

The first-ever study to examine use of a closed-loop insulin-delivery system — the so-called "artificial pancreas" — in an [outpatient home setting in pregnant women](#) with type 1 diabetes has shown some success, reducing hyperglycemia on the order of 25%.

While there is increasing use of this "closed-loop" approach — which employs an insulin pump and a continuous glucose monitor (CGM) plus an algorithm on a device such as an iPad — among different groups of patients with type 1 diabetes, there has so far been little evidence to support its routine use in pregnancy, Zoe Stewart, MD, and a PhD student from the Institute of Metabolic Science, University of Cambridge, United Kingdom, told the recent [Diabetes UK 2016 Professional Conference](#)

However, the research group at her institution has [already demonstrated](#) that the artificial pancreas effectively controls blood glucose in type 1 diabetic patients in both early and late pregnancy "under closely supervised inpatient conditions," she noted.

Now, with this small feasibility trial, they set out to determine the impact of overnight closed-loop insulin delivery in the real-life, home setting among such patients.

The best indicator of success in the trial was the fact that, after it finished, 14 out of the 16 women studied chose to keep using the artificial pancreas, 24 hours a day, 7 days a week, and use even extended to the period immediately after birth, without any problems, she noted.

"Overnight home closed-loop [delivery] appears to be safe and effective in pregnancy; it may be able to reduce hyperglycemia in the order of about 25%...without increasing hypoglycemia and without increasing insulin dose," Dr Stewart said.

"These results are consistent with studies in children, adolescents, and adults" and support the concept of larger and longer 24-hour clinical trials to examine clinical benefits of the closed-loop system in pregnant women with type 1 diabetes.

Pregnancy Poses Additional Risks for Those With Type 1 Diabetes

Pregnancy poses additional risks for women with type 1 diabetes, as hormonal changes make it very difficult to keep blood glucose levels within a safe range, especially at night. As a result of hyperglycemia, babies of women with diabetes are five times as likely to be stillborn, three times as likely to die in their first months of life, and twice as likely to have a major deformity. Hypoglycemia in pregnancy is also a major cause of maternal mortality.

And these "suboptimal" outcomes for pregnant women with type 1 diabetes and their children have remained fairly static for the past decade, Dr Stewart explained.

In their trial, 16 women aged 16 to 44 years of age, who had had type 1 diabetes for an average of 23 years and who were 8 to 20 weeks pregnant, were randomized — after a run-in phase of 2 to 4 weeks of training — to either sensor-augmented insulin-pump therapy or sensor-augmented insulin-pump therapy with the addition of CGM to create the closed loop at night (11 pm to 7 am), for 28 nights.

After this, they had a 2-week washout period and then completed the opposite intervention arm; at the end, the women could choose to continue with whatever components of the system they liked for the remainder of their pregnancy.

Dr Stewart noted that among the women randomized were some who had only been using multiple daily injections (MDIs) of insulin prior to the trial, who did not even have any prior experience with an insulin pump.

That makes this the first trial to examine women going straight from MDIs to a "closed-loop" system, she noted, adding that, importantly, there was no difference in outcomes between these women and those who had previously used an insulin pump.

Closed-Loop System Safe in a Range of Pregnancy Situations

The results showed that the women in the artificial-pancreas arm had a 25% relative improvement in the percentage of time they spent with their blood glucose in the target range (3.5 to 7.8 mmol/L) overnight — 59.5% of those in the pump-only arm compared with 74.7% of those in the closed loop arm ($P = .002$).

The reduction in mean glucose overnight was 0.8 mmol/L in the closed loop arm vs the pump-only arm ($P = .009$), and there was a corresponding halving of the time women spent with hyperglycemia (glucose > 10 mmol/L) in the closed-loop group, translating to an extra 2 hours a day spent in the target blood glucose range.

There was no difference between the arms in terms of the total daily insulin dose nor in number of hypoglycemic events.

And although there was no significant difference in HbA1c between the two groups in this trial, if these effects were sustained long term, "we might expect that to be associated with a reduction in HbA1c of about 0.5" with the closed-loop system, Dr Stewart told attendees.

The nature of the trial also meant that the artificial pancreas was tested in a range of situations commonly associated with pregnancy, particularly among women with type 1 diabetes. This included in-patient stays, administration of antenatal steroids for fetal lung maturation, and labor and delivery under a range of different conditions, including vaginal delivery and elective and emergency cesarean section.

The women gave birth at a median of 37 weeks' gestation; 15 of the 16 delivered their babies by C-section, and all 16 babies were born healthy.

And as the closed-loop system was also tested in the immediate postpartum period 24/7, with bolus insulin doses with meals as needed, the team showed it was "able to rapidly adjust to the very quick fall in insulin requirements after delivery," Dr Stewart noted.

Finally, although there were "ongoing frustrations with the technology in terms of calibration and connectivity" that need to be worked on, and the aim will be to get the algorithm from an iPad

into a smartphone instead, ultimately this system could be broadly generalizable, "because it doesn't require much patient input or specialist staff input," she said.

Her team is now conducting a new trial comparing 24/7 use of the closed-loop system with pump use in a further 16 pregnant women with type 1 diabetes.

Abbott provided devices for the trial at a discount. Dr Stewart declared no other relevant financial relationships.

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Artificial Pancreas Success in Type 1 Diabetes in Pregnancy. *Medscape*. Mar 18, 2016.

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