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Evidence-informed approaches to teleglaucoma in Canada

PREPARED BY THE CANADIAN GLAUCOMA SOCIETY TELEGLAUCOMA WORKING GROUP:

Stuti M. Tanya[1], Maryam Abtahi[2], Ali Hafez[3], Ken Roberts[4], Hady Saheb[3], Enitan Sogbesan[5], Steven Schendel[6], Jonathan Wong[7], and Karim F. Damji[8]

[1]Faculty of Medicine, Memorial University of Newfoundland, St. John's, NL

[2]Department of Ophthalmology, University of Ottawa, Ottawa, ON

[3]Department of Ophthalmology and Visual Sciences, McGill University, Montreal, QC

[4]Department of Ophthalmology and Visual Sciences, Dalhousie University, Fredericton, NB

[5]Department of Surgery, McMaster University, Hamilton, ON

[6]Department of Ophthalmology and Visual Sciences, University of British Columbia, Vancouver, BC

[7]Department of Surgery, Section of Ophthalmology, University of Calgary, Calgary, AB

[8]Department of Ophthalmology and Visual Sciences, University of Alberta, Edmonton, AB

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Stuti M. Tanya:

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Maryam Abtahi:

Glaukos, Novartis, Shire.

Ali Hafez:

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Ken Roberts:

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Hady Saheb:

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Enitan Sogbesan:

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Steven Schendel:

Allergan, Alcon, Bausch & Lomb, Glaukos, Labtician Thea, Novartis, Santen.

Jonathan Wong:

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Karim F. Damji:

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EXECUTIVE SUMMARY

This report provides a review of evidence-informed approaches to teleglaucoma (TG) care in Canadian contexts as of January 2021. TG is defined as a spectrum of options that adapts telemedicine approaches to enhance care for glaucoma patients (those diagnosed with as well as at risk for developing glaucoma). The objective of this document is to act as a foundation for Canadian ophthalmologists who wish to establish their own TG practice.

This work was undertaken by the Canadian Glaucoma Society Teleglaucoma Working Group, comprised of glaucoma specialists and comprehensive ophthalmologists from across the country.

Many physicians have transitioned to a partially virtual care paradigm since the onset of COVID-19. The rationale for widespread adoption of TG is three-fold. First, the demand for ophthalmic services in Canada is projected to increase with our ageing population and rising prevalence of sight-threatening conditions such as glaucoma, age-related macular degeneration, and cataract. Enhancing access to these services with a limited budget and supply of providers remains critically unresolved. Second, rural and remote communities continue to grapple with underservicing for specialist care, leading to poorer health outcomes. For many decades, health equity has been a central focus of Canadian health policy with limited progress. Third, there is a strong patient and provider preference for virtual care as it is more time- and cost-effective. Virtual care offers a feasible solution to meet the health needs of our population while allowing our health systems to optimally utilize finite resources.

This report outlines three models of care in TG with sample case scenarios and offers a template for a standardized TG setup. The models of care elaborated upon include modular extension, in-office, and collaborative.[12] These models describe how clinicians can accomplish virtual screening (including triage), consultation and monitoring of patients. Clinicians may wish to incorporate one or more elements of these models into their practice depending on their own situational context. This report also acknowledges an important gap in TG, which is the absence of gonioscopy. Clinicians should consider alternative methods to evaluate the risk of angle closure glaucoma.

This report also offers suggestions for practice patterns, outlines tools for remote assessment, summarizes licensure, medicolegal and safety considerations (including missing angle closure and other secondary glaucomas), reviews merits and challenges of TG (including the billing landscape), considers the promising future of TG, and offers suggestions on how to overcome barriers in order to optimize care for patients in the virtual environment.

COVID-19 has illuminated the ways in which limitations to virtual care have been largely self-imposed. Much of our advocacy in advancing virtual care must occur at the health systems level. We hope that this document can equip providers with the knowledge and inspiration to carve their own path in the realm of teleglaucoma and teleophthalmology at-large.

INTRODUCTION

The global COVID-19 pandemic is catalyzing our evolution towards telehealth, which has been met with success and enthusiasm by both patients and providers. Virtual clinical services are more time- and cost-efficient, improve collaboration with various care stakeholders (i.e. patients, caregivers, health professionals, and governing bodies), and democratize access to care in resource-challenged contexts.[1-2] The Canadian Medical Association (CMA), Royal College of Physicians and Surgeons of Canada, Information Technology Association of Canada, and specialty-specific and provincial/territorial organizations are accelerating their commitment to bolstering virtual care across the country.[3] Not only is telehealth critical for care provision while social distancing, but it merits warrant long-term integration in the realm of Canadian ophthalmology and glaucoma practice.

The core principles of telehealth are no different than traditional care delivery. Providers are encouraged to implement an evidence-based, patient-centred approach with optimal utilization of finite resources. All members of the care team should support the tenets of collaboration, communication, documentation, and legal considerations.

Ophthalmology is uniquely positioned to thrive in the virtual setting with advancements in biometric data and imaging acquisition that comprise the foundations of contemporary eye care. The precedent for teleophthalmology in Canada spans over two decades, with its primary applications in caring for remote and underserved patients. Imaging-based teleophthalmology screening for diabetic retinopathy (DR) and retinopathy of prematurity (ROP) has contributed substantially to improved outcomes in high-risk populations.[4-5] DR and ROP are exceptionally amenable to telemedicine since retinal imaging is typically sufficient for diagnosis. However, other sight-threatening conditions such as glaucoma and choroidal nevi can benefit from virtual care models as well.[5-6]

Glaucoma diagnosis and monitoring require structural assessment of the optic nerve through digital imaging, for example, fundus photographs and optical coherence tomography (OCT); functional assessment through visual field (VF) testing; and other ancillary tests such as angle evaluation and intraocular pressure (IOP) monitoring. These components of care can be increasingly performed as an extension, within an existing practice, or as part of a collaborative teleglaucoma model.[7] The latter builds on the 'Model of interprofessional collaboration in the care of glaucoma patients and glaucoma suspects' published by the CGS in CJO (Nov-Dec 2011;46(6 Suppl):S1-21).

This document will review current guidelines and tools to assist ophthalmologists in successfully scaling their glaucoma practice to a hybrid virtual and in-person clinical paradigm.

