

OCULOMICS



What it is, where it's going, and how optometry can prepare to play a central role.

BY SHANE KANNARR, OD

Oculomics may be a new term for some, but optometrists have long been familiar with the concept of applying ophthalmic biomarkers to detect, predict and understand the mechanisms of disease.¹ We know that the eye can reveal signs of systemic, neurologic, and metabolic diseases, including cancer, Alzheimer disease, diabetes, and heart disease.^{1,2} As a field of study, oculomics is still in its infancy, but it is growing quickly. Researchers are working steadfastly to develop technologies, databases, and protocols that will allow us to implement this practice not only within eye care, but across the broader health care landscape. At the same time, they are carefully considering the clinical, logistical, and ethical challenges that come with collecting, accessing, and sharing data at this scale.

Optometry can help lay the groundwork for oculomics to reach its full potential by focusing on four key areas critical for success. I explain how below.

KEY AREA NO. 1: COMMUNICATION

I practice in a rural area of Kansas where referrals can be challenging. The closest medical retina clinic is 45 minutes away, and the nearest retina surgeon is 2 hours away. I have four offices, which equate to more than 15 lanes and multiple pretest rooms with equipment from many different vendors. I am also on staff at two multispecialty medical centers. Such circumstances, which I suspect aren't uncommon, can make it challenging to efficiently collect, analyze, and share data with retina surgeons and other co-managing physicians. It's critical that we begin identifying and implementing solutions to overcome these barriers.

One of the steps my practice has taken to improve our communication capabilities is adopting a vendor-agnostic clinical image and data management solution. The platform we chose enables the integration of our instruments and the data they gather, regardless of vendor. This ensures we have efficient access to the "whole picture" so we can expedite diagnostic, treatment, and management decisions,

and information sharing with tertiary care providers. This is something we've discussed with our tertiary care providers who have expressed excitement about our practice's ability to share high-quality images and information that facilitate a more seamless referral process.

KEY AREA NO. 2: STANDARDIZATION

To properly evaluate images and identify common patterns, true standardization and established protocols are essential. These measures help eliminate variability, uncover correlations, and support informed decision-making. For example, standardization might involve defining and reaching consensus on the level or rate of retinal pigment epithelium changes that indicate kidney disease or recognizing arterial narrowing and a reduced adiponectin-leptin ratio as markers of cardiovascular disease.

Optometrists can help contribute to standardization efforts by working closely with AI companies to develop clinically applicable benchmarks and software to be shared, by collaborating with other specialties to find ways the

OCULOMICS DEFINED

What exactly is oculomics? Broken down, the word is a contraction of *oculus* (Latin for "eye") plus *omics*, which is a contraction of the suffix "-ome," meaning "whole of class," and "-ics," meaning "study of." *Oculomics* is the study of eye-body relationships.¹

1. Wagner SK, Fu DJ, Faes L, et al. Insights into systemic disease through retinal imaging-based oculomics. *Transl Vis Sci Technol*. 2020;9:6

professions can assist each other in early diagnosis, and to become part of data banks such as the American Academy of Ophthalmology's Intelligent Research in Sight registry, with optometry and ophthalmology teaming up to share information and discover common trends and best practices.

Standardization is also essential to the development and refinement of AI applications, which will soon play a key role in supporting clinical decision-making and referrals, both within eye care and across broader health care, by analyzing retinal biomarkers and recommending appropriate follow-up plans for diseases of vital organs such as the heart, kidneys, and brain.²

KEY AREA NO. 3: COLLABORATION

You can't have standardization for image evaluation without collaboration. Many medical specialties have long understood and valued the benefits of collaboration, which they've pursued through practices such as sharing research protocols and forming educational consortiums. This is how you get good, repeatable data.

Optometry must embrace this approach because there is no shortage of patients in need of care. We want to provide that care more efficiently; therefore, we need to work through the patterns necessary to make that happen. This means collaborating with fellow optometrists, other specialists, and industry to share learnings and ideas, evaluate new technologies, build infrastructure, and identify gaps that need to be filled along the way.

KEY AREA NO. 4: EDUCATION

It's easy to think that some technologies, such as AI, could someday replace the eye care professional. The fact is they are not replacements, but rather enhancements that will help us refine, improve, and expand upon what we do. We need to help our colleagues understand that such new technologies will not make optometry obsolete; instead, they will help us become a bigger and more integral part of the

OCULOMICS IN ACTION

A longstanding patient in his 90s with wet age-related macular degeneration and glaucoma had been receiving intravitreal injections. He is immunocompromised and developed endophthalmitis, which resulted in the enucleation of his better-seeing eye. Understandably, the patient was hesitant to proceed with further intravitreal injections in his remaining eye. The best plan forward was to monitor him closely to ensure further treatment was not indicated; however, having him travel from our rural area to a retina provider would be difficult. Working closely with the patient's retina specialist and taking both his and his family's concerns into consideration, we came up with a reasonable solution: The patient will be seen in my office every 2 weeks for a retina evaluation and imaging with AI assistance. The images will be made available to the retina specialist and further treatment will be provided only if the earliest signs of progression are noted.

overall health care landscape and allow oculomics to reach its full potential.

A noninvasive retinal image, when analyzed with AI tools, can help assess a patient's biological age in comparison to their chronological age by evaluating key ocular biomarkers, offering insights into overall health and aging. Similarly, retinal imaging can detect early signs of neurologic changes, allowing clinicians to triage patients more effectively and refer them for further evaluation when necessary (see *Oculomics in Action*).

Once we educate ourselves, we need to educate other health care professionals and patients about the data that optometrists can access and share. At the foundation of this education is developing relationships with providers in our area. The idea that a noninvasive and readily accessible image could inform diagnostic, treatment, and management decisions or even replace a more invasive test such as a CT scan, exploratory scope, or blood test most certainly would be compelling.

EYES ON THE FUTURE

Oculomics may look like a fragmented but promising network of studies, pilot programs, and AI tools

that help identify signs of systemic disease in retinal scans, but within the next decade, we can anticipate a future where it is deeply integrated into standard medical workflow. Optometrists will routinely contribute data to shared databases, AI tools making pre-screening predictions, and referrals being generated automatically based on consistent, standardized imaging biomarkers. The future will see optometry not just as eye care specialists, but as essential players in the early detection and monitoring of systemic disease.

We have the ability to lead the profession to become a deeper and more integral part of the overall health care picture. Let's start by taking an active role in advancing each of the four key areas described above. ■

1. Zhu Z, Wang Y, Qi Z, et al. Oculomics: current concepts and evidence. *Prog Retin Eye Res.* 2025;106:101350.

2. Li Z, Yin S, Wang S, Wang Y, Qiang W, Jiang J. Transformative applications of oculomics-based AI approaches in the management of systemic diseases: a systematic review. *J Adv Res.* 2024;S2090-1232(24)00537-X.

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