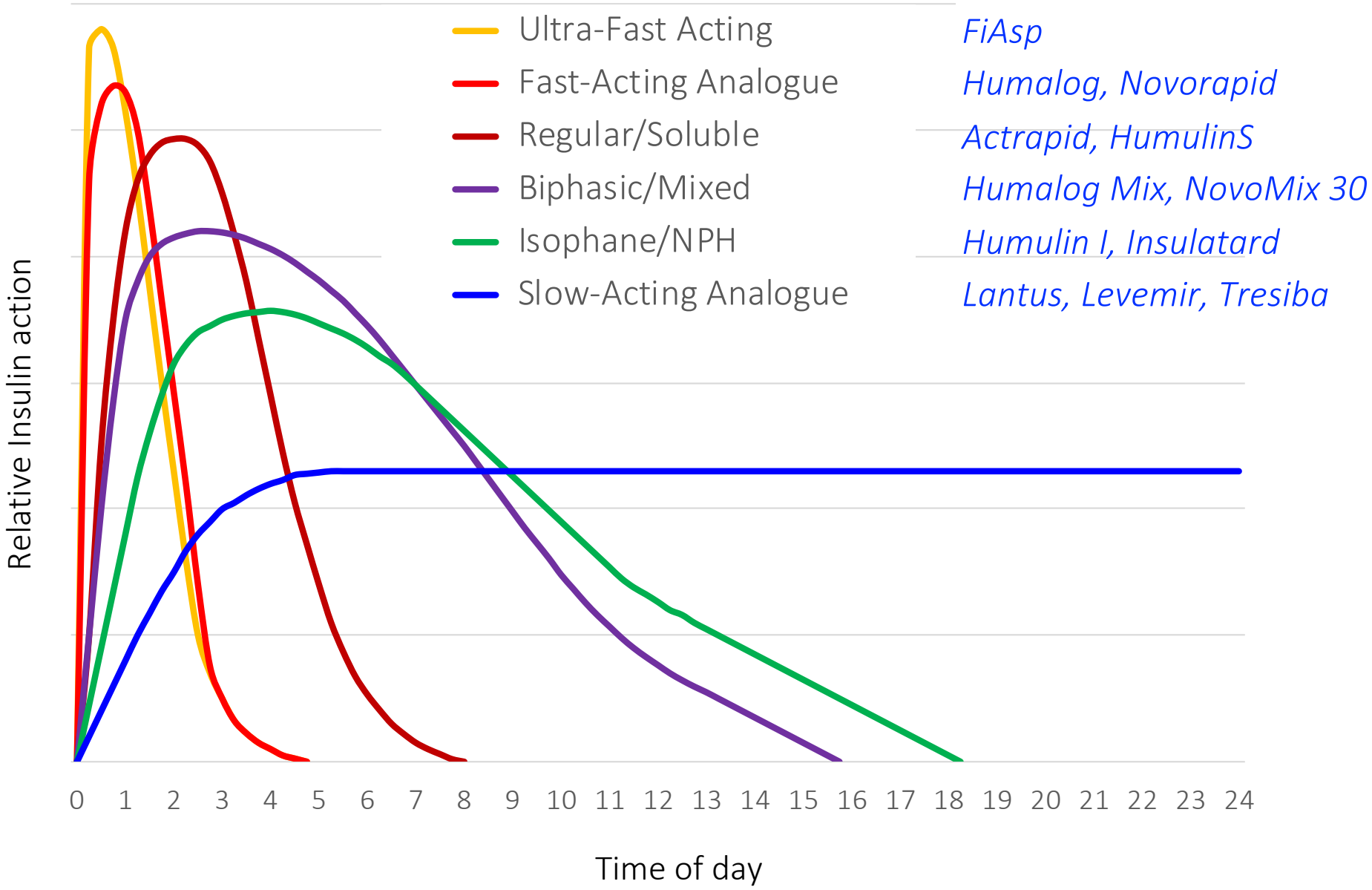
Adjusting Insulin Doses

Dr. Ian Craigie
GGC Children's Diabetes Service
Royal Hospital for Sick Children
Glasgow

Insulin Action Profiles

Insulin action profiles - SCI



Insulin actions

Description	Examples	Action	Onset	Peak	Duration
Ultra Rapid	FiAsp	Ultra-short	5 mins	30-40 mins	2 - 4 hrs
Rapid-acting analog	Apidra, Humalog Novorapid	Very short	10 - 15 mins	50-70 mins	2 - 4 hrs
Regular	Actrapid Humulin S	Fast / Short	30 mins	1 - 3 hrs	4 - 8 hrs
Isophane	Insulatard Humulin I	Intermediate	1 - 3 hrs	4 - 6 hrs	8 - 12+ hrs
Slow-acting analogue	Lantus Levemir, Tresiba	Slow / Long	3 - 4 hrs	-	18 - 24+ hrs
Biphasic (Mixed)	Humulin M3 Humalog Mix 25 Humalog Mix 50 Novomix 30	Mixed	Depends on types & amounts in mix (M3 = 30% Reg, 70% Isophane) (Mix 25 = 25% RAA, 75% PRAA) (Mix 50 = 50% RAA, 50% PRAA) (N'mix 30 = 30% RAA, 70% PRAA) PRAA = Protaminated Rapid Acting Analogue		

Initially consider these factors...

- In-take — carbohydrate
  - time of day
  - amount
  - type of food eaten
- In-activity (!) — exercise
  - *time of day*
  - *amount of activity*
  - *food taken before activity*
- In-jections — timing & sites
  - time of day
  - time before meals
  - injection sites
- In-firmity (illness) — “Sick Day” or “Ketone” guidelines

and only then consider...

- In-sulin — dose and type

Clinical Profiles and MDI adjustment

3y M 15kg HbA1c 55 (7.2%)

TDD: 16.5 U
TDD/k: 1.1 U/k
BBR: 40:60

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	4	4	4.6	5.1	5.5
	0900					
Lunch	1230	4		8.2	6.7	3.7
	1400					
Tea	1700	4	4	4.5	4.8	9.8
	1830					
Supper	2100			7.1	7.5	5.8
	2230					
	0300					

3y M 15kg HbA1c 55 (7.2%)

TDD: 16.5 U
TDD/k: 1.1 U/k
BBR: 40:60

- No significant concerns
- Growing well
- Excellent HbA1c
  - too low for this age group?
  - neurological development
- Regular nocturnal BG results advised
  - may have no signs of hypoglycaemia
  - to bed early, so longer without carbohydrate

TDD: 58 U
TDD/k: 1.2 U/k
BBR: 60:40

12y M 48kg HbA1c 48 (6.5%)

		H'LOG	LAN	Day 1	Day 2	Day 3	Day4
B 'fast	0730	8			7.8		8.2
	0900						
Lunch	1230	7		5.3		4.2	
	1400						
Tea	1700	7	36		4.1		6.1
	1830						
Supper	2100			6.2		6.0	
	2400			3.2	3.9	4.2	3.4
	0300			2.7	3.1	4.0	7.8

TDD: 58 U
TDD/k: 1.2 U/k
BBR: 60:40

12y M 48kg HbA1c 48 (6.5%)

- Multi-Dose Injection regimen
  - Humalog and Lantus
  - Only 2 BG tests daily, but still gives good idea of daily progress
  - Too few tests to allow regular use of Correction Doses
  - ? using fixed amounts of Carbohydrate (& fixed doses of Humalog?)
- Testing at varied times
  - Very good HbA1c
- Unrecognised hypos!
  - HbA1c low
  - no overnight BG test results
  - “Dawn Phenomenon” causes BB’fast BG rise, but beware overnight BG!

