Technology Review and Update
DTN update
New Devices
What's on the Horizon?

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Senior Diabetes Specialist Nurse
ABCD Diabetes Technology Network UK
Committee Member

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NHS Foundation Trust

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Priorities

- Address unacceptable variation in access in pumps and CGM
- Continue to provide educational opportunities for HCP

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NDA Mean HbA1c

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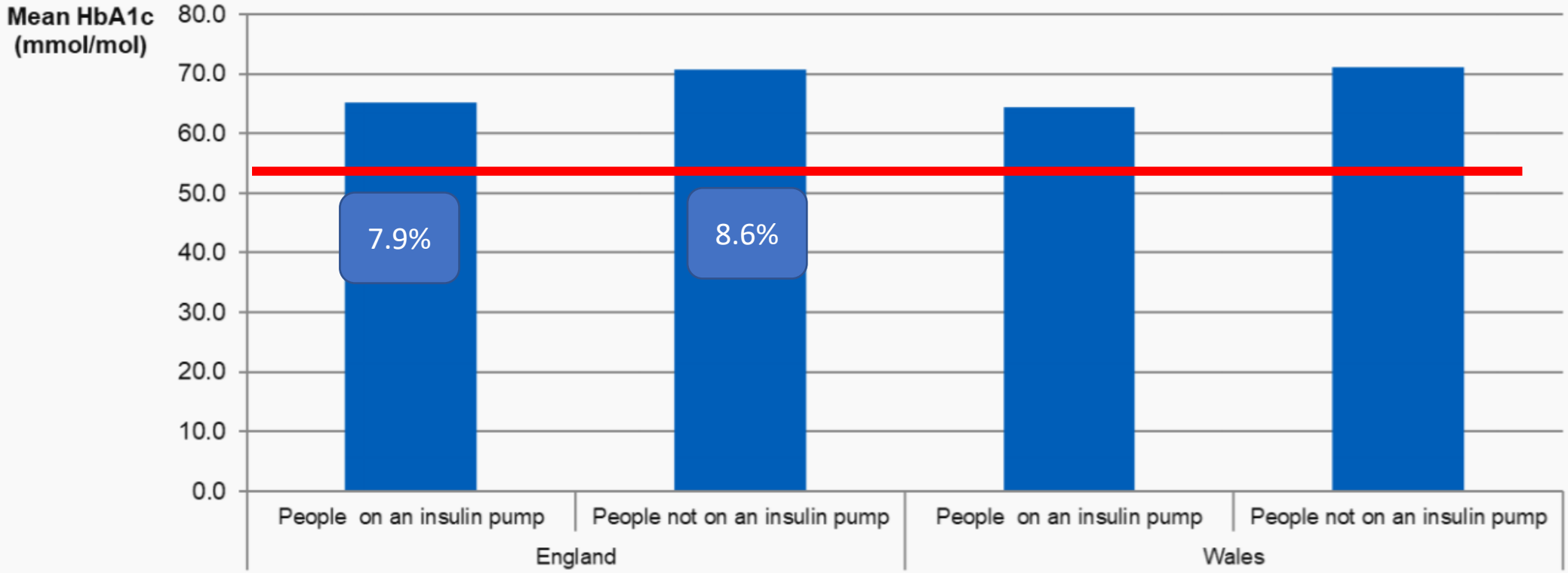
Figure 15: Mean HbA1c (mmol/mol) for people with Type 1 diabetes, by country and insulin pump status, England and Wales, 2017-18



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National Diabetes Insulin Pump Audit 2017/18

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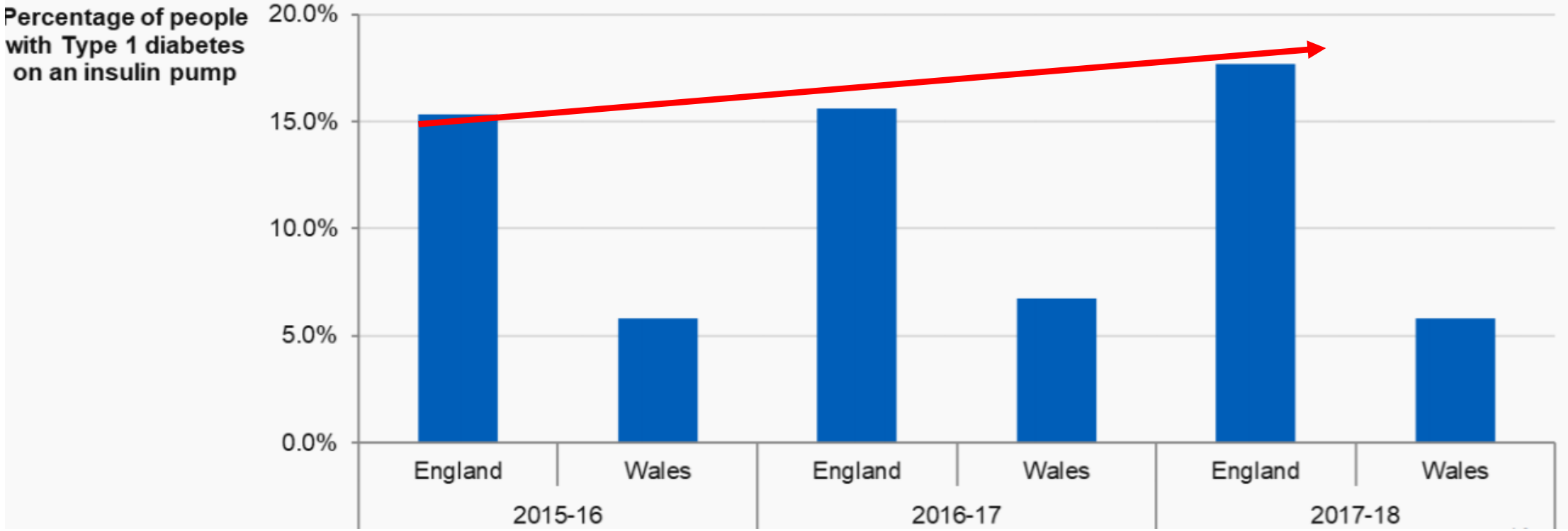
Figure 7: The percentage of people with Type 1 diabetes who are on an insulin pump, by audit period, England and Wales, 2015-16 to 2017-18



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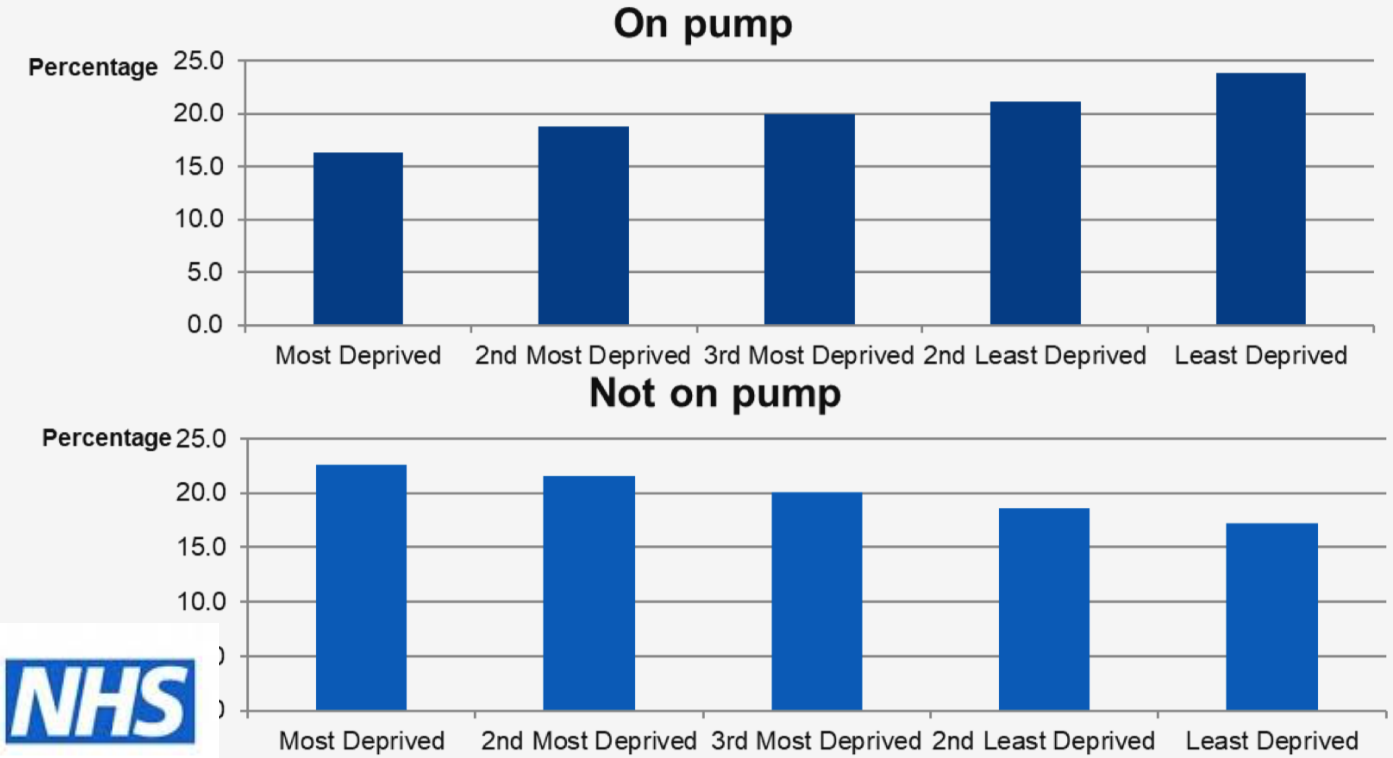
National Diabetes Insulin Pump Audit 2017/18

Deprivation - People on Pump

- The proportion of people with Type 1 diabetes is greatest in the most deprived quintile, however the highest proportion of people with Type 1 diabetes who are pump users is in the least deprived quintile.

