Editorial

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Law and order of modern ophthalmology: Teleophthalmology, smartphones legal and ethics

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Abstract

In recent years, new technologies used in the field of ophthalmology have been emerging and developing rapidly. Two major aspects of these advancements are teleophthalmology and smartphones, which have enabled practitioners to achieve optimal outcomes in record time with minimal costs. Several rules and regulations have been applied to these technologies in order to frame them under the appropriate medico-legal ethics, and specialized committees have been dedicated to maintaining their efficacy and avoiding shortcomings. In addition multiple studies and case reports conducted worldwide have assessed them according to specific diseases or global concerns. This review article constitutes an up-to date account of almost all of the applications and medico-legal perspectives of technologies used in ophthalmology in order to summarize and better visualize their advantages and disadvantages.

Keywords

Teleophthalmology, smartphones, legal, ethics, rules, regulations and telemedicine

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Introduction

Daily use of smartphones and telecommunication in the medical field generally and the field of ophthalmology specifically has become crucial at both personal and professional levels. It is vital for delivering the best treatment plans.

The evolution of such technologies began two decades ago and has evolved rapidly since then. As a result, technology use has become difficult to control and regulate.[1] Prevalence of use is difficult to calculate because of the multiple different contexts and practices. Thus, all ethical parameters and legal concepts regarding the use of technologies in medicine are applied with certain non-specific modifications. Some committees and associations have developed their own regulations, such as the European Parliament's standards for telemedicine.[2] Nevertheless, the sensitivity and accuracy of every application developed is far from controlled, evidence-based, or approved.[3] Despite the numerous benefits of the use of technology in medicine, regulations need to be developed in order improve the service and deliver the correct information and appropriate treatment.[1]

The objective of this article is to collate the new, diverse trending methodologies of teaching and evaluation used in ophthalmology and investigate their ethical and legal aspects, in order to produce a whole summary under one umbrella. The pros and cons of each methodology are discussed in order to prove their efficacy and improve their usage.

Methods used

To achieve the paper's objective, a literature search was performed by screening more than 50 articles, including systematic reviews, meta-analyses, and some case reports

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published mainly in ophthalmology journals and telemedicine journals, in PubMed, Medline, Google Scholar, UpToDate, SCOPUS, Embase, and many other peer-reviewed and open-access journals in the period between July 2019 and December 2019, after the title and purpose of the research had been chosen in June 2019. Specifically, the following keywords were used in the search: teleophthalmology, smartphones, telemedicine, ophthalmology, ethics, legal, rule, regulation, eye, and new technology.

Teleophthalmology

Overview

Electronic health first emerged during the 1990s, immediately after the age of IT and communications began. Telemedicine was one of the main components of electronic health that emerged in the subsequent years and branched gradually into almost all medical fields in response to increasing demand.[1] The most recent development in the field is cybermedicine, which is the use of the Internet to provide medical services.

Definition

Teleophthalmology is a sector of telemedicine which grants access to eye medical services over distance.[4]

Components

It consists of many fundamental elements that emulate a real ophthalmic exam in terms of tools and personnel, although adds-on can differ slightly; for example, image-taking, digitization, transfer, storage, reading, analysis, and feedback.[5]

All legal requirements applied to healthcare providers anywhere in the world are applied to the practice of teleophthalmology.

History and evolution

The practice started at different times worldwide, but generally it began in the late-1990s due to the emergence of telecommunications and the Internet and evolved in line with developing needs.[1]

Since then, many studies and trials have been conducted globally, led by large countries such as Canada and Australia due to their distant rural areas and lack of sufficient numbers of ophthalmologists to treat all patients.

Different programs have been created for use between professionals and between specialists and patients, notably:

Cybersight: An online teaching and consultancy service for eye health professionals in developing countries.[6]

The CARA system: Designed to help qualified ophthalmologists with the analysis of the retina.[7]

Eye-PACKS: A primary medical care based telemedicine for diabetic retinopathy screening.[8]

In addition to these programs, many trials have been conducted regarding regular e-health in response to emerging needs. For example:

SLICK: A screening project conducted in Alberta, Canada, for (L)imb, (I)Eye, (C)ardiovascular, and (K) idney (SLICK) complications in type 2 diabetic patients.[9]

SDI: Secure Diagnostic Imaging – a medical services solution company developed by doctors for doctors, helping them deliver optimal eye care to patients.[10]