TDD: 13 U
TDD/k: 0.8 U/k
BBR: -

3.7y M 16kg HbA1c 66 (8.2%)

		Insulin	Dose	Day 1	Day 2	Day 3
B ‘fast	0730	HM25	6	4.6	5.1	5.5
	0900					
Lunch	1230			16.3	12.1	17.9
	1400					
Tea	1700	NOV	2	13.3	14.7	9.8
	1700	LEV	5			
Supper	2100			3.9	3.6	3.8
	2230					
	0300					

TDD: 13 U
TDD/k: 0.8 U/k
BBR: -

3.7y M 16kg HbA1c 66 (8.2%)

- Breakfast BG results reasonable
- Lunch time results high
  - ? food
  - ? exercise
  - ? injections
  - ? illness
- Needs M25 increase BUT beware late effect of inc. biphasic mix
  - hypoglycaemia in late evening & overnight likely
  - to avoid consider changing to RAA Before all meals (i.e. MDI)
- Reduce tea-time Nov to 1.5 units if M25 increased
  - anticipate even lower BG results before tea

TDD: 32.0 U
TDD/k: 1.2 U/k
BBR: 35:65

8.2y M 28kg HbA1c 68 (8.4%)

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	6.0		10.8	3.2	10.3
	0900					
Lunch	1230	7.0		5.9	4.3	
	1400					3.9
Tea	1700	8.0	11	5.4	4.6	8.7
	1830					
Supper	2100			12.3	14.5	14.1
	2230					
	0300					

8.2y M 28kg HbA1c 68 (8.4%)

TDD: 32.5 U
TDD/k: 1.2 U/k
BBR: 35:65

- High results at Bed
  - increase tea-time Novorapid
- High results at B'fast
  - ? await effect of increased Novorapid
  - ? increase bed-time Levemir
  - ? rebound highs due to nocturnal hypoglycaemia

TDD: 98 U
TDD/k: 1.2 U/k
BBR: -

13y M 82kg HbA1c 52 (6.9%)

		Insulin	Dose	Day 1	Day 2	Day 3
B ‘fast	0730	M3	56	3.5	4.0	3.6
	0900					
Lunch	1230			10.3	3.8	11.6
	1400					
Tea	1700	NOV	20	3.8	5.1	3.4
		LEV	22			
	1830					
Supper	2100			3.7	3.5	3.6
	2230					
	0300					

TDD: 98 U
TDD/k: 1.2 U/k
BBR: -

13y M 82kg HbA1c 52 (6.9%)

- Lunch high (x 2) - beware acting too soon
  - rebound post hypo Rx
  - actually requires dose reduction
- Bedtime low
  - ? bedtime snack eaten
  - ? staying up later
  - ? evening football training
  - ? insulin dose too high -> reduce teatime Novorapid
- Breakfast low
  - reduce teatime Levemir
  - ? Basal: Bolus regimen

TDD: 44 U
TDD/k: 1.1 U/k
BBR: 20:80

14y F 40kg (10C) HbA1c 11C

		Insulin	Dose	Day 1	Day 2	Day 3
B ‘fast	730	NOV	~10	26.0	23.4	31.1
	900					
Lunch	1230	NOV	~12	Hi	33.1	28.0
	1400					
Tea	1700	NOV	~14	27.9	23.7	24.5
	1830					
Supper	2100	TRE	8	3.9	3.6	3.8
	2230					
	300					

14y F 40kg (10C) HbA1c 110

TDD: 44 U
TDD/k: 1.1 U/k
BBR: 20:80

- Multiple high results
  - insufficient insulin
    - low weight/weight loss
    - high HbA1c
    - ? insulin Total Daily Dose
- Very high results suggest insulin omission
  - discuss concerns openly
  - discuss serious risk of DKA
  - consider supervision, admission
- Parental assistance vital
  - supervision of results & injections
- Psychology review?
  - including family
- Social Work involvement?

11y F 41 kg HbA1c 83 (9.7%)

TDD: 42 U
TDD/k: 1.0 U/k
BBR: 40:60

		Insulin	Dose	Day 1	Day 2	Day 3
B ‘fast	0730	NOV	6	26.2	5.4	3.6
	0900					
Lunch	1230	NOV	9	5.5	11.2	6.3
	1400					
Tea	1700	NOV	9	7.1	3.7	4.2
		LEV	16			
	1830					
Supper	2100		2	11.1	3.6	30.2
	2230					
	0300					

11y F 41 kg HbA1c 83 (9.7%)

TDD: 42 U
TDD/k: 1.0 U/k
BBR: 45:55

- poor glycaemic control
- very erratic breakfast results
  - ? omitted insulin
  - ? erroneous dose
- minimal tea insulin
  - ? food-related
  - ? in response to hypos
- injection sites
- exercise
- illness

TDD: 76 U
TDD/k: 1.0 U/k
BBR: 60:40

16y M 75kg HbA1c 52 (6.9%)

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	10		8.3	10.0	3.8
	0900			5.3	14.6	4.7
Lunch	1230	10		4.6	4.1	4.2
	1400			10.3	12.0	9.6
	1600			3.4	4.2	2.7
Dinner	1830	8	46	17.5	9.5	14.8
Supper	2100	2		10.3	8.4	12.1
	2230			8.2	7.5	6.9
	0000			4.3	3.3	4.2
	0300			3.6	12.3	3.8

TDD: 76 U
TDD/k: 1.0 U/k
BBR: 60:40

16y M 75kg HbA1c 52 (6.9%)

- Too much basal!
- Not enough bolus!
- Results during the day are okay
  - BG rise before dinner = Levemir waning
- Tempting to split Levemir, but…
  - Nocturnal hypoglycaemia!
- Cut Levemir ++
- Add Bedtime Novorapid
- Insulin pump?

4y F 17kg HbA1c 72 (8.7%)

TDD: 14.5 U
TDD/k: 0.8 U/k
BBR: 40:60

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	3		4.1	5.3	3.2
	0900			8.3	5.6	4.7
Lunch	1230	2.5		9.6	6.1	7.8
	1400			6.5	7.2	8.4
Tea	1700	3		12.7	9.5	10.8
	1830			11.6	12.2	9.7
Supper	2100		6	16.7	13.0	18.3
	2230			18.2	12.7	16.5
	0300			9.3	7.5	10.6

4y F 17kg HbA1c 72 (8.7%)

TDD: 14.5 U
TDD/k: 0.8 U/k
BBR: 40:60

- Low BG in morning (on waking)
- BG rising during day, especially in evening
  - Typical hormonal pattern of BG in toddlers
- Needs less basal insulin
  - ? Move Basal insulin from evening to breakfast
- Needs more (frequent) boluses
  - Add evening Bolus
  - Lower CRs
  - ? Lower ISs

10y F 37kg HbA1c 73 (8.8%)

TDD: 36 U
TDD/k: 1.0 U/k
BBR: 45:55

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	8		3.6	12.8	5.7
	0900					
Lunch	1230	6		13.5	6.3	8.9
	1400					
Tea	1700	6	16	15.8	12.3	2.9
	1830					
Supper	2100			5.4	23.6	10.3
	2230					
	0300					

