Overcoming barriers of retinal care delivery during a pandemic—attitudes and drivers for the implementation of digital health: a global expert survey

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ABSTRACT

Background/Aims The SARS-CoV-2 pandemic has imposed barriers to retinal care delivery worldwide. In this context, retinal services are exploring novel ways to ensure access to healthcare.

Methods We conducted a worldwide survey among retinal specialists between March 31, 2020 and April 12, 2020. The expert survey was developed on the basis of focus group discussions involving retinal specialists and literature searches. It included 44 questions on alternative ways of care provision including digital health domains such as teleophthalmology, home monitoring or decentralised patient care.

Results 214 retinal experts participated in the survey, of which 120 (56.1%) had more than 15 years of experience in ophthalmology. Most participants were clinicians (n=158, 73.9%) practising in Western Europe (n=159, 74%). In the majority of institutions, teleophthalmology, home monitoring and decentralised patient care have not been implemented before the pandemic (n=46, 21.8.1%; n=64, 29.9%; n=38, 19.1%). During the pandemic, the use of teleophthalmology and home monitoring increased significantly (n=105, p<0.001; n=90, p<0.001). In the subgroup of institutions reporting no teleophthalmology service before and implementing a service during the pandemic (34/70, 48.6%), reimbursement was the sole significant parameter (OR 9.62 (95% CI 2.42 to 38.16); p<0.001).

Conclusion Digital health is taking the centre stage tackling unpreceded challenges of retinal care delivery during the SARS-CoV-2 pandemic and may sustainably change the way we practice ophthalmology.

INTRODUCTION

In ophthalmology, the term 'digital transformation' refers to the integration of digital services into eye care structures with the purpose of increasing efficiency of healthcare delivery.[1] In retinal care, the unmet need has fostered innovative concepts and technology for care delivery prior to the SARS-CoV-2 pandemic and in some cases even led to early-stage implementations.[2–4] Nevertheless, while individual programmes may have been successful, large-scale digital transformation has faced substantial barriers including regulatory and organisational hurdles or poor acceptance by clinicians and patients.[5–7]

The international attempt to reduce SARS-CoV-2 transmission by mandated 'social distancing' prompted a restriction of face-to-face consultations, contact time and physical proximity in routine ophthalmic assessments.[8 9] Inevitably, ophthalmic institutions—impeded to deliver routine care—refuelled the discussion about alternative ways of service provision, and digital healthcare delivery has been moved to the forefront of medical practice.[10] Remote patient management systems as used by teleophthalmology or home monitoring have been proposed for the safe access and delivery of retinal care.[10 11] Teleophthalmology has been adopted for risk stratification and triage or to substitute face-to-face examinations.[12–14] In chronic retinal disease, home monitoring has been used for follow-up and reassurance of patients.[10] Finally, patient care has been decentralised to non-medical settings during the pandemic to keep patients away from crowded hospitals and clinics.[15]

By disrupting long-standing practice, this pandemic offers the unique opportunity to investigate expedited digital health transformation in challenged healthcare systems.

In this study, we therefore conducted a worldwide expert survey, involving leaders in the field of retinal diseases, to (i) investigate their attitudes towards digital health, in particular remote management systems; (ii) assess the extent to which transformations occur due to the current pandemic and (iii) explore drivers and barriers of digital health transformation.

MATERIALS AND METHODS

Survey development

This expert survey was developed on the basis of a literature review and discussions held by a focus group of 10 retina specialists. The group discussions were held remotely. Participants reviewed pertinent issues regarding the management of retinal diseases, modern ways of care delivery and their barriers, particularly in regard to digital health services. Briefly, the group reflection indicated that retinal care delivery involving digital health fell into three

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categories: teleophthalmology, home monitoring and decentralised patient care. In addition, understanding potential barriers and drivers in the context of the respective healthcare system (ie, in view of reimbursement and infrastructure) was considered important.

