



## Teleophthalmology Implementation during COVID-19 Pandemic: Experience in Mexico City

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### Abstract

**Background:** Teleophthalmology (TO) is a fundamental tool to continue eye care delivery during the COVID-19 pandemic. TO programs allow follow-up of patients with chronic eye conditions, postoperative follow-up, triage, and referral of emergency conditions. Given the high risk of infection associated with ophthalmic examinations, TO enables safe and satisfactory interactions between patients and health care providers.

**Methods:** We conducted a cross-sectional study to evaluate a TO program implemented in Mexico City, between April 1<sup>st</sup>, 2020, and June 15<sup>th</sup>, 2020. TO consults were offered via telephone and video visits. The program included tele-triage and follow-up consultations. Patients meeting referral criteria for emergency face-to-face (EFTF) evaluation were scheduled for in-person evaluation. Demographic clinical and ophthalmological information, as well as the Net Promoter Score (NPS) for assessing the general patient satisfaction, were obtained.

**Results:** A total of 1,242 teleconsultations were conducted, including 1,159 first assessment consults and 78 follow-ups. The mean age of patients was  $59 \pm 18.6$  years, most were females (57.5%) and had previous eye conditions (65.5%). The most frequent ocular condition presumed during teleconsultation was dry eye syndrome. The prevalence of ocular emergencies requiring EFTF assessment was 12.4%, with a 26.8% no-show rate and a positive predictive value of 51.9%. Patients reported high satisfaction with TO services (NPS = 86.9).

**Conclusion:** TO stands as a viable alternative to limit COVID-19 transmission. Teleconsultation satisfaction rates are high, and most cases will not require immediate referral. Thus, TO programs may serve as a safe response to alleviate healthcare systems, while meeting patients needs during the pandemic.

**Keywords:** COVID-19; Teleophthalmology (TO); Emergency Face-to-Face (EFTF); Net Promoter Score (NPS)

### Introduction

The coronavirus disease (COVID-19) pandemic has overwhelmed healthcare systems and affected usual medical care

worldwide. Viral spread mechanisms through respiratory droplets and exposure to ocular secretions have transformed eye care visits into high-risk exposure events for patients, staff and health care

providers [1]. Standard protective measures such as safe distancing mandates conflict with routine ocular examinations, requiring practitioner-patient close face proximity and contact with the conjunctival mucosa [2]. As a result, telemedicine programs had become a fundamental tool to continuing health care delivery.

In ophthalmic care, telephone calls or video visits (VVs) allow distance monitoring, reassurance, and follow-up for most established and stable patients. For urgent or acute events, real-time video or images can aid close macroscopic evaluation and identification of patients requiring additional in-office management. Previously, Ophthalmic Tele-triage programs targeted areas without local access to eye care and referred patients from distant settings to in-office assessments. Due to the COVID-19 pandemic, highly dense urban areas still experiencing community transmission of the virus had implemented Teleophthalmology (TO) programs to address the population needs [3]. Here, we assess the implementation of a comprehensive TO program established in Mexico City during the first months with an exponential rise in COVID-19 cases in Latin American [4,5].

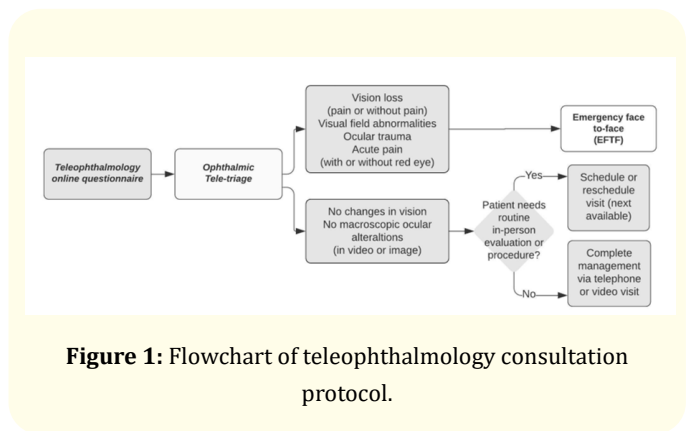
**Methods**

We conducted a cross-sectional retrospective study to evaluate teleconsultation services offered by Salauno Ophthalmology Clinic in Mexico City. The study received Institutional Review Board approval. Teleophthalmology (TO) first and follow-up consultations conducted between April 1<sup>st</sup>, 2020, and June 15<sup>th</sup>, 2020 were included in the study.

