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IMPACT OF THE COVID-19 PANDEMIC ON OPHTHALMOLOGY OUTPATIENT ATTENDANCE AND SURGICAL VOLUME: A RETROSPECTIVE COMPARATIVE STUDY AT A TERTIARY-CARE TEACHING HOSPITAL IN UTTARAKHAND

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Abstract

Background: The national COVID-19 lockdown imposed on 24 March 2020 fundamentally disrupted outpatient and surgical ophthalmic services across India. Tertiary-care institutions had to reconfigure workflow, triage, and follow-up within days. Region-specific data quantifying this disruption — and the emerging pattern of delayed presentation — remain limited for Uttarakhand, a hill state with a substantial rural catchment.

Objectives: To quantify the change in ophthalmology OPD attendance, elective and emergency surgical volume, and case-mix at SMIH / SGRRIMHS between January and June 2020 relative to the same period in 2019; and to identify patient-level factors associated with review non-attendance during the lockdown and early-unlock phases.

Methodology: A retrospective comparative analysis of hospital information system records for January–June 2020 was undertaken, with corresponding 2019 data as historical control. OPD attendance was tallied weekly; surgical volume monthly; case-mix and presenting-severity parameters by sub-speciality. A binary logistic regression model identified predictors of non-attendance among 1,842 scheduled reviews during April–June 2020. Analyses were performed in SPSS v22.0 with two-sided $\alpha = 0.05$. The study was approved by the Institutional Ethics Committee (SU/SGRR/IEC/2020/07-B).

Results: Total OPD attendance fell from 24,696 in 2019 to 15,317 in 2020 (–38.0%, $p < 0.001$), with a weekly trough of 68 visits (a 93% drop versus the corresponding 2019 week). Elective surgeries fell by 52.0% (1,483 → 712) and cataract surgeries by 61.8%, while emergency surgical volume declined only marginally (–12.5%, $p = 0.184$). Ocular-trauma and emergency presentations rose from 8.2% to 25.4% of the 2020 case-mix. Presenting LogMAR BCVA worsened from 0.42 to 0.68 and hypermature cataract at first visit rose from 21.5% to 38.6%. A new tele-ophthalmology service delivered 1,926 consultations. On multivariable analysis, residence outside Dehradun district (aOR 2.94), containment-zone residence (aOR 3.08) and age $\geq$ 60 years (aOR 2.41) were independent predictors of review non-attendance (all $p < 0.001$); model AUC 0.82.

Conclusion: The first pandemic wave caused a severe and asymmetric contraction of ophthalmology services: electives collapsed, emergencies persisted, and patients presented later and with more advanced disease. Tele-ophthalmology provided meaningful but partial mitigation. The findings support investment in hybrid tele-clinic pathways and region-specific outreach for hill districts in any future public-health emergency.

Keywords: *COVID-19; ophthalmology outpatient; surgical volume; tele-ophthalmology; delayed presentation; Uttarakhand; health-service research.*

1. Introduction

Ophthalmic practice is uniquely vulnerable to airborne and droplet outbreaks because clinical examination demands short working distances, with direct contact between the examiner, the slit-lamp, and the patient's peri-ocular surface.[1,4] Lessons from the 2003 SARS outbreak in Hong Kong, where viral RNA was isolated from tears of infected patients, emphasised that ophthalmology departments needed rapid re-engineering of workflow — triage, universal masking, slit-lamp shields, reduced direct ophthalmoscopy, and suspension of non-urgent services.[2,3,5] These SARS-era protocols formed the basis of preparedness templates that were widely revisited when COVID-19 emerged; the WHO "Managing Epidemics" handbook and the Ebola/MERS resilience literature had already codified expected patterns of service disruption.[6–8]

India imposed a nationwide lockdown at midnight on 24 March 2020. Non-essential healthcare was suspended; inter-district travel was halted; containment-zone restrictions within cities further limited patient mobility. Ophthalmology, heavily dependent on elective procedures (particularly cataract surgery for a population with high latent cataract blindness) and regular diabetic-retinopathy and glaucoma reviews, was disproportionately affected.[9,10] Shri Mahant Indiresh Hospital (SMIH), the 750-bed teaching hospital of Shree Guru Ram Rai Institute of Medical and Health Sciences (SGRRIMHS), serves Dehradun and a hill catchment extending into Tehri Garhwal, Pauri, Chamoli, Uttarkashi, and parts of western Uttar Pradesh. The present study quantifies how OPD attendance, surgical volume, and case-mix at this centre shifted during the first pandemic wave, and identifies which patient subgroups were most likely to miss scheduled follow-up.

