Clinical Ophthalmology

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Urgent Virtual Eye Assessments During the COVID-19 Pandemic

Jingyi Ma, Mariam Issa, Devesh Varma, Iqbal IK Ahmed

Department of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Ontario, Canada

Correspondence: Iqbal IK Ahmed, Ophthalmology and Vision Sciences, University of Toronto, 2201 Bristol Circle, Suite 100, Oakville, Ontario, L6H 0J8, Canada, Tel +1 (905) 456-3937, Email ikeahmed@mac.com

Purpose: We aimed to evaluate the effectiveness and safety of a virtual eye assessment triage system implemented in response to COVID-19.

Patients and Methods: We conducted a retrospective cross-sectional study using a consecutive sample of all virtual assessments conducted from March 24 to June 7, 2020 at a single ophthalmology center in Toronto, ON, Canada. Visual acuity and smartphone photographs were uploaded to an electronic assessment website. All patients were virtually triaged to an email or phone consult. Patient outcomes and satisfaction were assessed with a quality assurance survey. Primary outcome measures were the incidence of unplanned additional in-person visits and changes in treatment.

Results: We performed 1535 virtual assessments. Of the triage pathways, 15% received an email consult only and 85% received a phone consult. Subsequently, 15% required an in-person assessment, 3% were referred elsewhere, and 0.1% were sent to the emergency. Presentations were most commonly cornea (52%) and retina (25%). They were non-urgent in 68% of cases and no pharmacologic treatment was required for 49%. Of 397 patients that responded out of 653 patients surveyed, 4% had an unplanned additional visit to the emergency, after which two patients underwent urgent retinal surgery and one patient underwent urgent glaucoma surgery. Two patients (0.5%) had a minor change in treatment.

Conclusion: As routine regular in-person visits were not possible during the COVID-19 lockdown, virtual eye assessments provided an opportunity to triage patients. Virtual assessments have the potential to reduce in-person visits, but caution must be exercised to not miss vision-threatening conditions.

Keywords: virtual care, telemedicine, COVID-19, medical education

Introduction

The COVID-19 global pandemic presents a challenge to current models of healthcare delivery with its strict social distancing policies and lockdown measures.[1] At its peak, transmissibility and severity of the virus were uncertain with some countries in Europe reporting alarmingly high death rates. As a result, most countries put extreme measures in place out of concern for life, especially in vulnerable populations. Non-essential services were advised to close by federal and provincial governments in Canada.[2] Over a three-month period during a strict COVID-19 lockdown, most optometry and many ophthalmology clinics were closed, while others only offered some telephone consults and/or limited hours for urgent assessments. Furthermore, due to concerns of potential COVID-19 contact, surge of sick patients, and/or reluctance of patients to venture outside, the use of hospital emergency departments (ED) was also limited.[3]

As a result, virtual eye assessments emerged to fill the gap in patient care. This rapid rise was facilitated by recommendations from the Centers for Disease Control and Prevention and the American Academy of Ophthalmology for virtual care to replace in-person visits, introduction of updated billing codes, and loosened regulations governing virtual healthcare delivery.[4]

Received: 9 January 2022
Accepted: 28 April 2022
Published: 23 June 2022

Given ophthalmologists' close proximity to patients during clinical examinations, they are at significant risk for potential SARS-CoV-2 transmission via mucous membranes.[5] To mitigate COVID-19 risk and to respond to the national lockdown, we rapidly implemented a unique virtual assessment and consult system. We developed an electronic portal for patients to request urgent consultation through submission of an online history form, visual acuity, and smartphone external eye photography. This transformed our center from traditional in-person first encounters to almost entirely virtual visits for initial triage.

Reviews on how to implement virtual visits in ophthalmology have been described, including protocols for patient screening, clinic flows, triage systems, ophthalmic equipment modifications such as slit lamp breath shields, video visits, and incorporating video conferencing into intravitreal injection clinics.[6–10] However, outcomes of these virtual systems have not yet been assessed. Furthermore, there is a paucity of reports on implementation of virtual eye care during a pandemic and lockdown. Given this, we aimed to address the following questions: 1) Are virtual care models achieving their goal of reducing in-person visits during a pandemic? and 2) Are virtual eye assessments able to catch vision-threatening conditions and provide safe patient care?

