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ARTICLE

Transforming ophthalmic education into virtual learning during COVID-19 pandemic: a global perspective

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Abstract

Objective The coronavirus disease 2019 (COVID-19) pandemic has imposed measures of social distancing and barriers in delivery of "in person" education. Institutions, involved in training the next generation of ophthalmologists, are using alternative teaching methods to maintain the standard of education.

Methods We conducted a worldwide survey among physicians, who are actively involved in Ophthalmology-related education, between 3 and 14 April 2020. The expert survey, developed on the basis of literature search and focus group discussions, comprised 23 questions addressing the use of e-learning in Ophthalmology during the COVID-19 pandemic.

Results A total of 321 participants from both academic and non-academic institutions worldwide, with variable practice experience and expertise, completed the survey. Before the pandemic, the majority of participants used traditional training modalities, including lectures, grand rounds and journal clubs, and 48% did not use any e-learning. There was a statistically significant increase in the use of all e-learning alternatives during the pandemic ($p < 0.001$), associated mainly with the availability of e-learning facilities ($p < 0.001$) and the academic character of institutions ($p < 0.001$). Zoom® was recognized as the mostly used platform for virtual teaching. Although theoretical teaching may take place, the surgical training of residents/fellows was dramatically reduced. The latter was significantly associated with participants' perspectives about teaching practices ($p < 0.001$).

Conclusion COVID-19 pandemic imposed great challenges in the educational field of Ophthalmology. The experience related to virtual training in Ophthalmology, gained during the pandemic, may change the traditional teaching practices in the world and provide new educational opportunities.

Introduction

On the 31 December 2019, 27 cases of pneumonia of unknown aetiology were identified in Wuhan City, Hubei province in China [1]. According to reports, the ophthalmologist Dr. Li Wenliang first recognized the symptoms of severe acute respiratory syndrome coronavirus 2 (now known as coronavirus disease 2019 (COVID-19)) in seven of his patients, while developing the disease himself and eventually passed away on 7 February 2020 [2]. The global spread of COVID-19 led the World Health Organization to declare it as a pandemic on 11 March 2020 [3].

The pandemic quickly overwhelmed health provision throughout the world, with hospital resources to be stretched to manage the outbreak. Hospitals have adopted drastic changes to care structures, including upgrade of general wards to intensive care units, cancellation of elective surgeries and re-deployment of healthcare providers [4]. Besides the socio-economic impact of COVID-19 and the implemented changes in healthcare delivery systems, it has also affected all levels of the education system, from pre-school to tertiary education, mainly due to a decrease in workforce across all academic sectors, as well as due to measures to prevent the spread of the virus [5].

Social distancing is a key measure to slow virus transmission. Consequently, in many countries, governments

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decided to close schools and universities, resulting in a switch to online teaching [5, 6]. Whilst didactic teaching can continue via distance learning, practical aspects of education, including surgery training, have been halted precluding the development of surgical skills of residents and fellows. Combined with re-deployment of specialist trainees to help with the fight against COVID-19, concern has risen about the impact on specialist training [6]. Furthermore, concern has been raised about the number of conferences and meetings (both scientific and clinical) that have been cancelled or postponed, as such events are often the main route of scientific dissemination and collaborations, providing networking opportunities as well [7].

Since medical education remains crucial, one of the main challenges during the pandemic is to continue to provide high-standard education for residents and fellows. In order to address these concerns, distance learning systems can be used to prevent overcrowding, while ensuring the safety of students and the efficiency of the educational activities [8]. In the light of the above, the purpose of this worldwide survey-based study was to evaluate the implementation of tele-education (e-learning) in Ophthalmology during the COVID-19 pandemic and compare it with the well-established training system used in several institutions before the pandemic, giving potential recommendations for the future.

Materials and methods

This survey was developed by a focus group of ten retina experts, from the International Retina Collaborative, after literature review and remote discussions, so as to determine the most suitable questions to evaluate the use of e-learning in Ophthalmology before and during the pandemic. The initial survey draft was reviewed by the focus group, then tested and modified by 15 additional retina experts, who volunteered to participate as a trial group. During the pilot testing, the appropriateness of each question was evaluated, poorly worded questions and response options were identified and corrected and the survey was shortened to decrease respondent fatigue and improve the overall style, according to guidelines in the conduct and reporting of survey research [9, 10]. All experts agreed that the final version of the questionnaire was clear and unambiguous.

