

# Retrospective analysis of ophthalmology referrals during the COVID-19 pandemic compared to prepandemic



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**Objective:** This study was conducted to analyse emergency ophthalmology referrals to a Canadian tertiary academic centre during the current coronavirus disease 2019 (COVID-19) pandemic in comparison to prepandemic referrals.

**Design:** This was a retrospective chart review looking at emergency referrals seen by the ophthalmology service between March 18 to April 17, 2020 (representing the COVID-19 period), and March 18 to April 17, 2019 (representing the pre-COVID-19 period).

**Methods:** Data gathered from referral records included patient demographics, timing and site of referral, and ophthalmic diagnosis. Referrals were categorized as urgent or nonurgent, with urgent indicating the need for ophthalmic assessment within 24 hours.

**Results:** The total number of referrals decreased by 54.2% in the COVID-19 period versus the pre-COVID-19 period. There was a similar bimodal age distribution in both periods, with fewer patients over 65 years of age presenting during the pandemic. Tertiary hospital referrals decreased by 62% in the pandemic period, while nontertiary emergency department referral trends varied and outpatient clinic referrals increased by 16%. Overall, there was a significant shift in the distribution of referral sites ( $p = 0.04$ ). The proportion of urgent referrals increased by 14% during the pandemic; this was not statistically significant. There was no significant change in the timing of referrals or in the distribution of diagnostic segments.

**Conclusions:** This study offers insight into the impact of the COVID-19 pandemic on ophthalmology referral patterns in a Canadian context. Moving forward, it helps to guide resource allocation and public education on the importance of seeking necessary eye care.

**Objectif:** Cette étude s'est penchée sur le nombre de patients qui ont été orientés vers les services d'ophtalmologie d'urgence d'un centre hospitalier universitaire de soins tertiaires au Canada pendant la pandémie de maladie à coronavirus 2019 (COVID-19) actuelle, comparativement au nombre de patients qui ont été orientés de la même façon avant la pandémie.

**Nature:** Il s'agissait d'un examen rétrospectif des dossiers médicaux de patients qui ont été adressés d'urgence et examinés par le service d'ophtalmologie du 18 mars au 17 avril 2020 (soit la période COVID-19) et du 18 mars au 17 avril 2019 (soit la période pré-COVID-19).

**Méthodes:** Les données tirées des dossiers comprenaient les caractéristiques démographiques des patients, le moment et l'endroit où ils ont été adressés au service d'ophtalmologie ainsi que le diagnostic ophtalmologique. Les patients ont été classés en fonction du caractère d'urgence de leur état : un état urgent correspondait à la nécessité de réaliser un examen ophtalmologique dans les 24 heures.

**Résultats:** Le nombre total de patients ainsi adressés a baissé de 54,2 % pendant la période COVID-19, comparativement à la période pré-COVID-19. On a noté une distribution bimodale similaire quant à l'âge des patients pendant les 2 périodes : moins de patients de plus de 65 ans ont été orientés vers un service de soins d'urgence pendant la pandémie. Le nombre de patients adressés à des hôpitaux de soins tertiaires a baissé de 62 % pendant la période COVID-19. Par ailleurs, on note que le nombre de patients orientés vers un service de soins d'urgence non tertiaires variait et que le nombre de patients adressés à des cliniques externes a augmenté de 16 %. Dans l'ensemble, on a enregistré une variation significative de la distribution des centres vers lesquels les patients étaient orientés ( $p = 0,04$ ). La proportion de patients adressés d'urgence a augmenté de 14 % pendant la pandémie, ce qui n'était pas statistiquement significatif. On n'a pas non plus enregistré de modification significative au chapitre du moment auquel les patients étaient adressés, ni en ce qui a trait à la distribution des segments diagnostiques.

**Conclusions:** La présente étude donne un aperçu des répercussions de la pandémie de COVID-19 sur la façon dont les patients ont été adressés à des services d'ophtalmologie au Canada, et ses résultats permettront d'orienter l'allocation des ressources et de sensibiliser le public sur l'importance d'obtenir des soins oculaires quand le besoin s'en fait sentir.

