



CamAPS | FX

Automated Insulin Delivery



Managing Pregnancy – Practical Tips



Housekeeping



Please say “**Hi**” via **Chat**.



Please ask **questions** via the **Q&A**.



If you have any technical issues, please leave and join again.



This webinar is being recorded and will be shared widely.



Certificate of attendance and the slides will be emailed after the webinar.

Webinar Aims:

- Give an insight into the CamAPS FX compatible Dana-i insulin pump.
- Provide an understanding into how the CamAPS FX algorithm works and its features.
- Share practical tips in pregnancy planning, managing pregnancy, labour and the post-delivery period.

Dana  CamAPS | FX



Will Murray

Territory Manager

willmurray@atuk.ltd



SOOIL: manufacturer of Dana pumps

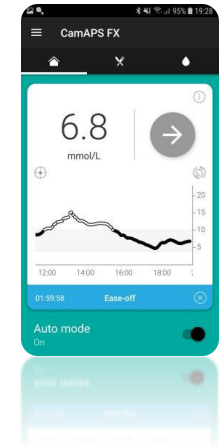


Dana-i: A logical choice for people with diabetes

- Clinical evidence
- Discretion (mobile phone)
- Accuracy of delivery
- Interoperability (connect to different apps)

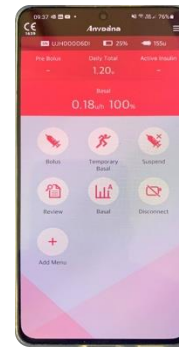
HCL (hybrid closed loop) Systems

- CamAPS FX (Used Dana pumps in clinical trials since 2010)



AnyDana app

- Give a bolus
- Set a temporary basal rate
- Change settings



Important things to remember about the Dana-i



CLINICAL RESEARCH^(1,2)

20+ studies with Dana pumps

- 1 year old
- Teenagers
- Adults
- Over 60s
- Pregnancy

1. <https://www.camdiabtraining.com/view/21/CamAPS-FX-research.htm>
2. N Engl J Med 2023;389:1566-1578 DOI: 10.1056/NEJMoa2303911 [VOL. 389 NO. 17](#)

ACCURACY

Unrivalled compared to other insulin pumps⁽¹⁾

“With regard to the use of pumps in artificial pancreas systems, short-term accuracy is especially important, because insulin delivery is frequently adapted to current glucose levels.”⁽²⁾

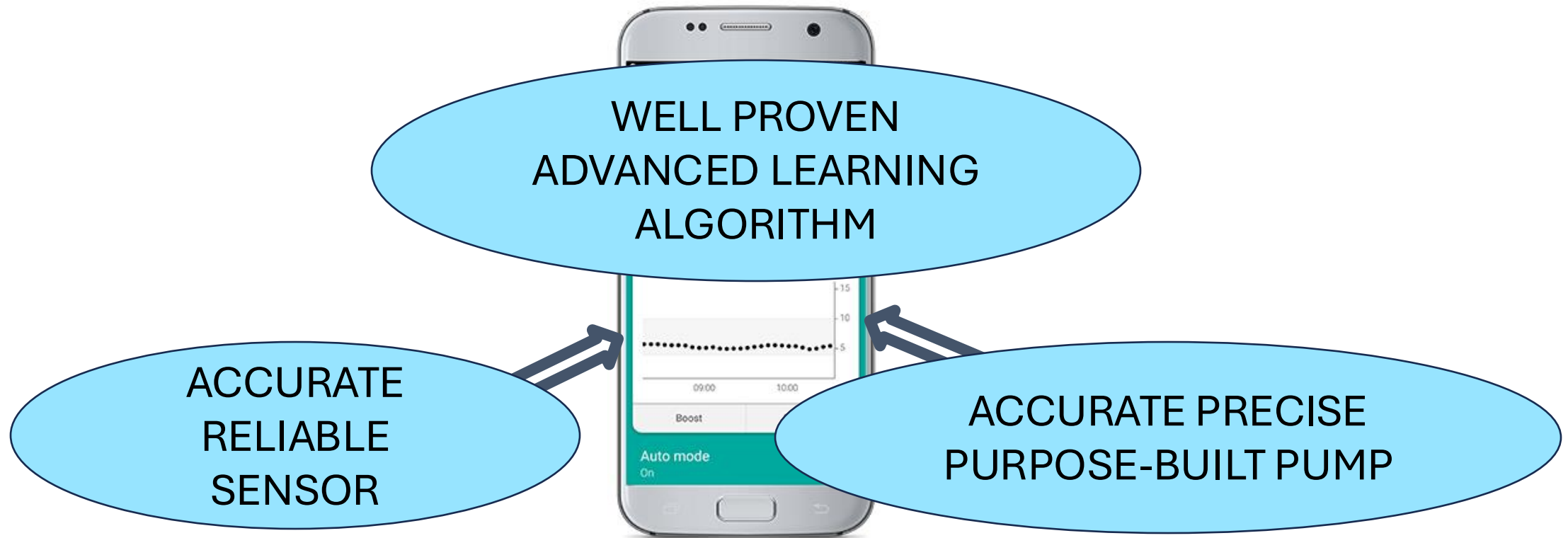
“Considerable differences in insulin delivery accuracy were observed between the tested pumps. In general, when using very low doses, accuracy of insulin delivery is limited in most insulin pumps”.⁽³⁾

1. Company User Guides

2. Ralph Ziegler, Nick Oliver et al. Diabetes Technology & Therapeutics Volume 23. Number 5. 2021

3. Ziegler R, Waldenmaier D, Kamecke U, Mende J, Haug C, Freckmann G. Accuracy assessment of bolus and basal rate delivery of different insulin pump systems used in insulin pump therapy of children and adolescents. *Pediatr Diabetes*. 2020;21:649–656 ⁽³⁾

HCL: Ideal Theoretical Considerations



Android Smartphone with



Large 300-unit CARTRIDGE

- Insulin requirements can increase to 2-3 times pre-pregnancy levels⁽¹⁾
- Requirements can further increase during illness
- Dana pumps would mean less frequent cartridge changes

Self-fill CARTRIDGE

NHSE Hybrid Closed Loop (HCL) Systems comparison chart⁽¹⁾

Dana is compatible with any rapid and ultra rapid acting insulin

1. <https://www.england.nhs.uk/publication/decision-support-tool-making-a-decision-about-managing-type-1-diabetes/>

Postprandial Glucose Excursions with Ultra-Rapid Insulin Analogs in Hybrid Closed-Loop Therapy for Adults with Type 1 Diabetes⁽¹⁾

Objective

To evaluate postprandial glucose control when applying faster-acting insulin aspart (Fiasp) compared to insulin aspart and ultra-rapid insulin lispro (Lyumjev) compared to insulin lispro using the CamAPS FX hybrid closed-loop algorithm

Research Design and Methods

Secondary analysis of postprandial glucose excursions from two double-blind, randomized, crossover hybrid closed-loop studies contrasting Fiasp to standard insulin aspart, and Lyumjev to standard insulin lispro

Endpoints

- Incremental area under curve 2h & 4h
- 4 h postprandial time in target range
- time above range, and time below range

HCL system used

- CamAPS FX
- Dana insulin pumps
- Dexcom G6.

Results

Mean TIR (3.9-10.0 mmol/L) for 4h postprandially significantly increased during Lyumjev compared with insulin lispro

- 6.7 percentage points for breakfast
- 5.7 percentage points for evening meal

Fiasp did not provide any advantage compared with insulin aspart

Postprandial Glucose Excursions with Ultra-Rapid Insulin Analogs in Hybrid Closed-Loop Therapy for Adults with Type 1 Diabetes⁽¹⁾

Conclusion

The use of Lyumjev with CamAPS FX closed-loop system improved postprandial glucose excursions compared with insulin lispro, while the use of Fiasp did not provide any advantage compared with insulin aspart.

SLOW BOLUS DELIVERY

Variable: 5U/min or 2U/min or 1U/min⁽¹⁾

- More comfortable delivery
- Less risk of leakage at cannula site
- Less risk of occlusions
- Speed can be altered via the app

NEW PRICING: Dana CamAPS FX

New patients (without Dexcom)

- Dana-i with 4 years CamAPS FX: £2750
- Consumables per year: £1580 (£132/month)
- A free of charge mobile phone if there is a genuine difficulty in the patient affording one

Existing Dana patients (without Dexcom)

- A one-year license will cost £175

In Summary

Dana CamAPS FX

- CamAPS FX was developed using predominantly Dana pumps
- Unrivalled accuracy
- Large 300U cartridge
- Slow delivery speed



CamAPS | FX

Automated Insulin Delivery

Managing Pregnancy – Practical Tips



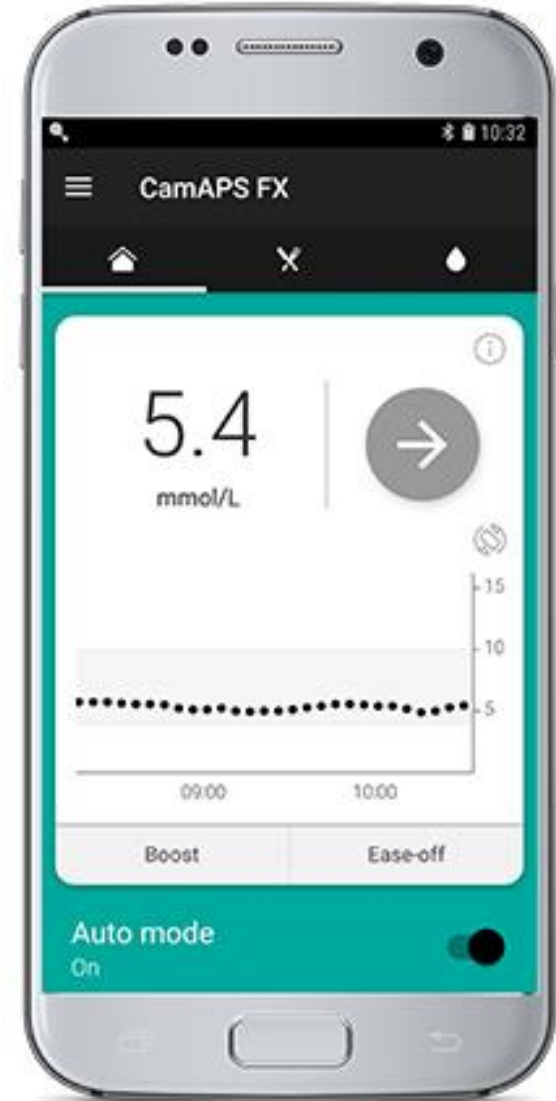
Sara Hartnell
Operations and Partnerships Manager



