



Cost-effectiveness of a National Telemedicine Diabetic Retinopathy Screening Program in Singapore

Hai V. Nguyen, PhD,¹ Gavin Siew Wei Tan, MMed(Ophth), FAMS,² Robyn Jennifer Tapp, PhD,^{3,4} Shweta Mital, MSc,⁵ Daniel Shu Wei Ting, MD, PhD,² Hon Tym Wong, FRCSEd(Ophth), MMed(Ophth),⁶ Colin S. Tan, FRCSEd(Ophth), MMed(Ophth),⁶ Augustinus Laude, FRCSEd(Ophth), FAMS(Ophth),⁷ E. Shyong Tai, FRCP, PhD,⁸ Ngap Chuan Tan, MMed(FM), MCI,⁹ Eric A. Finkelstein, PhD, MHA,⁵ Tien Yin Wong, MMed(Ophth), PhD,^{2,10,*} Ecosse L. Lamoureux, MSc, PhD^{2,10,*}

Purpose: To determine the incremental cost-effectiveness of a new telemedicine technician-based assessment relative to an existing model of family physician (FP)-based assessment of diabetic retinopathy (DR) in Singapore from the health system and societal perspectives.

Design: Model-based, cost-effectiveness analysis of the Singapore Integrated Diabetic Retinopathy Program (SiDRP).

Participants: A hypothetical cohort of patients aged 55 years with type 2 diabetes previously not screened for DR.

Methods: The SiDRP is a new telemedicine-based DR screening program using trained technicians to assess retinal photographs. We compared the cost-effectiveness of SiDRP with the existing model in which FPs assess photographs. We developed a hybrid decision tree/Markov model to simulate the costs, effectiveness, and incremental cost-effectiveness ratio (ICER) of SiDRP relative to FP-based DR screening over a lifetime horizon. We estimated the costs from the health system and societal perspectives. Effectiveness was measured in terms of quality-adjusted life-years (QALYs). Result robustness was calculated using deterministic and probabilistic sensitivity analyses.

Main Outcome Measures: The ICER.

Results: From the societal perspective that takes into account all costs and effects, the telemedicine-based DR screening model had significantly lower costs (total cost savings of S\$173 per person) while generating similar QALYs compared with the physician-based model (i.e., 13.1 QALYs). From the health system perspective that includes only direct medical costs, the cost savings are S\$144 per person. By extrapolating these data to approximately 170 000 patients with diabetes currently being screened yearly for DR in Singapore's primary care polyclinics, the present value of future cost savings associated with the telemedicine-based model is estimated to be S\$29.4 million over a lifetime horizon.

Conclusions: While generating similar health outcomes, the telemedicine-based DR screening using technicians in the primary care setting saves costs for Singapore compared with the FP model. Our data provide a strong economic rationale to expand the telemedicine-based DR screening program in Singapore and elsewhere. *Ophthalmology* 2016;■:1–10 © 2016 by the American Academy of Ophthalmology



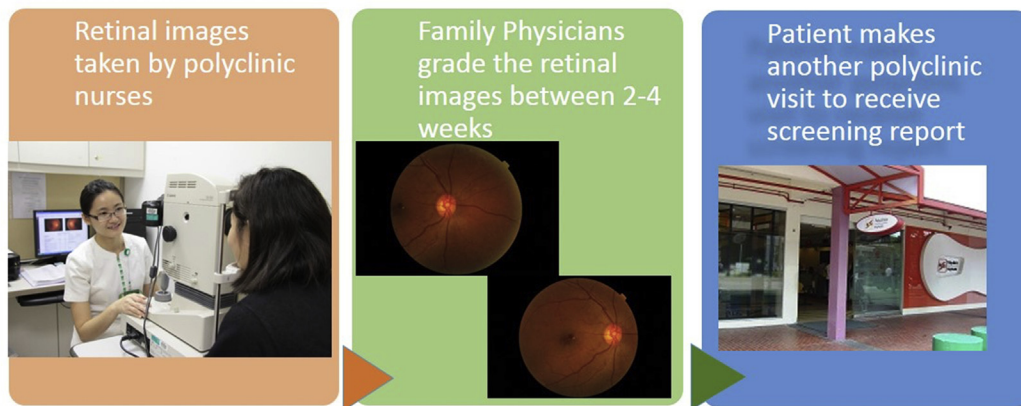
Supplemental material is available at www.aaojournal.org.

