Diabetes and AI
Workshop Report

27th June 2022

Introduction

Diabetes is a common disease which affects a significant proportion of the population. In the UK, it causes thousands of deaths and billions of pounds in cost to the NHS. The rise of AI has already had revolutionary impact in fields as varied as transportation, medical imaging, and environmental studies.

The IAS Seminar on Diabetes and AI aimed to bring together a panel of experts in all areas related to diabetes and its care, as well as world-leading AI experts, and engage in a discussion about the potential benefits AI can bring to diabetes and its care. The seminar will also allow AI Experts to understand the challenges faced by diabetics and their care team and use this knowledge to develop AI methods which are suitable for use in this setting.

Event Aims

The event was designed to accomplish two things:

1. Enable participants to understand the challenges in diabetes research, how AI can help solve them, and the challenges in deploying AI in a diabetes context
2. Stimulate discussion among participants that would lead to further funding for cross-disciplinary research.

The event was driven by a desire to open lines of dialogue between researchers in different domains. To establish a joint language, dispel jargon and generally promote cross-disciplinary research.

Organisers and Committee

As a fundamentally cross-disciplinary seminar, it was important that the event was organised and advised by a heterogeneous mix of researchers, clinicians and diabetes specialists. As such our organising committee and advisory board included AI Researchers, Diabetes Clinicians, Psychologists, Nutrition and Genetics Experts as well as members of the diabetic community. The team was fundamental in designing the programme for the event and was one of the key reasons for the success of the seminar. We consider it a key outcome of the event to have brought together a diverse cohort of experts which have now begun to collaborate in other areas.

Dr Oscar Mendez	Dr Shelini Surendan	Dr Danuta Sampson	Dr Helen Cooper	Prof. Vimal Karani	Prof. Christian Heiss	Dr Debbie Cooke	Dr Ben Field
Surrey Institute for People Centred AI	School of Biosciences and Medicine	University College London	Surrey Institute for People Centred AI	University of Reading	School of Biosciences and Medicine	School of Health Sciences	School of Biosciences and Medicine

Event Themes

The workshop was structured around six talks, each of which fitted into three key themes: Healthcare, Lifestyle and Technology. The overarching theme of the event was to enable collaboration, so the talks were preceded by an introduction to the day and a series of "Crash Courses".

Dr. Oscar Mendez delivered a crash course in Artificial Intelligence (AI), which covered the fundamentals of modern AI and how the field got to where it is. Dr. Mendez discussed common misconceptions, clarified confusing jargon and proposed ways in which Diabetes Experts can engage with their AI colleagues in order to have meaningful conversations. The crash course was generally well received and informative, and allowed the day to proceed with attendees having a solid grasp of the fundamentals of AI and its capabilities.

Dr. Ben Field then delivered a crash course in Diabetes. This course covered the fundamentals of Diabetes, from a biological, clinical and psychological point of view. Dr. Field explained the differences between the different types of diabetes, the interactions of Glucose, Insulin and other hormones in the bodies and touched upon the clinical challenges in treating diabetes patients. He then concluded with a discussion of the mental burden and resulting psychological factors resulting from diabetes self management. Dr Field's talk allowed the participants to have a solid understanding of the underlying mechanisms and open challenges in diabetes care.

Together, the crash courses put all attendees on an equal footing. It enabled participants to have a shared vocabulary to describe the challenges and issues faced by both diabetes and the application of AI to diabetes and healthcare in general.

Once all participants had a common understanding of the challenges, the day could start in earnest. The day enabled targeted discussions split into the 3 themes of Healthcare, Lifestyle and Technology.

Healthcare

First, Dr Chris Sainsbury (Consultant Physician, Diabetes & Endocrinology, NHS Greater Glasgow and Clyde NHS Research Scotland) from the University of Birmingham discussed machine learning approaches to clinical problems in diabetes. For many at the symposium this offered a new clinical perspective, and it was insightful to see how machine learning is being used in predicting drug dosages.