Figure 5: The distribution of people with Type 1 diabetes attending specialist services, by deprivation quintile and pump status, England and Wales, 2017-18



Based on a population of **12,270** people recorded as on a pump (with a valid deprivation quintile).

Based on a population of **66,460** people recorded as not on a pump (with a valid deprivation quintile).

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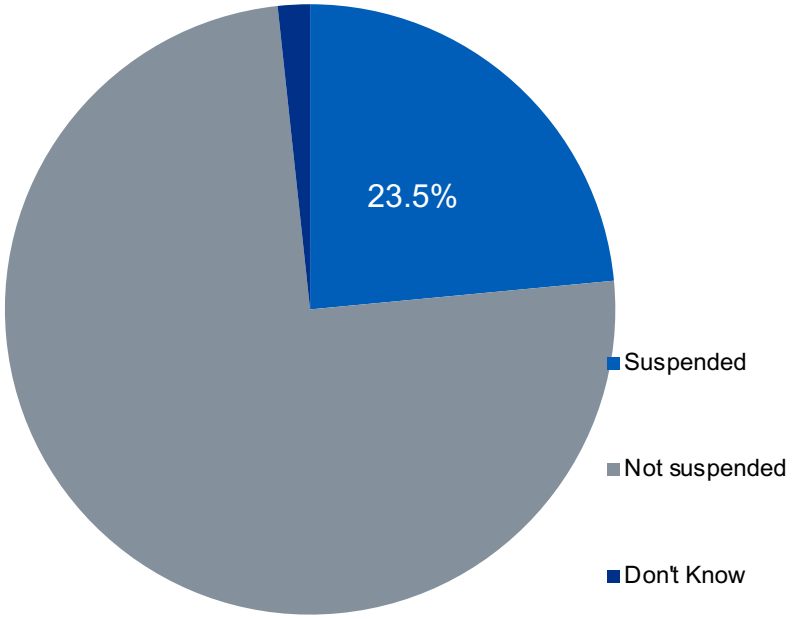
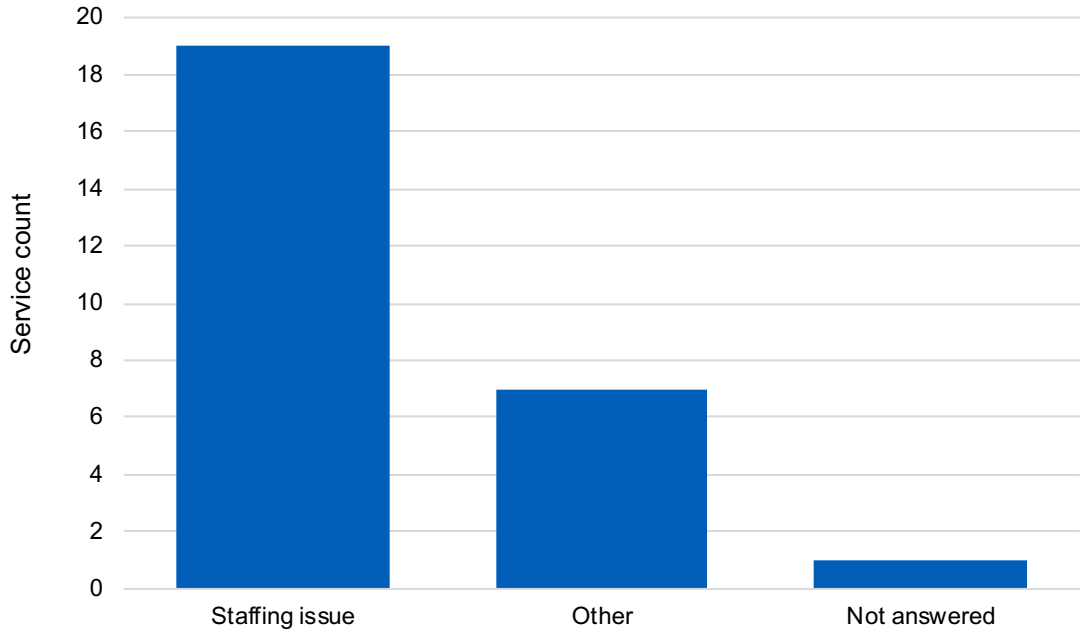
Percentage of services that suspended insulin pump starts in the last 2 years



Number of services that suspended insulin pump starts in the last 2 years, by stated reason



National Diabetes Insulin Pump Audit 2017/18

NICE TA 151 (2008)

- Insulin pump therapy is recommended for those with T1DM provided:
  - attempts to achieve target HbA1c levels with MDI has resulted in the person experiencing **disabling hypoglycaemia**

    or
  - **HbA1c** levels have remained high **(8.5% (69mmol/mol)** or above) on MDI therapy despite a *high level of care*

rtCGM funding: NICE NG17

- Consider real-time continuous glucose monitoring for adults with type 1 diabetes:

1. More than 1 episode a year of **severe hypoglycaemia** with no obviously preventable precipitating cause.
2. **Complete loss of awareness** of hypoglycaemia.
3. Frequent (more than 2 episodes a week) **asymptomatic hypoglycaemia** that is causing problems with daily activities.
4. Extreme **fear** of hypoglycaemia.

Access to CGM

- Roche commissioned FOI to determine whether CCGs in England have policies for the reimbursement of CGM
- Responses 99% (205/207) CCGs
- 45% (92/205) had policy on funding of CGM
- **21% (43/205) commission CGM in-line with NICE guidance**

