

## **ALL PUBLIC Q&AS (TO BE HOSTED ON MOORFIELDS WEBSITE)**

### **How did the partnership come about?**

Two years ago, Pearse Keane, a consultant ophthalmologist at Moorfields Eye Hospital, contacted DeepMind and requested a meeting to discuss whether artificial intelligence (AI) could help meet a growing clinical need to better analyse eye scans.

Pearse and Professor Sir Peng Khaw, Director of the National Institute of Health Research Biomedical Research Centre at Moorfields and the UCL Institute of Ophthalmology, met with the DeepMind Health team and were keen to initiate a collaborative research project between Moorfields and DeepMind.

### **What does the project involve?**

Eye health professionals use scans of patients' eyes to detect and diagnose serious eye conditions and diseases.

At Moorfields we perform more than 5,000 optical coherence tomography (OCT) scans every week. It takes eye health professionals a long time to analyse these highly complex eye scans, which can impact on how quickly patients can be seen to discuss their diagnosis and treatment.

Our research project with DeepMind Health is investigating how AI technology could help us to analyse these scans. We hope this will lead to earlier detection and treatment of eye disease before lasting damage occurs.

### **What is artificial intelligence?**

Artificial intelligence (AI) refers to a wide branch of computer science that attempts to build machines capable of intelligent behaviour.

### **What is machine learning?**

Machine learning is a type of AI, which refers to the development of programmes that are able to act without being explicitly programmed. A programme will use a variety of techniques to build a mathematical description or 'model', based on the data shown to it and 'learn from' this data to perform a function, such as making a prediction or identifying specific pixels.

Machine learning programmes will learn patterns that might not be picked up by other types of programmes. This can be useful for problems involving complex information, such as those in the medical domain.

### **What has the research found?**

Our first research paper, published on Nature Medicine's website on Monday 13 August 2018, demonstrated a significant step towards our goal of creating technology which would allow eye health professionals to prioritise patients with the most serious eye conditions and treat them before lasting damage occurs.

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Firstly, we have developed AI technology which can match the accuracy of expert ophthalmologists and optometrists when identifying a range of eye conditions – such as age-related macular degeneration and diabetic eye disease – and generating the correct referral recommendation.

Secondly, the research used de-identified OCT scans taken from routine care and benchmarked against real de-identified referral decisions used at Moorfields Eye Hospital, demonstrating that the AI technology is applicable to real-world healthcare settings.

The AI technology can also provide information that explains to eye health professionals how it arrived at its decisions. We think this is critically important for clinical application, since it will allow doctors, nurses and healthcare professionals to scrutinise these recommendations.

The research also demonstrated that the AI technology can be easily applied to different types of eye scanner, massively increasing the number of people across the world that it could benefit, and future-proofing the technology against new devices and models that could emerge in the future.

It's still early days, but we believe AI could revolutionise the way eye diseases are diagnosed, treated and managed, creating a system which enables eye care professionals to quickly prioritise patients with the most serious eye diseases before irreversible damage sets in – taking us one step closer to preventing avoidable sight loss.

### **What eye diseases can the AI system detect?**

The AI system was able to detect many forms of macular disease. Age-related macular degeneration (AMD) is the most common macular condition that the AI system is able to detect. Other macular conditions include myopic maculopathy, macular holes, diabetic macular oedema and retinal vein occlusion.

However, unlike previous studies in this area, we didn't focus on or exclude any specific eye conditions for this research because we want to create technology that can identify all patients in urgent need of eye treatment, regardless of the specific eye diseases they might have.

### **I have age-related macular degeneration (AMD). Can the AI system help me?**

The AI system is not a treatment for eye conditions like age-related macular degeneration (AMD). It is designed to detect many forms of eye disease so that it can help doctors and eye health professionals decide what care a patient might need.

There are two types of AMD: 'wet' and 'dry'.

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Dry AMD is the most common type of macular degeneration and affects about four in every five people who have the condition. Unfortunately, there is no treatment for dry AMD.

Wet AMD can develop very suddenly and causes serious changes to your central vision. The treatment available on the NHS for wet AMD is with a group of medications called anti-vascular endothelial growth factor (anti-VEGF) drugs. These are injected inside your eye.

