

RESEARCH PAPER

Optometric use of a teleophthalmology service in rural Western Australia: comparison of two prospective audits

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Roderick O'Day* MBBS

Constance Smith† BMedSci

Josephine Muir‡ PhD

Angus Turner†‡ MBBS MSc FRANZCO†

*Royal Victorian Eye and Ear Hospital, Melbourne, Australia

†University of Western Australia, Perth, Australia

‡Lions Eye Institute, Perth, Australia

E-mail: angus.turner@gmail.com

Background: Lions Outback Vision provides a telehealth service ('the telehealth service') to rural and remote communities in Western Australia aiming to deliver timely ophthalmic care to this underserved population. A number of barriers to its use were identified by an initial prospective audit. A multifaceted intervention was designed to increase the use of the telehealth service by optometrists.

Methods: Optometrists referred patients from rural and remote Western Australia to the telehealth service. Two five-month prospective audits of the telehealth service were compared. The first, in 2012, was prior to the implementation of the intervention. The second, in 2014, was during the period of the intervention, which included logistical support, remuneration to optometrists, a more user-friendly referral pathway and awareness raising. The outcome measures were the number of consultations conducted during the two audit periods and other quantitative changes to the telehealth service.

Results: After implementation of the intervention, use of the telehealth service increased 3.5 fold. A greater percentage of referrals were for non-urgent conditions (145 [69 per cent] versus 16 [32 per cent], $p < 0.001$) and less consultations recommended follow up with an ophthalmologist in clinic (42 [20 per cent] versus 17 [28 per cent], $p = 0.04$). Imaging studies were frequently used to supplement information provided by the referrer to the specialist during both audit periods.

Conclusions: Optometrists used the telehealth service more frequently after the implementation of an intervention that addressed the barriers to its use. This has a number of potential benefits to rural and remote ocular health service provision in Australia.

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Telehealth using real-time video consultations aims to tackle inequalities in rural and remote ocular health service provision. Residents of rural areas have an increased prevalence of some ocular pathology, including cataract, pterygia, ocular trauma and glaucoma and are less likely to have accessed the ophthalmological services available to them compared to urban residents.^{1–4}

Lions Outback Vision provides a telehealth service ('the telehealth service') that connects patients in rural and remote Western Australia to a general ophthalmologist ('the specialist') using real-time video consultations facilitated by general medical practitioners (GPs), hospital district medical officers (DMOs) and optometrists. A five-month prospective audit of the telehealth service was conducted in 2012.⁵ Logistical, technical and funding barriers were found to prevent

its widespread use.⁵ Video consultations may be more difficult to arrange, as three parties may be present during the consultations – referrer, patient and specialist. The software and hardware used for the consultation and for transmission of clinical information beforehand may have technical malfunctions. Most importantly, optometrists, who are the main referrers to the telehealth service, were not remunerated for their time and the use of their equipment, as opposed to GPs and hospital DMOs.⁶ Financial barriers are commonly cited as the most important to the uptake of a new telemedicine service.⁷ This current audit, conducted over the same months in 2014, was designed to assess the effect of an intervention that addressed these barriers and in doing so, improve collaboration between ophthalmologists and optometrists in a rural setting.

METHODS

Ethics

This study was granted exemption from formal ethics approval by the Human Research and Ethics Committee at the University of Western Australia on the basis that it was a clinical audit.

Service description

Lions Outback Vision is located at the Lions Eye Institute, Western Australia. It co-ordinates and delivers ophthalmological and optometric services to rural and remote sites in Western Australia. Outreach visits are augmented by the telehealth service. This study is based on data from two prospective audits of the telehealth service. The first ran from April to August 2012 and the second from April to August 2014. Referrals for video

consultations were received from varied sources, including GPs, hospital DMOs and optometrists. The current analysis only includes the referrals made by optometrists during these periods.

During the first audit period, the referring optometrist contacted the specialist directly to arrange a time for a video consultation. A referral letter and any relevant images captured by the optometrist or other trained staff member were transferred electronically to the specialist for review. A video consultation was then conducted with the patient, referring optometrist and specialist at the organised time.

