

# Meal Management For People Using HCL Systems

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## Disclosures

- NHS diabetes dietitian
- Consultancy panel for Medtronic and Ypsomed; received honoraria for speaking from Medtronic, SBK, and Diabetes MyWay. Delivered industry supported continuing medical education activities for Dexcom.
- **DTN** committee
- Faculty for Lead Academy for Nurses (Medtronic); Diabetes Educator Leader network member (Medtronic)

None of these activities are considered to be a conflict for this presentation.







# Agenda

- Options for delivering insulin with meals/snacks
- Timing of insulin impact on glucose outcomes
- Why can post-prandial response vary?
- Complex meals should we be educating people on different strategies for high fat meals and protein content





# Nutrition advice



Good nutrition provides energy to function, helps maintain a healthy weight, supports strong bones and muscles, boosts the immune system, and can significantly reduce the risk of developing chronic diseases like heart disease and certain cancers

Good nutrition is beneficial for adults with type 1 diabetes because it directly impacts blood glucose levels; a balanced diet helps maintain stable blood glucose, reducing the risk of complications associated with raised HbA1c, while also promoting overall health and well-being.

NICE guidance (2022) advises as part of dietary education after diagnosis (and as needed after this), provide information on how healthy eating can reduce cardiovascular risk. Include information about fruit and vegetables, types and amounts of fat, and how to make the appropriate dietary changes.





## What skills do our patients have?

Recommend structured education pre-pump start (NICE)

1.5 Only use HCL systems if the person or their carer:

- is able to use them, and
- is offered approved face-to-face or digital structured education programmes, or
- is competent in insulin dosing and adjustments.









## Access to education

**Options** 

Face to face

- DAFNE, diabetes service own programme
- Carb counting workshops (e.g. Roche)
- 1-1 support in clinical setting

## Online

- BERTIE, Diabetes MyWay, OU courses

- Barriers
- Face to face - Time commitment - Cost to person with diabetes
- Ability to learn in group setting

## Online

- Time commitment
- Focus
- Access to device to learn on/access course



## Carbohydrate counting and Carbohydrate Awareness

Determining ratios, meal estimation, and fixed doses requires skills in assessing carbohydrate content of typical meals eaten by the person and their insulin sensitivity. **Diabetes specialist dietitians** work closely with people with diabetes to create this assessment through various methods.



This is used as the starting point to create settings for bolus calculators alongside estimated insulin sensitivity based on body weight, duration of diabetes, or current established TDD as well as age.









## Why do we teach carb counting/carb awareness?

 It has been proven to achieve a reduction in HbA1c for people using MDI therapy

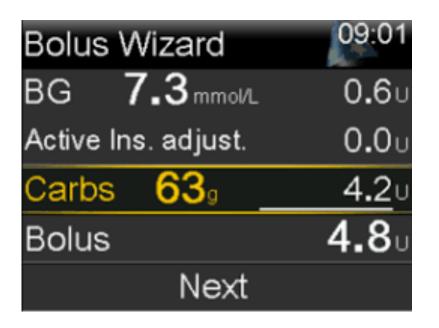
Bell et al. identified five studies that showed a 0.64% reduction in A1C with carbohydrate counting in adults with type 1 diabetes.





# Carbohydrate counting with HCL systems

• All systems have bolus calculators







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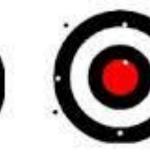
# Carbohydrate counting skills

• What do the skills translate to? Patient accuracy:

Several studies have assessed carb counting accuracy in MDI and CSII patients who have had some degree of education (1-5 days); the accuracy assessments range from 38%-67% (+/- 20% of actual carb value), with the inaccuracy mostly being over-estimation of carbs by an average of 40%.







Precise but not accurate

Accurate and precise

Accurate but not precise

- Not accurate or precise
- Impact of accurate carb counting (not HCL)? Outcomes:

Deeb (2016) followed up the accuracy assessment with analysis of post-prandial glucose levels and report **55%** of accurate counts resulted in a target post-prandial glucose level.



