

THINK GLOBALLY

A focus on the opportunities and challenges of international telemedicine.

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The worldwide prevalence of glaucoma in people aged 40 to 80 years is estimated to be 3.54%, disproportionately affecting individuals located in Asia and Africa.¹ Global projections estimate that 76 million people will

have the disease in 2020, rising to 111 million in 2040.¹

Individuals living in developing countries are particularly vulnerable to glaucoma, because a lack of routine eye examinations, awareness, and education, coupled with an absence of warning symptoms, leads to advanced disease.² Access to care may be the greatest challenge in developing countries, many of which lack qualified eye care professionals in rural settings. With an earlier onset and a clinically aggressive disease pattern in these populations, early detection and management are essential to prevent permanent vision loss.^{3,4}

Teleglaucoma platforms may offer a cost-effective solution while providing a high quality of care.

ADVANTAGES

Teleglaucoma allows early detection and management of glaucoma, before the onset of irreversible damage. It also enables providers to triage patients in developing countries. By reducing face-to-face time with patients who have simpler cases, physicians can leverage their expertise and redirect their time to the management of advanced disease or other complex cases requiring urgent care. Teleglaucoma also permits external observation of the eye, which can be beneficial for postoperative care in remote settings (eg, identifying a healthy vs infected bleb).

Tuulonen and colleagues compared patients examined at a rural health care center using a videoconferencing system to a control group of patients at the university eye clinic. The control group had to travel longer distances, spent more total time at the visit, and were absent a longer time from work.⁵ Both patient groups were equally satisfied with their overall ophthalmic care, and most patients examined at the rural health care center preferred to have follow-up visits conducted at the remote site again.⁵

Although there are mixed results when comparing stereoscopic digital imaging to the gold standard of stereoscopic slide film photography, some validation studies have

shown remarkable accuracy in detecting glaucomatous features. Li et al compared stereoscopic digital disc images to 35-mm slide photographs in 32 eyes, and they determined 100% agreement in vertical elongation and hemorrhages and 96.2% agreement in focal notching and rim pallor.⁶ In a meta-analysis evaluating the effectiveness of teleglaucoma versus in-patient examination, Thomas and colleagues concluded that teleglaucoma is more specific, 0.83 (95% confidence interval [CI], 0.77-0.88) but less sensitive, 0.79 (95% CI, 0.67-0.87) than an in-person examination.⁷ Although encouraging, more validation studies are needed.

Artificial intelligence has the potential to analyze the optic disc and integrate key pieces of the encounter (eg, history and physical examination) to assist with diagnosis and management. (See Dr. Al-Aswad's article on p. 45.) Finally, captured fundus photographs will create an extensive optic nerve database that will facilitate e-learning throughout the world.⁸ Medical students, residents, fellows, physicians, and other allied health care professionals can use these images and associated case-based information to enhance their understanding of the glaucomatous disease process and obtain pearls on triage and management.



AT A GLANCE

- Individuals living in developing countries are particularly vulnerable to glaucoma, in part because their access to care may be limited.
- Although there are mixed results when comparing stereoscopic digital imaging to the gold standard of stereoscopic slide film photography, some validation studies have shown that the former demonstrates remarkable accuracy in detecting glaucomatous features.
- Using a collaborative platform, international teleglaucoma has the potential to help relieve the burden of glaucoma in the developing world.



Figure. Dan Kiage, MD, reads stereo optic nerve images using the University of Alberta teleglaucoma platform.