The group then reviewed the scientific evidence for these three domains, aiming at achieving in-depth knowledge on a more granular level about teleophthalmology, home monitoring and decentralised care.[16–19] The review revealed associated topics of teleophthalmology such as automated, remote or electronic triage, smart-history taking, virtual consultations or clinics, electronic referrals, multimodal imaging approaches as a substitute of face-to-face investigations, and automated image analysis or decision-making (ie, via artificial intelligence algorithms).[16–18 20–22] The initial survey draft was reviewed by 10 retinal specialists and was modified after being tested by 20 additional retinal specialists who volunteered to participate. The final expert survey was organised into three sections (teleophthalmology, home monitoring and other types of decentralised patient care) with a definition of the terms and illustrative examples preceding the respective subsection to ensure a common understanding of participating experts. In total, the survey comprised 44 questions including basic information on the demographics of the experts (6 questions), the institutions in which they practise ophthalmology and their infrastructure (5 questions), attitudes towards digital health (11 questions) and the impact on the implementation of digital health solutions during the pandemic (22 questions). Question types involved single-choice (21), multiple-choice 'please select all that apply' (12), Likert scales (6) and full-text answers (5). The survey was conducted in English exclusively (see online supplemental file 1).

Independent and dependent measures and variables

Independent measures involved questions on participants' demographics (ie, sex, age, country of practice, years of experience in ophthalmology, expertise and current job positions) and their respective institutions (ie, setting, health records system, state of the infrastructure, state of interdisciplinary work and reimbursement structure).

Dependent measures involved questions on (i) participants' attitudes towards digital health before and during the pandemic (ie, its usefulness, implications for future applications and barriers) and (ii) the level of implementation of digital health services in their institutions before and during the pandemic (ie, how frequent and for what purpose was/is teleophthalmology, home monitoring and other types of decentralised patient care used?). In addition, participants were asked about current practice patterns in regard to the management of retinal diseases in their institutions and about their opinion on which patients are at particular risk for permanent vision loss in case of delayed management during the pandemic.

Participant selection

From the Masterfile of the 11th Annual Congress on Controversies in Ophthalmology (Europe COPHY 2020) and the Macula Society membership directory, we aimed to identify all retinal experts defined as consultant or fellowship level knowledge on retinal disease. Additionally, retinal specialists from Asia, Africa, North America, South America, Europe and Australia were contacted by the authors of this study via their professional network. Of about 600 retinal specialists contacted in total, 214 completed the questionnaire. To calculate the overall response rate, we divided the number of completed questionnaires by the number of contacted specialists. This yielded a rough estimate of a response rate of 36%.

Survey administration

Between March 31, 2020 and April 12, 2020, experts received a cover letter and link to access the survey on Google forms via email. The anonymity of the respondents was guaranteed. Non-respondents were not contacted repeatedly. We did not offer reimbursement for participation.

Statistical analysis

Continuous variables were described using means and standard deviation (SD) and dichotomous variables with percentages. To assess the association between specialists' demographics, attitudes and characteristics of their respective institutions and reimbursement structures (independent variables) on the novel adoption of the three digital health innovations (teleophthalmology, home monitoring and decentralised patient care: dependent variables), three separate logistic regression models were fitted. Parameters with a statistically significant association with the outcome were considered. A p value of less than 5% was considered statistically significant. To assess before–after effects, we compared changes in the percentages of participants stating no activity within one of the three outcome domains (teleophthalmology, home monitoring and decentralised care) and tested changes statistically using the McNemar test. Analyses were performed using the Stata 16.1 statistics software package (StataCorp. 2019, Stata Statistical Software: Release 16. StataCorp LLC, College Station, Texas, USA).

