Artificial intelligence equal to experts in detecting eye diseases

August 14 2018

Credit: University College London

An artificial intelligence (AI) system, which can recommend the correct

referral decision for more than 50 eye diseases, as accurately as experts has been developed by Moorfields Eye Hospital NHS Foundation Trust, DeepMind Health and UCL.

The breakthrough research, published online by *Nature Medicine*, describes how machine-learning technology has been successfully trained on thousands of historic de-personalised eye scans to identify features of eye disease and recommend how patients should be referred for care.

Researchers hope the technology could one day transform the way professionals carry out eye tests, allowing them to spot conditions earlier and prioritise patients with the most serious eye diseases before irreversible damage sets in.

More than 285 million people worldwide live with some form of sight loss, including more than two million people in the UK. Eye diseases remain one of the biggest causes of sight loss, and many can be prevented with early detection and treatment.

Dr. Pearse Keane, consultant ophthalmologist at Moorfields Eye Hospital NHS Foundation Trust and NIHR Clinician Scientist at the UCL Institute of Ophthalmology said: "The number of eye scans we're performing is growing at a pace much faster than human experts are able to interpret them. There is a risk that this may cause delays in the diagnosis and treatment of sight-threatening diseases, which can be devastating for patients."

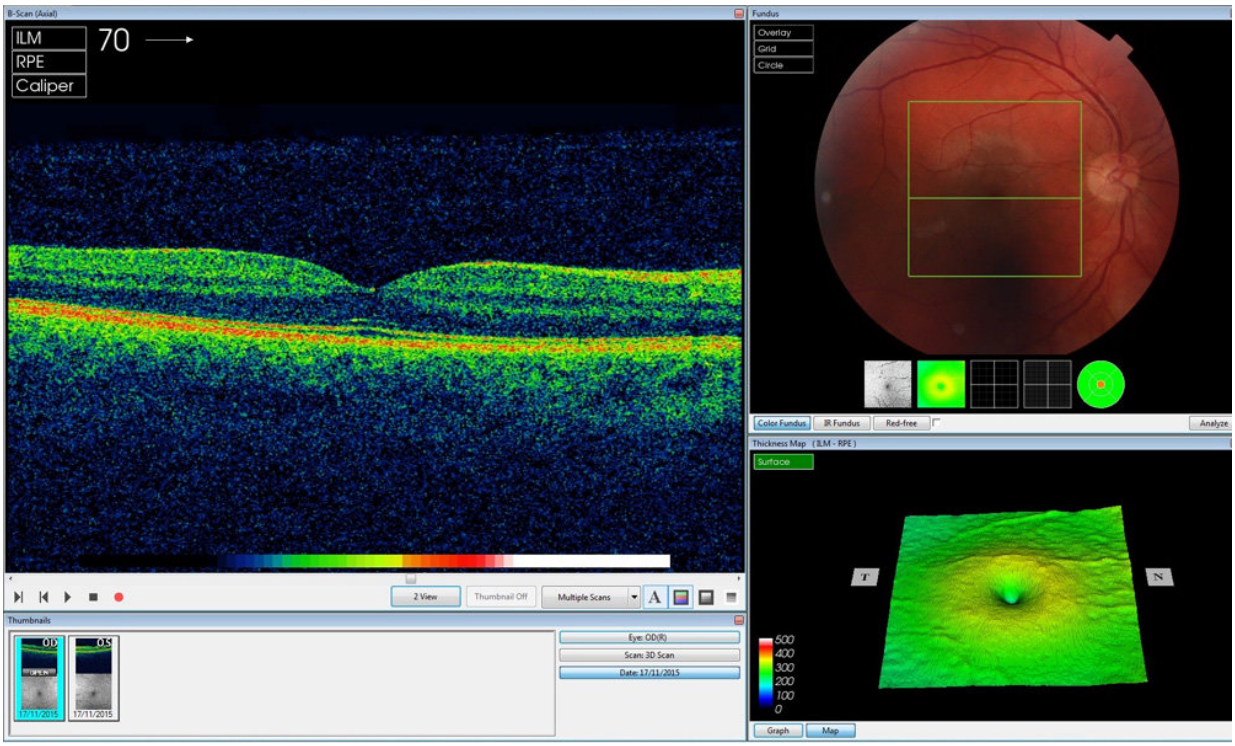
"The AI technology we're developing is designed to prioritise patients who need to be seen and treated urgently by a doctor or eye care professional. If we can diagnose and treat eye conditions early, it gives us the best chance of saving people's sight. With further research it could lead to greater consistency and quality of care for patients with eye

problems in the future."

