

# Diabetes revolution

The new 'artificial pancreas'

- Researchers reveal the successful trial of a new, fully-automated insulin delivery system for type 2 diabetes.
- The next-generation device, known as an 'artificial pancreas', significantly improves patients' glucose levels when compared to standard treatment.
- Co-lead of the study, Dr Charlotte Boughton, from the Wellcome-MRC Institute of Metabolic Science at the University of Cambridge, UK, talks to *Research Features* about the innovative device and their plans for a larger, multi-centre study.
- Their research is an exciting step forward for innovative medical technologies and for the future of management of diabetes.

In an exciting development for type 2 diabetes, researchers have successfully trialled a new 'artificial pancreas'. The device is powered by an algorithm developed at the University of Cambridge. Unlike previous devices, the new insulin delivery system is fully automated which

eliminates the need for time-consuming manual calculations. *Research Features* was delighted to speak with co-lead of the study, Dr Charlotte Boughton, from the Wellcome-MRC Institute of Metabolic Science, UK, about the world-first trial and the team's future research plans.



## SO, WHAT IS DIABETES?

Diabetes is a disease that occurs when the body is unable to regulate blood sugar (glucose) levels. If left untreated, the blood sugars become too high. Serious complications of unmanaged diabetes can include heart disease, kidney disease, or even amputation. With the right treatment, however, people with diabetes can manage their blood sugar levels to keep them in a safe range and therefore live a normal, happy life.

There are two main types of diabetes: type 1 and type 2. The new fully closed-loop insulin delivery system trialled in the study was developed specifically for type 2 diabetes.

Type 2 diabetes is the most common form of the disease. Over 400 million people worldwide have diabetes; of these, over 95% have type 2. It occurs when the body is unable to produce sufficient insulin (the hormone that regulates blood sugar), or when the body's cells stop reacting to insulin.

According to the UK's National Health Service (NHS), type 2 is often linked to being

overweight or inactive, or a having family history of type 2 diabetes.

## DELVING INTO THE BREAKTHROUGH

Until now, semi-automated (hybrid) insulin delivery systems have primarily been developed for type 1 diabetes. However, this new completely automated (fully) closed-loop system has been successfully trialled in people with type 2. It's also the first insulin delivery system to be completely automated, as opposed to the hybrid systems of its predecessors.

The device combines a readily available glucose monitor and insulin pump with an app (Figure 1, overleaf). The app predicts how much insulin is needed to maintain glucose levels within a target range,

relying on an algorithm developed by the Cambridge team.

## A WORLD-FIRST STUDY

The world-first study was recently published in the journal *Nature Medicine*. The Cambridge researchers recruited 26 people to trial the new, fully automated closed-loop insulin delivery system to gauge how effective the artificial pancreas is for people with type 2 diabetes.

The researchers measured the amount of time patients could maintain glucose levels within a safer target range (under 10 mmol/L) using the device. Notably, the overall time spent with blood levels lower than the 10 mmol/L target doubled. Overall, the previously high average of the glucose

levels for the patients was recorded as falling by approximately 25%. 'No patients experienced dangerously low blood sugar levels (severe hypoglycaemia) during the study', reports the University of Cambridge.

'In turn, the system also reduced levels of a molecule known as glycated haemoglobin, or HbA1c – a measure of average blood sugar levels over the previous two to three months. For people with diabetes, the higher the HbA1c, the greater the risk of developing diabetes-related complications.

After the control therapy, the average HbA1c level of patients was 8.7%, while patients who used the artificial pancreas had an average HbA1c of 7.3%', reveals the University of Cambridge. The breakthrough has the potential to reduce the disease's burden on the patient.

We spoke with the study's co-lead, Dr Charlotte Boughton, from the [Wellcome-MRC Institute of Metabolic Science UK](#) about the pioneering study of the new fully automated closed-loop system. Boughton explained the science behind the technology, future plans for their research,

**The new closed-loop system provides a new approach – and could potentially reduce the risk of complications of diabetes – Dr Charlotte Boughton, Wellcome-MRC Institute of Metabolic Science.**

The new technology has potential to give people with type 2 diabetes peace of mind by helping them achieve and maintain their recommended glucose levels.



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and how the device could transform the treatment of diabetes.

*Hi Charlotte! Thank you for taking the time to talk to Research Features about your research. Could you tell us more about the science behind the exciting development of a new 'artificial pancreas'?*

Initially, the device was used for people with type 2 diabetes who were in hospital, where we showed that it improved glucose control compared to the standard therapy. We then investigated the system in the outpatient setting in a highly vulnerable group of people with type 2 diabetes and

**This proof of concept trial of a fully automated closed-loop insulin delivery system in type 2 diabetes is very exciting – Dr John B Buse, Director, Diabetes Center, UNC.**

kidney failure – and, again, it showed benefits for patients (compared to their usual insulin therapy). Our latest study set out to test the system in the wider population with type 2 diabetes and showed very promising results.