RESULTS

Participants' demographics

Of the 214 participating experts, 97 (45.3%) were women and 1 person (0.5%) preferred not to disclose his or her gender. Most participants were older than 40 years (n=140, 65.4%). Most experts practised in Western Europe (n=152, 70.7%), followed by South America (n=15, 7%) and North Africa (n=10, 4.7%) while Australian experts were least represented (n=2, 0.9%). Most of the participants were clinicians (n=158, 73.9%) or clinical academics (n=44, 20.8%) with over 15 years of experience in ophthalmology (n=120, 56.1%). All participants had expertise in medical retina, and 123 (57.2%) reported additional expertise in vitreoretinal diseases. Neither age nor the level of experience were associated with attitudes towards digital health or the extent to which it was implemented in institutions (table 1).

Setting and infrastructure

One hundred and thirty-eight experts (64.6%) were affiliated to a tertiary care institution and 102 (47.7%) were affiliated to a secondary care institution. Most experts were able to access patient records electronically (n=151, 70.6%). On a 5-point Likert scale, the information technology infrastructure was predominantly described as average ('3': n=70, 32.7%) or good ('4': n=74, 34.6%), as was the degree of interdisciplinary work among eye care professionals ('average' n=60, 28%; 'good' n=88, 41.1%). Reimbursement of teleophthalmology services was reported by 92 participants (43%), while home monitoring and other types of decentralised patient care were reimbursed in 12 (5.6%) and 22 (10.9%) of the institution experts reported on, respectively (table 2).

Patients with retinal disease at particular risk for permanent vision loss during the pandemic

Participating retinal experts identified wet age-related macular degeneration (n=118, 84.6%), retinal detachments

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Table 1 Demographic information of experts participating in the survey

Total n=214						
Gender						
	Men 116 (54.2%)	Women 97 (45.3%)	Prefer not to say 1 (0.5%)			
Age in years						
	18–30 years 10 (4.6%)	31–40 years 64 (29.9%)	41–50 years 45 (21.1%)	51–60 years 43 (20.1%)	60–65 years 34 (15.9%)	>65 years 18 (8.4%)
Country of practice						
	Western Europe 152 (70.7%)	Eastern Europe 4 (1.9%)	United Kingdom 7 (3.3%)	United States 8 (3.7%)	Australia 2 (0.9%)	North Africa 10 (4.7%)
	South East Asia 8 (3.7%)	Middle East 5 (2.3%)	South America 15 (7%)	Other 4 (1.8%)		
Job title*	Clinician 158 (73.9%)	Clinical academic 44 (20.8%)	Purely academic 9 (4.2%)	Consultant 36 (16.8%)	Head of a department 24 (11.2%)	
Ophthalmology experience in years	<5 years 17 (7.9%)	5–10 years 43 (20.1%)	11–15 years 34 (15.9%)	>15 years 120 (56.1%)		
Expertise*	Medical retina 215 (100%)	Vitreous-retinal disease 123 (57.2%)	Uveitis 85 (39.5%)	Paediatric retinal diseases 34 (15.8%)	Retinal oncology 20 (9.3%)	

*Participants chose all answers that applied. Proportions do not add up to 100 percent.

Table 2 Information on the setting and infrastructure of survey participants' institutions

Total n=214					
Institution*	Tertiary centre 50 (23.4%)	Tertiary centre within a hospital 88 (41.2%)	Secondary care 102 (47.7%)	Academia 29 (13.6%)	
Healthcare record system	Electronic 151 (70.6%)	Paper-based 24 (11.2%)	Combined 39 (18.2%)		
State of the IT infrastructure	Very poor 8 (3.7%)	Poor 19 (8.9%)	Average 70 (32.7%)	Good 74 (34.6%)	Excellent 43 (20.1%)
Extent of interdisciplinary work	Very poor 12 (5.6%)	Poor 19 (8.9%)	Average 60 (28%)	Good 88 (41.1%)	Excellent 35 (16.4%)
Reimbursement of digital health					
Teleophthalmology	Yes 92 (43%)	No 80 (37.4%)	Don't know 42 (19.6%)		
Home monitoring	Yes 12 (5.6%)	No 159 (74.3%)	Don't know 43 (20.1%)		
Other types of decentralised patient care	Yes 22 (10.3%)	No 129 (60.3%)	Don't know 63 (29.3%)		

*Participants chose all answers that applied. Proportions do not add up to 100 percent.