10y F 37kg HbA1c 73 (8.8%)

TDD: 36 U
TDD/k: 1.0 U/k
BBR: 45:55

- Erratic results
  - no pattern seen
    - Intake ? variable
    - (In)activity ? variable
    - Infirmity ? intercurrent illness
    - Injection sites ? hypertrophied
    - Insulin ? dose ? adherence
- Parental supervision
  - BG results
  - Injections
  - Overnight BG results

TDD: 118 U
TDD/k: 2.8 U/k
BBR: 50:50

14y F 42kg HbA1c 116 (12.8%)

		NOV	LEV	Day 1	Day 2	Day 3
B 'fast	0730	18		4.1 [23.2]	5.3	3.2 [3.2]
	0900					
Lunch	1230	20		5.6	6.1	4.7
	1400					
Tea	1700	20	60	4.9	6.3 [27.5]	7.7 [HI]
	1830					
Supper	2100			6.1 [16.7]	5	6.5
	2230					
	0300					

TDD: 118 U
TDD/k: 2.8 U/k
BBR: 50:50

14y F 42kg HbA1c 116 (12.8%)

- Poor compliance (adherence)
- Incongruity:
  - Insulin Total Daily Dose
  - Weight
  - Recorded BG results
  - HbA1c
- Management
  - Admission
    - of non-compliance
    - to hospital ?

- Average plasma BG over last 4-6 weeks:

  (HbA1c (%) x 2) - 5.5

- Typical Insulin Total Daily Dose
  - Non-pubertal: 1 U/kg/day
  - Pubertal: > 1 U/kg/day

    > 2 U/kg/day Rare

8y F 36kg HbA1c 76 (9.1%)

TDD: 34 U
TDD/k: 0.9 U/k
BBR: 70:30

		NOV	LEV	Day 1	Day 2	Day 3
B ‘fast	0730	4	12	4.1	5.3	3.2
	0900			12.6	10.7	7.5
Lunch	1230	3		4.7	6.1	7.8
	1400			14.2	9.8	12.6
Tea	1700	3	12	4.3	5.2	3.1
	1830			11.6	12.2	9.7
Supper	2100			3.2	4.2	4.7
	2230					
	0300			3.4	3.8	2.8

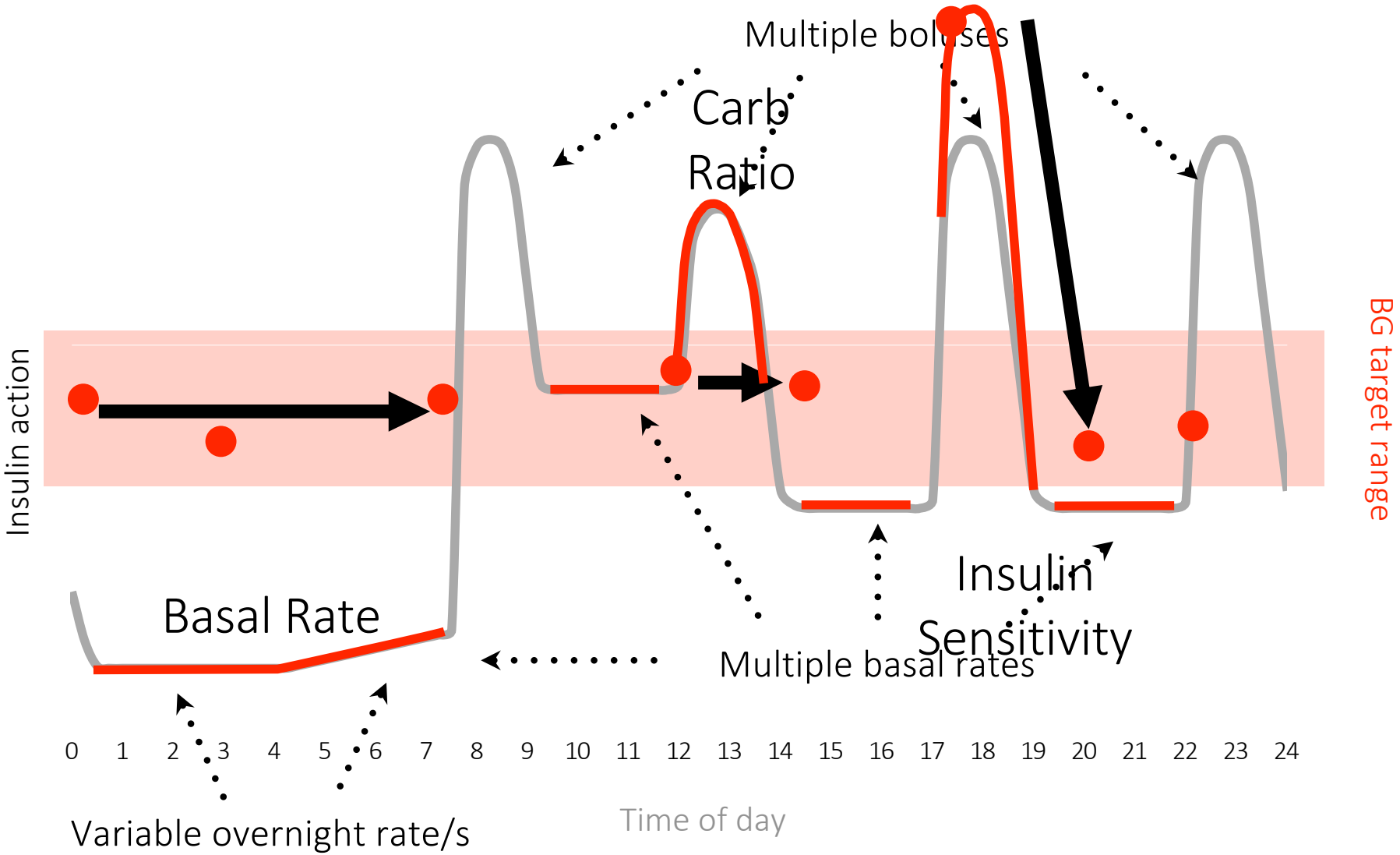
8y F 36kg HbA1c 76 (9.1%)

