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(REVIEW ARTICLE)

Telemedicine in ophthalmology or teleophthalmology

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Abstract

This review addresses the growing role of teleophthalmology in expanding access to eye care, particularly for rural and remote communities where traditional services are limited. Advances in imaging technology and real-time telemedicine have improved the reach and quality of ophthalmic care, offering diagnostic accuracy comparable to in-person consultations and demonstrating cost-effectiveness.

Studies from India and Australia highlight how mobile teleophthalmology and integrated service delivery models can effectively reduce avoidable blindness and enhance care coordination.

Teleophthalmology proves especially valuable for screening and management of conditions such as diabetic retinopathy, macular edema, and retinopathy of prematurity, with high diagnostic reliability and patient satisfaction.

However, challenges remain, including technological barriers, imaging quality, and the need for sustainable financial planning. Overall, teleophthalmology offers a promising solution to overcome barriers in eye care delivery, though continued innovation and investment are essential for broader implementation.

Keywords: Telemedecine; Teleophthalmology; Teleoglaucoma; Teleneurophthalmology; ROP

1. Introduction

Undoubtedly, blindness affects individual not only physically but also emotionally. There are approximately 46 million visually impaired people throughout the world(1) and that's becoming a global problem especially in rural and remote areas. The delivery of equitable eye services for those communities represents a unique challenge to healthcare providers (2) .

As in other medical fields, telemedicine has been introduced in ophthalmology care and has been applied and absorbed differently by the diverse subspecialties, as an ascending trend (3) ,thus , advances in imaging capabilities and the evolution of real-time telemedicine have the potential to provide increased coverage to areas with limited ophthalmology services (4) .

Certainly , teleophthalmology is not meant to substitute face-to-face eye examination; it is rather meant to facilitate and provide appropriate and timely distribution of ophthalmology assistance, prioritizing the demand for ophthalmology care, especially in underserved areas (5) . Thus, it proves especially valuable for screening and management of conditions such as diabetic retinopathy, macular edema, and retinopathy of prematurity, with high diagnostic reliability and patient satisfaction.

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2. Methodology

Pubmed research: Telemedicine in ophthalmology; Teleophthalmology; Teleglaucoma; Teleneurophthlamology.

2.1. Review

The delivery of equitable eye services for rural and remote communities represents a unique challenge to healthcare providers(2). Advances in imaging capabilities and the evolution of real-time teleophthalmology have the potential to provide increased coverage to areas with limited ophthalmology services. this one can delivered safely utilizing the correct expertise and case-selection. Teleophthalmology might be one of the most challenging applications of telemedicine given its level of detailed elements and need for refined imaging. Financial planning is essential for sustainability of teleophthalmology, as it may require more sophisticated and numerous equipment (6) such as high image resolution, audio clarity, and signal reception, specific protocols are required to provide ophthalmic clinical data (7). Studies showed teleophthalmology can improve access to specialty care, reduce the number of unnecessary visits, alleviate overloads on treatment centers, and provide more comprehensive exams. It also made services cost-saving for stakeholders and cost-effective in rural areas (8).

A systematic review finding that diagnostic accuracy for real-time teleophthalmology was comparable to face-to-face consultation (4) .Within Western Australia (WA), the integration of teleophthalmology into service delivery has played a pivotal role , in their article , Mark and al , present an overview of their journey toward the development of an integrated teleophthalmology model over the past decade, with a focus on the key lessons for building an effective telemedicine service (2) . In India a study , by Sheila John and al (9),over 1.5 year included 54,751 patients underwent evaluation at 872 camps across four states . Among these, uncorrected refractive error was the commonest cause of avoidable blindness (59%), followed by cataract (30%). Retinal diseases, mainly diabetic retinopathy, contributed 3.3% of avoidable blindness, and corneal diseases accounted for another 1%. Those results led them to conclude that comprehensive eye camps utilizing a mobile teleophthalmology unit appears to be a very useful tool to improve eye care delivery in the developing world.

For the coordination , multiple facets including facilitating engagement with the local community, eye professions and health facilities .This coordination is better with the integration of ophthalmology and optometry roles what may improve efficiency of services for patients (10).

