

Letter to the Editor

Survey of General Practitioners on Tele-Ophthalmology Practice in Singapore

Dear Editor,

A major burden faced by healthcare system in Singapore is its ageing population, which is Asia's third largest.¹ Those over 65 years old constitute about 8.7% of our population, and it is estimated that by 2030 and 2050, this will rise to 23% and 31%, respectively.² Currently, most tertiary eye departments continue to be major providers of ophthalmic care for simple to complex eye conditions.^{3,4} Without the development of integrated primary eye care services, it is conceivable that these services might be rapidly overwhelmed.

The use of tele-medicine is increasingly popular, and successful examples have been demonstrated.^{5,6} One such local example is the Singapore integrated Diabetic Retinopathy Programme (SiDRP),⁷ a national screening platform where fundus photographs taken in primary care setting are graded by a centralised team of experts.

While studies are being conducted to assess the advances and efficacy of tele-ophthalmology as well as patients' satisfaction, there are not many studies evaluating the perspectives of general practitioners (GP) towards tele-ophthalmology.⁸ New technology and healthcare models are potentially disruptive changes, but will have limited impact if the end-users are not willing or resistant to its adoption. We conducted an anonymised survey to assess our local GPs' confidence and interest in using tele-ophthalmology in their clinical practice.

Method

After obtaining our institutional review board's approval, this cross-sectional study was conducted by the distribution of questionnaires to GPs who attended ophthalmology GP symposia at the National University Hospital on 18.11.17 and 23.6.18. The study information sheet was distributed along with the questionnaire (Figure 1), and participation was voluntary. Quantitative and qualitative analyses of data were performed with software R. Chi square test and Fischer's exact test were employed for the analyses of categorical variables.

Results

In total, 104 out of 130 GPs who attended the symposia completed the questionnaires (80% response rate). 53 male (51%) and 51 female GPs participated, and 19 GPs did not mention gender. The mean age was 54.2 ± 9.2 years, with mean of 30.5 ± 11.7 years since graduation, with 24.2 ± 10.4 years of experience in general practice.

Our results showed that 95 GPs (91.34%) had not participated in any form of tele-medicine before. Diabetic retinopathy was the condition most of the GPs (89.3%) felt tele-ophthalmology could be successfully applied in their practice, followed by glaucoma (57.1%), cataract (50%), post cataract surgery review (39.2%), external eye lesions (3.6%) and acute eye conditions (3.6%).

When asked about the advantages of tele-ophthalmology, 92 GPs (88%) indicated that they would gain more confidence in managing ophthalmic conditions with ophthalmologist supervision; 89 GPs (86%) felt it would reduce the number of unnecessary specialist referrals, 67 GPs (64%) felt it would save patients' time and money and 37 GPs (35%) felt it would build patients' trust and confidence in GPs. When asked about the disadvantages, 71 GPs (68%) pointed to expensive machinery and set-up cost, 37 GPs (36%) felt it would be time consuming, 30 GPs (29%) felt patients might perceive lack of human interaction and 22 GPs (21%) felt patient confidentiality might be compromised. Portability/requirement of less storage space, ease in usage and low cost were the top 3 desirable features expected of the equipment. This was followed by others, in order: ophthalmologist-guided image interpretation system, auto focus and image capture facility, incorporation of artificial intelligence for diagnosis, and facility to train staff/revise skills (Figure 2).

There were 85 GPs (82%) who felt that incorporating tele-ophthalmology would improve their clinical practice, 15 GPs' (18%) responses were neutral, and none felt it would not improve their clinical practice. There was no significant association between this perspective and their age ($P = 0.358$) or years since