TDD: 34 U
TDD/k: 0.9 U/k
BBR: 70:30

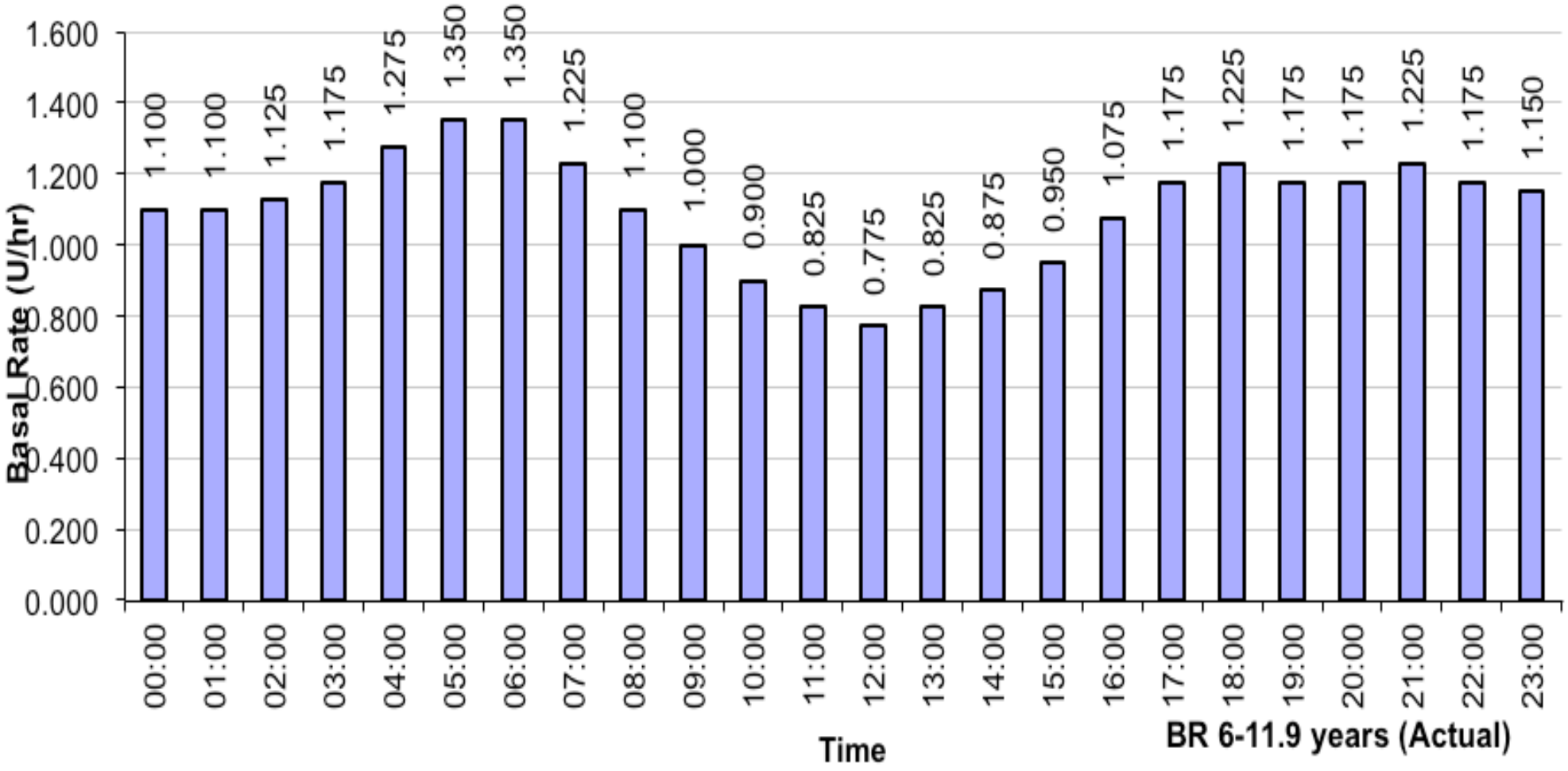
- Rising post-meal BG results
  - Bolus doses too small
- Recurrent pre-meal and nocturnal hypoglycaemia
  - Basal dose too large
- Beware disproportionate Basal: Bolus doses
  - usually ≤ 1: 1 ratio of basal: bolus insulin appropriate
  - very easy to concentrate on pre-meal BG results only and so steadily increase basal doses at expense of boluses
  - significant increase in risk of severe hypoglycaemia

Insulin Pump settings adjustment

Continuous SC insulin infusion (CSII)