The Vancouver General Hospital (VGH) Eye Care Centre provides a busy ophthalmic service to a large metropolitan centre. During the current coronavirus disease 2019 (COVID-19) pandemic, the on-call ophthalmology team has continued to cover emergency referrals for inpatients and outpatients from Vancouver Coastal Health Authority sites: Vancouver General Hospital, University of British Columbia Hospital, Richmond General Hospital, and Whistler Health Care Centre.

There have been few studies up to this point examining changes brought about by the COVID-19 pandemic to ophthalmic emergency referral patterns, epidemiology of urgent ophthalmic diseases, and demographics. One large eye hospital in China reported that during the pandemic, the no-show rate for outpatient ophthalmology appointments increased from 13% to 33%; there was also a 30% reduction in the 13 000 monthly patients seen in the hospital.<sup>1</sup> Another study out of a university hospital in Bologna, Italy, found a 73% decrease in the number of ophthalmological emergency department (ED) visits during the COVID-19 lockdown.<sup>2</sup>

This paper is an epidemiological study that aims to determine the impact of the COVID-19 pandemic on the incidence and distribution of ophthalmic emergencies in Vancouver. We hypothesized that there would be fewer referrals during COVID-19 but an increased proportion of urgent ophthalmic conditions as compared with before the pandemic. Our goal was to appreciate the effects of the pandemic on the public's willingness to seek eye care, which would then help inform our triaging practices.

## Methods

### Study Design

This study was a retrospective chart review of emergency referrals seen by the on-call ophthalmology service at the VGH Eye Care Centre. Approval for the study was obtained by the University of British Columbia Research Ethics Board. Data was then gathered from the electronic medical records of all emergency referrals seen during 2 discrete periods: March 18 to April 17, 2020 (corresponding to the onset of heightened COVID-19 service lockdowns in our region) and March 18 to April 17, 2019 (representing the prepandemic study period). The same calendrical date range from 2019 was selected as the pre-COVID-19 study period to account for potential seasonal variation in emergency referrals.

### Patient population

Patients first presented to referral sites for evaluation. Their cases were discussed by a referring physician with a resident ophthalmologist prior to acceptance for consultation.

Data extracted from referral records included patient age and sex, referring site, timing of presentation by day of the week and time of ED arrival, and ophthalmic diagnosis. Based on the ophthalmic diagnosis, referrals were categorized as either urgent or nonurgent. We defined an urgent

referral as one requiring ophthalmic assessment within 24 hours of presentation to the referring site.

Diagnoses were classified as urgent based on practice patterns at our centre in addition to guidelines from other academic centres and ophthalmology societies.<sup>3–6</sup>

To determine if the categorical distribution of patients who presented from March 18 to April 17, 2020 varied from what was expected, a  $\chi^2$ -square test was performed on eligible data. Where this analysis was not possible, a Student *t* test was used. Both 2019 and 2020 data were used to generate the expected distributions in these analyses to account for differences in sample size between the years, while 2020 data accounted for the observed distributions. Normality of the data was assessed with the Kolmogorov-Smirnov test. Statistical significance was set at  $p < 0.05$ . Statistical analysis was conducted using R statistical software.

## Results

A total of 379 charts were reviewed over the 2 study periods. From March 18 to April 17, 2020, we received 119 emergency referrals, which by comparison with March 18 to April 17, 2019 (260 emergency referrals), represents a 54.2% decrease. Referral data such as time of arrival to the ED or referring site was not available for certain patients and in those instances could not be included in the respective data analyses. Sixteen of the referrals in 2019 and 5 of the referrals in 2020 did not present to our clinic for assessment and could not be reached for rescheduling; these were labelled as “no-show” and were not included in the statistical analyses for ophthalmic diagnosis. The no-show rate did not change significantly over the 2 time periods (6.1% in 2019 and 4.2% in 2020). All data was found to be normally distributed.

### Patient demographics

Patient age was categorized by decade. The 61-to-70-year age group was the most common to present in both 2019 (21.6%) and 2020 (23.7%). Overall, there was a bimodal distribution of ages in the same pattern in both years, without a statistically significant difference between the age groups. Male patients made up a slightly higher proportion of referrals in 2020 (58.0% vs 42.0% female), and there was no significant change in sex distribution between 2019 and 2020 (Fig. 1).

