

Tele-health in pediatric ophthalmology: Promises and pitfalls

Telemedicine is a broad term that encompasses the exchange of medical information through electronic communication to improve patient care.^[1] The emergence of the severe acute respiratory syndrome coronavirus 2 pandemic (COVID-19) and its implications on social distancing policies has promulgated the need for innovative methodologies for ophthalmic assessment and management in a safe and timely manner. Ophthalmology, among other medical specialties, has shown potential for the adoption of telemedicine given the propensity for visual images to facilitate screening, aid diagnosis, treatment, and management. Although the weight of publications for telemedicine relates to adult ophthalmology, there remain challenges for its implementation in pediatric populations. Further understanding of the scope, modalities, strengths and limitations, economic and legal implications of telehealth in pediatric ophthalmology is required.

Defining the Platform of Telemedicine

Understanding the scope of telemedicine in pediatric ophthalmology involves firstly defining the formats by which it is accessed and delivered. Broadly speaking, the three major platforms of telemedicine visits are video visits (VVs), telephone visits, and email or secure messaging.

VVs utilize interactive audio and video telecommunication, permitting real-time communication between patient and clinician.^[2] These can be provided through Health Insurance Portability and Accountability Act (HIPAA) compliant platforms such as Zoom for Healthcare (© Zoom, Inc. San Jose, CA, USA), VSee (©, Sunnyvale, CA, USA), and Doxyme Pro (© LLC, Salt Lake City, Utah, USA); or public-facing everyday technologies including Facetime (© Apple Inc., Cupertino, CA, USA), WhatsApp (© Facebook, Inc., Mountain View, CA, USA), Skype (© Microsoft, Redmond, WA, USA), or Google Hangouts (© Google Inc., LLC. Mountain View, CA, USA). The public-facing platforms are commonly available, and relatively familiar to users, but often considered to be relatively less secure. They are also limited by patients having access to the clinician or practice personal number; requirement of a particular device, or both parties to have downloaded the application. There are also limitations with certain software regarding screen sharing capacity and ability to record the video consultation.

Scope of Telehealth in Pediatric Ophthalmology

Evaluating the scope of telehealth in a pediatric consultation must fundamentally consider the purpose of the activity. Much like a conventional face-to-face consultation there are several stages of a telehealth visit cycle which include: scheduling, history, examination, ancillary testing, and planning for interventions.^[3] Each of these respective components requires careful consideration and planning, and education of the clinical team involved. In terms of scheduling, administrative staff of the clinic should be aware of the range of services offered (VV, phone call, physical consult), or let the ophthalmologist decide based on triaging the referral. In this context, a simple telephone conversation with a patient and their carers to

ascertain the clinical history may be an invaluable step to aid the triage process itself. Somewhat of a greater challenge in pediatric teleconsultations rests with the next phase of the consultation involving assessment of objective clinical parameters.

Visual Acuity

There are established guidelines for assessing visual acuity at home for children which are typically assessed through mobile-based applications or printed charts. It is important to acknowledge that while neither of these methods are as accurate as in-office testing, printed charts have been more readily validated. Accordingly, in March 2020 the American Academy of Ophthalmology (AAO) provided recommendations for the use of a printed “tumbling E” chart at home. The chart is intended for use in children 3 years and above and is freely accessible via the AAO website where it can be printed and stuck onto a wall and used at a distance of 10 feet (3.1 m).^[4] It is accompanied by a single “E” practice card and clear instructions on its use and documentation of visual acuity. Using a consistent, validated measurement of visual acuity such as the tumbling E chart allows at minimum an estimate of the trend of a child’s vision.

General Inspection and Key Principles

Arguably the greatest yield of a video-based platform is in providing a basic general inspection of a patient. Emerging examples have shown the utility of innovative approaches in VVs to assess new-onset strabismus, corneal abrasion, ocular surface graft-versus-host disease, orbital cellulitis, and blunt ocular trauma.^[5] The key principles that have facilitated the examination relate to image acquisition, transfer, and optimal conditions for interpretation. Logically, it is important that the child is positioned in an area with sufficient natural lighting or a well-lit area. Video should be facilitated through larger devices that are stabilized rather than hand-held devices. This is to maximize the quality of image capture and viewing. Finally, it is imperative that both patient and physician have high-internet connectivity in order to provide “live” or dynamic feedback regarding adequacy of image capture and the findings themselves.

