ARTIFICIAL INTELLIGENCE

eyecare's friend or foe?

Eyetelligence Assure is a new Australian-developed AI system helping clinicians screen for three types of eye disease. PROFESSOR MING HE – the clinical expert behind the software – discusses why optometrists should embrace the technology and its potential in other health fields.

It's one of the ophthalmic sector's most pertinent questions today: will artificial intelligence (AI) replace eyecare professionals, or complement and enhance their capabilities?

It's a debate Melbourne's Professor Ming He is clear on. He's the clinical expert behind the Eyetelligence Assure – a new AI software tool that helps clinicians screen, grade and make decisions for the management of glaucoma, neovascular age-related macular degeneration (nAMD), and diabetic retinopathy (DR).

"The eyecare profession should think of it more as a new model of care. AI will not replace optometrists, but the optometrists with AI will be better off than those without."

A Professor of Ophthalmic Epidemiology at the University of Melbourne and Centre for Eye Research Australia (CERA), He has been working in the field of ophthalmology AI for more than 10 years and is extensively published on this topic. While many platforms focus on glaucoma or more definable DR, Eyetelligence Assure is among the first to screen for three forms of eye disease.

The algorithm is owned and being commercialised by Australian company Eyetelligence, CERA's commercial partner for a Medical Research Future Fund (MRFF) grant project. Prof He is the company's chief medical officer. The software secured Therapeutic Goods Administration (TGA) approval last year, bolstered by clearances in New Zealand, Europe and the UK.

Within seconds, the technology analyses fundus images to generate findings with 95% accuracy. It's the market's only AI software that runs offline, without the need for image upload to the cloud.

At present, the system is mainly being used in optometry practices, which the company hopes to grow even further via a monthly subscription-based model.

Prof He and Eyetelligence's team have also recently built a new algorithm that uses fundus imaging to analyse the retinal microvascular system and detect cardiovascular disease risk. This received TGA approval in March, opening up the technology to other health fields.

Prof Ming He, chief medical officer.

The company is keen to point out the system is a "decision support tool", and not an autonomous diagnostic platform that would remove the need for the involvement of a health professional.

The technology has largely been developed to standardise disease screening and help overcome diagnosis variation in optometry practices. In an ideal world, He says eyecare professionals would make the correct diagnosis each time, but – using glaucoma as an example – he says disease can be complicated.

"Many patients come up as borderline, so eyecare professionals aren't always sure whether it's suspect or certain glaucoma, or if the person is normal, for example," He explains.

In the optometry setting, He points out most patients are normal, but performing wide-spread visual field and OCT testing on these patients can become expensive and time consuming (10-15 minutes per patient).

"We thought there's an opportunity to develop a tool that uses fundus photos that labels patients as low, medium and high risk, and for those people specified as suspect (medium risk) and certain (high risk) glaucoma, they can go ahead and be tested with visual fields or OCT. With our product, additional testing can be more targeted, in a limited number of patients. That's the value proposition."

CHANGING PERCEPTIONS ABOUT AI

The Eyetelligence Assure software has been developed with a 'traffic light system' that's designed to make it easier for clinicians and staff with differing levels of expertise and experience to detect disease and monitor progression. Results are highlighted with red (high risk) and green (low risk) lights.

With glaucoma detection, the company's introduced an 'amber light' to indicate suspicious/medium risk patients who require closer analysis by the optometrist. The algorithm is trained not only on the easier cases (absolute normal and absolute abnormal) but also challenging cases, such as physiological cupping, localised RNFL defect and disc haemorrhage, as well as those with co-existing eye diseases such as pathologic myopia.

In line with the International Council of Ophthalmology, referrable DR is classified as mild, moderate, severe and proliferative. Consistent with the RANZCO Screening and Referral Pathway for DR, this grading system determines whether a patient should be monitored or referred to an ophthalmologist.

In nAMD, results are displayed as either green (no nAMD present) or red (nAMD is present). An alert will also notify of any images insufficient for disease diagnosis.

In any AI training, He says images need to be appropriately labelled. In this case, the system has been trained to recognise disease features by a panel of more than 10 sub-specialist ophthalmologists, drawing upon 200,000 retinal images for labelling and data validation sets. Each image's disease and grading requires consensus from three ophthalmologists on the panel before being fed into the algorithm.