Diabetic retinopathy (DR), a common microvascular complication, can affect approximately one third of people with diabetes^{1,2} and remains one of the leading causes of acquired vision loss and blindness in working-age adults.^{3,4} With the number of people with diabetes projected to increase from 387 to 600 million in 2035 worldwide,⁵ DR remains a significant economic burden on society, particularly in Asia, which accounts for more than 60% of the people with diabetes globally.⁶

Diabetic retinopathy screening is widely recommended and nationally conducted in several developed countries.^{7,8}

Traditional DR screening involves retinal evaluations by eye care professionals but has a low uptake rate (i.e., <60%) and is unlikely to meet the increasing need for DR screening.⁹ Telemedicine-based DR screening with a central assessment of DR using trained technicians (“readers”) has been proposed as an alternative strategy to the traditional DR screening model,² with sensitivity and specificity values comparable to those of standard DR screening tests.^{10–12} Compared with traditional DR screening, telemedicine-based DR screening has been shown to increase uptake,^{13,14} reduce vision loss,¹³ and yield higher patient

Family physician-based DR screening workflow



Telemedicine-based DR screening workflow

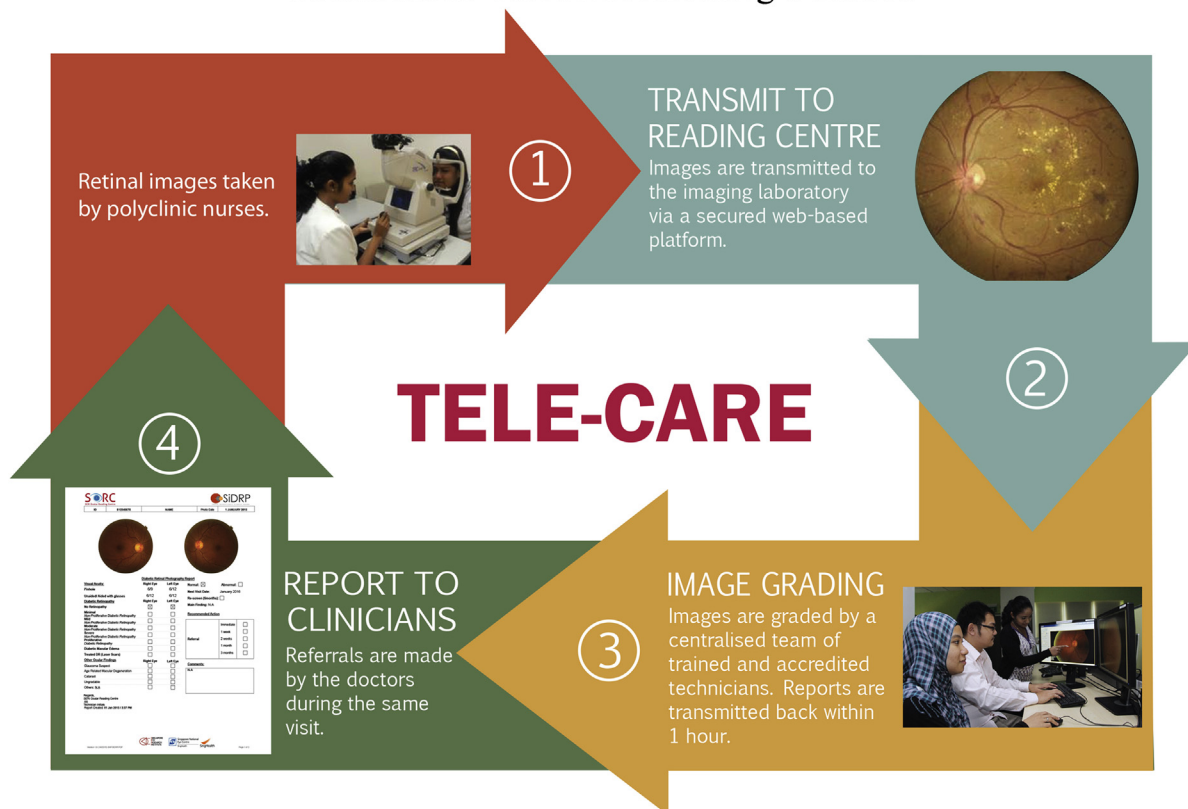


Figure 1. Workflow of alternative diabetic retinopathy (DR) screening strategies.

satisfaction.^{15,16} Although traditionally advocated for overcoming limited access to DR screening in rural and remote areas, telemedicine-based DR can address several barriers to DR screening in an urban setting, including working people's busy schedules and delayed access to tertiary eye care.¹⁷

There is limited evidence of the cost-effectiveness of telemedicine-based DR screening, especially in the general

urbanized diabetes population. To date, most studies have examined the cost-effectiveness of telemedicine-based DR screening in specific populations, that is, prisoners,¹⁸ defense personnel,¹⁹ or patients in nonurban settings.^{20–22} However, findings from these studies may not be generalizable to the general and urban metropolitan diabetes populations. One study estimated the cost-effectiveness of

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