Candice Ward
Training and Outreach Manager

Overview

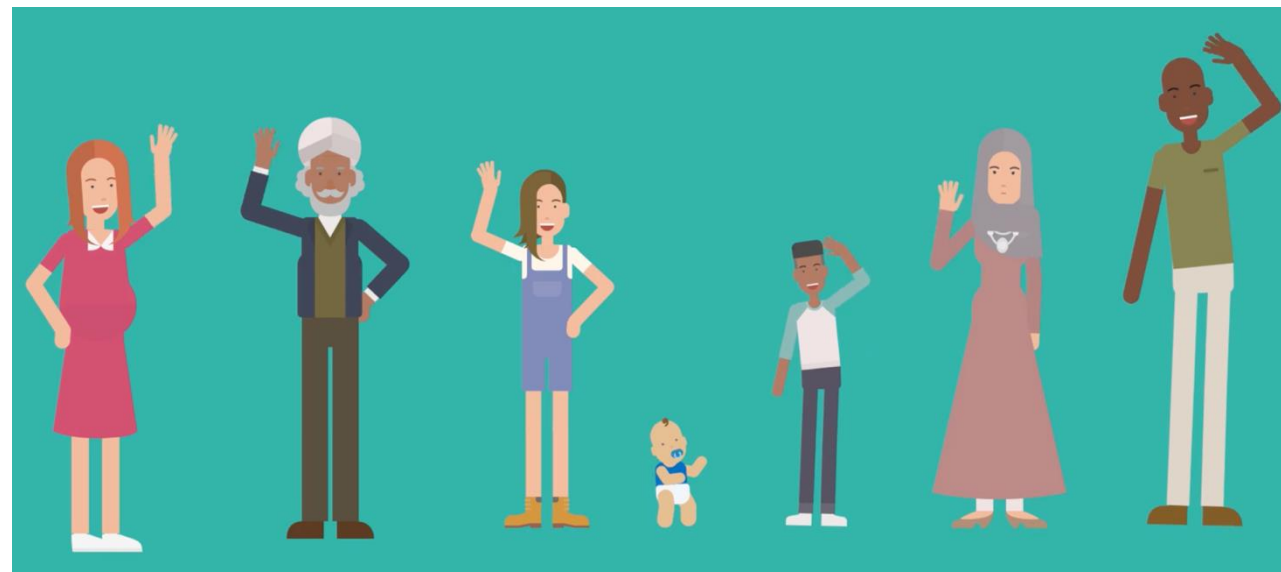
- ✓ Refresh of CamAPS FX system
- ✓ Personalisation
- ✓ Use in Pregnancy
- ✓ Optimisation



Medical Indication

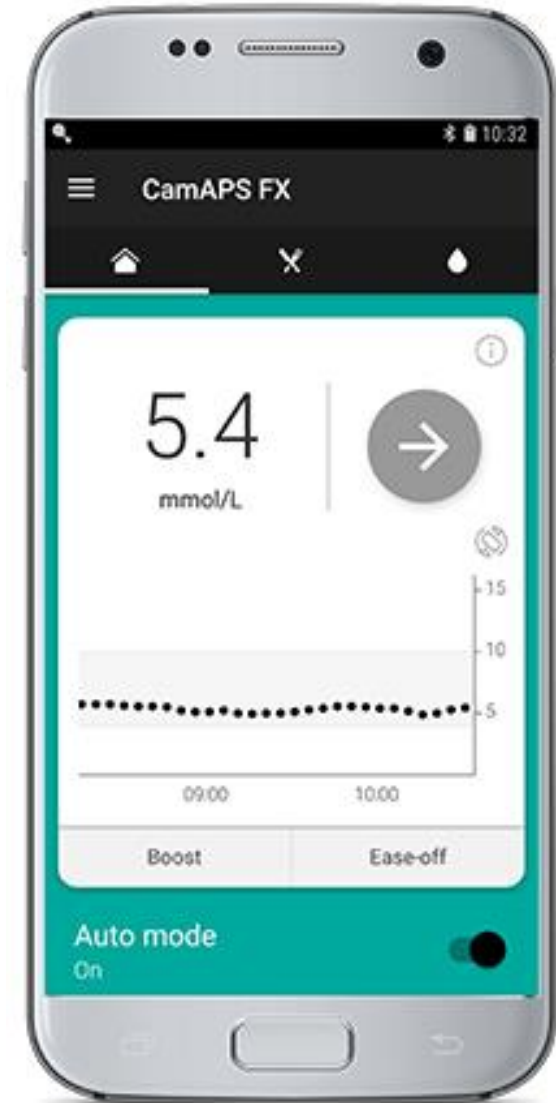
- ✓ Type 1 diabetes
- ✓ Age: from 1 years of age (including pregnancy) *
- ✓ Weight: 10 kg – 300 kg
- ✓ Total daily insulin: 5 U/day – 350 U/day

* Partner device medical indications influence system licensing



CamAPS FX

- ✓ App houses the hybrid Cambridge model predictive control algorithm
- ✓ Acts as “CGM receiver” with customisable alerts
- ✓ Incorporates a bolus calculator (open or closed loop)
- ✓ Automatic uploads data to Glooko
- ✓ 2-week PDF report (statistics menu)
- ✓ Offers real-time SMS alerts (for guardians)
- ✓ CamAPS Companion



How does CamAPS FX work?

Modulates insulin delivery by:

- ✓ Setting **pump basal rates to zero (0) units** and
- ✓ Adjusting **extended bolus every 8-12 minutes**.
- ✓ Hybrid closed-loop → **still requires insulin boluses for carbohydrates**

CamAPS FX

Simple setup:

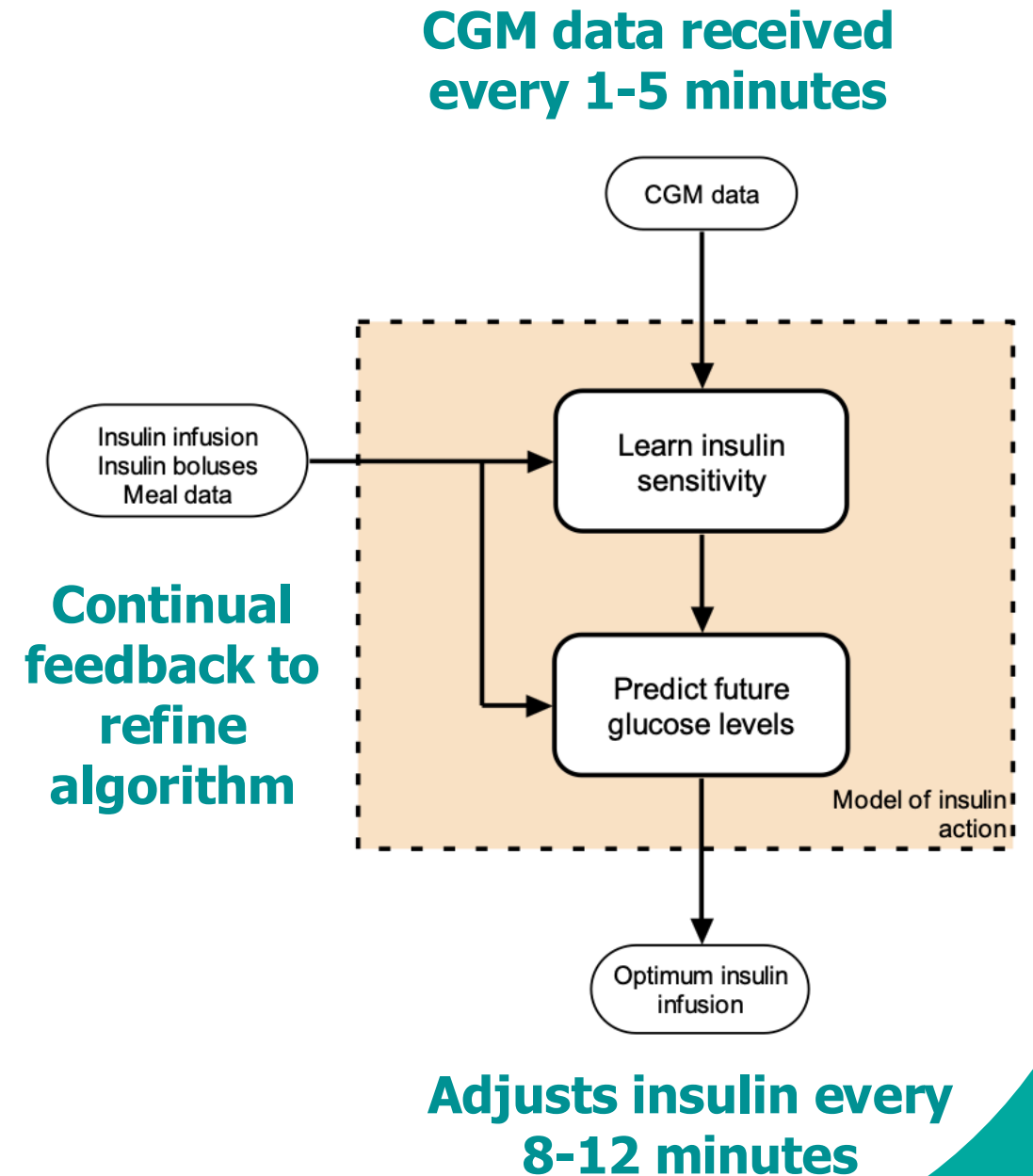
- ✓ Body weight (kg)
- ✓ Total daily dose (TDD)

Pre-set pump settings not used as part of algorithm's calculation for AID:

- ✗ Pre-programmed basal
- ✗ Insulin : carbohydrate ratio
- ✗ Insulin sensitivity factor
- ✗ Active insulin time

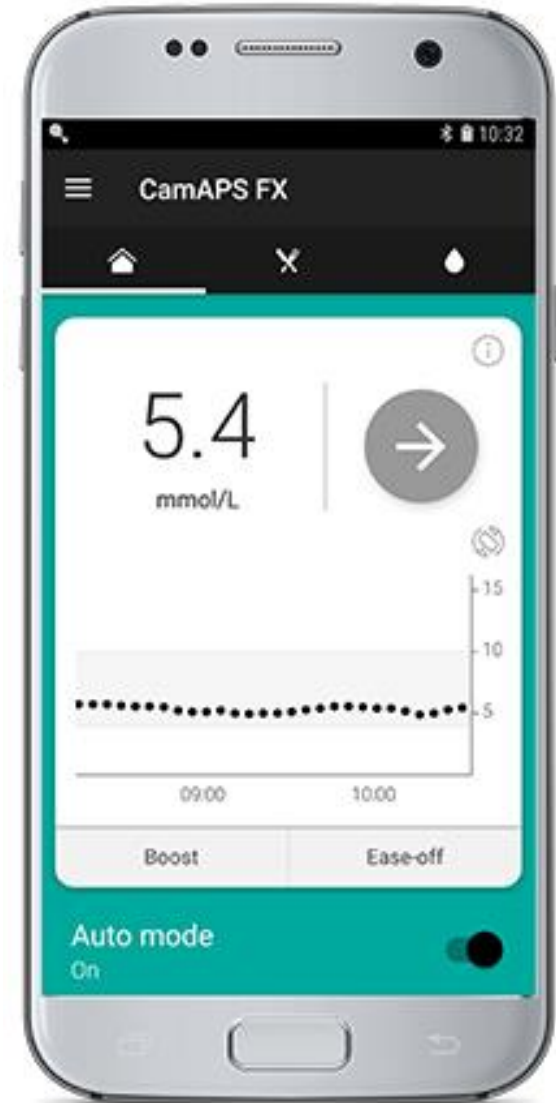
Highly adaptive:

