Management of type 1 diabetes

Flash glucose monitoring: Which users will benefit most?

Adrian Scott
Consultant Physician in Diabetes and General Medicine, Northern General Hospital, Sheffield

Some of my older patients with long-standing insulin-treated diabetes tell me how, before capillary blood glucose monitoring was available, they measured their urine glucose concentration in test tubes containing several drops of urine, tap water and a Clinitest tablet. A blue reaction signified no glucose, while various shades of orange indicated variable concentrations of urine glucose. How they were meant to interpret the result or adjust their insulin based on this is anyone's guess.

The latest NICE guidance on the management of type 1 diabetes recommends that people should be supported to test up to 10 times daily (NICE, 2015). Continuous glucose monitoring systems are advised for adults with type 1 diabetes who are willing to commit to using them at least 70% of the time and have recurrent problems with either hypo- or hyperglycaemia.

The NICE guidance was written before the release of Abbott's flash glucose monitoring system, in which an easily applied glucose sensor lasting 2 weeks measures tissue glucose levels every few minutes and the results can be transmitted via Bluetooth to a hand-held device. The study by Bolinder and colleagues in *The Lancet* (summarised alongside) shows that this technology allows people with well-controlled type 1 diabetes to spend less time in hypoglycaemia.

From a patient perspective, flash glucose monitoring is very popular, even though it is not available on prescription in the UK. However, healthcare professionals are still trying to catch up. In the real world, stacking insulin (giving repeated doses of short-acting insulin in response to high blood glucose) is both very tempting and likely to result in hypoglycaemia. Good-quality research is required to help us make the best use of this impressive new technology; otherwise, users may find it as helpful as an orange urine test. ■

NICE (2015) *Type 1 diabetes in adults: diagnosis and management* (NG17). NICE, London. Available at: www.nice.org.uk/guidance/ng17 (accessed 20.02.17)

Diabetes Technol Ther

App use in Australian adolescents with T1D

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

1 The Diabetes MILES (Management and Impact for Long-term Empowerment and Success) Youth–Australia study is a cross-sectional survey focused on behavioural and psychosocial aspects relevant to adolescents with T1D in Australia.

2 These authors sought to explore app usage among participants in this study. A total of 425 adolescents responded to questions on app usage.

3 Overall, 21% of the respondents (n=87) reported using apps, with carbohydrate counting listed as the most common purpose (n=77; 89%).

4 Of those not using apps, 44% (n=149) were either unaware of suitable apps or believed that apps could not help.

5 App usage was associated with shorter T1D duration, higher socioeconomic status and performing seven or more daily blood glucose checks.

Trawley S, Browne JL, Hagger VL et al (2016) The use of mobile applications among adolescents with type 1 diabetes: results from Diabetes MILES Youth–Australia. *Diabetes Technol Ther* **18**: 813–9

Lancet

Flash glucose monitoring improves hypoglycaemia rates

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

1 These authors report the results of the IMPACT clinical trial, which examined the impact of flash glucose monitoring on hypoglycaemia compared to conventional self-monitoring of blood glucose (SMBG).

2 Participants (n=241) were adults with well-controlled T1D (HbA_{1c}, ≤58 mmol/mol [≤7.5%]) of an average duration of 22 years. The intervention group (n=120) used Abbott's Freestyle Libre flash glucose sensor and reader system, while the control group (n=121) used the Freestyle Lite SMBG system.

3 After 6 months, there was a significant reduction in time spent in hypoglycaemia (blood glucose <3.9 mmol/L) of 38% in the intervention group compared with the control group (mean difference [±standard error], –1.24±0.24 hours/day; P<0.0001). The time spent with blood glucose levels <2.2 mmol/L was reduced by 65% (P=0.0003).

4 Time spent in hyperglycaemia (>13.3 mmol/L) in the intervention group was significantly reduced by –0.37±0.16 hours/day, while time in range (3.9–10.0 mmol/L) significantly increased by 1.0±0.30 hours/day (P=0.0006). No differences in mean glucose or HbA_{1c} levels were noted.

5 There were 13 device-related adverse events (including allergy and insertion-site reactions), resulting in five participants withdrawing. Despite these, treatment satisfaction and quality-of-life scores significantly improved with the Libre.

Bolinder J, Antuna R, Geelhoed-Duijvestijn P et al (2016) Novel glucose-sensing technology and hypoglycaemia in type 1 diabetes: a multicentre, non-masked, randomised controlled trial. *Lancet* **388**: 2254–63

Diabet Med

Random non-fasting C-peptide levels are accurate to assess insulin secretion

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

1 Assessment of blood C-peptide (CP) levels stimulated by a mixed meal tolerance test (MMTT) is the gold-standard measure of endogenous insulin secretion; however, a random, non-fasting sample, if proved accurate, would be more practical in clinics.