TERMINOLOGY

Telehealth – also referred to as virtual health, virtual care, digital health, or eHealth

An umbrella term for remote healthcare delivery that is facilitated by electronic communication technologies. This includes the notion of telemedicine as well as other aspects of healthcare delivery, such as diagnosis, management, education, and administration. Telehealth can also leverage artificial intelligence (AI) and machine learning (ML) to support diagnosis and data analytics.[4,8]

Telemedicine – also referred to as teleconsultation or eVisits

Clinical interactions between patients and providers that are facilitated by electronic communication technologies. Telemedicine can be synchronous or asynchronous. Synchronous telemedicine comprises live clinical interactions occurring in real-time via audiovisual modalities. Asynchronous telemedicine comprises the store-and-forward transmission of healthcare data whereby the provider evaluates the patient's images, texts, and/or chart information without a live clinical interaction. Instead, the clinician communicates their evaluation through an electronic medical record (EMR) portal, email, phone call, or text-based messaging in accordance with laws and regulations. The majority of teleophthalmology presently operates via the asynchronous store-and-forward model. [4,8]

Teleophthalmology

Telemedicine applied to care provision in ophthalmology.

Teleglaucoma

A spectrum of options that adapts telemedicine approaches to enhance care for glaucoma patients (those diagnosed with as well as at risk for developing glaucoma).

Telesurgery

A surgical procedure that is performed using remotely operated devices when the surgeon is not present in the operating room with the patient; this is uncommon in ocular surgery. Telesurgery can be performed in conjunction with telementoring, whereby highly specialized physicians can provide procedural guidance to less specialized physicians.[9]

Telehomecare

The use of digital technology to collect biometric data regarding a patient's health status remotely. One such example in glaucoma care would be IOP self-monitoring using a home tonometer.[3]

SUPPORT FOR OPERATIONALIZATION

Foundations of teleophthalmology

Teleophthalmology primarily deploys two broad categories of clinical equipment: data acquisition devices (i.e. imaging platforms, cameras, tonometers, visual field machines, and virtual slit-lamp) and information communications devices (i.e. computers and servers). These devices must be approved for use in a healthcare setting; there are several new tools and clinical applications for glaucoma that have not yet been validated or approved by the Food and Drug Administration (FDA) and thus should not be used for patient care.[4] It may be helpful for providers to outline how one's clinic is incorporating telehealth into their practice, including risks and benefits, on their clinic website to ensure that patients stay informed. A sample disclosure can be found in the CMA Virtual Care Playbook.[10]

Workplace setup

The CMA recommends that providers implement a dual monitor setup to ensure that the provider can see their patient's video feed and/or image(s) alongside their chart. Laptops may not be sufficient in terms of screen space, camera quality, and microphone quality. Earphones or headphones should be encouraged for both patients and providers to ensure privacy. Consider investing in document management software to securely process scanned or photographed documents such as prescriptions, incoming reports, and third-party forms.[10]

The workstation should be set up with good lighting and a neutral backdrop in a sufficiently private space such that the patient exchange cannot be seen or overheard by others. Your patient should also be in an appropriately private location. Make an active effort to engage with your patient, ensuring that your own video camera is positioned directly above your patient's video feed so that the patient knows you are looking at them. Mute all computer or mobile notifications to maintain professionalism. At the end of the visit, confirm that your patient understands the assessment and plan for care. Patient education resources and supports for digital health literacy can help to bridge gaps in the transition to virtual care.[2,10]

For clinicians who have their virtual care setup located at the clinic, it is important to ensure maintenance of physical distancing by providing adequate space as well as routine sanitization protocols, personal protective equipment, and other infection control measures.[4]

Standardized teleglaucoma set-up

There are four standard components to a comprehensive teleglaucoma practice: human resources, information technology, screening equipment, and a structured exam.[11] Human resources comprise a team that includes glaucoma specialists and comprehensive ophthalmologists, optometrists, ophthalmic technicians, primary care physicians, and nurses.[10] Information technology comprises secure software, appropriate computer hardware and an integrated service digital network (ISDN) for high-bandwidth telecommunication.[8,11] Screening equipment includes platforms for retinal, disc, and anterior chamber photography; tonometry, corneal pachymetry; slit-lamp examination; gonioscopy and equipment for diagnostic tests including perimetry and OCT.[11] A structured exam includes a medical and family history, visual acuity, pupil assessment, IOP, central corneal thickness, anterior chamber and angle assessment, fundus exam, and any ancillary tests.[11-12]

Please refer to Fig.1 for a graphic description and Appendix A for a sample template for televisits.

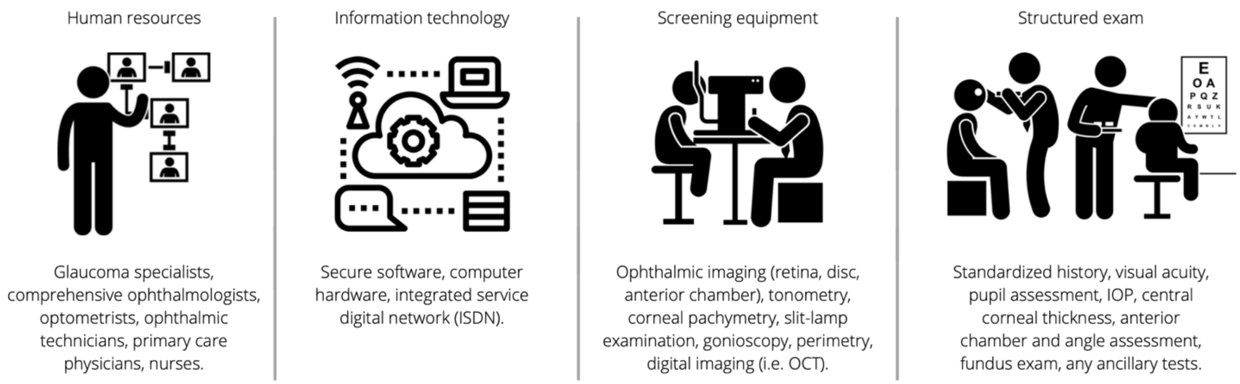

Figure 1: Components of a standardized teleglaucoma set-up.