**Teleophthalmology program and triage**

Services offered in the TO program included triage of acute conditions, rescheduling of appointments and procedures, referral to subspecialty departments, chronic conditions, and postoperative follow-up, reassurance, and questions in the care plan. Experienced ophthalmologists provided synchronous TO consultation via telephone or video visit (VVs) using a secure Zoom or GoTo-Meeting link. New and established patients had to schedule their TO appointments through the hospital website and answer a brief Tele-questionnaire. During the call, physicians used ophthalmic Tele-triage to identify high-risk patients and cases requiring emergency face-to-face (EFTF) evaluation. Emergency referral criteria included visual field abnormalities and decreased visual acuity or compromised vision, ocular trauma, and acute pain with or without red eye (Figure 1). Patients without emergency referral criteria, but needing routine evaluation or procedures were scheduled

for the next available visit. Those who did not require in-person evaluation were managed through telephone calls or VVs. Before ending the call, ophthalmologists determined the need for TO follow-up, which consisted of telephone calls to check on medication adherence or eye and vision health 1,5, 7, 10, 15, or 30 days after initial TO assessment. We collected data from the TO calls records



**Figure 1:** Flowchart of teleophthalmology consultation protocol.

and electronic medical records of established patients.

**Service satisfaction: Net promoter score**

To assess general patient satisfaction with TO services, non-medical personnel reached out to patients at the end of their TO appointments and asked for feedback to obtain the Net Promoter Score (NPS). The personnel asked patients to range from 0 to 10 the likeliness of recommending the TO services to friends and family. We categorized individual responses in detractors, those who responded with a score from 0 to 6, promoters, responding with a score of 9 to 10, and passive middle range scores. The difference between the percentage of promoters and detractors is the Institution NPS, which ranges from -100 to 100. Scores higher than 0 are considered good and above 50, may be interpreted as excellent [6].

**Data collection**

Demographic, clinical, and ophthalmological information, including past medical history, COVID-19 status, presumptive diagnosis, and time to follow-up or face-to-face visit, were retrieved from electronic medical records. We recorded the final in-person diagnosis for emergency face-to-face (EFTF) referred patients. For non-emergency referrals, we retrieved time to the next available visit and the department handling the appointment. We excluded pediatric patients. We collected NPS Survey data registered during the same period as the TO consultations included in the sample.

**Statistical analysis**

We begin by describing our study population and the characteristics of teleconsultation services. Three-month prevalence of ocular conditions identified by TO and EFTF referrals was calculated. The positive predictive value for EFTF referrals made by TO consultation was defined as all true emergency conditions identified during in-person assessment among the total number of patients referred to the emergency department through telephone call or VVs. We performed all analysis using R v.4.0.2 and Stata 16.1 [7, 8].

**Results**

A total of 1,242 video or telephone calls for 1,156 patients were conducted in a three-month period. Telephone calls and VVs were used at similar proportions (49.6% vs 49.3%). Our sample primarily comprised middle-aged and older adults, the mean was 59 years (SD, 18.6 years) with at least one eye condition previously diagnosed (65.5%). Fewer males employed TO services (42.5%) or had a history of ocular surgery (38.7%). Prevalence of diabetes and hypertension was 31% and 23.8%, respectively. Table 1 shows the sample description.

**Teleophthalmology triage and presumptive diagnosis**

The prevalence of ocular emergencies requiring EFTF assessment was 12 per 100 calls during the 3 months evaluated; 12.4% of all calls received (154 out of 1242 calls). Most patients were referred during their first assessment (146 out of 154), while 8 patients were referred for EFTF after their second TO follow-up call. Nearly two-thirds (62.3%) of all EFTF referrals required evaluation within the first 48 hours after teleconsultation. No-show rate for EFTF referrals was 26.8%. The positive predictive value (ppv) for EFTF referral through TO services was 51.9%. The most common criteria used for EFTF referral was a decrease in visual acuity (37.7%) and new visual field defects (28.1%) (Table 2). Sixty-one percent of the patients required in-person evaluation or a procedure. On average the time for in-person visit (next available) was 17 days after teleconsultation. Most of the reschedules or new appointments (non-emergency) were referred to the anterior segment (37.8%) and retina (26.3%) department.

**Ocular conditions**

The most presumed ocular condition during teleconsultation was dry eye syndrome (29.3%), of those only three needed EFTF evaluation because of intense pain. Other prevalent suspected diagnoses were: cataracts (8.6%), refractive errors (7.6%), and conjunctivitis (5.5%) (Table 3). Patients requiring postoperative follow-up were assessed via teleservices in 97% of the cases (85

Characteristic	N (%)*
<b>Teleophthalmology</b>	
Total consultations	1242
First TO consult	1159 (93.2)
Follow-up TO	78 (6.3)
<b>Mode of delivery</b>	
Videocall	613 (49.6)
Telephone	610 (49.3)
<b>Patient status</b>	
Established patients	672 (54.3)
New patients	565 (45.7)
<b>Demographics</b>	
Age, mean (SD), y	59 (18.6)
Females	712 (57.5)
<b>Comorbidities<sup>a</sup></b>	
None	665 (57.5)
Diabetes	359 (31.0)
Hypertension	276 (23.8)
Cardiovascular disease	27 (2.3)
<b>Ophthalmology history</b>	
Prior eye condition	757 (65.5)
History of ocular surgery	379 (38.7)

**Table 1:** Characteristics of teleophthalmology consultations (N = 1242).

TO: Teleophthalmology.