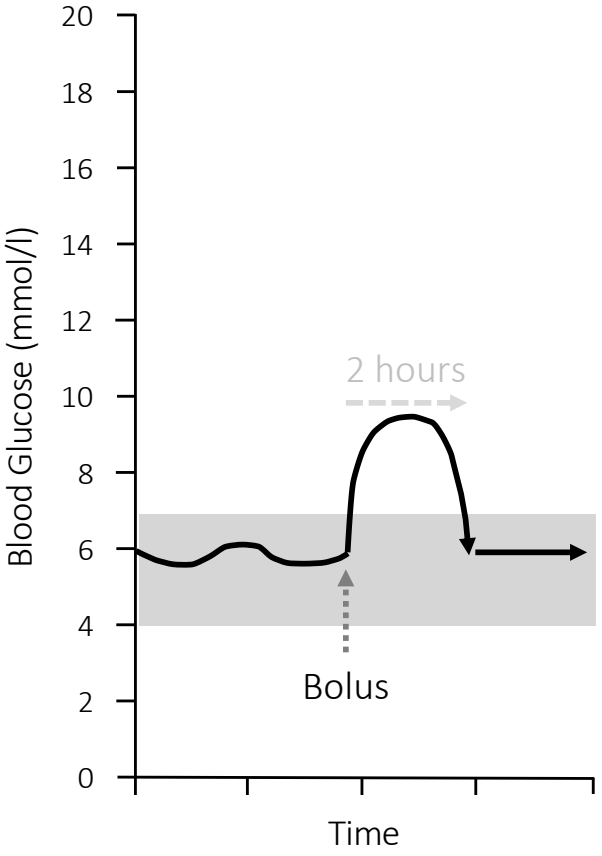


CSII Basal Rate Circadian Profile



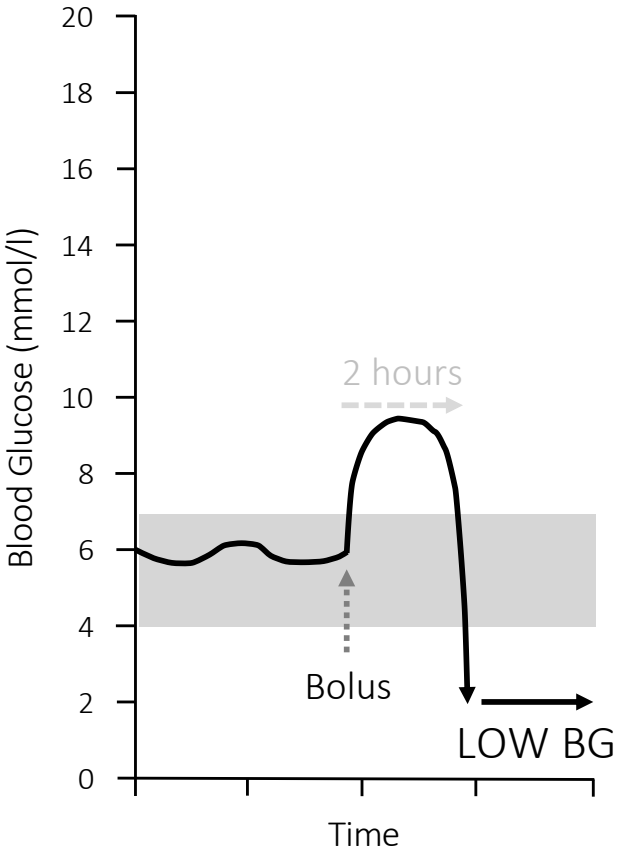
CSII: Carbohydrate Ratio

Bolus Appropriate



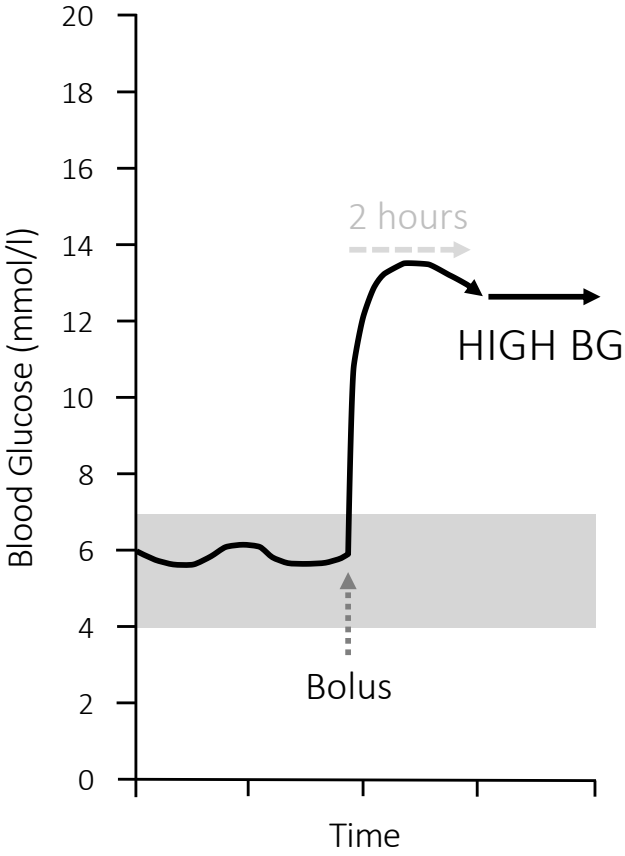
Post-prandial BG in target range
Bolus for Carbohydrate appropriate
Carb:Insulin Ratio **appropriate**

Bolus Too Large



Post-prandial BG below target range
Bolus for Carbohydrate too large
Carb:Insulin Ratio **too low**

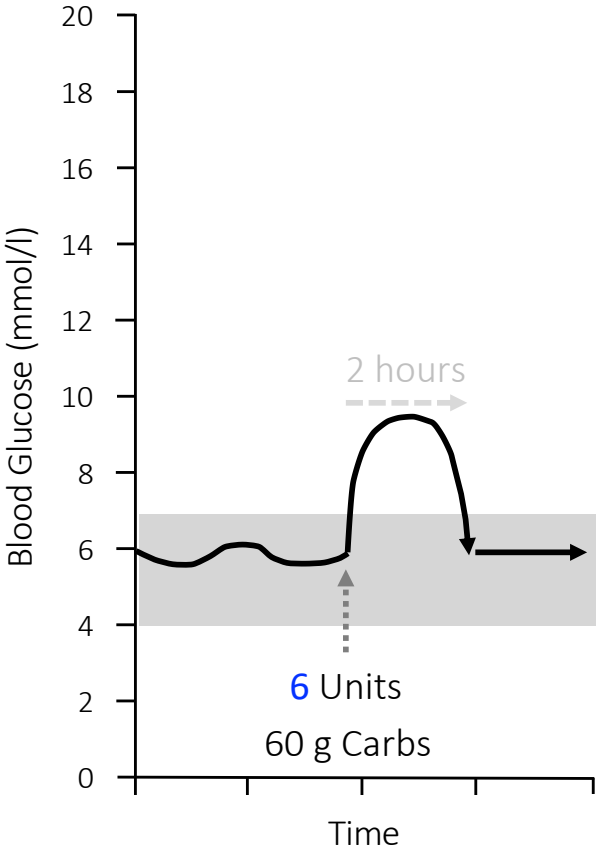
Bolus Too Small



Post-prandial BG above target range
Bolus for Carbohydrate too small
Carb:Insulin Ratio **too high**

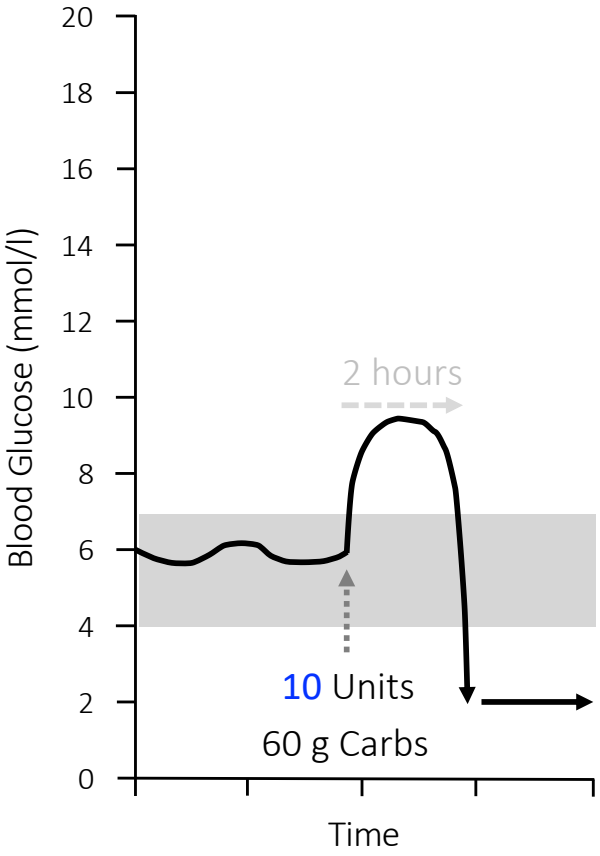
CSII: Carbohydrate Ratio

Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 6 units
Carb: Insulin Ratio: 10 g/U



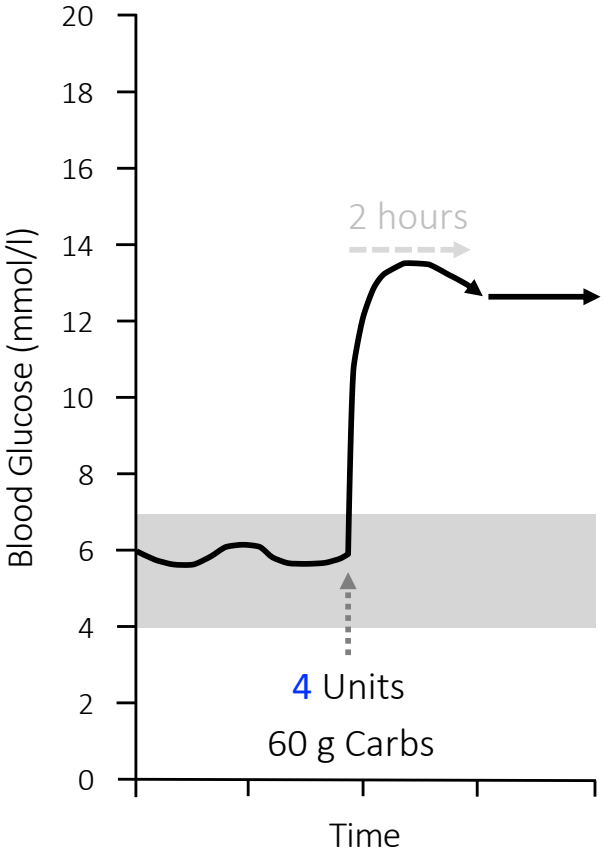
Post-prandial BG in target range
Bolus for Carbohydrate appropriate
Carb: Insulin Ratio **appropriate**

Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 10 units
Carb: Insulin Ratio: 6 g/U



Post-prandial BG below target range
Bolus for Carbohydrate too large
Carb: Insulin Ratio **too low**