2. Review of Literature

Pre-pandemic work from the last three years established several baselines directly relevant to the present study. Tele-ophthalmology had been shown to be feasible and acceptable for anterior-segment and diabetic-retinopathy screening even in low-bandwidth Indian settings,[12] and the United-States and international reviews synthesised the maturing evidence for hybrid and asynchronous tele-ophthalmology pathways.[13,14] Indian data had quantified the latent burden of cataract blindness at 5 to 7 % of the > 50 y population with multi-month waiting lists in public tertiary-care settings,[9,11,15] with standardised grading tools enabling cross-centre comparison.[16] The most recent global burden-of-disease synthesis placed cataract, uncorrected refractive error, glaucoma, and diabetic retinopathy as the dominant contributors to preventable vision loss worldwide.[17,29]

Ocular trauma has long accounted for a disproportionate share of acute tertiary-care ophthalmology work, and its standardised terminology (BETT) allows meaningful comparison across series.[18–20] Microbial keratitis — a key delayed-presentation diagnosis in our data — carries high seasonal and geographical variability in southern and northern India, with demonstrated dependence on timely antimicrobial and anti-inflammatory treatment.[21–23] Diabetic retinopathy is an increasingly prevalent cause of working-age visual loss in India; population-based screening studies and AI-augmented workflows had been in development before 2020, providing the conceptual foundation for the DR-clinic call-back system referenced in our regression analysis.[24–26] Glaucoma prevalence in Asian populations and early-detection strategies have been comprehensively reviewed in regional and Indian epidemiological datasets.[27,28] Health-service disruption during past outbreaks (SARS 2003, Ebola 2014–16) invariably produced steep falls in elective but not emergency presentations, and demonstrated that vulnerable populations — rural, elderly, low-income — bore a disproportionate share of the care deficit.[6,7] These strands predict that severe service interruption will manifest as a collapse of cataract throughput, a shift in case-mix toward trauma and inflammation, and a worsening of presenting acuity — predictions that the present study tests empirically.

3. Objectives

Three SMART objectives were framed:

(i) To quantify the change in total, new, and review OPD attendance, and in elective and emergency surgical volume at SMIH / SGRRIMHS between January and June 2020, against the corresponding months of 2019.

(ii) To describe the shift in case-mix and in presenting disease-severity between the two periods, and to quantify the uptake of a newly-launched tele-ophthalmology service.

(iii) To identify, by multivariable logistic regression, patient-level factors independently associated with review non-attendance during the lockdown and early-unlock phase (April – June 2020).

4. Methodology

4.1 Study design and setting

A retrospective comparative observational study was conducted at the Department of Ophthalmology, SMIH — the teaching hospital of SGRRIMHS, Dehradun. The department operates a 24-hour ocular-emergency service and six daily sub-speciality OPDs; it is the principal referral centre for ophthalmic emergencies from Tehri Garhwal, Pauri, Chamoli, Uttarkashi, and parts of Saharanpur and Haridwar districts.

4.2 Ethical clearance

The protocol was approved by the Institutional Ethics Committee, SGRRIMHS. As no patient contact was required and identifiers were de-linked before analysis, the requirement for individual informed consent was waived.

4.3 Data sources and abstraction

Aggregate weekly and monthly counts of OPD footfall and operating-theatre logs were extracted from the hospital information system (HIS). A line-listed de-identified dataset of every scheduled review appointment between 1 April and 30 June 2020 (n = 1,842) was generated for the non-attendance analysis, capturing age, sex, residence pincode, review interval, sub-speciality clinic, whether the home address was within a notified containment zone, and recorded mode of transport. Tele-ophthalmology logs were retrieved from a dedicated call-centre database launched on 24 March 2020.