- ✓ Daily insulin needs
- ✓ Day-to-day insulin needs
- ✓ Post-meal insulin needs



CamDiab

Personalisation

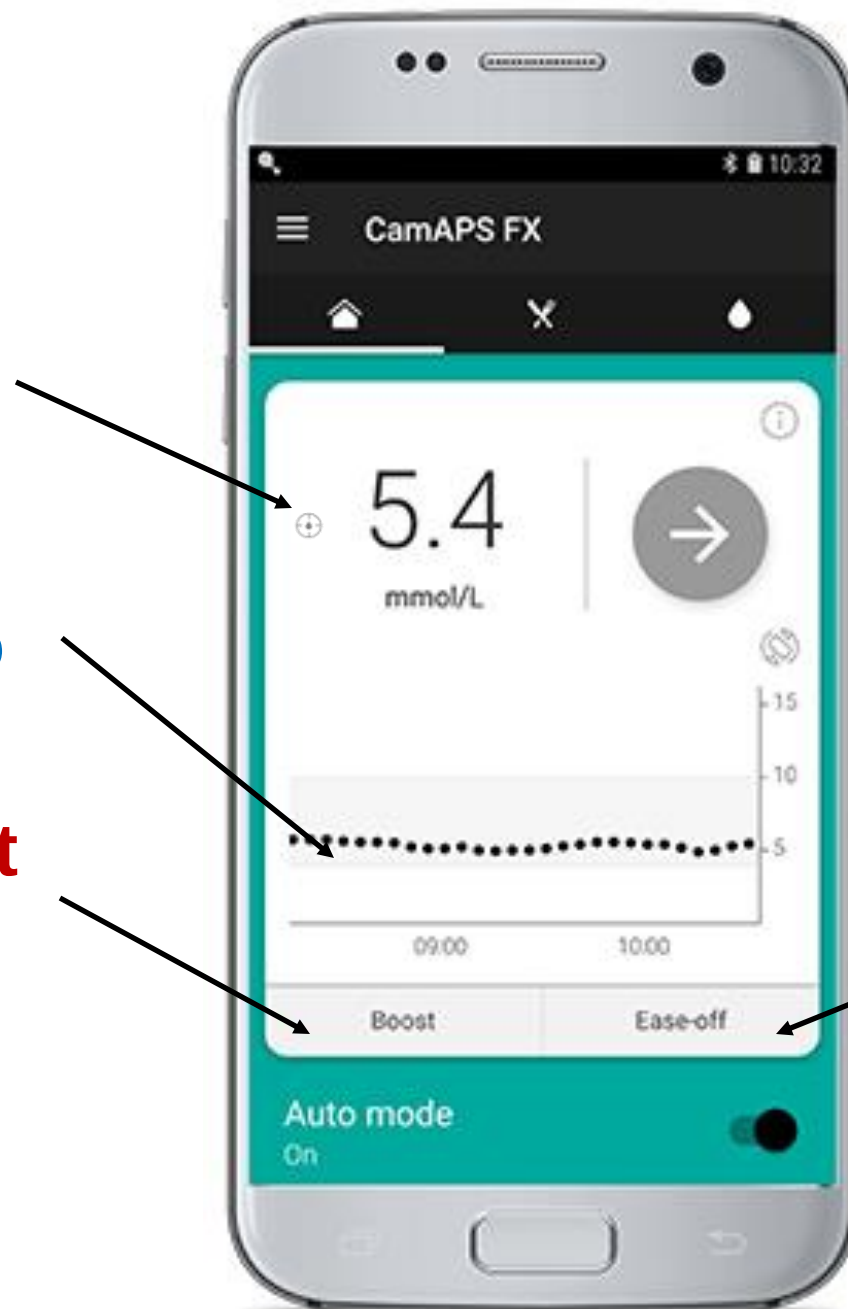


Personal glucose
target

Insulin: carb ratio

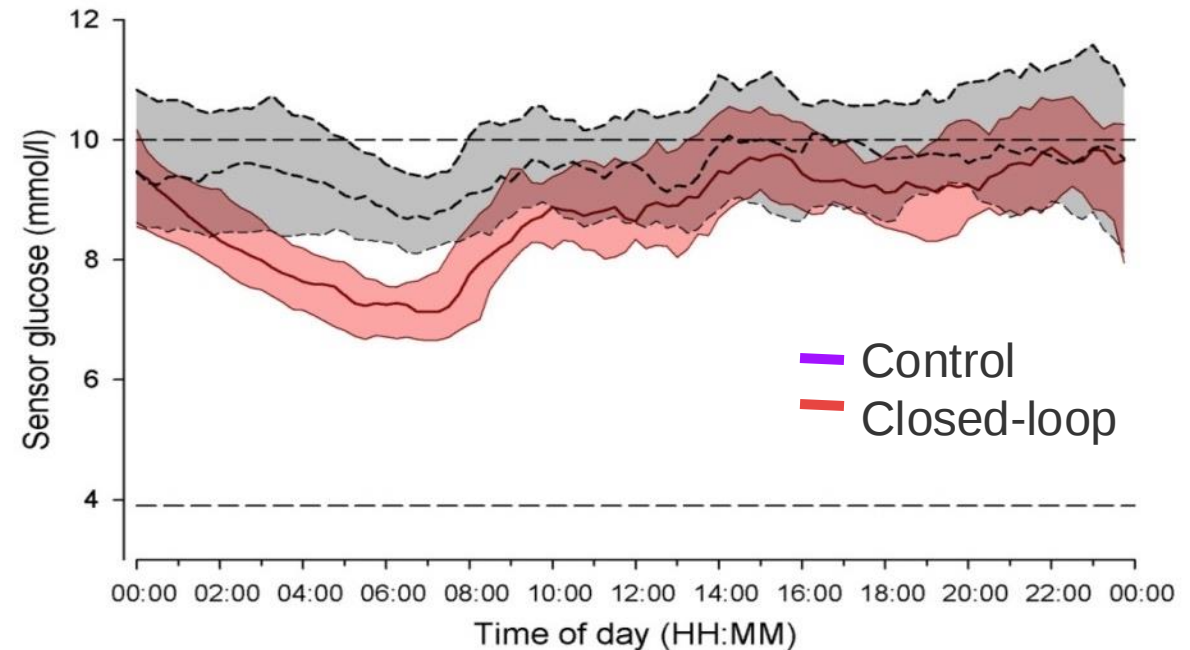
Boost

Ease-off



Personal Glucose Target

- ✓ Algorithm target (default 5.8 mmol/L)
- ✓ Adjustable at different times of day and night
- ✓ Minimum 4.4 mmol/L
- ✓ Maximum 11.0 mmol/L

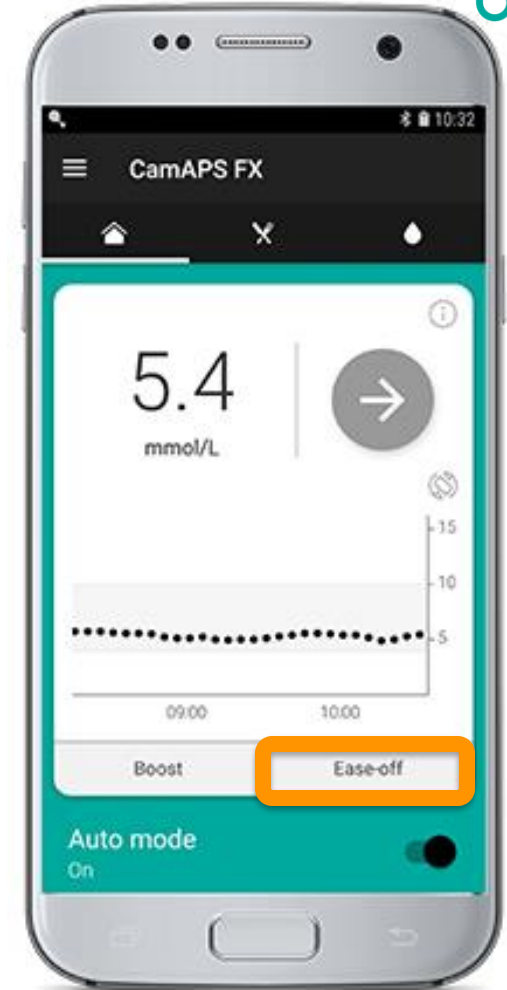


Ease-off

- ✓ Makes the algorithm more 'relaxed'
- ✓ Reduces considerably insulin delivery
- ✓ Shuts off insulin delivery earlier
- ✓ Raises glucose target temporarily

When to use Ease-off?

- ✓ Before (60-90 minutes), during and / or after planned exercise / activity
- ✓ Following recurrent hypos
- ✓ Hot weather
- ✓ Overnight after drinking alcohol

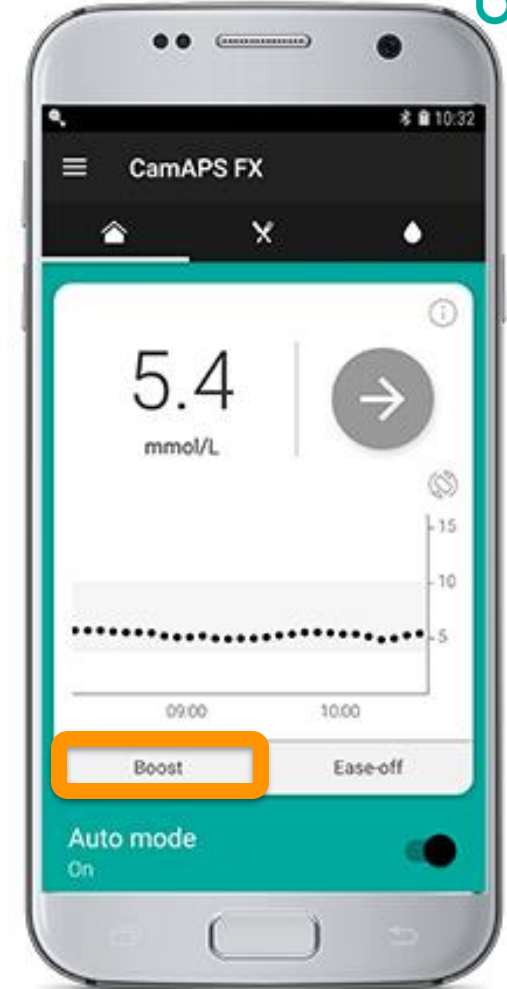


Boost

- ✓ Makes the algorithm more 'responsive'
- ✓ Increases insulin delivery by ~35%
- ✓ Once glucose predicted to reach target, will stop "Boosting" even if Boost still programmed.

When to use Boost?