- (Meade, 2016; Shapiro, 2010; Deeb, 2016; Keaver, 2020)



# So How Important is Carb Counting?

# What about happiness?

People who are taught and implement carbohydrate counting have lower HbA1C levels and better quality-of-life scores vs people who estimate pre-meal insulin dose in their usual empirical way (Laurenzi, 2011)











## Summary

- Carbohydrate counting is the preferred method of dosing mealtime insulin in patients with diabetes.
- Complex and challenging self-management requirements often take precedence and can leave little time to focus on counting carbohydrates.
- Patients may then begin over- and underestimating carbohydrate amounts, which is likely to result in hypo- or hyperglycaemia.





## Meal estimation

What is it?

- the process of approximating the size or carbohydrate content of a meal
- often done by visually judging portion sizes as sr medium or large.







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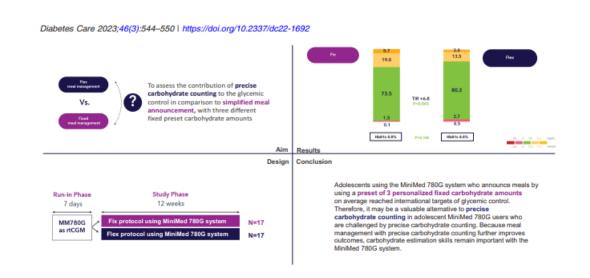
## Meal estimation



#### Simplified Meal Announcement Versus Precise Carbohydrate Counting in Adolescents With Type 1 Diabetes Using the MiniMed 780G Advanced Hybrid Closed Loop System: A Randomized Controlled Trial Comparing Glucose Control

Goran Petrovski, Judith Campbell, Maheen Pasha, Emma Day, Khalid Hussain, Amel Khalifa, and Tim van den Heuvel

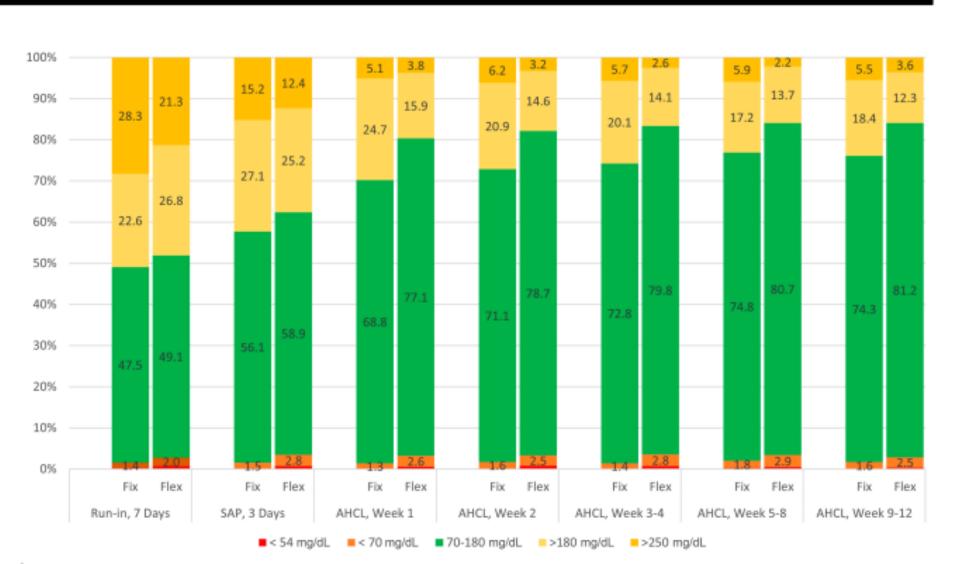
Diabetes Care 2023;46(3):544-550 | https://doi.org/10.2337/dc22-1692

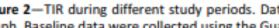


#### ARTICLE HIGHLIGHTS

- Adolescents using the MiniMed 780G system that announces meals by using a preset of three personalized fixed carbohydrate amounts on average reached international targets of glycemic control.
- · This method may be a valuable alternative to precise carbohydrate counting in adolescent MiniMed 780G users who are challenged by precise carbohydrate counting.
- Meal management with precise carbohydrate counting further improves outcomes, and carbohydrate estimation skills remain important with the MiniMed 780G system.

