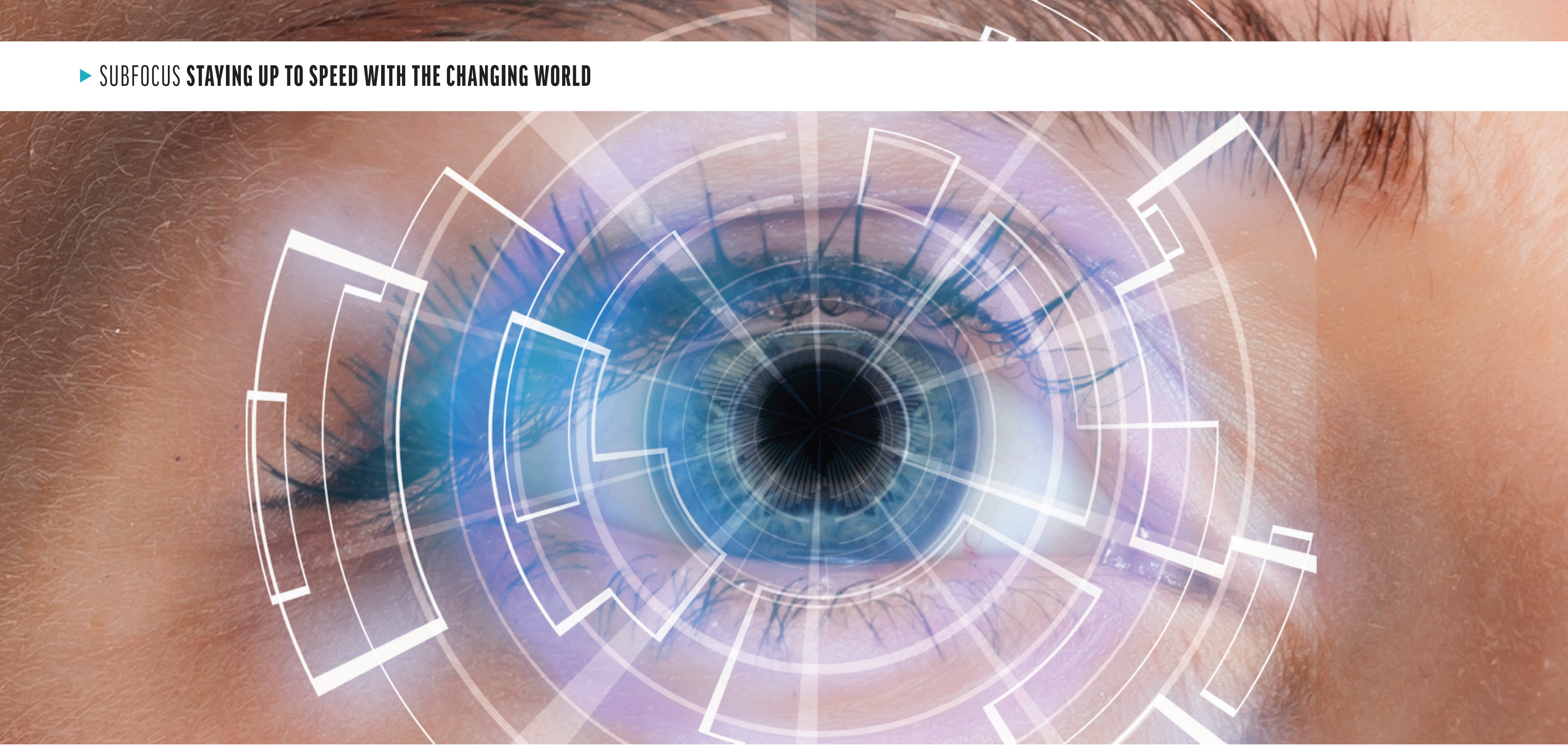

THE FUTURE OF EYE EXAMINATIONS

The author shares his thoughts on what factors will best set optometrists up for success in assessing patients in years to come.

BY THOMAS A. WONG, OD, FNAP

Eye care is rapidly advancing. Modern optometrists have provided quality eye care for many years and are properly focused on improving patient outcomes for diverse communities. In today's busy world, technology, when used appropriately, can help doctors and patients collaborate and maximize quality eye care even further. To do so, optometry must lead the charge by embracing new methods of delivering clinical care and managing patients.