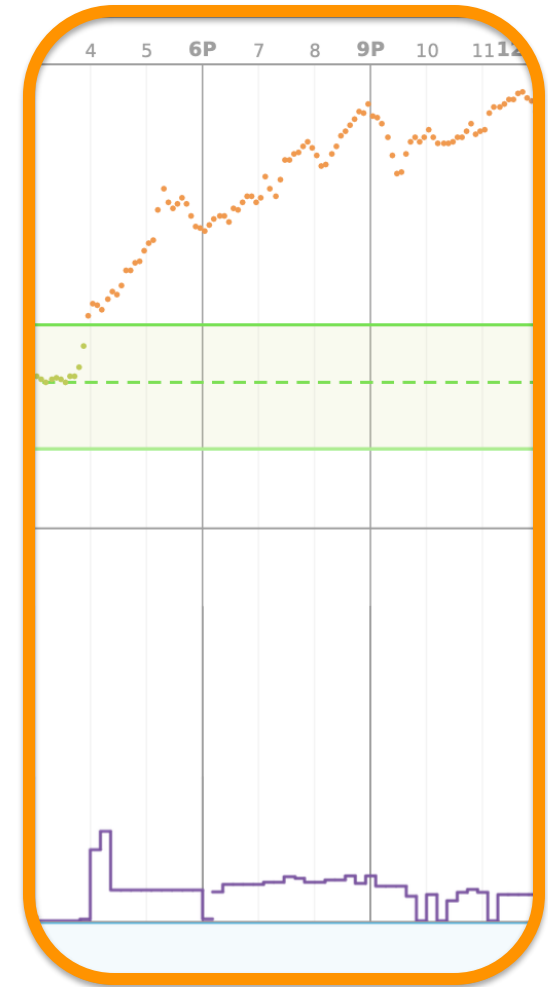
- ✓ Pre-menstrual
- ✓ Steroids
- ✓ Post prandial hyperglycaemia (missed bolus, inaccurate carb count, etc)
- ✓ Post infusion set failure
- ✓ Low grade illness (ketone negative)



Set Boost "Now" or up to 24 hours in advance
Run for up to 13 hours in "Boost mode"

TDD Adjustment

- ✓ TDD automatically updated by app on a daily basis
- ✓ TDD influences max insulin delivery via algorithm



Weight Adjustment

Supports post-prandial AID – algorithm fairly robust, if weight inaccurate

Weight should be updated on the app:

- ✓ Every 6-12 months in adults
- ✓ $\pm$ 3 monthly in children
- ✓ $\pm$ 4 weekly in pregnant women



Basal Rate Adjustment

Basal rates are the safety fall back and need to be adjusted occasionally:

- ✓ **± 4 weekly in pregnancy**
- ✓ **± 3 monthly in children**
- ✓ **± 6-12 monthly in adults**

Insulin



Daily Dose.....107.1units

Overrides (%).....0% (0 boluses)

Bolus/Day.....2.3

Carbohydrate counting

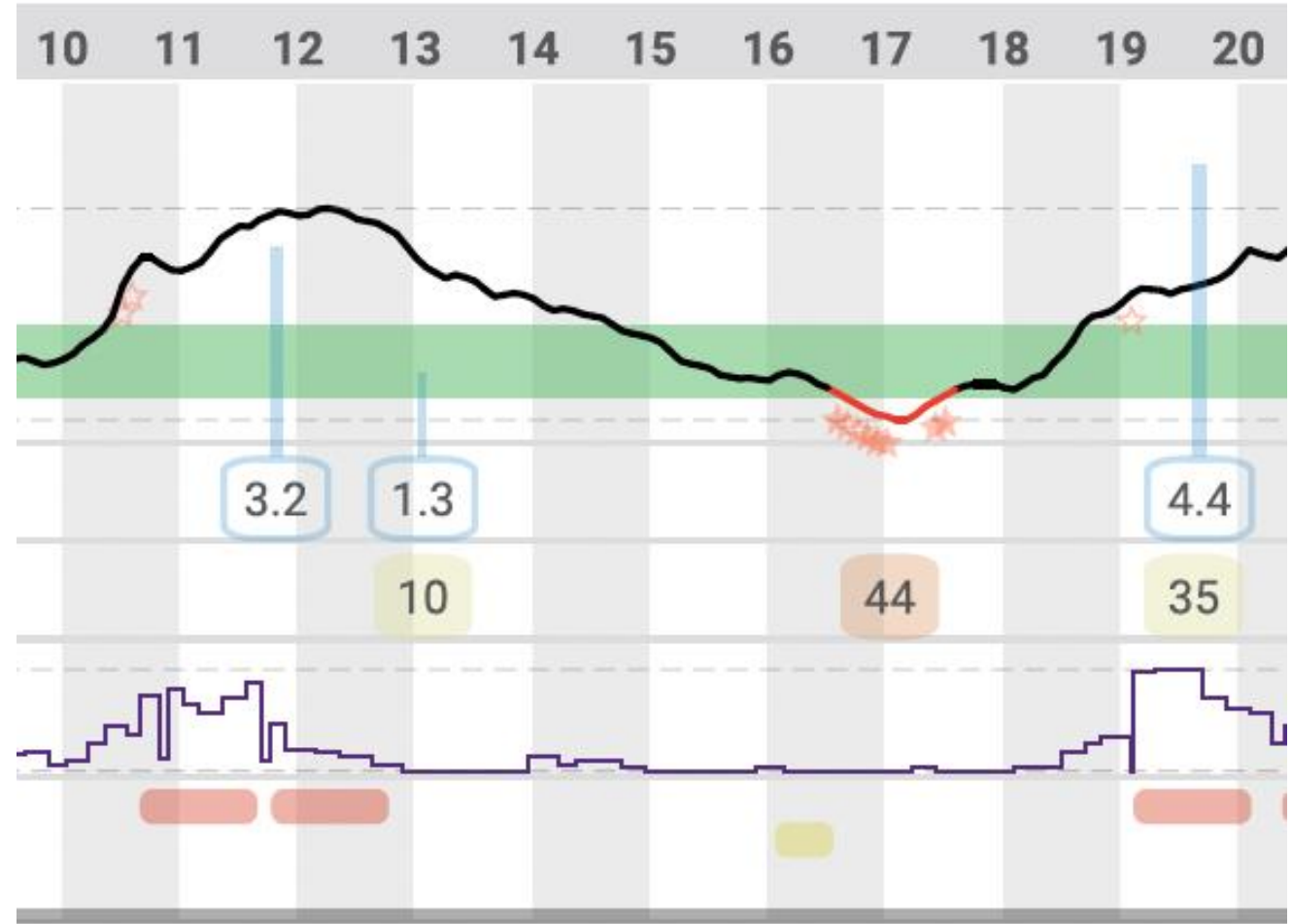
- ✓ Amount & type of carbohydrate still important
 - Encourage low GI
 - Pregnancy: small to moderate carbohydrate volume spread through the day
- ✓ Consider counting accuracy
- ✓ Auto mode will correct some post-meal hyperglycaemia



Meal Management ...

Pre-meal bolus

10 – 15 minutes



Legend: ★ Audio alert ★ Vibrate alert □ Bolus ■ Carbs ■ Hypo carbs ■ Slow Absorption
🚩 Sensor start event P Priming event F Refill event 🔴 Boost 🟡 Ease off 🟢 BG Readings

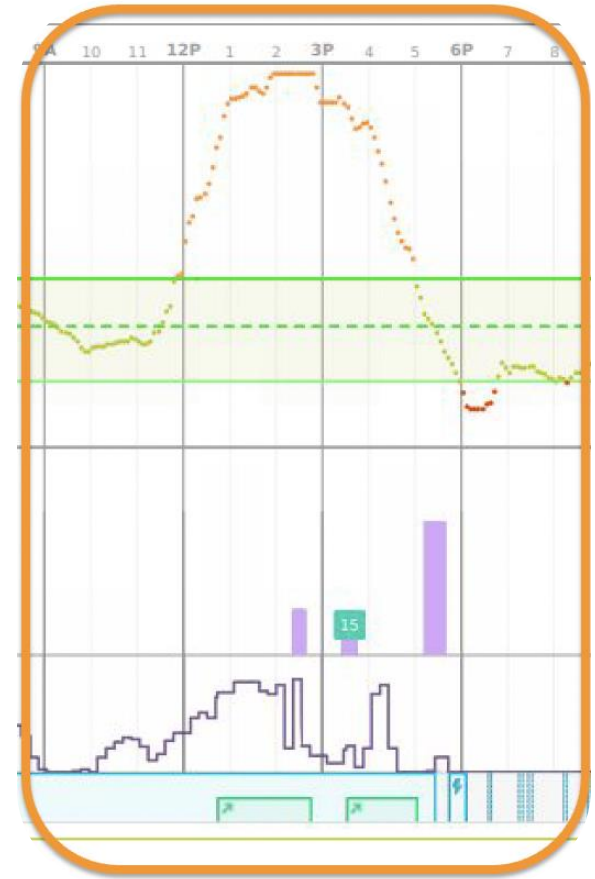
Missed or late bolus

✓ Within 1 hour

- Suggest $\frac{1}{2}$ of bolus for carbs consumed.
- Full bolus may cause delayed hypo.

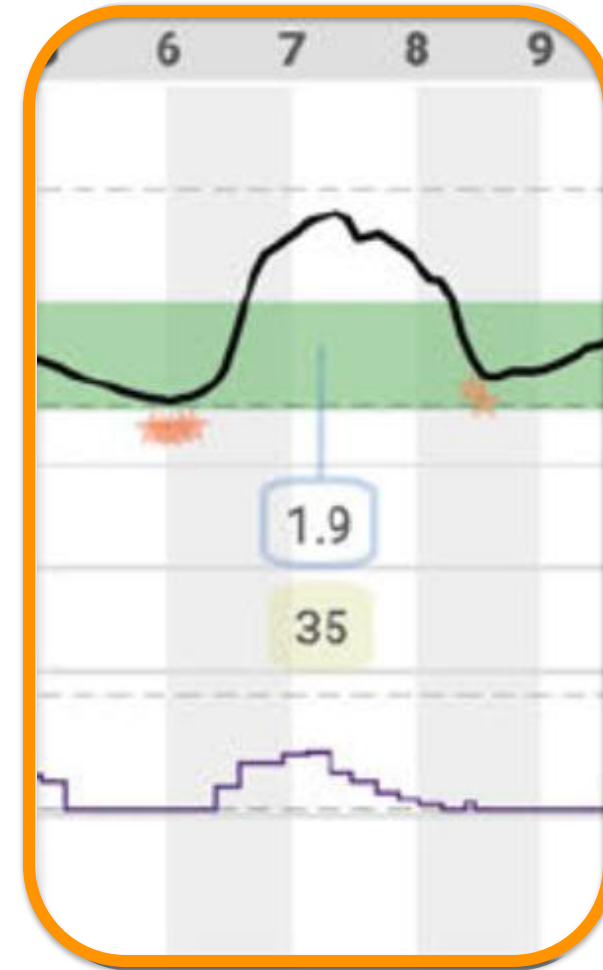
✓ More than 1 hour after eating

- Use “Boost”

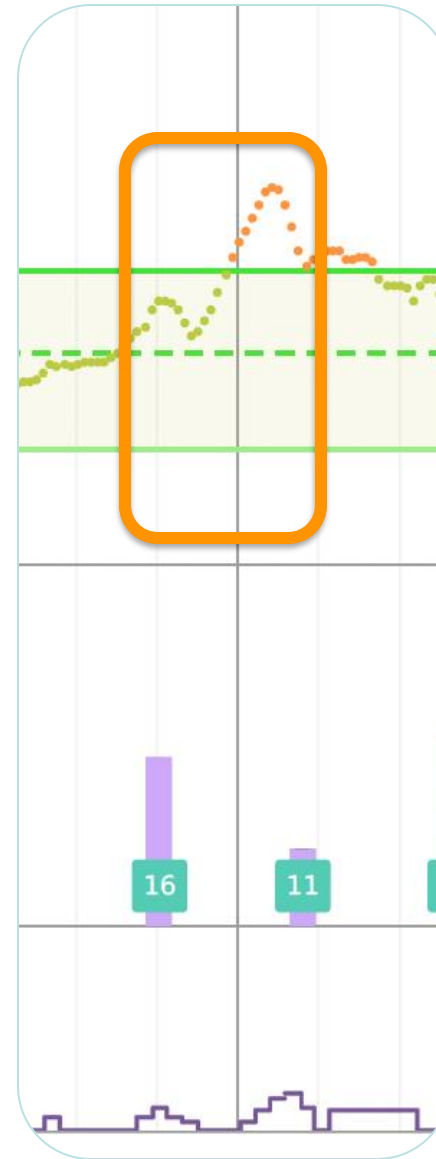


Low before meal

- ✓ Low but not hypo
 - Bolus and eat - Do not wait
- ✓ Hypo before meal
 - Treat hypo
 - Bolus and eat – Do not wait