Simplified Meal Announcement With MiniMed 780G 548







Diabetes Care Volume 46, March 2023

Figure 2—TIR during different study periods. Data are percentage of TIR during the interval. Glucose values <54 mg/dL are not shown on the graph. Baseline data were collected using the Guardian 4 sensor with the MiniMed 780G system for a 1-week period of training. AHCL, advanced

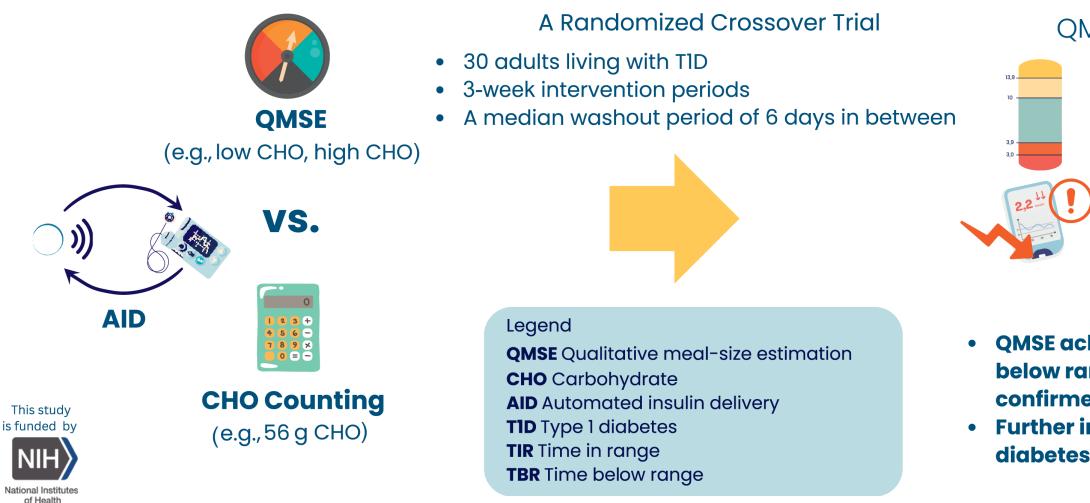


From: A Randomized Crossover Trial to Compare Automated Insulin Delivery (the Artificial Pancreas) With Carbohydrate Counting or Simplified Qualitative **Meal-Size Estimation in Type 1 Diabetes** 

Haider et al 2023 Diabetes Care. 2023;46(7):1372-1378. doi:10.2337/dc22-2297

#### Is qualitative meal-size estimation noninferior to carbohydrate counting in automated insulin delivery for people living with type 1 diabetes?

**Methods** 





Results

QMSE vs. CHO Counting

**Mean TIR** (3.9–10 mmol/L) 70.5% (vs. 74.1%)

Median TBR (<3.9 mmol/L)

1.6% (vs. 1.4%)

### Conclusion

- QMSE achieved high time in range and low time below range; however, noninferiority was not confirmed for QMSE vs. carbohydrate counting.
- Further improvements to QMSE might reduce diabetes management burden in T1D.