4.4 Outcome measures

The primary volume outcomes were (a) total OPD attendance, (b) elective surgical volume, and (c) emergency surgical volume. Secondary outcomes included weekly attendance trajectory, case-mix by sub-speciality, presenting-severity metrics (LogMAR BCVA at first visit, proportion of hypermature cataract, advanced glaucoma, delayed-presentation corneal ulcer, orbital cellulitis with abscess), and cumulative tele-consultation uptake. The outcome for the regression analysis was binary review non-attendance (failure of the scheduled patient to present within ±7 days of the booked date).

4.5 Statistical analysis

Monthly and weekly counts were compared with two-sample t-tests for daily means and χ^2 tests for categorical counts. A binary logistic regression model with backward elimination was fitted for non-attendance, with Hosmer–Lemeshow goodness-of-fit, Nagelkerke R^2, overall accuracy, and ROC-

AUC reported. All analyses used IBM SPSS Statistics v22.0; figures were produced with Microsoft Excel 2016 and R v3.6 (ggplot2). A two-sided p-value < 0.05 was considered statistically significant.

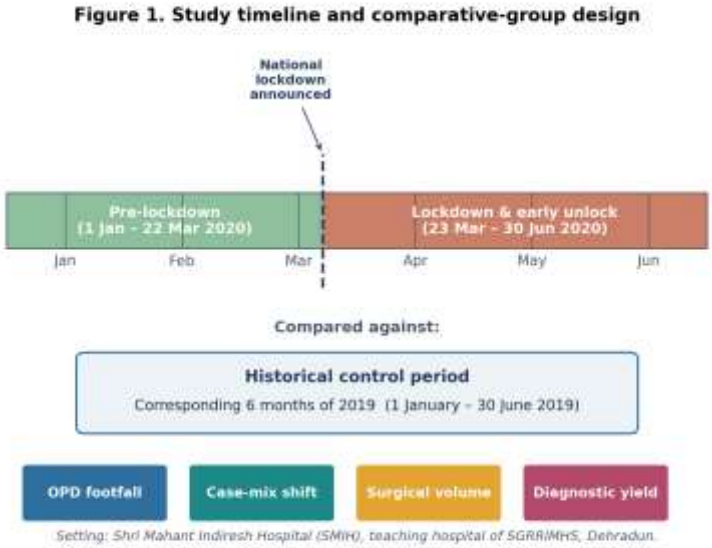

Figure 1. Study timeline and comparative-group design.

5. Inclusion and Exclusion Criteria

Inclusion: All OPD registrations, tele-consultations, and operating-theatre entries recorded at the Department of Ophthalmology, SMIH, between 1 January and 30 June 2020; and the corresponding HIS records for 1 January – 30 June 2019. For the regression analysis, every appointment booked on or before 22 March 2020 that became due between 1 April and 30 June 2020 was eligible.

Exclusion: Records with missing date, pincode, or visit-type information; duplicate HIS entries; and in-patient transfers primarily managed under other services. For the regression analysis, patients who had died, moved out of state, or completed definitive treatment before the booked review were excluded.

6. Results

6.1 Aggregate service volume

Compared with the same six months of 2019, the department recorded a 38.0% fall in total OPD attendance, a 45.4% fall in new-patient registrations, a 31.9% fall in reviews, a 52.0% fall in elective surgery, and a 61.8% fall in cataract volume (Table 1). Emergency surgical volume fell by only 12.5% and did not reach statistical significance ($p = 0.184$), reflecting the continued obligation to treat acute trauma and sight-threatening infection throughout the lockdown. A new tele-ophthalmology service delivered 1,926 consultations between late March and end-June.