"The images came from 20 major eye hospitals in China, who were using many different models of fundus cameras, so the algorithm has been trained on images with great variation and quality," He says.

"We then validate it and do what we call incremental learning to constantly improve the AI, and make sure the AI developed in the Chinese population performs equally well in the Caucasian, Malay, Singapore, and even Indigenous populations."

He says the system has 95% accuracy, which is taken from randomly selected population-based data in Australia and Singapore involving tens of thousands of scans. Within a subset of more challenging cases – like suspect glaucoma – he acknowledges the accuracy may not be as high.

"The first concern from optometrists whenever you launch a machine into their practice is, 'how accurate is this?'. They will try and challenge the machine with a lot of images. They are always looking at things like false negative/positives and say AI isn't 100% accurate, but then they forget AI is just like humans who also make mistakes. This should be used as a screening tool based on a digital fundus image only, to draw your attention and take a closer look."

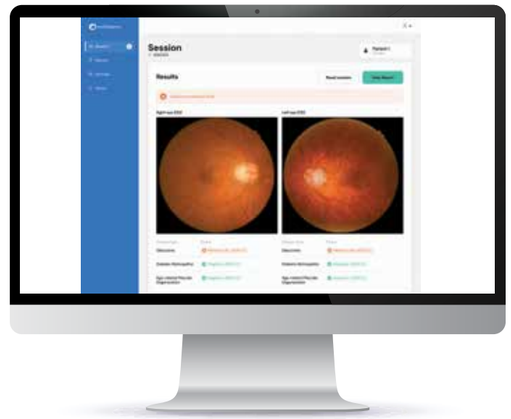
In customer engagement studies, Eyetelligence has interviewed optometrists to understand their views on the challenges and opportunities of AI. Initially many thought they would be out of a job, but He says they've come to realise the greater efficiencies and consistency it can bring to their care.

"They also saw that it helped them minimise the risk of missing a diagnosis, so they are convinced of that," he says.

"And ophthalmologists like the product because the AI helps generate a more targeted referral. As an ophthalmologist, you want to see patients who maximise the value of your time, who may need to be operated on or require treatments like AMD injections."

SIMPLE INTEGRATION

Easy and low-cost integration has been front of mind for the Eyetelligence software developers. For example, He says it will integrate with the practice's existing PC and digital fundus camera, which, until now, has been the only piece of optometry diagnostic equipment without any in-built diagnostic decision support.



The software uses fundus images and a traffic light system to help screen for disease.

The software runs automatically in the background and because it's an offline solution, it doesn't require an internet connection. Images don't need to be uploaded to a cloud and aren't stored in public servers.

"Many products including one developed by Google require the user to upload the image into the cloud, and then they deploy their graphics processing unit (GPU) – it's a powerful processor to analyse the images, but that potentially creates two problems. First, it's not convenient for the user to upload images and wait for results to come back, and secondly, patients' privacy protection can be affected.

"We decided to simplify the neuron network and make it lightweight to be able to run with a normal GPU, this is one of our innovations."

Eyetelligence has made subscriptions available for practices with just one retinal fundus camera and PC, and there are bundled options for enterprise clients with six or more cameras and a centralised IT department.

WHERE TO FROM HERE?

Another potential advantages of the Eyetelligence Assure in Australia is its application in Indigenous healthcare settings.

Access to eyecare professionals and reliable internet can be difficult in rural and remote areas, but by embedding the system into GP clinics, doctors could screen for the three types of eye disease, and use the new cardiovascular screening functionality.

Understanding the software's impact in this and other settings is part of a major $5 million grant He received from the MRFF, which is the largest AI grant of its kind in Australian history.

In addition to "opportunistic screening" in Indigenous clinics and GP practices, the funding is being used to investigate its impact in standardising screening in optometry settings, while the third setting is cardiovascular clinics.

"This grant is supporting us to prove the real-world impact, its real-world accuracy, and the feasibility of integrating this AI into the current clinical practice system," He says.

Overseas, Professor David Friedman at Massachusetts Eye and Ear, Harvard Medical School, has also been impressed by the software's simplicity and functionality.

The school has signed an agreement with Eyetelligence to trial and validate the system's use in the Mass General Brigham network. Prof He is also collaborating with Friedman on a range of ophthalmology AI related research.

Being able to screen for three types of eye disease, the question begs: what else is on the horizon? There may be more, but He's bound by confidentiality. ■