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## Meal estimation

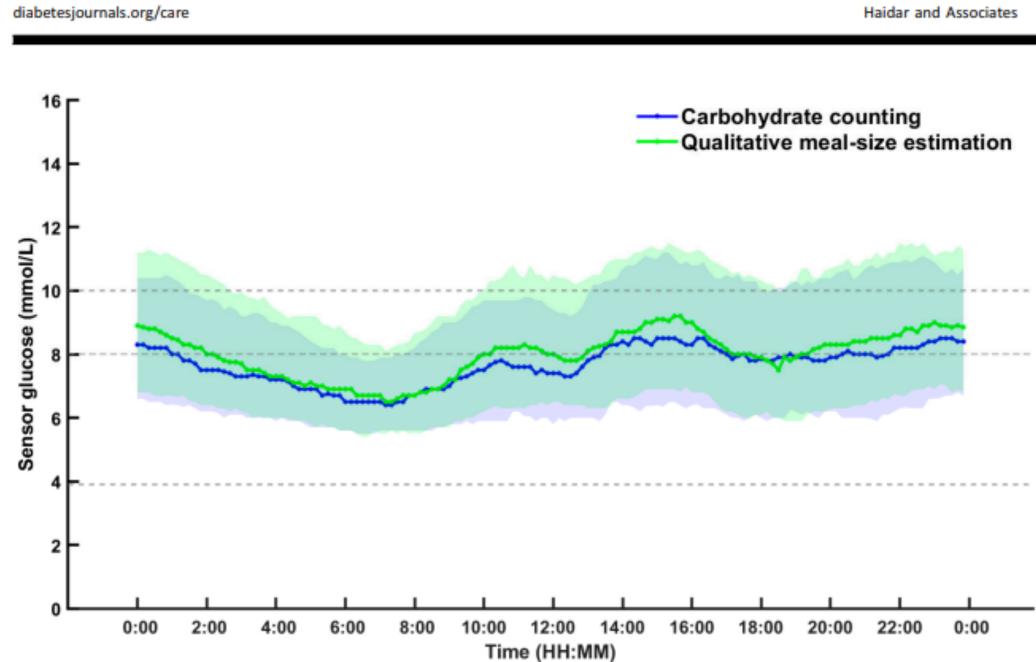


Figure 1—The median (IQR) profiles of individual mean glucose levels during 3 weeks of automated insulin delivery with CHO counting (blue; n = 30) and the qualitative meal-size estimation strategy (green; n = 30). At each time point, mean values were calculated for each participant, and then the medians (IQR) were calculated across participants.



1375



## Meal estimation

- How do we set it up?
- How does the patient implement it?









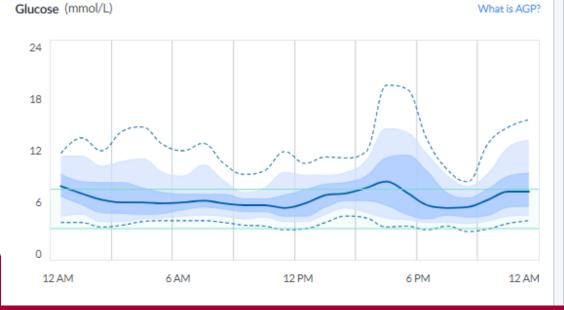
#### Glucose (CGM)

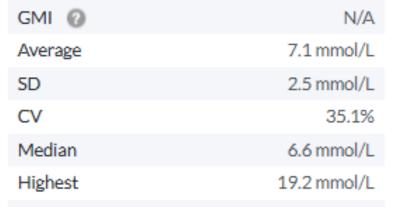
	2%	Very High > 13.9 mmol/L
	10%	High 10.1-13.9 mmol/L
	86%	Target Range 3.9-10 mmol/L
	2%	Low 3-3.8 mmol/L
	0%	Very Low < 3 mmol/L

#### Glucose (CGM)

■ 2% Very High > 13.9 mmol/L	GMI 🕜	N/A
<ul> <li>28% High 7.9-13.9 mmol/L</li> </ul>	Average	7.1 mmol/L
	SD	2.5 mmol/L
<ul> <li>69% Target Range 3.5-7.8 mmol/L</li> <li>1% Low 3-3.4 mmol/L</li> </ul>	CV	35.1%
2 200 200 3-3.4 mmol/ 2	Median	6.6 mmol/L
■ 0% Very Low < 3 mmol/L	Highest	19.2 mmol/L
% Time CGM Active 97.2% (6.8 days)	Lowest	3.1 mmol/L

AGP







From Insulin Pump

**System Details** 

CamAPS FX (7d)

🗲 Auto mode 'On'

🖊 Boost

Sase-off

Diet

134.3 g

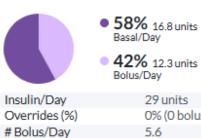
Carbs/Day

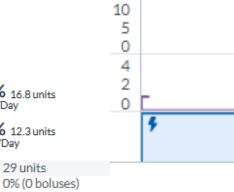
👶 Auto mode 'Off

Auto mode 'Attempting'

Mar 12 - Mar 18, 2024

5.6





20

15

10

5

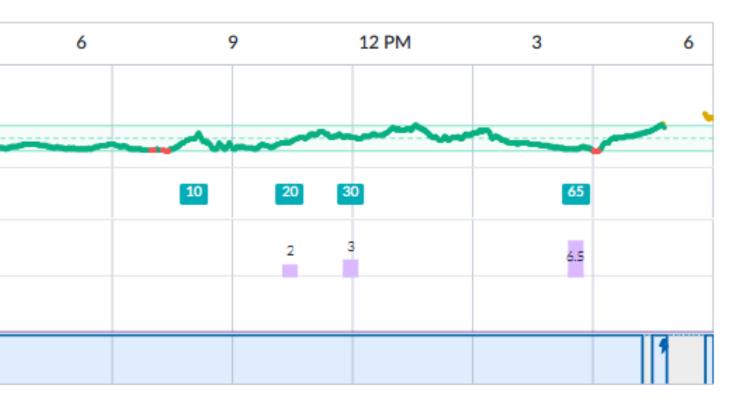
12 AM

3



#### Glucose (mmol/L)

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## Pre-bolus – what's the big deal?