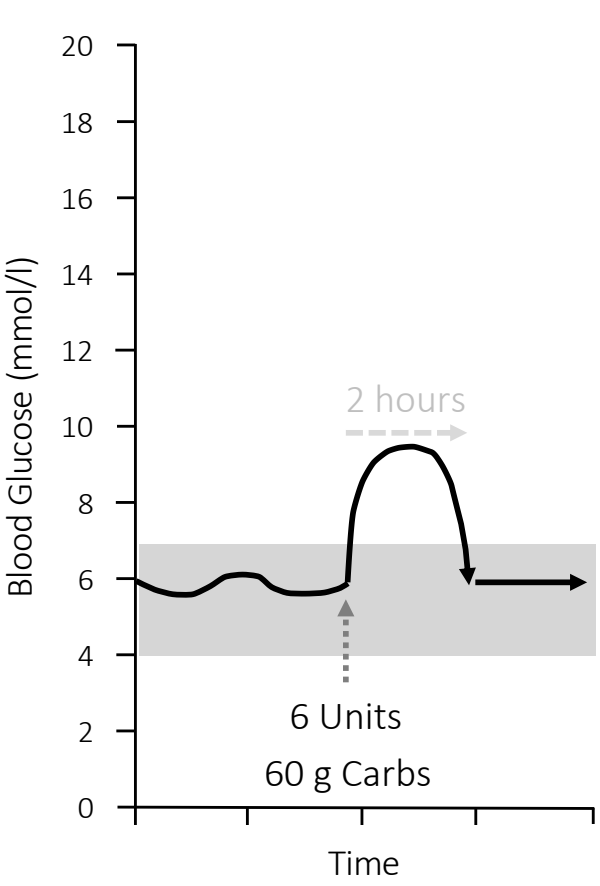
Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 4 units
Carb: Insulin Ratio: 15 g/U



Post-prandial BG above target range
Bolus for Carbohydrate too small
Carb: Insulin Ratio **too high**

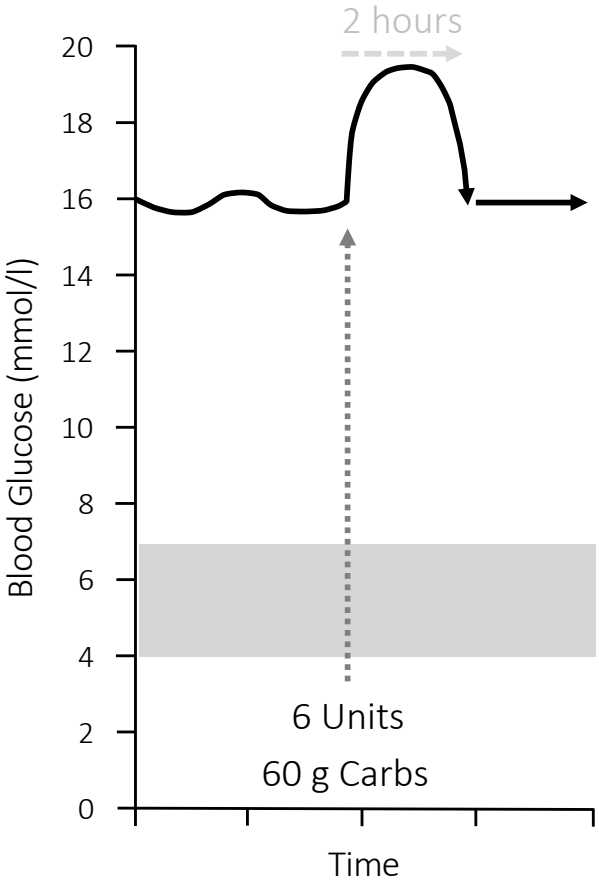
CSII: Insulin Sensitivity & Correction

Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 6 units
Carb: Insulin Ratio: 10 g/U



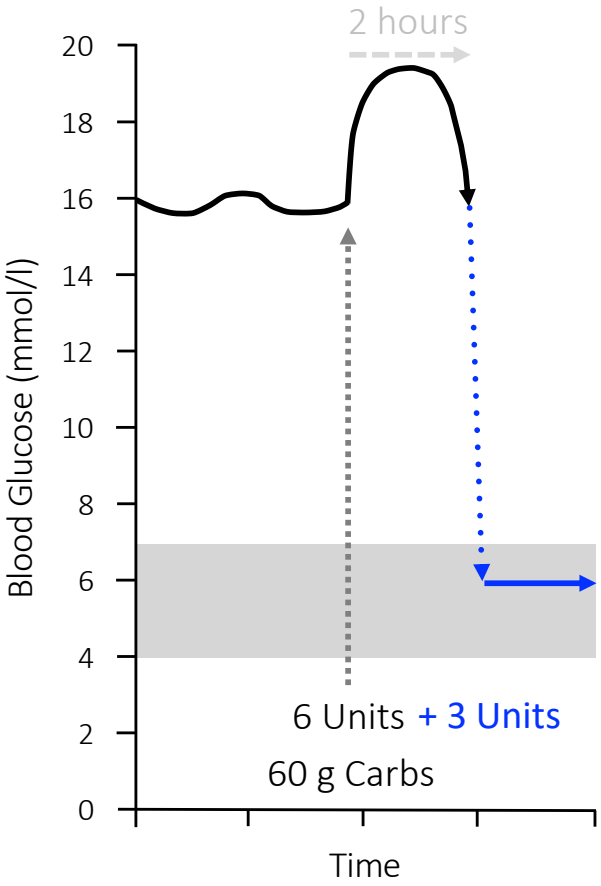
Bolus for Carbohydrate appropriate
Post-prandial BG in target range
No Correction Dose needed

Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 6 units
Carb: Insulin Ratio: 10 g/U



Bolus for Carbohydrate appropriate
Post-prandial BG HIGH
Correction Dose needed

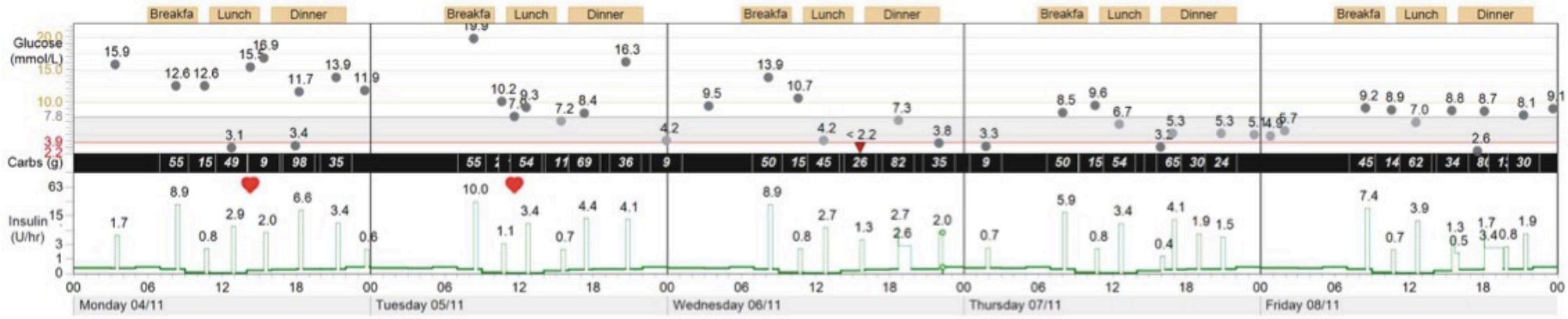
Carbohydrate eaten: 60 grams
Insulin Carbs Bolus: 6 units
Carb: Insulin Ratio: 10 g/U
+ Insulin Correction Bolus: 3 units