(n=189, 88.3%), proliferative diabetic retinopathy (n=169, 79%), uncontrolled (posterior) uveitis (n=157, 73.4%), retinal vein occlusions with neovascularisations (n=156, 72.9%), myopic choroidal neovascularisation (n=147, 68.7%) and retinopathy of prematurity (n=114, 53.3%) as retinal diseases that may render patients particularly vulnerable to permanent vision loss during the pandemic.

Attitudes towards and opinions about digital health

Opinions on barriers before the pandemic

One hundred and fifty-three participants (71.5%) described the level of the provided infrastructure as a potential barrier for the implementation of digital health. Regarding factors that may challenge the adoption of digital health, 118 participants (55.1%) stated reimbursement, 114 (53.3%) stated patients' acceptance and 92 (43%) stated doctors' acceptance. Two participants (1%) highlighted security concerns (quality of imaging and examination). Four (1.9%) experts reported no barriers to the implementation of digital health, and 14 (6.5%) were undecided.

Attitudes towards usefulness before the pandemic

Teleophthalmology was considered 'not useful at all' (n=52, 24.3%) or 'not useful' (n=68, 31.8%) by the majority of participants before the pandemic. Home monitoring was considered useful by 125 (58.4%) participants and 27 (12.6%) were undecided. Moreover, the majority of experts described that they would feel 'not at all comfortable' (n=66, 30.8%) or 'uncomfortable' (n=59, 27.6%) to deliver decentralised patient care in non-medical settings.

Attitudes towards applications of teleophthalmology during the pandemic

If all participating experts were to use teleophthalmology, they would use it for the purposes of triaging (n=161, 75.2%), counselling (n=161, 75.2%), follow-up (n=152, 71.0%) and therapy instruction (n=150, 70.1%).

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Opinions on the robustness of newly implemented digital healthcare solutions

While exactly half of the experts were convinced that the experiences they were making with teleophthalmology during the pandemic would sustainably change the way they will deliver retinal care in the future (n=107, 50.0% for 'yes', vs n=46, 21.5% for 'no' and n=58, 27.1% for 'don't know'), this was the case for only about one-third in regard to home monitoring (n=70, 32.9% for 'yes', n=56, 26.3% for 'no' and n=84, 39.4% for 'don't know') and other types of decentralised patient care (n=63, 29.6% for 'yes', n=79, 37.1% for 'no' and n=69, 32.4% for 'don't know').

Impact of the pandemic on the implementation of digital health

Teleophthalmology

In the majority of institutions, teleophthalmology was not used before the pandemic. More particularly, smart-history taking was used by 41 (19.2%), automated imaging analysis or decision-making by 21 (9.8%), triage by 60 (28%), virtual consultations or clinics by 25 (16.4%) respectively, 33 (15.4%), electronic referrals by 57 (26.6%) and the substitution of slit-lamp examinations by 54 (25.2%).

The use of teleophthalmology was significantly increased by the pandemic (n=46 vs n=105, p<0.001, see figure 1).

Home monitoring

Most institutions performed some kind of home monitoring before the pandemic (n=168, 79.5%). Most used paper-based (n=150, 70.1%), smartphone-based (n=40, 18.7%), and few hardware-based (n=16, 7.5%) home monitoring. Hyperacuity, metamorphopsia and scotoma were the visual qualities that were most frequently monitored (n=115, 53.7%), followed by visual acuity (n=84, 39.3%) and contrast sensitivity (n=16, 7.5%). Only a minority used home monitoring of retinal anatomy (optical coherence tomography, n=17 and fundus photography n=17, 7.9%). During the pandemic, 42.1% (n=90) of the investigated institutions increased efforts to home-monitor. In 2.5% (n=5) of cases, the extent of home monitoring was decreased. Overall, the use of home monitoring was significantly increased by the pandemic (n=64 vs n=90, p<0.001, see figure 1).