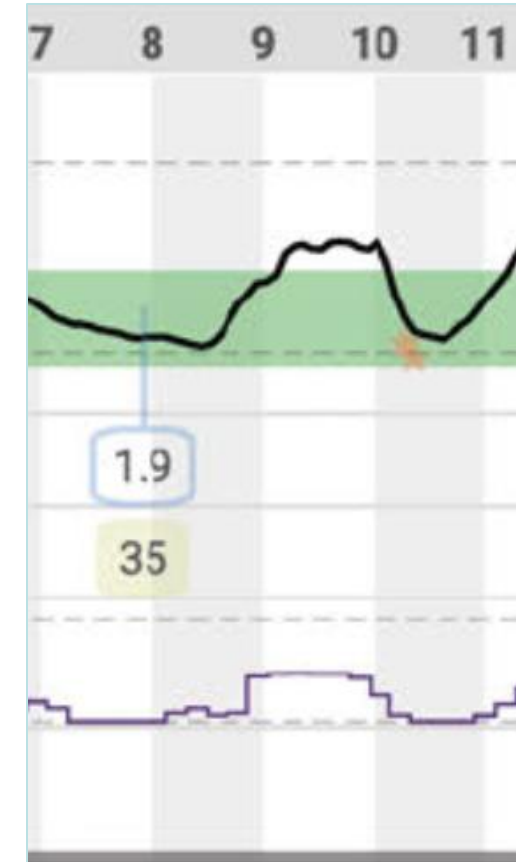
Too early meal bolus



Insulin to Carb Ratio



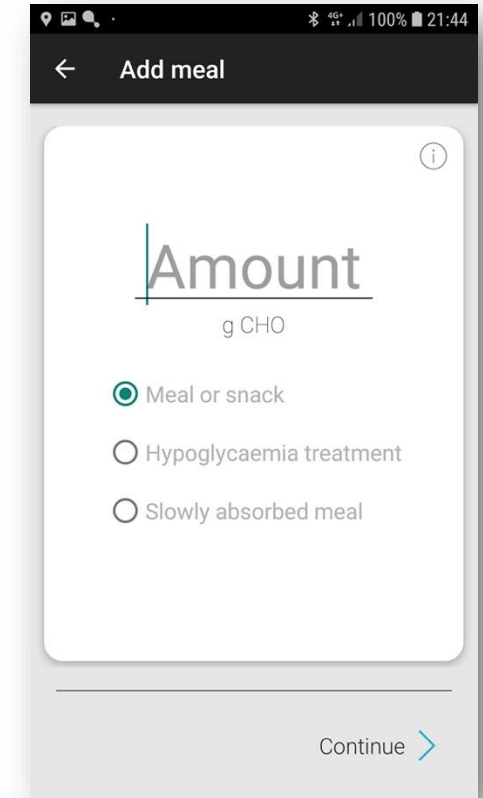
Too weak



Too strong

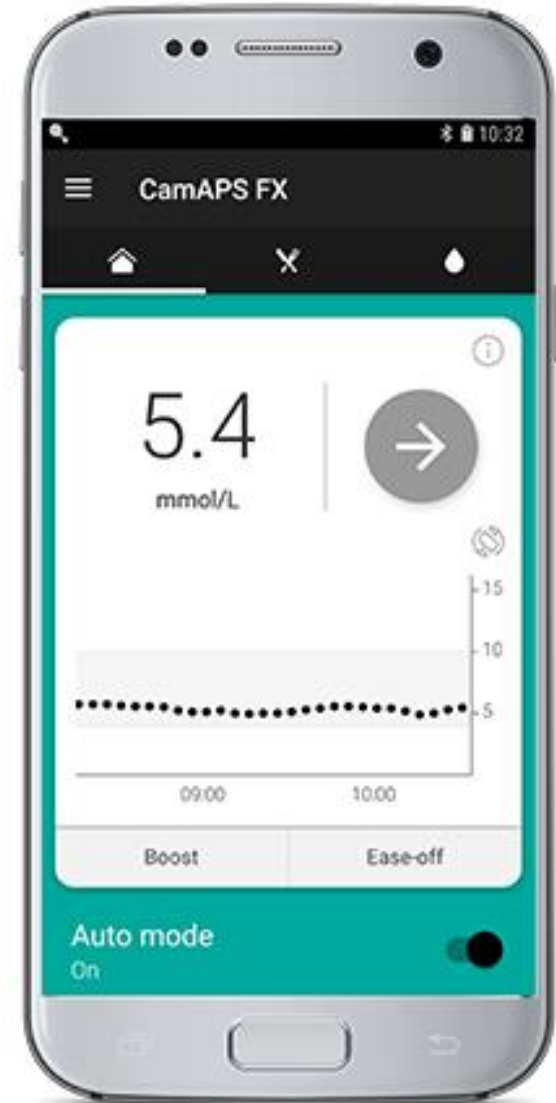
Add meal function

- ✓ **Hypo treatment**
 - Makes algorithm “softer” post hypo
 - Good for education around hypo management
- ✓ **Meal or Snack – may be helpful in hyperemesis gravidarum**
 - Small snack (<15-20g) esp if close to previous meal
 - Unpredictable appetites or to split large carb meal
 - Not to be used to completely replace pre-meal bolus
- ✓ **Slowly absorbed meal**
 - Good for splitting bolus for high fat, high protein
 - 60:40% g starting point
 - ICR needs to be correct



CamDiab

Use in Pregnancy



Pregnancy Planning

✓ Before stopping contraception

- Aim for HbA1c 48 mmol/mol (6.5%) or less
- Optimise medication, check eyes & kidneys and prescribe 5mg folic acid
- Start CamAPS FX
- Time in Range (TIR): 3.9 - 10 mmol/L



Using CamAPS FX in Pregnancy

✓ 1st trimester

- Hypo risk, morning sickness
- If not on already, start CamAPS FX as soon as possible
- Bolus timing: 10 - 15 minutes
- Personal Glucose Target: 5.5 mmol/L
- Pregnancy Time in Range (pTIR): 3.5 - 7.8 mmol/L



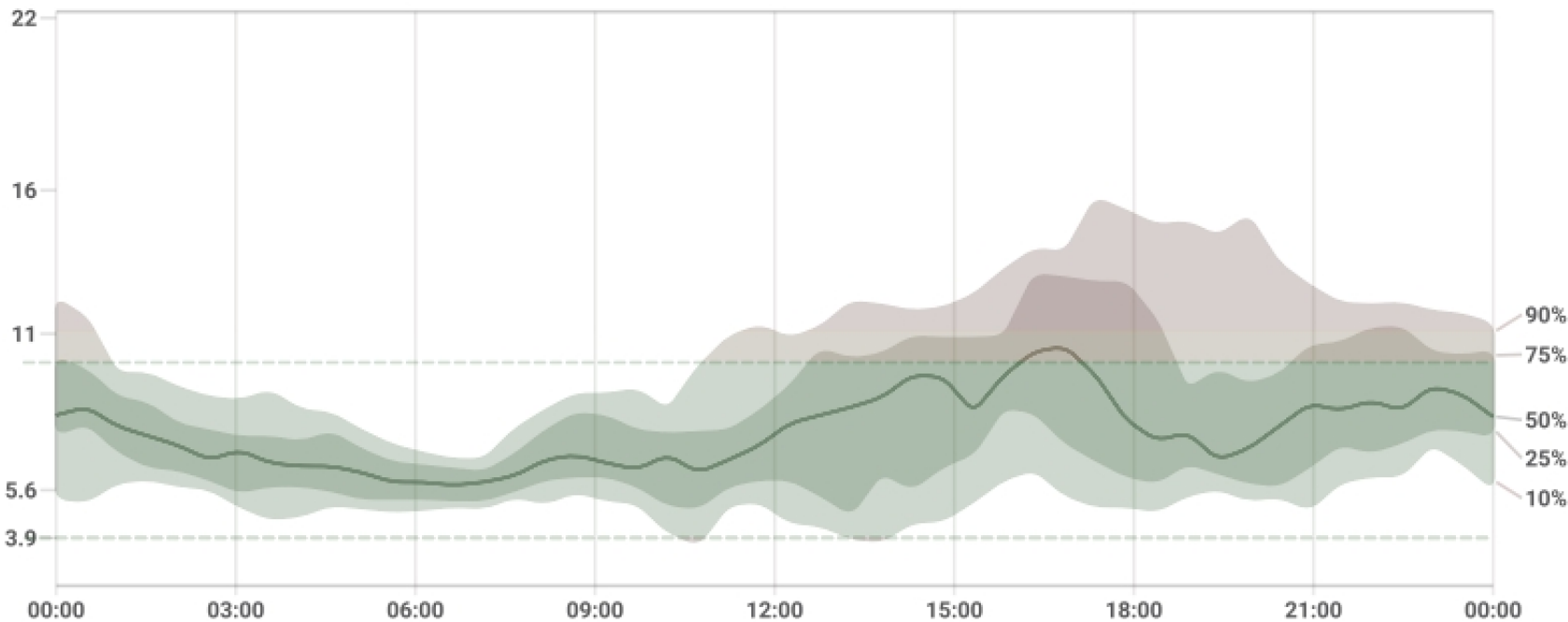
TIR vs TIRp



Dexcom G6

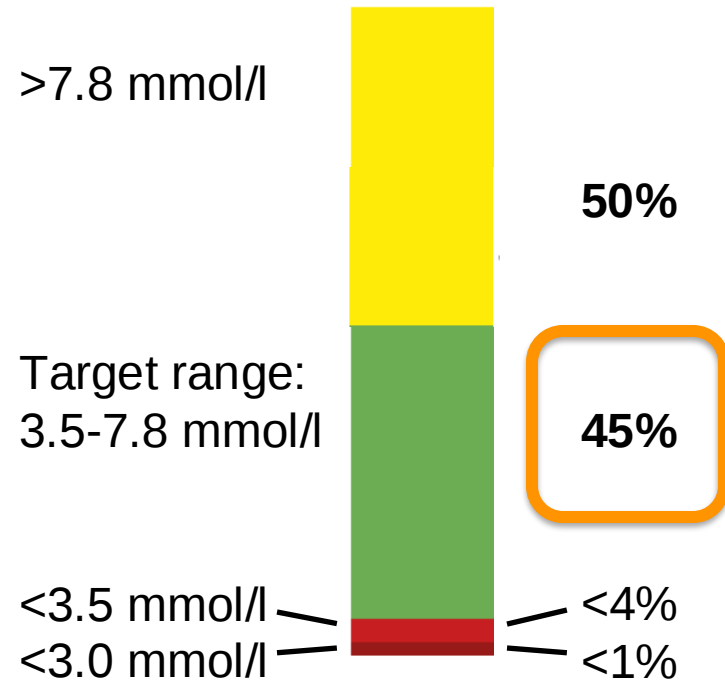
19%
Above
79%
Within target
2%
Below

Target range [mmol/L]	3.9-10.0
Average glucose [mmol/L]	7.8
Standard deviation [mmol/L]	2.7
Coefficient of variation [%]	35
Glucose Management Indicator (GMI) [%]	6.7
Glucose Management Indicator (GMI) [mmol/mol]	49
Time below 3.9 mmol/L [%]	2.5
Time below 3.0 mmol/L [%]	0.96