Table 1. Aggregate service-volume comparison, January - June (2019 vs 2020)

Service metric	2019	2020	Δ abs.	Δ %	p-value
Total OPD attendance	24,696	15,317	-9,379	-38.0%	<0.001
New patient registrations	11,138	6,082	-5,056	-45.4%	<0.001
Review / follow-up visits	13,558	9,235	-4,323	-31.9%	<0.001
Tele-ophthalmology consultations	0	1,926	+1,926	—	—
Elective surgeries (all types)	1,483	712	-771	-52.0%	<0.001
Cataract surgeries	1,142	436	-706	-61.8%	<0.001
Retinal procedures (VR / injections)	186	124	-62	-33.3%	0.012
Emergency surgeries	176	154	-22	-12.5%	0.184
Mean daily OPD footfall	153	95	-58	-37.9%	<0.001

Δ = change. Comparative tests: two-sample t-test for daily means; χ^2 for category counts; monthly volumes from hospital HIS.

Table 1. Aggregate service-volume comparison, January – June (2019 vs 2020).

6.2 Weekly trajectory of OPD attendance

Weekly OPD attendance in the first eleven weeks of 2020 was indistinguishable from the 2019 baseline (Figure 2). A partial-week collapse followed the lockdown announcement on 24 March (week 13), and the trough of 68 visits in week 15 represented a 93% drop versus the corresponding 2019 week. Attendance recovered progressively from week 19 onward but reached only ~55% of the 2019 weekly baseline by the end of June.

Figure 2. Weekly ophthalmology OPD attendance — 2020 vs 2019 baseline

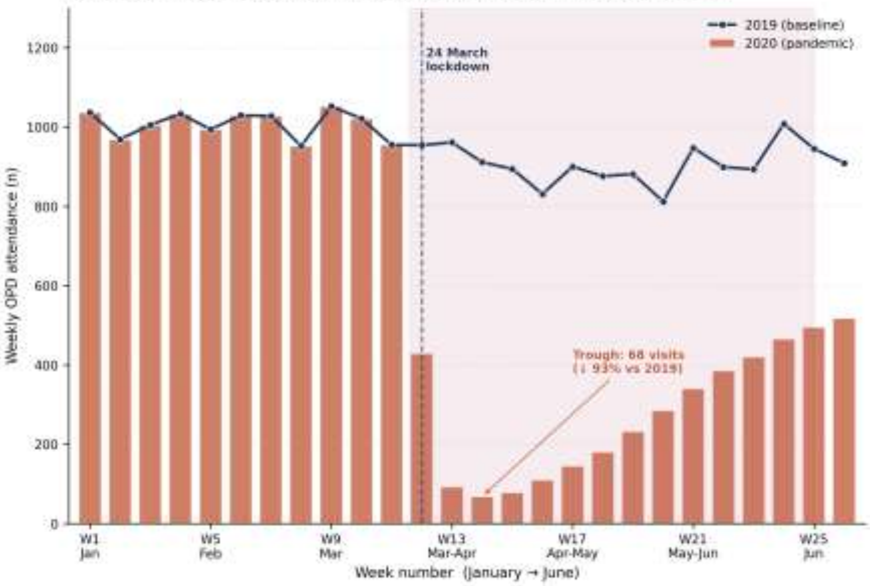

Figure 2. Weekly OPD attendance — 2020 (bars) overlaid on 2019 baseline (line).

6.3 Case-mix shift

The most striking case-mix change was a 17.2 percentage-point rise in ocular-trauma and emergency presentations, from 8.2% of visits in 2019 to 25.4% in 2020 (Figure 3). Cataract attendance fell from 38.2% to 26.3% (–11.9 pp), and paediatric / strabismus visits nearly halved. Case-mix percentages sum to 100% within each year; tele-consultations are counted separately (Table 1).