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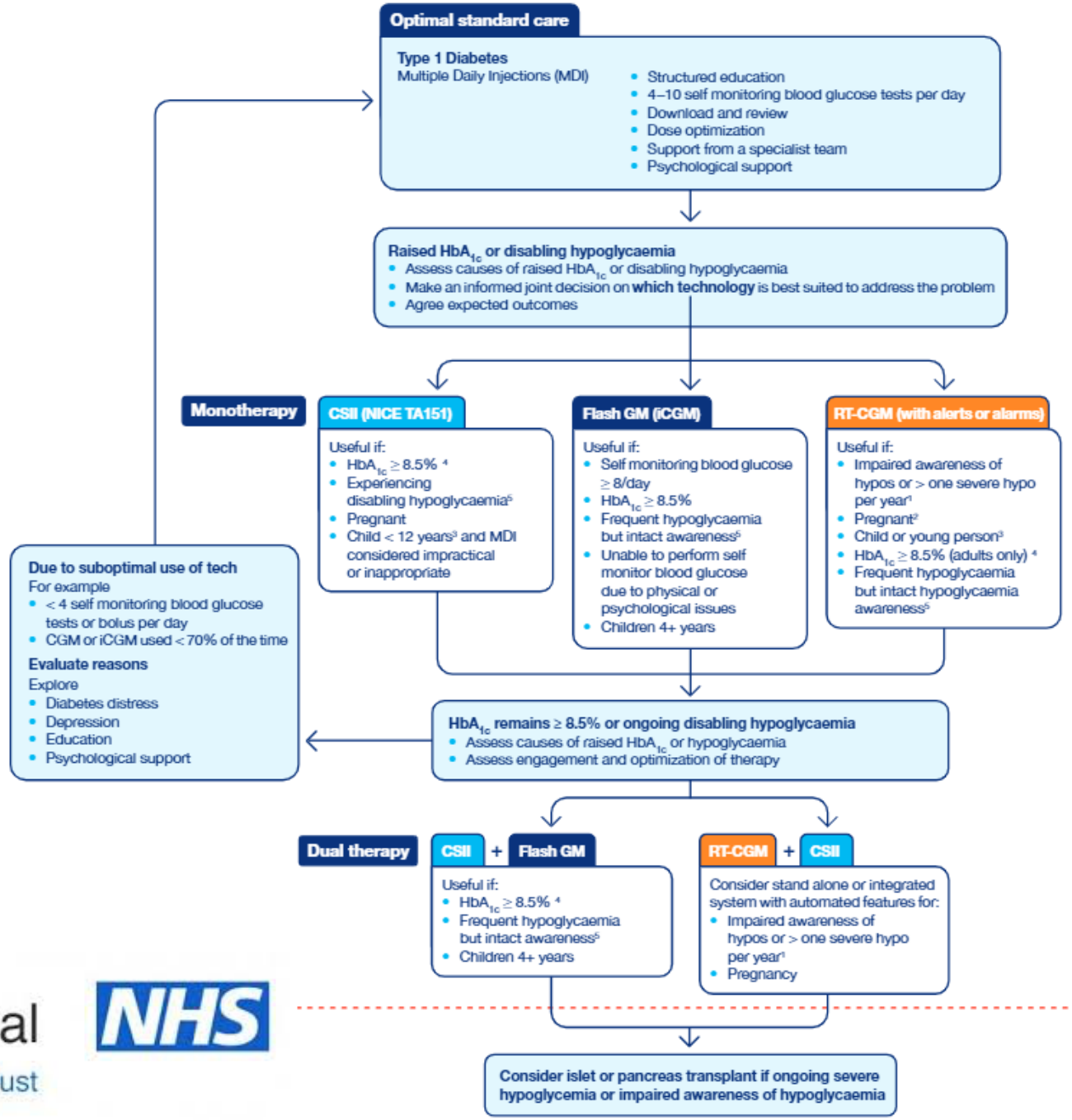
In <u>every</u> consultation with someone with Type 1 diabetes

THINK ~~PUMP~~ Technology



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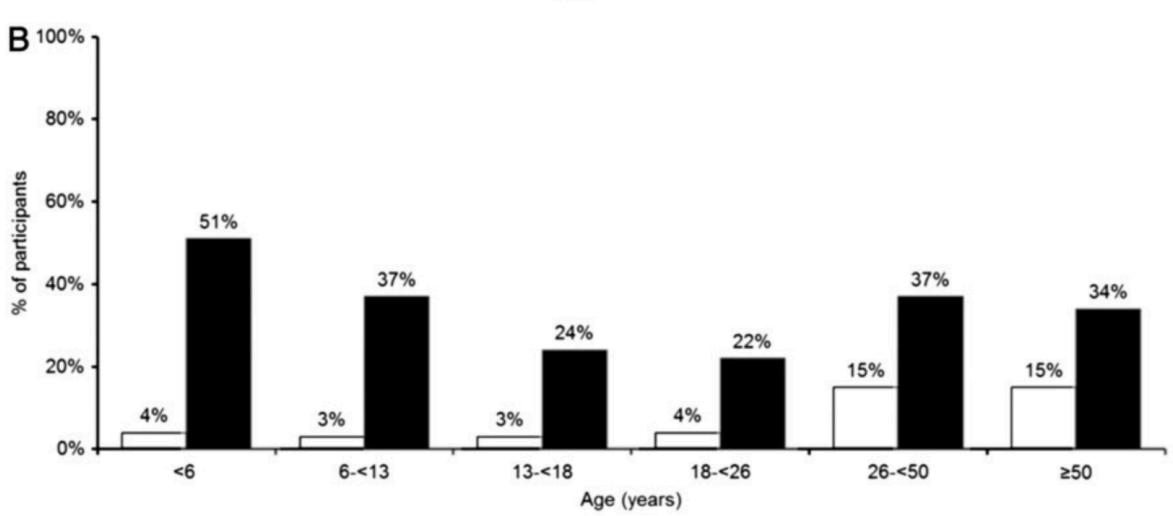
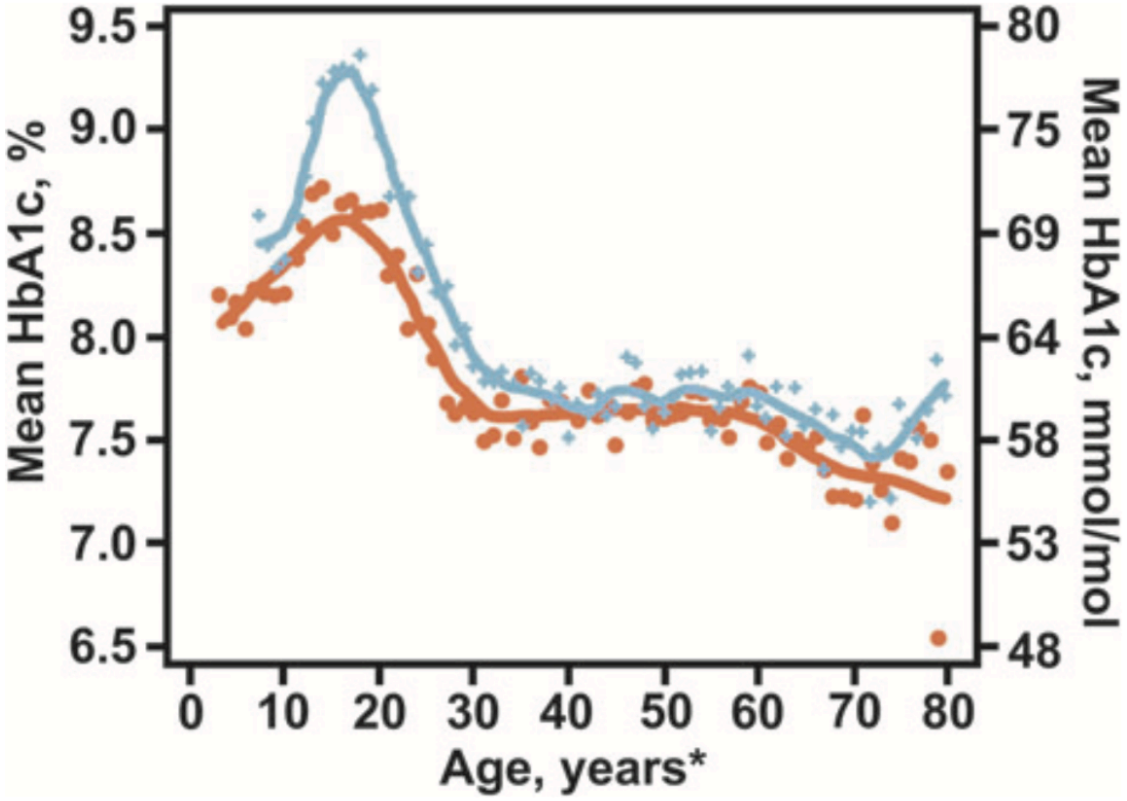
Diabetes control remains suboptimal despite increase in uptake of technology



% of participants using CGM



T1 Diabetes Exchange

Foster et al, Diabetes Technology and Therap; 2019 21(2)

DTN Update

- Launched in 2016
- DTN committee (inc DSN, DSD, Person with Diabetes)
- Working with Diabetes UK, JDRF, INPUT Diabetes and NHS England to address inequitable access to CGM
- Expert advisory group for National Diabetes Audit
- Flash Glucose Monitoring
  - Diabetes UK position statement
  - Development of ABCD nationwide FreeStyle Libre Audit

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DTN Update

- Provided 640 spaces at our educational events per year
  - Annual Meeting in Loughborough
  - X2 regional meetings (Scotland and East England)
    - Diabetes Network, commissioners and service providers meeting
  - First educators meeting
- Flash Glucose Monitoring Educational Videos
  - Easily accessible education for both HCP and people with diabetes
  - 13 videos released over 3 live webinars (1000)

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DTN-UK

FREESTYLE LIBRE EDUCATION PROGRAMME

ABCD
Association of British Clinical Diabetologists

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This series of engaging videos is designed for people with Type 1 diabetes who use the FreeStyle Libre and the health care professionals supporting them.