Our next speaker Dr Marika Kaakinen (University of Surrey) discussed the discoveries from genome wide association studies of type 2 diabetes. This talk highlighted the importance of genetics in improving the diagnosis of people at risk and the treatment of those already affected by the disease.

Together, both Dr. Sainsbury and Dr. Kaakinen proposed a series of discussion points for the delegates, which were:

1. Data Access
2. Irregular Time Series of Data Points
3. Managing Missingness

Most delegates agreed that Data access was a major roadblock in the adoption of AI into Diabetes Care. Generally, the attendees discussed issues around data ownership and whether it was ethical/desirable for governments and private companies to own and share patient data. The fact most studies collect data in the 10s or 100s, rather than the 1000s needed was also raised as an issue that might affect adoption of AI. This is also combined with missingness in data and irregular time series, where limitations in data capture strategies have meant there are many small cohorts of patient data, but no unified framework. One of the main ideas was to encourage legislation which would enable easy and quick access to such data, for the purposes of research. This would have to include privacy assurances, such as anonymisation.

Lifestyle

First, Professor Katherine Barnard (Spotlight Consultations, Southern Health NHS Foundation Trust, Bournemouth University, BHR Limited) set the scene and tone for the session outlining the psychosocial aspects of diabetes management and how the Spotlight-AQ platform could be used to uncover hidden barriers to optimal health. Providing insights from a healthcare setting.

Our second speaker, Professor Vimal Karani (University of Reading) added to Dr Marika Kaakinen's earlier presentation by looking into the role of gene-diet interactions across ethnically diverse populations and focused on the significance of precision nutrition approaches for the prevention and management of diabetes. Key challenges emerging from the keynotes included the gaps in data collection and whether personalised nutrition was hype or hope?

The discussion was then guided by Prof. Barnard and Prof. Karani, who provided the discussion points:

1. How do we check that the assumptions for our models are robust and valid? How do we incorporate different perspectives / different disciples into developing our research questions, methodological approaches and bids?
2. Is personalised nutrition for diabetes hype or hope?

Personalised nutrition was an interesting topic for discussion. There were attendees on both sides of the argument, but generally the consensus was that group-specific nutrition profile (by e.g. ethnically driven nutri-genetic profiles) was an interesting direction for research, while at the same time psychological and social factors should take into consideration what is achievable by the individual. Most delegates enjoyed the discussion around model assumptions which enabled them to propose approaches which ranged from acknowledging and disclosing assumptions, while also liaising with members of the community to ensure our approaches actually model the underlying issue.

Technology

The final workshop theme included speakers who were currently implementing A.I technology in healthcare. Dr Aisling O'Kane's (University of Bristol) talk on Personal Health, Care & Wellbeing Technologies 'In the Wild' outlined how diabetes technologies are used, abused, mis-used and not used in the real world. Finally, Dr Simon Mezgec (Computer Systems Department at the Jožef Stefan Institute, Slovenia) talked about the use of food image recognition systems and any current challenges in technology.

The discussion was then guided by Dr Aisling O'Kane and Dr Simon Mezgec, who provided the discussion points:

1. What technologies do diabetic patients & clinicians need? Can AI identify and develop them?
2. How do we close the gap between what is needed vs. what is developed. How do we make patients/clinicians have a stake in development of new technologies?
3. How do we close the gap between data we capture now and what is necessary for AI-driven technologies?
4. Can we capture Psychology in AI and use it to drive models?

Most delegate agreed that technology must be a key component in diabetes care going forward. It was agreed that AI will play a crucial role in delivering this technology. Generally, it was also agreed that enabling the diabetes community to engage in the design of these technologies was a key ingredient to ensure appropriate technology is developed.