The study, launched in 2016, brought together leading NHS eye health professionals and scientists from the National Institute for Health Research (NIHR) and UCL with some of the UK's top technologists at DeepMind to investigate whether AI technology could help improve the care of patients with sight-threatening diseases, such as age-related macular degeneration and diabetic eye disease.

Using two types of neural network – mathematical systems for identifying patterns in images or data – the AI system quickly learnt to identify ten features of eye disease from highly complex optical coherence tomography (OCT) scans. The system was then able to recommend a referral decision based on the most urgent conditions detected.

To establish whether the AI system was making correct referrals, clinicians also viewed the same OCT scans and made their own referral decisions. The study concluded that AI was able to make the right referral recommendation more than 94% of the time, matching the performance of expert clinicians.



Credit: University College London

The AI has been developed with two unique features which maximise its potential use in eye care. Firstly, the system can provide information that helps explain to eye care professionals how it arrives at its recommendations. This information includes visuals of the features of eye disease it has identified on the OCT scan and the level of confidence the system has in its recommendations, in the form of a percentage. This functionality is crucial in helping clinicians scrutinise the technology's recommendations and check its accuracy before deciding the type of care and treatment a patient receives.

Secondly, the AI system can be easily applied to different types of eye scanner, not just the specific model on which it was trained. This could significantly increase the number of people who benefit from this

technology and future-proof it, so it can still be used even as OCT scanners are upgraded or replaced over time.

The next step is for the research to go through clinical trials to explore how this technology might improve patient care in practice, and regulatory approval before it can be used in hospitals and other clinical settings.

If clinical trials are successful in demonstrating that the technology can be used safely and effectively, Moorfields will be able to use an eventual, regulatory-approved product for free, across all 30 of their UK hospitals and community clinics, for an initial period of five years.

The work that has gone into this project will also help accelerate wider NHS research for many years to come. For example, DeepMind has invested significant resources to clean, curate and label Moorfields' de-identified research dataset to create one of the most advanced eye research databases in the world.

Moorfields owns this database as a non-commercial public asset, which is already forming the basis of nine separate medical research studies. In addition, Moorfields can also use DeepMind's trained AI model for future non-commercial research efforts, which could help advance medical research even further.

Mustafa Suleyman, Co-founder and Head of Applied AI at DeepMind Health, said: "We set up DeepMind Health because we believe artificial intelligence can help solve some of society's biggest health challenges, like avoidable sight loss, which affects millions of people across the globe. These incredibly exciting results take us one step closer to that goal and could, in time, transform the diagnosis, treatment and management of patients with sight threatening eye conditions, not just at Moorfields, but around the world.

Professor Sir Peng Tee Khaw, director of the NIHR Biomedical Research Centre at Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology said: "The results of this pioneering research with DeepMind are very exciting and demonstrate the potential sight-saving impact AI could have for patients. I am in no doubt that AI has a vital role to play in the future of healthcare, particularly when it comes to training and helping medical professionals so that patients benefit from vital treatment earlier than might previously have been possible. This shows the transformative research than can be carried out in the UK combining world leading industry and NIHR/NHS hospital/university partnerships."

Matt Hancock, Health and Social Care Secretary, said: "This is hugely exciting and exactly the type of technology which will benefit the NHS in the long term and improve patient care—that's why we fund over a billion pounds a year in health research as part of our long term plan for the NHS."

More information: Jeffrey De Fauw et al. Clinically applicable deep learning for diagnosis and referral in retinal disease, *Nature Medicine* (2018). DOI: 10.1038/s41591-018-0107-6

Provided by University College London