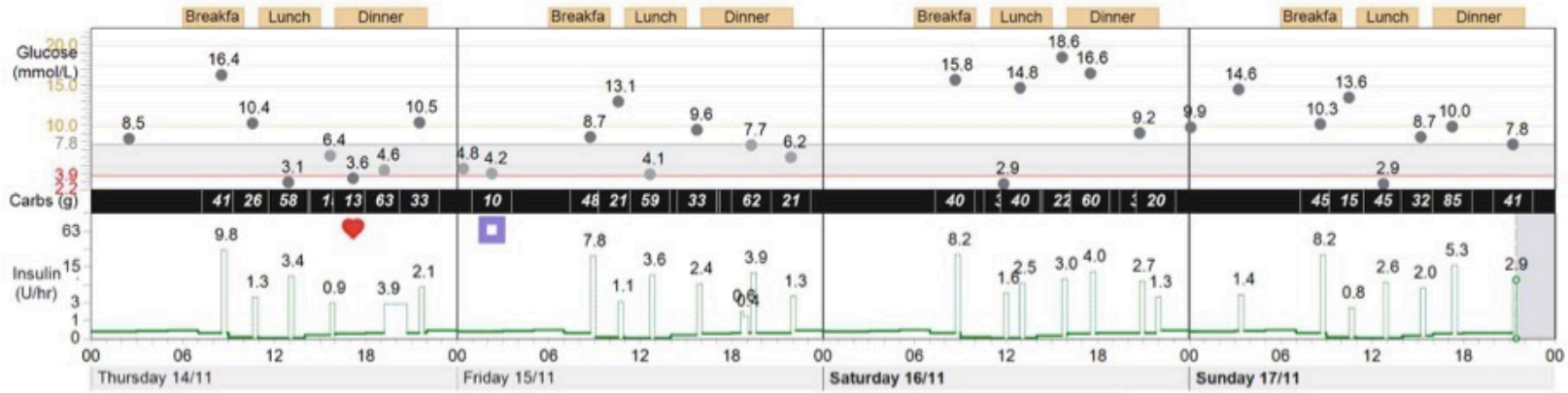


Bolus for Carbohydrate appropriate
Post-prandial BG HIGH
Correction Dose returns BG to Target

Insulin Pump data uploads

AF 14y M





What can you learn from this Pump data upload?

AF 14y M

BG rises steadily overnight ➤ Basal rate too low ➤ ↑ Basal Rate

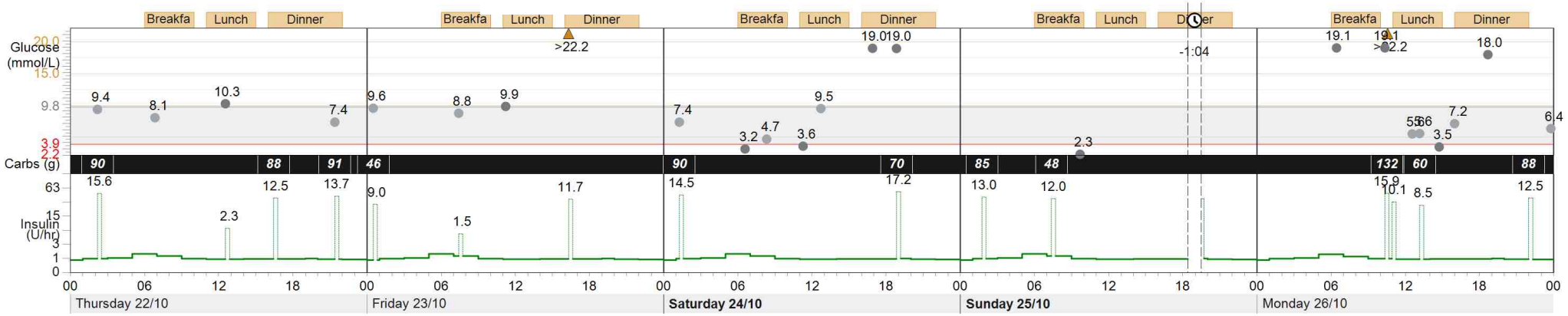
AF 14y M

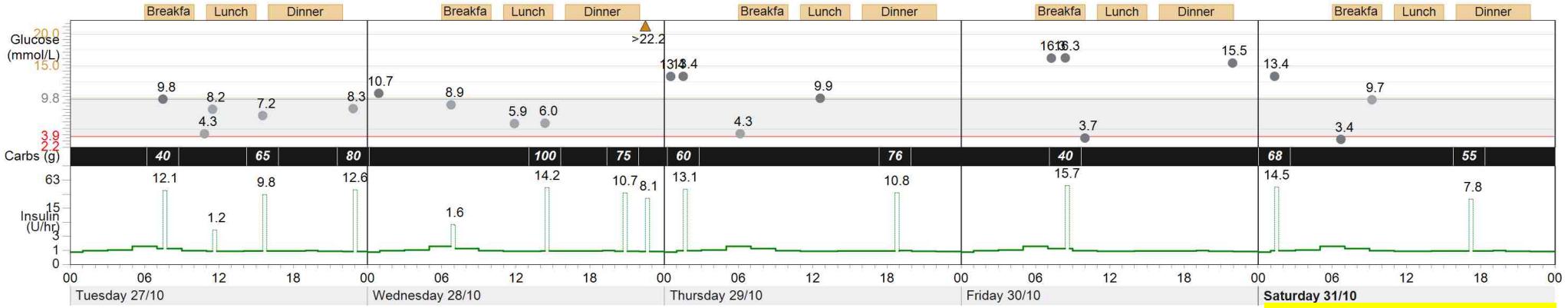
a.m. BG falls (to Hypo): ?↑CR ?↑IS ➤ When BG on Target *CR OK* ➤ ∴ ↑ IS