Tele-Ophthalmology Survey for General Practitioners	
<p>Dear doctors,</p> <p>We are conducting a survey on general practitioners' perspective on Telemedicine, in particular Tele-Ophthalmology. We are trying to evaluate the effectiveness of Tele-Ophthalmology as a clinical tool and its impact on diagnosis and management of eye conditions in the community. We invite all of you to participate in this survey.</p> <p>For this survey, we refer to Tele-Ophthalmology as an internet-based system which uses digital medical equipment to capture information of the eye (e.g. photographs, visual fields, eye pressure etc.) and the results will be transmitted to an ophthalmologist for interpretation. In this system, the patient and the ophthalmologist will not have to be in the same place. The patient may be able to go to a clinic near his/her house and have their ophthalmic tests performed. The results can be interpreted by an ophthalmologist remotely or by the primary physician in consultation with an ophthalmologist.</p> <p>The result of this survey will provide useful information about the idea of incorporating tele-ophthalmology into primary care practice.</p> <p>We would be grateful if you could answer this short survey on Tele-Ophthalmology. It will hardly take ten minutes to finish the survey. Please circle one option unless indicated in the question. And kindly make sure you do not skip any questions.</p> <p>Your responses and personal information will be kept confidential and will not be used for other purposes.</p> <p>Your participation in this study is purely voluntary and you are free to withdraw from this study at any point of time. Your refusal to participate in this study will not have any impact on your medical care or service. By agreeing to fill up the questionnaire, you have voluntarily consented to take part in the study.</p>	
<p>Age:</p> <p>Sex: M / F</p> <p>Year of graduation:</p> <p>Years of experience in general practice:</p> <p>1) Have you participated in Telemedicine with patients or other doctors before?</p> <p>a) No.</p> <p>b) Yes. With patients</p> <p>c) Yes. With other doctors.</p> <p>2) How many hours of Telemedicine do you practice per day?</p> <p>a) None.</p> <p>b) <1 hour</p> <p>c) 1-2 hours</p> <p>d) >2 hours</p> <p>3) For what conditions do you think Tele-Ophthalmology would be successful? (Choose 1 or more options)?</p> <p>a) Cataract</p> <p>b) Post cataract surgery review</p> <p>c) Glaucoma check</p> <p>d) Diabetic eye check</p> <p>e) Others (please specify): _____</p> <p>4) On an average, how many diabetic patients do you manage in your practice in a week?</p> <p>a) >50</p> <p>b) 50-100</p> <p>c) 100-200</p> <p>d) >200</p> <p>5) How often do you grade digital fundus photographs for diabetic retinopathy?</p> <p>a) Never.</p> <p>b) <10 photos per week</p> <p>c) 10-50 photos per week</p> <p>d) > 50 photos per week</p> <p>6) Do you think your current clinical knowledge in ophthalmology is sufficient for the grading of diabetic retinopathy using digital fundus photographs?</p> <p>a) Yes. I am confident of doing it without any training.</p> <p>b) Maybe. But I may need some refresher course</p> <p>c) No. I am not confident of my skills and I am not interested in seeing eye conditions in my practice</p> <p>d) No. However, I am keen to explore Tele-Ophthalmology as an additional service to detect diabetic retinopathy for my diabetic patients</p>	
<p>7) Do you think your current clinical knowledge in ophthalmology is sufficient for the detection of glaucoma in your practice?</p> <p>a) Yes. I am confident of doing it without any training.</p> <p>b) Maybe. But I may need some refresher course</p> <p>c) No. I am not confident of my skills and I am not interested in seeing eye conditions in my practice</p> <p>d) No. However, I am keen to explore Tele-Ophthalmology to screen my patients for glaucoma in my practice.</p> <p>8) Do you think incorporating Tele-Ophthalmology would improve your clinical practice?</p> <p>a) Yes. Definitely</p> <p>b) Not at all.</p> <p>c) Not sure.</p> <p>9) What do you think are the advantages of Tele-Ophthalmology? (Choose 1 or more options)?</p> <p>a) Reduce the number of unnecessary referrals to specialist</p> <p>b) Gain confidence in managing ophthalmological conditions with guided supervision by ophthalmologist</p> <p>c) Patients will start trusting and develop confidence in their general practitioners in managing their eye conditions.</p> <p>d) Saves time and money for patient.</p> <p>10) What do you think are the disadvantages of Tele-Ophthalmology? (Choose 1 or more options)</p> <p>a) Loss of patient confidentiality</p> <p>b) Expensive machinery and set up</p> <p>c) Time consuming</p> <p>d) Patient's perspective of lack of human interaction/ inability to understand.</p> <p>11) What do you think should be the cost of these consults?</p> <p>a) Cheaper than visit to general practitioner</p> <p>b) Costlier than visit to general practitioner</p> <p>c) Cheaper than visit to ophthalmologist</p> <p>d) Costlier than visit to ophthalmologist</p>	<p>12) If you are to introduce a new equipment in your practice to detect eye conditions, what are the key features (Top 3) you would like to see in it (please circle 3)</p> <p>a) Low cost of equipment</p> <p>b) Portable and require little storage space</p> <p>c) Easy to use</p> <p>d) Automated capture of images once the device is positioned appropriately</p> <p>e) Physician support software (artificial intelligence) which would provide preliminary diagnosis</p> <p>f) Integrated into a Tele-Ophthalmology service in which the ophthalmologist interprets all the results to confirm diagnosis</p> <p>g) Others: _____ very keen</p> <p>13) On a scale of 1-5 (1= Not keen, 5= very keen), kindly rate your willingness to participate in our proposed system of artificial intelligence?</p> <p>a) 1</p> <p>b) 2</p> <p>c) 3</p> <p>d) 4</p> <p>e) 5</p> <p>Comments (if any) : _____</p> <p>14) For which conditions do you think artificial intelligence based grading and diagnosis would be useful/reliable?</p> <p>a) Diabetic retinopathy</p> <p>b) Age Related Macular degeneration</p> <p>c) Glaucoma</p> <p>d) Cataract.</p> <p>15) What type of collateral materials would you like to receive from NUH Ophthalmology in the future? (You may tick more than one box)</p> <p>a) Leaflet with information on upcoming events and talks by the department</p> <p>b) Newsletter featuring past events by the department</p> <p>c) Educational materials regarding different eye conditions and diseases</p> <p>d) None</p> <p>e) Others (please specify): _____</p>