Most of the discussion was centered around exactly how this technology is delivered, and there was heated discussed about the use of psychology in AI, with some audience members pointing out the cultural norms associated around 'mental health' and the difficulty of asking people to self-evaluate their psychological states.
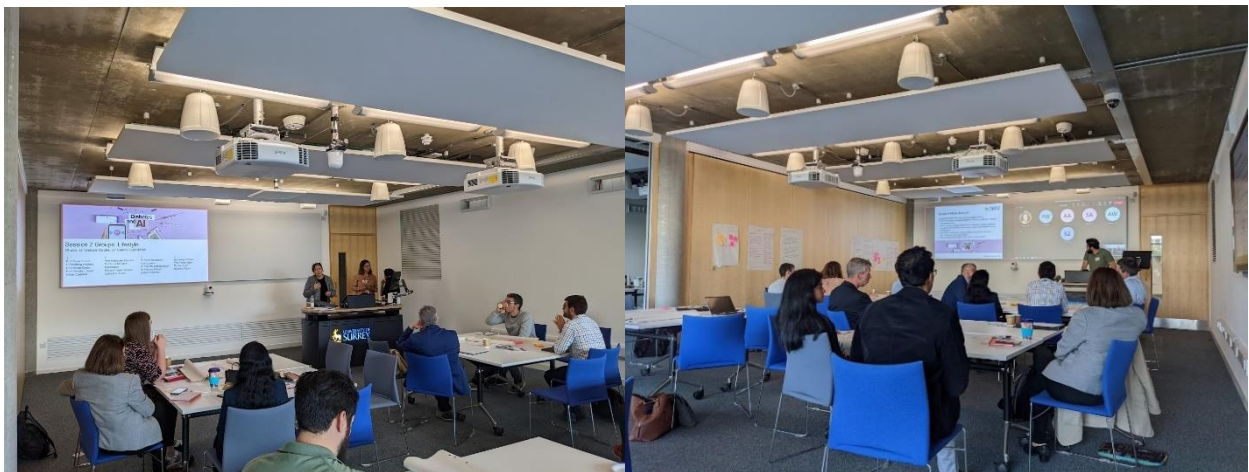
Attendee Perspective

Attendees generally liked the event, as the evaluations from delegates below illustrate. There was a clear indication that seminars of this nature attract researchers due to their inherently cross-disciplinary nature.

Reasons to Attend

Delegates generally expressed interest in the combination of AI and Diabetes, indicating there is appetite in the community for more research of this nature, some quotes below show that the combination these two fields was important:

"My research expertise and personal interest in diabetes. Wanting to stimulate discussion and collaboration"

"The topic being AI and Diabetes which is the same topic as I'm focusing on for my PhD"

There was also interest in exploring more about AI and its capabilities, as well as connecting with other people involved in the research:

"The possibilities of AI were unknown for me"

"New approach in the science including AI for improving health care"

"Connecting with others working in this area"

Overall it was clear that delegates were interested in the driving principles in organising this workshop.

Feedback

The reception of the workshop was also extremely positive, with delegates commending the organisation and theme of the event:

"Great workshop, had a fantastic time both presenting and then engaging in interesting discussions after the presentation. All the technical aspects of the remote presentations were handled perfectly and there were no issues. Overall the organisation of the workshop was top tier!"

"Really great event... Great speakers and good mix of expertise and focus. Great support for online attendance which I enjoyed"

"It was well organised and the sessions were perfect for a 1 day workshop"

Reflections of an Early Career Researcher

Finally, the reflections of an ECR working in Healthcare and AI were captured, which shows that not only is this an interesting direction or upcoming researchers, but also delivered on its goal of establishing new links between the Diabetes and AI communities.