I have created a diagram that illustrates my view of what the eye exam of the future will need to include (Figure). The doctor-patient relationship is the basis of the eye examination of the future. Clinical outcome support often uses technological advances to provide quality patient care. Using my diagram as a guide, this article will review the areas I believe will be key in performing successful eye examinations in the future. In the interest of space considerations, I won't go into great detail in each section, but I want to give you some food for thought.

PREPARING FOR FUTURE SUCCESS

Optometry has a long and distinguished history. How do we prioritize the future? In addition to primary eye care services, we will surely also continue to provide specialized services for ocular disease, pediatrics, contact lenses, vision rehabilitation, low vision, and more.

When I supervise optometry students and residents, it is increasingly important that I prepare them to be modern clinicians in a variety of clinical practice settings (eg, hospitals, community health centers, optometry-ophthalmology practices, universities, etc.) so that when they are ready to go into practice, they are ready for anything. Students and residents must prepare to interpret large volumes of information from previous records, health information exchanges, and pharmacy reports and prepare to develop differential diagnoses in real time.

I use the illness script model[1] for my students and residents to make problem-focused, concise case presentations. This model is based on the understanding of predisposing

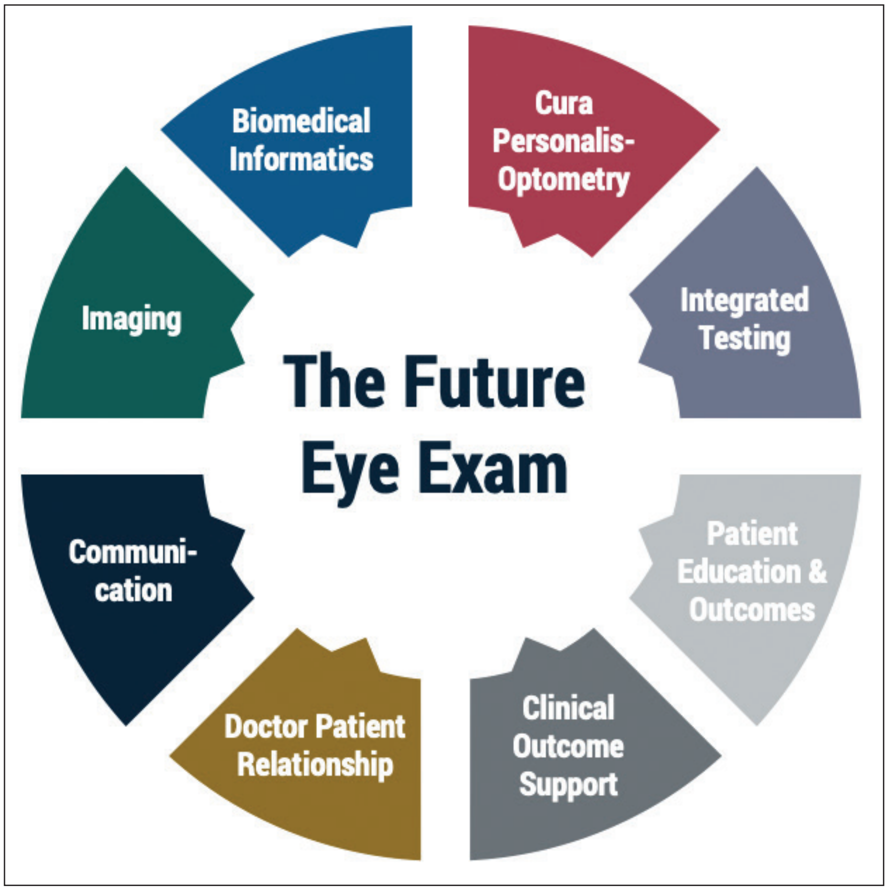

Figure. Advanced clinical outcome support.

conditions, pathophysiology, objective clinical findings, and a concise presentation to direct patient education, management plans, and medical coding. Optometrists have become important members of modern health care teams, and problem-focused presentations are important for interprofessional communication. The use of long-standing techniques will endure, but in many situations, it will be necessary to embrace innovation, which in health care is trending in the digital direction. Below, we'll look at how some of the important components of digital eye care blend with existing traditional diagnostic (and other) tools.