Fig. 1. Sample of the information sheet and questionnaire used in our study

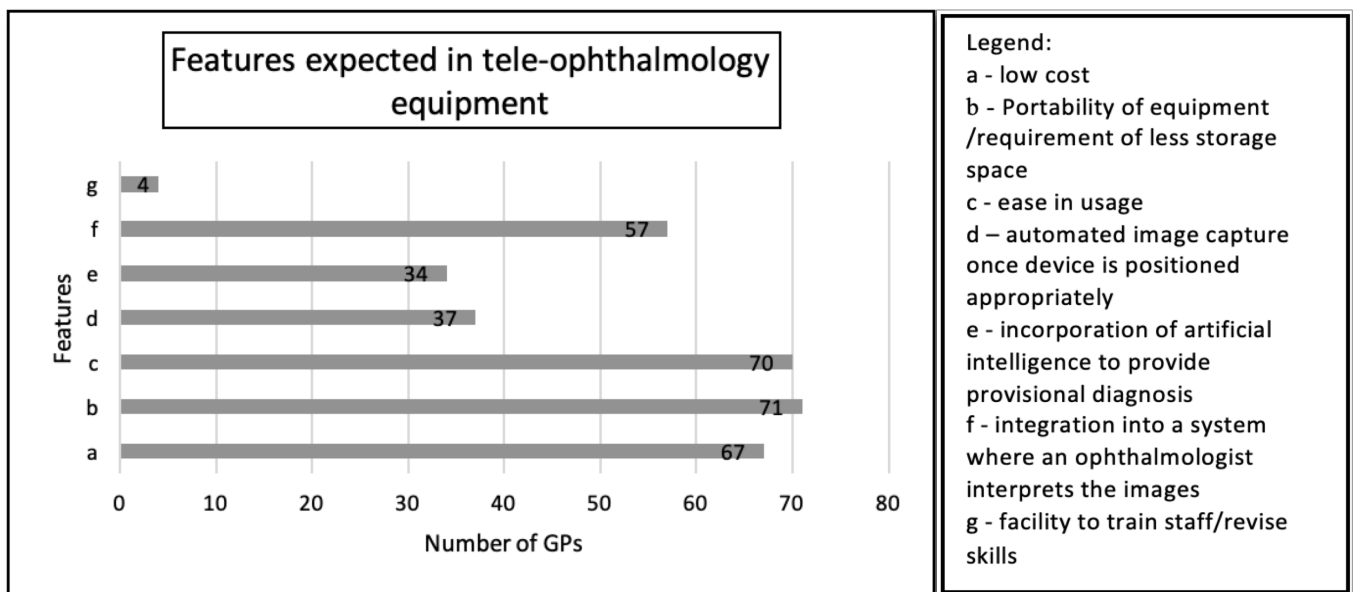


Fig. 2. Bar chart representing GPs' opinion on features expected in tele-ophthalmology equipment