"The Diabetes and AI seminar held at the Stag Hill Campus on 27th June was a unique event that brought together researchers, diabetologists and machine learning technologists from different universities, healthcare settings and specialisms. The day began with a quick overview of diabetes – cause, types and presentation - and then AI – types of algorithms and data, and a quick overview of a typical AI pipeline. This helped bring the audience to a common level of understanding of both, regardless of their background. The day was then divided into 3 sessions. The "Healthcare" session consisted of two presentations – one on disease prediction and treatment strategies, and another on the use of ML approaches to clinical problems related to diabetes. Following the Q&A, a workshop focussed on the technical and healthcare challenges in disease prediction. One challenge the group recognised was that diabetes prediction is made more complex due to the prevalence of co-morbidities within the diabetic community. This interactive session consisted of 5 groups of 5 participants brainstorming answers to set questions within their groups, ending in a brief presentation from each group, and summary of discussion. The second session focussed on "Lifestyle". This included presentations on self-management of diabetes using the Spotlight-AQ tool, and advancements in nutrigenetics and precision nutrition for the prevention of Type 2 diabetes. The interactive workshop that followed, discussed vital questions such as the potential for assistive AI in diabetes self-management, early patient involvement, and the importance of multi-ethnic studies to make any AI clinically meaningful. The final session of the day centred on "Technology", i.e. how AI

can, and is helping with the management of diabetes in the real world. The first presenter discussed the importance of a rounded view of technology requirements put together by cross-functional teams, including patients, carers, technologists and others, to make any AI solution a success. The second presenter gave a fascinating talk on successfully applying deep learning for detecting and analysing food from images uploaded by the diabetic individual, to aid self-management. In the ensuing workshop, we discussed the challenges in the use of such assistive AI due to the wide range of foods and food preferences across the globe. We discussed the importance of incentivising users to log their insulin level alongside food images on a regular basis to help build greater intelligence into the technology to enable it to adapt to user behaviour and set alerts.

The organisation of the day and the idea of bringing in different perspectives on diabetes and AI was excellent. The discussion groups were sufficiently small and given the adequate length of time for each session, we were able to brainstorm effectively within our groups, as well as hear from other groups. Each group had participants from different backgrounds and institutions, which enabled us to not only hear different points of view on the same subject, but also forge new connections. I left the day with at least 5 new connections that I might potentially follow up for more information or collaboration. Hopefully, I contributed with my own real-world experience of having worked in the technology industry for several years, as well as issues with data and algorithms from my own research journey! As a PhD researcher in healthcare anomaly detection using AI, I was particularly interested in available datasets that I could explore for my own research. Most importantly, although I currently work in health monitoring for people with dementia, I could immediately appreciate the large overlap with ongoing diabetes care and monitoring. They say "you don't know what you don't know". The workshop on Diabetes and AI brought to light new information related to diabetes, self-management of the condition, research, and sparked several ideas on how to use AI to detect and predict significant aspects of the condition in meaningful, usable ways."

-Nivedita Biljani (PG/R, University of Surrey)

Next Steps & Outcomes

The symposium stimulated many discussions around shared interests, and this has already facilitated activities beyond the symposium itself.

From one of the parallel sessions, there was a clear synergy in the interests of the group around the need for A.I in reducing the burden of diabetes. A prominent recurring theme was the need for greater support mechanisms and a greater push for data access. A group of 3 researchers from Europe have forged a collaboration, to create a diabetes prediction model using A.I, this is leading to a paper publication in 2023.

As an outcome of the symposium, we were able to synthesise the discussions to distil a set of key future research directions, including:

• Creating a working group of experts in Diabetes and A.I, with quarterly meet-ups

• Connecting nutrition and psychology in future diabetes prediction models

• A mailing list of all participants

Acknowledgments

We would like to thank Mirela Dumic and Vicki Blamey from IAS for all their support and advice throughout the process, particularly in helping us organise the event and create the website for registration.

We are also extremely grateful to Helen Cooper for providing administrative support and technical support for the event. This event would not have been possible without our fabulous organisation committee, consisting of: Oscar Mendez, Shelini Surendran, Danuta Sampson, Helen Cooper, Vimal Karani, Christian Heiss, Debbie Cooke & Ben Field.

Dr. Oscar Mendez

Dr. Shelini Surendran