Remote assessment tools

Smartphone media can be very helpful for teleglaucoma, particularly for post-operative triage and screening of patients in remote communities. The utility of smartphone media depends largely on image and/or video quality. Poor quality can hinder a proper diagnosis and ultimately require an in-person visit. Simple household tools such as a hand magnifier (i.e. magnifying glass or reading aid) placed in front of the camera lens can dramatically improve image quality to facilitate successful remote evaluation.[13] Patients can also be provided with an inexpensive standard macro lens (i.e. 10 diopters for orbital structures, 90 diopters for anterior segment) or custom lens adapters to provide more precise anterior segment and fundus images. Under optimal settings, smartphone imaging is almost equivalent to slit-lamp biomicroscopy in measures such as assessment of cup-to-disc ratio.[14-16] Portable smartphone ophthalmoscopes can capture retinal images that may provide sufficient information for initial triage; however, this may need to be operated by a local primary care provider rather than the patient. Mobile technology may be used for other aspects of the exam, such as visual acuity, for which there are several validated software applications available on the market.[17-18]

There are many upcoming innovations for remote assessment. Home tonometry with the iCare home tonometer (iCare, Vantaa, Finland) is already being incorporated into many practices, and self-monitoring of IOP via an implantable sensor can leverage smartphones for data collection and transmission in the near future.[15,19-21] Computer, laptop, smartphone, or tablet-based visual field screening software may be used by providers who do not have access to a perimeter and rely on confrontation visual field testing for crude assessment.[22-25] Similarly, portable virtual reality-based visual field perimeters may offer a feasible modality for screening in remote or underserved settings since they are more compact and cost-effective than traditional perimeters.[26] Online, app-based perimeters such as Peristat (Keep Your Sight Foundation, San Francisco, California, USA) may also be considered.[2] Portable, computer automated Amsler grid testing can assess scotomas and metamorphopsias.[27] Comprehensive teleophthalmology screening tools such as the GlobeChek (GlobeChek, Vero Beach, Florida, USA) kiosk are promising as well.[28] Automated triage and referral algorithms that rely primarily on clinical history may also be used for teleophthalmology in liaison with primary care providers.[29]

Smartphone media in clinical decision-making and documentation pose security and confidentiality concerns, so it is important to limit the use of unsecure or undocumented clinical media. Patient privacy and data security measures are paramount. Recommendations regarding the use of smartphone media for medical purposes include: documented informed consent, encrypted transmission via Canadian servers, omitting all identifying information from clinical media or associated messages, storing all information on a secure and password-protected computer, retaining an audit trail of media and associated messages, and implementing a thorough breach prevention and management protocol. This is not an exhaustive list, and all of these principles are relevant to broader applications of telehealth.

Other conventional digital practices such as instant message and videoconferencing software must also be configured to protect patient privacy. Email is usually not secure enough for use in patient care.[10] The CMA recommends that providers stay updated on best practices regarding the use of clinical photographs and digital technology in care provision.[30]

MODELS OF CARE

Screening (including triage), consultation, and monitoring

The applications of teleglaucoma can be divided into screening (including triage), consultation, and monitoring. These describe clinical utility– i.e. what clinicians can accomplish by adopting teleglaucoma.

Screening comprises evaluation of asymptomatic patients for early detection (secondary prevention) of glaucoma. The sensitivity and specificity of teleglaucoma-based screening are estimated to be 83.2% and 79.0%, respectively. The sensitivity and specificity are higher if patients with high-risk characteristics are screened – i.e. case finding. Screening can also be used as triage to determine which patients need to be seen in-person. Consultation refers to remote, asynchronous evaluation of patient data (i.e. history, physical exam, imaging) collected from an in-person interaction with their primary eye care provider. Monitoring refers to the provision of long-term follow-up care for glaucoma suspects or stable patients with in-person visits when necessary.[12]

Virtual care for glaucoma already exists in many practices in the form of phone, web, or video conference-based discussions in which practitioners can address patient concerns such as new symptoms, medication reactions, prescription refills, pre-operative consultation, post-operative symptoms, etc.

There are three models of care in teleglaucoma: modular extension, in-office, and collaborative.[12] These models describe how clinicians can accomplish the aforementioned components of care delivery in a virtual setting. All three models exist on a spectrum, and clinicians may need to implement different models of care in different circumstances.

Modular extension teleglaucoma model

A teleglaucoma program establishes a modular extension of regular clinic operations. This extension—also referred to as a remote kiosk or office—brings diagnostic tests and equipment to underserviced communities. It can exist as a standalone unit or an adjunct to a pre-existing general practice, pharmacy, or other health service establishment. The primary purpose of the extension is to collect patient data via tests and imaging. As such, it is staffed with trained technicians (who devote part of their time to this endeavor). The patient only sees their ophthalmologist in-person if deemed necessary, thus reducing their travel burden. For providers, this model has a greater up-front capital investment and requires training of appropriate personnel; however, the long-term costs at the health system level are much lower. Some teleophthalmology programs have used this model with success for DR, which relies on less equipment than glaucoma.[12]

Please refer to Fig. 2 for a graphic description and Appendix B for sample cases related to this model.

Figure 2: Modular extension teleglaucoma model. Multiple kiosks in different communities collect patient data and send this data to an ophthalmologist. The ophthalmologist reviews patient data within an appropriate timeframe and liaises with patients virtually. Patients do not need to see the ophthalmologist in-person unless deemed necessary.

In-office or digitally integrated teleglaucoma model

Patients visit their ophthalmology clinic for imaging and testing, which is serviced by a technician. The ophthalmologist reviews data collected from this visit and follows up with the patient virtually. This model works for patients who are able to attend a pre-existing clinic and it allows for optimal utilization of finite resources; however, it does not address disparities in rural and remote contexts. Many ophthalmology clinics adopted this model during the COVID-19 pandemic.[12]

Please refer to Fig. 3 for a graphic description and Appendix C for sample cases related to this model.

Figure 3: In-office or digitally integrated teleglaucoma model. Patients visit a pre-existing ophthalmology clinic only for data acquisition. The ophthalmologist reviews patient data within an appropriate timeframe and liaises with patients virtually. Patients do not need to see the ophthalmologist in-person unless deemed necessary.

Collaborative teleglaucoma model

Collaborative care with an interdisciplinary approach improves care delivery, access, and patient outcomes across specialties. The integration of nurses, technicians, optometrists, and ophthalmologists in a shared-care scheme has been shown to be successful for glaucoma care.[30] Interprofessional collaboration and telehealth can play a role in relieving the burgeoning human resource constraints in Canadian ophthalmology, which can subsequently contribute to improved quality of care. Guidelines and recommendations for interprofessional collaboration within the Canadian landscape are available as well. Progression analysis between providers can be maintained if the care network operates on mutually compatible infrastructure (i.e. same or interconnected technologies).[12,31-32]

Please refer to Fig. 4 for a graphic description and Appendix D for sample cases related to this model.

