

THE ROLE OF SMART PHONES IN OPHTHALMOLOGY

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ABSTRACT

The potential use of use Smart phones in ophthalmology is constantly evolving. This article describes the various tools available on Smart phones, for examining the ophthalmic patients. Additionally, it discusses how Smart phones can be used for ophthalmic photography and image management. The usefulness of the applications such as the Eye Handbook for the ophthalmologists, students, patients, physicians and researchers, currently available on Smart phones is also explored.

KEY WORDS: Smart phones, Eye hand books, Testing tools.

INTRODUCTION

A Smart phone, is a multifunctional electronic device that combines the features of mobile phone with advanced computing capability and connectivity. In addition to making phone calls & sending text messaging, Smart phones provides advanced functionality and ability to run multiple advanced applications, send and receive e-mails, create and display photos, videos and office documents (1,2, 3). Technological advances and increasing number of available applications, coupled with reduced costs, led to wide spread use of Smart phones. The assumed number of Smart phones users in the world in 2012 was 1 billion and is projected to increase to 1.75 billion in 2014 (4).

There has been significant increase of Smart phones users among health professionals, from estimated 30% in 2001 to 64% in 2009 (5,6). Currently, 86% of health professionals daily use Smart phones for various purposes (7), portable interface (8). Medical applications make Smart phones useful tools for the practice of evidence-based medicine, mobile clinical communication, patient

education, disease self-management and remote patient monitoring (5). Aim of this article is to present many useful applications of Smart phones in ophthalmology.

Smart phones applications in ophthalmology:

Ophthalmological applications are transforming Smart phones into medical devices & more than 342 different ophthalmological applications currently available (1). from 2009 to 2012 there was a 9-fold increase in the number of available surgical applications for Smart phones (9). Currently, there are 621 different surgical Smart phones applications available, Apple's iOS and Google's Android are two most used platforms among healthcare professionals (2,10). Some surveys indicated that the Apple iPhone to be the most popular Smart phones among the ophthalmologists worldwide (2,11). There is a wide range of Smart phones applications ranging from simple flashcards to virtual surgery applications that provide surgical exposure and familiarization with common operative procedures (9).

These applications can be divided into three groups based on their targeted user:
1. Healthcare professionals.

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2. Medical or nursing students.

3. Patients (5).

Smart phones have many potential functions in the field of ophthalmology and their uses can be classified into following categories (2):

- Patient assessment tools.
- Patient education–visual aids.
- Health care profession education and reference.
- Patient records and administrative tools; and other multiple functions.

Patient assessment tools:

Ophthalmological examination requires use of various diagnostic tools. While these examinations can be easily performed in clinical settings, the use of Smart phones applications for different visual tests can be very useful in outpatient or in-patient consults & emergency room visits (2,5,8,12). Patient assessment tools include several applications. That can assess visual acuity using the Snellen visual acuity test or modern interactive visual acuity tests for pre-school children and illiterate individuals. Some applications have tests for color vision, astigmatism, pupil size, Amsler grid test, oculomotor reflexes, a Worth 4 dot test and accommodation targets, red desaturation test and OKN drum simulator (2,8,13) (figure 1).

it is important to note the potential use of fluorescein light and penlight in non-ideal settings. In these conditions the examiner will need to increase the screen brightness to maximum and reduce surrounding light to minimum (3). Smart phones can be used as pediatric fixation targets that are bright & feature, motion and sound, to entertain pediatric patients (8). “Eye Handbook” is one of the most widely used applications that includes almost all of the mentioned testing tools and other popular applications are: “I Sight test”, “Vision test”, “Macula tester” and “Color blind test”,