These programs can be used between states in the same country or between countries, for screening, emergency cases, of even for regular follow-up. They are generally used for diagnostic or research purposes. However the range, costs, or goals must always be in line with the rules and regulations of the related country or institution. Thus, legal and ethical perspectives have tended to grow together with the expansion of teleophthalmology usage. Legal and ethical standards were relatively unclear when the practice first emerged, as it depended on evidence-based materials, but they became clearer over time and with the increasing demand. Ethical and legal committees from different regions began to establish standards for telemedicine in general, and international agreements had to be made to confirm legal and ethical standards at both national and international level.[2]

Forms

Teleophthalmology can be categorized in several ways, either according to the methods used, mechanisms, diseases, purposes, or level of interaction. Studies have tended to focus on particular methodologies chosen in relation to their objectives, and no classification has been identified as more reliable than the others.

Classifying teleophthalmology according to method or timing is one the most common classification methods; it can be either storage-forward (for non-emergency situations) or real-time (for instantaneous cases) and either for teaching or medical purposes.[5] A more general classification is level of interaction, which can be between doctors (mainly ophthalmologists) and patients or between two healthcare practitioners, depending on the purpose of the practice. Another more generalized classification is national (same country) versus international (overseas) level. A more detailed way of categorizing the practice is

according to purpose; for instance: screening, medical regulation (triage), consultation, diagnostic, follow-up, emergency (which is usually real-time; video conferencing), support of the provision of treatment, monitoring a medical condition, teaching (among specialists or even young doctors or patients – either national or international), research, or surgeries.[8]

Mostly teleophthalmology studies or applications have focused on a specific disease and have been directed toward a special investigation, primarily diabetic retinopathy (screening/treatment/follow-up), due to the increased incidence and prevalence of diabetes and its complications worldwide.[9] This has allowed crucial treatment to be delivered from continent to the other using the most skilled personnel.[4] For example, tele-glaucoma has been used for follow-up appointments instead of regular frequent clinic visits.[11] Other crucial screening that needs expert consultation is retinopathy of prematurity, which has been reviewed in many studies.[12]

Pros and cons

There are several reasons for the utilization and improvement of teleophthalmology. The primary purpose of the practice is to overcome distance, especially in large countries or overseas, for any of the above-mentioned purposes such as screening and follow-up. A patient can be followed up without the need to travel every time, and it decreases the number of patients in need of direct referral for examination.[13] Thus, pointless visits to a specialist clinic can be avoided. This is very cost-effective for the healthcare system or any beneficiaries. It reduces the number of patients and distance they need to travel to receive optimal treatment from a specialist. It also facilitates access to experts for patients, students, and other doctors. Furthermore, a comprehensive exam enables a consultant to arrange the required treatment before a patient's arrival, which also conserves time and costs.

Teleophthalmology also improves disparity in the health services available in less-developed, more isolated areas where experts are few.[14] It also increases patient compliance, as it enables better communication. Similarly, it plays a major role in facilitating accessibility and knowledge exchange between young doctors in rural areas and experts in prominent hospitals and universities. Furthermore, it leads to greater numbers of patients being screened and diagnosed.[15]

The difficulties and weaknesses of teleophthalmology vary according to how, why, and to whom the services are provided. Insufficient knowledge regarding its value and usefulness in specialists and patients can limit its use. Logistical difficulties, technical errors, poor communication, and lack of interaction can also minimize its effectiveness.[13] Other possible obstacles regarding accuracy of diagnosis can affect the health care provided. Finally, privacy issues, and legal and regulatory concerns can limit its development and make it difficult to implement.[16]

Thus, it may be better viewed as an extension of existing ophthalmologic services rather than a replacement.[15]

Legal frameworks

There are many regulating policies related to medicine worldwide, including teleophthalmology. However, specific guidelines for the practice have not yet been set. Rather, current regulations are a combination of the legal rules of telemedicine and ophthalmology.

Telemedicine in general is a horizontal discipline with many aspects, including public health, free movement of services across borders, electronic commerce, personal data protection, electronic consent, medical devices, and pharmaceuticals. Similarly, ophthalmology is a very well-known area of medicine.