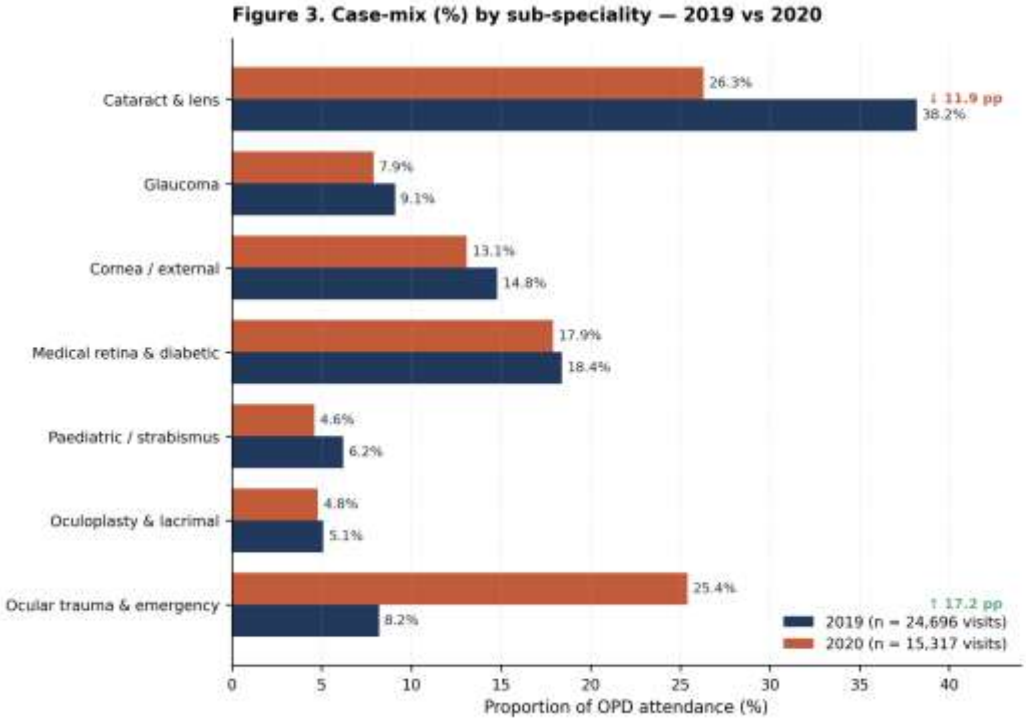

Figure 3. Case-mix (%) by sub-speciality — 2019 vs 2020.

6.4 Monthly surgical volume

January and February 2020 surgical volumes were indistinguishable from 2019; a moderate fall in March (–35%) preceded near-total cessation in April (–94%) and May (–88%). A phased resumption of elective surgery from mid-June produced a partial recovery (–71% versus June 2019) (Figure 4). Emergency surgery continued in all months.