Materials and Methods

Prism Eye Institute is a large academic ophthalmology center in the Greater Toronto Area and consists of 22 eye care professionals. In response to the COVID-19 lockdown, we quickly developed a virtual eye assessment system as a triage tool to reduce in-person visits for non-urgent conditions. This portal was available for our existing patients, patients from other ophthalmology, optometry, and family doctor offices that were closed, and ED patients. At the beginning of the lockdown, all existing patients, optometry, and family doctor offices received a message that our office was closed and directed all urgent queries to the website. Educational webinars were provided on how to use the online portal to other health care providers in the early stages of implementation. For ED patients, the triage nurse offered all patients presenting with an eye concern with the option to use our online portal in lieu of waiting for an in-person assessment by the emergency physician.

Figure 1 illustrates the progression of a patient through this system. All patients submitted an online form with the following information: current eye concern, previous eye conditions and procedures, current eye drops, other general

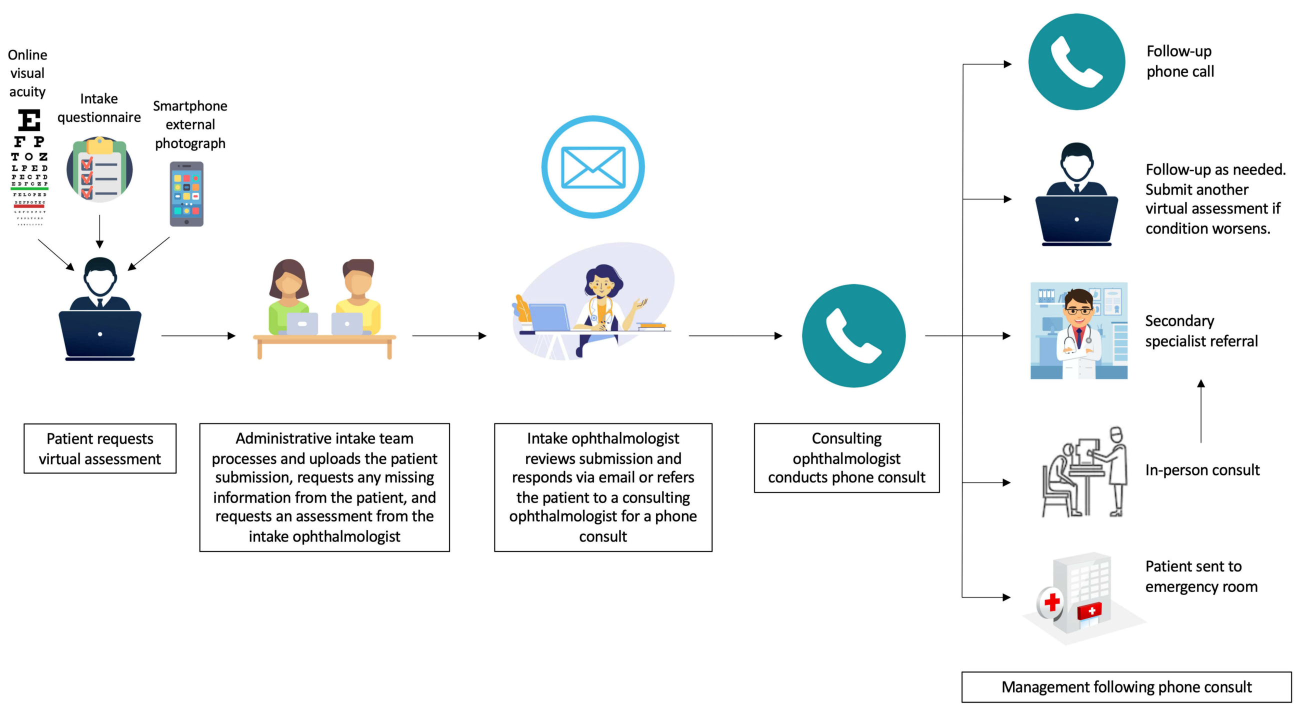

Figure 1 Patient progression through the virtual eye assessment system.

medical conditions, current medications, visual acuity using an online resource, and smartphone external eye photographs. For patients unable to submit the form themselves, a family member was recommended for assistance and our call center was available on a limited basis.