The second audit period was of optometric referrals to the same telehealth service after a multifaceted intervention to increase its uptake. This intervention consisted of:

1. Remuneration to optometrists at \$50 per video consultation to simulate Medicare Benefits Schedule payments to other referring health practitioners,⁶
2. Logistical and administrative support at the Lions Eye Institute,
3. A dedicated online service to book appointments, capture Medicare details, patient and referrer information, referral indication and securely transmit examination and investigation data,
4. Awareness raising through visits to local optometrists and
5. Scheduling times in the week that could be booked by the referrer for video consultations, rather than performing *ad hoc* consultations.

The primary outcome is change in the number of video consultations performed that were referred by optometrists to the telehealth service between the two audit periods. Secondary outcomes include a descriptive analysis of the second audit period and the differences in patient demographics, reason for consultation, follow-up plan and technology used between the two audit periods.

Data collection and statistical analysis

Data were collated on clinical log-sheets completed by the specialist following a consultation. These are recommended as a simple evaluation tool and have been used previously to evaluate telehealth consultations in Western Australia.^{8,9} The information collected was then recorded into a secure password-protected database (MS Excel 2011; Microsoft Corporation; USA). The participants' electronic medical records (MMEx; UWA Centre for Software Practice; WA, Australia) held by

the specialist were reviewed to verify the validity of the information collected. Any forms not completed immediately following a video consultation were completed retrospectively using the participants' electronic medical record and referral information.

Referrals were classified as urgent or non-urgent. Referrals were assessed according to the Western Australia ophthalmology referral guidelines by one author (O'Day) and confirmed by another (Turner).¹⁰ Category 1 (urgent) and category 2 (semi-urgent) referrals were defined as urgent for this study. Category 3 (routine) referrals were defined as non-urgent. Differences in proportions between two groups were analysed using Fisher's exact test. *A priori*, a p value of less than 0.05 was defined as statistically significant. All data were analysed using a commercially available software package (PASW 22, SPSS Inc, Chicago, Illinois, USA).

RESULTS

The number of video consultations referred by optometrists to the telehealth service increased by 3.5 times between the first and second audit period. In the first audit period, 60 video consultations with 49 patients were performed, compared to 211 consultations with 184 patients in the second.

Demographics

The average age of patients seen during the first audit period was 50.5 years (range 9 to 86) and 61.4 years (range 7 to 96) in the second. There were 22 females (45 per cent) in the first audit and 97 females (53 per cent) in the second. The location of the referring

optometrist is given in Table 1. The majority of video consultations originated from referring optometrists in Karratha (41 of 60, 68 per cent) and Albany (111 of 211, 57 per cent) in the first and second audit periods, respectively. All but two locations had increased numbers of video consultations; however, the number from Karratha halved, from 41 to 20 and from Broome remained the same at seven during both audit periods.

Reasons for referral

The working diagnoses after video consultations for previously undiagnosed conditions are listed in Table 2. The most commonly made working diagnoses were anterior uveitis (9 of 41, 22 per cent) in the first audit period and cataract (56 of 162, 35 per cent), in the second. The reason for video consultations when the diagnosis was and was not known prior are provided in Tables 3 and 4, respectively. The two most common referrals in the first audit period were for red eye (15 of 41, 37 per cent) and painless vision loss (6 of 41, 15 per cent). In the second, the two most common referrals were for cataract (56 of 162, 35 per cent) and glaucoma assessments (22 of 162, 14 per cent). Consultations where the diagnosis was known were most commonly for glaucoma review (7 of 19, 37 per cent) and uveitis review (7 of 19, 37 per cent) in the first audit period and for post-operative assessments in the second (26 of 49, 53 per cent). Of all consultations, there was a significant increase in the number of non-urgent conditions being assessed in the second as compared to the first audit period (145 of 211 versus 16 of 50, $p < 0.001$).

	ASGC* Remoteness Area	Second audit period	First audit period
Albany	RA3	111	11
Kalgoorlie	RA3	31	0
Port Hedland	RA4	22	0
Karratha	RA4	20	41
Denmark	RA3	10	0
Broome	RA4	7	7
Other	-	10	1
Total		211	60

*ASGC: Australian Standard Geographical Classification used by the Australian Bureau of Statistics, RA3: outer regional, RA4: remote.