DR. EMMA WILMOT


DR. PETER HAMMOND


GERALDINE GALLEN


NICOLA TAYLOR


DR. JACKIE ELLIOTT


DR. PARTH NARENDREN


DR. FRASER GIBB


DR. PRATIK CHOUDHARY


DR. IAIN CRANSTON


MIKE KENDALL


NICK RYCROFT


DR. ROB ANDREWS

Register at **www.abcd.care/dtn/education**

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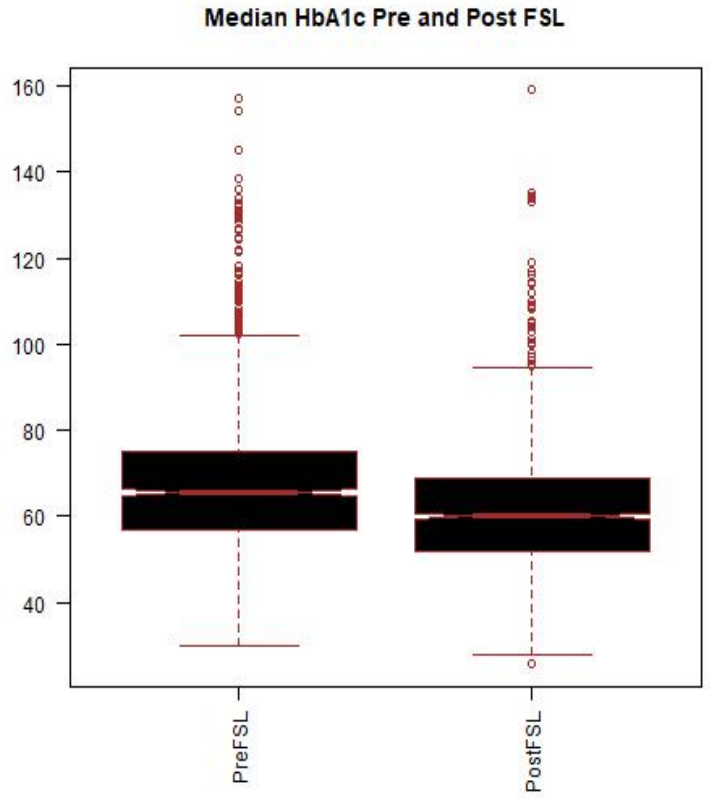
1. **Introduction** – Dr Emma Wilmot, Derby Watch now (4:14)
2. **Mike's experience of FreeStyle Libre** – Mike Kendall, DTN-UK representative Watch now (15:34)
3. **Getting started with FreeStyle Libre** – Dr Peter Hammond, Harrogate Watch now (11:58)
4. **Interpreting daily traces** - Geraldine Gallen, DSN, London Watch now (19:48)
5. **Basal insulin** - Dr Emma Wilmot, Derby
   - with insulin pens Watch now (7:54)
   - with insulin pumps (online only) Watch now (8:26)
6. **Carbohydrates** – Nicola Taylor, Dietitian, Derby
   - Introduction Watch now (11:59)
   - Fats and Protein and the Freestyle Libre (online only) Watch now (15:10)
7. **Bolus insulin** – Dr Jackie Elliott, Sheffield
   - with insulin pens Watch now (13:10)
   - with insulin pumps (online only) Watch now (13:03)
8. **Reviewing my data: what does it all mean?** – Dr Fraser Gibb, Edinburgh Watch now (11:27)
9. **The diabetes rollercoaster** – Dr Emma Wilmot & Nick Rycroft, Derby Watch now (11:34)
10. **Exercise strategies** – Dr Parth Narendran, Birmingham & Dr Rob Andrews, Exeter Watch now (25:06)

ABCD UK FreeStyle Libre audit

8.1 % vs 7.6%

Median pre-FSL HbA1c (IQR)	65.5(18)
Median post FSL HbA1c (IQR)	60 (17)
P-value*	<0.0001

n=4,709



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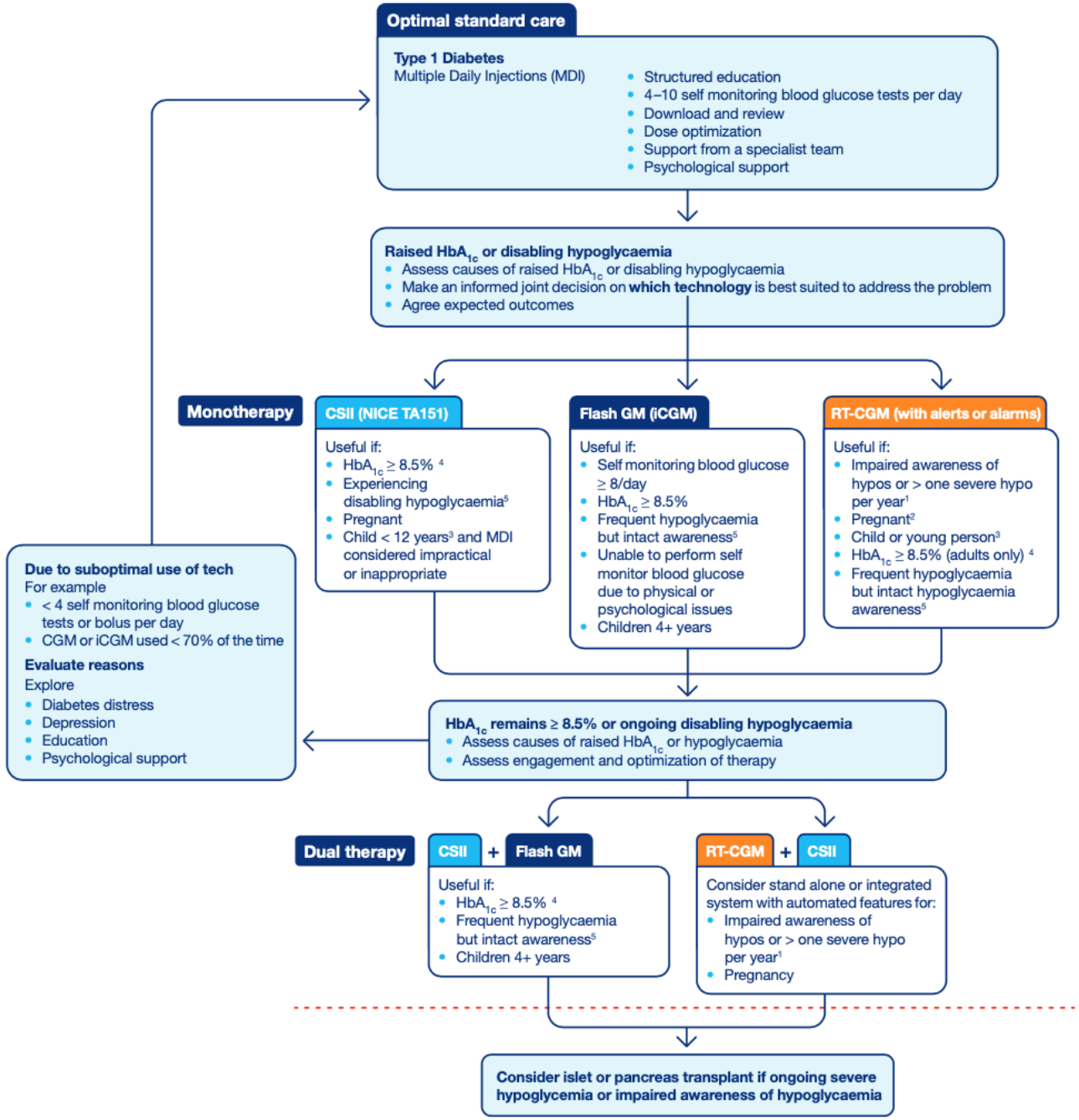
Deshmukh H, Wilmot EG, et al. Diabetes Jun 2019, 68 (Supplement 1) 299-OR

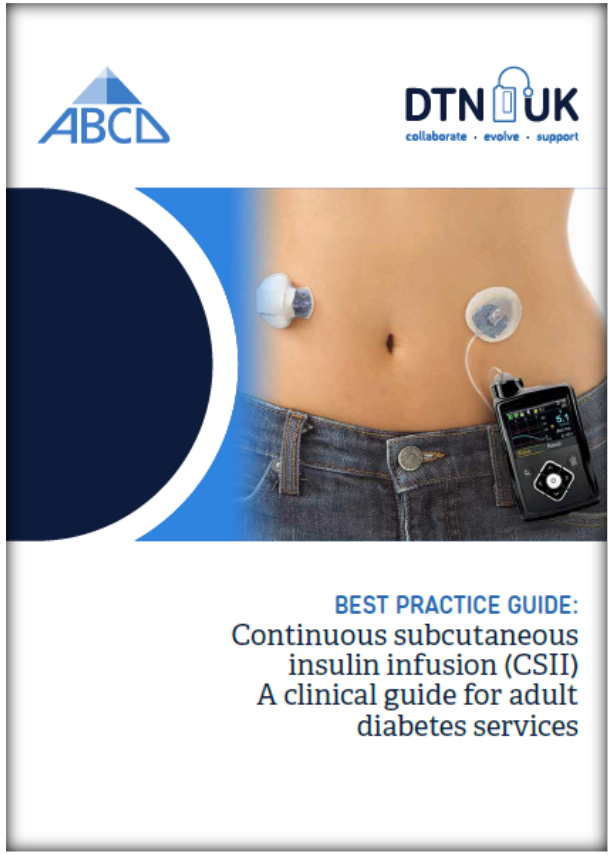
Association of British Clinical Diabetologists

