Practical Tips on Pump Management



Maisy Mok

Diabetes Nurse

AHKDN

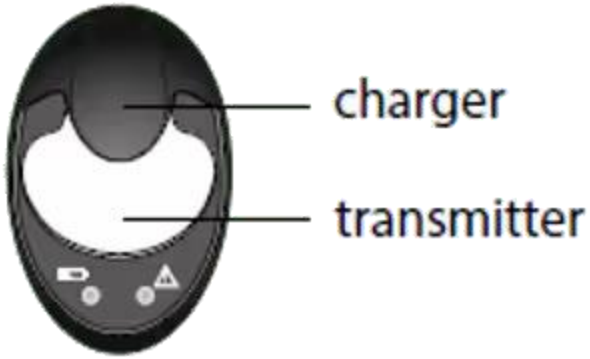
Sharing content

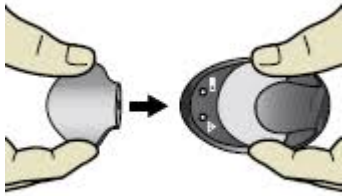
1. Sensor management in a hybrid closed loop system
2. Tips on bolus before eating
3. Hypoglycemia prevention and management in insulin pump user
4. Pump failure management

Sensor management in a hybrid closed loop system

Guardian Connect Sensor

- Charge transmitter fully before using a new sensor
- Charge around 2 hours at the 1st time of a new transmitter
- Change the sensor at every 7 days









GC Sensor 3 _ 670G



- Do the calibration to ensure the accuracy of sensor glucose
- Warm up time (new sensor) ~ 2 hours
- Day 1 : 1st calibration ~ 2 hours then 6 hours, usually the calibration will be required more than usual to ensure the accuracy
- Day 2 -7 : at least every 12 hours, advise to calibrate at fasting before dinner and before sleep

☆Calibration should be done before meals to minimize the discrepancy

GC Sensor 4_780G

1. Install sensor in fasting or at least 3 - 4 hours after bolus
2. Not required calibration after warm up, however will calibrate the sensor reading if enter BG in 780G insulin pump
3. Do not use SG values for bolus dose when using Manual Model



Bleeding occurs after inserted sensor

1. Apply steady pressure by sterile gauze on top of sensor for 3 minutes
2. Connect the transmitter to the sensor
3. ✗ connect the transmitter if bleeding does not stop
4. Change a new sensor in a different location if bleeding continues

Tips on meal bolus

Normal meal bolus



1. Calculate all carbohydrate portions including food and drink, then deliver a bolus 10 – 15 minutes before eating
2. Missed meal bolus
   - ❖ Elevate glucose above target for few hours or delayed hypoglycemia

❖Never input fake carbohydrate

❖Do the correction dose according to algorithm recommendation

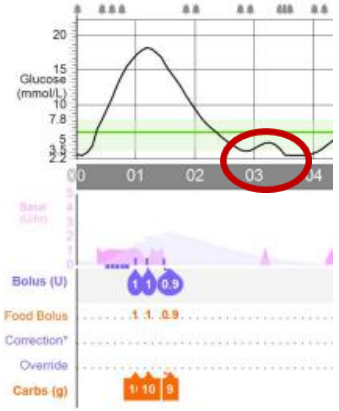
Delayed meal bolus



1. Within 30 mins > 50% carb input
2. Over 30 mins > correction bolus

Review the CGM response >> individualized

1. Within 30 mins > full carb bolus
2. 30 -60 mins since eating > 50 % of total carb bolus
3. Over 60 mins – deliver a correction bolus for current glucose value



Bolus for high fat and / or protein food

1. Manual model or non hybrid closed loop system
   - ✓Dual mode
   - ✓Square mode



2. A hybrid closed loop system
   - ✓Auto basal and auto correction may help to management the delayed post meal glucose rises
   - ✓Require to split bolus if low glucose in initial phase and delayed post meal high glucose > 2nd bolus within 1 hour of eating