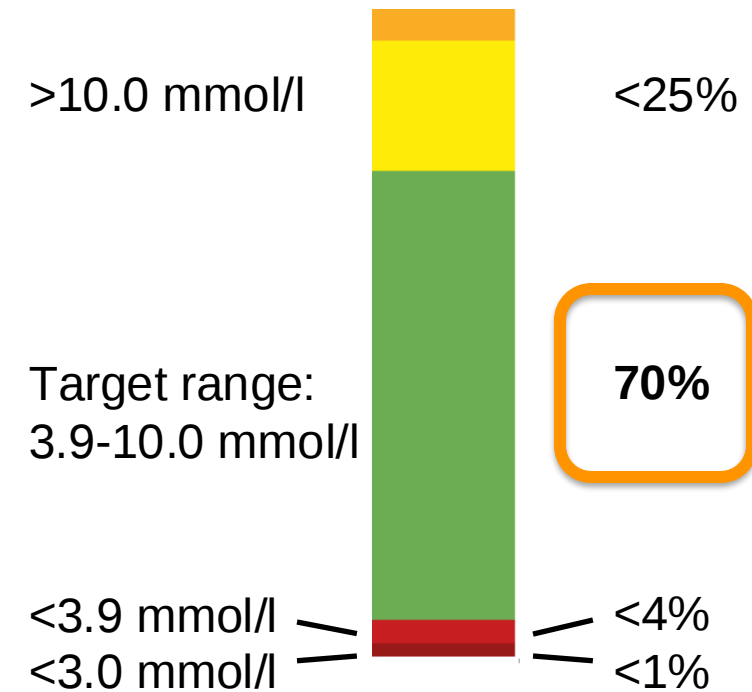


CGM Time in T1D Pregnancy Range (TIRp)

Pregnancy glucose target TIRp



Non-pregnant target range TIR



Using CamAPS FX in Pregnancy

✓ 2nd and 3rd trimester

- Bolus timing: might need to bolus pre-meal slightly earlier?
- ICR adjustment
- Carbohydrate portion management
 - Possibly protein only breakfast (3rd trimester) and snacks
- Personal Glucose Target:
 - 5.0 mmol/L for the 2nd & 3rd trimester
 - consider 4.5 mmol/L overnight



Using CamAPS FX in Pregnancy

✓ Boost

- Much more 'proactive' use in pregnancy.
- Set if glucose rising about 7.8 mmol/L
- Towards end of pregnancy
 - Preset to come on pre-waking and over breakfast to help manage post-meal glucose.
- Use for steroids.

✓ Corrections

- Used more commonly in pregnancy
- Need to adjust in bolus calculator settings



Planning Delivery

- ✓ Programme reduced pump basal rate (Pattern B)
 - Pre-pregnancy basal rates, if known
 - If not, consider flat basal of 25% of current 3rd trimester TDD



Planning Delivery

- ✓ Discuss and document post-delivery changes to bolus calculator settings:
 - ICR
 - Pre-pregnancy ICR, if known
 - If not, consider using 12-15g
 - Glucose target (for corrections)
 - Correction factor (for corrections)
 - Active insulin time (for corrections)
 - Max bolus



Labour & Delivery

- ✓ Successfully used during delivery.
 - Use “Boost” or Ease-off” as required
- ✓ If planned C-section, use CamAPS FX if in agreement with obstetric team and anaesthetist.
- ✓ Diathermy – check sensor, if inaccurate stop closed-loop and restart when accurate again.
- ✓ Devices placed out of the way of the surgical field.
- ✓ Pack spare sensors, infusion sets etc.



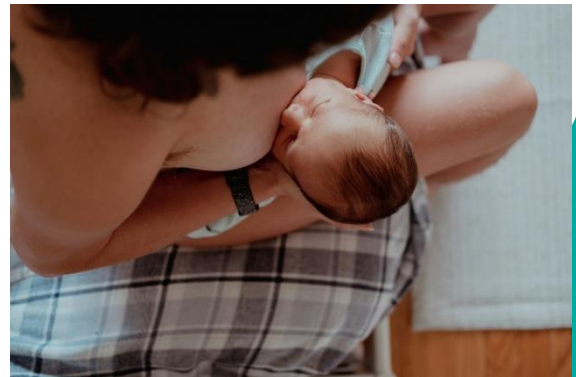
Post Delivery

- ✓ No insulin for 1st meal post delivery for small meals
- ✓ Switch to reduced pre-programmed pump basal (pattern B)
- ✓ Change bolus calculator settings
- ✓ Increase the Personal Glucose Target (PGT > 6 mmol/L)
- ✓ Consider using “Ease off” for first few days, esp. if breastfeeding.
- ✓ Adjust body weight and TIR



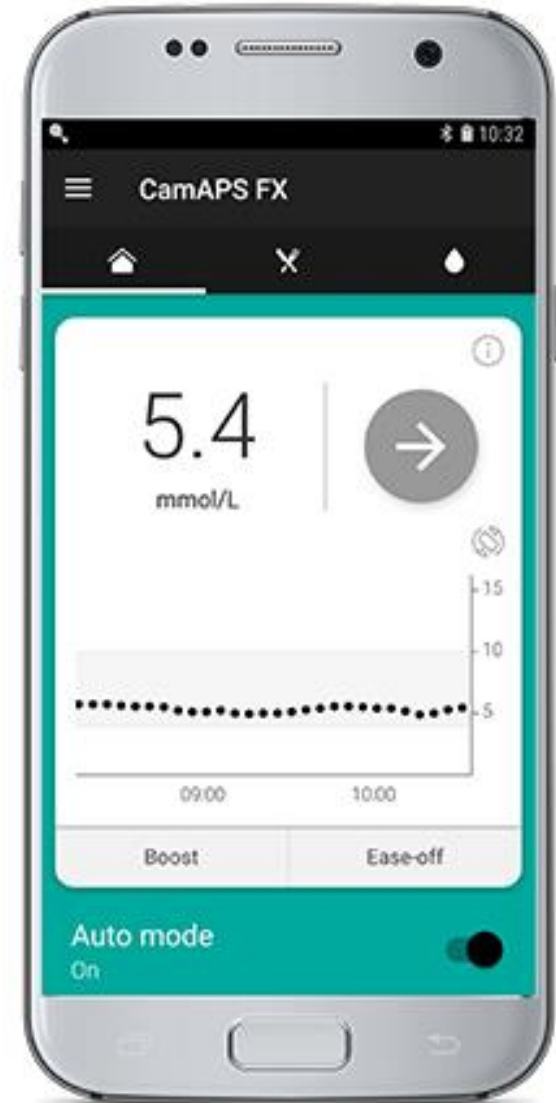
Breastfeeding

- ✓ Easy access to hypo treatment and snacks while feeding
- ✓ Consider using “Ease-off”
- ✓ Review ICR and PGT, if hypos an issue



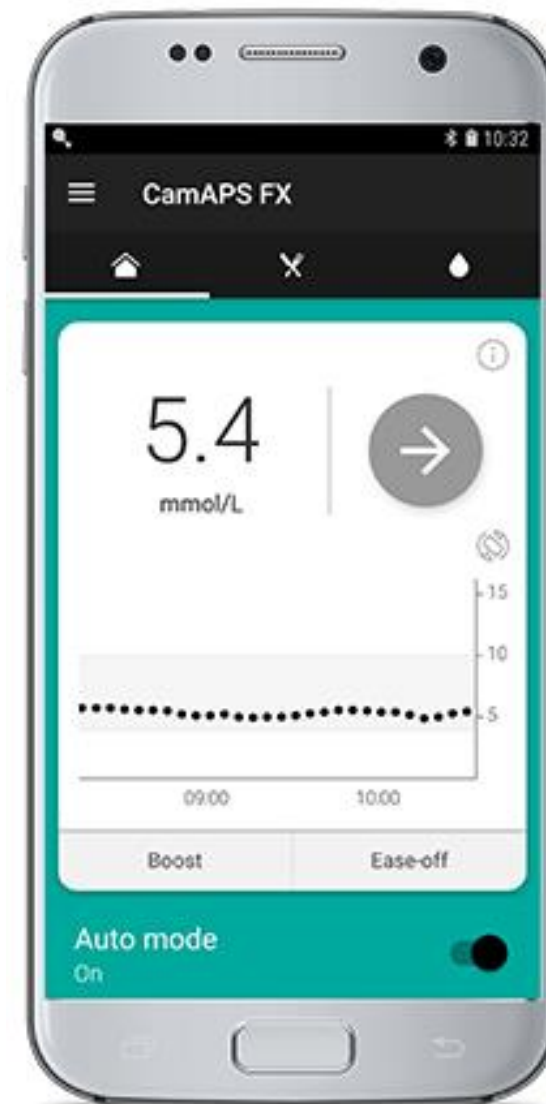
CamDiab

Optimisation



Case Study 1

- ✓ Late 2nd trimester
- ✓ Started CamAPS FX in pregnancy
- ✓ Existing pump and CGM user
- ✓ Husband travels for work
- ✓ Toddler at home
- ✓ Very anxious about hypos





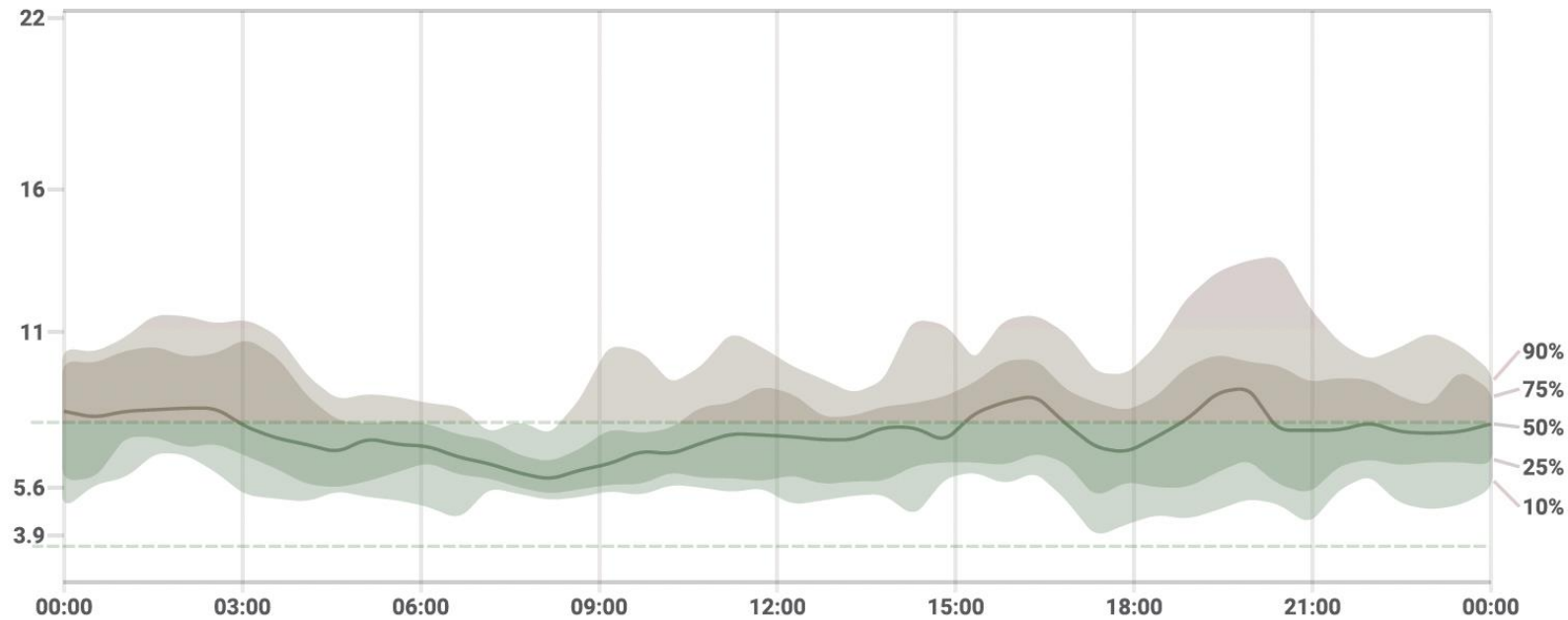
Dexcom G6

39%
Above

61%
Within target

0%
Below

Target range [mmol/L]	3.5-7.8
Average glucose [mmol/L]	7.6
Standard deviation [mmol/L]	2.1
Coefficient of variation [%]	28
Glucose Management Indicator (GMI) [%]	6.6
Glucose Management Indicator (GMI) [mmol/mol]	48
Time below 3.9 mmol/L [%]	0.8
Time below 3.0 mmol/L [%]	0.03