### Referral sites

Referral sites in our study comprised 1 tertiary care centre (VGH), several nontertiary emergency departments (University of British Columbia Hospital, Richmond General Hospital, Whistler Urgent Care Centre), and various outpatient community clinics in British Columbia. This catchment area included over 1 million patients, all of whom were covered under the provincial public health insurance plan titled the Medical Services Plan.

Between 2019 and 2020, tertiary hospital referrals decreased by 62%. Nontertiary hospital referrals

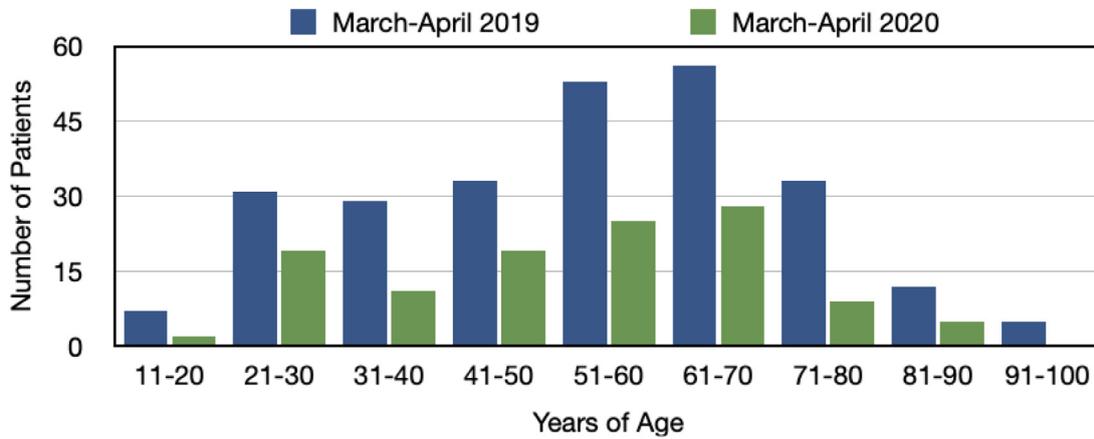


Fig. 1—Age distribution of emergency referrals presenting to the Vancouver General Hospital Eye Care Centre in 2019 versus 2020.

demonstrated different trends: referrals from the UBC Hospital ED declined by 63.6%, referrals from Whistler Urgent Care ED were unchanged, and referrals from Richmond Hospital ED increased by 66.7%. Outpatient clinic referrals increased by 16%. Our analysis found a significant change in the distribution of referral sites from the prepandemic to pandemic period ( $p = 0.04$ ) (Fig. 2).

**Urgency**

In 2019, 38.5% ( $n = 94$ ) of referrals were considered urgent. The proportion of urgent referrals rose to 43.9% ( $n = 50$ ) in 2020. This represented a 14% increase of the

proportion of urgent referrals in the pandemic period, but this was not found to be statistically significant ( $p = 0.87$ ).

**Timing and modality of presentations**

During the pandemic, most referrals presented during weekdays (80.7%) between 1200 to 1759 hours (41.0%); this was not significantly different from the same period prepandemic ( $p = 0.91$ ). No (0%) consults were seen directly via telehealth in the 2019 period, 9 (7.6%) patients were seen via telehealth in the 2020 period ( $p < 0.0001$ ). Two (22%) of these consults were from a rural community, and 1 (11%) was from an inpatient setting at a tertiary hospital;