The final version of the survey was organized into four sections and comprised 23 questions, including demographic characteristics of the participants (three questions), their educational status (four questions), attitudes towards tele-education before the pandemic (six questions), attitudes towards tele-education during the pandemic (five questions) and future impact of e-learning in Ophthalmology (five questions). Question types involved single choice (ten), multiple choice "please select all that apply" (eight), five-point ordinal Likert Scales (three) and full text answers (two). The survey was conducted in English language exclusively (see Supplementary Material 1 for the original survey). Supporting data and answers are available upon request from the corresponding author.

The potential participants of the survey were identified from the Masterfile of the 11th Annual Congress on Controversies in Ophthalmology (Europe Cophy 2020), while all members of the focus group (authors of the study) have contacted their professional networks and members of their national ophthalmological societies, including residents/fellows in Ophthalmology, as well as physicians involved in training ophthalmologists (attending physicians/academics).

The survey was sent out to the potential participants on 3 April 2020 via e-mail with a cover letter and link to access the survey on Google Forms (Google LLC, Mountain View, CA, USA). Complete questionnaires were received between 3 and 14 April 2020. Responders could answer the survey only once. Participation in the survey was voluntary, anonymous and without reimbursement.

Statistical analysis

Descriptive statistics of counts with percentages were used for categorical data. Comparisons between "before" and "during" the pandemic periods were performed, using the McNemar test for categorical data. Logistic regression models were fitted to assess the association between physicians' characteristics and their perspectives about teaching practices. A p value < 0.05 was considered statistically significant. Statistical analysis was performed using SPSS 24.0 statistical software (IBM Corp., Armonk, NY).

Results

Of about 750 physicians contacted, 321 completed the questionnaire, yielding a response rate of 43%.

Participants' demographics

The demographic and specific characteristics of the survey participants are shown in Table 1. Overall 145 out of 321 participants were males (45.2%) and 176 were females (54.5%). One person (0.3%) preferred not to disclose his/her gender. Most participants were older than 30 years ($n =$ 253, 78.8%). Various regions from all over the world were well represented in this survey, with Europe, including the United Kingdom, to be the most represented ($n = 125$, 38.9%), followed by Asia ($n = 66$, 20.6%), South America ($n = 39$, 12.1%), Middle East ($n = 36$, 11.2%), North America ($n = 33$, 10.3%) and Australia ($n = 17$, 5.3%), while Africa was the least represented ($n = 5$, 1.6%).

The sample was also representative of all educational grades, including residents ($n = 116$, 36.1%), fellows ($n = 34$, 10.6%), academic or non-academic clinicians ($n = 168$, 52.3%) and heads of teaching programs ($n = 45$, 14.0%), with variable experience in Ophthalmology. Most participants worked in academic institutions ($n = 211$, 65.7%), followed by non-academic institutions that host residents/fellows ($n = 84$, 26.2%) and private practices, hosting residents/fellows ($n = 26$, 8.1%). The majority of participants had expertise in retinal diseases ($n = 215$, 67.0%), while other specializations were also well represented, as shown in Table 1.

Training before and during the pandemic

Figure 1 shows the various alternatives used for training in Ophthalmology in several institutions worldwide, either academic or non-academic, before and during the pandemic. Before the pandemic, most participants used lectures ($n = 298$, 92.8%), grand rounds with case studies ($n = 231$, 72%), journal clubs ($n = 178$, 55.5%) and videos ($n = 138$, 43.0%) for teaching residents and fellows, while web-based lessons ($n = 118$, 36.8%), access to virtual meetings from conferences ($n = 58$, 18.4%), live streaming video conferences ($n = 49$, 15.3%) and e-class platforms ($n = 37$, 11.5%) were less prevalent. During the pandemic, a statistically significant decrease in the use of traditional teaching modalities, such as lectures, grand rounds, journal clubs and videos ($p < 0.001$ for all comparisons) is noted, along with a significant increase in the use of all e-learning alternatives ($p < 0.001$). About 13% of participants used none of the teaching modules, i.e. "in person" or "e-learning". The use of tele-education in Ophthalmology was associated with the academic character of institutions (OR = 1.71; 95% CI: 1.32–2.17; $p < 0.001$) and availability of e-learning facilities (OR = 3.78; CI 95%: 1.15–9.22; $p < 0.001$), while there was no association with gender, age, level of experience and educational level.