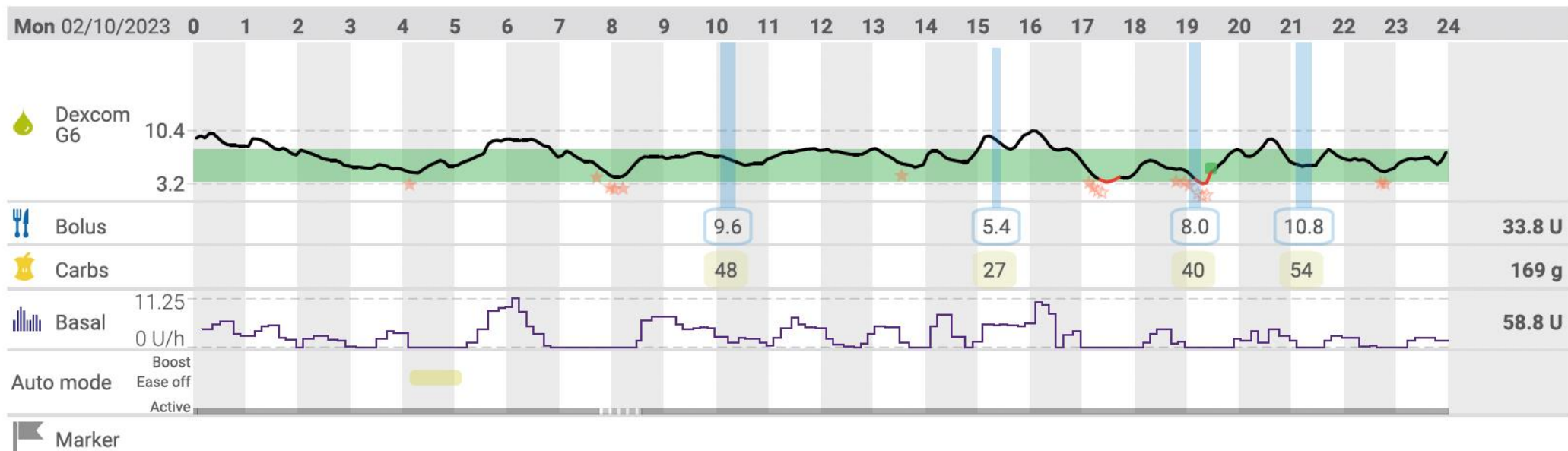
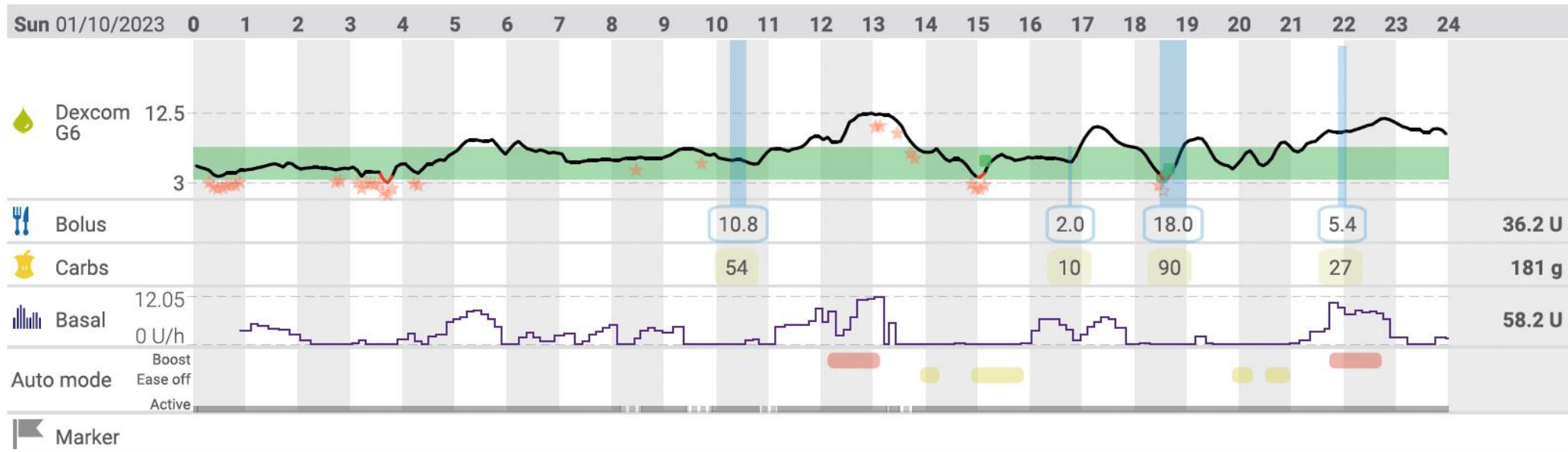
Insulin statistics

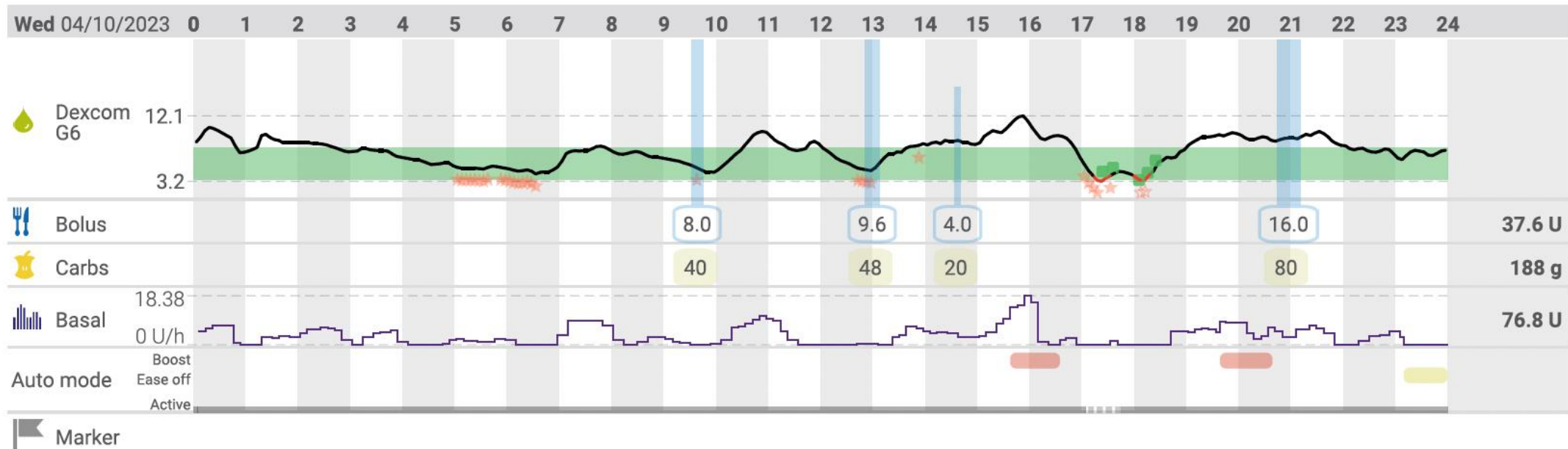
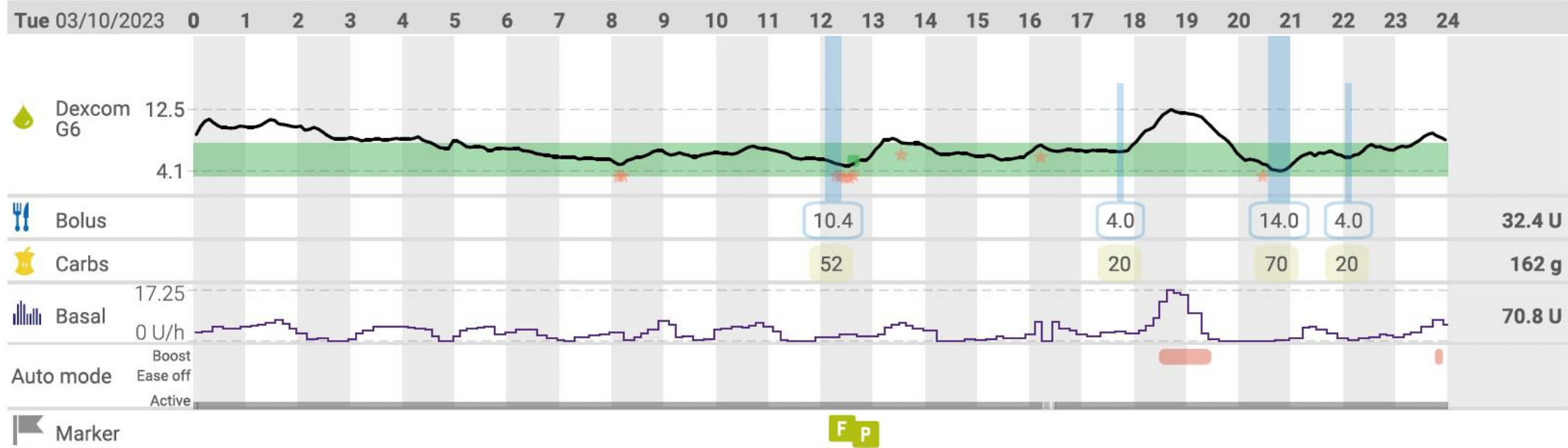


39%
Bolus

61%
Basal

Total daily insulin [U/day]	95.8
Total daily bolus [U/day]	36.9
Total daily basal [U/day]	58.9





Legend: ★ Audio alert ★ Vibrate alert □ Bolus □ Carbs □ Hypo carbs □ Slow Absorption
 🚩 Sensor start event 🟩 Priming event 🟩 Refill event 🟩 Boost 🟩 Ease off 🟩 BG Readings

Case Study 2

- ✓ Late 2nd / early 3rd trimester
- ✓ Started from MDI in early pregnancy
- ✓ Busy job – stopping next week
- ✓ Gastroparesis
- ✓ C-section planned



Glucose – Time In Range

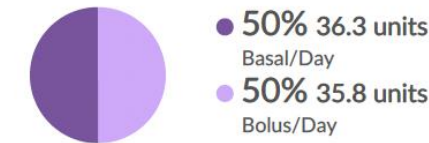


Summary

GMI	SD	2.1mmol/L
6.1% (43.3 mmol/mol)	CV	32.1%
Average	Median	6.1mmol/L
6.5 mmol/L	Highest	16mmol/L
% Time CGM Active	Lowest	2.2mmol/L
98.6% (29.6 days)		