Hypoglycemia prevention and management

Possible causes of hypoglycemia

- Overestimation of carbohydrate
- Carbohydrate ratio too strong
- Late bolus
- Giving a manual bolus on top of an increasing basal rate
- Aerobic Exercise
- Drinking alcohol

Prevention for all insulin pump user

- Accurate carbohydrate
- Reduce ICR
- Using temporary target or temporary basal 60 – 90 minutes before aerobic exercise

Prevention for a closed loop system user

- Comply on delayed meal bolus rules
- Never take carbohydrate loading before exercise
- May need longer time temp target after exercise even overnight temp target
- Anaerobic and mixed type exercise > individualized management plan
- While drinking alcohol: Do bolus for any carbohydrate in food and use a temporary target overnight

Hypoglycemia Management

- Non closed loop system
  1. Take 15g fast acting carbohydrate without bolus
  2. Check SMBG after 15 minutes > continue insulin pump if SMBG over 4 mmol/L, otherwise repeat step 1
  3. Suspended insulin pump if SMBG < 2.5 mmol/L, follow step 1 & 2

Hypoglycemia Management

- Closed loop system – individualized
  1. Take 5g fast acting carbohydrate without bolus if only one down arrow
  2. Take 10g fast acting carbohydrate without bolus if 2/3 down arrows
  3. Check SMBG after 15 minutes > continue insulin pump if SMBG over 4 mmol/L, otherwise repeat step 1 or 2

☆ Never enter blood glucose reading in your closed loop insulin pump after hypo treatment

Insulin Pump Failure

Response alert and alarm message always

High SG alert

1. Assess the pump condition in home screen – auto basal and auto correction & check tubing for a blockage, kink, leak, or air bubbles
2. Bolus: Assess the time of last dose bolus, do the correction dose (Glucose bolus) if over 2 hours
3. Check: the glucose trend (arrows) after 1 hour
4. Change cannula and infusion set if persist high SG alert

Suspected insulin pump failure

1. Persistently high blood glucose, despite correction bolus such as two unexplained high BGs in a row or high BG that is not responding to a correction bolus
2. Evidence of ketosis (eg. Urine ketone: mod/large or blood ketone > 1.5 mmol/L)

Immediate Action

1. Change to a new infusion set (according to high blood glucose management)
2. Give correction bolus by “New Insulin Pen” - Novorpaid
3. Drink plenty of clear fluid (100-150 ml every hour)
4. Continue to monitor the blood glucose and ketone level every hour