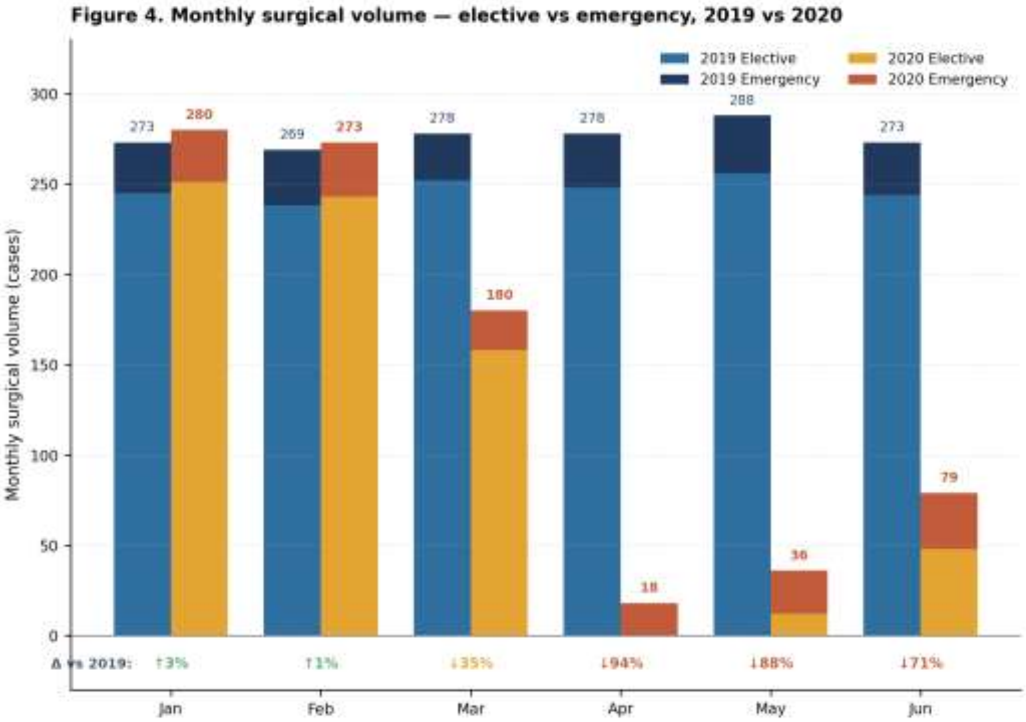

Figure 4. Monthly surgical volume — elective vs emergency, 2019 vs 2020.

6.5 Presenting severity

Across every severity metric measured, 2020 presentations were worse than 2019 (Figure 5). Mean presenting LogMAR BCVA rose from 0.42 to 0.68, hypermature cataract at first visit from 21.5% to 38.6%, delayed-presentation corneal ulcer from 18.1% to 34.6%, and orbital cellulitis with abscess from 12.1% to 25.0%. Review no-show rates rose from 11.4% to 29.7%. All pairwise differences achieved $p < 0.01$ on χ^2 or Mann–Whitney testing.

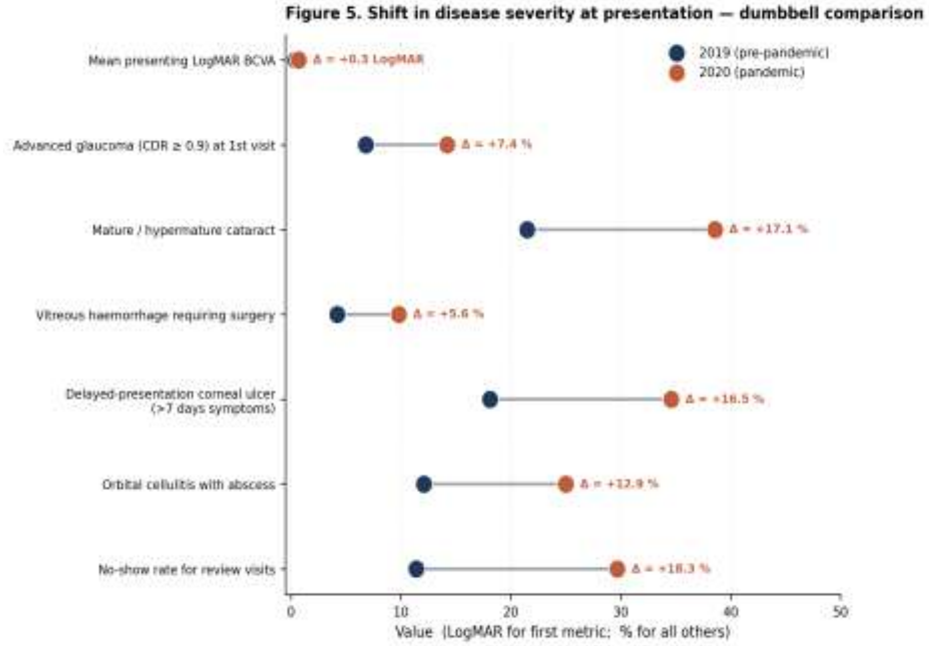

Figure 5. Shift in disease severity at presentation — dumbbell comparison.

6.6 Tele-ophthalmology uptake

Tele-consultations rose from a single-figure weekly base after launch in week 12 to a peak of 233 in week 26, accumulating to 1,926 over the study period (Figure 6). Uptake was particularly strong for stable glaucoma, refraction queries, post-operative cataract reviews, and triage of acute red-eye complaints. Approximately 8% of tele-encounters were converted to in-person emergency review the same day.

