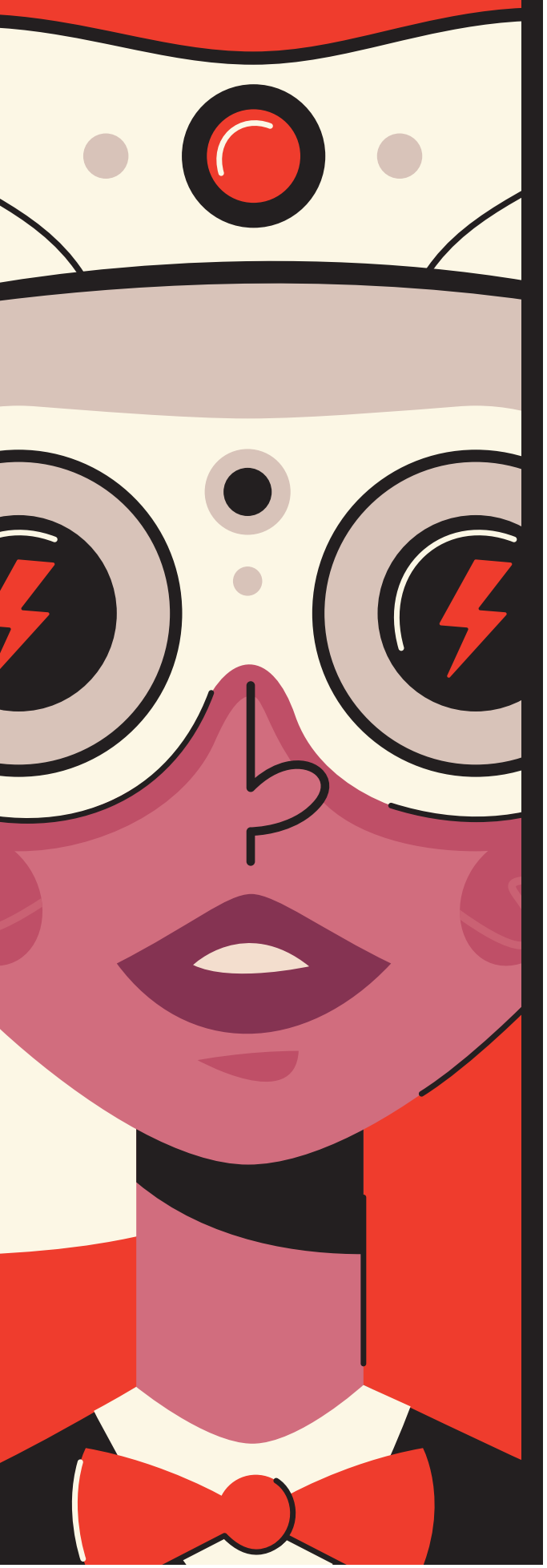

TELEMEDICINE IS INCREASING PATIENT ACCESS TO EYE CARE

A look at the technology's applications and limitations.

BY ANTHONY DEWILDE, OD, FAAO

TELEMEDICINE

The use of telecommunication technology to provide traditional clinical services remotely.

The use of telemedicine has grown in recent years due to increasing recognition of its benefits: enhanced communication of patients with providers, improved access to care for patients in rural areas, and early detection of disease.

There are multiple ways that telemedicine can be used; in eye care, the modality most commonly used is known as *asynchronous*, or *store-and-forward*, telemedicine. The American Academy of Ophthalmology (AAO) Task Force on Telemedicine in Ophthalmology defines asynchronous telemedicine as "electronic transmission of health care data (eg, images, text, or other digital data) to a provider for evaluation and service delivery using methods other than real-time interaction with the patient."[1]

A common example of asynchronous telemedicine in eye care is teleretinal examination, in which images are acquired at a clinic and graded digitally by an optometrist or ophthalmologist at a remote site. Perhaps the most common use of telemedicine in eye care is screening for common eye diseases.

TELEMEDICINE IN EYE CARE

The two areas within eye care that have developed the most mature use of telemedicine are screening for diabetic retinopathy (DR) and for retinopathy of prematurity (ROP). Other uses of telemedicine that are being explored but have seen limited clinical use thus far include IOP monitoring, optic nerve analysis for macular disease detection, visual field analysis, and anterior segment diagnosis.[1] Online refractions are not considered telemedicine as they do not involve information given to a health care provider for management of the patient.

Figure. Fundus photo of a 29-year-old patient with proliferative diabetic retinopathy that was discovered via teleretinal screening.