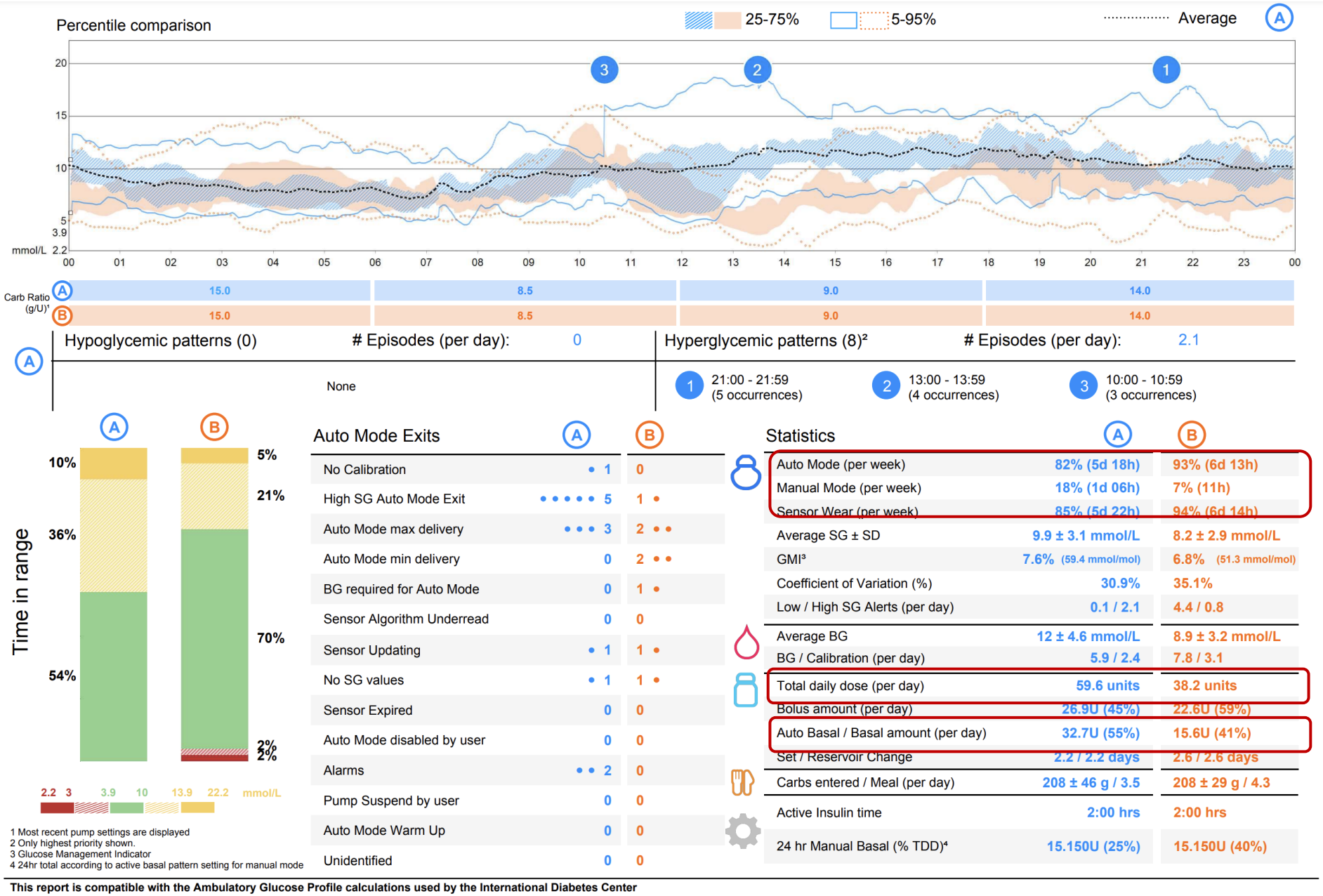
☆Never resume SmartGuard at least 4 hours after bolus by insulin pen

Confirmed Insulin pump failure

1. Call Medtronic support to loan a insulin pump
2. Give long acting insulin by insulin pen also (*when pump is disconnected) such as travel without pump support
3. Convert to Multiple dose injection with prescribed medication plan
4. Go to emergency room if still high blood glucose or ketosis (Urine ketone: mod/large or blood ketone > 1.5 mmol/L) or with DKA symptoms

Case Sharing

Any clinical questions from this report?



Brief history

11 yrs old girl

Presented with moderate DKA

Anti Islet cell Ab +ve

C peptide 0.14↓

On medtronicn 670G hybrid closed loop pump

79% in automode

Average BG 9.6+/-4.5

BG average 7-8 times/day

Basal 40%

TDD 44.6unit

Before admission

- Admitted for DKA with central abd pain since the night before (8 Apr 2023)
- Didn't check H'stix as sleeping. Vomiting since last morning (9 Apr 2023), ~10x total
- Last H'stix from pump 20+ at ~11am 9 Apr 2023
- Noticed pump failure since noon
- Muted the alarm

