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Comparison of three modalities of teleophthalmology delivery in regional Western Australia during the COVID-19 lock-down

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ABSTRACT

Clinical relevance: In conjunction with local optometry services, telehealth may be used in to provide specialist care for patients living in rural areas underserved by ophthalmology.

Background: To combat travel restrictions for specialist outreach to regional areas during the 2020 COVID-19 lockdown, Lions Outback Vision introduced three different modalities of teleophthalmology consultations; home-based telephone, hospital-based video, and optometry-based video. This study evaluated the utility of these in providing specialist care to rural patients during the pandemic.

Methods: Data from patients referred during the COVID-19 lock-down period (23 March 2020 to 5 June 2020) were analysed. If sufficient clinical information and imaging were available then ophthalmologists conducted home-based telephone consultations. If further ocular imaging or examination was required, then optometry-based video or hospital-based video were used. Data were analysed using ANOVA and two-sided t tests for continuous data and Chi Square statistics for categorical data ($p < 0.05$).

Results: Majority of the 431 consultations were conducted via home telephone (38%) or optometry-based video (37%). Indigenous patients ($p = 0.014$) and patients in very remote communities ($p < 0.01$) were more likely to receive a home-based telephone consultation. Because sufficient clinical information had already been obtained for home-based consultations, these patients were more likely to be booked for surgery than optometry ($p < 0.01$).Cataracts were the predominant diagnosis in optometry consults compared to hospital ($p < 0.01$).

Conclusion: Primary optometry and home telephone represent a new modality for providing specialist care for patients living in very remote regions and for Indigenous patients. When appropriate clinical testing has been completed, telephone-based ophthalmology may continue to be useful for certain conditions such as waitlisting patients for cataract surgery and should continue to be funded beyond the duration of the pandemic for rural patients.

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Introduction

Teleophthalmology incorporates the delivery of ophthalmic services in which providers, their patients and/or referrers are separated by distance. The use of these telehealth services in ophthalmology may be restricted by regulations and rules around reimbursement, and Saleem et al[1] reported that the relaxation of regulatory restrictions and increased remote care reimbursement led to a greater number of ophthalmologists considering the use of virtual ophthalmic services in America.

In remote Western Australia, ophthalmology coverage is up to 19 times lower than that in urban Australia.[2] In Western Australia, the capital city Perth has been the only tertiary level centre for ophthalmology services despite being over 3000 km from towns and remote communities in the Kimberley and Pilbara regions.[3] Outreach services through the Lions Outback Vision (LOV) program, aim to address these inequities in access to ophthalmic services in regional and remote Western Australia.[4,5]

Prior to the COVID-19 pandemic, telehealth services at LOV had only been available with a community optometry-based service providing the facility and assessment for online video consultations (Optom (Vid)). Patients were referred to this service by general practitioners, hospital staff, or visiting optometrists. Published studies have previously demonstrated that optometry-facilitated telehealth was cost-effective and achieved high patient satisfaction.[6,7] Furthermore, data has shown surgical wait times were halved and the visual outcomes for patients were superior compared with face-to-face services.[8,9]

The teleophthalmology on call service provided by LOV has also increased the uptake of Indigenous patients ten-fold.[10] During the COVID-19 lockdown period in 2020, LOV rapidly implemented novel teleophthalmology video consultations in the hospital outpatient setting as well as providing telephone calls to patients at home. This allowed for the continued access to eye care services, and facilitated ongoing avenues of communication between ophthalmologists, general practitioners, emergency physicians and optometrists throughout remote and regional Western Australia.

This study aimed to obtain an understanding of the use of teleophthalmology services during the COVID-19 pandemic. It compared the baseline characteristics and short-term outcome measures of three different types of teleophthalmology services used during the COVID-19 lockdown period with the inclusion of two novel patient home-based and hospital-based modalities.

Methods

This study was conducted in accordance with the National Statement on Ethical Conduct in Human Research and was

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consistent with the principles that have their origin in the Declaration of Helsinki. Approval from the University of Western Australia Research Ethics Committee was obtained prior to its commencement.

Two ophthalmology consultants performed a retrospective audit of medical records of all patients referred to the LOV service during the COVID-19 lock-down period from 23 March 2020 to 5 June 2020. This study period was selected as it coincided with the duration of the regional travel restrictions imposed by the Western Australia State Government for COVID-19. At this time two novel modalities for teleophthalmology were introduced; (1) home-based telephone consultation (Home (Tel)) and (2) regional hospital-based video consultation (Hosp (Vid)).