Diabetic Retinopathy

In 2017, based on the most recent US Census data, the Centers for Disease Control and Prevention estimated that 30.3 million Americans have diabetes mellitus.[2] An estimated 35% of individuals with diabetes have DR. Around 7% have vision-threatening diabetic macular edema (DME), and another 7% are at risk from proliferative DR.[3]

Unfortunately, self-reported receipt of a dilated eye examination in patients with diabetes is low, with only 39% reporting undergoing annual evaluation.[4] The patients who are least likely to receive care are those in lower socioeconomic brackets, those lacking insurance, and those without convenient access to a provider.

The aim of most teleretinal programs is to screen for the presence of DR (Figure). Teleretinal evaluation for DR is the most popular use of telemedicine in eye care, not only because of the high prevalence of diabetes, but also because the screening equipment is relatively easy to use.

At screenings, if retinopathy is detected, a recommendation is made for the patient to follow up with a dilated eye examination performed by an optometrist or ophthalmologist. This is a proven modality with good sensitivity and specificity for diagnosing and continued monitoring of DR.[5-7]

Retinopathy of Prematurity

ROP is another area in which there is high utilization of telemedicine related to the lack of trained specialists available to screen at-risk infants and to the increasing rate of ROP. The rate of ROP has increased in recent decades due to factors such as increased maternal age, assisted conception, and other socioeconomic issues.[8] A 2006 survey by the AAO found that only 54% of retina specialists and pediatric ophthalmologists are willing to manage ROP, and that more than 20% of those who were managing ROP planned to stop because of concerns such as poor reimbursement, logistical difficulty, and medicolegal liability.[9]

To address the resulting shortage of eye care providers who manage ROP, many clinics use teleretinal photography to screen for ROP. This modality has been shown to be an accurate and cost-effective method to screen for this treatable eye disease.[10]

CURRENT IMPLEMENTATION

The most common way that telemedicine is implemented is in programs that capture teleretinal images of patients during office visits with a primary care provider, an endocrinologist, or another diabetic service provider. Some private companies, such as EyePACS (www.eyepacs.com), facilitate this service, offering secure methods of transmission that allow trained optometrists and ophthalmologists to grade retinal

AT A GLANCE

- Telemedicine is the use of telecommunication technology to provide traditional clinical services remotely.
- In eye care, the telemedicine modality most commonly used is known as asynchronous, or store-and-forward, telemedicine.
- Teleretinal evaluation for DR is the most popular use of telemedicine in eye care.

images for clinics remotely.

The Veterans Health Administration (VA) has been a leader in the teleretinal space. Since the inception of VA teleretinal services in 2006, some 1,000 imaging sites have screened more than 2.5 million veterans for DR. A planned expansion of the teleretinal imaging program will add screening programs for age-related macular degeneration and glaucoma.

Other new modalities are also emerging within eye care at the VA. Some hospitals are employing telemedicine to conduct low vision evaluations and training with visual rehabilitation specialists and social workers. As with any technology, there are concerns over efficacy, safety, cost, and purpose. Many screenings are limited in scope (retinal photo) and are only part of a complete examination. *Turn to page 10 for additional reading.*

FUTURE OF RETINAL SCREENING

Deep learning technology is based on the use of artificial neural networks that constantly receive learning algorithms and continuously add data to increase the efficiency of training processes. The larger the volume of data, the more efficient this process is.[11]

By using large datasets, an artificial intelligence program can train itself how to recognize the signs of ocular conditions such as DR, age-related macular degeneration, ROP, and glaucoma. Recent research by retina specialists and companies such as Google, using existing datasets such as those compiled by the French Messidor consortium and the previously mentioned company EyePACS, has shown that deep learning algorithms can detect these eye diseases with high levels of accuracy and repeatability.

There are limitations to the application of deep learning in telemedicine. Although the existing datasets are robust, they are limited by their homogeneous populations and a lack of rare disease presentations. Also, diagnosing certain conditions such as DME and choroidal neovascularization relies on stereoscopic views that 2D images cannot provide. This limitation could potentially be overcome by combining information from OCT imaging with fundus photography.[12]

> "MANY BENEFITS OF TELEHEALTH IN EYE CARE ARE ALREADY BEING REALIZED, SUCH AS INCREASED PATIENT ACCESS TO CARE, IMPROVED COST-EFFECTIVENESS, AND IMPROVED HEALTH OUTCOMES."

NOT AN ALTERNATIVE

Many benefits of telehealth in eye care are already being realized, such as increased patient access to care, improved cost-effectiveness, and improved health outcomes. The main barriers to implementation include cost, lack of availability of high-speed internet in rural areas, and the perceptions of telemedicine on the part of patients and doctors. For example, some patients may view a screening evaluation as equivalent to a face-to-face examination, and this could discourage some from seeking further eye care beyond the screening experience.

It should be noted that, although telemedicine has proven itself to be a helpful complement to traditional doctor-to-patient examinations, there still are many benefits of live face-to-face evaluation of patients that cannot (yet) be provided by remote caregivers. ■

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