Protecting the rights of the provider and the recipient regardless of when and where they a service is provided should be applied in all cases. In teleophthalmology, the following regulations apply:

- Data protection: All medical data and information should be confidential in all forms: text, sound, images, or videos, as well as diagnosis, treatment and follow-up with patients.
- Freedom of choice of healthcare provider: What applies in regular medical situations should be applied in e-health services with the help of ICT tools.
- The costs of cross-border healthcare: This should be paid directly by the beneficiary in their own territory and should not exceed the actual cost of the healthcare received.
- In the case of an insured person benefiting from cross-border healthcare, they must be treated under the same conditions, criteria of eligibility, and regulatory and administrative formalities, whether set at a local, regional, or national level.
- Patients' rights:
  1. General information should be provided to the patient regarding the standards and guidelines on quality and safety.
  2. Continuity of care.
  3. Non-discrimination.
- Licensing/registration of health professionals performing telemedicine services according to each place.
- Liability
  1. Telemedicine services: where the healthcare provider is established.
  2. Healthcare professionals: should be provided following the standards and guidelines on quality and safety.
  3. Products: should apply the same way as it applies to any product sold on the market.[17]

Ethical aspects

The evolution of medicine and technology has led to their misuse, either separately or – as in the case of this paper – combined. Bioethics and moral standards have become essential components of the service that must be met.[18] The commonest basic principles of ethics are always applied in all medical fields, even in a remote doctor–patient relationship such as in teleophthalmology. These are:

- Justice: Health care services should be equally distributed among people regardless of they are provided (routine or remote).
- Non-maleficence: Medical practitioners must do no harm to the patient at any stage of the treatment.
- Beneficence: Medical practitioners must act in the best interests of the patient, even at distance.
- Autonomy: The patient must be capable of choosing their preferred medical intervention, and this must be equally applied in teleophthalmology.
- Confidentiality and privacy: This must be special consideration in remote services such as teleophthalmology, as it could be at risk of being hacked, pirated, or broken during processing.[19]
- Informed consent: This must never be withdrawn, as it protects the healthcare providers as well as patients. In the case of teleophthalmology, an electronic consent form/signature should be created and approved.[20]
- Disclosure of medical errors.

In addition to these principles, it is important to note that certain aspects of the doctor–patient direct relationship might be impacted by remotely-delivered healthcare, such as eye-contact and other fundamental basics that cannot be implemented except in a routine face–face visit. This is the main reason why teleophthalmology is difficult to apply and can never replace a clinical routine visit.

Methodology

1. Before:
   - Training: This should begin before practice commences and continue, and it should be consistently regulated and evaluated.
   - Malpractice insurance: This is covered by usual insurance.
   - Licensing and accreditation: These are mandatory for both personnel and content.
   - Declaration: The facility providing the service or devices used should be declared to the concerned party.
   - Agreement and collaboration: These should be documented and registered according to the rules.
   - Health information: This should be sufficient, relevant, preserve security and privacy, and at the same time be accessible to the concerned parties.
   - Patient rights: Patients must give valid online informed consent and be given the right to choose or refuse treatment and the ability to complain, and they should be educated on how teleophthalmology works.
2. During: Maintaining confidentiality and respecting ethical and legal responsibilities. A defined protocol should be set regarding cases of technical or medical incidents. Each and every step should be added to the patient's record. If investigations and prescriptions need to be administered, this should be done according to the regulations.
3. After: Medical records should be kept, an evaluation report must be written, and periodic inspection is advisable.[21]

Discussion

The worldwide advancement of teleophthalmology and its increasing effectiveness in almost all fields, from screening patients to treatment and remote surgeries, is rapidly increasing.

Teleophthalmology teaching, learning, and research are also well-known and useful in all areas. The ease and accessibility of the practice has made it a subject worthy of discussion and development, and younger generations of medical practitioners are gaining a lot from different experts' knowledge.

However, a balance between the advantages and disadvantages of this combination of technology and ophthalmology will not be achieved quickly. Many studies and clinical trials have proved the effectiveness of the service at the same time as identifying many points of weaknesses, including choosing the right way to implement it, how to deliver it, and ensuring that all involved personnel achieve an acceptable level of satisfaction.

Although remote ophthalmology services first emerged 10 to 20 years ago, as yet no global unified ethical and legal standards have been established.[1] The rapid advancement of technology has also made the service difficult to regulate.

Applying all the basic legal and bioethical rules and regulations in ophthalmology is vital. Numerous evidence-based studies of teleophthalmology have revealed the significant advancement of diabetic retinopathy screening.[8] In addition, teleophthalmology has played a major role in distanced learning in developing countries.

Findings

Teleophthalmology is an excellent educational tool. Guidelines should always be established and policies should be followed,[22] and providing education to communities

and healthcare providers about their rights and responsibilities is essential.[23] Finally, although teleophthalmology has a long history, it is still a relatively new practice and needs significant development and increased awareness and knowledge regarding why and how it should be used.