 It is well researched and documented that administering rapid-acting insulin boluses 15–20 minutes before a meal leads to reduction in post-prandial glucose compared with boluses delivered immediately before the meal.

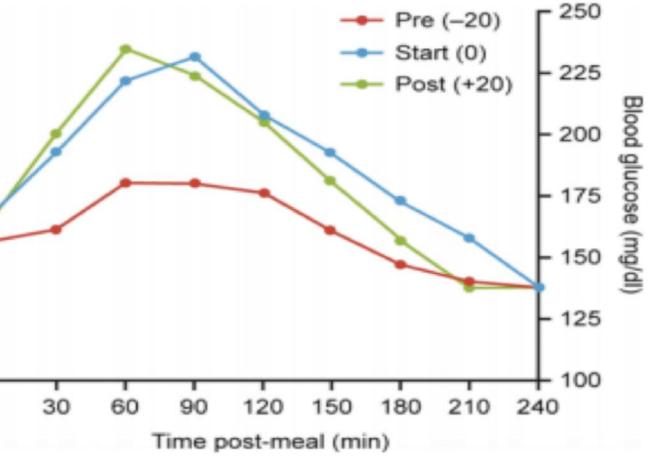
(Mozillo, 2022; Slattery, 2018; Annuzzi, 2024)

 To get the best results from a HCL system, the user still needs to bolus at least 15 min before meals if using rapid acting insulins such as Novorapid or Humalog

(Griffin et al, 2023)

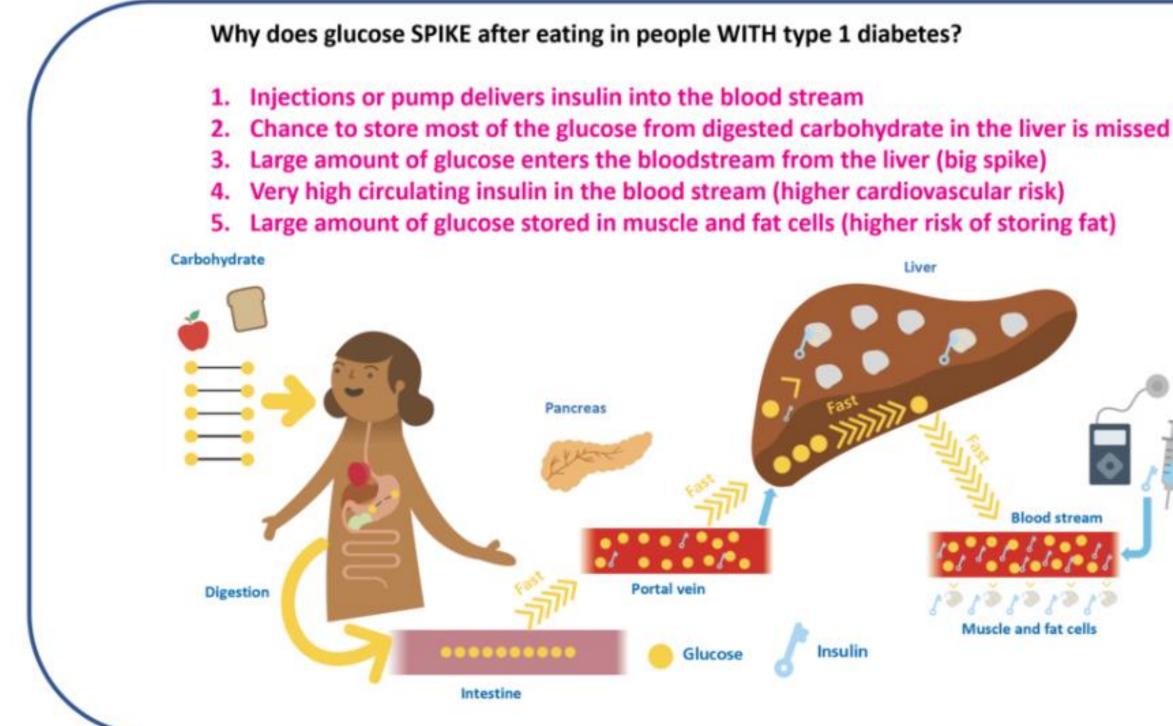






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## Pre-bolus – what's the big deal?