Table 1. The number of video consultations according to the location of referring optometrist

Diagnostic category	Diagnosis	Second audit (n = 162)	First audit (n = 41)	
External eye	Lid mass	2	0	
	Blepharitis	0	2	
Conjunctiva	Pterygium	1	1	
	Conjunctivitis	1	0	
	Conjunctival naevus	1	0	
	Episcleritis	0	1	
Cornea	Corneal oedema	2	1	
	Recurrent corneal erosion syndrome	2	0	
	Peripheral ulcerative keratitis	1	0	
	Keratoconus	1	0	
	Undifferentiated corneal disease	2	3	
Anterior chamber	Anterior uveitis	4	9	
Lens	Cataract	56	4	
	Posterior capsular opacification	6	0	
Retina	Age-related macular degeneration			
	Non-neovascular	5	1	
	Neovascular	3	0	
	Diabetic retinopathy			
	Diabetic retinopathy only	2	0	
	Diabetic maculopathy	3	0	
	Posterior vitreous detachment	4	3	
	Central serous chorioretinopathy	2	0	
	Macular hole	2	0	
	Macular oedema, non-diabetic, non-pseudophakic	2	0	
	Branch retinal vein occlusion	1	1	
	Retinal detachment	1	0	
	Vitreomacular traction	1	0	
	Undifferentiated retinal disease	7	3	
	Optic nerve / glaucoma	Primary open angle glaucoma	13	2
		Glaucoma suspect	6	0
		Ocular hypertension	4	0
Optic neuropathy – undifferentiated		4	0	
Optic disc drusen		2	0	
Other	Migraine	1	1	
	Medication allergy	1	1	
	Horner's syndrome	1	1	
	Idiopathic intracranial hypertension	1	1	
	Systemic lupus erythematosus	1	0	
	Strabismus	1	0	
	Homonymous hemianopia	1	0	
	Herpes zoster ophthalmicus	0	1	
	Normal/Unknown	Normal	7	4
Unknown		7	1	

Table 2. The working diagnoses after video consultations, where diagnosis was not known prior to the consultation

Follow-up plan

Follow-up with an ophthalmologist was recommended after 21 video consultations (35 per cent) in the first audit period, 17 for a clinic appointment and 4 for a further video consultation. In the second audit period, follow-up with an ophthalmologist was recommended after 149 video consultations (71 per cent), 54 consented for surgery at a future outreach visit, 51 for a further video consultation and 42 for a clinic appointment. A significantly lower proportion of patients was recommended for a follow-up clinic appointment with an ophthalmologist in the second audit than the first. This was true for all consultations (42 of 211 versus 17 of 60, $p = 0.04$) and for consultations only that recommended follow-up with an ophthalmologist (42 of 149 versus 17 of 21, $p < 0.01$). Two cases required urgent transfer to Perth in both audit periods and three required admissions to a local hospital in the second.

Technology used

IMAGING EQUIPMENT

The referring optometrist provided imaging studies of the eye to the specialist in 27 consultations (45 per cent) in the first audit period and 76 (36 per cent) in the second, $p = 0.23$. Optical coherence tomography (OCT) was used in seven (12 per cent) consultations in the first audit period and 45 consultations (21 per cent) in the second, $p = 0.14$; automated perimetry in seven (12 per cent) and 41 (19 per cent), $p = 0.18$; fundus photos in eight (13 per cent) and 24 (11 per cent), $p = 0.65$ and slitlamp photographs in eight (13 per cent) and three (one per cent), $p < 0.01$, respectively.

SOFTWARE

Three software services were used for video consultations – Skype (Microsoft Corporation; USA), VSee (VSee Lab LLC; USA), and FaceTime (Apple Inc; USA). In the first audit period, all 60 video consultations were performed using Skype. In the second, 140 (66 per cent) used Skype, 57 (27 per cent) used VSee and 14 (seven per cent) used FaceTime. Skype, VSee and FaceTime are proprietary voice-over-Internet-Protocol services that allow group video chat and are available free to download.