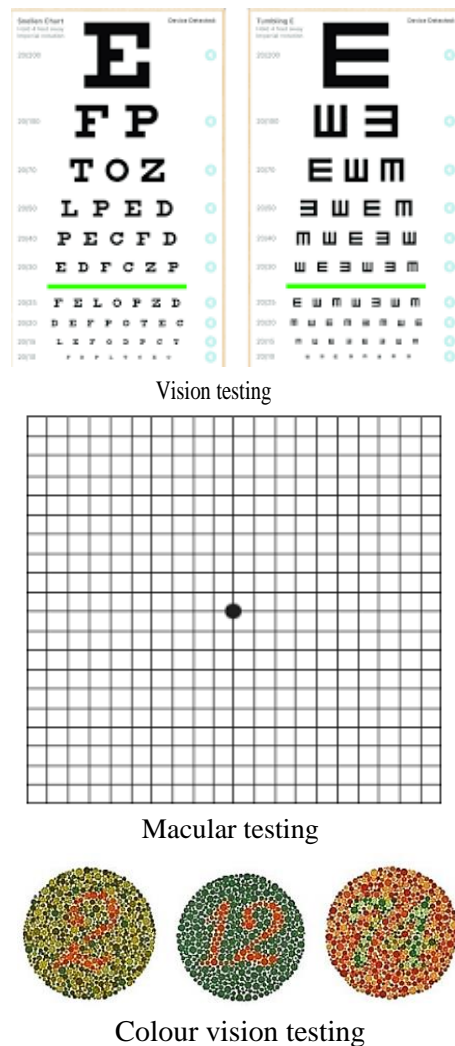


Figure 1: Eye Hand book shows: I sight test, Vision test, Macula tester & color-blind test.

Patient education–visual aids:

Patient management involves not only patient examination and treatment, but also, education to improve patients understanding of ophthalmic diseases and their processes. Clinician led patient education in disease prevention and management using of smart phones is convenient and effective (5). Educational materials such as instruction sheets, brochures and videos and can be used to help patients’ better understanding of their condition. Smart phones are capable of reproducing high resolution images, videos and office

documents that containing information about medical conditions (8). High-resolution images of the various ocular conditions can easily explain anatomy and pathology various treatment procedures and options to the patient (3,8). Patients can download the application and the informative material to their own smartphone, review the information and show it to friends and relatives, relieving them of the burden of translating sometimes complicated explanations of their ophthalmological condition (2).

Several applications contain list of common ocular conditions that are encountered in everyday ophthalmology practice, with a short description of clinical features and treatment options (3). This information can be presented or even e-mailed to the patient and his family. In some cases, this may allow for self-diagnosis without presence of the physician (10). Currently two most popular patient education applications are “Eye Handbook” and “IKONION”. With the “Eye Handbook”, physician can e-mail the required educational materials directly to from patients their smartphone, which is a great feature (3). Patients with severe visual impairment can use applications such as voice-activated assistant to cope with daily activities (17). Smart phones can be also used for tracking and monitoring of disabled patients with Global Positioning System (GPS) (10).

The use of Smart phones for ophthalmic photography has become increasingly popular. New Smart phones have cameras with resolution of 5 mega pixels and higher, allowing users to capture high quality images. Several photo-adapters are available for Smart phones making them useful ophthalmic devices for taking images of both, anterior and posterior eye segments (figure 2). When using, photo-adapters the Smart phone's camera

is aligned with the optical axis and placed close enough to the slit lamp eyepiece. There are also adapters designed to attach to the “Pan Optic Ophthalmoscope” for capturing fundus photos through an un-dilated pupil. It is even possible to take quality pictures of retina using only a Smart phones and indirect lens (8,14). The examiner can view the real-time images of the anterior and posterior eye segment with other practitioners, record and share their findings (15). A Smart phone using pinhole adaptor (Near Eye Tool for Refractive Assessment-NETRA) can be used to estimate the refractive error (Subjective Spherical Equivalent) without astatistically significant difference from subjective refraction (16). However, when interpreting examination results, the ophthalmologist should keep in mind that testing tools are not ideally standardized and should be used the eye care professionals using their professional experience and judgment (3, 8).



Figure 2: Photo-adapters for Smart phones for anterior and posterior eye segments photography

Useful Smart phones and iPhone applications (the eye hand book EHB):

Eye Handbook (EHB) is an eye care reference book and an all-in-one application for Ophthalmologists, Optometrists as well as students and residents pursuing the field of eye care.

diagnostic and treatment reference

The Eye Handbook is a Smart phones application for Ophthalmologists and Optometrists.

Eye Handbook is the most comprehensive iPhone application available on iTunes and Android Stores, which can be downloaded for free. This application can link to meetings and various societies, and ophthalmic instruments information. Several references to ophthalmic genetics, ophthalmic acronyms and eponyms, differential diagnosis and classifications, ophthalmic dictionary and mnemonics are also available (21,25). Important journals with access to their websites and contents are available on EHB. Treatment section of EHB has ophthalmic medications, preparation of the fortified antibiotics, and laser settings for ophthalmic procedures (27). Another part in EHB which is important for training is Free download of lectures, flash cards. Patient and physician educational movies are also available. The EHB is being used worldwide, with about 50% of downloads in North America, 20% in Europe, and 10% each in Australia and Asia (34) (Figure 3).



Figure 3: Eye Hand book application.