Age-related macular degeneration (n=146, 68.2%), diabetic macular oedema (n=74, 34.6%) and cystoid macular oedema (n=69, 32.2%) were the most commonly monitored diseases before the pandemic.

Other types of decentralised care

In regard to other types of decentralised care, 14.6% were providing retinal care in non-medical settings (screening n=31, 14.6%; intravitreal injections n=11, 5.1%) before the pandemic. Screening efforts were slightly reduced during the pandemic (n=25, 11.7%) while decentralised intravitreal injections increased (n=15, 7.0%). Overall, decentralised care has not been significantly changed by the pandemic (N=199, n=38 vs N=198, n=37, p=1.000) (see figure 1).

Drivers for the implementation of digital health approaches

In the subgroup of institutions reporting no teleophthalmology service before the pandemic and adopting it during the pandemic (34/70, 48.6%), reimbursement was the sole significant parameter (Odds ratio (OR) 9.62 (95% confidence interval (CI) 2.42 to 38.16); p>0.001). The same analyses performed for home monitoring or decentralised care revealed no significant association with other possible barriers.

DISCUSSION

Main findings

This study found a significant increase in the implementation of teleophthalmology and home monitoring services during the SARS-CoV-2 pandemic. Of note, other types of decentralised patient care initiatives, such as intravitreal injections in non-medical settings, were infrequently adopted. The main driver for the implementation of teleophthalmology services in institutions that did not provide such service before the pandemic was reimbursement. The sceptical attitudes towards digital health found within an international group of retinal experts prior to the pandemic, however, stand in contrast to previously observed results in a general clinicians' population.[23 24]

Results in the light of the existing literature

This is the first study to investigate the impact of a global health crisis as an external disruptive force on digital health transformation in retinal care delivery. Indisputably, the SARS-CoV-2 pandemic has accelerated the transformation in a unique manner beyond previously described implementation strategies. In the United Kingdom, policymakers have even expressed enforcement discretion in regard to remote communication systems to empower healthcare providers.[25 26]

Within the three evaluated areas, retinal specialists showed the highest short-term acceptance towards teleophthalmology, followed by home monitoring. However, attitudes towards

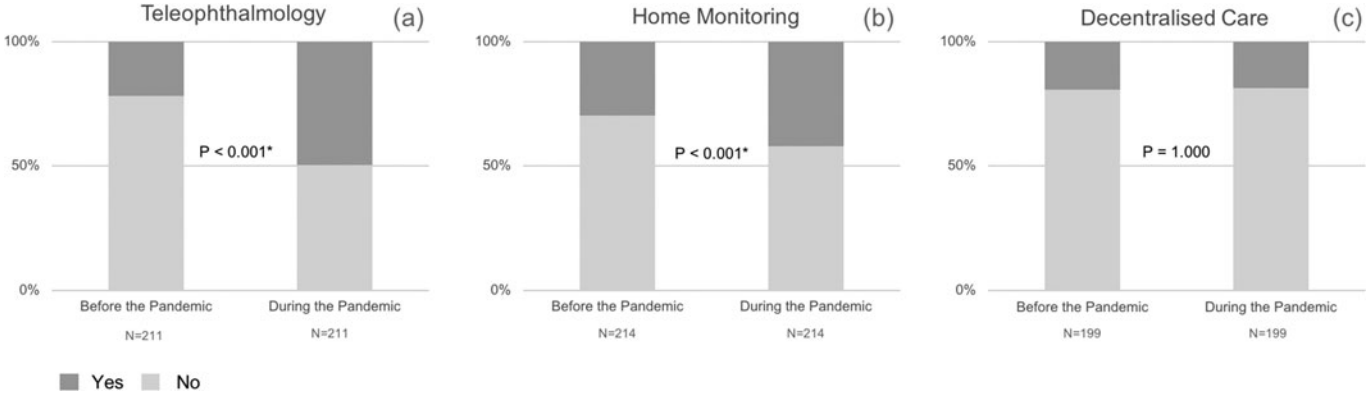

Figure 1 Comparison of the levels of implementation of teleophthalmology (A), home monitoring (B) and other types of decentralised care (C) before and during the pandemic.

