

# Ocular Telehealth: A Wider View of the Need and the Opportunity in Ophthalmology

Ultra-widefield retinal imaging will help ophthalmology address growing needs.

**BY SHACHAR TAUBER, MD**

**T**he development and implementation of ocular telehealth programs is both an urgent necessity and a golden opportunity for ophthalmology.

The need is being driven by the mounting pressure to serve more patients with chronic eye disease in an increasingly resource-constrained environment. The opportunity arises from the significant potential that telehealth has to contribute to the delivery of more efficient, convenient, and cost-effective care in just about any setting. Because it can strengthen existing referral and comanagement patterns among general practitioners, primary eye care providers, and specialists—while also facilitating the development of new ones—ocular telehealth can be a catalyst for increased practice efficiency and better medicine along the full continuum of care, from screening and diagnosis to disease management and treatment planning. In particular, wider distribution of sophisticated eye examination capabilities holds great promise to effect earlier detection of the ocular sequelae of systemic diseases, especially diabetes. This is essential if improvements in both clinical outcomes and health economics are to be realized.

One technology that is proving to be useful in reaching these objectives is ultra-widefield (UWF) retinal imaging (Optos). These systems and the software supporting them facilitate the rapid capture and remote evaluation of high-resolution digital images of 200° of the retina in a patient-, operator-, and reader-friendly manner. The single-shot optomap provides the widest view of the retina among available retinal imaging platforms.<sup>1</sup> Although it is well-correlated with standard imaging techniques such as ETDRS seven standard fields, Optos UWF imaging allows the clinician to visualize retinal pathology that

otherwise might be missed and to do so efficiently, often without requiring dilation of the patient.<sup>2-7</sup> The optomap is available immediately for evaluation or patient education and, through the use of cloud-based transmission and storage, can also be readily shared with a distant reading center and retained as a record of the disease or treatment process.

## **PILOT STUDY**

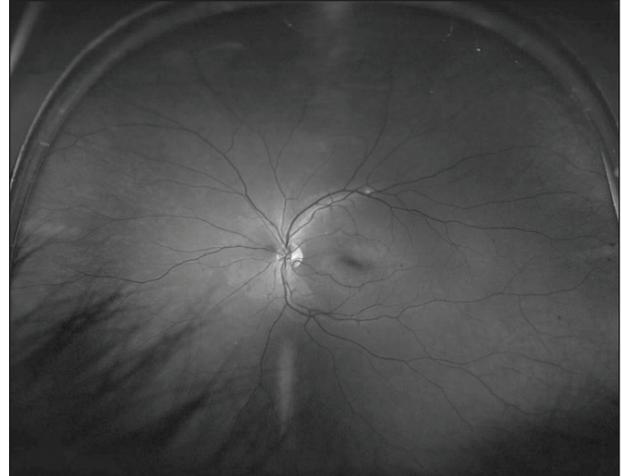
Our center is one of several that have formally evaluated Optos UWF retinal imaging in ocular telehealth programs. We piloted an ocular screening program in four primary care clinics in an integrated tertiary care

## **At a Glance**

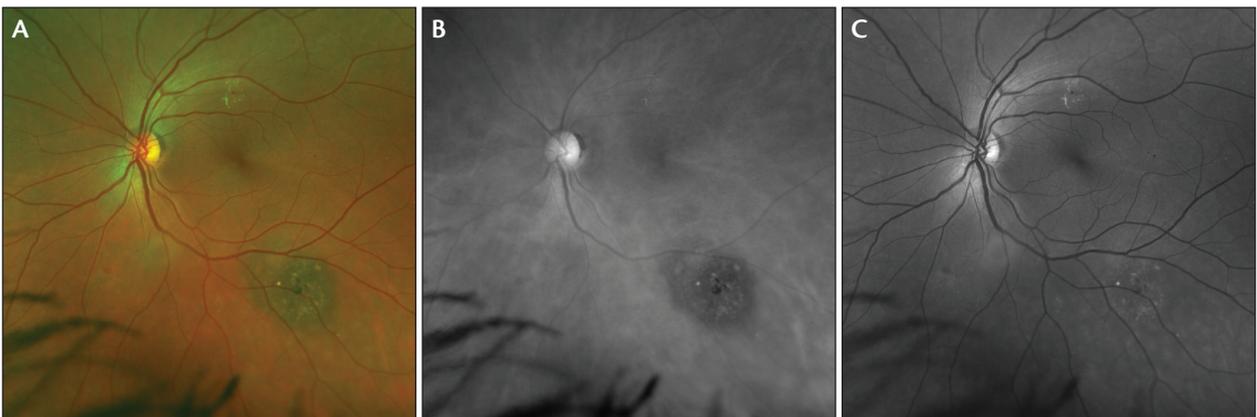
- Telehealth may be a mechanism to facilitate more efficient and better delivery of medicine across the continuum of care, and recent technological advances are making remote screening and diagnosis an increasingly viable option.
- A pilot study demonstrated the utility of ultra-widefield imaging for detection of diabetic retinopathy, in some cases detecting patients in need of further follow-up who might otherwise have gone undiagnosed and untreated.
- Although regulatory, economic, and technological obstacles remain, the wider adoption of telehealth programs would seem in line with a renewed interest in health care to integrate low-cost, high-yield standards of care.