*How will the new closed-loop insulin delivery system transform diabetes treatment?*

This new system is known as a fully closed-loop, so the user does not have to tell the system when, or what, they are eating.

This is a key difference to the currently available hybrid closed-loop systems. The new system has the important advantage of reducing user interaction and, therefore, overall management burden. It also reduces the training required to use the devices and healthcare professional input needed to optimise the system. This makes it much easier to implement in clinical practice.

The new closed-loop system provides a new approach that allows people with type 2 diabetes to achieve the recommended glucose targets – and could potentially reduce the risk of complications of diabetes.

*What are the next steps for the research?*

Once this closed-loop system receives regulatory approval, we plan to do a much larger study across different countries in Europe, including a more diverse population with type 2 diabetes.

Our aim is to ensure that the benefits we observed in this small trial can be replicated in a larger study. This will help us to provide important information to support the adoption and reimbursement of this technology by healthcare systems.

**RESEARCH IS 'VERY EXCITING'** *Research Features* also spoke with former President of Medicine and Science at the

American Diabetes Association and current Director of the Diabetes Centre at University of North Carolina, Dr John B Buse PhD, about the study. Buse commented that 'This first proof of concept trial of a fully automated closed-loop insulin delivery system in type 2 diabetes is very exciting'.

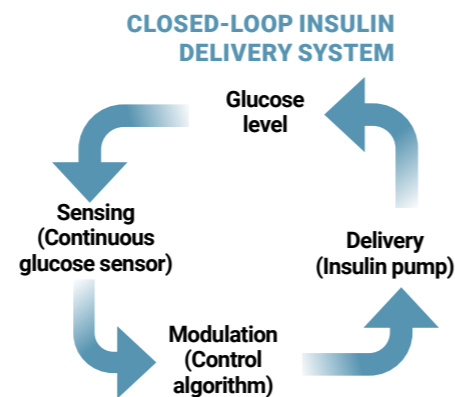
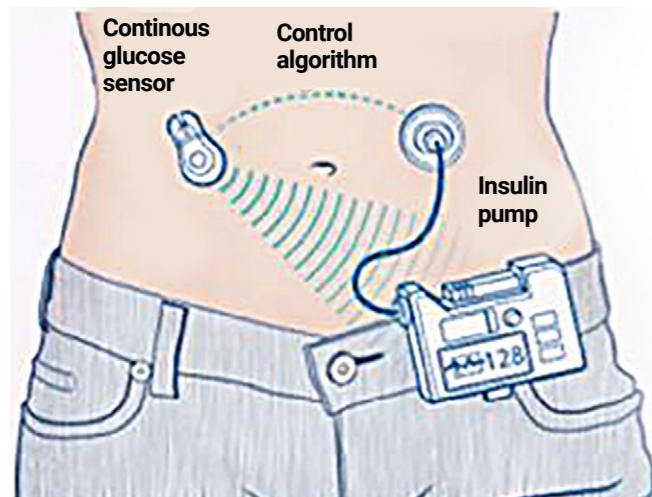
He continued, 'If this result can be confirmed in larger and longer trials in more diverse populations the system will certainly provide an attractive alternative for many patients with type 2 diabetes – because of the relative simplicity of the approach compared to other insulin-based strategies'.

The University of Cambridge researchers' plans for a much more extensive international study of the new device will hopefully provide just that.

Buse also made the point that, 'There will be great interest in understanding the system's role in type 1 diabetes, a less forgiving population, particularly with regards to hypoglycaemia' (dangerously low blood sugar levels).

As Buse highlights, the ramifications of the Cambridge research could extend beyond type 2 diabetes. If it is shown to work for patients with type 1 diabetes, the new fully automated closed-loop insulin delivery system could be the natural successor to the semi-automated hybrid closed-loop insulin delivery system currently used by many people with type 1 diabetes.

This next-generation 'artificial pancreas' is an exciting step forward in innovative medical technologies and for the future of management of diabetes.



**Figure 1.** By releasing insulin whenever your body needs it, a closed-loop insulin delivery system works like a pancreas, and is often referred to as an 'artificial pancreas'.

**Further reading**

- Daly, AB, Boughton, CK, Nwokolo, M, et al, (2023) [Fully automated closed-loop insulin delivery in adults with type 2 diabetes: an open-label, single-center, randomized crossover trial.](#) *Nat Med*, 29, 203–208.
- University of Cambridge (2023) [Artificial pancreas successfully trialled for use by type 2 diabetes patients.](#) [online] The University of Cambridge.

Luna Dewey is a UK-based writer blogging on the latest research topics.