have also cropped up [14]. What is more alarming to note is the possibility of transmission of pathogens due to the excessive use of smartphones. In a recent study, 96.2% mobile phones were contaminated with bacteria [15]. Such microbiological data is adding up every day, and in the future it is possible that hospital administrations across the world will come forward with tougher protocols to deal with the usage of smartphones in critical areas like the intensive care units and admission wards.

We are sure of the fact that smartphones and their usage in medicine are here to stay, more so in branches like ophthalmology that are so dependent on image acquisition and its interpretation. With their expanding use into screening the population for diabetes, glaucoma and other ocular pathologies, the utility of smartphones outweighs their shortcomings [12, 16, 17]. This book is an attempt to make sense out of the several 'apps' that are available to an ophthalmologist on their phone today and how they can easily integrate them into their clinical practice. We have enough evidence how mobile applications can enhance the safety, efficiency, effectiveness and timeliness of patient care [18]. Some authors even mention that phones have become as essential to a doctor as a stethoscope, and this statement only underlines the role that smartphones will have in patient care in the future [19]. Till we have a clearer understanding of mobile etiquette and consensus-based guidelines to use mobile phones at work are framed, all we can do is to keep up with the wireless revolution by clicking, downloading and healing.

---

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# Apps and Social Networking Pages for Basic Workup

# 2

Many ophthalmologists need to perform consultation and examination in emergency rooms where ophthalmic test equipments are not readily available. With the advent of smart devices, several basic vision tests can now be carried at the patient's bedside in emergency room or outside the clinic. Additionally, patients with some ocular diseases, such as age-related macular degeneration, can also use their smart-phones to perform regular checks between office visits for timely detection of any change.

Apps for oculo-visual system are available both on iOS platform and Google Android store. iOS does not traditionally support older apps once a newer version of the operating system becomes available. This contrasts with Google Android, where older apps may remain available to users in the marketplace unless they are manually removed by the app developer.

---

## Smartphone Applications

This chapter will broadly address some basic vision testing applications under the following heads:

- A. Apps for Visual acuity assessment and Refraction
- B. Apps for Color Vision testing
- C. Apps for Amsler grid testing
- D. Apps for Pupil assessment
- E. Apps for Contrast sensitivity
- F. Apps for Physician training

### A. Apps for Visual Acuity Assessment

Accurate visual acuity assessment is quintessential to the workup of any patient with visual complaints, especially those presenting in the emergency settings.

Precise visual acuity assessment using Snellen test depends on how much effort and confidence the patient puts in to read the alphabets and whether the patient is wearing a recently obtained refractive correction (glasses or contact lenses). The emergency staff is most of the times not formally trained in ophthalmic examination and hence may not understand the nuances of administering the Snellen test.

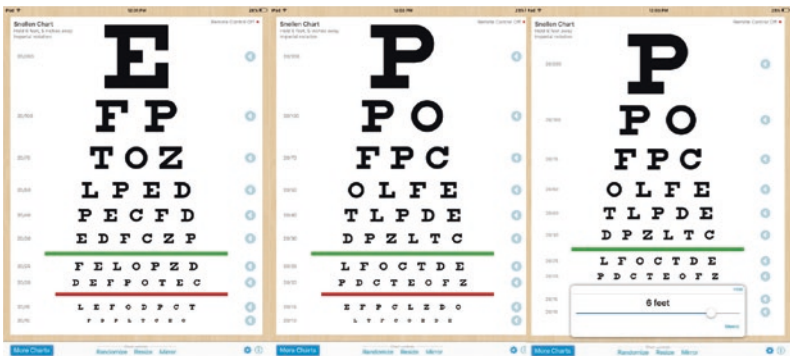
Studies have shown that vision measured by non-ophthalmic emergency department staff with a mobile app is more accurate than with a Snellen chart [1]. Therefore, such apps may serve as a valuable tool for non-ophthalmic emergency department staff.