Smartphones and ophthalmology

Overview

The invention of smartphones and the Internet, the increased use of social networks, and the manufacturing of high resolution cameras have led to increased information sharing. This has had a particular impact on the medical field, which has evolved significantly, especially regarding photo-documentation and expert consultation.[24]

Different types of medical devices and operation systems are now available for all kinds of procedures, including medical services; different operating systems are also used, including iOS, Android, and Windows, each of which has a unique associated applications store.[25]

The increased use of smartphones has prompted developers to design more mobile applications tailored to a vast range of uses, including most medical fields and particularly the field of ophthalmology. For example, a personal digital assistant (PDA) has become a necessity for more than half the doctors operating worldwide, and this number is expected to increase.[26]

Furthermore, advancements in the development of mobile devices has led to them becoming important medical diagnostic tools.[27] In particular, smartphones have recently been established as an important resource in the ophthalmology sector.[28]

Due to their widespread range of ophthalmic applications, smartphones can be used in many ways, including for clinical photography, which is especially useful in ophthalmic practice as it enables the storing, documenting, and secure sharing of different pictures, pathologies, and diagnoses between colleagues and patients.[29]

History and evaluation

Since the launch of the first smartphone in 2007, it has become an all-in-one device in both developing and developed countries. More than 271 ophthalmology-based applications can be found on the Google Play™ store, and approximately 170 can be found on the Apple App Store®.[3]

Over the past 10 years, the launch and rise of the smartphone (a device combining mobility, computing potential, and downloadable applications) has led to them becoming an everyday tool within the medical field on both a personal and professional level.[25]

Since the rise of personal digital assistants, mobile devices such as PDAs, smartphones, and Laptops have become a widespread tool of medical professionals, and they are quickly becoming an irreplaceable source of clinical information, especially for younger health professionals and trainees.[30]

In the past two decades, modern medical practice has been revolutionized by the rise of smartphones. The field of medical photography in particular has seen huge advancements and has grown exponentially.[31]

There are many useful smartphones applications that benefit medical professionals. Ophthalmology specifically, being a field that requires several testing tools for a basic patient exam, has received different applications that provide functionality in even imperfect situations, and the applications for ophthalmology have significant potential for future growth.[32]

Forms

A search of the various application stores revealed multiple medical applications, ranging from simple, quick to use apps to some more advanced apps requires additional hardware such as an external lens. The following list presents the most used and beneficial applications, according to the opinion of the researcher and multiple opinions obtained from medical journals (mHealth applications):

- *Atlas of Ophthalmology*: E-learning by Open-Access: A library of more than 2000 photos and ancillary tests, providing a detailed look into the pathophysiology, diagnosis, and treatment of various diseases.

- *The Eye Handbook*: An ophthalmology-focused collection of tools for ophthalmologic diagnosis and education for the patient as well as the physician.

- *Wills Eye Manual*: A library of most reviewed journals related to ophthalmology, which are accessible through the application or the website.

- *iExaminer* (Welch Allyn PanOptic Ophthalmoscope): An external lens that fits over most smartphones, allowing for fundus and retinal nerves to be digitally photographed.[33]

- *O.N.E. Network* (Ophthalmic News and Education Network): Helps to improve the quality of patient care and helps patients update treatment regimens.

- *EyeWiki*: An Encyclopedia written by ophthalmologists which other physicians, patients, and the public can use to view, read, and gain information about a vast array of eye diseases, diagnoses, and treatment methods.[34]

- *GoCheck Kids Vision Screener*: Through the smartphone camera, it enables the diagnosis of strabismus and refractive errors, and can be compared to commercial screeners. It is backed by leading pediatric ophthalmologists and registered with the FDA.[35]

- *StrabisPIX*: Provides the ability to utilize a series of images of the head position and the alignment of the eyes which can then be reviewed by clinicians.[3]

- *Eyeturn*: An application used to calculate binocular and dissociated eye deviations. Uses measurements which meet the clinical gold standard.[36]

- *SuperVision*: A magnifier application with an excellent image stabilization ability.[37]

- *Ocular CellScope*: Retinal imaging device that is portable and inexpensive and provides imaging that can be used in the hospital as well as at home.[27]

- *EyeGo*: An eye muscle training application that utilizes a red ball which is tracked on the screen.[38]

- *D-eye*: A portable retinal imaging system that fits over the iPhone camera, turning it into a lens capable of taking videos and photos of the posterior segments of the eye.[39]

- *Peek Acuity*: A vision check application developed by experts that allows any person to check their visual acuity using their Android device.[40]

Pros and cons

Benefits and need: Through the use of smartphone applications, it is possible to overcome graphical barriers and long distance boundaries.