	Glucose Measurements		Bolus Events					Fill Events					
	BG Readings	Sensor Duration (h:mm)	Manual Boluses	Bolus Wizard Events	With Food	With Correction	Overridden	Rewind	Cannula Fills	Cannula Amount (U)	Tubing Fills	Tubing Amount (U)	Suspend Duration (h:mm)
Friday 17/3/2023	5			4	2	4		1	1	0.05	1	1.0	0:02
Saturday 18/3/2023	10	13:25		7	4	7							0:02
Sunday 19/3/2023	10	23:45		5	4	4		1	1	0.05	1	0.6	1:30
Monday 20/3/2023	6	23:45		5	4	3							0:34
Tuesday 21/3/2023	5	23:55		5	4	4		1	1	0.05	1	0.6	0:09
Wednesday 22/3/2023	3	24:00		3	3	2		1	1	0.05	1	0.6	0:30
Thursday 23/3/2023	5	16:35		4	3	2							0:21
Friday 24/3/2023	5	23:40		3	3	1							0:27
Saturday 25/3/2023	10	16:05		5	4	4		1	1	0.05	1	0.6	0:20
Sunday 26/3/2023	5	23:55		5	5	5							0:04
Monday 27/3/2023	4	23:55		3	2	3		1	1	0.05	1	1.7	0:20
Tuesday 28/3/2023	4	23:30		4	4	2							0:07
Wednesday 29/3/2023	5	23:55		3	3	1		1	1	0.05	1	1.2	0:02
Thursday 30/3/2023	5	23:55		5	4	3							
Summary	5.9/day	11d 20h 20m	0.0/day	4.4/day	80.3%	73.8%	0%	7	7	0.05U /fill	7	0.9U /fill	4h 28m

Partial day Suspend Suspend On Low Suspend Before Low

	Glucose Measurements		Bolus Events					Fill Events					
	BG Readings	Sensor Duration (h:mm)	Manual Boluses	Bolus Wizard Events	With Food	With Correction	Overridden	Rewind	Cannula Fills	Cannula Amount (U)	Tubing Fills	Tubing Amount (U)	Suspend Duration (h:mm)
Saturday 1/4/2023	9	19:05		6	5	4							
Sunday 2/4/2023	8	22:05		8	3	8		1	1	0.05	1	0.6	0:02
Monday 3/4/2023	9	23:55		6	4	6	1	1	1	0.05	1	0.6	2:06
Tuesday 4/4/2023	8	24:00		7	5	6	4	4	3	0.15	1	5.8	4:46
Wednesday 5/4/2023	6	23:40		5	4	3							0:20
Thursday 6/4/2023	9	23:35		8	5	8		1	1	0.05	1	0.6	2:11
Friday 7/4/2023	7	23:50		6	6	4	2						0:25
Saturday 8/4/2023	12	19:30		10	5	8	2	1	1	0.05	1	0.6	1:07
Sunday 9/4/2023	6	22:25		4	3	4	4	4	3	0.15	4	3.1	17:16
Monday 10/4/2023	7	4:55		3		3		2	1	0.05	2	12.6	17:58
Tuesday 11/4/2023	3	18:00											24:00
Wednesday 12/4/2023	2	23:20											24:00
Thursday 13/4/2023	2	23:40											24:00
Friday 14/4/2023	2	14:10											24:00
Summary	6.4/day	11d 22h 10m	0.0/day	4.5/day	63.5%	85.7%	20.6%	14	11	0.05U /fill	11	2.2U /fill	5d 22h 11m