Three teams were involved in the entire process. First, an administrative intake team processed and uploaded the submission, requested any missing information from the patient, and liaised with the intake ophthalmologist. Then, the intake ophthalmologist rapidly reviewed the submission and triaged the patient to an email or phone consult based on patient symptoms described in the submission form. For example, a subconjunctival hemorrhage or a visible stye with no vision loss or pain was usually triaged to an email consult. If the intake ophthalmologist felt more details were needed for diagnosis or management, or the concern was more involved, a consulting ophthalmologist conducted a phone consult. After speaking with the patient, the consulting ophthalmologist determined the urgency based on symptoms that the patient described and decided on management over the phone, in-person, immediate assessment in the ED, or a secondary specialist referral. Depending on urgency, patients were assessed in different time frames. For example, if a patient was suspected to have potential uncontrolled intraocular pressures (IOP) or retinal detachment (RD) based on their described symptoms after the phone consult, they were seen in-person. Table S1 was used as a guidance, but the final decision was always at the consulting ophthalmologist's discretion. All patients were advised to submit another e-assessment if their condition worsened or new concerns arose. Standard COVID-19 protocols including personal protective equipment and N95 mask use were followed for patients examined in person.

This study consisted of two parts: 1) to assess the triage pathways and types of presentations of all patients; and 2) to administer a quality assurance survey to a subset of patients.

Part I: Assessing Patient Demographics, Triage Pathways, and Types of Presentations

We performed a retrospective cross-sectional study of all virtual assessments from March 24 to June 7, 2020. Patients whom we were unable to contact after 3 phone call attempts over 48 hours, who did not provide all requested information, and who received care elsewhere by the time we contacted them were excluded. The proportion of new and follow-up assessments, patients assessed in each triage pathway, urgency and type of presentation, and recommended management were documented. Common ophthalmologic presentations were classified as non-urgent, semi-urgent, and urgent based on a previously proposed system using ICD-9-CM diagnosis codes and based on clinical input from ophthalmologists (Table S1).[11] The type of presentation was categorized into cornea, glaucoma, retina, oculoplastics, pediatrics, neuro-ophthalmology, and ocular oncology.

Part II: Evaluating the Effectiveness and Safety of the Virtual Eye Clinic

We assessed the number of patients who, despite our virtual eye assessment system, went on to additional unplanned visits outside of our system and/or developed serious vision-threatening conditions that were missed. A quality assurance survey was administered to a subset of patients from April 15 to May 15, 2020 after obtaining informed consent. Patients were called at least 3 times and asked the questions in Table S2. Our primary objectives were the incidence of 1) unplanned additional in-person visits and 2) changes in treatment.

This study was submitted to the Trillium Health Partners Research Ethics Board and was determined to not be classified as human subjects research given its quality assurance nature. All guidelines outlined in the Declaration of Helsinki were followed.

Results

Part I: Patient Presentations to the Online Portal

From March 24 to June 7, 2020, 1535 virtual assessments were performed with a volume of 20–30 patients each day. Table 1 shows the demographic characteristics and initial triage pathways. The mean age was 55 years (SD 19.2, range 0–98) with the majority of patients between 50 to 70 years-old. Eighty-eight percent were new assessments and 12% were follow-up assessments from patients who submitted another e-assessment request. Of the triage pathways, 235 patients (15%) received an email consult and 1300 patients (85%) received a phone consult. Subsequent to the phone

Table 1 Demographic Characteristics and Triage Pathways

	Virtual Assessments (n=1535)
Mean age (SD), years, range	54.9 (19.2), 0–98
Female, n (%)	863 (56)
Type of virtual assessment, n (%)	
New	1352 (88)
Follow-up	183 (12)
Initial triage pathway, n (%)	
Phone consult	1300 (85)
Email consult	235 (15)

consult, 334 patients (22%) received a follow-up phone call, 233 patients (15%) were seen in-person, 47 patients (3%) were referred to another specialist (eg neurology, rheumatology) if it was felt their presentation was more in keeping with a primarily non-ophthalmological diagnosis, and 2 patients (0.1%) were sent to the ED (Table 2). One was for investigation of possible giant cell arteritis and one preferred to have removal of a corneal foreign body performed there.