Figure 2 shows the specific platforms, which were used by the participants for e-learning activities. Before the pandemic, 48% of participants ($n = 154$) did not use any platform for e-learning. During the pandemic, this fell significantly to 25.2% ($n = 81$, $p < 0.001$). Prior to pandemic, commonly used platforms were Zoom® (Zoom Video Communications, San Jose, CA, USA, $n = 74$, 23.1%), Skype for Business® (Microsoft, Palo Alto, CA, USA, $n = 48$, 15.0%), Go to Meeting® (Citrix Systems, Fort Lauderdale, FL, USA, $n = 39$, 12.1%), specific e-class platform provided by each institution ($n = 38$, 11.8%), Cisco Webex® (Cisco Systems, Milpitas, CA, USA, $n = 33$, 10.3%), Microsoft Teams® (Microsoft, Palo Alto, CA, USA, $n = 16$, 5%) and Adobe Connect® (Adobe Inc., San Jose, CA, USA, $n = 8$, 2.5%). During the pandemic, there

Table 1 Demographic and special characteristics of survey participants.

Participants ($n = 321$)	n (%)
Gender	
Male	145 (45.2%)
Female	175 (54.5%)
Prefer not to say	1 (0.3%)
Age (years)	
<30	68 (21.2%)
31–40	130 (40.5%)
41–50	60 (18.7%)
51–60	41 (12.8%)
>61	21 (6.5%)
Prefer not to say	1 (0.3%)
Region/Country of practice	
Europe	125 (38.9%)
Western	36 (11.2%)
United Kingdom	29 (9.0%)
Eastern	58 (18.1%)
Nordic	2 (0.6%)
Middle East	36 (11.2%)
East Asia	31 (9.7%)
South/South East Asia	35 (10.9%)
North America (United States/Canada)	33 (10.3%)
South America	39 (12.1%)
Australia	17 (5.3%)
Africa	5 (1.6%)
Current academic status[a]	
Head of program/Director	45 (14.0%)
Academic	76 (23.7%)
Attending physician	92 (28.7%)
Fellow	34 (10.6%)
Resident	116 (36.1%)
Institution	
Academic (directly linked to university)	211 (65.7%)
Non-academic (hosts residents/fellows, but not linked to university)	84 (26.2%)
Private practice, which hosts residents/fellows	26 (8.1%)
Ophthalmology experience (years)	
<5	118 (36.8%)
5–10	67 (20.9%)
11–15	44 (13.7%)
>15	92 (28.7%)
Expertise[a]	
Medical retina	119 (37.1%)
Surgical retina	96 (29.9%)
Uveitis	41 (12.8%)
Ocular oncology	16 (5.0%)
Cataract	71 (22.1%)
Glaucoma	41 (12.8%)
Cornea and refractive surgery	26 (8.1%)
Paediatric ophthalmology	17 (5.3%)
Neuro-ophthalmology/Strabismus	11 (3.4%)
Orbit, lids and lacrimal system	17 (5.3%)
None	102 (31.8%)

[a]Participants close all answers that applied.

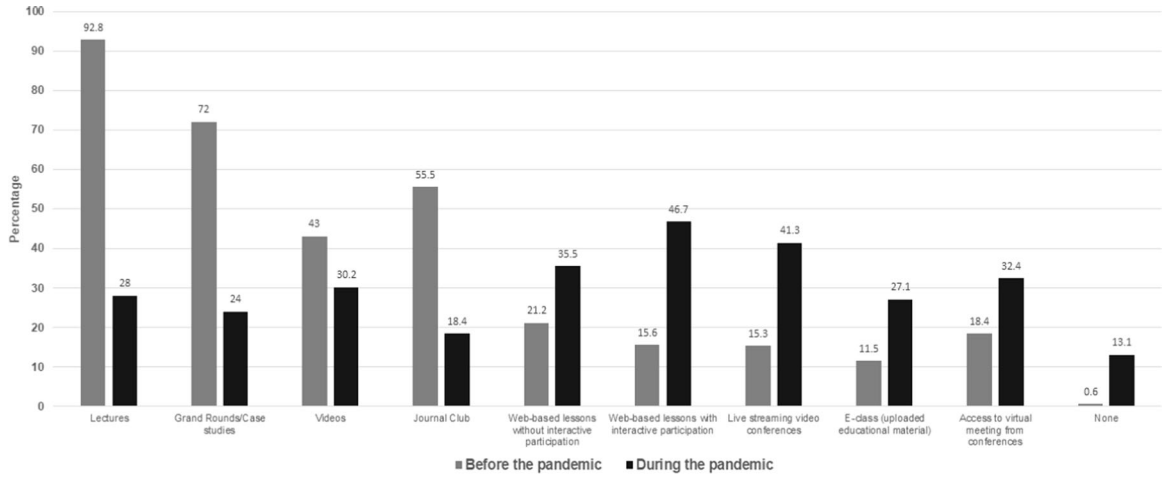

Fig. 1 Teaching methods before and during the pandemic.

