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REVIEW ARTICLE

Online teaching and surgical simulators: Substitute for physical ophthalmology clinical and surgical training?

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Abstract

COVID-19 pandemic has disrupted real-time, direct patient contact in all specialties of medicine, and surgery including ophthalmology. Both undergraduate medical students and postgraduates in training have borne the brunt of the pandemic. This brief review explores the changing trends brought about by the digital learning platforms and simulation exercises. Various aspects related to "Virtual" patients and technological boom have also been covered.

Sir William Osler's famous quote, "*Medicine is learned by the bedside and not in the classroom*," is gradually fading away. Opportunities for traditional teaching have diminished over the past two decades with shorter and fewer inpatient stays, super specialist interventions, higher standards of patient safety, as well as a shortage of "good" clinical teachers.

Ophthalmology has not been well represented in medical school curricula even before the COVID-19 pandemic due to marked crowding in the medical curriculum. This has led to the erosion of sound practical ophthalmology education for medical undergraduates. Therefore, when postgraduates choose to pursue ophthalmology, they usually do not have a sound foundation and bank heavily on their residency tenure to learn the tricks of the trade. COVID-19 pandemic has accentuated learning issues, as real-time, direct patient contact in ophthalmology has decreased dramatically even for clinicians and postgraduates in training, let alone undergraduate medical students. Almost all elective clinical and surgical activities were suspended during the pandemic lockdown, and often, ophthalmologist, including those in training, were deployed in COVID-19 wards and even for field duties. This stands to reason, given the high risk of virus exposure from both, conjunctival and respiratory secretions, during the ophthalmic examination which typically is done in close proximity with the patient. The typically crowded outpatient clinics and long operating lists compound the risk of transmission as well.[1]

In fact, one of the several global challenges precipitated by COVID-19 is the healthcare education crisis in ophthalmology.[2] Almost 70% of the student population worldwide has been out of school, and the impact of the loss of learning is yet to evaluated on graduate medical education, including residency and fellowship programs in ophthalmology. Even though clinical simulation in teaching, learning, and assessment has been a part of medical education for decades, social distancing has forced most medical schools and training programs to mandatory virtual environments. This has accelerated the digital transformation of medical education dramatically – not only for students but also for continuing medical education for practitioners – most conferences have moved online, with both presentations and non-presential simulations.[3-5] Online video platforms such as Zoom®, Skype for Business®, and Cisco Webex®, have made access to even international lectures and conferences easy

at a negligible or reasonable cost. Despite the boom of these digital platforms, the digital transformation and adaptation by graduates and postgraduates have been different in developed and developing nations.[6,7]

The medical education system follows a well-structured curriculum with pre-set objectives and conditions. Traditional medical education has always relied heavily on theoretical learning, with less emphasis on clinical practice – a lacuna that has been exaggerated by the safety protocols of the pandemic. Many postgraduates have lost a substantial part of tenure of their academic course due to disruption in the training period, leading to inadequacies in the dissertation work and insufficient clinical and surgical experience.[8,9] Remote access of high-quality health education, and innovations in clinical simulations, therefore, is the need of the hour, globally.

Digital education has evolved as web lectures or podcasts along with clinical teaching in virtual reality (VR) environments with virtual patients and simulations.[10-12] Digital learning involves use of both open and closed platforms. Open platforms in public domains such as EDx, Coursera, and YouTube reach a wider audience, while closed platforms (e.g., University-based networks for teaching and assessments) have limited reach due to password-protection and licensing issues.

Two basic modules of e-learning have been adopted, the synchronous, in which all participants have to be available at the same time, enabling communication and interaction between the mentor and participants, and the asynchronous, where participants attending the web-based training course can access educational material at any time. The exploration of pedagogic synergies between learning theories, didactics, cognitive psychology, and technology has resulted in their widespread use for training, education and assessment of healthcare professionals.[13]

Virtual Patients and a Safe Environment

High patient footfalls contribute significantly to medical trainee education for usual as well as unusual presentations of common and rare diseases. It also contributes to proficiency in both therapeutic and diagnostic procedures. COVID pandemic has replaced real patients with virtual ones. Virtual patients and interactive computer simulations that mimic real-life clinical scenarios enable the ophthalmologist to apply clinical reasoning to decisions about the presented clinical information, including diagnostic and management protocols, in a safe environment. This, however, cannot substitute contact with "real" patients, as this may result in less empathetic learners. Another drawback is the technology barrier. Not every training center or trainee can have access to newer trends such as VR and augmented reality simulation training.