Cornea/anterior segment and retina comprised almost 80% of presentations to the online portal (Table 2). Almost half did not require pharmacologic treatment, 21% were prescribed new treatment, and 15% were asked to continue present

Table 2 Types of Presentations and Management of Patients Following the Phone Consult

	Phone Calls (n=1521), n (%)
Type of presentation [a]	
Cornea and anterior segment	797 (52)
Retina	387 (25)
Oculoplastics	178 (12)
Glaucoma	152 (10)
Neuro-ophthalmology	95 (6)
Pediatrics	19 (1)
Management [b]	
No pharmacologic treatment required	755 (50)
Follow-up phone call	334 22)
New treatment prescribed	315 (21)
In-person consult	233 (15)
Continue present management or revise existing dose	227 (15)
Secondary specialist referral	47 (3)
Sent to emergency room	2 (0.1)

Notes: [a]A presenting complaint was sometimes classified under more than one sub-specialty, leading to a total percentage greater than 100%. [b]More than one management was sometimes recommended, leading to a total percentage greater than 100%.

management or to revise an existing dose. If appropriate, patients were asked to return to their own eye care provider once offices reopened. If they did not have one, an in-person appointment after the clinic re-opened was arranged for follow-up of non-urgent presentations.

Table 3 shows the distribution of cases in terms of urgency. Almost 70% of cases were non-urgent. The top five most common presentations were ocular surface disease (n=343, 23%), posterior vitreous detachment (PVD) (n=240, 16%), conjunctivitis (n=74, 5%), blepharitis (n=61, 4%), and cataract (n=60, 4%), which together comprised 75% of non-urgent assessments. All patients diagnosed with PVD virtually or in-person were educated on the signs and symptoms of an RD, asked to perform monocular occlusion testing, and to submit another e-assessment if those signs and symptoms developed. Semi-urgent and urgent presentations accounted for 17% and 15% of virtual assessments, respectively. Of the semi-urgent cases, more than half were iritis. Among the urgent assessments, neovascular glaucoma or uncontrolled IOP, suspected RD or retinal tear, suspected corneal ulcer, exudative age-related macular degeneration (AMD), paralytic strabismus, and retinal vascular occlusion were most common.

Specifically looking at retinal pathology, 27 patients (2%) had a suspected RD or retinal tear and were seen in-person. After the in-person consult, 10 patients (1%) were referred for urgent retinal detachment surgery. Eight patients (0.5%) received barrier laser for a retinal tear or hole, and 7 (0.5%) patients had a PVD. Two patients were diagnosed with other

Table 3 Five Most Common Urgent, Semi-Urgent, and Urgent Presentations. VZV, Varicella Zoster Virus; HSV, Herpes Simplex Virus

	Phone Calls (n=1521), n (%)
Non-urgent [a]	1027 (68)
Ocular surface disease/dry eye disease	343 (23)
Posterior vitreous detachment/flashes and floaters	240 (16)
Conjunctivitis	74 (5)
Blepharitis	61 (4)
Cataract	60 (4)
Semi-urgent [a]	262 (17)
Iritis	154 (10)
Vitreous hemorrhage	47 (3)
VZV ophthalmicus	29 (2)
Episcleritis	20 (1)
HSV ophthalmicus	17 (1)
Urgent [a]	232 (15)
Neovascular glaucoma or uncontrolled intraocular pressure	65 (4)
Corneal ulcer	30 (2)
Retinal detachment or retinal tear	27 (2)
Exudative age-related macular degeneration	20 (1)
Paralytic strabismus	15 (1)
Retinal vascular occlusion	15 (1)

Notes: [a]A presenting complaint was sometimes classified under more than one diagnosis, which may lead to a total percentage greater than 100%.

https://doi.org/10.2147/OPTH.S353660

retinal conditions. One had a branch retinal vein occlusion and received an intravitreal injection. The other had vitreous hemorrhage secondary to proliferative diabetic retinopathy and received pan-retinal photocoagulation laser.

Part II: Effectiveness and Safety of the Virtual Assessment System

From April 15 to May 15, 2020, all 653 patients who received a virtual assessment were called with a quality assurance questionnaire. Of those, 397 responded for a survey response rate of 61%. After receiving a virtual assessment and being recommended virtual care only, 17 patients (4%) had an unplanned additional visit to the ED (Table 4). After their visit, almost half of patients were asked to continue their present management. Three patients (1%) underwent urgent surgery, two for retinal detachment and one for glaucoma. Both RD patients were high myopes and were initially diagnosed with PVD on a phone consult only. One patient had known glaucoma and was stable on medications prior to the pandemic. He presented with eye pain after discontinuing his glaucoma drops and was told to restart them. However, he presented to the ED with persistent pain and was found to have uncontrolled high IOP, and referred back to us. Subsequently, he received an Ahmed Glaucoma Valve (AGV; New World Medical, Inc., CA) within 3 days. Two patients (0.5%) had a revised diagnosis after their in-person assessment. The presumed diagnoses and revised diagnoses were: episcleritis to scleritis, and unknown to myopia. For the 2 patients (0.5%) in whom treatment was changed, one was recommended to have intravitreal injections for exudative AMD and one was referred for elective cataract surgery.