Patients were either referred to LOV by their general practitioner, optometrist, or other medical professional, or were patients who were previously seen by LOV and booked for follow-up (i.e., referred by LOV). Registrars working at LOV triaged referrals to one of the three modalities based on the information available in the referral, the equipment required for patient evaluation and the location of the patient and facilities available in that area. If the referral included an adequate clinical history, examination findings and ocular imaging then Home (Tel) was used.

If further assessment and ocular imaging were required, then a Hosp (Vid) consultation was initiated by a regionally located optometrist. This included patients with undifferentiated ophthalmological complaints as well as those who required specialised equipment that was only available at the hospital, such as the biometry machine.

The third modality for telehealth (3) was the pre-existing community Optom (Vid) consultation, which involved patients undertaking the video consultation at their local optometrist. Optometrists were able to directly book these appointments and Optom (Vid) was particularly useful for patients who required visual field testing, as the Humphrey Visual Field machine was only available at the optometrist. The three tele-ophthalmology consultation types were used for all specialist assessment as regional travel restrictions throughout WA meant it was not possible for patients to be seen by an ophthalmologist in person.

Baseline characteristics of the patient included age, gender, Indigenous status, type of referrer and community location including Modified Monash (MM) classification. Primary outcome measures included the type of follow-up required, provisional diagnosis and urgency. Univariate comparisons were conducted between the three teleophthalmology consultations – (Home (Tel), Hosp (Vid), and Optom (Vid)). Data were analysed using ANOVA and two-sided Student's *t* tests for continuous data and *Chi* Square statistics for categorical data. Post-hoc analyses incorporated the Bonferroni correction method. A p-value of 0.05 or less was considered statistically significant.

Results

There were 431 teleophthalmology consultations conducted between 23 March 2020 and 5 June 2020 inclusive, of which 160 received Optom (Vid), 108 with Hosp (Vid) and 163 were assessed with Home (Tel). The baseline characteristics for the three modalities are shown in Table 1. There was a statistically significant difference in age between the three groups ($P < 0.014$) with post hoc analysis showing the Optom (Vid) group was significantly older than the Hosp (Vid) group ($P < 0.01$) using the Bonferroni correction method.

Table 1. Baseline demographics by teleophthalmology consult type.

	Optom (Vid) $N = 160$	Hosp (Vid) $N = 108$	Home (Tel) $N = 163$	*P*-value
Age (years)[a]	58.8 ± 19.2	51.6 ± 19.6	56.3 ± 19.9	0.01*
Gender (female)[b]	75/160 (46.9)	55/108 (50.9)	77/163 (47.2)	0.78
Indigenous[b]	25/160 (15.6)	30/108 (18.8%)	44/163 (27.5%)	0.02*

[a]Mean ± SD.
[b]Number (percent).

There was no significant difference in gender ($P = 0.78$) between the three modalities. However, there was a statistically significant difference in Indigenous status ($P = 0.02$) with post hoc analysis showing that Indigenous Australians were significantly more likely to receive a Home (Tel) ($P = 0.014$) or Hosp (Vid) ($P = 0.016$) consultation than an Optom (Vid) consultation.

Rurality

Teleophthalmology services were provided for patients from a total of 30 remote and regional communities during this period. The MM scale classifies communities according to their geographical remoteness and population size.[11] The scale ranges from MM1 for metropolitan areas to MM7 for very remote and small population communities.

The frequency distribution by MM1–7 classification and teleophthalmology consult type is shown in Table 2. There were no communities with an MM2 or MM4 classification that received teleophthalmology services in WA. There was a statistically significant difference in the MM classifications between the three telehealth consult types with post hoc analysis finding a significant difference (all P values < 0.01) in the MM classifications for all three telehealth consult types. Notably, patients from remote communities (MM6) were more likely to receive a Hosp (Vid) consult as compared to Optom (Vid) or Home (Tel). Patients from very remote communities (MM7) were more likely to receive a Home (Tel) consult as compared to Optom (Vid) or Hosp (Vid).

