



RIDE

THE WAVE

In the final part of our series looking at OCT retinal biomarkers, **Helen Bird** asks where optometry fits in with the rapidly developing fields of oculomics and multiomics.

In the Winter 2026 edition of *Acuity*, we began to look at the health insights afforded by oculomics, the field of medical science combining advanced eye imaging, large-scale data analysis and artificial intelligence (AI) to identify systemic conditions. But research is showing how the study of other “omics”-based biomarkers, such as genomics (studying the totality of DNA) and

exposomics (which looks at environmental exposures) can be combined with ocular data to gain a holistic understanding of complex biological systems. This comprehensive approach can be described as multiomics.

Though its direct applications in optometric practice are still developing, it’s important for optometrists to be aware how multiomics may come to affect future practice. “As oculomics evolves to encompass linked genomic data, the combined approach holds the potential for

a transformative impact on healthcare,” says Pearse Keane, Professor of Artificial Medical Intelligence at University College London (UCL) and Consultant Ophthalmologist at Moorfields Eye Hospital. “Although a genomics-enriched AI system will not necessarily require specialist knowledge for interpreting an OCT [optical coherence tomography] scan, it will be important for optometrists to be aware of how the “omics” relate to the eye, particularly for patient communication.”

Acuity Clinical Editor Chris Steele FCOptom agrees. “Optometrists are often the first point of contact in a person’s healthcare journey, so it’s important they understand how the eye can reveal changes that reflect overall health. Oculomics and multiomics research is opening up exciting new ways to detect systemic diseases earlier, just by identifying subtle changes in the eye. Being aware of these developments helps optometrists stay at the forefront of both eye and general healthcare.”

COMBINED APPROACH

Currently, says Pearse, genomics is among the most advanced of the omics, but others are growing in their capability for real-world use, including transcriptomics (RNA), proteomics (proteins) and metabolomics (molecules). Amalgamating data from other types of health biomarkers is expanding oculomics investigation “to provide a more precise and nuanced understanding of the connection between biomarkers in the eye and systemic conditions”.

“It’s moving the field forward hugely,” adds Chris. “Rather than relying on a single fundus photograph, newer research models integrate multimodal imaging – such as OCT – with systemic health data and, in some cases, lifestyle factors. Deep learning can identify subtle structural and vascular patterns that may not yet be clinically apparent. This makes analysis more comprehensive and potentially more sensitive in detecting disease risk, sometimes before symptoms develop. With appropriate future care pathways in place, this could give clinicians an earlier opportunity for prevention or intervention.”

Members of the public can also seek out their own genomic markers for eye disease, says Anthony Khawaja, Professor of Ophthalmology at UCL Institute of Ophthalmology and Honorary Consultant Ophthalmologist at Moorfields. “Already, many people are aware of their genetic risk of glaucoma and age-related macular degeneration [AMD] through direct-to-consumer services like 23andMe. Knowing you are at high risk of glaucoma can



prompt more frequent checks with the optometrist and also lifestyle changes that can mitigate that risk.

“The genetic risk of AMD is helpful for predicting the risk of late AMD for the huge numbers of people with early AMD.”

A key breakthrough for oculomics was the merging of patients’ OCT data with NHS hospital episode statistics (HES) – and, recently, to death certificates. The AlzEye project, says Pearse, links more than 24 million anonymised retinal images from more than 350,000 people attending Moorfields with their corresponding HES covering myocardial infarction, all-cause stroke and all-cause dementia. Data linkage was authorised through appropriate ethical and legal mechanisms.

“We are currently exploring opportunities to link with routinely collected brain imaging at our partner hospitals,” he adds. “This could help us unlock even more information about systemic changes that are detectable from eye images.”

In 2026, the team is embarking on a genomics linkage project with the INSIGHT

Ethical considerations

Acuity Clinical Editor Chris Steele FCOptom highlights ethical issues around the use of oculomics that should be taken into account.