In gauging patient satisfaction, 63% of patients were either satisfied or very satisfied with the online portal whereas 19% of patients were dissatisfied or very dissatisfied. Common reasons for dissatisfaction included the lack of a specific diagnosis over an email or phone consult for non-urgent conditions, inability to receive prompt in-person care, difficulty

Table 4 Patient Outcomes and Satisfaction with the Online Portal

	Quality Assurance Survey Responses (n=397), n (%)
Unplanned additional in-person visit to the emergency room	17 (4)
Outcome of unplanned additional in-person visit	
Surgery	3 (1)
Diagnosis changed	2 (0.5)
Treatment changed	2 (0.5)
Advised to continue present management	8 (2)
Other	2 (0.5)
Patient satisfaction level	
Very satisfied	151 (38)
Satisfied	99 (25)
Neither satisfied nor dissatisfied	58 (15)
Dissatisfied	32 (8)
Very dissatisfied	45 (11)
Where patients would have sought care if the online portal did not exist	
Emergency room	150 (38)
Another physician	162 (41)
Another online portal	15 (4)
I would not have sought care elsewhere	36 (9)

navigating the online portal, and re-entry of patient information for new assessment requests. The remaining 15% had a neutral experience. When asked where they would have sought care if the online portal did not exist, 38% indicated they would have gone to the ED and 41% indicated they would have attempted to find another clinic that was open. A minority of patients (9%) indicated they would not have sought care elsewhere.

Discussion

Virtual care may be defined as the provision of health care remotely and has the potential to overcome physical barriers to health care access through the use of electronic communication technologies.[12] Since March 2020, there has been an exponential growth in virtual care across all areas of medicine including ophthalmology.[6,7,9,10,13,14] However there is currently a lack of data on the effectiveness and safety of these systems.

To the best of our knowledge, this study is one of the first to evaluate patient outcomes from a virtual care model implemented in response to a pandemic – in this case COVID-19. The goal was to virtually triage the initial in-person contact and was not designed to replace all acute in-person consults. Patients who were felt to need an urgent in-person visit after the virtual consult were brought into clinic. Those that could be managed electively were asked to make a non-urgent appointment with their regular eye care provider once offices re-opened. With this system, we found 4% of patients had an unplanned additional in-person visit to the ED after their virtual assessment. Using patient reports as a surrogate marker, our virtual care model potentially prevented almost 40% of patients from seeking care in the ED for their initial presentation. Three patients had a major change in treatment. One required urgent glaucoma surgery, and two required urgent retinal surgery.

While tele-ophthalmology has been in place for decades prior to COVID-19, its adoption has been slow and most telemedicine visits were limited to primary care or mental health.[15] Current applications of tele-ophthalmology includes diabetic retinopathy, AMD, and retinopathy of prematurity screening with recent expansions to choroidal and iris nevi monitoring and idiopathic intracranial hypertension detection.[16–23] An economic analysis showed that tele-ophthalmology screening could save up to $48 per patient.[24] Despite these benefits, a survey of 58 ophthalmologists and ophthalmology trainees found that 71% did not use telemedicine and 59% had low confidence in using remote screening for making clinical decisions.[25] However, the COVID-19 pandemic has provided an impetus for rapid adoption and implementation of virtual healthcare delivery.

Hong Kong was one of the earliest cities to implement a combined telemedicine and in-person workflow in January 2020. During a three-month period, they maintained 80% of their outpatient service seeing over 300 patients each day with no hospital acquired infections.[26] The University of Pittsburgh also adopted virtual video visits and triaged patients into three groups: in-person visit, video visit, and rescheduled for 3–6 months.[9] In a tele-consultation practice implemented in India from March 23 to April 19, 2020, patients were triaged using a three-level protocol and almost 3000 clinical queries were addressed.[27] Similar to our findings, cornea and retina presentations were most common, and 16% of patients required further in-person evaluation. A pilot study in Chile evaluated their telemedicine model during a ten-week period amidst the pandemic, during which 291 consultations were performed.[28] They found that inflammatory conditions of the ocular surface and eyelids comprised almost 80% of their consultations, substantially higher than the 39% of assessments we performed for ocular surface disease and blepharitis. Only 7.5% of their patients required an in-person visit. Their system also demonstrated a high level of satisfaction, both among patients and providers.