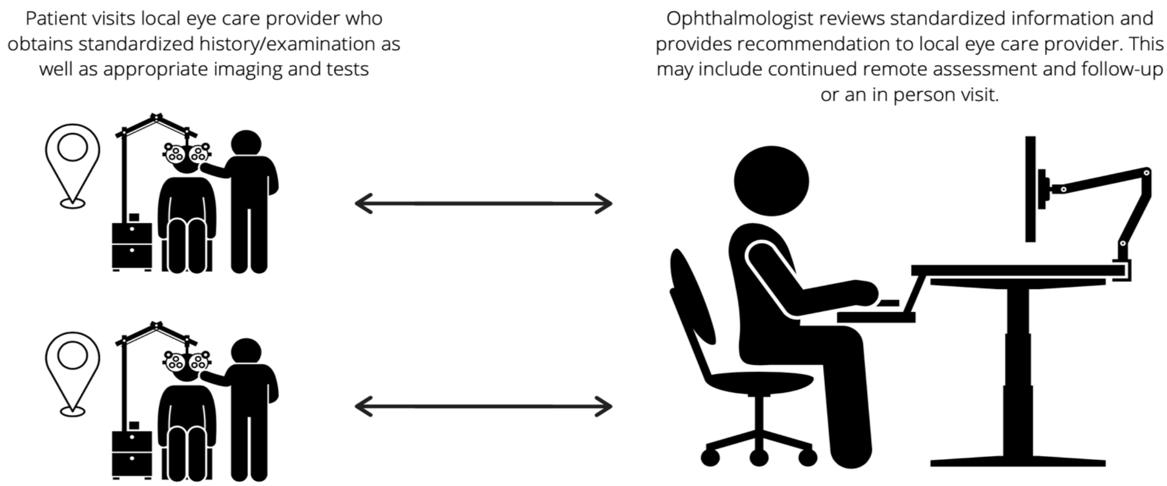

Figure 4: Collaborative teleglaucoma model. Patients visit a pre-existing eye care provider (i.e. optometrist, nurse practitioner) in their community for data acquisition. The ophthalmologist reviews patient data within appropriate timeframe and liaises with patients virtually. Patients do not need to see the ophthalmologist in-person unless deemed necessary.

Eligibility for teleglaucoma

All of the aforementioned models of care must prioritize the quality of data collection. Suspected pathology on virtual assessment must be reported in a timely fashion with verifiable transmission and receipt of next steps. Ungradable images or indeterminate biometric information should warrant a referral.[1,4,31]

EXCELLENT CANDIDATE FOR TELEGLAUCOMA	POOR CANDIDATE FOR TELEGLAUCOMA
Lower disease burden – i.e. normal, glaucoma suspect, early or moderate stage glaucoma (deemed to be low risk for progression)	Higher disease burden – i.e. high IOP, advanced or unstable glaucoma, secondary etiologies, pediatric or younger adult patients, new or significant symptoms
Stable patients requiring ongoing specialist care including refills, follow-ups, troubleshooting, and/or patient education	Emergent presentations – i.e. angle-closure glaucoma
	Significant anxiety regarding diagnosis and/or virtual care
Not currently receiving care	Limitations in access to technology or poor-quality diagnostic tests (e.g. fundus photo where nerve details cannot be well visualized)

Precedent for teleglaucoma

The infrastructure to support the widespread transition to teleglaucoma beyond COVID-19 already exists.[33] Not only does teleglaucoma allow providers to continue caring for patients while respecting social distancing, but it also eliminates redundant and unnecessary referrals to glaucoma specialists and is therefore more time- and cost-efficient.

Prior studies have shown that many patients do not require in-person consultation and can be managed remotely via distance collaboration. Some patients with definite glaucoma on virtual assessment can even be started on medications before an in-person consultation, allowing for prompt initiation of sight-saving treatment.[34] The access time (date of referral to date of booked visit) and cycle time (time of registration to time of departure) are significantly shorter for patients seen via teleglaucoma compared to an in-person consultation.[35]

For rural and Northern patients, this model also serves as an opportunity to gain access to continuity of glaucoma care.[31] Furthermore, some glaucoma specialists may even prefer grading images independently rather than in a clinical setting as it allows them the time and opportunity to perform a thorough evaluation.[36]

Digital technologies across many components of the glaucoma evaluation have been validated to uphold standard of care, such as digital imaging of the optic nerve head and portable digital retinal cameras.[37-38] Tools that are presently being validated for clinical use include digital visual function tests and perimetry facilitated by computer simulation and virtual reality.[39]

LICENSURE AND LEGAL CONSIDERATIONS

The reading ophthalmologist must meet licensure requirements in the jurisdiction in which they practice and in which the patient resides. There is significant variability across Canada for registration and licensure of out-of-province physicians practising telemedicine.[3] The reading ophthalmologist must also confirm medical malpractice liability coverage for teleophthalmology services from their insurer. Only an ophthalmologist or other approved, supervised staff can interpret patient data. Standard of care for interpretation will be that of an ophthalmologist, and the supervising ophthalmologist is ultimately responsible for all interpretation under their care. Specification of standard of care in teleglaucoma is essential as we move forward. Presently, guidelines vary by province and jurisdiction. Providers have an obligation to review local laws and medical board regulations in their own jurisdiction and that in which patient data is being acquired.[3-4]

Providers must also consider patient safety with reduced or diminishing in-person care, such as missing a critical diagnosis (i.e. angle closure glaucoma or pigment dispersion syndrome), missing disease progression in a patient who was lost to virtual follow-up, accuracy of instruments in the remote setting (i.e. non-contact tonometry), evaluation based on incomplete information (i.e. missing CCT), evaluation of complex and/or pediatric patients, and negative patient perceptions of virtual care (i.e. anxiety). Furthermore, incidental or non-glaucomatous findings that are clinically significant must be communicated to the patient and followed up or referred to an appropriate care provider. *Ultimately, virtual care is held to the same standard as in-person care, so providers must appropriately consider risks and mitigation strategies in order to have confidence in their virtual care encounters.*

Results of the telemedicine service must be communicated to the requesting provider in a timely manner (i.e. primary care physician, optometrist, or nurse practitioner) as well as the patient; failure to do so can result in adverse events or malpractice. Informed consent and patient privacy (HIPAA) fall under the physician's purview as well.[4,40] Privacy and information security are paramount.