\*: Numbers may not sum to totals because of missing data, and column percentages may not sum to 100% due to rounding. Percentages are calculated over the total number of distinct individuals (n = 1159).

<sup>a</sup>: Patients may have one or more comorbidities.

out 88 patients). Nineteen percent of the patients had at least one of the following chronic eye diseases, in descending order: diabetic retinopathy, glaucoma, neovascular glaucoma, maculopathy or age-related macular degeneration. Of these patients, 1 in every 5 were referred for EFTF evaluation. All patients with a presumptive diagnosis of retinal detachment or a positive history for retinal lesions predisposing to retinal detachment with one or more alarm symptoms were referred for EFTF assessment, and represented 30.1% of all EFTF referrals.

Characteristic	N (%)*
<b>Emergency face-to-face (EFTF) referrals</b>	
EFTF referrals	153
Missed EFTF consults, %	41 (26.8)
TO Predictive value, %	52.9
<b>Mode of delivery, %</b>	
Videocall	74 (48.4)
Telephone	75 (49.0)
<b>Time to EFTF consult, %</b>	
24 - 48h	96 (62.3)
> 48h	58 (37.7)
<b>Criteria for EFTF referrals, %</b>	
Decrease in VA	57 (37.3)
Corneal burn/ulcer	3 (2.0)
Conjunctivitis with red flags <sup>a</sup>	9 (5.9)
Severe pain	21 (13.7)
Foreign body	7 (4.6)
New visual field defects	43 (28.1)
Trauma	10 (6.5)
Other <sup>a</sup>	3 (2.0)
<b>Reschedule appointments or procedures</b>	
Schedule visits	707
Time to in-person visit, mean, (SD), days	17 (10.3)
<b>Department handling visit, %</b>	
Cornea	28 (4.0)
Glaucoma	76 (10.7)
Oculoplastic Surgery	7 (1.0)
Optometry	47 (6.6)
Pediatric Ophthalmology	3 (0.4)
Retina	186 (26.3)
Anterior Segment	267 (37.8)
General Ophthalmology	93 (13.5)

**Table 2:** Characteristics of teleophthalmology triage.

Abbreviations: EFTF: Emergency Face-to-Face; VA: Visual Acuity.

\*: Numbers may not sum to totals due to missing data, and column percentages may not sum to 100% due to rounding.

<sup>a</sup>: Red flags: severe pain, visual loss, marked decreased vision, or decreased vision in contact lenses users, trauma, chemical injury and recent eye surgery.

<sup>b</sup>: Non-conclusive diagnostic or requested by the patient.

	TO consultations	EFTF referral
<b>Ocular condition, %</b>	<b>(N = 1159)</b>	<b>(N = 153)</b>
<b>Chronic condition follow-up or related event<sup>a</sup></b>		
AMD	4 (0.3)	-
Diabetic retinopathy	101 (8.7)	19 (12.4)
Glaucoma	70 (6.0)	10 (6.5)
Glaucoma Neovascular	15 (1.3)	13 (8.5)
Maculopathy	17 (1.5)	2 (1.3)
<b>Postoperative follow-up</b>	85 (7.3)	3 (2.0)
<b>Disorders of choroid and retina</b>		
Retinal lesions	26 (2.2)	26 (17.0)
Retinal detachment	20 (1.7)	20 (13.1)
Retinal vein occlusion	5 (0.4)	2 (1.3)
<b>Disorders of ocular muscles, accommodation and refraction</b>		
Refractive errors	88 (7.0)	-
Presbyopia	7 (0.6)	-
Third nerve palsy	4 (0.3)	-
<b>Disorders of lens</b>		
Cataracts	100 (8.6)	3 (2.0)
Posterior capsular opacification	8 (0.7)	-
<b>Disorders of sclera, cornea and ciliary body</b>		
Corneal lesion or burn	4 (0.3)	3 (2.0)
Dry eye	340 (29.3)	2 (1.3)
Foreign body	7 (0.6)	7 (4.6)
Keratitis	4 (0.3)	3 (2.0)
Keratoconus	3 (0.3)	-
Keratopathy	3 (0.3)	1 (0.7)
Uveitis and keratouveitis	2 (0.2)	1 (0.7)
Subconjunctival hemorrhage	20 (1.7)	-
Pterygium	7 (0.6)	-
<b>Disorders of eyelid, lacrimal system and orbit</b>		
Blepharitis	35 (3.0)	3 (2.0)
Chalazion and Styne	56 (4.8)	2 (1.3)
Periorbital cellulitis	3 (0.3)	1 (0.7)
Nasolacrimal duct disorder	4 (0.3)	-
Thyroid associated orbitopathy	2 (0.3)	-
<b>Disorders of conjunctiva</b>		
Conjunctivitis	59 (5.1)	9 (5.9)