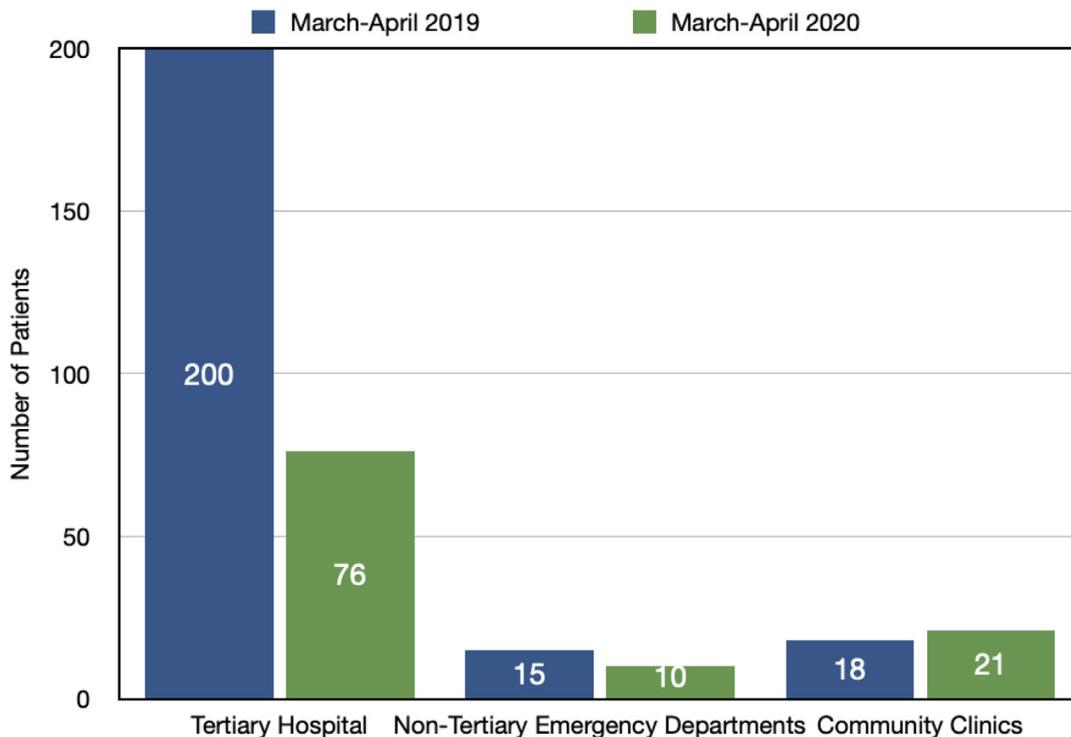
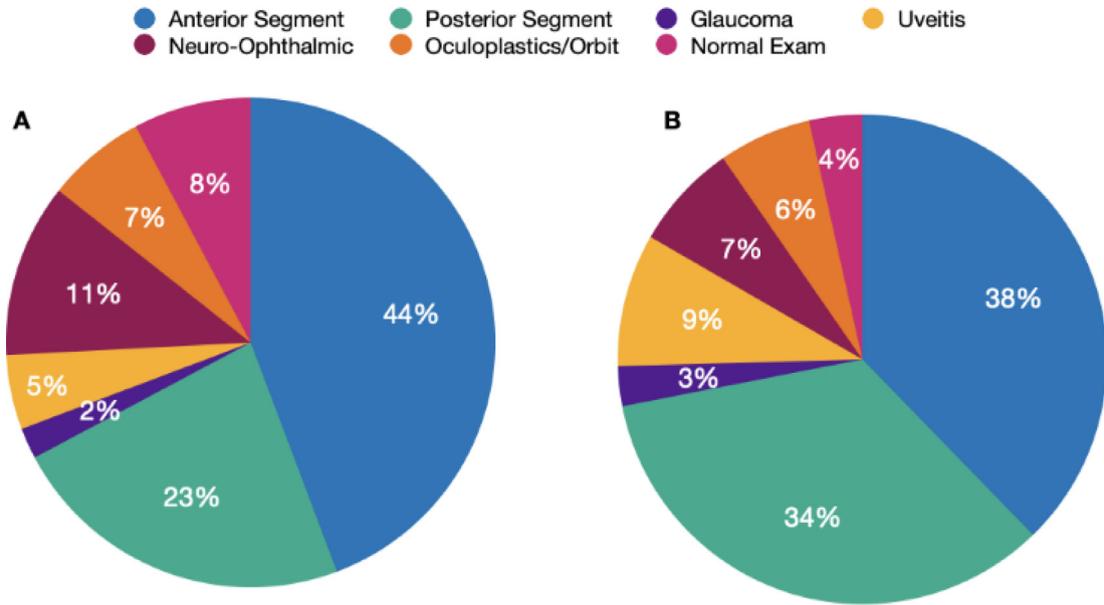


Fig. 2—Distribution of referral sites to Vancouver General Hospital Eye Care Centre in 2019 versus 2020.