The Canadian Medical Protective Association (CMPA) can assist with telehealth-related medicolegal matters for professional work done in Canada. CMPA cannot assist with matters that pertain to care provided outside of the country – i.e. the patient needs to have been a Canadian resident and located in Canada at the time of the encounter; however, the provider can be located outside of Canada and still be eligible for assistance. The patient and CMPA member do not necessarily need to be in the same province or jurisdiction, but it is important to note that each province or jurisdiction may have their own policies regarding licensure and practice regulations.[40]

BILLING AND REIMBURSEMENT

Provinces have their own definitions of telehealth including what constitutes an agent of care, referral, examination, consultation, and criteria for reimbursement. These definitions and applicable fee codes are evolving across the country as provincial and territorial health authorities adapt to the widespread adoption of virtual care beyond COVID-19. The tables below summarize the national billing landscape for ophthalmologic services as of January 2021. N/A indicates that this information was not available.

Eastern provinces

	NL	PE	NS	NB
PERMANENT BILLING CODES FOR TELEHEALTH CONSULTS WITH PATIENTS	Yes, pre-existing telemedicine codes available (separate from in-person; both patient and physician required to be in a hospital telemedicine unit) with addition of temporary pandemic codes	Yes, pre-existing telemedicine codes available (same as in-person) with addition of temporary pandemic codes	No, new pandemic codes are temporary (separate from in-person)	Yes, pre-existing telemedicine codes available (separate from in-person) with addition of temporary pandemic codes
TYPE OF SERVICES BETWEEN PATIENT AND PROVIDER	Consultation, reassessment	Comprehensive office visit	Management, follow-up	Comprehensive office visit
REFERRAL REQUIRED FOR PATIENT INTAKE (I.E. REIMBURSEMENT)	Yes, from physician or optometrist for first visit	Yes, from physician, resident, nurse practitioner, or optometrist	Yes, from physician, nurse practitioner, midwife, optometrist, or dentist	Yes, from physician, oral and maxillofacial surgeon, nurse practitioner, optometrist, or registered nurse who works in a pre-operative clinic
PHYSICIAN SUPERVISION REQUIRED ON-SITE FOR IMAGING/TESTS	No, medical supervision not required on-site	No, but delegated provider must be approved by Health PEI to bill for services	Yes, physician required	Yes, physician required and 50% deduction if 2+ services billed at same time
RESOURCES	COVID-19 Virtual Care Codes Update MCP Medical Payment Schedule	Health Care Providers Guide to Virtual Care MSPEI Master Agreement	MSI Physicians' Bulletins MSI Physician's Manual	COVID-19 Virtual Care Codes Update NB Physicians' Manual

Central provinces

	QC	ON
PERMANENT BILLING CODES FOR TELEHEALTH CONSULTS WITH PATIENTS	No, new pandemic codes are temporary (same as in-person) but there is a commitment to develop permanent telehealth codes	Yes, pre-existing telemedicine codes available (separate from in-person) with addition of temporary pandemic codes
TYPE OF SERVICES BETWEEN PATIENT AND PROVIDER	Consult, main visit, follow-up visit	Initial, repeat, and follow-up e-assessments
REFERRAL REQUIRED FOR PATIENT INTAKE (I.E. REIMBURSEMENT)	Yes, from physician or optometrist for first visit. Nurse practitioner approval currently in progress.	Yes, from physician, nurse practitioner, or optometrist for first visit
PHYSICIAN SUPERVISION REQUIRED ON-SITE FOR IMAGING/TESTS	No, but nursing supervision required for ophthalmic drop application	Yes, physician must supervise performance of the procedure
RESOURCES	Payment methods for medical specialists during the COVID-19 pandemic	OHIP Bulletin – March 13, 2020 ON Schedule of Benefits

Western provinces

	MB	SK	AB	BC
PERMANENT BILLING CODES FOR TELEHEALTH CONSULTS WITH PATIENTS	Yes, pre-existing telemedicine codes available (same as in-person) with addition of temporary pandemic codes	Yes, pre-existing telemedicine codes available (separate from in-person) with addition of temporary pandemic codes	Yes, virtual care codes introduced during the pandemic are permanent	Yes, pre-existing telemedicine codes available (separate from in-person) with addition of temporary pandemic codes
TYPE OF SERVICES BETWEEN PATIENT AND PROVIDER	Comprehensive assessment	Limited virtual visit, subsequent virtual visit, or virtual partial assessment	Comprehensive consultation, repeat or referred visit, focused assessment, email or telephone patient discussion	Consultation, repeat consultation, office visit, hospital visit
REFERRAL REQUIRED FOR PATIENT INTAKE (I.E. REIMBURSEMENT)	Yes, from physician, registered nurse (extended practice), or optometrist	No, but higher rates for referred consults from a physician, optometrist, chiropractor, or nurse practitioner	Yes, from physician, audiologist, midwife, chiropractor, podiatrist, dentist, optometrist, physical therapist, or nurse practitioner	Yes, from physician or optometrist
PHYSICIAN SUPERVISION REQUIRED ON-SITE FOR IMAGING/TESTS	Yes, physician required and cannot bill for two services at once	Yes, physician must be able to intervene promptly if necessary	N/A – jurisdiction of hospital/regional health authority	No, but real-time ultrasound fees may only be claimed if a physician is on site
RESOURCES	COVID-19 Virtual Care Codes MB Physicians' Manual	COVID-19 Billing Information Sheet SK Payment Schedule	AHCIP Bulletin – June 9, 2020 AHCIP Medical Governing Rules List	COVID-19 Fee Codes Update BC Payment Schedule