The frequency distribution of the type of referrer by teleophthalmology consult type is shown in Table 3. There was a statistically significant difference in referrers between the three consult types ($P < 0.01$). Specifically, there was a significant difference between the Optom (Vid) and Hosp (Vid) consultations ($P < 0.01$) in which both GP and LOV follow up referrals were more likely to be associated with a Hosp (Vid) as opposed to Optom (Vid) consultation. In contrast, referrals from optometrists were more likely to be triaged to an Optom (Vid) rather than a Hosp (Vid) consultation. This is further highlighted IN Figure 1, which illustrates the overall proportion of different referrer types during the COVID-19 lock-down for all teleophthalmology services delivered.

The frequency distribution of follow-up plans is detailed by the type of teleophthalmology consult is shown in Table 4.

Table 2. Community numbers by teleophthalmology consult type.

MM Classification	Optom (Vid)	Hosp (Vid)	Home (Tel)
MM 1	1	0	5
MM 3	84	0	52
MM 5	2	0	22
MM 6	65	108	36
MM 7	6	0	46

Table 3. Referrer frequencies by teleophthalmology type.

Referrer[a]	Optom (Vid) $N = 160$	Hosp (Vid) $N = 108$	Home (Tel) $N = 163$
GP	6 (4)	19 (18)	21 (13)
LOV (follow up)	40 (25)	48 (44)	90 (55)
Optometrist	112 (70)	39 (36)	41 (25)
Non-GP Doctor	1 (1)	2 (2)	8 (5)
Ophthalmologist	1 (1)	0	2 (1)
No Referral or N/A	0	3 (3)	1 (1)

[a]Number (percent).
LOV, Lions Outback Vision; GP, general practitioner; N/A, not available.

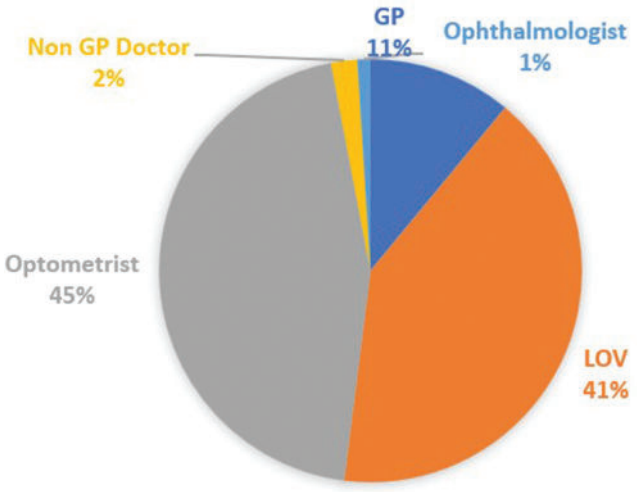

Figure 1. Overall distribution of referrer types during the COVID-19 lock-down period.

Table 4. Follow-up plan by teleophthalmology type.

Management plan	Optom (Vid) $N = 158$	Hosp (Vid) $N = 108$	Home (Tel) $N = 160$
Discharge to optometry	40 (25)	32 (30)	47 (29)
Face to face follow-up	48 (30)	44 (41)	70 (44)
Booked for surgery	47 (30)	20 (19)	22 (14)
Booked for future telehealth	23 (15)	12 (11)	21 (13)

#Number (percent).

There was a statistically significant difference between the type of follow-up and teleophthalmology consult type ($P < 0.02$) in which there was a significant difference between the Optom (Vid) and Home (Tel) consult types ($P < 0.01$). Here, patients were more likely to be discharged or booked for surgery in a Home (Tel) rather than Optom (Vid) consultation. In contrast, face-to-face follow up in a future specialist outreach clinic was more likely to occur in an Optom (Vid) rather than Hosp (Vid) consult.

The frequency distribution of different diagnoses for the most common eye disorders by teleophthalmology consult type is shown in Table 5. A significant difference ($P < 0.01$) was only found between the Optom (Vid) and Hosp (Vid) consult types in which cataract was more likely to be diagnosed from an Optom (Vid) consult as compared to a Hosp (Vid) consult.

The referral urgency triage category is shown in Table 6. A significant difference in the triage categories between the three consult groups ($P < 0.01$) was observed. There was a significant difference between both the Optom (Vid) and Hosp (Vid) consults ($P < 0.01$) as well as between the Hosp (Vid) and Home (Tel) consults ($P < 0.01$). Urgent (within 30 days) referrals were more likely to be triaged from both Optom (Vid) and Home (Tel) consults as compared to Hosp (Vid) consults.

Table 5. Most common ocular diagnoses by teleophthalmology consult type.