LIMITATIONS

Teleglaucoma has limitations. The patient-physician relationship is at risk of being adversely affected, so it is critical that front-line eye care providers be understanding, respectful, empathetic, and available to maintain a rapport with and the confidence of patients.⁹ Another limitation is the inability to perform anterior segment evaluation, including gonioscopy and slit-lamp examination, which can reveal important characteristics of the angle structure. Additionally, equipment requirements for teleglaucoma platforms may be costly, and bandwidth may be limited. Finally, working collaboratively with local governments can be challenging, medicolegal aspects may not be well defined internationally for shared-care models, and physician reimbursement strategies need to be defined over time.^{8,9}

INTERNATIONAL REQUIREMENTS

International teleglaucoma platforms require imaging modalities and visual function analysis that can operate in areas with a relatively low bandwidth to accurately evaluate both the structure and function of the optic nerve. Based on the experience of one of us (K.F.D.) using the University of Alberta teleglaucoma models, it would be helpful to have a standardized history and a screening examination, including visual acuity, IOP measurements, corneal pachymetry, slit-lamp examination or anterior segment photo capability, visual fields, and 2-D or 3-D photos of the nerve and posterior pole. If optical coherence

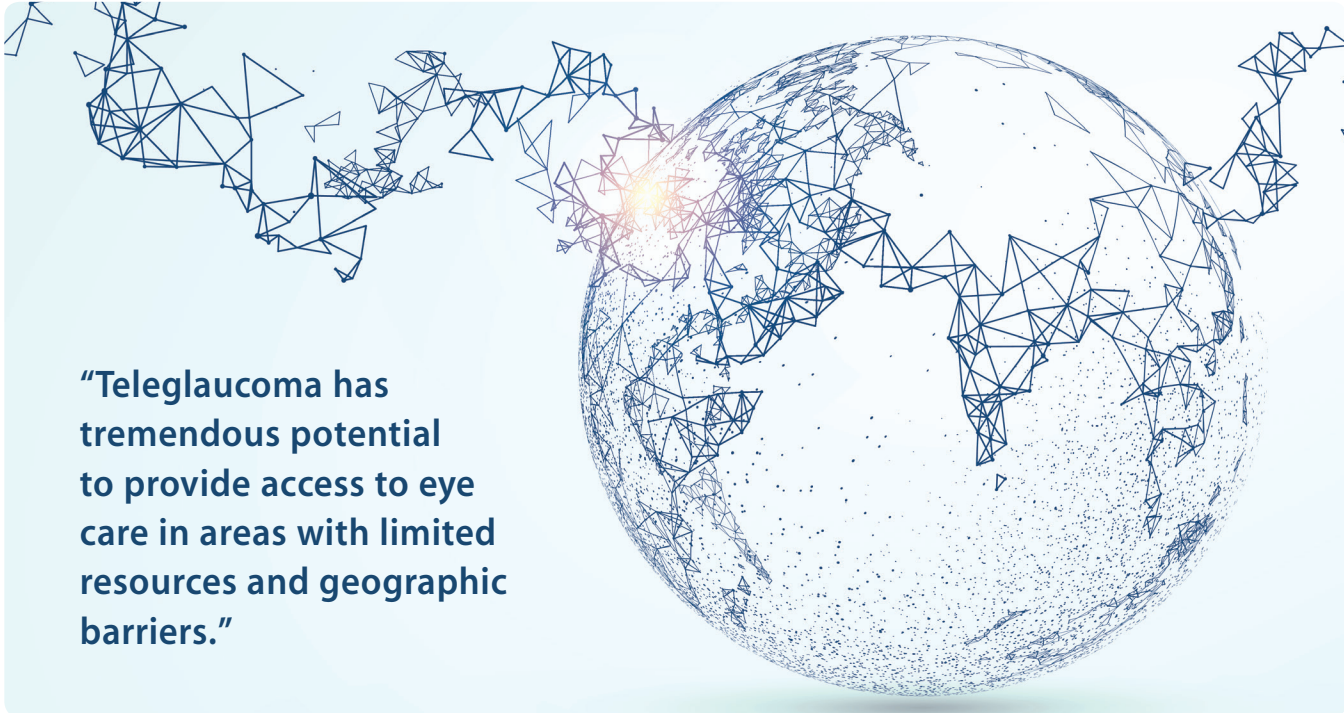
tomography and other imaging devices are available, they would be helpful for—but not essential to—the diagnosis of glaucoma.⁸

This information then needs to be assessed and integrated to provide a diagnosis or differential diagnosis and management plan (Figure). The management plan will involve communication with front-line staff and suggestions for referral and urgent treatment as appropriate.⁸ Optimal technical requirements are a friendly user interface that includes good usability and navigation, the ability to



IMPLEMENTATION SPECTRUM

A traditional telemedicine model pays for all equipment and staff for the remote site. A collaborative telemedicine model uses an interdisciplinary approach to share resources and manage patients. In-house telemedicine occurs when providers use their own resources to manage patients. Developing countries would benefit from collaborative and in-house strategies, which lower site costs while allowing for optimal utilization of finite resources.