Territories

	YT	NT	NU
PERMANENT BILLING CODES FOR TELEHEALTH CONSULTS WITH PATIENTS	Yes, pre-existing telemedicine codes available (separate from in-person) with addition of temporary pandemic codes	N/A – telehealth is available but no further information regarding fee codes	N/A – residents can access telehealth services with facilities in Ontario, Manitoba, the Northwest Territories, and Nunavut
TYPE OF SERVICES BETWEEN PATIENT AND PROVIDER	Transmission or review (asynchronous), consultation (synchronous)	N/A	N/A
REFERRAL REQUIRED FOR PATIENT INTAKE (I.E. REIMBURSEMENT)	Yes, from a physician or health care practitioner	N/A	N/A
PHYSICIAN SUPERVISION REQUIRED ON-SITE FOR IMAGING/TESTS	Yes, the medical practitioner be physically present in the office or clinic at which the service is rendered even if otherwise occupied	N/A	N/A
RESOURCES	YT Payment Schedule	NWT Virtual Care Information	CIHI Nunavut Information

CONCLUSION

Merits of teleglaucoma

As demonstrated, the power of telehealth lies in supporting current practices to improve care delivery, access, and clinical workflows. Virtual clinics can streamline access to care in those with lower disease burden and/or patients in remote settings.[4] A 2018 study based out of the US found that telemedicine reduced in-person visits by 33% but increased total visits by over 80% over a period of 1.5 years—suggesting that virtual clinics may be the key to closing gaps in care continuity, which is especially important in caring for and monitoring patients with glaucoma.[3] There may also be benefits to telehealth on physicians' work flexibility with the option to provide virtual care from home.[10]

Thomas and colleagues' systematic review reported that teleglaucoma detects more cases of glaucoma than in-person examination. Over the span of one year within rural Alberta, teleglaucoma resulted in a 20% increase in ophthalmologist referral rate, 30% reduction in physician wait times, and 80% reduction in the cost per patient screened. Additionally, data from 37 patients over one year showed that only 4 patients required an in-person consultation, leading to a reduction in travel time of nearly 2 hours per patient or 61 hours cumulatively in the non-referred cohort. Long-term care via teleglaucoma can prevent 24% of glaucoma blindness after 30 years.[41] Thus, teleglaucoma conveys significant improvements to time, cost, and health outcomes.

More recent studies have validated individual teleglaucoma programs, demonstrating that they can be a viable alternative to clinical examination, particularly for screening and triage, with similar inter-observer agreement as compared to in-person clinical interactions.[42-43]

Challenges of teleglaucoma

The CMA has identified three main barriers to uptake of virtual care in Canada—all of which are rooted in the fragmentation of Canadian health infrastructure between and across various stakeholders. First, compensation and insurance for services across provincial and territorial boundaries remain unclear. Second, licensure restrictions across provincial and territorial boundaries limit the ability of clinicians to practice in a decentralized fashion. Third, lack of interoperability and communication between patients, providers, and health facilities makes it difficult to navigate the system and patient rosters. Variations in support for reimbursement can also be a barrier.

In the context of teleglaucoma, a standardized reporting and patient allocation protocol as outlined by Kassam and colleagues offers a sustainable solution to the problem of fragmented communication between the referring and reporting centres.[36]

Another barrier is that patients may not have the resources to connect virtually—access to high-speed internet can be challenging in remote communities and there may be socioeconomic disparities in access to technology. As part of a coordinated effort to integrate telehealth into current practice models, we must also ensure that we address barriers in access to care for our vulnerable populations. Reforms in physician payment, licensure, socioeconomic disparities, telecommunication, and health system infrastructures will be essential as we move forward in creating a sustainable hybrid model of care.[3]

Furthermore, regulatory oversight needs to include special considerations for teleophthalmology to ensure that staff involved in healthcare delivery are sufficiently trained, that all clinical equipment is validated, and that the care delivery pipeline is not privy to breaches of data privacy or medical malpractice. Many virtual modalities in teleglaucoma are new and need to be validated to ensure that patients are accessing the highest quality of care.[5] Validation will help with adoption of teleglaucoma by ophthalmologists and with the development of evidence-based reimbursement models—which, in turn, will encourage the implementation of teleglaucoma.[3-4]

Some gaps in virtual glaucoma care that may be augmented by emerging technologies include the lack of good anterior segment information which traditionally comes from the slit-lamp examination and gonioscopy. Alternative mechanisms for evaluation of risk of angle closure include Van Herick examination, anterior segment OCT, penlight, refraction, age, and ethnicity. Slit-lamp photography and anterior-segment OCT may partially be able to address these needs. The inability to develop patient rapport and trust in a virtual format may also be a barrier to teleglaucoma, although many patients and providers report great satisfaction from telemedicine and do not feel that virtual care is a detriment in this respect. Lastly, Thomas and colleagues showed that teleglaucoma may be more sensitive but less specific, leading to a potentially higher rate of false positives.[11]

Reimbursement strategies vary by jurisdiction as well. Since the onset of COVID-19, many Canadian provinces and territories have implemented temporary virtual fee codes and removed caps for virtual visits; some have implemented permanent virtual fee codes.

Future directions

The foundations for teleglaucoma have been established over the past two decades with the ophthalmic community striving towards advancing technologies for virtual care. As we evolve towards the widespread adoption of teleglaucoma in our practices, we must be mindful to implement quality assurance (QA) and quality improvement (QI) programs as part of an ongoing, iterative process to bolster quality of care.

QA and QI will be especially important in validating devices used for imaging and biometric data acquisition. Image analyses supported by AI and ML are presently used in the research setting but need to be validated for clinical use. AI and ML are particularly powerful tools for image analysis as they can enhance grading and decision-making. Characterizing the inter- and intra-reader variability of readings will be an important addition to the body of knowledge as well. The efficacy and safety of teleglaucoma need to be evaluated in the relevant clinical setting. For example, if a patient is seen in a primary care clinic for their imaging tests, then that clinic—along with its imaging devices and clinical staff—need to be assessed as part of QA/QI. All components of image acquisition, processing, and data transfer must be evaluated. QA/QI programs also need to establish thresholds for sensitivity and specificity.[4]

A comprehensive set of standards and best practices, including risk stratification tools, can help to ensure a standardized approach.[7] Economic evaluations for the cost efficacy of teleglaucoma can also inform evidence-based health policies. These evaluations should assess all aspects of telehealth to contribute to a national digital health strategy, which can facilitate the development of regulations that allow for cross-boundary patient care. Lastly, for those with an interest in global health, research on applications of teleglaucoma in international as well as local underserviced contexts should also be assessed as part of our commitment to creating sustainable and mutually beneficial global partnerships.[44-45]

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APPENDICES

Appendix A – Sample template for televisits

Pre-workup visit for Dr. ________________

Patient label

Last seen by Dr.___________ (MM/DD/YYYY): ______________
Previous visit was: ☐ Virtual ☐ In-person