# Liver Blood stream

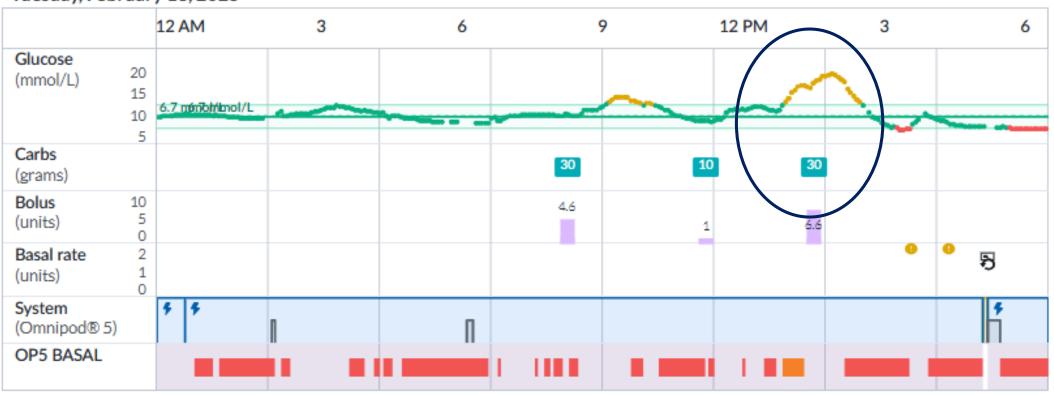
## https://theglucoseneverlies.com/

### Saving lives, Improving lives

Post-meal bolus

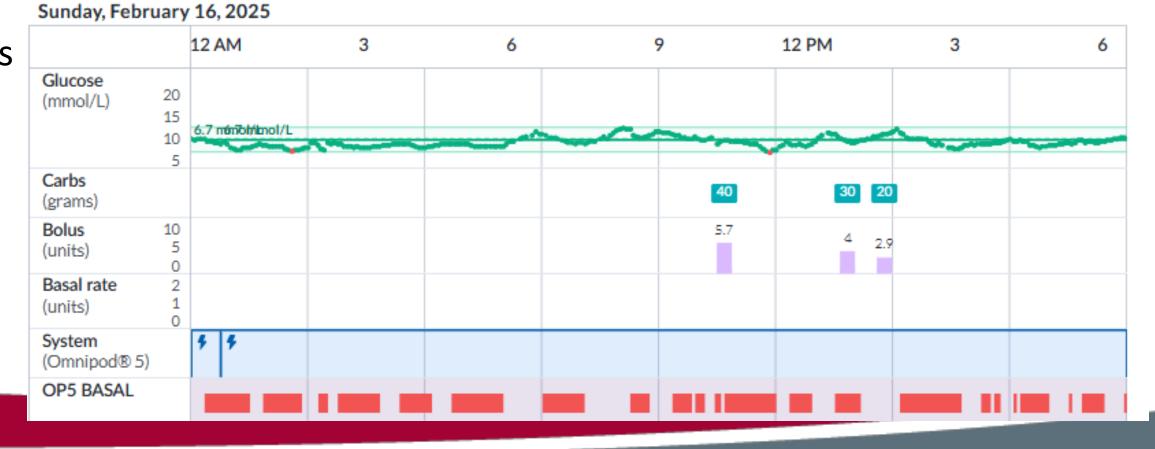
- Rise in glucose triggers max basal
- Delayed bolus for full amount results in hypoglycaemia

#### Tuesday, February 18, 2025



## Pre-bolus

- No post-prandial rises
   Note: system in pause
   for long-periods
- Basal 20% less on
   16/2 compared to
   18/2





# Managing missed pre-bolus

Within 30 minutes of pre-bolus time

• Cover whole meal bolus but be aware of risk of hypoglycaemia in the 1-2 hours post meal