If you notice a sudden change in your vision, you should have your eyes examined by an eye health professional as soon as you can.

### **Where can I get more information about macular disease?**

If you or a family member have been diagnosed with macular disease, help and support is available from charities including Macular Society and RNIB. They can answer questions and provide information and advice about any aspect of living with sight loss.

### **What are the next steps for this research?**

It's still early days and this technology will need to go through rigorous clinical trials before it could be deployed at Moorfields and in other clinical settings, but we're excited about the potential it has demonstrated.

### **Can patients register their interest to take part in future clinical trials?**

No. It is not possible to register your interest to take part in future trials due to the strict recruitment criteria.

At the time a study is recruiting, patients who have been referred to Moorfields as a patient and match against the strict recruitment criteria will be contacted by the care team to ask if they are interested in taking part.

You can always ask your GP or hospital consultant about any clinical trials or other well designed studies that you may be suitable or eligible for. The NHS also provides further information on participating in research and where to find out about active clinical studies: <https://www.nhs.uk/conditions/clinical-trials>.

### **How long will the project last?**

The research project agreement is for five years.

### **How much data has been shared with DeepMind?**

Over the course of the research project, Moorfields Eye Hospital will share approximately one million de-personalised digital eye scans, used by eye health professionals to detect and diagnose eye conditions.

Anonymous clinical diagnoses, information on the treatment of eye diseases, the model of the machine used to acquire the images and demographic information on age (shown to be associated with eye disease) will also be shared during the course of the project.

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### **What will happen to the data now?**

This is only the first phase of a five-year research collaboration. At the end of the research work, the data held on DeepMind drives will be destroyed with 8-pass overwrite and a certificate of destruction will be provided to Moorfields.

### **Do patients have to give their consent for their data to be used?**

When research is conducted using de-personalised data, with no way for researchers to identify individual patients, explicit consent from patients for use of their data is not required. (For more information, please refer to the [ICO code of conduct](#).)

As with all research collaboration agreements with non-NHS organisations, patients can opt out of any data-sharing system by emailing the trust's data protection officer IG.Team@moorfields.nhs.uk. Patients will need to include their NHS or medical records number in any messages. Opting out of research applies to all research projects at Moorfields, not just the DeepMind collaboration.

If you don't want your confidential patient information to be used for research and planning, you can opt out of this. If you do opt out, there are some specific situations where your data may still be used. Data that does not identify you may still also be used.

In this case, all future research will take place excluding those who have opted out. As with all studies on anonymised datasets, measures will be adopted to render it impossible to identify any individual patients. It is therefore not possible to opt-out of research already underway for this reason.

### **What are the data protection measures in place for this project?**

We rigorously ensure that no personally identifiable data is included in the database of scans which is provided to DeepMind for this project.

During the course of the project DeepMind is taking rigorous measures to protect the security of the data, and avoiding disclosing it to anyone other than the researchers and engineers working on the project.

Data contributing to this study can only be used for research that explores the use of machine learning to support clinicians in their management and diagnosis of eye diseases. The data itself cannot be linked with any other dataset, although any new models or software produced by the research may be linked to other datasets to allow for it to be used to help treat patients in the future, and also to enable further research to improve the models by drawing upon other approved sources of data.

### **How can patients be sure that no identifiable data is being shared with DeepMind?**

Anonymisation procedures are thoroughly validated and formally approved by the Moorfields Eye Hospital information governance team before any data transfer to

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DeepMind takes place.

### **What processes are in place to ensure the data transferred to DeepMind is only ever seen by the research team?**

A data custodian has been appointed by DeepMind to control access to the data. Only those who require access to conduct the research work will be granted access. All researchers who are involved in the study are required to complete Health and Social Care Information Centre (HSCIC) and internal DeepMind information governance training before beginning research work.

### **What approvals has DeepMind been given for this research project?**

DeepMind has been given permission for data access via a Research Collaboration Agreement with Moorfields Eye Hospital, and an approval to carry out research from the Moorfields Research & Development department through their Research On Anonymised Data (ROAD) approval pathway.

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