☐ NEW patient, referred by: _____________________________

Check reason for visit:

☐ Glaucoma work-up (NEW)	☐ Glaucoma work-up (F/U)	☐ Cataract work-up
• BCVA & Rx glasses • Brief history (also review new patient questionnaire) • VF as per plan: ☐HVF24-2 ☐HVF10-2 ☐OVF ☐Other:________ • IOP by GAT (backup iCare) • CCT with pachymeter • OCT – anterior segment (angles) • OCT – macula & nerve • Non-mydriatic fundus photo	• BCVA & Rx glasses • Brief history • VF as per plan: ☐HVF24-2 ☐HVF10-2 ☐OVF ☐Other:_________ • IOP by GAT (backup iCare) • OCT – macula & nerve • Non-mydriatic fundus photo	• BCVA & Rx glasses • Brief history (including impact of vision difficulties on daily activities and quality of life) • AR/K • IOLMaster • A-scan OU if poor axial length measurements • IOP by tonopen or iCare; GAT if glaucoma • Non-mydriatic fundus photo

If patient needs refill on medications, please have pharmacy fax in a request to (_ _ _) _ _ _ - _ _ _ _

VA cc / sc	**OD** **OS**	**PH** **PH**	**Rx Glasses**	**OD** **OS**
IOP	**OD** **OS**	**@_____**	**CCT**	**OD** **OS**

Presenting complaints/concerns:

Medication allergies:

Relevant ocular and systemic history:

Current ocular meds:

Date of last med: _____________________

 # drops missed per week: ______________

Family history (new glaucoma):

Current systemic meds:

Physician notes:	Test done (initials)
	☐ AR/K ______ ☐ IOLMaster ______ ☐ A-scan ______ ☐ VF ______ ☐ OCT ______ ☐ Fundus photo ______

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LIST OF ABBREVIATIONS IN SAMPLE TEMPLATE

AR/K: Auto-refractor and keratometer.

BCVA: Best corrected visual acuity.

CCT: Central corneal thickness.

GAT: Goldmann applanation tonometer.

HVF: Humphrey visual field; a perimeter for visual field analysis. 24-2 and 10-2 refer to the extent of visual fields assessed.

IOL Master: Intraocular lens master; allows for measurements of eye length and surface curvature.

IOP: Intraocular pressure.

OCT: Optical coherence tomography.

OD: Right eye.

OS: Left eye.

OVF: Octopus visual field; a perimeter for visual field analysis.

PH: Pinhole visual acuity.

Rx: Prescription for eyeglasses.

VA: Visual acuity. ‘CC’ is assessment with correction, ‘SC’ is assessment without correction.

VF: Visual fields.

Appendix B – Modular extension case scenarios

The following are illustrative case examples. Each physician should utilize their judgement in deciding whether teleglaucoma is appropriate for their patient and when to see the patient in person.

SCREENING/CASE FINDING:

WH is a 62-year-old female from a remote community who has not had an eye exam in over 15 years. She has a history of diabetes and hypertension as well as a family history of glaucoma. There are no optometrists or ophthalmologists in her community, but there is a kiosk where some of her friends go for publicly insured diagnostic vision care services. She books an appointment at this kiosk and is seen within two weeks. The technician obtains a standardized ophthalmic and medical history, imaging, visual fields, optic disc photograph, and a basic evaluation including visual acuity, IOP measurement, and medication review. This appointment takes 30 minutes. Her ophthalmologist, who is located in a different part of the same province, reviews her chart and finds that she has elevated IOPs, cup-to-disc ratio of 0.9, and superior arcuate defect in both eyes. One week later, she meets with her ophthalmologist via videoconference and receives a provisional diagnosis of primary open angle glaucoma (POAG). She is started on drops and booked semi-urgently for an in-person appointment, which takes place within one month.

SCREENING/CASE FINDING:

PT is a 50-year-old Caucasian male with a family history of glaucoma. His optometrist notes that he has an IOP (by applanation) of 25 OD and 28 mmHg OS. CCT (ultrasonic pachymetry) is 610 microns OD and 630 microns OS. Angles are open and there is no evidence of features suggesting secondary glaucoma. The optic nerve appears healthy OU and the OCT RNFL and VF are unremarkable in both eyes. A virtual evaluation taking into account findings from OHTS and EGPS suggests that he is at low risk of developing glaucoma. His ophthalmologist suggests that the patient be followed annually by his optometrist, and if IOP increases above 30 mmHg and/or there are changes in structure/function testing that treatment should be initiated to lower IOP based on the Canadian target IOP guidelines.

TRIAGE:

SK is a 60-year old female patient of Asian descent who has experienced pain and reduced vision in her left eye over the past week. She has no issues with her right eye. SK is evaluated at a teleophthalmology station in her community for some initial testing. Her left eye exam reveals reduced vision (CF) and a mid-dilated pupil with an IOP of 50 mmHg. This high IOP finding triggers an urgent-evaluation process such that a phone call is made by a technician to the nearest ophthalmologist, who evaluates the patient within hours. She receives a presumptive diagnosis of angle closure glaucoma and is urgently sent to the closest urban center for further evaluation and treatment of her condition.

MONITORING:

JL is a 34-year-old male followed by his glaucoma specialist for early-onset POAG that is well-controlled on topical therapy. He is moving to a community that is approximately two hours away from his current ophthalmology clinic, but there is a teleophthalmology kiosk in the area. JL would like to continue his care with his current glaucoma specialist. JL's glaucoma specialist arranges for his routine tests and imaging to be done at his local ophthalmic kiosk, with reports provided to JL via the doctor's office and in-person appointments arranged as needed. JL and his specialist are both very happy with this arrangement as it saves them time, alleviates the travel burden, and allows for continuity of the therapeutic relationship.

CONSULTATION:

TC is an 87-year-old female with rheumatoid arthritis and progressing moderate POAG OD and severe POAG OS for 10 years. She had a tube shunt implanted (OS) two weeks ago. TC has noticed increasing redness, pain, and mildly decreased vision for the past few days. She is not able to attend to her glaucoma surgeon's office as she cannot drive and does not want to ask her son to take time off work. She lives approximately four hours away from the city. Her surgeon suggests that she attend the ophthalmic kiosk that is located at a nearby family doctor's office. She is evaluated by a technician, who immediately sends her surgeon a standardized ophthalmic and medical history, as well as high-quality photographs of her anterior segment which show corneal edema with a small hypopyon. Her vision is counting fingers. She is diagnosed with endophthalmitis and advised to be seen urgently by an ophthalmologist for appropriate treatment.