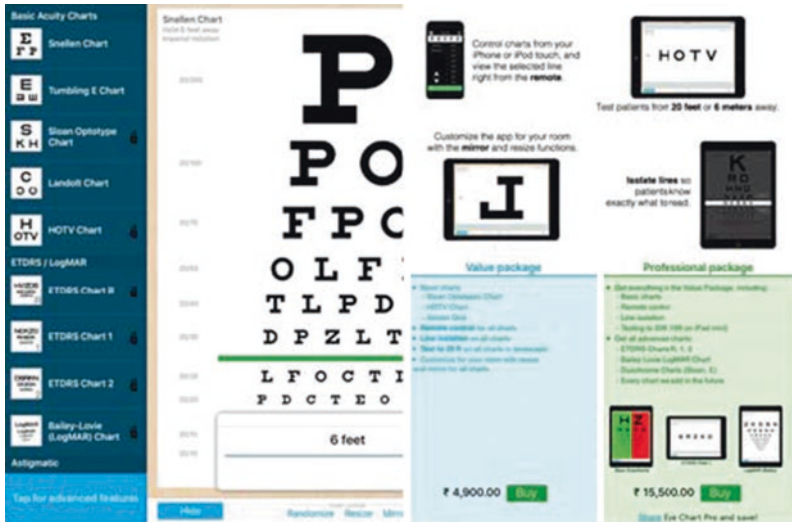
1. *Eye Chart Pro*

- *Platforms:* iPad (Free)
- *App Creator:* Dok LLC (Manu Lakkur)
- *Version:* 2.0.4
- *App Size:* 24 MB
- *App Icon:*



- *App Screenshots:*





- **Features:**

Eye Chart Pro is a randomizable visual acuity tool. User can easily toggle between Snellen and Tumbling E chart. It is useful for triaging and house visits and especially for patients who memorize the office chart. Zhang and coworkers reported that the Eye Chart Pro iOS app was a reliable method for testing distance visual acuity in outpatient, only when the Snellen visual acuity was better than 20/200 [2].

- **QR Scanning Code for the App**



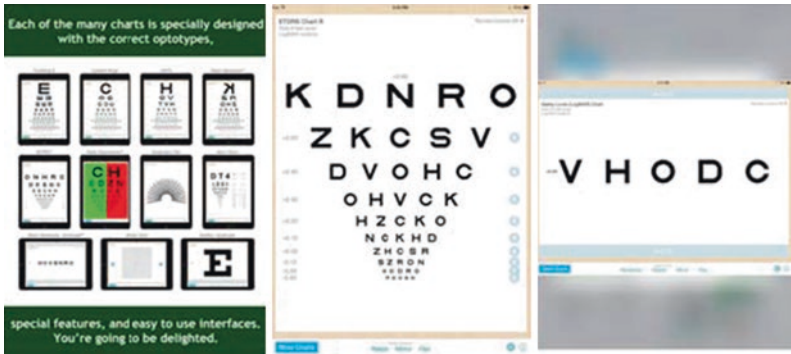
2. **Eye Chart Professional**

- **Platforms:** iPad
- **App Creator:** Dok LLC (Manu Lakkur)
- **Version:** 2.0.1
- **App Size:** 22.1 MB

- **App Icon:**



- **App Screenshots:**



- **Features:**  
This app is appropriate for house visits by the doctor, hospital bedside testing or mounted to a wall as an upgrade to eye chart projector.

**QR Scanning Codes for the App**



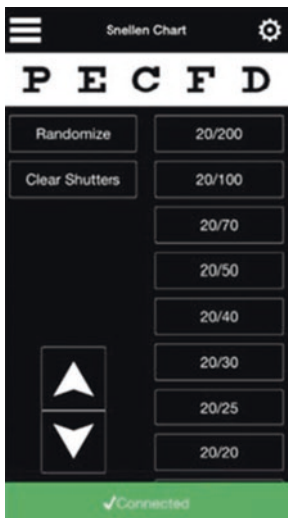
**3. Eye Chart Pro Remote Control**

- **Platforms:** iPhone
- **App Creator:** Dok LLC (Manu Lakkur)
- **Version:** 2.0

- *App Size:* 2.3 MB
- *App Icon:*



- *App Screenshots:*



- *Features:*  
This app works in tandem with the Eye Chart Pro, Eye Chart Premium and Eye Chart Professional apps on the iPad, as the remote control.