Insulin – Device

From insulin pump

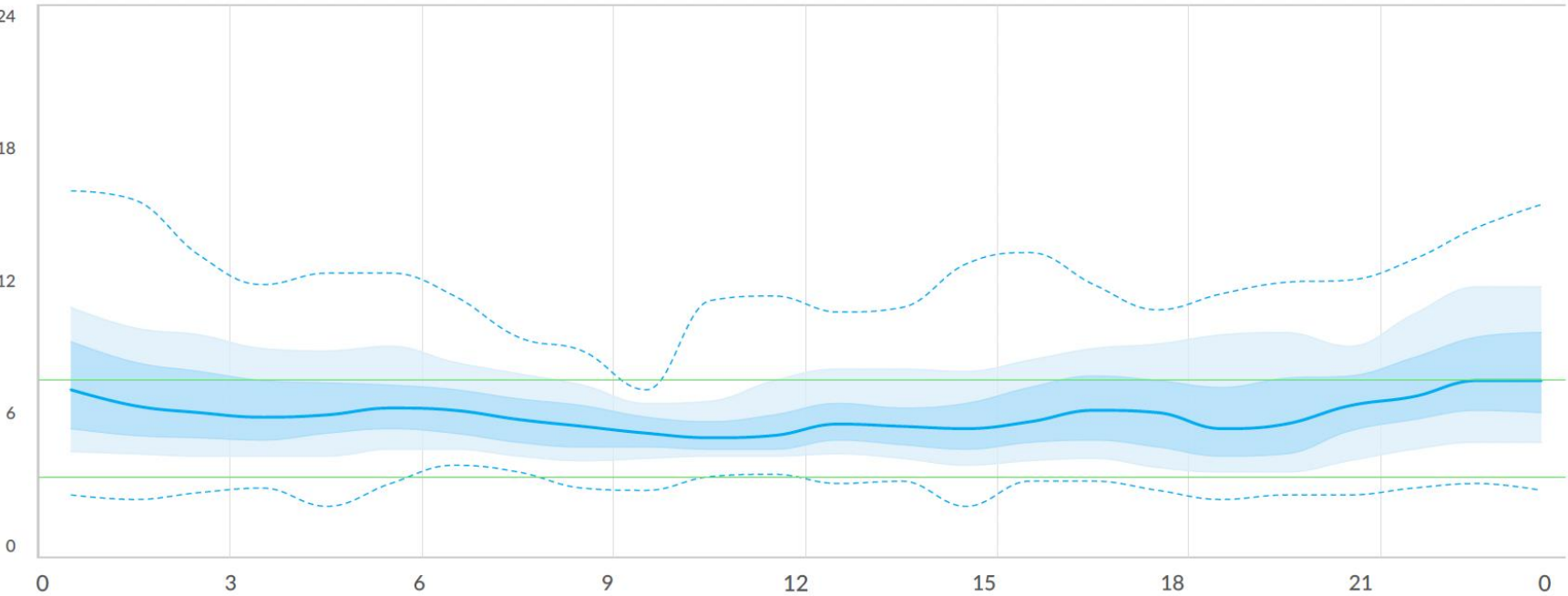


Insulin/day 72units

Overrides (%) 0% (1 boluses)

Bolus/Day 10.2

Ambulatory Glucose Profile (AGP)



System Details

CamAPS FX (29d 1h)



- Auto mode 'On' 99% (28d 17h)
- Boost 14% (4d 5h)
- Ease-off 0%
- Auto mode 'Off' 0% (2h)
- Auto mode 'Attempting' 1% (7h)

Diet

Carbs/Day 164.3g

Entries/Day 3.9

Basal

1 Active

00:00 (4 hr)	1.05 Units/hr
04:00 (3 hr)	1.1 Units/hr
07:00 (17 hr)	1.2 Units/hr

Total	27.9 Units
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Sensitivity (ISF, correction)

Bolus Program Active

00:00 (24 hr)	2 mmol/L
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Insulin to carbohydrate ratio (ICR)

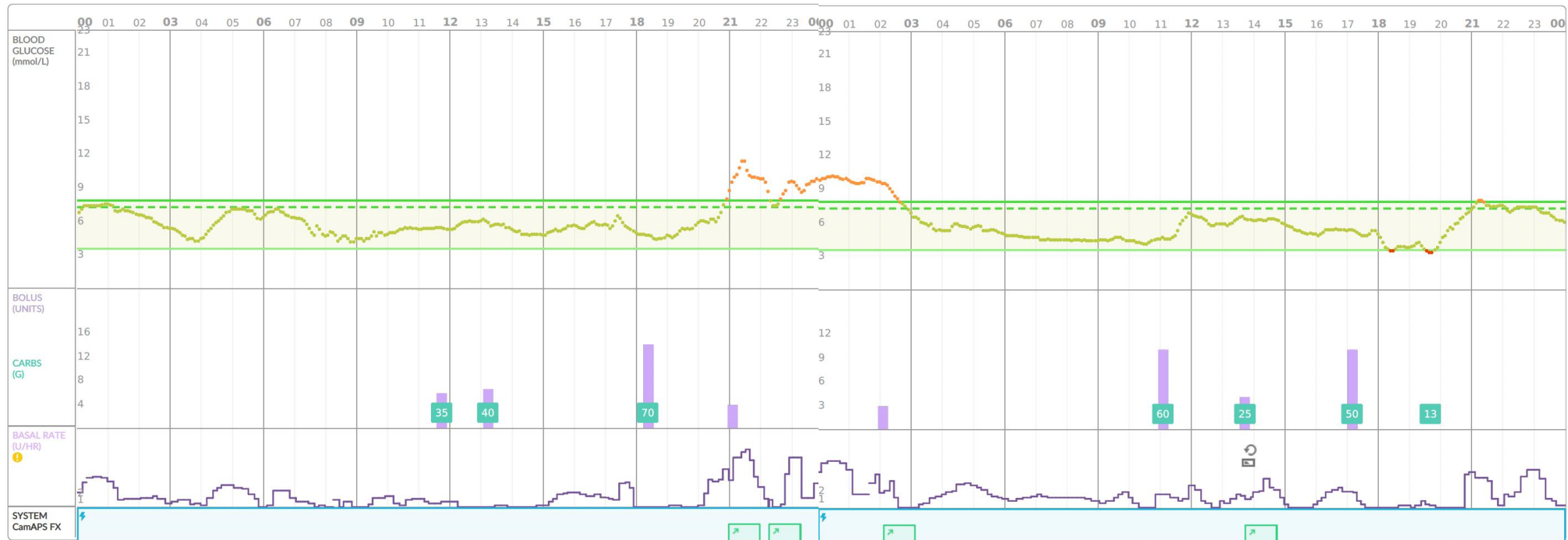
Bolus Program Active

00:00 (6 hr)	6 g/Unit
06:00 (5 hr)	7 g/Unit
11:00 (5 hr)	6 g/Unit
16:00 (8 hr)	5 g/Unit

Personal glucose target

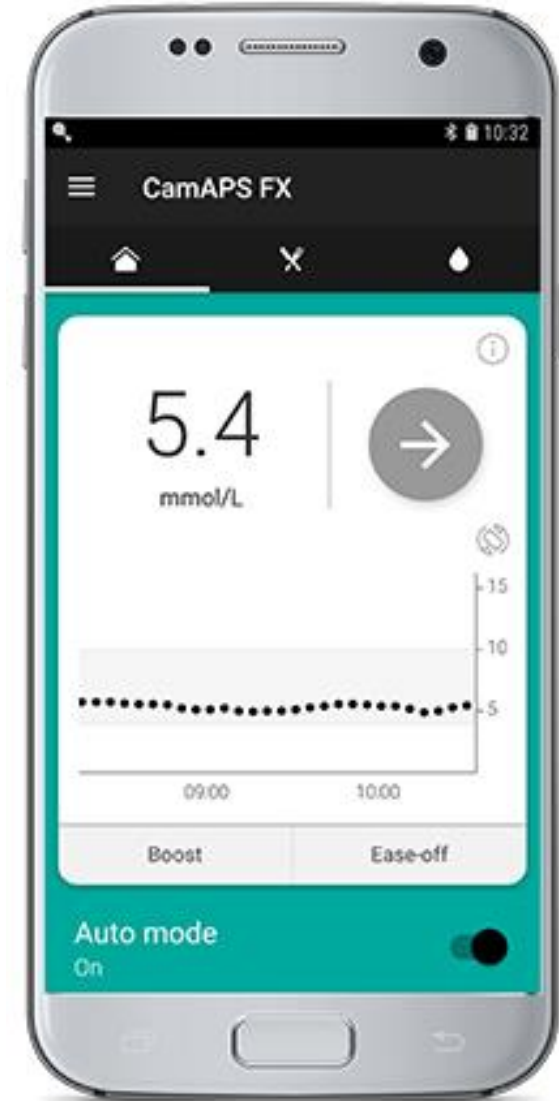
Bolus Program Active

00:00 (7 hr)	4.5 mmol/L (+0/-0)
07:00 (12 hr)	5.2 mmol/L (+0/-0)
19:00 (5 hr)	4.5 mmol/L (+0/-0)

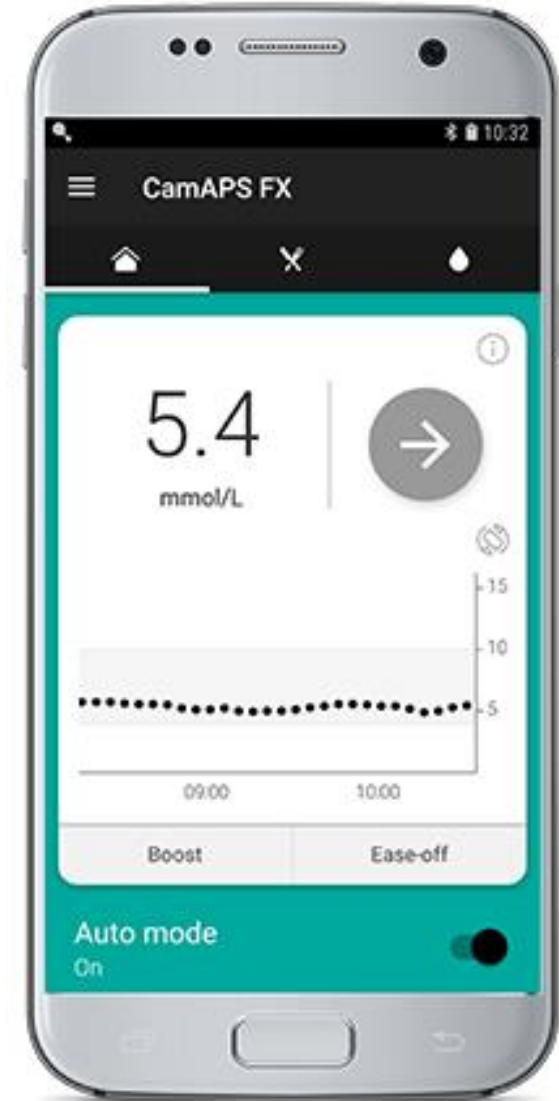


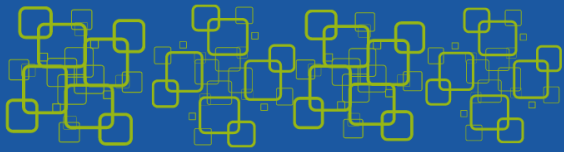
Summary

- ✓ Refresh of CamAPS FX system
- ✓ Personalisation
- ✓ Use in pregnancy
- ✓ Optimisation



Questions





Thank you for attending



You will receive via email in the next 1-2 weeks:

- **Your attendance certificate**
- **PDF of presentation slides**

Please contact CDEP at info@cdep.org.uk if you have any questions.