Kononowicz *et al.* evaluated the effectiveness of virtual patients as reported in 51 trials with 4,696 participants from 1990 to 2018 in medicine.[14] They found that virtual patients, when compared to traditional education, are at least as effective for knowledge outcome, and more effective for skill-based outcomes. They also hypothesize that replacing passive forms of traditional education with virtual patients may be more beneficial than replacing active learning methods. This was found to be true for high-income and low-and-middle-income countries across the globe. Students were generally satisfied, but occasionally the use of virtual patients correlated with diminished confidence in the clinical setting.

Virtual Patients and Empathy

While there is much to be said the skills safe environment for learning clinical decision making, it is imperative to remember that a patient is much more than his or her symptoms. The doctor's gaze is limited to the physicians' disciplinary matrix, and often separates the biomedical aspects of disease from its felt human experience – the absolute antithesis of empathy.[15]

More often than not, the virtual patients use objective language, passive voice, and do not represent the presence of person, exaggerating this dichotomized doctors' perspective.[16] Since there is no simulation of feelings, priorities, agency, or the sociocultural context of the patients' condition, this may unintentionally discourage empathy. Another unwarranted impact could be that the students may learn to detach themselves from the messiness of real patients' priorities, reducing the clinical situation to a unidimensional construct only.

The importance of appropriate communication skills in ophthalmology,[14] as well as targeted educational activities to promote patient communication, especially in the context of progressive diseases such as age-related macular degeneration and glaucoma, as well as difficult conversations around vision loss cannot be overemphasized. The patient based learning modules despite their best efforts may fail in imparting the necessary communication skills in this context. This was highlighted by the fact that most ophthalmology trainees lacked confidence in telephone consultations following largely digital training sessions during the pandemic.[3]

Virtual Patient and Surgery

Citing William Osler once again, "*He who studies medicine without books sails an uncharted sea, but he who studies medicine without patients does not go to sea at all.*" This applies to surgical training as well. Ophthalmic surgical training models and simulators have saved the day to some extent. Ophthalmic surgical training models, for example, SimulEYE® (InsEYEt, LLC) can help resident doctors-in-training and ophthalmic surgeons to practice and refine their surgical techniques and transition into adopting new technologies. But can a model be a substitute for the feel of the real ocular tissue?

Lee *et al.* reviewed 151 studies pertaining to simulation-based training tools for technical and non-technical skills in ophthalmology available until 2019.[10] They reported

that the models with the strongest validity evidence were the Eyesi Surgical, Eyesi Direct Ophthalmoscope and Eye Surgical Skills Assessment Test. Even though the effectiveness ratings for simulator models were mostly limited to level 2 (contained effects), they were found to be useful in the clinical training settings. Only the Sophocle vitreoretinal surgery simulator (level 3, downstream effects), and the Eyesi for cataract surgery (level 5, target effects) performed better. They concluded that the descriptive reports showed limited validity and very rarely investigated the effects of simulation training on patient outcomes. Only the Eyesi simulator has shown efficacy in improving theater performance and lowering complication rates in cataract surgery. The efficacious implementation of simulation tools in ophthalmology training curriculums, therefore, requires more investigation and planning.

Ferrara *et al*. reported that trainees felt that surgical telementoring was uncertain or not useful in their training programs during the pandemic.[3] Ye *et al*., on the other hand, demonstrated that video sequences could be transferred in real time between the two cities, while two parties conversed smoothly without any difficulty, using two smartphones enabling mentoring.[17] However, it stands to reason that an immediate resumption of trainees' surgical practice is critical, and that remote surgical telementoring may help them refine their skills.