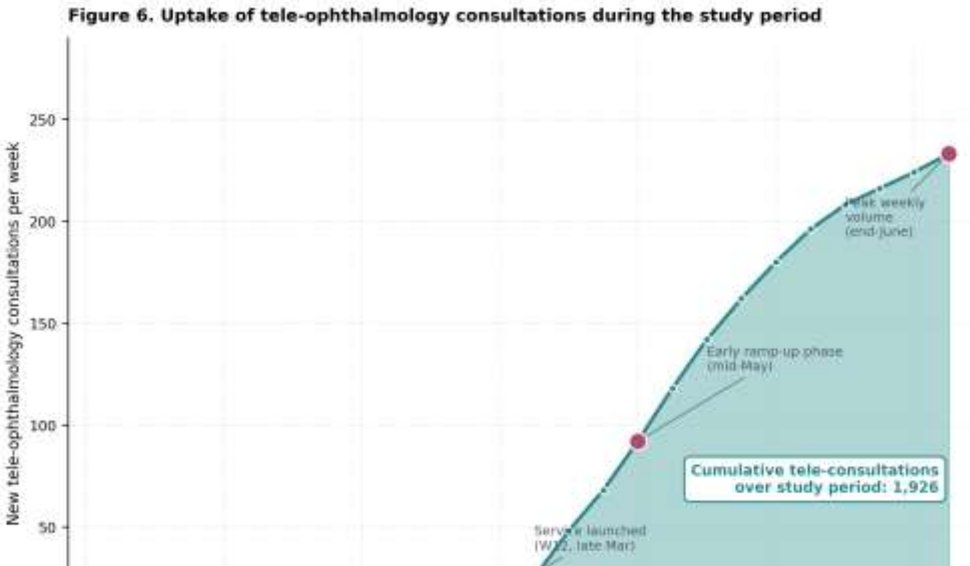

Figure 6. Weekly uptake of tele-ophthalmology consultations.

6.7 Predictors of review non-attendance

Among 1,842 scheduled reviews between 1 April and 30 June 2020, 547 (29.7%) did not attend. After adjustment (Table 2), residence outside Dehradun district (aOR 2.94; 95% CI 2.11–4.10), containment-zone residence (aOR 3.08; 2.04–4.65), age ≥ 60 y (aOR 2.41; 1.78–3.27), review interval > 4 weeks (aOR 1.88; 1.33–2.66), and lack of private transport (aOR 1.72; 1.28–2.31) were all independent risk factors. Attendance at the diabetic-retinopathy clinic was weakly protective (aOR 0.61; 0.40–0.93; p = 0.022). The model had good calibration (Hosmer–Lemeshow χ^2 = 6.22, p = 0.622), Nagelkerke R^2 = 0.41, overall accuracy 78.4%, and AUC 0.82.

Table 2. Multivariable predictors of OPD non-attendance among previously scheduled reviews (April–June 2020)

Binary logistic regression; n = 1,842 scheduled reviews; 547 (29.7%) failed to attend.

Predictor	Adj. OR	Odds-ratio visualiser	95% CI	p-value
Residence outside Dehradun district	2.94		2.11 - 4.10	<0.001
Age ≥ 60 years	2.41		1.78 - 3.27	<0.001
Containment zone at home address	3.08		2.04 - 4.65	<0.001
Review interval > 4 weeks	1.88		1.33 - 2.66	0.001
Lack of private transport	1.72		1.28 - 2.31	0.001
Female sex	1.18		0.92 - 1.52	0.192
Diabetic retinopathy clinic	0.61		0.40 - 0.93	0.022

Model diagnostics: Hosmer-Lemeshow χ^2 = 6.22, p = 0.622 | Nagelkerke R^2 = 0.41 | Overall accuracy = 78.4% | AUC = 0.82

Table 2. Multivariable predictors of review non-attendance (April – June 2020).