**Figure 1.** Ultra-widefield color image demonstrating predominantly peripheral diabetic lesions captured during retinal screening initiative.



**Figure 2.** Capturing simultaneous ultra-widefield color and red-free images allows for visualization of diabetic lesions.



**Figure 3.** Case of a melanoma caught during the retinal screening initiative. The ultra-widefield color (A), green (B), and red (C) channel images supported the diagnosis of the suspicious nevus as a melanoma.

health system in southwest Missouri. We also designed a study to determine whether Optos UWF retinal imaging, combined with a single electronic health record (EHR) system, could increase the screening rate for diabetic eye disease.<sup>8</sup> Patients were screened in a primary care provider (PCP) office, and optomap images were read remotely by a board-certified ophthalmologist. The EHR was used to send recommendations for follow-up care back to the PCP's office.

In the first 3 months of the program, 340 optomap images were evaluated, and clinically significant pathology was identified in 55 patients. Findings included diabetic retinopathy (DR) in 26 patients, including five with proliferative disease, as well as age-related macular edema, branch retinal vein occlusion, asymmetrical cupping, hypertensive changes, cataract, a small nevus, and a Hollenhorst plaque, among other diagnoses

(examples of findings can be seen in Figures 1-3, including the identification of a suspicious nevus that was later determined to be melanoma). Our preliminary findings suggested that the integration of PCP offices equipped with UWF retinal imaging capabilities into this ocular telehealth program not only increased the screening rate for DR but also identified pathology that would not otherwise have been detected, particularly in the primary care setting.

### **SCREENING PROGRAMS**

Well-established ocular screening programs built around conventional imaging methods may also benefit from a switch to UWF. In a large retrospective study, nonmydriatic UWF retinal imaging was compared to nonmydriatic fundus photography in a standardized ocular telehealth program designed to identify DR.<sup>9</sup>

## Ultra-Widefield Retinal Imaging in the Community: A Partnership to Improve Retinopathy Screening for an At-Risk Population

By Judy E. Kim, MD

There is a growing incidence of diabetes and diabetic complications, including retinopathy, in the large Latino community in Milwaukee, Wisconsin. This community has not been adequately served by traditional health care delivery models due to various barriers such as language, culture, and lack of insurance. In collaboration with the United Community Center (UCC), which serves more than 20 000 Latino residents of Milwaukee, and Marquette University's computer science team, we obtained a 2-year grant through the Healthier Wisconsin Partnership Program, which aims to improve public health by fostering collaborations with community organizations. The grant supports a program to increase eye care screening rates and preserve vision in this high-risk population, dubbed Teleophthalmology to Improve Eye Health among Latinos (TIEHL).

TIEHL has three goals: to implement an ocular telehealth program to improve access to care; to test this program's use as an innovative tool for education; and to train a community health workforce capable of extending the reach of diabetes care. Our idea was to use the community center, which is frequented by the Latino community for various programs, instead of health clinics or primary care offices that the target population often has difficulty accessing, to expand the availability of eye screening. There was no regional precedent for this model, and we learned many

valuable lessons about implementing a telehealth program in a nonmedical setting.

The program has been a success, due in part to our ability to deploy a retinal imaging system in a nontraditional setting and to the ability of trained community center staff to consistently capture gradable images through undilated pupils. It was also critical that the Latino community accepted telehealth as a screening modality. The Optos Daytona UWF retinal imaging system met our requirements as a tool that facilitated efficient screening at a familiar location in the patients' community, and acceptance of the program was enhanced by the use of staff who speak the language of the community. We confirmed that participants found the imaging process user-friendly, and the immediate viewing afforded by optomap images helped to enrich our educational efforts for both participants and families. We also demonstrated that lay people and allied health professionals can be trained to capture and reliably upload retinal images for later evaluation, an important step in our efforts to build a future workforce for diabetes and ophthalmic care.

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A consecutive series of patients underwent fundus photography (n = 1633) and UWF imaging (n = 2170), with images graded for DR and diabetic macular edema (DME) at a central reading center applying a standardized evaluation protocol. Use of UWF imaging revealed more pathology than conventional photography, and readers identified DR 17% more often with the UWF approach. In a subgroup analysis, the ability to visualize the retinal periphery with UWF also resulted in an assessment of more severe DR in 9% of eyes. Another important observation was that UWF imaging improved the accuracy and efficiency of the screening effort, reducing the ungradable rate by 71% (to less than 3%) and the time needed for image evaluation by 28%.