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decentralizsed care initiatives remained at a low level and did not change significantly due to the pandemic. We speculate that the availability of teleophthalmology and home monitoring technology, as well as initial experience with these technologies prior to the pandemic, may have allowed for short-term introduction, while decentralised care may have encountered regulatory and procedural obstacles that are more time-consuming and complex to overcome. Regardless, the availability of a robust evidence base for digital health is necessary to build sufficient trust within the community to facilitate the implementation of digital health. Li *et al*'s study, which compared the quality of routine care with a teleophthalmology service, showed no differences in the quality of care in terms of visual acuity in patients with age-related macular degeneration.[27] For some time now, a collaborative project of the Big Picture Medical Platform with the Moorfields Eye Hospital (National Health Service Foundation Trust, London, United Kingdom) has been in progress. In preliminary analyses, the project showed significant efficiency gains in the organisation of a virtual medical retina clinic, in which mainly patients with diabetic retinopathy were treated.[17] In the field of home monitoring, the external validity of the Amsler Grid—although popular in clinic—has been questioned.[21 28] At the moment, preliminary evidence is available for two smartphone-based tests approved by the United States Food and Drug Administration, the mVT (Genentec) and Alleye (Oculocare medical).[29 30] Decentralised care of age-related macular degeneration by means of intravitreal injections at the patient's home may prevent severe deterioration of vision in patients with little access to healthcare. In many countries, however, this form of care is still prohibited for regulatory reasons. It is therefore not surprising that activity in this area was hardly affected by the SARS-CoV-2 pandemic in our survey.

Limitations

The limitations of this study included the lack of validation of the survey prior to its application, which was reflected by the occurrence of incoherent answering patterns. Second, the selection process of experts was done in a non-random manner and is therefore likely to be non-representative of the diversity of the retinal expert community worldwide. Despite this limitation, it is a frequently conducted sampling method used in social science.[31] The exclusive use of a Google product as a survey tool and the language restriction may have additionally limited representativeness. Another limitation to be considered is that we relied on participants' reports about practice patterns of their respective institutions and asked for their attitudes in retrospect (~~memory~~ bias). However, the survey questionnaire format is an accepted approach for gathering knowledge on expert opinions, attitudes and practice patterns.[32] Moreover, some of the questions bore high face validity and therefore suggestive character. Lastly, we were not able to objectively quantify the degree to which retinal care delivery has been impeded to contextualise participants' responses.[33]

Implications for research

Further studies may investigate attitudes of upcoming generations of retinal specialists towards digital health. Moreover, since this survey predominantly represents a European perspective on digital health, other geographic areas may be highlighted. With regard to a long-term perspective, robustness of newly implemented service extensions during the SARS-CoV-2 pandemic may be investigated.

Implications for practice

In Great Britain, nearly eighty percent of the consultations in ophthalmology have been cancelled during the SARS-CoV-2 pandemic.[34] This disruption of retinal care delivery has expanded on the previous unmet need in eye care. Poorly prepared care structures necessitated hasty implementations of remote management systems, which offers now the opportunity to transform them into long-term solutions. A vital driver for this transformation, as identified by this expert survey, may be the reimbursement structure acknowledging the complementary role of digital care. Moreover, transferring care closely to the patient will require additional expertise coming from other areas than medicine. The development, maintenance and evolution of telemedical services require dedicated information specialists and engineers with sufficient insight into the clinical problem. Furthermore, particularly when implementing automated systems using artificial intelligence applications, staff with sufficient insight into the development and local adaptation of these algorithms should be available.

CONCLUSION

Digital health is taking the centre stage tackling the unpreceded challenges of retinal care delivery during a pandemic and may sustainably change the way we practice ophthalmology. Short-term implementations may be transformed into permanent solutions if policymakers acknowledge their complementary role for care delivery.

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