

## Technology

### ***New technological aid for real-time glucose monitoring***



Peter Hammond,  
Consultant in General  
Medicine, Harrogate

**C**ontinuous glucose monitoring, using retrospective downloaded data, has been available in routine clinical practice for almost a decade. Although many centres in the UK have reportedly used this technology, very few of them are routinely providing this for their patients with type 1 diabetes.

Recently, the development of real-time monitoring technology has enabled the user to view glucose readings from continuous sensing and adjust therapy in real-time. In the UK, the Medtronic Guardian Real-Time system is the only real-time monitor commercially available; however, a new alternative in the form of the Abbott Freestyle Navigator system will soon be on the market.

One of the major obstacles to the uptake of continuous monitoring in clinical practice appears to be the uncertainty as to how to interpret the data obtained and give appropriate advice about therapeutic adjustments. This concern is compounded when considering real-time monitoring, where the amount of data immediately available to the user can appear to be overwhelming in the absence of clear guidelines on how to use the information. The study from the DirecNet study group (summarised alongside) provides valuable information about the utility and efficacy of the algorithm the group have developed (the DATA algorithm [DirecNet Applied Treatment Algorithm]); this enables a paediatric population to use the data obtained from real-time monitoring with the FreeStyle Navigator. In this pilot study, 30 children aged 4–17 years who were using insulin pumps to

treat type 1 diabetes, were initially enrolled and 28 completed the study. Five children dropped out during the study, with four citing difficulties wearing the sensor as their reason.

The algorithm, which was tabled as an appendix, provided advice on therapy adjustments based on both real-time and retrospective data. Real-time data was used to adjust insulin doses according to the rate-of-change arrows and the high and low alerts. Retrospective data was used to adjust basal rates or mealtime boluses, according to out-of-target glucose values, more than or less than 3 hours post-prandially. After 13 weeks, 59% of participants and 73% of parents felt the DATA gave good and clear directions for insulin management, and 59% used the algorithm at least 50% of the time in response to alarms. These figures were all lower than at week 3, perhaps indicating that the participants were better at self-interpretation after using the system for 3 months.

The DATA is likely to have imperfections, and may need adjustment when applied to an adult population. Bolus dose changes were made in real time, and patients and parents reported frequent use of the guidelines to change bolus doses with good efficacy; but, in contrast, basal rates were changed retrospectively, and, therefore, this element of the algorithm was used less frequently and was felt to be less effective in altering blood glucose levels. However, it is clear from user feedback that algorithms of this type have the potential to make real-time glucose monitoring an easy-to-use tool for adjusting intensive insulin regimens, overcoming one of the principal obstacles to the more widespread uptake of this technology.

### PEDIATRIC DIABETES

#### The DirecNet Applied Treatment Algorithm DATA

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

**1** Although the data from real-time glucose monitors can be more useful for insulin adjustment, there are no available guidelines on how to best utilize this technology.

**2** This study presented the DirecNet Applied Treatment Algorithm (DATA), which aims to provide guidelines for diabetes management decisions using both real-time changes in glucose levels and retrospectively downloaded sensor data; the authors evaluated the effectiveness of the algorithm used with the FreeStyle Navigator, a real-time continuous glucose sensor.

**3** A total of 30 children and adolescents were included in this study; all participants were taught how to use the DATA, and instructed to download their Navigator glucose patterns weekly.

**4** Participants and their parents were asked to complete an Algorithm Satisfaction Questionnaire at weeks 3, 7, and 13.

**5** Overall, all participants and parents (except for 1 parent) reported satisfaction with the DATA; the majority of patients reported using the DATA in response to alarms; use of DATA was increased in the early weeks of the study, and gradually decreased towards the end of the study period.