30-60 minutes since pre-bolus time

 Cover 50% of the meal; some systems may need more than this and others less depending on size and composition of meal

60 minutes +

Use bolus calculator for correction only

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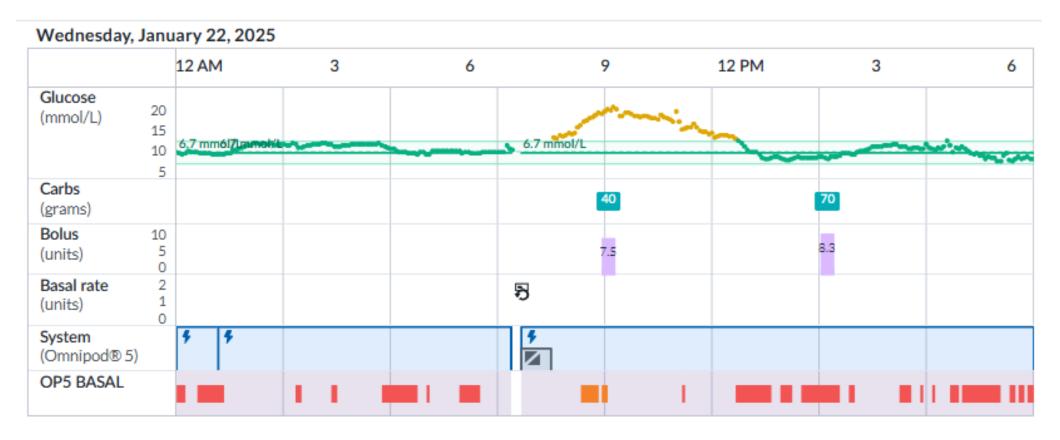
• Transition clinic

During the day independent managing OP5 controller use:

- post-meal bolus
- No input for snacks

Evening meal supported by parent:

- Pre-meal bolus 15 minutes

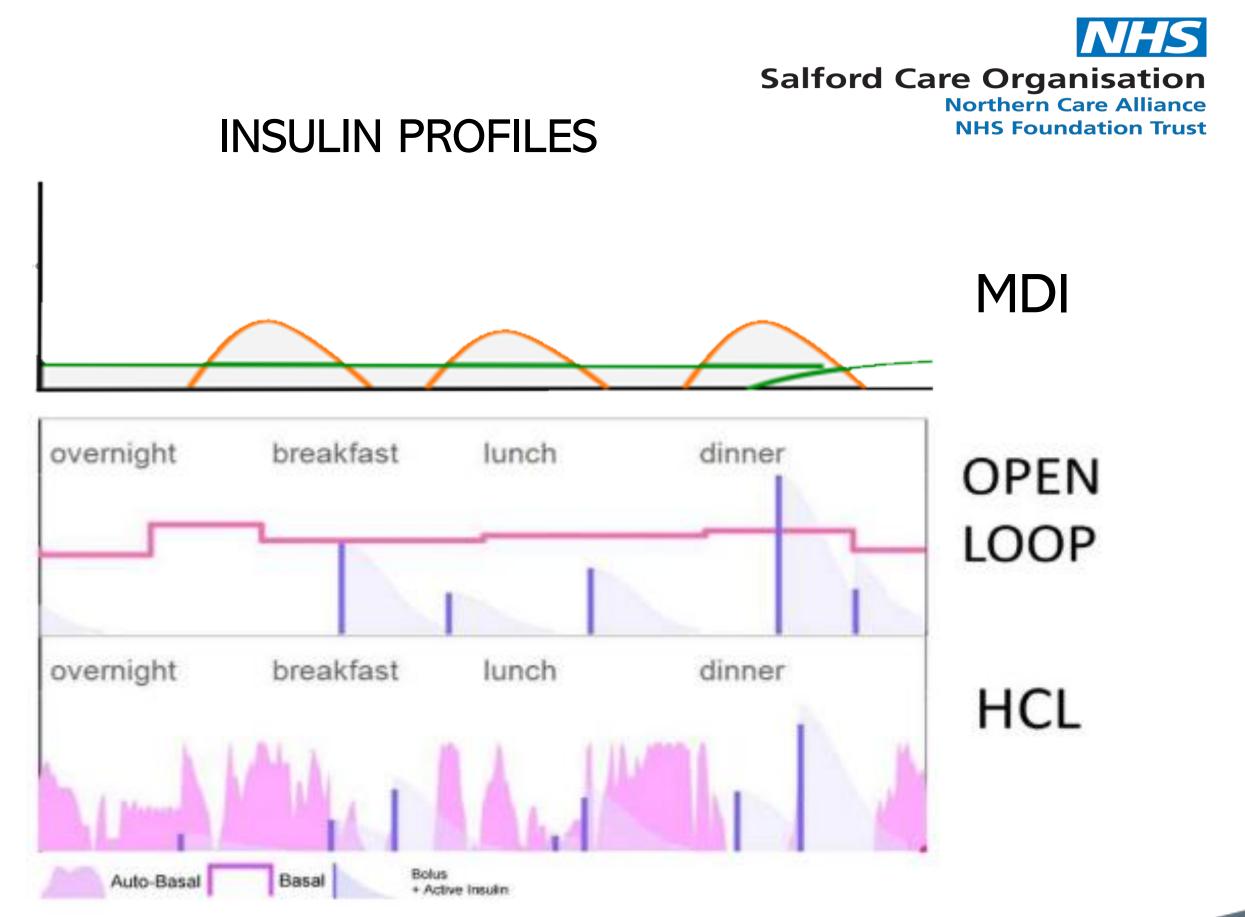




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## Advancing from basics: Post-prandial variation

- Can be helpful to PWD to have the impact of variable insulin delivery explained.
- This can support decisions with food bolus, exercise, and managing high glucose/set failures



# Complex meals? Tip – keep it simple

- Can the system manage meals higher in protein and/or fat?
- Why not find out first?
- If the PWD demonstrates they need some advanced advice – understanding the algorithm of their system is key!







# Complex meals? Tip – keep it simple

Studies have shown 42-125% dose increases may be needed to stabilise glucose levels post-meal.

The post-prandial rise occurs but with a flattened response. Glucose rises at 2-8 hours with high fat meals.

Manipulate bolus by splitting dose

programme some pre-meal and the rest during/after

Can increase dose if needed using this method?
 Is it needed though?



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# Complex meals? Tip – keep it simple

- Advanced bolus options manually programmed
- Extended bolus in Control IQ HCL; others will need switch to manual mode to use this feature
- Boost feature on CamAPS
- Lower glucose target if not at lowest already OP5/MM780G/CamAPS
- Automated responses:
- Auto-corrections in Smartguard (5 mins) and Control IQ (60 mins) alongside basal modulation
- Slowly absorbed meal; delivers extended bolus + correction if required in CamAPS
- Smartadjust basal modulation







## Complex meals summary

- "Find out before you fiddle"
   Francesca Annan
- Meet your patient where they are at!

















- Haidar A, Legault L, Raffray M, Gouchie-Provencher N, Jafar A, Devaux M, Ghanbari M, Rabasa-Lhoret R. A Randomized Crossover Trial to Compare Automated Insulin Delivery (the Artificial Pancreas) With Carbohydrate Counting or Simplified Qualitative Meal-Size Estimation in Type 1 Diabetes. Diabetes Care. 2023 Jul 1;46(7):1372-1378. doi: 10.2337/dc22-2297. PMID: 37134305; PMCID: PMC10300520.
- Griffin TP, Gallen G, Hartnell S, Crabtree T, Holloway M, Gibb FW, Lumb A, Wilmot EG, Choudhary P, Hussain S. UK's Association of British Clinical Diabetologist's Diabetes Technology Network (ABCD-DTN): Best practice guide for hybrid closed-loop therapy. Diabet Med. 2023 Jul;40(7):e15078. doi: 10.1111/dme.15078. Epub 2023 Apr 10. PMID: 36932929.
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- Mozzillo E, Franceschi R, Di Candia F, Ricci A, Leonardi L, Girardi M, Rosanio FM, Marcovecchio ML. Optimal Prandial Timing of ٠ Insulin Bolus in Youths with Type 1 Diabetes: A Systematic Review. J Pers Med. 2022 Dec 13;12(12):2058. doi: 10.3390/jpm12122058. PMID: 36556278; PMCID: PMC9781659.
- The Glucose never lies https://theglucoseneverlies.com/bolus-insulin/ ٠