Smartphones have widespread usability in patient education, as resources to influence decision-making, as a significant source of information (including high-resolution media) available for sharing, and in medical education.

Smartphones can also accommodate tools used in ophthalmology, including tools measuring visual acuity and tools that assist the diagnosing and treating of some conditions such as amblyopia and glaucoma.[35]

External hardware such as a specialized lens may be connected to allow all the parts of the human eye to be digitally photographed.[33]

The growth in availability of smartphones utilizing high-end technology instead of traditional high-cost equipment may decrease the financial burden on healthcare systems.

Some of the applications are aimed at increasing patient compliance with a reminder system, ease of access and communication between a patient and a professional, and the availability of valuable information.[3]

It appears that ophthalmology-focused applications will become more relevant in daily practice for both patient care and educational purposes.[34]

Through the use of smartphones, data collection has become more efficient and cost-effective. It also offers more comfort for patients due to its time and cost-saving aspects.[32]

Difficulties and weaknesses: As this technology is still new, it is lacking some major aspects. Another weakness is the confusion regarding the best control group to use in studies: the majority of current smartphone applications do not possess sufficient scientific evidence to validate their claims and for them to be fully integrated into clinical education or practice.[3]

Another obstacle faced during real-time video conferencing is time delay (lag), which can be a major issue if it occurs during a time-sensitive event such as mid-surgery or in the case of an emergency.[41]

Legal frameworks

Due to concerns raised regarding the development of applications, the involvement of medical professionals, the validation of the information, and the security of the information stored, certain steps and precautions must be taken in order to govern and regulate the integration of smartphones into medical fields.[3]

It is necessary to bring together a telemedicine team in ophthalmology which encompasses both academic and research aspects by utilizing a wide range of resources and forming a collaboration between the ophthalmologists of the Association of Doctors, the Ophthalmology Society, and the Society of Legal Medicine in Ophthalmology to create legal guidelines and legislate telemedicine.[42]

Although the use of mobile phones in medical fields is widespread and beneficial, it still raises a considerable number of legal and ethical issues, which sometimes overlap. General medico-legal rights are the same but they apply to the use of smartphones in a particular way.

Patients' rights are a standard set of rules, but their application in terms of smartphones remains unclear.[42]

Medical liability and responsibility can take many forms. For example, high resolution imagery may not be as clear as seeing the case in person, which may hinder a professional's judgment and cause misdiagnosis, making them eligible for being medically liable.

Regarding data protection, smartphones can be connected through multiple channels (network and wireless), all of which have security measures that protect privacy, yet there are ways that data can be leaked and privacy can be compromised, including abuse of data possession, accidental leaks, releasing the information to a third party, all of which amount to a greater threat of privacy loss.[43]

According to the National Health Service (NHS), Patients' records are the most important and delicate data, and information security functions perfectly when all reasonable care is performed to prevent unauthorized access and deter any tampering that could occur.[44]

Specific legislation

Due to a higher rate of concern about the security of the data saved on computers, some legislation has been implemented that criminalizes the abuse of and unauthorized access to information.

The current set of rules includes: The 1984 Data Protection Act, which states that all personal data including patient information which are saved on computers and used by NHS bodies must be registered with the Data Protection Registrar, and the 1990 Computer Misuse Act, which implements criminal sanctions as punishment for unauthorized access or misuse and vandalism of digitalized information, and states that authorized personnel may operate on the data within the designated limitations, and if they cross these boundaries it is considered a criminal act; fraud, extortion, and blackmail are all covered by the act as well.[45]

Ethical aspects

Similar to the legal regulations, the ethical standards of smartphone use in the medical field are roughly the same as the general rules, but there is more focus on confidentiality, privacy, and the principle of informed consent.

With regard to informed consent, smartphones differ from general cases because instead of face-to-face and on paper consent, the consent form is signed digitally and remotely.