Of course, the locus of ocular telehealth can be adjusted to the particular demands of the care setting or community, as accompanying examples of two pilot programs

described by Judy Kim, MD (see *Ultra-Widefield Retinal Imaging In The Community: A Partnership to Improve Retinopathy Screening for an At-Risk Population*), and Rishi Singh, MD (see *Evaluating Ultra-Widefield Retinal Imaging in a Concierge Telehealth Program*), demonstrate.

The role of telemedicine was first explored as a way to extend the reach of centralized specialist care to patients living in rural or remote locations. Several countries, including Australia and Canada, are well ahead of the United States in implementing such programs, although the jury may still be out on their practicality and ultimate value.<sup>10</sup> In the United States, the sheer density and variable access to care of urban and suburban populations make these settings the new frontiers for telemedicine.

We see the practical challenges and significant promise of ocular telehealth every day. The Springfield, Missouri,

## Evaluating Ultra-Widefield Retinal Imaging in a Concierge Telehealth Program

By Rishi P. Singh, MD

For nearly seven years, my colleagues and I have provided retina specialty services to a Cleveland-area executive health program that delivers comprehensive, concierge-level care to 3000 to 4000 patients. In this program, enrollees receive an annual wellness check during which they see a primary care doctor and appropriate specialists, all in a single office visit. Part of this yearly assessment is an eye examination that includes visual acuity, intraocular pressure testing, and fundus photography. Until recently, we have employed traditional retinal imaging techniques that provided a 45° field of view and required a professional photographer.

Last year, we initiated an evaluation of the Optos Daytona system, which provides a 200° field of view from a single, nonmydriatic capture. A study was designed to examine the feasibility of replacing traditional fundus photography with this modality, from the standpoint of both image quality and operator efficiency, and to determine whether the significantly greater visualization of the retinal periphery provided by the Daytona would help to identify more pathology. Although this study is ongoing, the convenience of the system in a telemedicine setting like ours is already evident. Imaging can be performed by a medical assistant in

a patient-friendly manner in less than a minute. The resulting high-quality digital images are immediately and automatically uploaded to a central server and populated into our electronic health records system. A retina specialist can then complete the reading within 24 to 48 hours and refer patients for additional follow-up as needed.

The stored optomap images not only facilitate identification of retinal pathology at the time of the visit but also provide a convenient way to compare retinal changes over time. The final results of this evaluation should add to the growing body of evidence for the utility of incorporating UWF retinal imaging into ocular telehealth programs.

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catchment area to which Mercy Eye Specialists provides specialty care is home to 1.6 million people. It is unlikely that the growing number of patients with eye disease in a population of this size could be identified and managed properly without a tiered delivery system that increasingly relies on distributed diagnostic technology such as UWF retinal imaging.

### EXPANDING REACH THROUGH TECHNOLOGY

With more compact footprints than earlier Optos UWF platforms (the Daytona and recently introduced California systems from Optos are table-top devices) and a steady stream of technological advances enhancing their capabilities and improving ease of operation, the utility of UWF retinal imaging systems in ocular telehealth programs continues to grow. We can now begin thinking about other care delivery nodes in which having single-capture, nonmydriatic UWF retinal imaging on hand could improve efficiency, accuracy, and cost-effectiveness. Including UWF retinal imaging on mobile screening vehicles, in laboratory testing locations,

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in hospital emergency rooms, and in neonatal intensive care units are just a few possibilities. It is easy to imagine the benefits of ruling out retinal detachment, vitreous hemorrhage, and other sight-threatening retinal pathologies with UWF in an emergency room, with a remote ophthalmologist determining whether transportation of the patient is necessary.

This is not to imply that there are not challenges remaining. In the near term, policy, economic, and technological obstacles must be overcome to allow adoption of telehealth programs on a wider scale. Differences in professional licensing and regulatory schemes among states

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currently limit interstate telemedicine, for example. With many moving parts and interested parties involved in linking systems of care with new technologies, there have been calls for systemic approaches to telehealth on national or regional scales (several bodies have outlined such plans for Australia). However, the absence of a comprehensive solution in the United States need not delay the evaluation and implementation of telehealth programs designed to address specific patient populations, disease types, or risk factors within existing delivery models.

## CONCLUSION

Comprehensive eye care should be a principal beneficiary of the inevitable advance of telehealth. Ophthalmology is leading this process and must continue to do so to increase access to high-quality, sight-saving care in a challenging environment. Fortunately, ongoing technological innovation paired with the evolution of health policy and care delivery models will accelerate both the refinement and adoption of ocular telehealth programs. Distributed UWF retinal imaging capabilities, powered by evolving diagnostic and management protocols, cloud-based networks, and increasing harmonization of EHR systems, will help ophthalmology to meet the demand for telehealth while seizing the opportunity it provides to improve eye care. ■

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