**Fig. 3—Distribution of emergency referrals to the Vancouver General Hospital Eye Care Centre in 2019 versus 2020, categorized by diagnostic segment.**

the rest of the consults were from community hospitals or clinics.

**Diagnostic segments**

Diagnostic categories were adapted from Alangh et al.<sup>7</sup> There was no significant difference between the distribution of diagnostic segments in 2019 and 2020 ( $p = 0.92$ ). Anterior segment pathologies represented the most common category in both 2019 and 2020 (Fig. 3). A breakdown of the most common diagnoses within each diagnostic category is represented in Table 1 for 2019 and in Table 2 for 2020.

**Table 1—Most common diagnoses in 2019**

Category	Diagnosis (Percent Total in 2019)
Anterior segment	Dry eye/blepharitis (6.1)
	Corneal abrasion (5.7)
	Subconjunctival hemorrhage (3.7)
	Herpetic keratoconjunctivitis (3.3)
Glaucoma	Viral conjunctivitis (2.5)
	Acute angle closure (1.6)
	Glaucoma, not specified (0.4)
Neuro-ophthalmic	Migraine visual equivalent (2.9)
	Optic neuritis (2.0)
	Amaurosis fugax (1.6)
	Decreased vision, unspecified (0.8)
Oculoplastics	Cranial nerve palsy (0.8)
	Orbital wall fracture (1.2)
	Periorbital haematoma (1.2)
Posterior segment	Posterior vitreous detachment (5.3)
	Vitreous syneresis (2.9)
	Retinal vein occlusion (1.6)
	Vitreous hemorrhage (1.6)
Refractive and cataract	Cataract (0.4)
	Postrefractive surgery change (0.4)
	Presbyopia (0.4)
	Anterior uveitis (3.3)
Uveitis	Herpetic related (1.2)
	Posterior uveitis (0.4)

**Discussion**

There is currently a relative lack of epidemiological data regarding how the COVID-19 pandemic has affected ophthalmic emergency presentations and referral patterns in Canada and across the world. Characterizing the nature of ophthalmology referrals at a tertiary care centre under a single-payer health-care system is of value for the purpose of heightened preparedness during the pandemic and for establishing appropriate triaging protocols.

Of note, there was a 54.2% decrease in emergency ophthalmic referrals during the COVID-19 period. This likely reflects patient concerns of heightened transmission risk in hospitals and clinics. Interestingly, however, while the number of patients referred from tertiary care centres known to

**Table 2—Most common diagnoses in 2020**

Category	Diagnosis (Percent Total in 2020)
Anterior segment	Corneal abrasion (7.0)
	Herpetic keratoconjunctivitis (5.3)
	Dry eyes/blepharitis (3.5)
Glaucoma	Hyphema/microhyphema (2.6)
	Neovascular glaucoma (1.8)
	Acute angle closure (0.9)
Neuro-ophthalmic	Optic neuritis (1.8)
	Cranial nerve palsy (1.8)
Oculoplastics	Facial burns (1.8)
	Orbital wall fractures (0.9)
	Orbital foreign body (0.9)
Posterior segment	Lid laceration (0.9)
	Posterior vitreous detachment (11.4)
	Diabetic retinopathy (3.5)
	Vitreous syneresis (2.6)
	Hemorrhagic posterior vitreous detachment (2.6)
Refractive and cataract	Retinal vein occlusion (2.6)
	High myopia (0.9)
	Refractive monocular diplopia (0.9)
Uveitis	Anterior uveitis (5.3)
	Herpetic related (3.5)

be COVID treatment “hot spots” (i.e., Vancouver General Hospital) declined significantly, patients from other community hospitals known to have significantly less COVID exposure (i.e., Richmond General Hospital) did not experience the same drop. In addition, there was a significant increase in patients referred from non-ED outpatient clinics, suggesting that patients were looking for avenues other than EDs to seek the care they needed.