Rules and guidelines to be followed before recording:

- The purpose and aim of the recording and how the information will be used must be explained to the patient.
- The method and duration of information storage must be clarified.
- The patient has the right to withhold or remove consent before, during, or after the recording, and this will not have any effect on the level of care they receive or the patient/doctor relationship.[31,41]

One of the most important aspects of the relationship between healthcare professionals and their patients is confidentiality. It is also an important aspect of the ethics maintained by healthcare professionals, and is a main focus point of the information protection imposed by law and statute.[46]

The sharing of telemedicine information must be encrypted in order to ensure confidentiality, and higher levels of encryption (data anonymization) must be specifically designed to make sure the information isn't leaked.[42]

Hi-Ethics consortium is a group of volunteers whose goal is to merge the websites and information of the most reliable health information providers in order to gain consumer confidence in digital health services.[43]

Data protection considerations. The 1998 Data Protection Act implemented a set of rules to regulate the handling and processing of information regarding personal data, including storing, obtaining, recording, using, and disclosing information. The act is applicable to all forms of media, whether paper or digital.[47]

The 1996 Act of Healthy Insurance Portability, Accountability, and Confidentiality must always be maintained.[8]

Methodology

Traditional methods of ophthalmic evaluation – such as slit-lamp and direct face-to-face contact –have evolved or have newer alternatives such as telemedicine, smartphone applications, and the use of artificial intelligence, all of which can be used in diagnosing, treating, educating, and following up with patients.

The use of smartphones in the medical field isn't without its issues, and the main concern for a lot of people is the issue of privacy, as the privacy of information stored on smartphones cannot be fully guaranteed due to the fast development of the technology. However, governments and professionals have started implementing guidelines and general principles to be followed in order to keep up with developments and maintain information privacy, which are as follows:

Privacy principles: Flexible and safe user-friendly privacy settings that give users freedom over their preferences; privacy settings which allow users to fine tune their settings for every section of personal data so that others may not obtain access to it without explicit consent.

Privacy preservation model: Firstly, some applications and sites have "public" privacy settings as the default and users may forget to change it. Secondly, some individuals may lack self-control and others may be influenced by the design of the application or website.

Finally, privacy settings give users the ability to customize who can view what on their online profiles, but they do not give control over what the website or application reveals about them.

A global model should be implemented in order to standardize the integration of privacy and security across multiple websites and applications and prevent conflict.[43]

Discussion

Ophthalmologists' use of smartphones has become a daily habit that is increasing both professionally and in functionality. Smartphones have become much more than just single use devices, and are now easier than ever to use, affordable to nearly everyone, and much more cost effective than conventional treatment methods. They are also more convenient due to their portability. Furthermore, the speed of data and information storage and sharing and the ability to add applications makes them highly customizable. They have the functionality to be used as more than one medical instrument, and their data storage capabilities are much higher and more organized than the conventional paper methods.[27] Smartphone use in medicine is growing and developing rapidly, as they are the most in-demand

commodity of this era and connect even the most remote areas to healthcare at a lower cost.

Smartphone functionality can expand to personal, surgical, educational, and pharmaceutical levels. Everyone at all academic levels can use and benefit from them, and with the addition of mobile-based health systems, solutions have become more efficient.[26]

However, smartphones also have some limitations in terms of the reliability of the services provided, issues with security, and concerns regarding their correct usage at all levels. The most efficient solution to these limitations is to utilize evidence-based learning to maintain their development and improvement.

Findings

The rapid growth of information technology during the past decade is highly promising but also complex. The vast number of applications developed coupled with the lack of reliability may be problematic; however, the desire of professionals for applications that aid their practice is prompting the further development of such technologies. The foundation of medical ethics had been breached, and this should be controlled by applying clear guidelines to maintain confidentiality and data protection.[31]

Conclusion

"I agree that the line between what is required and what is not required by the principle is difficult to draw, and that drawing a precise line independent of context is impossible." (Tom L. Beauchamp).[48]

Reaching an optimal outcome in a short time with a low cost in line with all rules and regulations is the ultimate target in all situations.

Although this framework is difficult to apply and to monitor, it should at least be attempted or followed as closely as possible approximated.

This investigation of ophthalmic technology revealed that it is important to establish a global teleophthalmology society of specialists from both technology and ophthalmology fields from all over the world in order to regulate the legal and ethical principles of the practice and unify it in a common language, with standards that are evidenced-based.

Although smartphone technology has evolved significantly, it is yet to replace more traditional ophthalmic evaluation methods, and ensuring smartphones reach a global golden standard will require a collaborative, transformational healthcare system with a standardized medical record system. Clear rules and guidelines should be well-studied, clearly set, and uniformly applied.

In ophthalmology, smartphone applications have provided considerable functionality and a huge potential for future developments.

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