Appendix C – In-office or digitally integrated model case scenario

The following are illustrative case examples. Each physician should utilize their judgement in deciding whether teleglaucoma is appropriate for their patient and when to see the patient in person.

MONITORING:

YK is a 73-year-old male followed by his glaucoma specialist for well controlled moderate POAG OD and mild POAG OS for the last five years. He has been well controlled on a fixed combination beta-blocker prostaglandin analogue in both eyes. He is usually evaluated twice a year. Alternative visits are performed in a digitally integrated teleglaucoma model whereby YK undergoes imaging, visual fields, optic disc photograph, and a basic evaluation including visual acuity, IOP measurement, and medication review by a technician at his ophthalmologist's clinic. These results are reviewed by his glaucoma specialist at a later time point, followed by a phone call to discuss the findings.

MONITORING:

GT is a 54-year-old female followed by her glaucoma specialist for well controlled mild POAG OD and moderate POAG OS for the last 2 years. She is usually evaluated twice a year. With the onset of COVID-19, GT has been evaluated asynchronously whereby she only attends her glaucoma specialist's clinic for diagnostic testing. Her ophthalmologist evaluates her chart within one week and communicates the results to her virtually. When the state of public health emergency is over, she requests to continue being seen virtually as this method is more convenient for her.

MONITORING:

FL is a pseudophakic 87-year-old male who is followed in clinic for pseudoexfoliation glaucoma, OD greater than OS. He had been started on travoprost several years ago, with IOP as high as 21 mmHg OD and 20 mmHg OS while on treatment. His maximal IOP prior to treatment is unknown. He has been followed at six monthly intervals with HVF testing and OCT. He undergoes regular HVF testing and OCT on March 10, 2020 with a technician and is noted to have IOP of 11 mmHg OD and 13 mmHg OS by Tonopen. He does not see the physician at this visit. He is scheduled to see his ophthalmologist two weeks later for review but is unable to attend this visit due to onset of the COVID-19 pandemic. A phone call review is organized on March 30, 2020 and the ophthalmologist notes progression of a right superior arcuate defect with OCT findings that are supportive of progression. After discussion with the patient, therapy is advanced with brimonidine 0.15% BD in the right eye. Plans are made to review the IOP when safe to do so. The patient is instructed to notify the office if side-effects with the drops are noted.

Appendix D – Collaborative teleglaucoma model case scenarios

The following are illustrative case examples. Each physician should utilize their judgement in deciding whether teleglaucoma is appropriate for their patient and when to see the patient in person.

SCREENING:

MJ is a 55-year-old man who is originally from the Caribbean. He is seen by his optometrist for a routine eye examination and found to have elevated IOPs in the mid-20 mmHg range in both eyes with normal gonioscopy. He is brought back a few weeks later for more extensive testing. On this visit, his pressure is confirmed to be in the mid-20s in both eyes, a dilated examination finds thinning of the neuroretinal rim, and a reliable visual field test finds measurable scotomas in both eyes. He is diagnosed with POAG and started on topical prostaglandin drop therapy. His baseline information and his test results are sent to a consulting ophthalmologist for review. The ophthalmologist agrees with this diagnosis and management plan, and decides to see the patient in two months to review his case and response to treatment.

CONSULTATION:

WT is a 75-year-old male followed by his comprehensive ophthalmologist for moderate POAG OD, mild POAG OS for the last four years. He has been stable and well-controlled on a prostaglandin analogue OU and a fixed combination of beta-blocker/alpha-agonist OD. WT presents to his comprehensive ophthalmologist with redness, discomfort, tearing OD for one week. The ophthalmologist sends a referral letter to a glaucoma specialist with photos of the eye and everted right lower lid showing a severe follicular conjunctival reaction. The photos are transmitted virtually. The patient's chart is reviewed by the glaucoma specialist, who notes the presence of an allergic reaction OD to the fixed combination drops (likely the brimonidine component). A decision to discontinue these drops is discussed via telephone with the referring ophthalmologist. The patient is also booked for selective laser trabeculoplasty (SLT) OD and re-assessed on the same day before the laser treatment.

CONSULTATION:

GR is an 82-year-old male followed by his comprehensive ophthalmologist and was referred for unstable glaucoma from another city within the same province. The referral letter includes the patient's visual acuity, pressure, slit lamp, and gonioscopy exams. It also contains the visual fields with trend-based progression analysis and OCT. The consult and pre-operative visits are performed virtually in a teleglaucoma model and confirm progression OD. Risks and benefits of surgical options are discussed with the patient. Considering limitations with commuting to an in-person appointment as well as GR's age, the procedure is decided upon virtually. GR is then booked for the surgery and seen in-person the day before surgery.

MONITORING:

SH is a 62-year-old female followed by her optometrist for suspicion of NTG OU over the past 3 years. She is evaluated twice a year and the referral letter includes her visual acuity, IOP, slit lamp, and gonioscopy exams. It also contains disc photos, 24-2 HVF with GPA, and imaging by OCT for ONH and GCC with progression report, all transmitted virtually. These results are reviewed by a glaucoma specialist. The findings suggest a diagnosis of NTG OU with confirmed progression OD; however, the ophthalmologist is not sure that a thorough history had been taken and asks the optometrist to check at the next visit if there had been a history of trauma, steroid use, blood loss, and/or migraine. The optometrist is also asked to send the results of an Ishihara colour test for each eye and the findings from an office hours diurnal pressure check (with IOP measured at 9am, 11am, 1pm and 3pm). The diagnosis of NTG is confirmed and it is recommended that treatment be initiated with medication—or, if the patient desires SLT, then they may be booked for this within two months.

MONITORING:

KM is a 70-year-old woman with a diagnosis of POAG. She has been stable and has been monitored by her optometrist. At her most recent examination, the optometrist suspects there may be some progression of her visual field—although the IOP, optic nerve, and OCT RNFL seem stable. The information is relayed to a consulting ophthalmologist digitally. The ophthalmologist reviews the information, including ancillary testing, and recommends that KM be reassessed by the optometrist in four months for repeat visual field testing in order to determine whether progression can be confirmed.

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