The Promises and Limitations of Artificial Intelligence for Population Health in Diabetes.

by Matthew Williams

Between **1980** and **2014**, the number of people living with diabetes[1] quadrupled. In **2020**, 10.5% of all Americans had diabetes[2], of which 95% was Type 2, although disease incidence is increasing more in low- and middle-income countries. ***Diabetes is now an epidemic.***

While early detection and newer treatments significantly improve disease outcome and quality of life, novel methods using technologies such as artificial intelligence (AI) offer innovative ways to diagnose, treat and manage the disease. AI's inherent ability to learn, process and automate rapidly and at scale takes treatment beyond glucose and HbA1c management and can also help people manage their health more effectively.

The potential of AI in diabetes treatment and management

On the diagnostic setting, screening for diabetic retinopathy successfully uses machine learning to analyse retinal photographs, delivering earlier detection, lower costs, improved diagnostic accuracy and increased access. The technique is currently one of the more widely adopted uses of AI in diabetes care. AI can also play a role in clinical decision-making, such as treatment response prediction [3], which helps quicken treatment optimisation.

The ability of AI to rapidly analyse vast datasets of information makes detection at scale a reality. A trial implementation in the UK [4] successfully identifies patients at risk of diabetic foot disease and amputation at a population scale beyond the reach of conventional screening. AI is also being used to analyse massive and complex datasets to identify genetic and other markers, for example, microbiome data, for disease prediction and treatment.

The technology also helps put tools in the hands of patients. Novel closed-loop systems – the "artificial pancreas" [5] – combine continual glucose monitoring and automated insulin delivery to offer around-the-clock management. Onboard systems also help patient engagement and compliance with real-time insights into a person's diabetic status, allowing them to respond accordingly.

AI drives many of the scores of publicly available apps for patient self-management, behaviour change and lifestyle tools. For example, photo apps to assess meal content, and lifestyle modification programs using the principles of cognitive behavioural therapy, can help people make better lifestyle decisions.

Technical and system limitations to AI-driven developments

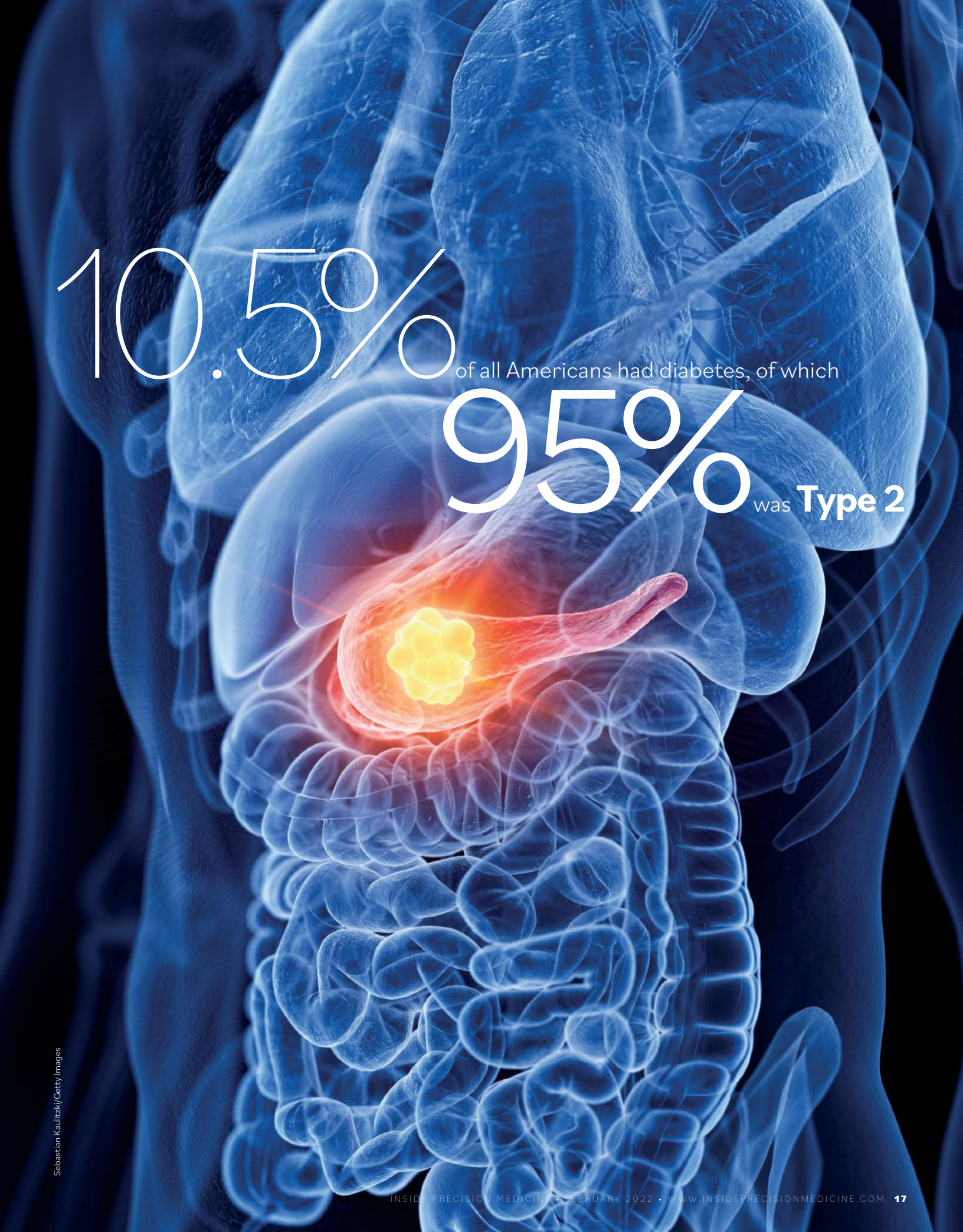
Such novel AI-driven applications suggest a very positive future for diabetes care. However, many significant barriers are calming excitement.