Diagnosis	Optom (Vid) *n*	Hosp (Vid) *n*	Home (Tel) *n*
Cataract	47	16	28
DMO	8	5	5
NPDR	2	7	3
POAG	8	3	12
Pterygium	7	5	5
CSCR	1	5	2
Other	87	67	108

DMO, Diabetic macular oedema; NPDR, Non-proliferative diabetic retinopathy; POAG, Primary open angle glaucoma; CSCR, Central serous chorioretinopathy.

Table 6. Estimated treatment timeframes by teleophthalmology consult type.

Triage Category	Optom (Vid)	Hosp (Vid)	Home (Tel)
Within 30 days – Urgent	28	7	24
1–3 months	40	36	68
3 to 12 months	42	48	34

Discussion

Teleophthalmology provided a useful solution to the intraregional travel restrictions that prevented ophthalmology visits in Western Australia during a COVID-19 lockdown period. Novel modalities of teleophthalmology were introduced for pragmatic reasons including clinical detail and ocular imaging available in referrals, as well as patient location.

This study identified that Indigenous Australians were significantly more likely to receive a Home (Tel) or Hosp (Vid) consult as compared to an Optom (Vid) consultation. This may be attributed to the Home (Tel) consultations eliminating clinic booking and travel logistics for those located in very remote locations. Home (Tel) consultations also reduce the risk of COVID-19 exposure.[6] Given Hosp (Vid) and Home (Tel) teleophthalmology consultation types were not available prior to the COVID-19 lockdown, this study highlights the important role these novel teleophthalmology modalities may play in increasing Indigenous participation and access to ophthalmic care.

Furthermore, patients from remote communities with an MM6 classification were more likely to receive a Hosp (Vid) as compared to an Optom (Vid) or Home (Tel) consult. Patients from very remote communities (MM7) were more likely to receive a Home (Tel) consult as compared to Optom (Vid) or Hosp (Vid), which may reflect a lack of optometry and hospital services available in the most remote communities.

Referrals from optometrists were more likely to be triaged to Optom (Vid) as opposed to a Hosp (Vid) consultation. This may be attributed to pre-existing familiarity with the previously established community optometry facilitated video consultation. In contrast general practitioner and LOV-initiated review appointments were more strongly associated with a Hosp (Vid) consultation. General practitioners may be more inclined to refer their patients to visiting specialists at the hospital and lack accompanying ocular imaging.

Patients were more likely to be discharged or booked for an upcoming ophthalmic surgery in a Home (Tel) rather than Optom (Vid) consultation. 81% of those who had Home (Tel)

consultations had previously seen LOV or an optometrist locally, enabling an adequate history to be obtained with a clinical examination. As such, it is understandable that these patients were more likely to be booked for non-urgent ophthalmic surgery since the treating ophthalmologist had sufficient clinical information to make an informed management recommendation.

This study was limited by a small sample size affecting statistical analysis. Furthermore, given the rapid implementation of the service including new modalities during a lockdown period, there may have been limitations in the understanding of referrers and patients about access to each of the three teleophthalmology types. Although previous research has demonstrated a high levels of patient acceptance for teleophthalmology,[6] future research could explore patient preferences for different types of teleophthalmology services. For example, Home (Tel) may be a preferable option for older patients, or those with significant blindness or mobility issues as it may remove some of the barriers around access to healthcare such as arranging transport and carer assistance for travelling to and from appointments.[12]

In remote and regional Western Australia, teleophthalmology provides a well-established accessible specialist care service for patients and referrers. It has an important role to play in providing ophthalmic care in an acute or follow-up setting where travel, time, expense and or contact precautions impede access to ophthalmic care. In Western Australia the rapid introduction of regional travel restrictions during the COVID-19 pandemic provided an opportunity for LOV to implement and trial the use of three different types of teleophthalmology services.

Since the COVID-19 pandemic, the Australian Government has recognised the importance of telehealth for the ongoing provision of healthcare to those living in regional and remote locations by including telehealth consultations (video and telephone) on the Medicare Benefits Schedule.[13] This study supports the ongoing use of the expanded modalities including telephone for telehealth in ophthalmology with improvements in access for Aboriginal populations and very remote communities. It also highlights the necessity for primary optometry in regional locations, as clinical assessment conducted by optometrists is necessary for facilitating telehealth consultations with ophthalmology, regardless of the modality of telehealth used.

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No potential conflict of interest was reported by the author(s).

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