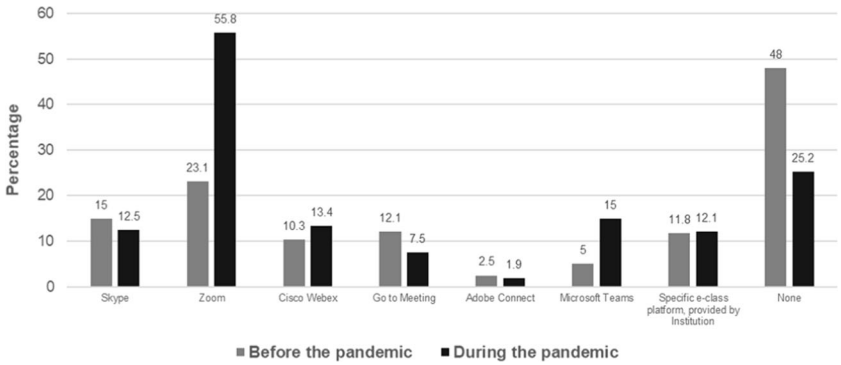

Fig. 2 Specific platforms for e-learning before and during the pandemic.

was a statistically significant increase in the use of Zoom® ($n = 179$, 55.8%, $p < 0.001$) and Microsoft Teams® ($n = 48$, 15.0%, $p = 0.018$) platforms, while the use of other platforms did not differ before and during the pandemic. Of note, 194 of 321 participants (60.4%) reported that their institutions neither provided facilities nor appropriate software for e-learning.

It has to be noted that 25.2% of respondents reported that there was no teaching provision in their institutions during the pandemic (6.9% vs. 25.2% before and during the pandemic, respectively, $p < 0.001$). However, most institutions managed to maintain theory training at a satisfactory level, as shown in Fig. 3a. As expected, there was a statistically significant decrease in hours spent for surgical training during the pandemic ($p < 0.001$ for all comparisons). Suspension of surgical training was reported by 63.2% of participants ($n = 203$) and about 11.5% ($n = 37$) responded that residents and fellows performed only emergency surgeries, as shown in Fig. 3b.

Regarding the quality of teaching, there was a statistically significant decrease in participants describing the teaching practice of their institution as "good" on a five-point Likert scale ($n = 138$, 43% before vs. $n = 66$, 20.6% during the pandemic, $p < 0.001$). Similarly, there was a statistically significant increase in those describing the teaching practice

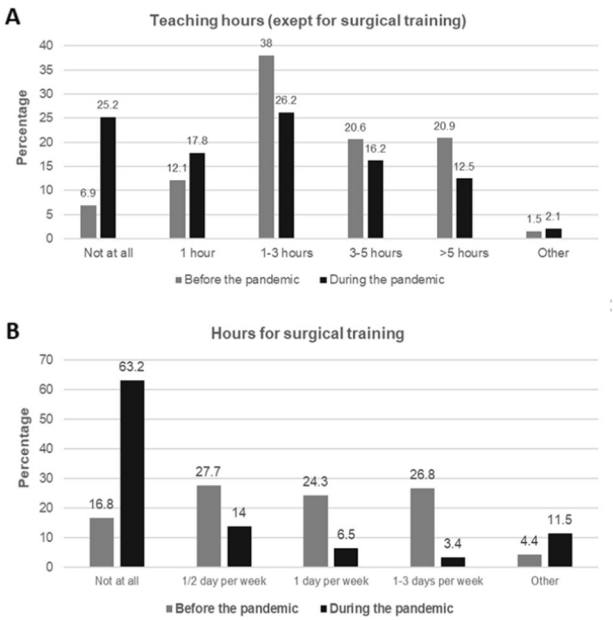

Fig. 3 Training weekly hours before and during the pandemic.