Rayhan Lal, Stanford University

As Dr. Rayhan Lal, a computer scientist and engineer turned endocrinologist at Stanford University, points out, AI isn't always the best tool for the job, despite the 'sexy appeal' to Silicon Valley venture capitalists. He also explains that the technology just isn't as smart as we would like it to be and still requires significant human intervention.

"It's important to realise that because we cannot predict all human behaviour, it's very hard to know when a person will have a sudden change in, say, insulin needs. That works for someone with a fixed schedule; otherwise we have to help the system with patient inputs such as carbohydrate counting, which is an extra burden for the user."

Dr. Lal also commented on the extra challenges patient interventions face in the strict regulatory space where regulators might baulk at a "black box" of AI technology. He believes retinal screening was helped through approvals because of its more transparent technology, although he identifies another contributing factor.



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"Retinopathy screening has fewer problems with regulatory if it flags everyone, so industry may be tuning this technology to a very low false-negative rate. You might screen everyone positive but you ultimately don't reduce clinician workload, which was the goal in the first place."

Regulatory hurdles also impact investment. Clinician support tools with an easier route through the FDA can offer "lower-hanging fruit" for investors, although their uptake by clinicians is not yet significant.

"As a clinician, I have limited time for a patient visit. I'm going to maximise time with them, and not take on another app or algorithm unless it's baked into the Electronic Medical Records system."

Consumer apps, which frequently employ AI, offer an even quicker time to market. However, their clinical benefit remains unproven.

Patient limitations, device uptake and compliance

Dr. Katharine Barnard, a psychologist specialising in diabetes in the UK, highlights some pros and cons of patient devices. These tools offer significant benefits for glucose control and valuable real-time insights for patients about their current status, such as the consequences of certain foods, which helps drive compliance. However, uptake is still limited.

"The majority of people with Type 1 or Type 2 Diabetes do not use these technologies, they'll use a finger prick and glucometer. Why? Because they're expensive and not everyone can access them."

Katherine Barnard

She points out that access is only part of the problem, and the devices themselves present significant challenges for people.

"Devices can add considerable burdens like visibility and a constant reminder of your diabetes. Wearable devices can limit what you wear, compromise intimacy, or draw unwanted attention in, say, a work meeting. And such issues imperceptibly change the way people perceive your ability to manage your health or do your job."

In addition, regular data input and device maintenance create additional burdens, likely a low priority for those in challenging circumstances.

These factors add to the systemic shortcoming of the medical model of treatment favouring outcomes like blood glucose or HbA1c levels, "scores" that already contribute to a sense of failure if the numbers are "bad". This is problematic for a population with disproportionately high rates of depression. Dr Barnard urges that diabetes should instead be understood as a psychosocial disease that includes multiple non-medical factors.

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"Glycemic control doesn't exist in a vacuum. If it did, it would be easy. In reality, it exists in the context of a person's broader social and individual settings."

Ways AI can help improve uptake and outcomes

AI's ability to learn and adapt can offer solutions to these sorts of problems. Dr. Barnard is a key stakeholder in Spotlight-AQ, a web-based platform where patients complete a pre-consultation psychosocial questionnaire that algorithmically responds to an individual's unique inputs. The result is a more holistic patient profile to help clinicians tailor treatments to an individual's needs more effectively.

Dr. Lal believes better use of non-invasive technology would also help the appeal of wearables, using already ubiquitous technology like smartwatches for glucose monitoring or gathering other biometric health data that could control a drug delivery system. Such concepts would build a more comprehensive real-time picture of a patient's variables not only at a given moment but, more importantly, over the longer term. That could address individual needs more dynamically and in a critical area where existing AI technology falls short.

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Matthew Williams is a London-based freelance writer. He studied music at university but has worked in healthcare communications for the last 23 years, in both editorial and technical roles. He's interested in the arts and lifestyle topics when he needs a change, and splits his time between London and Athens.