Strabismus

Telemedicine has also been adapted for assessment and follow-up of pediatric strabismus.^[6] The weight of literature in strabismus has largely arisen from studies of nine-gaze photographs taken remotely by general ophthalmologists and sent to strabismus sub-specialists. Nine gaze photographs can be taken in a studio setting or through readily accessible smartphone apps including “9 Gaze” (© See Vision, LLC., Richmond, VA, USA). Helveston *et al.* showed high concordance between digital and in-person diagnoses for a breadth of pediatric strabismus conditions.^[7] These included non-refractive esotropia, intermittent exotropia, cranial nerve palsies, Duane syndrome, Brown syndrome, cyclotropia, double elevator palsy, strabismus fixus, and traumatic strabismus. The authors were able to qualitatively describe anomalous head posture, lid fissure abnormalities, ptosis, and facial asymmetry. The purpose of these studies was largely to explore the accuracy

of image-based methods for qualitative diagnosis. In most cases, precise angular measurements were not required. It is important to acknowledge that in these studies a trained ophthalmologist was present face-to-face to examine and obtain appropriate clinical images.

Oculoplastics

Telemedicine has also been shown to be useful in triaging pediatric oculoplastic patients. This has been explored in VV format, and transfer of static clinical images. Hunter *et al.* at Boston Children's Hospital showed the utility of a video format in the dynamic assessment of a child with possible orbital cellulitis. In this context, live video assessment afforded the examiner to instruct the patient to position themselves for targeted optimal assessment, for example, a "worms eye" view to appreciate proptosis.^[5] Helveston *et al.* showed the utility of clinical image capture using low-cost digital cameras by general ophthalmologists who physically saw the patient, and subsequently transmitted images to sub-specialists with adjunctive clinical history in formulating management plans.^[8] The authors showed its role in the management of conditions such as congenital ptosis. Overall, there was a high concordance between generalists and subspecialists in diagnostic accuracy for oculoplastics cases (86%), with greater variation in concordance with treatment plans (60%). Although acknowledging that their study did not attempt to show superiority of telemedicine to in-person examination, the authors failed to comment on specific protocols for image capture, and proportion of ungradable or limited quality images.

Posterior Segment

Telemedicine has perhaps showed the greatest utility in pediatric retinal disease. The focus of published literature relates to the interaction between health professionals and not directly patient to doctor. With this caveat, teleophthalmology has shown promise in the management of retinopathy of prematurity, particularly in low-resource and remote settings where access to pediatric ophthalmologists are limited. Studies have shown the utility of appropriately trained clinicians to capture dilated wide-angle fundus photographs using technology such as RetCam® (Clarity Medical Systems, USA), which can then be reviewed by pediatric ophthalmologists remotely to assess, objectively record and monitor disease progression.^[9,10] The store-and-forward synchronous telehealth method has been adapted for other posterior segment diseases including retinal vascular disorders.^[11] This has also been shown to improve patient access and facilitate timely care.

Medico-Legal Considerations

Telemedicine raises a number of medico-legal challenges. Issues surrounding privacy and confidentiality arise due to the transmission of electronic data and the cybersecurity considerations this raises.^[12] Furthermore, there are challenges verifying doctor and patient identity in a telehealth environment. Questions exist regarding the need for informed consent to be obtained before conducting telehealth consultations. This would necessitate a minimum level of understanding regarding issues such as data transmission and cybersecurity by the doctor, to ensure patients have a full understanding of

what they are consenting to. Telehealth also allows clinicians to practice across jurisdictions in ways not previously possible, and doctors must be cognizant of their legal obligations in such instances. Lastly, given that practicing telehealth brings unique challenges and requires specific skills, issues around the need for formal professional accreditation and training also exist.

The social distancing measures introduced in pandemic situations have forced medical subspecialties, including, ophthalmology to adapt to remote operations. Although tele-health in ophthalmology has shown promise in adults, there remain challenges in its adaptation in pediatric patients. Current evidence is largely based on clinic platforms in which a trained examiner captures images and forwards them to a sub-specialist for interpretation and assessment. This is limited to access to facilities with appropriate technology and trained practitioners. Despite these limitations, cautious optimism and willingness from patients are driving innovative methods to improve remote ophthalmic monitoring. This has the scope to strengthen collaboration between primary eye care and pediatric service providers with pediatric ophthalmologists. This is particularly important in low-resourced and regional settings and also applicable to high-density metropolitan environments that are more exposed to pandemic clusters. Continued development of telehealth has the potential to be an important permanent adjunct to in-person standards of care. The ultimate goal is to improve access and ensure timely provision of eye care while maintaining highest standards of clinical care for all children.

**Rahul Chakrabarti^{1,2}, Louis J Stevenson¹,
Susan Carden^{1,2,3}**

¹Department of Ophthalmology, The Royal Victorian Eye and Ear Hospital, East Melbourne, Victoria, Australia, ²Department of Ophthalmology, The Royal Children's Hospital Melbourne, Parkville, Victoria, Australia, ³Department of Pediatrics, University of Melbourne, Parkville, Victoria, Australia.
E-mail: rahul.chakrabarti@eyeandear.org.au

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