Technology

Continuous glucose monitoring: Does utilisation make a difference?

Peter Hammond, Consultant in General Medicine, Harrogate

Continuous glucose monitoring (CGM) has been extensively used since it was first available in clinical practice at the end of the last decade, but it is yet to be widely adopted as a part of routine diabetes care. This reflects clinicians' lack of confidence in interpreting the data obtained, and, as importantly, a lack of evidence as to the benefits that users gain from CGM.

The Juvenile Diabetes Research Foundation (JDRF) is funding a number of research strands with the ultimate aim of developing an artificial pancreas, and CGM is central to these systems. The study summarised alongside was designed to determine the benefits of real-time CGM in three patient groups randomised to receive intensive insulin therapy with CGM or routine home blood glucose monitoring: 8–14 year olds, 15–24 year olds and those aged 25 and over. A significant reduction in HbA_{1c} (mean difference 0.53%), without an increase in biochemical hypoglycaemia, was seen only in the adult group, but other glycaemic outcome measures, such as percentage achieving target HbA_{1c}, were improved in the paediatric group. Only the adolescent group did not show significant benefit in any outcome measures. However, the potentially more important observation was that improvement in glycaemic control relates to compliance with real-time CGM sensor usage. Eighty-three per cent of the adult group wore the sensor for at least 6 days per week on average, compared with 50% of the paediatric group and 30% of the adolescent group. This suggests that duration of sensor usage is a crucial determinant of the glycaemic benefit achieved by CGM.

It is in accord with the findings of the study by Hirsch et al, summarised below. In this treat-to-target study with sensor augmented pump therapy, subjects with greater sensor utilisation showed greater improvements in HbA_{1c}.

The two studies do differ in that the JDRF study found no relationship between baseline HbA_{1c} and sensor usage, but there was significant correlation between these measures in the Hirsch study. However, both studies confirm that if CGM is to be used effectively to improve glycaemic control then the users must be willing to use the technology virtually continuously and have the ability to interpret the data and make appropriate treatment adjustments. This is the challenge if CGM is to be adopted as a core method of improving outcomes for people with type 1 diabetes.

DIABETES TECHNOLOGY AND THERAPEUTICS

Compliance with RT-CGM improves glycaemic outcome

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

1 The study objective was to determine the safety and efficacy of an insulin pump combined with real-time continuous glucose monitoring (RT-CGM) versus an insulin pump combined with self-monitoring of blood glucose.

2 Of 146 adults and children, 74 were assigned to pump therapy with RT-CGM and 72 were assigned to insulin pump therapy with self-monitoring of blood glucose for 6 months.

3 A significant decrease in HbA_{1c} levels from baseline was seen in both groups. People in the RT-CGM group showed an increase in hypoglycaemia area under the curve.

4 Successful use of RT-CGM therapy significantly improved glycaemic control; failure to use RT-CGM correctly contributed to hypoglycaemic events.

Hirsch IB, Abelseth J, Bode BW et al (2008) Sensor-augmented insulin pump therapy: results of the first randomised treat-to-target study. *Diabetes Technol Ther* **10**: 377–83

NEJM

Continuous glucose monitoring may improve glycaemic control

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

1 This 26-week, multicentre, randomised controlled trial was conducted to evaluate the safety and efficacy of continuous glucose monitoring (CGM) in people of all ages with type 1 diabetes.

2 Inclusion criteria were: age >8 years with a minimum duration of diabetes of 1 year prior to randomisation; use of insulin pump or multiple daily injection therapy; an HbA_{1c} level of 7–10%; and no use of CGM in the previous 6 months.

3 Following a run-in period where a "blinded" continuous glucose monitor was used (the individual could not see the values being recorded), 322 people were randomised to CGM (n=165) or home monitoring using a blood glucose meter (control group, n=157).

4 The two groups were stratified by age: 8–14 years (n=114), 15–24 years (n=110), ≥25 years (n=98). The primary outcome was HbA_{1c} at 26 weeks.

5 In those ≥25 years of age, CGM yielded a significant improvement in HbA_{1c} compared with home blood glucose monitoring (P<0.001), but there was no difference between monitoring methods in those aged 15–24 years or 8–14 years (P=0.52; P=0.29, respectively).

6 Rates of severe hypoglycaemia were low in both monitoring groups, but no difference was seen between them.

7 The authors conclude that CGM can aid improvement in HbA_{1c} in adults, but further work is needed to elucidate the barriers seen in younger individuals.

Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study Group et al (2008) Continuous glucose monitoring and intensive treatment of type 1 diabetes. *N Engl J Med* **359**: 1464–76

DIABETIC MEDICINE

A bolus calculator with CSII therapy improves post-meal blood glucose levels

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

1 This study assessed the efficacy of a bolus calculator incorporated into the insulin pump of children with type 1 diabetes on continuous subcutaneous insulin infusion (CSII) therapy, to determine its effect on pre- and postprandial glycaemic control at various stages of pubertal development and its impact on treatment satisfaction.

2 In total, 36 children with type 1 diabetes on CSII therapy were enrolled in this two-phase crossover study: 18 began phase A using the bolus calculator for 2 weeks, followed by phase B, their usual insulin dosing regimen for 2 weeks, to determine pre-meal boluses; 18 were randomised to begin with phase B followed by phase A. There was a 2-week break between phases.

3 In phase A, there was a significant reduction in blood glucose levels before and 2 hours after meals compared with in phase B, with fewer correction boluses, without differences in prandial insulin requirements, and without restricting the carbohydrate content of meals.

4 The treatment satisfaction questionnaire indicated that the bolus calculator was easy to understand and use, and improved glycaemic control and flexibility regarding meals.

5 Ninety per cent of children recommended that others should use the bolus calculator, indicating a high level of satisfaction in both pubertal and post-pubertal young people.

Shashaj B, Busetto E, Sulli N (2008) Benefits of a bolus calculator in pre- and postprandial glycaemic control and meal flexibility of paediatric patients using continuous subcutaneous insulin infusion. *Diabet Med* **25**: 1036–42

DIABETES TECHNOLOGY AND THERAPEUTICS

Insulin advisor software improves glycaemic control

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

1 There is an increasing need for new technology that will help people with diabetes improve their glycaemic control at home, without increasing risk of hypoglycaemia.

2 This 1-year trial involved 61 adults with type 1 diabetes who were in the insulin advisor software group, and 60 adults with type 1 diabetes in the control group; the aim was to gauge the software's effect on HbA_{1c} at 6 and 12 months.

3 Baseline mean HbA_{1c} was 8.54±0.11% in the control group and 8.42±0.11% in the software group.

4 Mean HbA_{1c} was significantly lower from 3–12 months in the software group, with an HbA_{1c} reduction of ≥0.6% being maintained at 12 months.

Garg SK, Bookout TR, McFann KK et al (2008) Improved glycaemic control in intensively treated adult subjects with type 1 diabetes using insulin guidance software. *Diabetes Technol Ther* **10**: 369–75

DIABETES RESEARCH AND CLINICAL PRACTICE

RT-CGM improves diabetes control and lifestyle habits

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

1 This prospective, open-label, randomised controlled clinical trial was set up to determine the effectiveness of a real-time continuous glucose monitoring (RT-CGM) system in behaviour modification and glycaemic control for people with type 2 diabetes.

2 In total, 65 people with poorly controlled type 2 diabetes were included: 32 were in the RT-CGM group, with monthly monitoring (3 days at a time for 3 months); 33 were in the control group, with self-monitoring blood glucose (at least four times a week for 3 months).

3 After 12 weeks there was a significant reduction in body weight, BMI, HbA_{1c} levels and total calorie intake in the RT-CGM group.

4 Thus, RT-CGM is an effective lifestyle intervention tool to improve diabetes self-management and modify peoples' diet and exercise habits.

Yoo HJ, An HG, Park SY et al (2008) Use of a real time continuous glucose monitoring system as a motivational device for poorly controlled type 2 diabetes. *Diabetes Res Clin Pract* **82**: 73–9

BMJ

Continuous glucose monitoring improves antenatal care

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

1 The authors evaluated the effectiveness of antenatal continuous glucose monitoring (CGM) on maternal glycaemic control and pregnancy-related morbidity in women with diabetes.

2 Of 71 women with diabetes (type 1, *n*=46; type 2, *n*=25), 38 received antenatal care plus CGM and 33 received standard antenatal care.

3 Outcome measures included maternal antenatal HbA_{1c} levels (measured every 4 weeks), infant birth weight and risk of macrosomia.

4 Women in the CGM group had consistently lower HbA_{1c} levels than those receiving standard antenatal care, with a further reduction at 32–36 weeks' gestation (5.8% CGM group versus 6.4% standard care group).

5 The use of supplementary CGM during pregnancy for a woman with diabetes improves maternal glycaemic control, especially in the third trimester, and reduces the risk of macrosomia.

Murphy H, Rayman G, Lewis K et al (2008) Effectiveness of continuous glucose monitoring in pregnant women with diabetes: randomised clinical trial. *British Medical Journal* **337**:a1680doi:10.1136/bmj.a1680

"Real-time continuous glucose monitoring is an effective lifestyle intervention tool to improve diabetes self-management and modify people's diet and exercise habits."