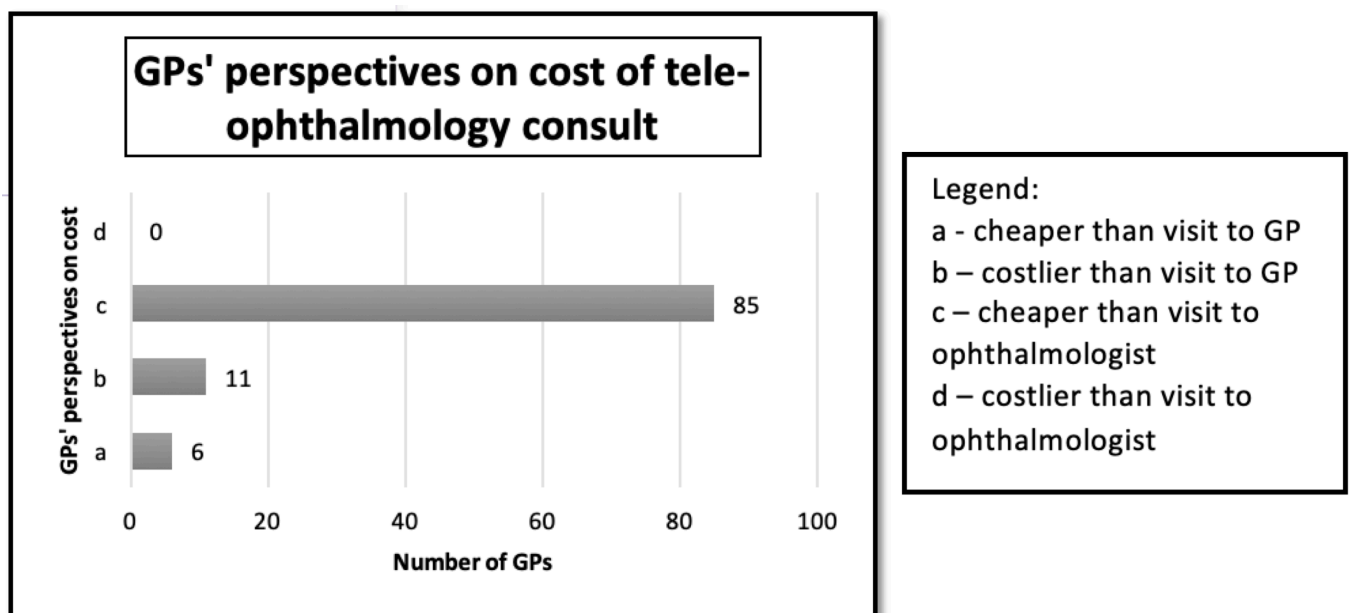


Fig. 3. Bar chart representing GPs' opinion on cost of tele-ophthalmology consult.

graduation ($P = 0.398$) or experience in general practice ($P = 0.788$). On a scale of 1 to 5 (1 = not keen and 5 = very keen) rating their willingness to participate in tele-ophthalmology and artificial intelligence, we received a modal response of 4.

Regarding cost, 85 GPs (82%) felt that these visits should be cheaper than visits to the ophthalmologist (c), 11 GPs (12%) felt it should be costlier than visits to GP

(b), 6 GPs (6%) felt it should be cheaper than visits to GP (a) and none felt they should be costlier than visits to ophthalmologist (d) (Figure 3).