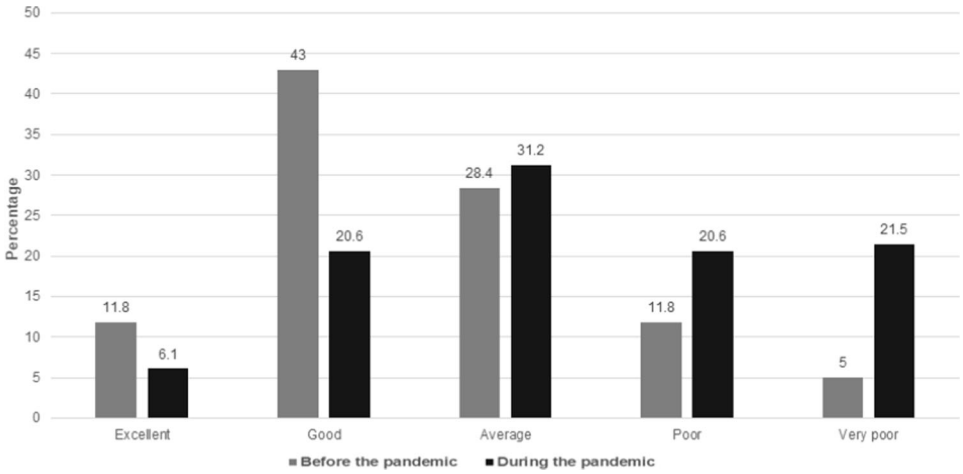

Fig. 4 Current teaching practice description before and during the pandemic.

of their institution as "very poor" ($n = 16$, 5% before vs. $n = 69$, 21.5% during the pandemic, $p < 0.001$). Rating for current teaching practices was significantly associated with the number of hours spent in surgical training (coefficient = +0.63; 95% CI = +0.39 to +0.81; $p < 0.001$), while no other factor was found to affect the participants' perspective about teaching practices (Fig. 4).

Future implementation of e-learning in Ophthalmology

When asked about the future of e-learning, 60% of participants ($n = 194$) think that e-learning can replace "face-to-face" education, while 82.6% ($n = 265$) believe that the experience gained during the pandemic with regards to e-learning methods will be used in the future training in Ophthalmology. Noticeably, 186 participants (57.9%) were "very" or "extremely" satisfied with using e-learning as a teaching method in Ophthalmology, while only 8 participants (2.5%) were "not satisfied at all".

Regarding the barriers on the adoption of e-learning for the future training in Ophthalmology, 87 participants (27.1%) felt that there were no barriers. However, potential barriers included the absence or restricted availability of e-learning facilities in some institutions, as well as the trainees' or trainers' difficulty to accept e-learning methods because they might allow less interactions. The most significant barrier seems to be associated with the fact that Ophthalmology is a surgical specialty and since there should be hands-on training, e-learning does not provide any surgical option.

Discussion

This cross-sectional online survey demonstrated that there was a statistically significant increase in the use of virtual training in Ophthalmology during the COVID-19 pandemic era. Specifically, before the pandemic, ~48% of participants did not use e-learning modalities, while about 60% reported that their institutions did not provide facilities nor appropriate software for e-learning. During the pandemic, there was a switch to distance learning, with Zoom being the most preferred platform for synchronous tele-education, supporting a large number of participants and giving the ability to share content. Availability of e-learning facilities and the academic character of institutions were found to be associated with the use tele-education. However, it should be noted that although most institutions managed to maintain the teaching hours for theoretical training at a satisfactory level, the surgical training was dramatically decreased during the pandemic due to the suspension of elective surgeries in most of countries. The lack of practical training was probably the driving force behind the more negative perspectives on the quality of training during the pandemic. Therefore, we hypothesize that should this aspect be removed, the overall satisfaction of the e-learning as a training tool during the pandemic would be markedly improved.

Online learning, defined as the use of a platform to provide education over the internet, has become an increasingly popular component for education of adult learners, including medical providers [11, 12]. Most higher-learning institutions have implemented e-learning to their curriculum, since it is cost effective, accessible and flexible in terms of time and place. Two basic modules of e-learning exist; the synchronous, which requires all participants to be available at the same time, enabling communication and interaction between the educator and trainees, and the asynchronous, where participants can access educational material at any time, attending a web-based training course [12].

The pandemic has shifted attention towards virtual learning capabilities and fortunately will result in the

development and expansion of e-learning and conference ideas, software and infrastructures. As healthcare systems are set to be further stretched with the increasing burden of COVID-19, disruption of medical education is inevitable across the world and arrangements need to be made whereby residents/fellows can continue gathering clinical skills and knowledge. In this context, tele-education approaches may not only effectively address the education dilemma during the pandemic, but also lay the foundation for teaching opportunities in the future [4, 8, 13–15].