#### *QR Scanning Codes for the App*

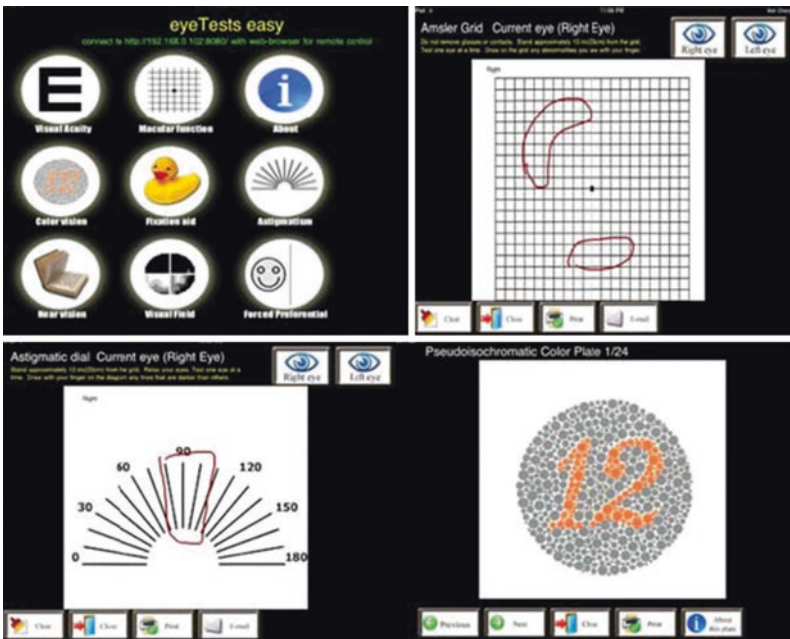


4. *eyeTests Easy*

- **Platforms:** iPad, iPhone, iPod Touch (Free; English, Japanese)
- **App Creator:** George Kong Softwares
- **Version:** 8.0
- **App Size:** 13.7 MB
- **App Icon:**



• **App Screenshots:**



• **Features:**

This app tests several parameters including distance and near visual acuity, colour vision, macular function and peripheral vision. Hence, it is useful not only for ophthalmologists but also general practitioners, optometrists, opticians and even patients. The scrolling of visual acuity chart can be done using any mobile phone device or laptop using Wi-Fi. The viewing distance can be adjusted for distance and near (6 m, 3 m, 1.2 m and 40 cm).

In preverbal children, forced preferential looking test can be done by following the child's gaze, on projecting engaging cartoon images. Clinicians can also maintain child's fixation using these cartoon images. It also allows free-hand drawing onto colour plates to outline the projected number or shape.

The app also allows monitoring of macular function using a standard Amsler grid. Patients can chart any abnormalities in their macular vision on the Amsler grid using a finger, and the Amsler grid images can then be emailed to their clinician.

Peripheral vision is tested using suprathreshold method.

The app can test near acuity from N18 to N5.

**Note:** When any device or tool is used for measuring near visual acuity, it must be calibrated for use at 36 cm and represent similar number of characters and distance between the characters themselves within each line equated to the conventional near cards. The difference in the contrast ratios of the high-definition smartphone screens (with variable screen technology, resolution, size and pixel density) and the near vision cards may result in some discrepancies of the measured near acuity [3].

#### *QR Scanning Code for the App*



#### 5. *Smart Optometry*

- **Platforms:** iPhone, iPad, Android
- **App Creator:** Smart Optometry d.o.o
- **Version:** 3.5
- **App Size:** 114 MB (iOS); 30.9MB (Android)
- **App Icon:**



- **App Screenshots:**



- **Features:**

Smart Optometry includes 16 ophthalmic tests including colour vision, contrast sensitivity, visual acuity, worth four dot, Schuber, OKN stripes, fluorescein light, red desaturation, Hirschberg, accommodation, duochrome test, aniseikonia, Amsler grid, MEM retinoscopy, maze for amblyopia test and visual acuity +. The app also has a vertex conversion calculator and a visual acuity conversion calculator. This app is available in 11 languages.

**QR Scanning Code for the App**



iOS

Android

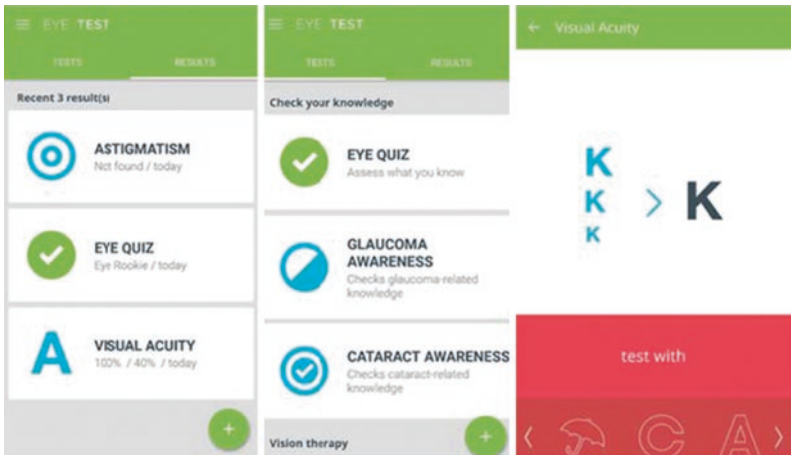
**6. Eye Test-Eye Exam**

- **Platforms:** Android
- **App Creator:** healthcare4mobile
- **Version:** 1.1.0
- **App Size:** 6.5MB

- **App Icon:**



- **App Screenshots:**



- **Features:**

The app has 12 ophthalmic tests that help assess visual acuity (based on standard charts such as Snellen chart, LogMAR chart, Golovin-Sivtsev table, Landolt C/Japanese Vision Test, Tumbling E chart) and colour perception disturbances and helps screen for accommodation spasm, dry eye, cataracts and macular degeneration. Additionally, it also has eight eye health quizzes to see if the user knows about the common vision-related or ocular problems.