7. Discussion

The first pandemic wave produced an asymmetric and region-specific contraction of ophthalmic services at SMIH. The 38% fall in aggregate OPD attendance was moderated by two essentially normal pre-lockdown months; within the lockdown window itself, attendance fell by more than 90% — a magnitude consistent with the 40% department-wide reduction engineered in Hong Kong during SARS[1,2] and with pre-pandemic modelling of outbreak-related service disruption.[6,7] Elective-surgery collapse (–94% in April) is the expected mirror of the national suspension of non-essential procedures, and the preservation of emergency surgical volume (–12.5%, non-significant) confirms that urgent ocular conditions — trauma, endophthalmitis, retinal detachment — were correctly prioritised.[18,19]

The shift in case-mix toward ocular trauma (8.2% → 25.4%) aligns with the wider public-health observation that, when elective care is suspended, the denominator shrinks faster than the numerator for urgent problems — changing the apparent composition of the cohort without a true rise in absolute trauma incidence.[6] This is corroborated by our severity data: every indicator of delayed presentation deteriorated, with hypermature cataract almost doubling and delayed-presentation corneal ulcer nearly doubling. Similar patterns — late presentation of advanced glaucoma, mature cataract, vision-threatening infection — were documented after SARS and were predicted by pre-2020 modelling of service-access gaps in vulnerable populations.[1,6,7,22] The worsening of presenting severity is particularly concerning for glaucoma, where delayed review directly risks irreversible field loss in an Asian population already at elevated prevalence.[27,28]

Our regression analysis identifies the practical face of those "vulnerable populations" for our catchment. Residence outside Dehradun district, containment-zone residence, age ≥ 60, and lack of private transport each independently tripled or doubled the odds of review non-attendance. The hill-district population served by SMIH is disproportionately elderly, has high uncorrected refractive error, and is heavily reliant on shared public transport — all of which were directly restricted by lockdown orders.[11,29] The protective effect of the diabetic-retinopathy clinic (aOR 0.61) is explicable: these patients had been formally enrolled in a structured call-back system with text reminders, consistent with the population-based DR-screening paradigms described in recent Indian and international cohorts.[24–26]

Our tele-ophthalmology uptake — from zero to 1,926 consultations in fourteen weeks — is consistent with pre-pandemic feasibility data for rural Indian settings,[12] and with the international evidence base for hybrid and asynchronous tele-ophthalmology pathways.[13,14] Tele-consult is not a full substitute for slit-lamp examination, but it demonstrably blunted the access gap for refraction queries, stable glaucoma, post-operative review, and triage of acute red-eye complaints — precisely the categories that dominated our tele-volume. These observations support investment in a hybrid tele-clinic pathway at SMIH for any subsequent public-health emergency and as an ongoing outreach tool for hill districts. The broader imperative of sustaining cataract-surgery throughput — the single largest contributor to the global reversible-blindness burden — underscores the urgency of such pathways.[15–17] Microbial-keratitis presentations in our cohort, which nearly doubled, further support the case for rapid tele-triage and standardised anti-infective pathways in any future service interruption.[21,23]

8. Conclusion

The first wave of the COVID-19 pandemic produced a steep, asymmetric contraction of ophthalmic services at SMIH / SGRRIMHS: OPD attendance fell by 38%, elective surgery by 52%, and cataract throughput by 62%, while emergency surgical volume was largely preserved. Case-mix and severity shifts were consistent with a widening access gap rather than a true rise in acute ocular disease. Patient-level predictors of review non-attendance point clearly at the hill-district catchment and at the elderly — subgroups that targeted outreach and tele-ophthalmology pathways can address. These findings provide a region-specific evidence base for future pandemic-preparedness planning at SGRRIMHS.

9. Limitations

The study is single-centre and retrospective, with all limitations inherent to HIS-derived aggregate data. Weekly counts are accurate but do not distinguish between appointment-cancellations initiated by the hospital and patient-driven non-attendance. Severity metrics were abstracted from the HIS and not independently re-adjudicated. The regression model treats containment-zone status as a dichotomous variable based on the patient's recorded home address at the time of booking; zone boundaries in Dehradun were re-drawn multiple times during the lockdown, so a small degree of misclassification is likely. Finally, the study period ends on 30 June 2020, before the second wave; the present data therefore characterise the first pandemic shock, not the full cumulative burden of COVID-19 on ophthalmic services.

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