- **Informed consent.** “If a retinal image is analysed for more than just eye health, patients need to understand what information might be uncovered and who will have access to it.”
- **Data privacy and ownership.** “As AI can reflect biases in the data it’s trained on, we must ensure these tools work equally well across different populations.”
- **Governance.** Who is responsible for acting on oculomic and multiomic data? “Clear guidelines will be needed to define responsibility for any systemic health signals arising from eye scans, alongside robust patient education.”
- **Psychological and emotional impact of predictive diagnostics.** “Early identification of conditions such as dementia or cardiovascular disease, particularly where definitive treatment options are limited, may increase anxiety or distress for some patients.”
- **Regulation and accountability.**
- **Potential implications for insurance and employment.**

Health Data Research Hub at Moorfields. This will allow them to link large-scale retinal imaging data and genetic data from UK Biobank and NIHR BioResource to explore shared genetic architecture between retinal traits and systemic diseases. “It will then be possible for researchers to build a multimodal AI framework for our oculomics research including retinal images, HES and genomics data,” says Pearse.



Research is opening up exciting new ways to detect systemic diseases earlier

EXAMPLES OF KEY OCT BIOMARKERS	OCULOMICS INSIGHTS	IMPACT
Cardiovascular Retinal nerve fibre layer (RNFL) thickness Vessel calibre and density (via OCT-A) Choroidal thickness	Predicts hypertension, atherosclerosis, stroke and heart disease Reflects systemic endothelial dysfunction and microvascular disease AI-enhanced models reportedly achieve high predictive accuracy for cardiovascular disease risk	Non-invasive cardiovascular disease risk screening Early detection in asymptomatic individuals Supports preventive cardiology
Dementia and neurodegeneration RNFL and ganglion cell layer thinning Macular volume loss Choroidal thinning	Detects mild cognitive impairment and early Alzheimer's before symptoms Reflects neuroaxonal integrity. Correlates with MRI and cognitive scores Reflects impaired blood flow and neurodegeneration	Early, accessible dementia biomarkers Increased risk of developing all-cause dementia. Potential for mass screening and monitoring of early dementia Aids clinical trials in early-stage detection

Source: Chris Steele FCOptom

PERSONALISING CARE

In the meantime, an ever-growing body of research continues to show just how much ocular data, particularly when combined with AI models, can tell us about a person's health. A paper by Cheng et al (2025) reviews current evidence around the use of ocular biomarkers in monitoring environmental exposures and predicting systemic health outcomes. These biomarkers provide “valuable insights into how these exposures contribute to microvascular and neurodegenerative changes”, say the researchers.

And it's not just retinal imaging modalities that are helpful: tear-derived extracellular vesicles are proving a useful and non-invasive source of biomarkers for both ocular and neurodegenerative diseases, according to a review of current evidence (Sanroque-Muñoz et al, 2025).

Another recent study identified early-stage retinal alterations in type 2 diabetes using texture-based OCT analysis, revealing a promising tool for detecting diabetic retinopathy before visible clinical signs emerge (Oliveira et al, 2025). Such advances, through which it's becoming possible to identify early OCT changes or biological signatures, represent a step towards “truly personalised care” for

patients, says Chris. “With future multiomic insights, we may be able to combine visual information with molecular data, such as metabolic markers or gene expression patterns, to better predict who's most at risk or who might respond best to certain treatments. Much of this work is emerging, but the trajectory is clear.”

For patients, the benefits of these huge strides in research are earlier disease detection and more accurate disease management, says Pearse. “Even people who don't attend regular GP checks could be flagged and directed to a care pathway for priority healthcare treatment and support.

“For therapy response monitoring, OCT imaging used with an oculomics AI system would be a non-invasive way to monitor subtle changes to ocular biomarkers linked to systemic health. Captured regularly, these can then help clinicians understand more quickly whether a certain treatment or course of action is having the desired effect,” he adds.

But will this simply result in greater demands on the NHS? “What still needs to be worked out is how to action high risk from an eye scan and how the NHS can handle that extra burden effectively,” says Anthony. “In the longer term, the disease

prevention afforded by retinal imaging pre-screening for systemic disease should save the NHS costs.”

AT THE FOREFRONT

What could the use of oculomics look like in optometric practice? Thanks to the work of Cascader, a medical technology company launched in May 2025 by Moorfields, UCL and Topcon Healthcare, it may not be far away, suggests co-founder and chief medical adviser Pearse. The company's initial focus is on macular diseases such as AMD but, says Pearse, “Our long-term mission is to develop a portfolio of AI tools, including those for the detection of systemic conditions. Although the translation of a research model to one that is used in clinical practice is challenging and time-consuming from a validation and regulatory perspective, we are optimistic that oculomics tools could be in use in the real world within the next five years.”