**QR Scanning Code for the App**

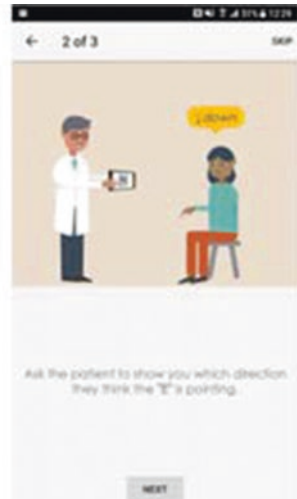


### 7. Peek Acuity

- **Platforms:** Android (English, French and Spanish)
- **App Creator:** Peek Vision
- **Version:** 3.5.0
- **App Size:** 24 MB
- **App Icon:**



- **App Screenshots:**



- **Features:**

This ETDRS visual acuity-based app generates visual acuity scores in standard units of Snellen [both metric (6/6) and imperial (20/20) values] and LogMAR (0.0). It also includes equivalents of 'count fingers', 'hand movement' and 'light perception' and a simulated representation that helps explain those scores to patients.

The app uses only the letter 'E' in four orientations. The examinee points in the direction of the arms of the E, and the examiner records the response

by swiping across the screen in the same direction. The app is smart as it senses ambient light and automatically adjusts screen brightness. If the surroundings are too bright for accurate measurements, the examiner is alerted.

Bastawrous et al. validated the Peek Acuity app against Snellen charts and a clinic measurement using the ETDRS chart as part of an epidemiologic eye survey in central Kenya [4]. The investigators found the use of their app took almost similar time as Snellen vision testing and concluded that the app was repeatable and consistent.

**Peek Acuity Pro:** This is a CE-registered class 1 medical device available in countries where it is registered for use (UK and Ireland).

*QR Scanning Code for the App*



8. *Optics Clinical Calculator*

- *Platforms:* iPhone, iPad, iPod Touch (English, Italian, Portuguese)
- *App Creator:* Evan Schoenberg
- *Version:* 3.5.0
- *App Size:* 24 MB
- *App Icon:*



• **App Screenshots:**



• **Features:**

This is a comprehensive calculator application including calculators for several parameters including base curve, diopter conversion to millimetres, diopters from focal distance, convergence, intermediate and near vision prescriptions from standard refraction, lens power in oblique meridians, oblique crossed cylinders, ocular curve, optical centre decentration, slab-off calculator (induced prism) and vertex distance.

**QR Scanning Code for the App**



**Note:** There are more than 100 vision assessment apps in the Google Play Store and iTunes Store, but only a few have been robustly validated in scientific settings. Therefore, it is prudent to remember that these apps are not a substitute for a clinical examination at the ophthalmologist’s clinic but just a broad guide of the functioning of the visual system. One must always remember that individual handsets vary in size and resolution (720p, 1080p and 1440p displays), requiring users to calculate and adapt appropriate distance between the examiner and patient.

## B. Apps for Colour Vision Testing

Congenital colour vision deficiency affects around 8% of men and 0.4% of women across the world. In addition to the importance of recognizing colours in day-to-day life, for example, looking at traffic signals, maps or graphs, many aspects of health (e.g. change in colour of urine) and healthcare (e.g. colour-coded diagnostic tests, coloured medication pills or coloured medication bottle caps) depend upon colour coding.

Recently, a study has shown dyschromatopsia testing for optic neuritis using a commercially available application on an iPad was comparable to using the pseudo-isochromatic plates of Ishihara [5].

Some of the apps that test for colour vision deficiency have been mentioned in the previous section such as eyeTests Easy, Smart Optometry and Eye Test-Eye Exam which also assess colour vision in addition to other parameters.

Users of smartphone application testing for colour vision deficiency must remember that some apps may have different sensitivity for detection of colour vision deficiency compared to Ishihara booklet, limiting their usefulness for clinical use [6].

### 1. *ColorBlindness SimulateCorrect*

- **Platforms:** Android
- **App Creator:** Seewald Solutions
- **Version:** 1.562
- **App Size:** 54.6KB
- **App Icon:**



- **App Screenshot:**



- **Features:**

This simple augmented reality application uses the integrated camera of the smartphone to simulate and correct colour blindness in real time. Not only are all common forms of colour blindness supported, but it is also possible to compare with normal vision.

*QR Scanning Code for the App*



## 2. *Color Blind Pal*

- **Platforms:** iPhone, iPad, Android
- **App Creator:** Vincent Fiorentini