A potential positive outcome of the pandemic has been greater access to online educational platforms for participants around the world, where facilities exist. In Ophthalmology, in the majority of institutions, lectures have been rapidly converted from "face-to-face" to online video conferences, using several platforms, i.e. Zoom®, Skype for Business® and Cisco Webex®, while access to international conferences has increased, often at reduced cost, as almost all of them have moved online [16, 17]. This approach allows faculty and residents/fellows to attend at more convenient times based on their schedules. In addition, basic versions of many of these online platforms are free at the present time and allow for the participation of invited national and international speakers, with reduced costs. However, a significant and inescapable disadvantage of the shift online is the restriction of professional networking and opportunities for "in person" collaboration [16]. In addition, the most obvious barrier to the implementation of e-learning is the restricted availability of facilities in the workplace [8], as it was also shown in this survey.

An interesting point that should be commented is the significant decrease in hours spent in surgical training during the pandemic and its impact on the participants' perspectives about their institutions' teaching practices. Despite greater availability of online educational options, the decrease in direct clinical care and surgical training poses a significant educational challenge. Whilst online platforms may be sufficient for the theoretical training of residents and fellows, sound clinical practice requires patient contact, which is necessary for building an appropriate diagnostic clinical thought process. As William Osler asserted, "He who studies medicine without books sails an uncharted sea, but he who studies medicine without patients does not go to sea at all" [14]. The same applies to surgical practice. Diminished case volume, due to the suspension of elective surgeries and social distancing, has dramatically reduced the involvement of residents/fellows in the practice of surgery [4]. Even though surgical simulation, including wet labs and cataract or vitreoretinal surgical simulators, are powerful tools for supporting some educational needs, they cannot substitute for real-life surgical scenarios. Despite their promise of improved surgical education, high "observational" surgical volume and time spent on direct patient are major barriers to their widespread adoption [4].

Nevertheless, increased experiences with tele-education had positive impacts on survey respondents for their future role in Ophthalmology curricula. Approximately 83% of participants believed that the experience gained during the pandemic regarding tele-education will be used for future training in Ophthalmology, with about 30% perceiving no barriers in adopting e-learning. It is crucial that the educational community learns from the pandemic experience and prioritizes a forward thinking and scholarly approach to provide consistent and practical solutions. There is a need for an adjunct to, not a substitute for, the traditional teaching methods, and this is offered by virtual learning. Online video lectures are likely to continue after the pandemic, while online access to conferences will have a positive impact, providing increased international exposure to excellent content at reduced costs [16]. However, it should be noted that in order to ensure a valuable learning experience, quality control on content needs to be guaranteed.

Potential limitations of the study pertain to the inherent nature of survey methodology. This survey was not validated prior to its application and selection bias of participants in a non-random manner may exist. However, the survey was largely representative of physicians from all experience levels, practising in both academic and non-academic sectors, which make the results generalizable. In addition, memory bias of the participants is inevitable, since we asked them to report their practice patterns, recalling their attitudes. Nevertheless, the survey questionnaire format is an accepted approach for gathering knowledge on expert opinions, attitudes and practice patterns [9]. It is also worthy to note that this is the first study to investigate the impact of tele-education as an alternative to traditional teaching methods in Ophthalmology during a global pandemic, using an expert survey.

In conclusion, the COVID-19 pandemic presents an unprecedented challenge for education. Ophthalmology departments must develop a list of priorities based on their institutional needs to guide their decision making during these times of uncertainty. However, amidst the uncertainty, there are unique opportunities for residents and fellows to develop their knowledge. Such modalities include various tools, such as virtual meeting platforms, independent home study and surgical simulation. There is no doubt that e-learning will become the future of ophthalmic education, used as a supplement to traditional teaching, with a large number of virtual courses to be widely available to anyone with an internet connection and desire to learn worldwide. Embracing these changes will enable training programs to rise to the challenges of COVID-19 and ensure the provision of high-quality education for the future.

Summary

What was known before

- Traditional training methods in Ophthalmology included lectures, journal clubs and hands-on surgical training.

What this study adds

- The study highlights the importance of virtual learning in Ophthalmology during the COVID-19 pandemic era.

Compliance with ethical standards

Conflict of interest Irini Chatziralli reports grants and personal fees from Allergan and Novartis, personal fees from Innovis and grants from Thea Laboratories, outside the submitted work. Anat Loewenstein reports grants and personal fees from Allergan, Bayer and Novartis, grants from Multicentre Trial and Sensor and personal fees from Notal-Vision, Syneos Health, Beyeonics, Roche, Oxurion, Oculis, Pres-By, Xbran, WebMD and KHB, outside the submitted work. All other authors have nothing to disclose.

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