DISCUSSION

This analysis compared two prospective audits of video ophthalmological consultations

Reason for consultation	Second audit (n = 162)	First audit (n=41)
Cataract assessment	56	2
Glaucoma suspect	22	4
Loss of vision		
Painless	18	6
Abnormal image		
OCT	14	2
Retinal photograph	13	2
Painful eye	7	1
Ocular health assessment	6	0
Red eye	3	15
Flashes / floaters	1	4
Other	22	5

Table 3. The reasons for video consultations, when the diagnosis was not known prior to the consultation

Reason for consultation	Second audit (n = 49)	First audit (n = 19)
Post-operative review		
Cataract	24	0
Intravitreal injection	2	0
Glaucoma	11	7
Corneal pathology	7	4
Idiopathic intracranial hypertension	3	1
Anterior uveitis	2	7

Table 4. The reasons for video consultations when the diagnosis was known prior to the consultation

referred by optometrists in rural areas of Western Australia. A significant increase in the use of this service was demonstrated after the implementation of a multifaceted intervention aiming to reduce the barriers that prevent its widespread uptake. There was a significant increase in non-urgent referrals – mainly for cataract and glaucoma assessment. A greater proportion of patients seen had follow-up with an ophthalmologist arranged, with a greater proportion of further care involving direct surgical bookings. Imaging studies were used frequently to supplement the information provided by the referrer for the video consultation. A significant reduction in the proportion of referrals being accompanied by a slitlamp photograph was found but there was no significant change in the use of OCT, automated perimetry or fundus photographs. Skype remained the software of choice for video consultations; however, other modalities were also used.

It is probable that the intervention caused the changes that we found in the use of the telehealth service between the two audit periods for a number of reasons. First, the referrals to the service increased 3.5 fold, a highly significant rise. Secondly, there was a shift to non-urgent conditions being referred. The intervention targeted the barriers to using teleophthalmology. With reduction of these barriers, it is logical that the number of referrals would increase and that teleophthalmology would cease being reserved purely for urgent conditions. This study was not designed to assess causal relationships and the change in use of the service may have been due to other factors. In particular, in the rural and remote setting, there is high turnover of health practitioners and referrals are heavily reliant on personal relationships between referrer and specialist. These are thought to have been responsible for the reduction in the number of video

consultations referred from optometrists in Karratha between the first and second audit periods.

The significant shift in the referral pattern during the two audit periods, with non-urgent referrals becoming more common, may improve the utilisation of outreach services.¹¹ We did not foresee this change when planning the study. Outreach clinics may have long waitlists and be heavily booked.¹² We found a significantly lower proportion for patients being referred to clinic appointments with an ophthalmologist during the second audit than the first. This reserves clinic appointments for more complex cases better using the limited time a specialist spends in the rural or remote location. Video consultations for non-urgent conditions may lead to reductions in the time to initiation of treatment, for example the medical management of glaucoma or surgery for cataract.¹³ It may also increase the surgical case rate per outreach visit, which may act as a surrogate marker for effective use of specialist skills and reduction in primary eye care.⁴ Future studies should measure these factors. Video consultations for non-urgent conditions may also enable better continuity of care. For example, in the second audit timely post-operative assessments were performed that would normally not be seen until the next outreach visit, which can be up to six months.

The limitation of this analysis is that it is descriptive in nature. Studies are required to assess the validity of video consultations as an effective and safe means of diagnosing and treating common ocular conditions as compared to the traditional referral pathway.^{14,15}

Barriers remain that impede the uptake of teleophthalmology. Videoconferencing is time-consuming and logistically more challenging compared to 'store and forward' asynchronous teleophthalmology as previously described.¹² Clinic booking systems and facilitation by co-ordinators may support increased utilisation of telehealth. Exploration of asynchronous telehealth methods for meeting specialist demand also warrants further study but remains unsustainably funded in Australia.

CONCLUSIONS

Video consultations are increasingly being used by rural and remote Western Australians to access specialist ophthalmic care. After an intervention targeting the major barriers to the uptake of a service at the Lions Eye Institute, significant increases in service delivery

were demonstrated. The use of telehealth may help tackle the disparities in specialist access in rural and remote Australia and the higher prevalence of ocular disease.

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