One of the strengths of our virtual assessment system was the presence of a robust internal assessment and communications protocol. We created 3 teams consisting of administrative intake staff, intake ophthalmologists, and consulting ophthalmologists to ensure patients were appropriately triaged, managed, and followed up. A daily schedule was created outlining who was on each team. For a virtual assessment system to handle large volumes of patient submissions daily, it is imperative to have a robust process as the backbone. With this process in place, we served a broad population including existing patients, new patients from other ophthalmology, optometry, and family doctor offices that were closed, patients who were uncomfortable seeking in-person care, and patients presenting to the ED. Furthermore, it leveraged the universality of digital technologies such as smartphones, cameras, computers, and internet to continue providing care during a time of crisis.

Learnings from this virtual eye assessment system can be useful for potential future lockdowns. Many patients presenting to our practice are elderly and at increased risk of COVID-19 morbidity and mortality. Virtual care also relieves strain on personal protective equipment and ED personnel and resources, allowing providers in the ED to focus on more urgent patients. Furthermore, reducing hospital and emergency room traffic helps to limit the spread of COVID-19. In the future, applications of virtual care may be extended to the provision of eye care services in remote regions with limited access to eye care providers and may have the potential to complement regular in-person consultations once the pandemic is over. Particularly as health care systems transition to incorporating virtual care more permanently into daily workflows, the focus should be on ensuring sensitive systems that minimize the number of false negatives. From our experience, we recommend most patients receive at least a phone consult for diagnosis and management. Email alone may be sufficient for simple follow-up inquires or basic clinical conditions. To avoid missing potentially vision-threatening diagnoses, it is also important to have a standardized protocol for initial and repeat assessment requests. For example, all patients who were initially triaged to an email consult but subsequently re-submitted an assessment request to the portal were triaged to a phone consult by default the second time out of caution. In addition, it is important to set realistic patient expectations for virtual consults. Educational materials explaining the purpose of virtual assessments and demonstrating how to navigate them, and a more sophisticated database that stores patient information to avoid re-entry upon repeated use may result in higher patient satisfaction.

Limitations of a virtual care system includes accessibility for patients who do not know how to navigate it or do not have access to the internet and/or technologies required. For example, an online visual acuity was requested as part of the initial submission. Furthermore, virtual assessments cannot fully replace in-person examinations and missing vision-threatening diagnoses is a potential risk. From our experience, retinal concerns are the most difficult to triage so we recommend having a lower threshold for in-person consults for these cases due to the high possibility of their urgent nature. While we try to mitigate this risk by having a robust and organized triage pathway with multiple levels of assessment, suggested guidelines on urgency, appropriate follow-up, methods for patients to contact us again, and quality assurance, there is no doubt that an in-person assessment remains the gold standard. Other adverse effects of delaying care for non-urgent and elective procedures such as cataract surgery during the COVID-19 lockdown period includes progression of disease (eg glaucoma), more advanced cataracts that are more technically challenging to remove, and patients who were lost to follow-up. Unfortunately, these adverse effects plaque all medical specialties and will be a challenge for health care providers to address in the coming years.

Limitations of this study includes our survey response rate. While 61% is reasonable, patient outcomes of the other 39% are unknown. It is possible that those patients who declined participation or whom we were unable to reach had a poor experience with their virtual assessment. Furthermore, evaluation of our effectiveness and safety outcomes were primarily based on patient reports of additional in-person visits and the outcome of their in-person assessment. As a result, there may be recall bias. Lastly, patient reports of where else they would have sought care is only a surrogate measure for how effective our virtual care model was at reducing in-person visits. In reality, this number is difficult to quantify.

Conclusions

A virtual care model has the potential to mitigate COVID-19 exposure risk to healthcare providers, staff members, and patients by reducing initial in-person visits with good safety and patient satisfaction. However, caution must be exercised to not miss vision-threatening conditions, particularly those of the retinal nature. As providers become more acquainted with virtual care during the pandemic, we may observe it assuming a more permanent role in clinic work flows in the future.

Acknowledgments

Dr. Nima Noordeh, Dr. Michelle Khan, and Dr. Ronaldo Santiago for their contribution to the design of this study.

Funding

There is no funding to report.