2 Therefore, these authors compared the accuracy of random CP levels and urinary CP:creatinine ratios, measured within 5 hours of a meal, with that of MMTT-stimulated CP levels.

3 A total of 41 people with insulin-treated T2D (mean age, 73 years; median diabetes duration, 21 years) were enrolled.

4 CP was detectable in both random and stimulated tests, at all time points, in 40 of 41 participants. Random CP and stimulated CP levels were similar (median, 546 vs 487 pmol/L; P=0.92), and the two tests were highly correlated (r=0.91; P<0.001).

5 The random, fasting CP test had 100% sensitivity and 93% specificity for detecting severe insulin deficiency (stimulated CP <200 pmol/L), and 87% sensitivity and 83% specificity to detect stimulated CP levels of <600 pmol/L.

6 Random urinary CP:creatinine ratio was also well correlated with stimulated CP (r=0.82; P<0.0001), with sensitivity of 93% and specificity of 83% to detect severe insulin deficiency.

7 The authors conclude that, although validation in different and larger cohorts is required, the random CP test is a practical way to assess endogenous insulin secretion.

Hope SV, Knight BA, Shields BM et al (2016) Random non-fasting C-peptide: bringing robust assessment of endogenous insulin secretion to the clinic. *Diabet Med* **33**: 1554–8

Diabet Med

Use of a bolus calculator aids carb counting in adults with poor control

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

1 These authors assessed the use of a bolus calculator (BC) in adults with suboptimally controlled T1D who had no previous experience with carbohydrate counting.

2 In a 12-month, parallel-group, open-label study, 168 people were randomised to receive training in carbohydrate counting alone or carb counting assisted by a BC. Weight and HbA_{1c} were measured at baseline and then every 3 months for 1 year.

3 Dropout rates were similar in the two groups, at around 20%.

4 At 12 months, there were significant reductions in HbA_{1c} in both groups: 2 mmol/mol (0.2%) in the carb counting group and 5 mmol/mol (0.5%) in the BC group; however, the reduction was significantly greater in the latter (P=0.033 for comparison).

5 The proportion of time spent in target glycaemic range, as measured by continuous glucose monitoring, was also greater in the BC group (50.1% vs 40.9%; P=0.002).

6 Weight increased in both arms; however, there was no significant difference between the two groups.

7 The authors suggest that the differences between groups were because the BC users were more likely to adhere to carb counting, with 83% vs 55% of insulin doses administered based on carbohydrate content, according to self-report.

8 The BC manufacturer funded the study but had no other role in its design, analysis or reporting.

Hommel E, Schmidt S, Vistisen D et al (2016) Effects of advanced carbohydrate counting guided by an automated bolus calculator in type 1 diabetes mellitus (StenoABC): a 12-month, randomized clinical trial. *Diabet Med* 20 Oct [Epub ahead of print]

Diabetes Care

Effects of injecting insulin into lipohypertrophy

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

1 Lipohypertrophy (LH) is a common side effect of long-standing insulin administration, particularly in the absence of injection site rotation, and is characterised by fibrous and poorly vascularised lesions in the subcutaneous adipose tissue.

2 To the authors' knowledge, this was the first systematic study to quantify the effects of LH on insulin absorption and pharmacodynamics using glycaemic clamp techniques.

3 In a crossover study, 13 people with T1D and LH (confirmed with ultrasound and physical examination) were given insulin lispro injections into LH and normal subcutaneous tissue, during euglycaemic clamp conditions and prior to a standardised mixed meal, all in a randomised order.

4 In the clamp studies, compared with normal adipose tissue, LH reduced insulin absorption and effect, with lower glucose infusion rates required to maintain euglycaemia. Generally, insulin absorption was similar in the first 30 minutes in the two groups but was markedly blunted thereafter in the LH group.

5 From 2 hours post-meal, blood glucose levels were ≥26% higher with injections into LH, and peak concentrations were reached later.

6 Effects were highly individual, with two participants having almost no insulin action with the LH injections, compared to normal action when injecting into normal tissue. Both participants had profound postprandial hyperglycaemia (glucose >16 mmol/L) in these circumstances.

Famulla S, Hövelmann U, Fischer A et al (2016) Insulin injection into lipohypertrophic tissue: blunted and more variable insulin absorption and action and impaired postprandial glucose control. *Diabetes Care* **39**: 1486–92

> *"The authors conclude that, although validation in different and larger cohorts is required, the random C-peptide test is a practical way to assess endogenous insulin secretion."*