**6** Consequently, the DATA seems to be a promising tool that could aid effective use of real-time glucose monitoring.

Diabetes Research in Children Network (DirecNet) Study group (2008) Use of the DirecNet Applied Treatment Algorithm (DATA) for diabetes management with a real-time continuous glucose monitor (the FreeStyle Navigator). *Pediatric Diabetes* 9: 142–7

## DIABETIC MEDICINE

### Glucose monitoring during labour reduces risk of hypoglycaemia in newborns

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

- 1 Children born to mothers with diabetes often present with early postnatal hyperglycaemia.
- 2 This study investigated the effect of continuous monitoring of maternal glucose levels during labour; the researchers also tried to determine the association between maternal glucose levels and postnatal glucose adaptation and need for intravenous glucose treatment in newborns.
- 3 A total of 15 pregnant women with diabetes were included in this study; during labour, the continuous subcutaneous glucose monitoring system was used to measure glucose control up to 2 hours before delivery.
- 4 Mean glucose concentration and area under the curve measurements were obtained from all participants; all mothers coped well with glucose monitoring during labour and a total of five infants received intravenous glucose after delivery.
- 5 Area under the curve measurements and mean glucose concentration levels, as well as cord plasma insulin levels, were all significantly associated with the need for glucose in newborn infants.
- 6 Measuring maternal glucose levels during labour was effective for maintaining maternal normoglycaemia, as well as reducing the risk of hypoglycaemia in newborns.

Stenniger E, Lindqvist A, Aman J et al (2008) Continuous subcutaneous glucose monitoring system in diabetic mothers during labour and postnatal glucose adaptation of their infants. *Diabetes Medicine* **25**: 450–54

## THE DIABETES EDUCATOR

### Contributing factors for unexplained hyperglycaemia

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓

- 1 This study aimed to evaluate the underlying causes of intermittent hyperglycaemia and identify potential preventative measures.
- 2 The authors conducted a literature review for information

on hyperglycaemia and continuous subcutaneous insulin infusion; technical data was obtained from apparatus manufacturers, and data on reported incidence of hyperglycaemia related to pump failures was obtained from clinicians.

- 3 Problems with pump, basal or bolus reviews, insulin reservoirs, tubing, catheter site selection and placement were all implicated as causes of intermittent hyperglycaemia.

Ponder SW, Skyler JS, Kruger DF et al (2008) Unexplained hyperglycemia in continuous subcutaneous insulin infusion: evaluation and treatment. *The Diabetes Educator* **34**: 327–33

## DIABETIC MEDICINE

### CSII preferable to MDI with a basal insulin

Readability	✓✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓✓

- 1 Whether continuous subcutaneous insulin infusion (CSII) is more effective at maintaining glycaemic control than multiple daily injections (MDI) with insulin glargine is not known.
- 2 This study compared the effect of both treatments on 36 patients with diabetes who were already receiving treatment with CSII; patients were

randomly allocated to receive one of the two treatments for 4 months, at which time they alternated to the other treatment group for a further 4 months.

- 3 Data on blood glucose variability, mean amplitude of glycaemic excursions and average daily risk ranges were obtained at the end of each treatment phase.
- 4 Patients receiving treatment with CSII demonstrated 5–12% lower glycaemic variability than those on MDI with a long-acting insulin analogue; glycaemic control and patient satisfaction were also improved in the CSII group.

Bruttomesso D, Crazzolara D, Maran A et al (2008) In type 1 diabetic patients with good glycaemic control, blood glucose variability is lower during continuous subcutaneous insulin infusion than during multiple daily injections with insulin glargine. *Diabetic Medicine* **25**: 326–32

## DIABETES MEDICINE

### Continuous infusion or daily injections for improved glucose control?

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

- 1 This study compared the effect of continuous subcutaneous infusion of rapid-acting insulin aspart with a single daily injection of long-acting insulin glargine on insulin and glycaemia

profiles in patients with type 2 diabetes.

- 2 Participants were randomly allocated to alternatively receive one of the two treatment regimens for 8 days each.

- 3 Measurements on the last day of each treatment phase showed that the area under the curve for glucose was 10% lower in the continuous injection treatment group, compared with the single-dose group ( $P=0.001$ ); plasma insulin levels were also improved in patients receiving this treatment regimen.

Parkner T, Laursen T, Vestergaard ET et al (2008) Insulin and glucose profiles during continuous subcutaneous insulin infusion compared with injection of a long-acting insulin in type 2 diabetes. *Diabetic Medicine* **25**: 585–91

‘Measuring maternal glucose levels during labour was effective for maintaining maternal normoglycaemia, as well as reducing the risk of hypoglycaemia in newborns.’