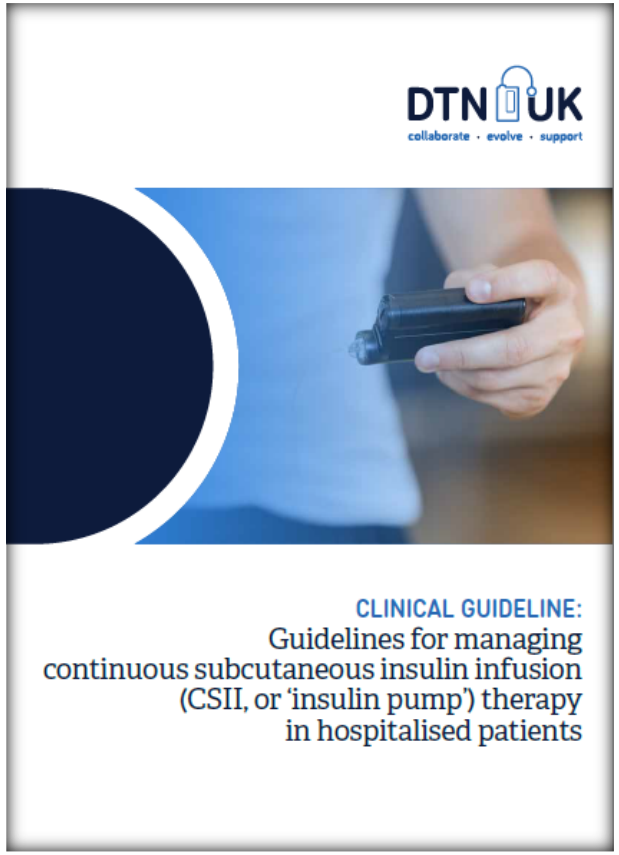
DTN Update

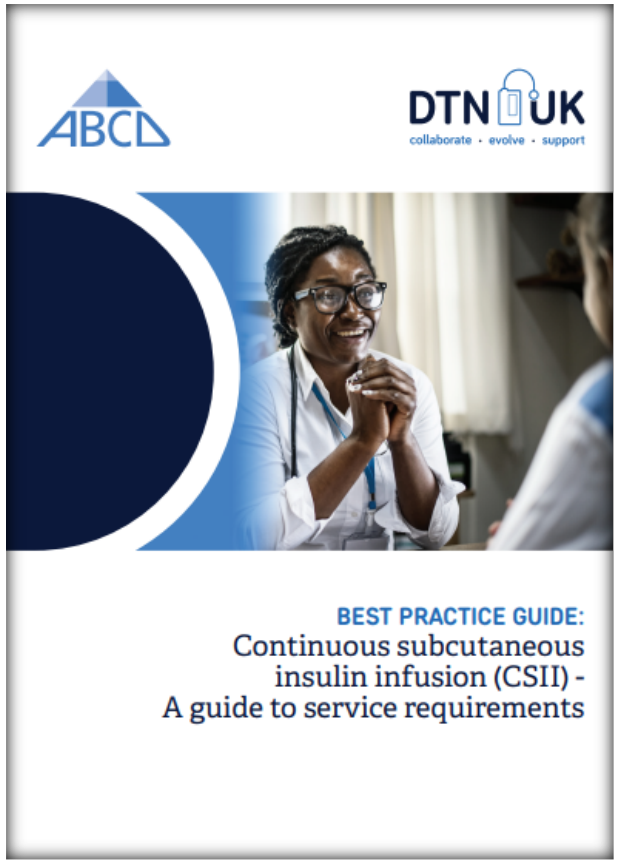
- DTN Technology pathway published in Diabetic Medicine and position statement
  - Diabetes UK
  - NHS England
- Aim- Pull together current technology guidelines into a common pathway to facilitate access to appropriate technology



Best practice guides - 2018







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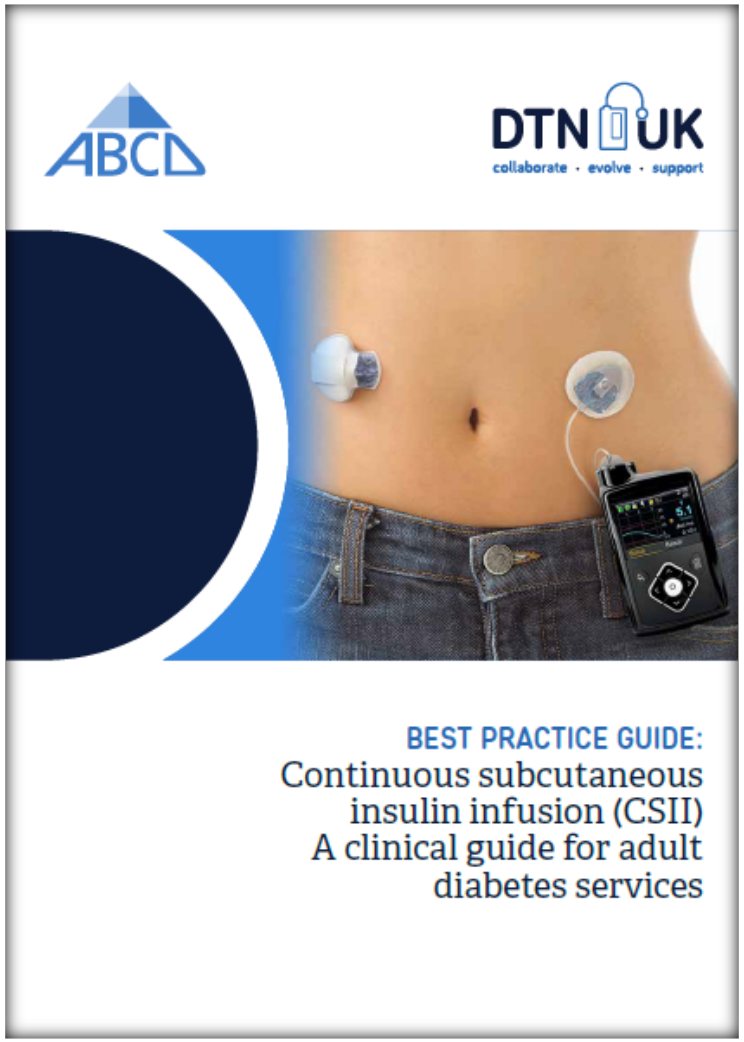

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Overview of CSII: Clinical guide for adult diabetes services

AIM

- Facilitate access to pump therapy
- Improve outcomes for insulin pump users by describing what is required for successful use of insulin pump therapy
- The guide covers:
    - Initiation
    - Optimisation
    - Safety issues
    - Specific circumstances