Health care professions education and reference:

Professional development is essential for healthcare professionals. However, with

limited time available for professional development can be difficult to keep up with the latest results finding (2). With the implementation of information technology, namely use of Smart phones, the latest results and findings are just a “click” away from the practitioners. All classifications and grading systems such as angle anatomy, diabetic retinopathy, macular holes, optic nerve edema and melanoma are easily accessible (3).

Several applications provide access to clinical trials database and literature searches in biomedical literature databases such as PubMed and MEDLINE. The most popular database search applications are “Pub-Search” and “PubMed on Tap”. These applications also allow for sharing information with both, patients and colleagues (5). Other Smart phones applications have videos, color atlas images that are very useful in training process and surgical skills development. These applications can help in patient follow up, calculating intraocular lens (IOL) or surgically induced astigmatism (SIA) (2). Some applications include a list of diagnoses not to miss, with definition and differential diagnosis, a color-coded diagram of retinal drawings, questionnaires for commonly encountered ophthalmic diseases and a summary of benchmark randomized control trials in ophthalmology (3, 21).

Patient records and administrative tools:

The number of applications for Smart phones that can be used in medicine is constantly growing. With use of Smart phones communication between the physicians and hospitals is continuously improving (10). Dynamic interface has great functionality and potential for future growth in the field of ophthalmology (8). Applications for Hospital Information Systems (HIS) allow secure

access to patient's records from remote locations (2,5). These applications such as "OsiriX" and "MEDITECH" enable use of information's from hospitals picture archiving and communication system (PACS), as well as their secure transfer from one physician to another and from one location to another. Other useful information's including visual acuity and intraocular pressure values, eye images taken from mobile or stationary ophthalmic camera, optical coherence tomography findings, corneal topography images or even patients complete electronic health record (EHR) can also be transferred (5).

Tele-ophthalmology involves the use of electronic communication and information technologies to provide or support a diverse range of activities related to eye care (12). Smart phones applications enable true appliance of Tele-ophthalmology, covering many medical activities, including making diagnoses, treatment, prevention, education and research. Transferred information's can be later analyzed in detail or compared to previous findings. Tele-ophthalmology makes the practice of eye care independent of location or time (12). It is important to mention that there are some applications dealing with coding diseases according to The International Classification of Diseases (ICD) which can be very helpful and time saving (8,35).

Multiple functions:

There are several applications that combine many of the previously mentioned functions into one package. These features including reference search, links to journals, eye atlas, various tests, recording patient details, collaboration with other colleagues, tool kit to calculate eye related calculations such as (intraocular lens calculation, surgically induced astigmatism, vertex distance etc.) and

patient information images with videos for explaining different conditions (2). On the other hand, there are several general medical Smart phones applications designed to provide information on general health conditions, including symptoms, diagnosis, differential diagnosis, pathogenesis and treatment options that can be helpful for ophthalmic patients as well as. Most popular of these are "Medscape" and "Epocrates" and "Up-to-date" which provide most recent information useful for practicing evidence-based medicine (5). There are also several applications such as Normal Lab Values and Pocket Guide to Diagnostic Test, that offer information's on common laboratory tests, including reference values and interpretation, causes for abnormal values and laboratory unit conversations. Smart phones enable the use of drug reference applications, such as Skycaps Drug's or Safe-Med Pocket, which provide information of drugs, names, indications, dosages, pharmacology, drug interactions, contraindications and costs. Other applications such as Med-Mat and Med-Calc offer options for calculating various clinical scores, individual drug dosing etc. (5). Smart phones applications with multiple functions can be very useful in limited resources settings with poor implementation of information technology such as Bosnia and Herzegovina (18).

Our mission:

As a social enterprise use are empowering all ophthalmologist as well as health workers by providing portable tools to help &to detect avoidable blindness.

Benefits but with limitations:

Smart phones are portable & come equipped with a safe light source, provide ready access to secure networks for data transmission. But, it is with caveats.

1. Learning curve:

Same as conventional method of direct & indirect ophthalmology, the Smart phones technique needs many moving parts (Doctor, camera, lens & patient). So, unless you have someone already adept at ophthalmoscopy or someone who expert in Smart phones. In general, it can be difficult to obtain high quality images that are useful for a comprehensive ophthalmologist.

2. Image Quality:

Unfortunately, you are also facing a lot of problems with image quality (Glare & improper exposure are the major culprits).

3. Field of view:

Smart phones cameras don't have the ability to access the full retina.

4. Use of Smart phones in different settings carries a risk for contamination. Special attention should be given to this (33).

CONCLUSION

Smart phones can be used as tools to facilitate the work of several professionals in improving visual assessment. They are useful in the inpatient wards or travelling clinics, also improves the understanding of patients about their clinical condition.

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