Discussion

The major drivers of tele-ophthalmology are ageing population, prevalence of chronic eye conditions, increased demand for specialist expertise and the need

for cost-effective and safe methods of eye-care delivery. Among chronic conditions, cataract has a prevalence rate of about 78.6% among the elderly above 60 years in Singapore, followed by diabetic retinopathy affecting nearly 33% of diabetics, age-related macular degeneration affecting 5.6%, and glaucoma affecting 3.2% of Singapore's population.⁴ In Singapore, it is projected that the prevalence of diabetic retinopathy, glaucoma and cataract will increase by 113%, 102% and 82%, respectively, from 2015 to 2040.³

The main advantages of tele-ophthalmology are remote monitoring and diagnosis of eye conditions by specialists, shifting the diagnostic burden away from GPs. It benefits the elderly who cannot travel long distances for appointments, and reduces the costs involved, eventually leading to better compliance with review visits. For the tertiary centres, tele-ophthalmology will reduce patient load by bringing healthcare to the community. It also reduces unnecessary clinic visits for early eye conditions requiring only routine surveillance, e.g. early cataracts, glaucoma suspect.

In Singapore, primary healthcare is provided at 20 polyclinics and nearly 1700 GP clinics. GPs are the main providers of primary care accounting for nearly 81% of all patient attendances and a 55% market share of chronic disease care.⁹ The screening rates for diabetic retinopathy has shown a substantial improvement with the introduction of digital fundus camera in outpatient polyclinics. However, annually, up to 13.8% of patients with diabetes miss their appointments at polyclinics, which may be attributed to an over-burdened centralised screening program.¹⁰

Diabetic retinopathy and glaucoma require long-term follow up and regular visits to ophthalmologist. Currently, diabetes contributes to an estimated 10% of total disease burden in Singapore with nearly 450,000 Singaporeans affected. This is projected to rise to 1 million by 2050.¹¹ The lifetime risk of diabetic retinopathy in type 2 diabetes is 50 to 60% and 90% in type 1 diabetes.¹² Screening for diabetic retinopathy and follow-up can be made more accessible with the availability of fundus photographs at GP clinics. Of the 3 microvascular complications of diabetes, screening for peripheral neuropathy and nephropathy are usually done by GPs, who refer patients to specialists only when a specific threshold is reached. The current workflow of SiDRP can be extended to include GP clinics. Screening and follow-up of glaucoma can also be made possible with fundus photos to assess cup: disc ratio (C:D ratio), intraocular pressure check and perimetry at GP clinics. Attempts can be made to train graders to interpret visual fields or employ artificial intelligence for the same.

In Singapore, a cost-effectiveness analysis showed that tele-medicine-based DR screening had significantly lower cost compared to family physicians-based manual DR screening, with approximate saving of about S\$30 million over a patient's lifetime.⁷ On the other hand, expensive ophthalmic diagnostic equipment and low utilisation rates of these equipment makes it less likely that GPs will adopt it to expand their capabilities to manage chronic eye diseases. This survey highlights the major barriers, including that of cost, which have to be addressed in order to achieve any success.

The availability and cost of qualified graders are important considerations. The use of artificial intelligence for diagnosis and grading appears to be a promising solution. However, currently more studies are required to verify the efficacy of artificial intelligence in clinical setting.^{13,14} Our study also showed that most of the GPs felt tele-ophthalmological consults should be less expensive than visits to the ophthalmologist, but costlier than conventional visits to the GP. Although the initial cost of set-up, training and equipment is high, it is expected to be outweighed by the benefits and returns that this system will yield in the long run.¹⁵

Our results also showed that attempts need to be made to protect patient confidentiality, decrease the cost of initial set-up and patient's perception of lack of human interaction. Also, making attempts to improve access to patients and maintaining patient satisfaction are significant factors towards a successful programme.

The results from this study represent the views of a group of GPs who attended an open-invitation eye symposium; hence, these GPs could be the ones already interested in primary eye care. Public and private sectors have their own unique challenges while adopting new technology. Further nation-wide studies can be aimed at determining practice-specific differences in challenges for tele-ophthalmology. A questionnaire with open ended questions would have provided unrestricted perspective with qualitative comments. GPs' views on who would be responsible for clinical decision-making was not assessed, and it can be considered in the future.

Overall, there is a positive perspective on tele-ophthalmology from GPs. Given that past research, experiences and patient satisfaction surveys have validated the efficacy of tele-ophthalmology, the current finding of a welcoming outlook from local GPs suggests that this model has a good chance of success. Even though this system is available in Singapore, the GPs seem to have little hands-on experience. This gap can be filled by providing practice sessions and assessing their comfort level.

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