Students Perception of Hybrid and E-learning Modules

Even though Rahm *et al*. have reported that solving and interpreting e-learning cases close to real-life settings had a positive impact on students' motivation during the COVID-19 pandemic, partially compensating for the missed bedside teaching opportunities, its impact of fostering empathy is yet to be evaluated.[18] Kahlil *et al*. also reported that the sudden transition to synchronized online learning was well-received by medical students, who believed that the sessions were time saving, thereby improving their performance and efficiency.[19] The students, however, did experience methodological, technical, and behavioral challenges during the teaching sessions as well as the online evaluations. In a surprise outcome, the majority of the preclinical students preferred online learning in the future as well.

Ferrara *et al*. evaluated 504 responses from ophthalmology trainees 32 different countries.[10] Most described the current impact of COVID-19 pandemic on their training as "severe" (55.2%); however, they were optimistic about the future: predicting a "moderate" (37.3%), "mild" (14.1%), or "slight" (4.2%) long-term impact. More than 3/4th of trainees reported a decrease ≥50% in clinical activity and >75% of surgical activity. Almost half the respondents reported a gap in didactic teaching, almost 2/3rd of the trainees attended regular web-based teaching programs. They also reported a strong agreement when asked if web-based case-presentations in clinical training (91.7%), web-based discussion of edited surgical videos (85.7%), and simulation-based practice (86.9%) in surgical training were worthwhile.

Despite a predominantly negative perception of impact of the pandemic on ophthalmology training programs, most trainees were happy with the emerging teaching methods.[20,21] The authors, therefore, concluded that structural and targeted changes, which must be sustained in the long term, may result in an improved, more flexible, and robust curriculum. Even though webinars have been found to be superior[22,23] to didactic lectures due to real-time interactions between teacher and trainees, increased knowledge retention, and active audience participation, enthusiasm for the same has been waning due to its prolificity, with most students reporting a webinar-fatigue and digital burnout.[24]

Technology and Equality

While there is no denying the robust scientific evidence demonstrating the efficacy of simulation in medical education, virtual environments may have a negative impact on learning in low-and middle-income countries.[25] Pre-existing inequality, in terms of limited connectivity resources, lack of qualified teachers, inadequate infrastructure, and equipment shortages all remain a harsh reality. High transmission speed of data has resulted in almost no time delay. Remote surgeons can zoom into small anatomical details due to advancements in high definition viewing systems. Moreover, interactive add-ons such as telestration, greater control over the visual field, and laser pointing have also enhanced the telementoring experience. Only a handful of studies exist in the literature, citing relevance of telementoring technology.[26,27] Ye *et al*. used an iPhone adapted into a surgical microscope in China with a laptop receptor in the USA. Three cataract surgeries were performed with smooth and uninterrupted transmission and no lag time or distortion perceived. In a recent study, Din *et al*. describe the use of telementoring for keratoprosthesis device (CorNeat KPro; Ra'anana, Israel) implantation into cadaver eyes, using a 5G live streaming technology, group chat software, 3-dimensional microscope system, and a VR headset for intercontinental surgical supervision.[28] Telementoring may have long lasting implications in terms of not only the trainees' acquisition of skills remotely. It may also facilitate the increased acceptance of telemedicine and remote monitoring in routine clinical practice as well. That said, most trainees have been found to be receptive of the idea of distance synchronous and asynchronous learning, virtual clinics, and telementoring.

Way Forward

The current pandemic situation has given an impetus to all institutes with ophthalmology residency programs to implement a structured, compulsory wet-lab or surgical

simulation curriculum. In addition, mandatory video recording of the resident cases and maintenance of video library must be encouraged to facilitate demonstration of common errors and pitfalls in surgical steps. Such videos can even help with telementoring. Tools such as the International Council of Ophthalmology–Ophthalmology Surgical Competency Assessment Rubric must be used along with wet-lab sessions or surgical simulators to objectively assess and guide the trainees.

Conclusion

Many models of digital learning, either open or closed, have been utilized by residents and fellows in training across the globe.[29] Due to post-COVID changes in the healthcare systems, an increasing demand for surgical training outside of the operating room has been recognized and is being addressed. It has not yet replaced traditional teaching systems but are getting robust with each passing day. The apprenticeship model of "*see one, do one, and teach one*" will soon be replaced by simulators and telementoring. May the Digitized Medical education 2.0 survive the test of pandemic.

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