Teleophthalmology has proven to be effective and useful in several fields .New studies were conducted on the application of teleophthalmology in retinal diseases and examined the reliability of the image quality to be used for assessment and were particularly focused on screening and referral for DR (11). Telemedicine using nonmydriatic cameras increased the proportion of participants who obtained diabetic retinopathy screening examinations, and most did not require follow-up with an eye care provider (12) . Recently, it was shown that when nonmydriatic cameras were used for DR screening, different eye diseases such as glaucoma and age-related macular degeneration (AMD) were detected with this modality (13).

Teleophthalmology is also useful for detecting diabetic macular edema (DME). More recently, the concept of telephotocoagulation was described for the treatment of DME in a study led by Igor Kozak and Al (14). In this strategy, one site provides the retinal imaging, including fluorescein angiography, and another site creates an image-based treatment plan , this teleretinal treatment plan was able to be successfully completed in 16 eyes that all demonstrated improvement in the area of retinal edema after laser photocoagulation, and no eyes demonstrated visual acuity loss 3 months after treatment.

Another article ,reported , four-year experience of the Stanford University Network for Diagnosis of Retinopathy of Prematurity (SUNDROP) telemedicine initiative, which was developed to reduce the risk of blindness from retinopathy of prematurity (ROP) (15) , enrolled 820 eyes and found that telemedicine had a calculated sensitivity of 100%, specificity of 99.8%, positive predicative value of 92.9% and negative predictive value of 100% for the detection of TW-ROP (treatment warranted) and the study noticed that no patient progressed to retinal detachment or any adverse anatomical outcome. Other conditions such as AMD, cytomegalovirus retinitis, and choroidal nevi can be identified by teleophthalmology (5).

The use of teleophthalmology in neuro-ophthalmology has also been described : tele-neuro-ophthalmology programs can be used for triage, diagnostic consultation, and long-term treatment monitoring (16). Ocular fundus imaging with retinal photography has been considered a helpful tool for diagnosis of neuro-ophthalmologic disorders in the emergency department (17).

For glaucoma , a meta-analysis was conducted to provide estimates of diagnostic accuracy, diagnostic odds ratio, and the relative percentage of glaucoma cases detected by Serah Melisa and al , founding that teleglaucoma is more specific and less sensitive than in-person examination and detects more cases of glaucoma than in-person examination (18).

Besides retinal diseases and neuro-ophthalmology , teleophthalmology has been used more progressively in other areas such as emergency medicine , an investigation of the The feasibility of an internet-based emergency consultation has been led (19) : After being taken using a slit-lamp connected to a video camera , ocular images are processed and forwarded to a chief medical officer by e-mail and each case was re-examined by the same chief physician the next day, the 100% agreement between the diagnosis made during the consultation and the on-site examination performed by the senior ophthalmologist thereafter. 98% of patients said they would prefer to be seen as part of the telemedicine system at their next emergency department visit, rather than the traditional on-site examination by residents.

To evaluate patient satisfaction with teleophthalmology, the current study recruited patients who underwent a video consultation with Lions Outback Vision, for a follow-up telephone-based questionnaire assessing satisfaction (20): 137 eligible patients included in the study , 69.1% were very satisfied , 24.5% satisfied service and no one reported being either dissatisfied or dissatisfied.

In general, regions without quality health services may find it more difficult to access advanced communication technologies and thus telemedicine In general, regions deprived of quality health service might face more significant difficulties to have proper access to advanced communication technology and, hence, to telemedicine (5) .

Despite innovations and advances, telemedicine remains challenged by the usual obstacles faced by technology in matters of access, communication process, service quality, and security (5) . Poor imaging is responsible for the large majority (86%) of referrals ,this issue may result from inadequate equipment and/or insufficient training (21,22)

3. Conclusion

Although telemedicine is not a replacement for traditional care and still faces challenges for adequate implementation, it represents an effective care delivery method, facilitating appropriate and timely distribution of service especially in remote and/or underdeveloped regions (5) , thus , teleophthalmology is a promising new way to overcome barriers to the delivery of eye care services to rural and remote populations , who have high level of overall satisfaction with this procedure and accept this emerging consultation modality , regardless of age (20) . But to the present day, several challenges exist n in many regions, especially in underdeveloped regions, access to technology and telemedicine is itself very difficult, hindering the realization of teleophthalmology

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

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