Partial day Suspend Suspend On Low Suspend Before Low

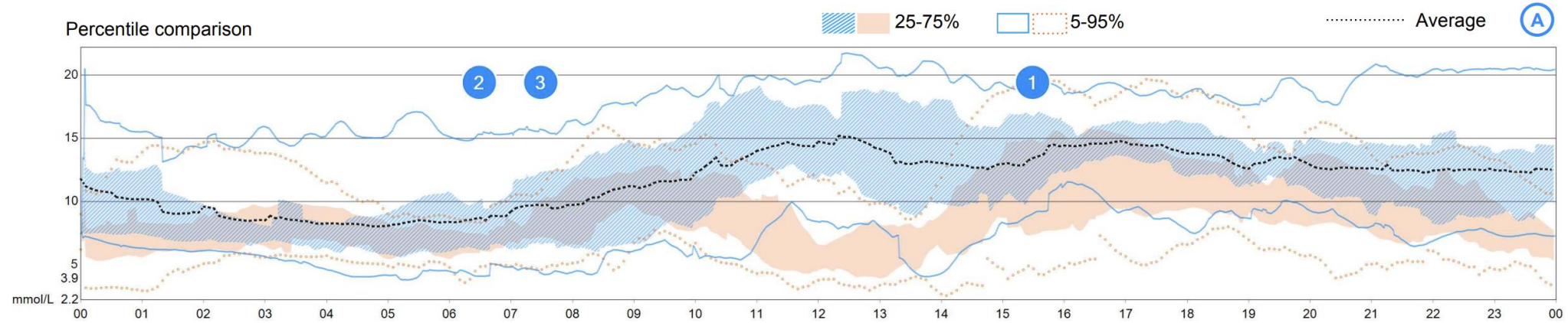
Normal pattern

	Glucose Measurements		Bolus Events					Fill Events					
	BG Readings	Sensor Duration (h:mm)	Manual Boluses	Bolus Wizard Events	With Food	With Correction	Overridden	Rewind	Cannula Fills	Cannula Amount (U)	Tubing Fills	Tubing Amount (U)	Suspend Duration (h:mm)
Sunday 22/12/2024		17:55		6	5	1	2	1	1	0.6	1	6.3	0:20
Monday 23/12/2024	3	23:05		9	9	3							0:15
Tuesday 24/12/2024	3	24:00		12	11	3	1						0:08
Wednesday 25/12/2024	1	24:00		10	10	3							0:09
Thursday 26/12/2024	1	24:00		9	8	1	1						0:12
Friday 27/12/2024	1	24:00		12	11	2	1	1	1	0.6	1	6.8	0:12
Saturday 28/12/2024	2	24:00		12	10	3	2						0:13
Sunday 29/12/2024		24:00		5	5	1							0:10
Monday 30/12/2024	2	20:30		12	11	2	1	1	1	0.6	1	6.7	0:22
Tuesday 31/12/2024		24:00		7	7	3							0:11
Wednesday 1/1/2025		24:00		6	6	4							0:15
Thursday 2/1/2025		24:00		10	10	1							
Friday 3/1/2025		24:00		10	10	3							
◔ **Saturday 4/1/2025**		21:50		10	10	2		1	1	0.6	1	6.8	0:30
Summary	0.9/day	13d 11h 20m	0.0/day	9.3/day	94.6%	24.6%	6.2%	4	4	0.6U /fill	4	6.6U /fill	2h 57m

◔ Partial day Suspend Suspend On Low Suspend Before Low

B 1/1/2023 - 14/1/2023 (14 Days)