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Initiation

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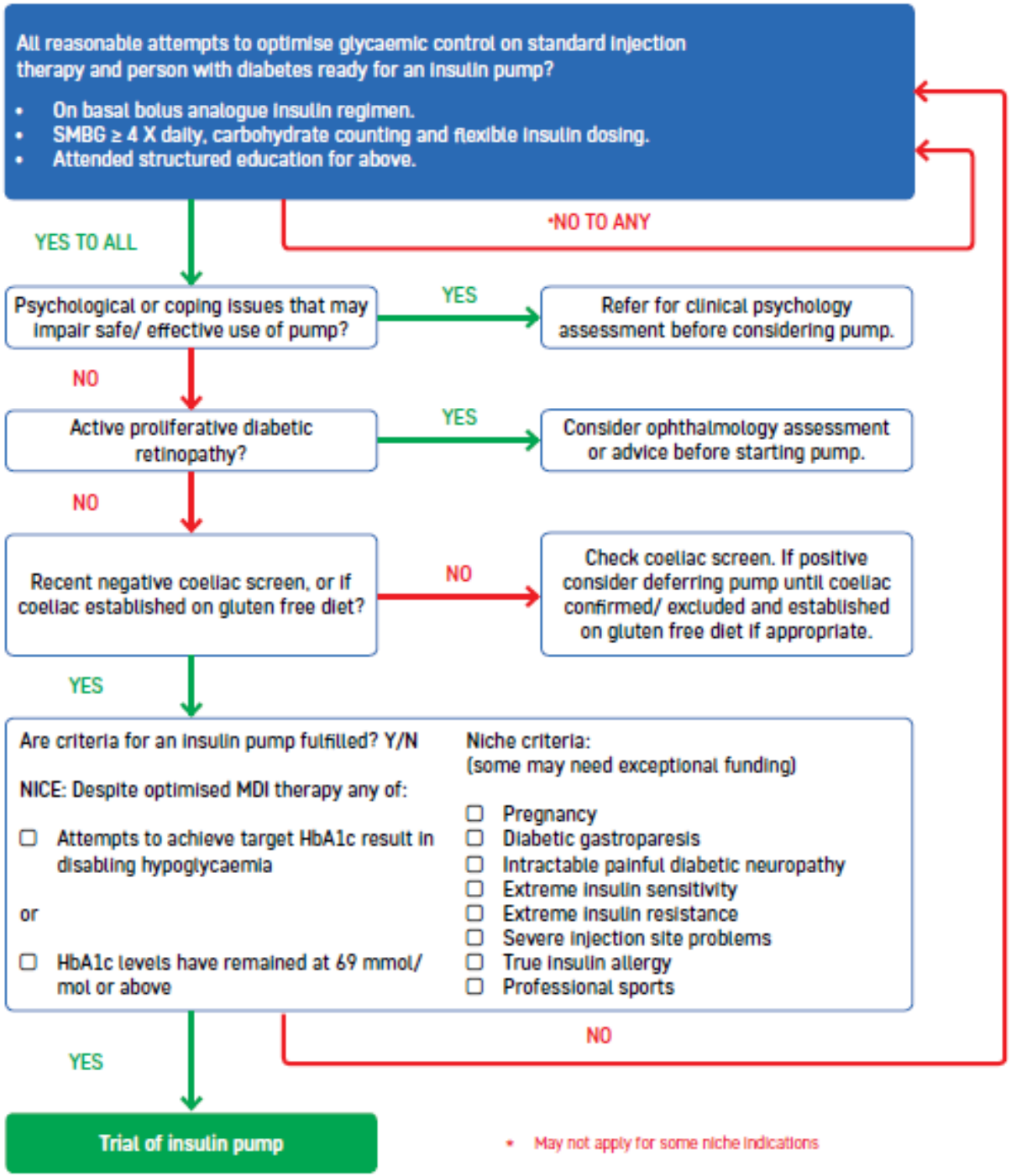
Advantages of pumps over MDI	Disadvantages of pumps over MDI
Fewer needle injections • No need to inject every time insulin delivery is required	**Constant attachment to pump** • Must be worn all the time, including when asleep • Constant visibility and reminder of diabetes • Can affect perceived body image
Insulin delivery can be conveniently varied so allowing more flexibility • Basal rates can be varied and programmed to match activity, shift work, changing requirements (eg pregnancy, hormonal changes, growth spurts, illness, travelling) • Bolus can be delivered over a varied time to help with other conditions eg malabsorption, gastroparesis or dealing with particular foods eg pizza • Temporary suspension or reduction of insulin delivery (activity and hypoglycaemia) • Allows pre-programming of insulin to deliver variable amounts insulin without constant input (e.g. whilst asleep or working) • The greater flexibility in insulin delivery and reduced variability in glucose levels can enhance quality of life	**No long-acting insulin depot** • Risk of rapid diabetic ketoacidosis development if technical failure or interruption in pump insulin delivery • Pumps should only be disconnected for short periods (eg swimming) **Complicated set up - infusion set changes** • Set changes are complicated compared to injections and infusion sets and cannulas need to be changed every 2-3 days
Small insulin doses • Deliver tiny doses (0.05-0.1 units) versus 0.5 -1 units from an insulin pen/syringe (useful for insulin-sensitive and young people)	**Infusion set problems** • Improper priming, air bubbles, tubing breaks and cannula kinks or slippages can interrupt delivery of insulin
Overcome variations in insulin absorption • Long-acting insulin can be absorbed differently in different people. Delivering programmed basal rates tailored to individual needs may overcome this problem, with the low volume of rapid-acting insulin at the infusion site resulting in a more consistent, reliable insulin absorption and hence circulating insulin profile (Bruntomesso et al. 2008)	**Infusion site problems** • Uncommon but risk of skin infections
Less snacks • Tailored insulin delivery and reductions in insulin delivery during activity reduces the need for snacking	**Increased education and training needed** • Requires higher level of education, understanding and motivation to get best use of pump and avoid problems
Improved patient experience and satisfaction • Improved self-management • Technology can motivate and improve engagement	**Increased health care provider training needed** • Health care providers need to have adequate knowledge and clinical systems in place to support pump therapy
Better integration with technology • Newer pumps can link with other technology such as meters, continuous glucose monitors, bolus advisors and diabetes information management systems	**Expense** • Pump costs as well as running costs (infusion sets, cannulas, batteries, accessories) are significantly more expensive than standard injections



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Optimisation

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Initial insulin setting at CSII initiation

Below is a summary flowchart to assist with dose calculation for CSII initiation, adapted from AACE (Consensus statement of AACE task force, 2014).

Calculations for Insulin Pump Settings		
Pump TDD calculation		
Method 1 Pre-pump TDD Pre-pump TDD × 0.75	**Method 2 Patient weight** Weight: kg × 0.5	
Clinical considerations on pump TDD: • Average values from methods 1 and 2 • Problematic hypoglycaemia: consider lower TDD • Hyperglycemic, elevated HbA1c, or pregnant, consider higher TDD		
Pump dose adjustment		
Basal Rate (Pump TDD × 0.5)/24 h	**Carbohydrate Ratio (I:C) ratio** 400/TDD	**Insulin Sensitivity Factor (ISF)** 130/TDD
• Start with one basal rate, adjust according to glucose values over basal rate testing • Add additional basal according to need (e.g. Dawn phenomenon)	• e.g. TDD 35 units = 400/35 = 11.4, I:C ratio 1 unit: 11g • Most adults require 1 unit: 8-15g • Acceptable post prandial rise is ~3mmol/l • Adjust based on low-fat meals with known quantity of carbohydrate	• Correction insulin dose should bring glucose back to target range in 4-5 hours

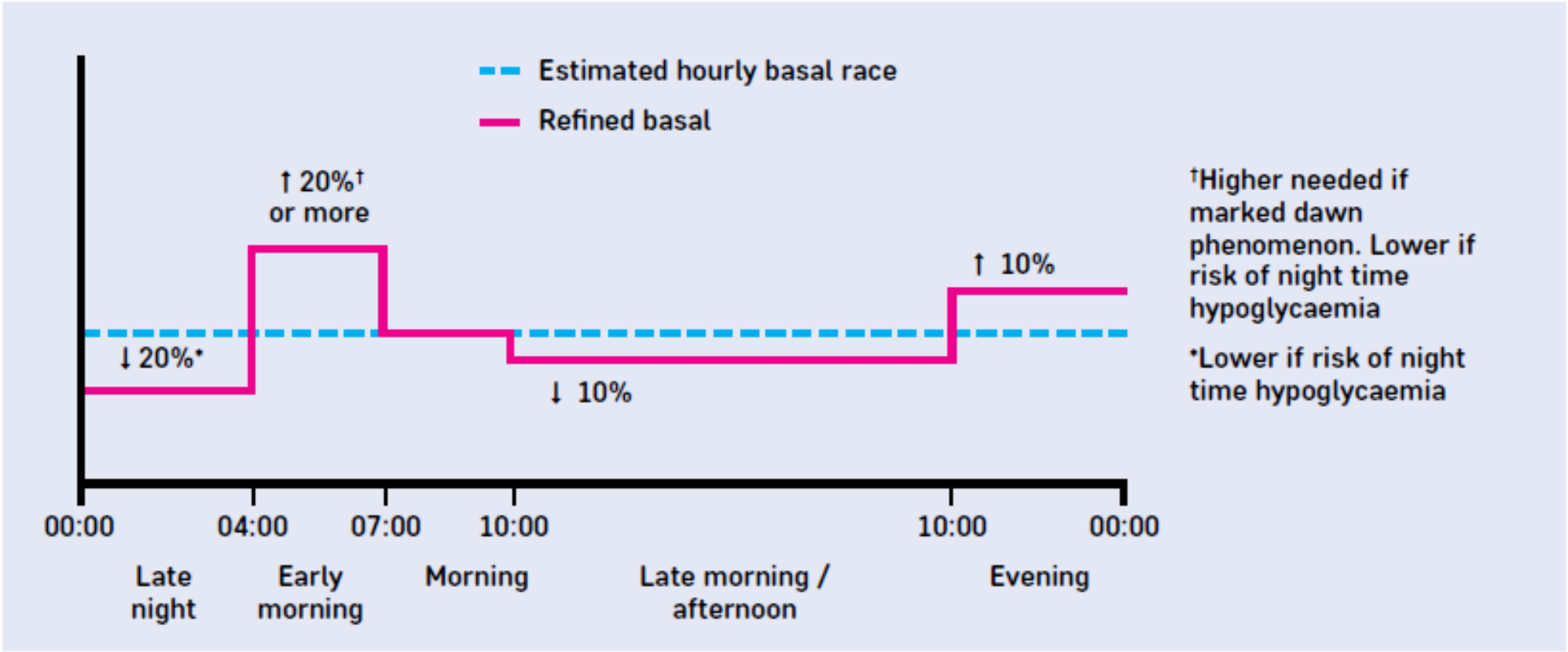

Figure 2. Modified Basal Rate Profile
(Adapted from Hussain & Oliver: Insulin Pumps and Continuous Glucose Monitoring Made Easy, 1e, 2016, Elsevier Ltd)