DIGITAL EYE CARE TRENDS

Technology is well-established in modern optometric care. The future of digital eye care will depend on the use of existing and forthcoming technology to provide patient-centric care and collaboration with clinicians, academic institutions, hospitals, and other health care entities (eg, pharmacies, ophthalmic companies, etc.).

Retina

Retina evaluations commonly involve the use of fundus photography, including wide-field retinal imaging, OCT, ultrasound, and angiography (both fluorescein and OCT angiography [OCTA]). Ultrasound continues to be a useful diagnostic tool for examining limited autonomy and other difficult-to-examine patients. Portable fundus cameras help examine both young and old patients and those in mobile clinic settings. OCTA and other non-invasive technologies are useful in evaluating retinal vasculature.

Artificial intelligence (AI) helps clinicians accurately diagnose retinal disease and this technology continues to improve. Autonomous AI models used in the care of patients with diabetic retinopathy and other retinal diseases are being studied in clinical trials, as we need more evidence-based studies to identify their accuracy.[2] Multicenter diagnostic studies have been performed comparing autonomous detection of vision-threatening diabetic retinopathy and more than mild diabetic retinopathy with reading center clinical reference standards.

An example of a reading center clinical reference standard used in studies is the use of 4-wide field stereoscopic dilated fundus photographs. The retinal coverage of the four 45-degree field of view images is equivalent to that of 7-field Early Treatment Diabetic Retinopathy Study images (30-degree field of view).[2] The direct examination of patients by optometrists with binocular indirect ophthalmoscopy, condensing lenses, and direct ophthalmoscopy continue to be important in the management of patients.

Glaucoma

OCT is a powerful tool in the evaluation of the optic nerve, retinal nerve fiber layer, and ganglion cell complex, and thus is an important device in the diagnosis and treatment of glaucoma. Visual field analyzers are necessary for understanding the function of the optic nerve. Changes in the structure and function of this nerve occur simultaneously.[4] Fundus photography completes the digital glaucoma testing.

Glaucoma progression analysis software helps clinicians monitor disease progression and is a type of AI. Virtual reality (VR) visual field analyzers now exist that are portable and easy to use.[5] These devices provide optometrists with other tools to improve patient flow and can be more enjoyable for patients. Compatibility with progression analysis software will be important for clinicians to integrate these devices into their practices. Evidence-based studies to verify the accuracy of these portable visual field analyzers are growing and will guide optometrists in the use of these devices.[6]

Refraction

When possible (in the absence of significant obstructions in the optical pathway [eg, mature cataracts)], a good objective refraction, in addition to an accurate subjective refraction, is the best way to evaluate the refractive status of an eye. However, when examining pediatric, geriatric, and limited autonomy patients (eg, patients with intellectual disabilities), a lens rack and retinoscopy is my preferred method of obtaining an objective refraction. The use of autorefractors is common in the refractive analysis of patients, but the addition of wavefront aberrometers integrated with topography and other medical imaging provides for a more complete assessment of the optical pathway.

Additionally, understanding higher-order aberrations is significant for certain patients (eg, those with corneal ectasia, cataracts, lenticonus, etc). Integrated wavefront aberrometers can identify patients with corneal ectasia earlier in your examination flow, which will help guide you in the diagnosis and management of refractive errors (spectacles, contact lenses including specialty contact lenses, and surgery).[7] Furthermore, the integration of Placido disc imaging with higher-order aberrations can aid in the diagnosis and management of ocular surface disease and other anterior segment pathology.

Retinoscopy also remains an important diagnostic tool, and integrated wavefront aberrometers provide additional information about the refractive status of the optical pathway from the tear film to the retina, especially in cases of corneal ectasia, such as keratoconus and pellucid marginal degeneration.

Anterior Segment

Anterior segment imaging (eg, meibomian gland imaging and ultrasound biomicroscopy) can provide important information in the diagnosis and management of ocular surface disease, such as the presence of narrow anterior chamber angles and abnormalities of the ciliary body.[8]

Specialty contact lenses, especially scleral lenses, have grown tremendously in use over the past decade.[9,10] Wavefront aberrometers, corneal topography, anterior segment OCT, and other anterior segment medical imaging devices are valuable tools to optometrists who fit these lenses and manage anterior segment disease.[11]

PATIENT PORTALS AND TELEHEALTH

Biomedical informatics (eg, electronic health records [EHRs], telehealth, patient portals, etc.) are being used more and more, requiring us to stay current and adapt to the changing times. The rapid rise of EHRs is one example of how change takes many years but can move very quickly when it does occur.