Percentile comparison



Carb Ratio (g/U)				
A	15.0	8.5	9.0	14.0
B	15.0	8.5	9.0	14.0

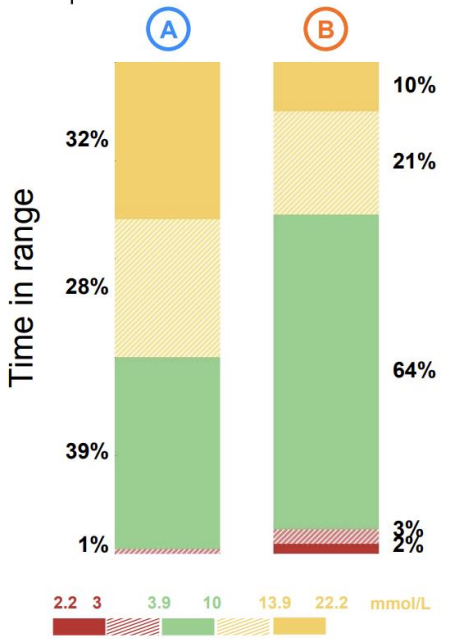
A

Hypoglycemic patterns (0) — # Episodes (per day): 0.1

None

Hyperglycemic patterns (7)² — # Episodes (per day): 1.8

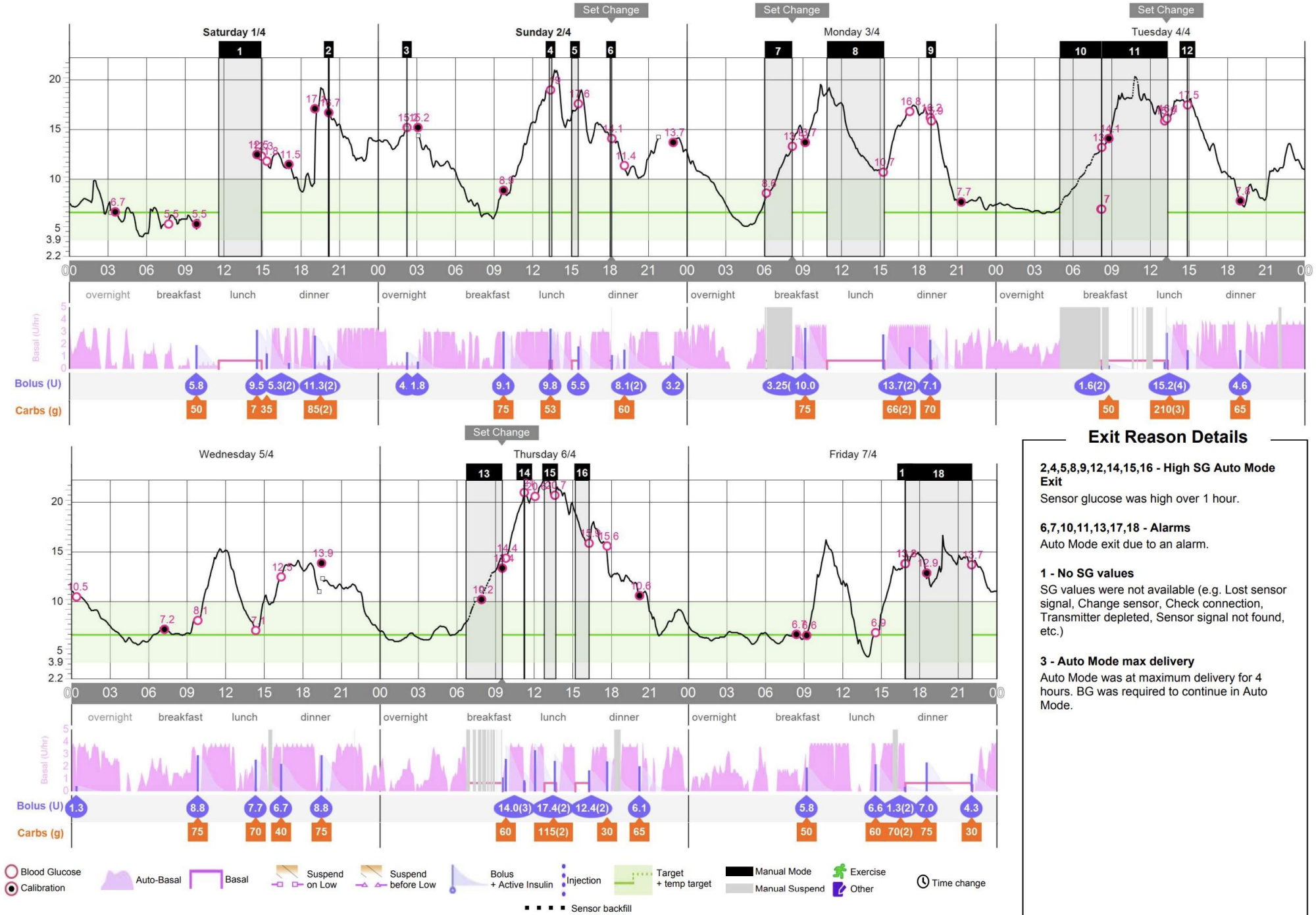
1. 15:00 - 15:59 (3 occurrences)
2. 06:00 - 06:59 (2 occurrences)
3. 07:00 - 07:59 (2 occurrences)