Basal rate testing

There are a few strategies that can be used to optimise and adjust basal rates:

1. **Formal basal rate testing.** This is particularly useful for overnight/dawn phenomenon or troubleshooting or to help user understanding and engagement. See Appendix 1 for basal rate testing protocol.
2. **Opportunistic basal rate testing.** This is easier to conduct using continuous or flash glucose monitoring to capture and assess glucose values in the fasting state >4 hours since last meal/bolus during day to day living.
3. **Download review.** If the user is unable/unwilling to perform basal rate testing then the download can be interrogated to assess the appropriateness of basal insulin; although more challenging, this is probably the most common approach in clinical practice.

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Settings

Figure 3 Insulin pump settings

	Settings
Total Daily Dose (TDD)	If problematic hypoglycaemia consider a 10% reduction
Insulin:Carbohydrate ratio	300-400/TDD
Insulin Sensitivity Factor (ISF)	130/TDD
Insulin active time	4 hours*
Blood glucose target	5 mmol/l**

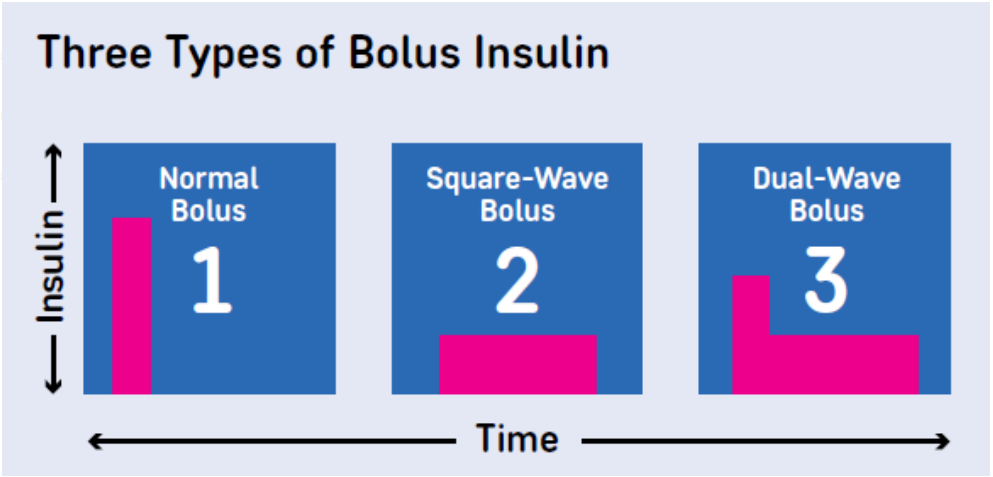

Table 3: Predicted ICR and ISF based on insulin pump total daily dose (TDD)

TDD	I:C Ratio 1 unit of insulin for X g of carbs	ISF 1 unit reduces glucose by...
	400 rule	130 rule
10	40	13
20	20	6.5
30	13	4.3
40	10	3.3
50	8	2.6
60	7	2.2
70	6	1.9

Table 4. A guide to insulin pump download interpretation

Glucose	Insulin	Pump settings
• What is the frequency of glucose monitoring? - Be aware that in those achieving HbA1c < 58mmol/mol (7.5%) the average BG tests per day is ≥ 5 • What is the mean glucose and therefore estimated HbA1c? • What is the glycaemic variability? - Standard deviation (SD) ≥ 3.5 mmol/l or CV (SD/mean) ≥ 36% suggests high variability (Danne et al. 2017) • What percentage of time is spent in hypoglycaemia? - ≥ 10% in someone monitoring ≥ 4/day is a concern, so identify the cause.	• What percentage of the total daily dose is basal? - ~40-60% expected - but take number of boluses and carbohydrate intake into account • Is the basal insulin adequate? - Is the glucose stable overnight and fasting at times when there are no other confounding factors? • What is the frequency of boluses? - Is all carbohydrate covered with a bolus? - Optimal glucose control often requires ≥ 5 bolus /day	• What is the total daily dose? • Do the I:C ratio and ISF fit with expectations taking into account the 400 and 130 rules? • If more insulin resistant at certain points of the day, are I:C and ISF in keeping with this? • Are set changes occurring at least every 3 days? • Is the bolus calculator used for the majority of boluses? - Is bolus calculator advice being over-ridden? • What is the target range? - Remember Medtronic pumps correct to the upper level so consider using 4.5-5.5mmol/l for most to overcome this - but do individualise targets following discussion with users. • If settings are way off those expected, with ineffective basal rates and bolus ratios, and sub-optimal control, consider resetting insulin pump settings based on weight calculations. Note that this will require close contact thereafter for further optimisation.

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Safety concerns & specific circumstances

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Management of unexplained hyperglycaemia

Set failure can occur and if not detected can potentially result in the development of ketosis/ketoacidosis within a matter of hours. All people with diabetes who use insulin pump therapy should be aware of the potential for set failure and how to manage this.

Rules for the management of **unexplained** hyperglycaemia:

- If glucose >13 mmol/l, take a correction bolus by the pump
- Check BG in 2 hours - if no change or glucose is higher, take a correction injection with a syringe or pen, check for ketones
- Change infusion set and reservoir
- Check glucose and blood ketones in 2 hours and take a correction bolus via the pump if required, check for ketones if glucose still high
- Follow sick day rules if ketones are positive
- Do not go to sleep:
  - with unexplained hyperglycaemia which has not resolved
  - or, within 2 hours of a new set change

Back up insulin pens

Pump users should have some long acting insulin available to them which they can use in the event of CSII failure. This is particularly important if they are travelling away from home. Users should carry a note of their ICR, ISF and basal insulin requirements. In the event of CSII failure, the emergency basal insulin would be the same as the total daily basal insulin on the pump and the ICR/ICF would be the same as on the pump.

In the event that a user experiences pump failure but they do not have long acting insulin with them, they should check glucose and take an injection of rapid acting insulin every 3 hours.

Some users may wish to plan a temporary return to multiple daily injections for holidays; they should be supported to do this. Some pump companies offer a holiday loan pump.