Every optometrist will make their own decisions on how to design patient flow. To help in this effort, patient portals can streamline insurance verification, consent form signatures, payment of copays, requests for prescriptions, and medical reports, including medical imaging (eg, MRIs, CT scans, etc.). Telephone call center triage systems have long provided support for triaging ophthalmic emergencies. The use of digital imaging and other testing can be used by optometrists and other clinicians via telehealth to help guide their clinical decision-making.

THE PRESENT AND FUTURE

Technology is widely used in optometry, from pretesting to assist optometrists in developing differential diagnoses to allowing problem-focused examinations. AI is growing in use to monitor disease progression in patients with diabetic retinopathy, glaucoma, and other ophthalmic conditions. In some cases, clinicians will use autonomous AI to assist in their diagnoses and to help them make management decisions.

The modern optometrist needs to be able to understand and interpret digital information and data properly. Ideally, direct patient examination, in addition to technology such as OCT, wavefront aberrometry, and medical imaging, will lead to more accurate diagnoses and better patient outcomes. I am hopeful that our profession will take the lead in the use of digital technology. If enough of us embrace it, we can detect disease earlier, treat it earlier, and make a difference in patient outcomes. ■

1. Clinical reasoning exercises: illness scripts overview. Journal of General Internal Medicine. Accessed March 22, 2023. www.sgim.org/web-only/clinical-reasoning-exercises/illness-scripts-overview#
2. Lim JI, Regillo CD, Sadda SR, et al; for the EyeArt Study Subgroup. Artificial intelligence detection of diabetic retinopathy subgroup comparison of the EyeArt system with ophthalmologists' dilated examinations. *Ophthalmol Sci.* 2023;3(1):100228.
3. Ipp E, Liljenquist D, Bode B, et al; for the EyeArt Study Group. Pivotal evaluation of an artificial intelligence system for autonomous detection of referrable and vision-threatening diabetic retinopathy. *JAMA Netw Open*. 2021;4(11):e2134254.
4. Hood DC, Tsamis E, Bommakanti NK, et al. Structure-function agreement is better than commonly thought in eyes with early glaucoma. *Invest Ophthalmol Vis Sci*. 2019;60(13):4241-4248.
5. Virtual reality perimetry. American Academy of Ophthalmology. August 15, 2022. Accessed March 5, 2023. eyewiki.aao.org/Virtual_Reality_Perimetry
6. Kashem R, Goldbach AH, Elsawy A, et al. Comparison of Heru visual field as a cloud based artificial intelligence-powered software application downloadable on commercial augmented reality headset with Humphrey Field Analyzer SITA standard. *Invest Ophthalmol Vis Sci*. 2021;62:3389.
7. Maeda N. Clinical applications of wavefront aberrometry - a review. *Clin Exp Ophthalmol*. 2009;37(1):118-129.
8. Robin M, Liang H, Baudouin C, Labbé A. In vivo meibomian gland imaging techniques: a review of the literature. *J Fr Ophtalmol*. 2020;43(4):e123-e131.
9. Nau CB, Harthan J, Shorter E, et al. Demographic characteristics and prescribing patterns of scleral lens fitters: the SCOPE study. *Eye Contact Lens* 2018;44 Suppl 1:S265-272.
10. Fuller DG, Wang Y. Safety and efficacy of scleral lenses for keratoconus. *Optom Vis Sci*. 2020;97(9):741-748.
11. Marsack JD, Ravikumar A, Nguyen C, et al. Wavefront-guided scleral lens correction in keratoconus. *Optom Vis Sci.* 2014;91(10):1221-1230.

THOMAS A. WONG, OD, FNAP

- Associate Clinical Professor and Director of Clinical Externships and New Technologies, SUNY College of Optometry
- tawong@sunyopt.edu
- Financial disclosure: Key Opinion Leader (Carl Zeiss Meditec, Haag-Streit, Marco)