Paediatrics

Continuous glucose monitoring in children and young people: Reducing the "hassle factor"

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The vast majority of children and young people with diabetes are not meeting their treatment targets owing to suboptimal self-care associated with psychological factors and physiological changes due to puberty. Only 18.5% of children and young people in the 2013/2014 UK National Paediatric Diabetes Audit (NPDA, 2015) achieved optimal diabetes control. New diabetes technologies may offer opportunities for young people to improve their diabetes control, especially given that the "millennium generation" of 14- and 15-year-olds are the most technology-savvy in the UK and that 6-year-olds have a similar "Digital Quotient" to 45-year-olds (Ofcom, 2014). It is therefore hoped that young people would adopt these new technologies easily. In clinical practice, however, this is not always the case.

Real-time continuous glucose monitoring (CGM) provides continuous display of blood glucose levels as well as alerts for impending high or low glucose levels and, therefore, provides opportunities to make adjustments to treatment plans that should help improve glycaemic control. The efficacy of CGM in improving glycaemic control is related to the amount of sensor use. Sadly, a study exploring the effectiveness of CGM in improving diabetes control in children and young people aged between 8 and 24 years showed that they only wore the CGM system 30–50% of the time (where sensor wear of 6 days or more was defined as 100% compliance; Juvenile Diabetes Research Foundation CGM Study Group, 2008). This non-adherence has been blamed on the "hassle factor" of wearing the sensors. This includes, among other factors, frustration from frequent sensor inaccuracies, which lead to annoying false alarms and alerts, and discrepancies between blood glucose readings from glucose meters and interstitial glucose readings from CGM sensors.

In the study of children and young people aged 2–17 years summarised alongside, Lori Laffel compared the performance of two CGM systems: the Dexcom G4 Platinum system (G4P) and the same system with the new Software 505 algorithm (SW505). The sensors were compared in two separate, 7-day studies. Sensor glucose measurements from both the G4P and SW505 were compared with reference glucose measurements using arterialised venous blood and with glucose meter results using finger-prick capillary samples. The study demonstrated that the updated SW505 algorithm was significantly more accurate than the G4P. The mean absolute relative difference (MARD) compared with venous measurements was 17% for G4P versus 10% for SW505 ($P<0.001$ for comparison).

The level of accuracy for modern CGM systems is better than that of the original finger-prick blood glucose meters that were approved to inform insulin adjustment 35 years ago (Rodbard, 2016). It is hoped that, as sensor accuracy improves, the hassle factor will be reduced, especially if CGM data can be routinely used for adjustment of insulin therapy. ■

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

National Paediatric Diabetes Audit (2015) *National Paediatric Diabetes Audit 2013–14. Report 1: Care Processes and Outcomes*. Royal College of Paediatrics and Child Health, London. Available at: http://bit.ly/1Y5ubBc (accessed 26.09.16)

Ofcom (2014) *Techie teens shaping communications*. Ofcom, London. Available at: http://bit.ly/1skbFGz (accessed 26.09.16)

Diabetes Technol Ther

Comparison of two CGM algorithms in young people with T1D

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! Factor	✓✓✓✓

1 These authors compared the accuracy of two continuous glucose monitoring (CGM) systems – the Dexcom G4 Platinum (G4P) and the same system with the new Software 505 algorithm (SW505) – in two paediatric cohorts.

2 In study 1, the G4P system was assessed in 176 children and young people, and in study 2 the SW505 system was assessed in 79.

3 In both studies, the CGM readings were compared with self-monitoring of blood glucose (SMBG) readings over a 7-day period, as well as readings from arterialised venous blood samples taken over 1 day in the clinic.

4 Compared with venous blood glucose measurements, the mean absolute relative difference (MARD) was 17% for the G4P and 10% for the SW505 ($P<0.001$ for comparison). Compared with SMBG measurements, the MARD was 15% and 13%, respectively ($P<0.001$).

5 Similarly, compared with venous measurements, 90% of SW505 measurements fell in zone A of the Clarke error grid, whereas only 68% of G4P measurements did.

6 The SW505 system had fewer false alarms for hypoglycaemia (14% vs 34%) and hyperglycaemia (12% vs 33%).

7 The new G4 Platinum system and the G5 Mobile system, both of which include the SW505 algorithm, have now received the European CE mark for use in paediatric patients.

Laffel L (2016) Improved accuracy of continuous glucose monitoring systems in pediatric patients with diabetes mellitus: results from two studies. *Diabetes Technol Ther* **18**(Suppl 2): 223–33

Diabetes Care

Day-and-night closed-loop insulin delivery in adolescents with T1D

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! Factor	✓✓✓✓

1 This study compared sensor-augmented pump (SAP) therapy and a "hybrid" closed-loop insulin delivery system, in which overnight and between-meals insulin was delivered according to a predictive algorithm, while prandial insulin was administered by the participant using a bolus calculator.