We had hypothesized that patients of older age would present less frequently with eye complaints owing to the higher risk of COVID-19 complications in those age groups. Indeed, the percent of patients aged 65 years and older comprised 30.1% in 2019 but decreased to 25.4% during the pandemic. However, this trend of lower numbers of older patients during the pandemic did not reach significance, possibly owing to data from only 1 month. On the other hand, our data would suggest that the number of patients presenting to the ED with eye complaints was reduced similarly across all age groups, possibly indicating that all patients were similarly hesitant about the risk of contracting COVID-19 in hospital EDs. Additionally, some of the most urgent diagnoses are more common in older patients and result in marked visual impairment (e.g., neovascular glaucoma, retinal vessel occlusions, and cranial neuropathies), therefore motivating these patients to present to hospital.

We hypothesized that there would be a relative increase during times thought to be less crowded during the pandemic (overnight hours or first thing in the morning), but there was no statistically significant shift in this regard. This may be due to overall less crowding of the EDs during COVID-19. Additionally, the baseline distribution of “busy” hours in EDs was likely shifted owing to altered working hours for a larger proportion of patients working from home and self-isolating during the pandemic.

We had hypothesized that the number of urgent referrals would be similar between 2019 and 2020 whereas the number of nonurgent referrals would diminish. What we saw instead, however, was that both urgent and nonurgent referrals decreased in similar fashion; there was a trend toward a greater decrease in nonurgent referrals, but this was not statistically significant. One concern relating to this overall decrease in urgent presentations would be that patients with significant pathologies did not present in a timely fashion, and it remains to be seen what the sequelae of this delay will be for the individual patients and for the population.

Further insight into the epidemiological trends in emergent ophthalmic care associated with the initial wave of the COVID-19 pandemic can be derived from European publications on this topic. These studies found a 65% to 73% decrease in the number of ophthalmic emergencies in 2020 in comparison to a comparable period.<sup>8–10</sup> Comparatively emergent diagnoses were agreed to have increased by 7.4 to 11 percentage points whereas those that were comparatively less emergent decreased by 8.6 to 14.1 percentage points.<sup>8,9</sup> These findings were in line with those found by the current study, as would be expected from studies

carried out in similar public health-care institutions in the midst of the pandemic.

The most notable limitation of this study is that it is retrospective in nature; hence, it lacks the design and data on confounding factors to most accurately characterise ophthalmic referrals. Another limitation is that this is a relatively small sample size, looking at 1 month for each period compared, and hence with a larger data pool, more power can be applied to our statistical analyses. Furthermore, we only looked at the very beginning of lockdowns during the first wave. Population behaviour and public health guidance all experienced dramatic shifts in the subsequent months.

This study provides data comparing the most commonly referred ophthalmic pathologies to the on-call ophthalmology service at the VGH Eye Care Centre before and during the COVID-19 pandemic. Information gleaned from this study offers insight into how this pandemic has affected referral patterns to ophthalmology. Knowledge regarding the most common presentation to our ophthalmic department during the current pandemic will aid our department in better preparedness moving forward. The steep drop in eye-related visits was likely a result of pandemic lockdown and care-avoidance behaviour, so 1 potential area of improvement may be further increased utilization of telehealth in ophthalmic triage to counteract this effect. This shift to teleophthalmology has been seen and explored further in depth in other eye care institutions such as Moorfields Eye Hospital.<sup>11</sup>

Another area of improvement could be increasing access for community clinicians to arrange expedited ophthalmic referrals. For example, a rapid access clinic at the teaching hospital will help patients bypass the ED and reduce risk of exposure. It would be of utmost importance to continue to find ways to educate the public as well as primary health-care providers as to which eye conditions are considered urgent and thus needing immediate attention, even in the midst of a pandemic.

During a pandemic lockdown, it appears that all patients, both with urgent and nonurgent eye complaints, stayed away from EDs. It is key to note that there was a trend toward a rise in the percentage composition of urgent consults. In addition, the notable decrease in urgent consults from tertiary EDs and corresponding increase in number of presentations from non-ED sites may suggest that there was a shift in burden and distribution of ophthalmic disease during the early stages of the pandemic. As such, it is paramount for ophthalmologists across Canada to increase awareness and to improve accessibility to eye care for patients during similar scenarios in the future.

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## Footnotes and Disclosure

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The authors have no proprietary or commercial interest in any materials discussed in this article.

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