Disclosure

Dr Iqbal Ahmed reports personal fees from Aequus, personal fees from Aerie Pharmaceuticals, personal fees from Akorn, grants, personal fees from Alcon, grants, personal fees from Allergan, personal fees from Aquea Health, Inc, personal fees from ArcScan, personal fees from Avisi, personal fees from Bausch Health, personal fees from Beaver Visitec, personal fees from Beyeonics, grants, personal fees from Bionode, personal fees from Carl Zeiss Meditec, personal fees from Centricity Vision, Inc, personal fees from CorNeat Vision, personal fees from Custom Surgical, personal fees from Elios Vision, personal fees from ElutiMed, personal fees from Equinox, personal fees from eyeFlow, Inc, personal fees from Genentech, grants, personal fees from Glaukos, personal fees from Gore, personal fees from Heine, personal fees from Heru, personal fees from Iantrek, personal fees from InjectSense, personal fees from Iridex, grants from iCare, personal fees from iStar, grants, personal fees from Ivantis, grants, personal fees from Johnson & Johnson Vision, personal fees from LayerBio, personal fees from Leica Microsystems, personal fees from Long Bridge Medical, Inc, personal fees from MicroOptx, personal fees from MST Surgical, personal fees from Myra Vision, grants, personal fees from New World Medical, personal fees from Ocular Instruments, personal fees from Ocular Therapeutix, personal fees from Oculo, personal fees from Omega Ophthalmics, personal fees from PolyActiva, personal fees from PulseMedica, personal fees from Radiance Therapeutics, Inc, personal fees from Ripple Therapeutics, personal fees from Sanoculis, grants from Santen, personal fees from Shifamed, LLC, personal fees from Sight Sciences, personal fees from Smartlens, Inc, personal fees from Stroma, personal fees from Thea Pharma, personal fees from ViaLase, personal fees from Vizzario, personal fees from VSY Biotechnology, outside the submitted work. Devesh Varma received consulting fees from Alcon and Allergan. Dr Devesh Varma received consulting fees from Alcon and Allergan, outside the submitted work. The authors report no other conflicts of interest in this work.

References

1. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet*. 2020;395(10223):470–473. doi:10.1016/S0140-6736(20)30185-9
2. Ontario. News Release: Ontario orders the mandatory closure of all non-essential workplaces to fight spread of COVID-19. Available from: https://news.ontario.ca/en/release/56435/ontario-orders-The-mandatory-closure-of-all-non-essential-workplaces-to-fight-spread-of-covid-19. Accessed June 10, 2022.
3. Jørstad ØK, Moe MC, Eriksen K, Petrovski G, Bragadóttir R. Bra- gadóttir R. coronavirus disease 2019 (COVID-19) outbreak at the department of ophthalmology, Oslo university hospital, Norway. *Acta Ophthalmol*. 2020;98(3):e388–389. doi:10.1111/aos.14426
4. Centers for Disease Control and Prevention. Get your clinic ready for coronavirus disease 2019 (COVID-19). Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinic-preparedness.html. Accessed April 18, 2020.
5. Lu CW, Liu XF, Jia ZF. 2019-nCoV transmission through the ocular surface must not be ignored. *Lancet*. 2020;395(10224):e39. doi:10.1016/S0140-6736(20)30313-5
6. Saleem S, Pasquale L, Sidoti P, Tsai J. Virtual ophthalmology: telemedicine in a covid-19 era. *Am J Ophthalmol*. 2020;216:237–242. doi:10.1016/j.ajo.2020.04.029
7. Safadi K, Kruger JM, Chowers I, et al. Ophthalmology practice during the COVID-19 pandemic. *BMJ Open Ophthalmol*. 2020;5:e000487. doi:10.1136/bmjophth-2020-000487
8. Saedon H, Gould G, Begum M, Aslam T. Video conferencing in the intravitreal injection clinic in response to the COVID-19 pandemic. *Ophthalmol Ther*. 2020;9(3):1–6. doi:10.1007/s40123-020-00262-w
9. Williams A, Kalra G, Commiskey P, et al. Ophthalmology practice during the coronavirus disease 2019 pandemic: the university of Pittsburgh experience in promoting clinic safety and embracing video visits. *Ophthalmol Ther*. 2020;9(3):1–9. doi:10.1007/s40123-020-00255-9
10. Kalra G, Williams AM, Commiskey PW, et al. Incorporating video visits into ophthalmology practice: a retrospective analysis and patient survey to assess initial experiences and patient acceptability at an Academic Eye Center. *Ophthalmol Ther*. 2020;9(3):1–14. doi:10.1007/s40123-020-00269-3
11. Stagg B, Shah M, Talwar N, et al. Factors affecting visits to the emergency department for urgent and nonurgent ocular conditions. *Ophthalmology*. 2017;124(5):720–729. doi:10.1016/j.ophtha.2016.12.039
12. Dorsey E, Topol E. State of telehealth. *N Engl J Med*. 2016;375(2):154–161. doi:10.1056/NEJMra1601705
13. Bowe T, Hunter D, Mantagos I, et al. Virtual visits in ophthalmology: timely advice for implementation during the COVID-19 public health crisis. *Telemed J E Health*. 2020;26(9):1113–1117. doi:10.1089/tmj.2020.0121
14. Scanzera A, Cole E, Valikodath N, et al. Implementation of COVID-19 protocols and tele-triage in an academic ophthalmology department. *J Acad Ophthalmol*. 2020;12(02):e151–e158. doi:10.1055/s-0040-1715807
15. Barnett ML, Ray KN, Souza J, Mehrotra A. Trends in telemedicine use in a large commercially insured population, 2005–2017. *JAMA*. 2018;320(20):2147–2149. doi:10.1001/jama.2018.12354
16. Kanjee R, Dookeran R. Tele-ophthalmology for diabetic retinopathy in Canada—meeting the needs of a growing epidemic. *Can J Ophthalmol*. 2016;51(3):133–134. doi:10.1016/j.jcjo.2016.04.004
17. Lapere S, Weis E. Tele-ophthalmology for the monitoring of choroidal and iris nevi: a pilot study. *Can J Ophthalmol*. 2018;53(5):471–473. doi:10.1016/j.jcjo.2017.11.021
18. Medert C, Lynch M, Maa A. Detection of idiopathic intracranial hypertension, enabled by tele-ophthalmology. *Can J Ophthalmol*. 2017;52(3):e117–e120. doi:10.1016/j.jcjo.2016.11.009