Pinguecula	7 (0.6)	-
<b>Disorders of vitreous body and globe</b>		
Close ocular trauma	14 (1.2)	10 (6.5)
Vitreous hemorrhage	15 (1.3)	9 (5.9)

**Table 3.** Description of clinical impressions and emergency face-to-face referrals using Teleophthalmology assessment.

Abbreviations: AMD: Age-Related Macular Degeneration; EFTF: Emergency Face-to-Face; TO: Teleophthalmology.

<sup>a</sup>: Follow-up and new acute related condition in patients with a chronic eye disorder.

### Net promoter score (NPS)

A total of 619 individuals were randomly selected after TO consultation to evaluate satisfaction with the services (Table 4). Of those, 549 individuals (88.9%) gave the service a score of 10 or 9 and were classified as promoters. Eleven individuals (1.8%) scored the service less than six and were classified as detractors. The total NPS for the TO services was 86.6%.

Characteristic	N (%)
Individual responses	619
<b>Categories<sup>a</sup></b>	
Promoter (10 - 9)	549 (88.7)
Passives (8 - 7)	59 (9.5)
Detractor (0 - 6)	11 (1.8)
Net Promoter Score <sup>a</sup>	86.9

**Table 4:** Net promoter score (NPS).

<sup>a</sup>: Promoters minus detractors (%).

### Discussion and Conclusion

TO implementation has rapidly increased during the COVID-19 pandemic. The widespread availability of telecommunication services has enabled a smooth transition in most urban areas around the globe [9]. To the best of our knowledge, this large third-level ophthalmology hospital study is the first to investigate the implementation of a teleophthalmology model during the COVID-19 pandemic in Mexico.

In this study, we found TO was particularly valuable for postoperative follow-ups. Our findings suggest that more than 95% of the

postoperative consultations were managed through VVs or phone calls. Here, only 3 out of 88 patients were referred for EFTF assessment after surgery. In addition, our results suggest TO may aid in the monitoring of patients with long-standing eye conditions and mild anterior segment disorders. These patients represented more than 40% of all consultations. Patients with known conditions of the retina are also likely to benefit from on-demand services. Our results showed that patients with the retinal disease were among those with the highest probability of referral (31.3% of all EFTF patients).

During the three months, only 12.4% of all telephone calls or VVs were classified as emergencies and sent for in-person assessment. Although the number of EFTF varies across studies from 10 to 30%, most agree that the minority of patients will require emergency or urgent in-office assessments [3,10]. Therefore, TO may prevent unnecessary visits lowering the cost for institutions and patients. In this study, the PPV for referral was 51.9%. This result may have been impacted by the low prevalence of ophthalmologic emergencies, the high no-show rate, and the conservative referral approach.

Levels of satisfaction were high among users (NPS = 86.9), consistent with reports in Germany, India, Chile, and the United Kingdom [10-13]. Studies on quality of care state that no significant differences are found when comparing telemedicine and regular ophthalmology practices [14]. Based on reasons for detraction obtained in our study and previous information [15], we acknowledge telemedicine may not be suitable for all patients, particularly those with hearing impairment, language limitations, or limited access to internet connection as well as pediatric patients, older patients, and patients with other disabilities without caregivers, among others.

We acknowledge several limitations in the study. We did not investigate whether non-referred patients presented to the hospital with emergency conditions (false negatives). Reasons for patients not showing up to the appointments could not be ascertained. The design and retrospective nature of the study did not allow the evaluation of negative predictive value (NPV). Knowing the NPV may provide further evidence on relevant safety aspects of TO consultations for patients using these services. This study uses data from a third-level hospital, and therefore, results may be more comparable across similar centers.

Overall, TO stands as a viable alternative to alleviate healthcare

systems and help meet the needs of ophthalmic patients during public health emergencies. Other benefits include convenience, potential cost reduction, and avoiding treatment delays and long waiting times. Digital health is at the center of healthcare delivery during a social distancing era and may change ophthalmology practice. Overall, patients seem to be coping with the system. Most patients found great value in TO as a tool for reassurance and a channel to ask questions related to the care plan. Once the immunization levels increase, studies should evaluate the accuracy in urban settings. Additionally, further studies should assess the barriers to access teleophthalmology services, particularly among patients with severe visual impairment.

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