“Teleglaucoma has tremendous potential to provide access to eye care in areas with limited resources and geographic barriers.”

handle a higher bandwidth, and easy system maintenance to seamlessly deliver care. Recent smartphone innovations allowing for anterior segment photographs and fundus images may provide portable and cost-effective alternatives, potentially transforming teleglaucoma delivery.

FUTURE OF INTERNATIONAL TELEGLAUCOMA

Remote and underserved regions in the developing world have strained health care systems lacking qualified eye care professionals. Teleglaucoma has tremendous potential to provide access to eye care in areas with limited resources and geographic barriers. By strategically including teleglaucoma at underserved sites, screening information for patients at high risk of glaucoma or with definite disease can be interpreted and patients can be managed locally and/or referred to larger centers for intervention. Collaboration with community leaders, civil society organizations, and local governments is paramount, with a focus on enhancing glaucoma awareness and reducing the stigma of disease.⁸

The development and evolution of an international teleglaucoma program depend on strengthening institutional capacity. Training subspecialist leaders according to best practice guidelines for glaucoma care and having trainees understand infrastructure, management, and clinic workflow are critical.¹⁰ These leaders would then provide mentoring through education and clinical training to local allied health care professionals, including physicians in training, nursing staff, and other front-line providers, thereby strengthening institutions and optimizing teleglaucoma care.¹⁰ Using a collaborative platform, international

teleglaucoma has potential to help relieve the burden of glaucoma in the developing world.¹⁰ ■

1. Tham YC, Li X, Wong TY, et al. Global prevalence of glaucoma and projections of glaucoma burden through 2040: a systematic review and meta-analysis. *Ophthalmology*. 2014;121(11):2081-2090.
2. Kyari F, Abdull MM, Bastawrous AH, et al. Epidemiology of glaucoma in sub-Saharan Africa: prevalence, incidence and risk factors. *Middle East Afr J Ophthalmol*. 2013;20(2):111.
3. Tielsch JM, Sommer A, Katz J, et al. Racial variations in the prevalence of primary open-angle glaucoma. The Baltimore Eye Survey. *JAMA*. 1991;266:369-374.
4. Wilson R, Richardson TM, Hertzmark E, Grant WM. Race as a risk factor for progressive glaucomatous damage. *Ann Ophthalmol* 1985;17:653-659.
5. Tuulonen A, Ohinmaa A, Alanko HJ, et al. The application of teleophthalmology in examining patients with glaucoma: a pilot study. *J Glaucoma*. 1999;8(6):367-373.
6. Li HK, Tang RA, Oschner K, et al. Telemedicine screening of glaucoma. *Telemed J*. 1999;5(3):283-290.
7. Thomas SM, Jeyaraman M, Hodge WG, et al. The effectiveness of teleglaucoma versus in-patient examination for glaucoma screening: a systematic review and meta-analysis [published online ahead of print December 5, 2014]. *PLoS One*. doi:10.1371/journal.pone.0113779.
8. Kassam F, Yogesan K, Sogbesan E, et al. Teleglaucoma: improving access and efficiency for glaucoma care. *Middle East Afr J Ophthalmol*. 2013;20(2):142-149.
9. Sreelatha OK, Ramesh SV. Teleophthalmology: improving patient outcomes? *Clin Ophthalmol*. 2016;10:285-295.
10. Damji K, Nazari S, Giorgis A, et al. STOP Glaucoma in Sub Saharan Africa: enhancing awareness, detection, management, and capacity for glaucoma care. *Expert Rev Ophthalmol*. 2017;12(3):197-206.

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