19. Rathi S, Tsui E, Mehta N, Zahid S, Schuman J. The Current State of Teleophthalmology in the United States. *Ophthalmology*. 2017;124 (12):1729–1734. doi:10.1016/j.ophtha.2017.05.026
20. Tozer K, Woodward M, Newman-Casey PA. Telemedicine and diabetic retinopathy: review of published screening programs. *J Endocrinol Diabetes*. 2015;2(4):1–10. doi:10.15226/2374-6890/2/4/00131
21. Owsley C, McGwin G, Lee D, et al. Diabetes eye screening in urban settings serving minority populations. *JAMA Ophthalmol*. 2015;133 (2):174–181. doi:10.1001/jamaophthalmol.2014.4652
22. Legarreta JE, Conner IP, Loewen NA, Miller KV, Wingard J. The utility of iPhone-based imaging for tele-ophthalmology in a triage capacity for emergency room consultations. *Invest Ophthalmol Vis Sci*. 2014;55:4876.
23. DeBuc D. The role of retinal imaging and portable screening devices in tele-ophthalmology applications for diabetic retinopathy management. *Curr Diab Rep*. 2016;16(12):132. doi:10.1007/s11892-016-0827-2
24. Brady C, Villanti A, Gupta O, Graham M, Sergott R. Tele-ophthalmology screening for proliferative diabetic retinopathy in urban primary care offices: an economic analysis. *Ophthalmic Surg Lasers Imaging*. 2014;45(6):556–561. doi:10.3928/23258160-20141118-11
25. Woodward M, Ple-plakon P, Blachley T, et al. Eye care providers' attitudes towards tele-ophthalmology. *Telemed J E Health*. 2015;21(4):271–273. doi:10.1089/tmj.2014.0115
26. Wong J, Shih K, Chan J, Lai J. Tele-ophthalmology amid COVID-19 pandemic—Hong Kong experience. *Graefes Arch Clin Exp Ophthalmol*. 2020;259(6). doi:10.1007/s00417-020-04753-1
27. Das AV, Rani PK, Vaddavalli PK. Tele-consultations and electronic medical records driven remote patient care: responding to the COVID-19 lockdown in India. *Indian J Ophthalmol*. 2020;68(6):1007–1012. doi:10.4103/ijo.IJO_1089_20
28. Arntz A, Khaliliyeh D, Cruzat A, et al. Open-care telemedicine in ophthalmology during the COVID-19 pandemic: a pilot study. *Arch Soc Esp Oftalmol*. 2020;95(12):586–590. doi:10.1016/j.oftal.2020.09.005