2 In an open-label, crossover trial, 12 adolescents with T1D (mean HbA_{1c}, 67 mmol/mol [8.3%]) were randomised to wear one system for a 7-day period and then to switch to the other for another 7 days. Both systems were worn under free-living conditions, with no input from the investigators.

3 The primary endpoint – the amount of time spent in the target glycaemic range of 3.9–10.0 mmol/L – increased significantly in the closed-loop arm compared with the SAP arm (72% vs 53%; $P<0.001$).

4 Mean blood glucose also fell to a greater extent in the closed-loop arm (8.7 vs 10.1 mmol/L; $P=0.028$).

5 The proportion of time spent in hyperglycaemia was lower in the closed-loop arm (26% vs 43%; $P=0.005$), and the time spent in hypoglycaemia was similar in the two arms (2.9% vs 1.7%; $P=0.87$).

6 No serious adverse events or severe hypoglycemia were observed during either study arm.

7 While the authors acknowledge the small study size, short duration and the highly motivated participants, these results support the benefit of closed-loop insulin delivery in adolescents.

Tauschmann M, Allen JM, Wilinska ME et al (2016) Day-and-night hybrid closed-loop insulin delivery in adolescents with type 1 diabetes: a free-living, randomized clinical trial. *Diabetes Care* **39**: 1168–74

ADA 2016

Dapagliflozin lowers insulin requirements

1 In this placebo-controlled, randomised crossover study, the effect of dapagliflozin 10 mg on insulin requirements in 33 young people with T1D was assessed.

2 Insulin was administered intravenously, with blood glucose levels kept at 8.9–12.2 mmol/L, over the 24 hours following administration of dapagliflozin or placebo.

3 Dapagliflozin reduced the required insulin dose by 13.6% (mean, 0.92 vs 1.10 unit/kg/day; $P<0.001$).

Biester T, Fath M, Aschemeier B et al (2016) Dapagliflozin lowers insulin requirement independent from baseline A1c in youth with type 1 diabetes. *American Diabetes Association 76th Scientific Sessions*: abstract 1296-P

ADA 2016

Metformin improves insulin sensitivity in overweight young people with T1D

1 In this study, 37 overweight teens with T1D had their insulin sensitivity tested using a hyperinsulinaemic-euglycaemic clamp after 13 weeks of treatment with either metformin or placebo.

2 Compared with baseline, the glucose infusion rate needed to maintain euglycaemia increased by 0.5 mg/kg/min in the metformin group and reduced by 0.6 mg/kg/min with placebo, suggesting that metformin improved insulin sensitivity.

Biester T, Fath M, Aschemeier B et al (2016) Dapagliflozin lowers insulin requirement independent from baseline A1c in youth with type 1 diabetes. *American Diabetes Association 76th Scientific Sessions*: abstract 1296-P

Diabetes Technol Ther

CSII in neonatal and infant T1D: Guide to basal and bolus rates

Readability	✓✓✓
Applicability to practice	✓✓✓✓
WOW! Factor	✓✓✓

1 Continuous subcutaneous insulin infusion (CSII) is the most common treatment for diabetes in neonates and infants. However, diabetes is rare in children so young, and individual clinicians are unlikely to be familiar with treating this age group.

2 Therefore, these authors reviewed all patients below 1 year of age treated with CSII in the German/Austrian diabetes registry, in order to determine effective basal and bolus rates.

3 A total of 67 cases of neonatal diabetes and 101 cases of diabetes onset at 7–12 months (58 with confirmed T1D and 43 with diabetes and unknown antibody status) were reviewed.

4 At diabetes onset, infants and neonates had similar total insulin requirements (median, 0.82 vs 0.74 units per kg of bodyweight, respectively; $P=0.63$).

5 However, basal requirements differed (0.56 vs 0.44 unit/kg; $P=0.036$), as did prandial requirements (0.18 vs 0.39 unit/kg; $P=0.003$). The low prandial requirement for neonates could be due to an almost continuous feeding schedule with up to 12 small feeds per day.

6 These data can be used to guide CSII treatment in this age group. However, in order to prevent hypoglycaemia, the authors recommend starting on lower doses (the first quartiles of their data) and titrating up to the median on a day-by-day basis.

Kapellen TM, Heidtmann B, Lilienthal E et al (2015) Continuous subcutaneous insulin infusion in neonates and infants below 1 year: analysis of initial bolus and basal rate based on the experiences from the German Working Group for Pediatric Pump Treatment. *Diabetes Technol Ther* **17**: 872–9

> ***"While the authors acknowledge the small study size, short duration and the highly motivated participants, these results support the benefit of closed-loop insulin delivery in adolescents."***