2 Only highest priority shown.
3 Glucose Management Indicator
4 24hr total according to active basal pattern setting for manual mode

Auto Mode Exits	A	B
No Calibration	0	1 •
High SG Auto Mode Exit	+ • • • • • 9	5 • • • • •
Auto Mode max delivery	• 1	1 •
Auto Mode min delivery	0	0
BG required for Auto Mode	0	1 •
Sensor Algorithm Underread	0	0
Sensor Updating	0	2 • •
No SG values	• 1	0
Sensor Expired	0	0
Auto Mode disabled by user	0	0
Alarms	+ • • • • • 11	0
Pump Suspend by user	0	0
Auto Mode Warm Up	0	0
Unidentified	0	0

Statistics	A	B
Auto Mode (per week)	45% (3d 04h)	85% (5d 22h)
Manual Mode (per week)	55% (3d 20h)	15% (1d 02h)
Sensor Wear (per week)	85% (5d 23h)	84% (5d 22h)
Average SG ± SD	11.7 ± 4.5 mmol/L	8.9 ± 3.6 mmol/L
GMI³	8.3% (67.6 mmol/mol)	7.1% (54.6 mmol/mol)
Coefficient of Variation (%)	38.6%	40.4%
Low / High SG Alerts (per day)	1.1 / 6.8	4.6 / 2.1
Average BG	14.4 ± 6.4 mmol/L	9.2 ± 3.9 mmol/L
BG / Calibration (per day)	6.4 / 2.4	8.9 / 2.8
Total daily dose (per day)	61.9 units	40.5 units
Bolus amount (per day)	30.1U (49%)	23.7U (59%)
Auto Basal / Basal amount (per day)	31.8U (51%)	16.8U (41%)
Set / Reservoir Change	0.9 / 0.7 days	3.0 / 3.0 days
Carbs entered / Meal (per day)	152 ± 128 g / 2.9	205 ± 30 g / 4.6
Active Insulin time	2:00 hrs	2:00 hrs
24 hr Manual Basal (% TDD)⁴	15.150U (24%)	15.150U (37%)



Exit Reason Details

2,4,5,8,9,12,14,15,16 - High SG Auto Mode Exit
Sensor glucose was high over 1 hour.

6,7,10,11,13,17,18 - Alarms
Auto Mode exit due to an alarm.

1 - No SG values
SG values were not available (e.g. Lost sensor signal, Change sensor, Check connection, Transmitter depleted, Sensor signal not found, etc.)

3 - Auto Mode max delivery
Auto Mode was at maximum delivery for 4 hours. BG was required to continue in Auto Mode.

Cause of non-compliance

- Painful experience of change infusion set
- Inconvenience > before dinner
- Not familiar with procedures

Check the adherence chart and injection sites

Reference List

- https://www.medtronic.com/content/dam/medtronic-wide/public/canada/products/diabetes/780g-gs3-system-user-guide.pdf
- https://nhsforthvalley.com/wp-content/uploads/2024/10/Insulin-Pump-Workbook-Medtronic-780G.pdf
- https://www.uhmb.nhs.uk/our-services/patient-information-leaflets/guide-using-medtronic-780g-closed-loop-system
- https://www.a-c-d-c.org/wp-content/uploads/2012/08/Medtronic-MiniMed780G-hybrid-closed-loop-training-booklet-2.pdf

Thanks