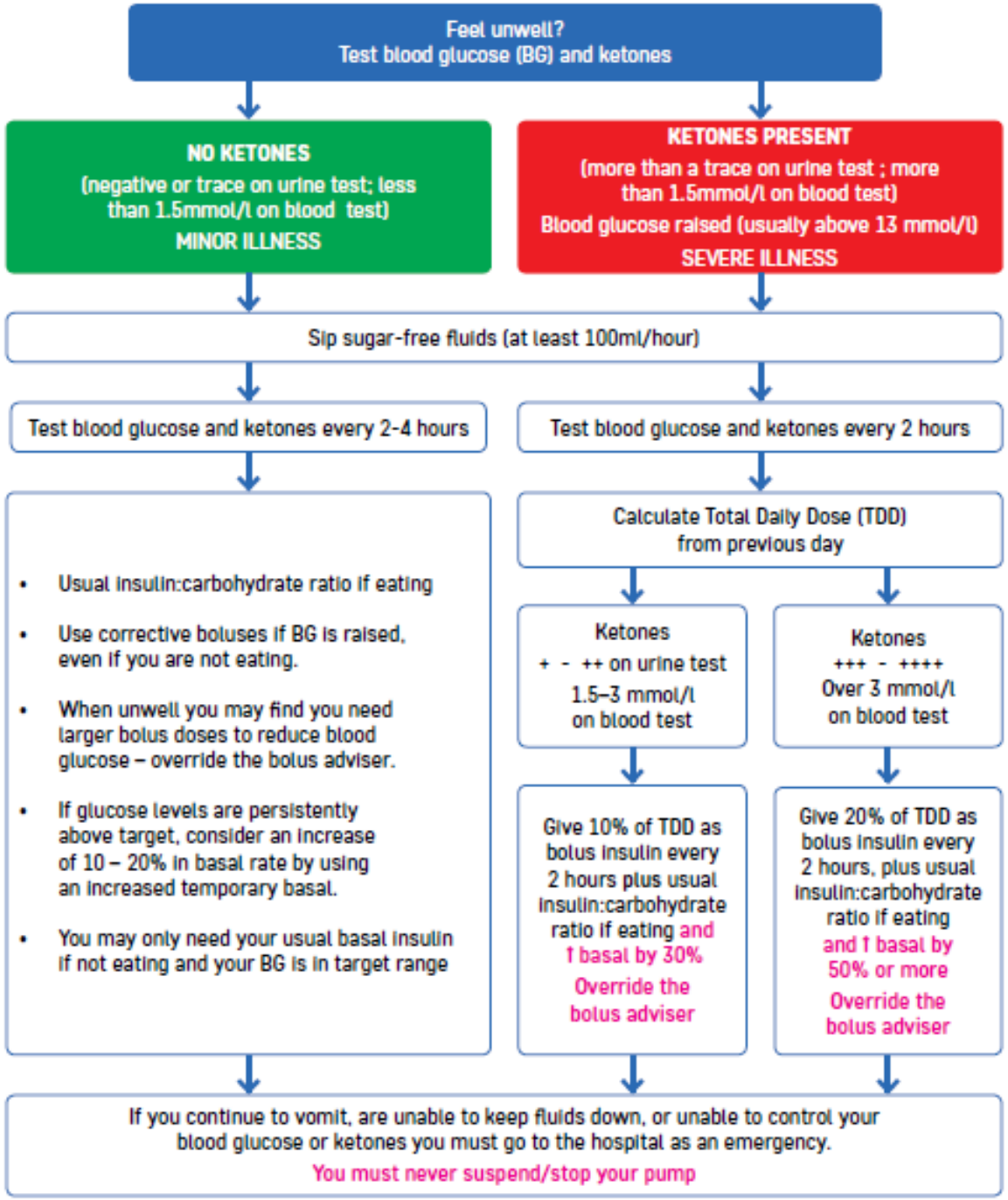
Consider CSII discontinuation in the following circumstances:

1. User choice
   User would prefer MDI

2. Safety concerns
   a. Admission with ketosis/diabetic ketoacidosis related to unsafe insulin pump use
   b. Inadequate glucose monitoring (<4 / day on download)
      i. If monitoring <2 per day, consider temporary immediate withdrawal on the basis of safety concerns

      ii. If monitoring 2-4 times per day, consider withdrawal if unable to increase to >4 times per day
   c. Unable to self-manage CSII safely (user or carer, e.g. cognitive impairment)
   d. Non-attendance at clinic for review

3. Absence of clinical benefit
   Failure to meet the objectives of CSII described at pump start eg failure to improve HbA1c and / or reduce hypoglycaemia frequency in absence of extenuating circumstances



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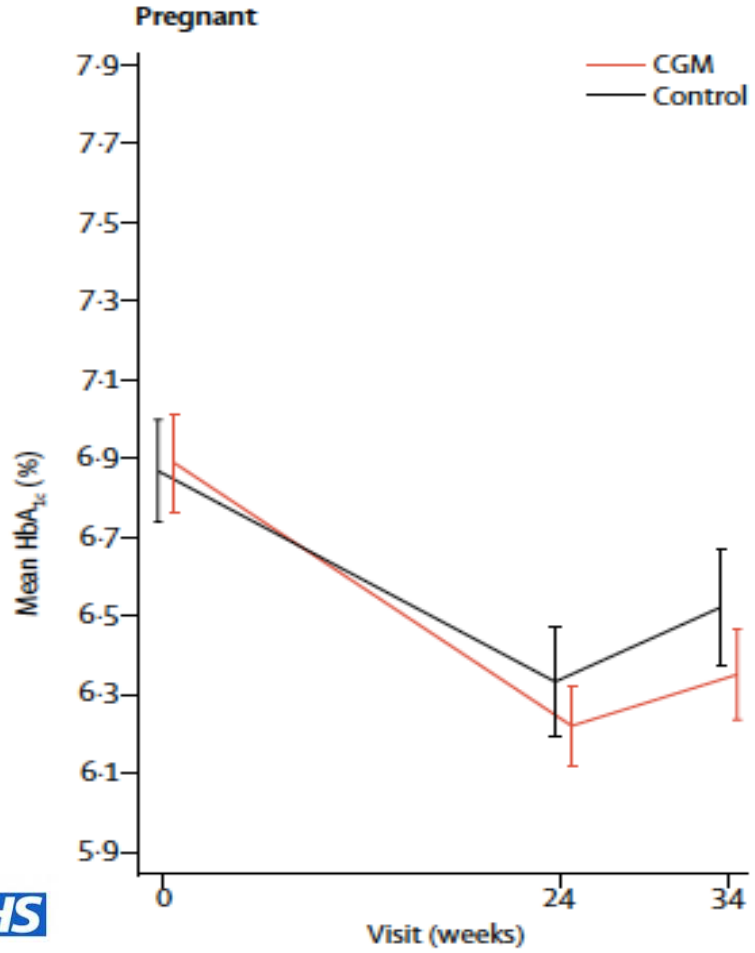
Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT): a multicentre international randomised controlled trial



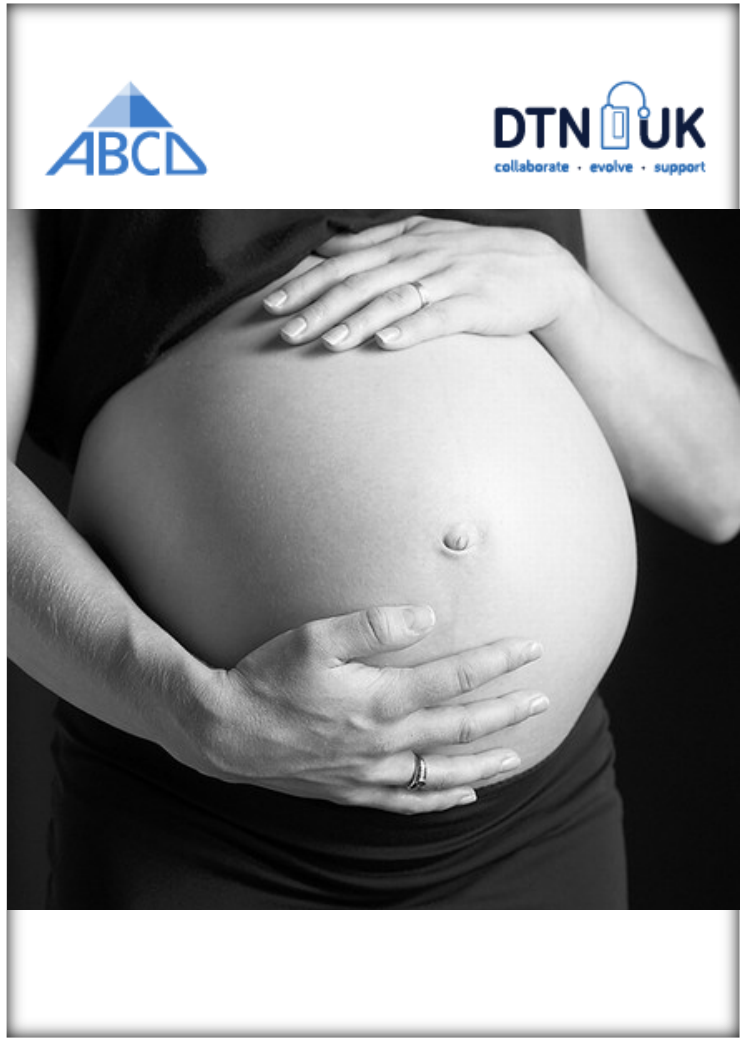
	CGM	Control
Stillbirth	0	1
Congenital Anomaly	2	3
Early preterm < 34 weeks	5%	7%
LGA > 90%	53%*	69%
Macrosomia > 4000g	23%*	27%
NICU > 24 hrs	27%*	43%

Feig DS et al. *Lancet* 2017;390:2347-59

3.80. The NHS will ensure that, in line with clinical guidelines, patients with type 1 diabetes benefit from life changing flash **glucose monitors** from April 2019, ending the variation patients in some parts of the country are facing. In addition, by 2020/21, all pregnant women with type 1 diabetes will be offered continuous glucose monitoring, helping to improve neonatal outcomes.

2020

Best practice Guidelines For CGM in Pregnancy and videos



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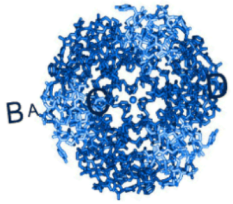

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