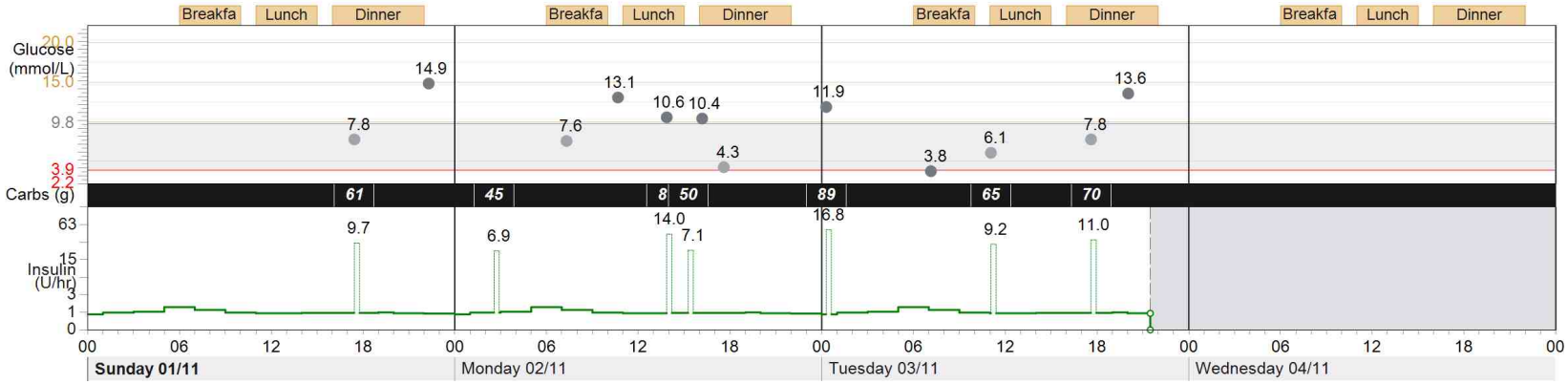
AF 14y M

p.m. “On Target” BG falls > 2 mmol/l ➤ CR too low ➤ ↑ CR

FC 15.8y F

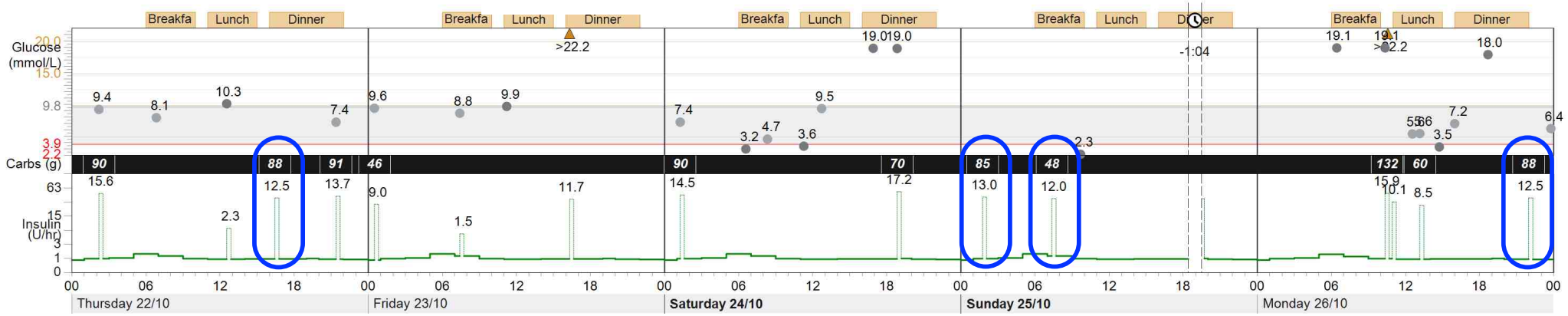


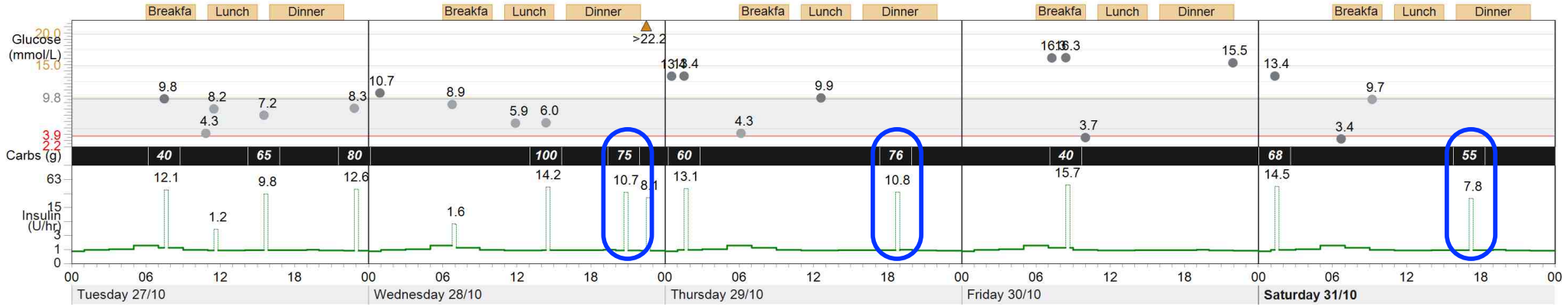


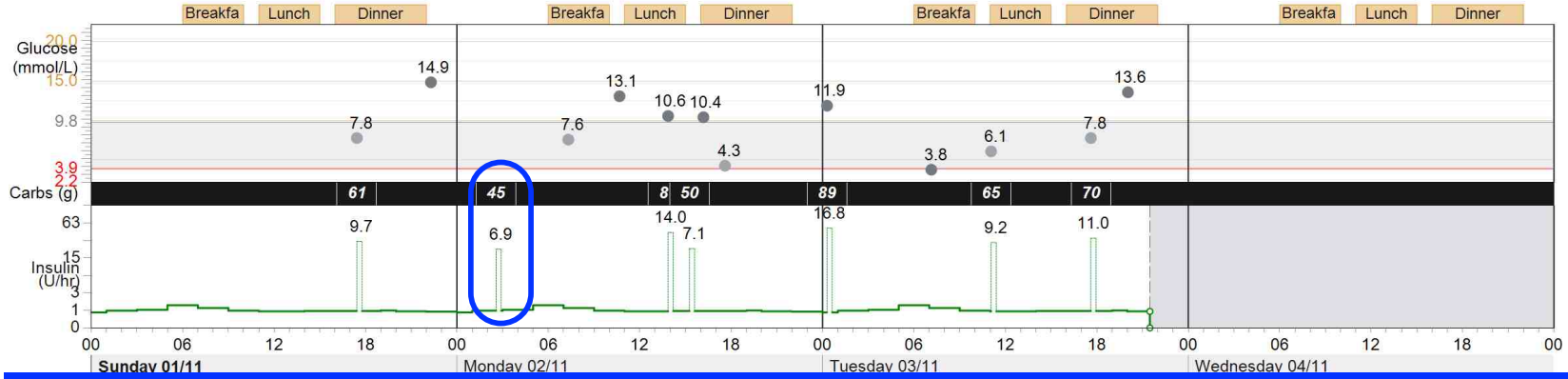


What can you learn from this Pump data upload?

FC 15.8y F

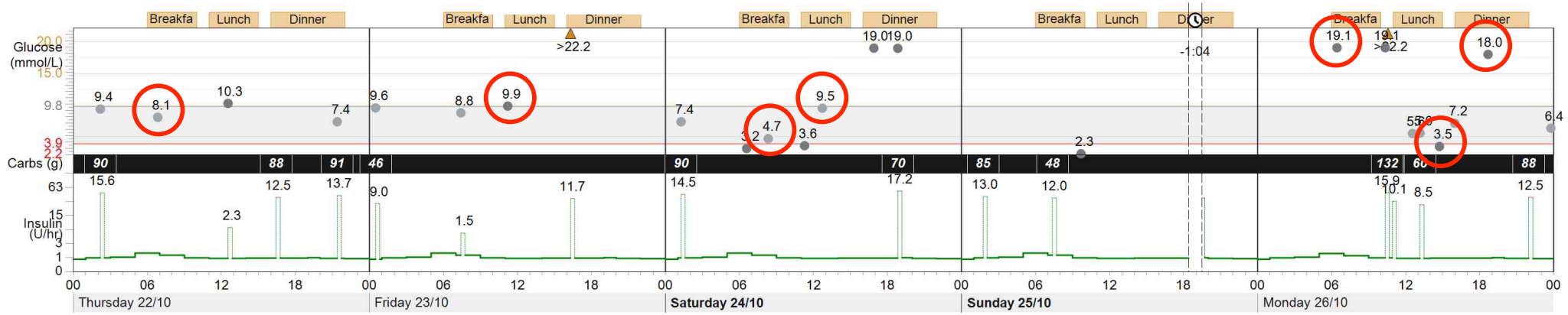


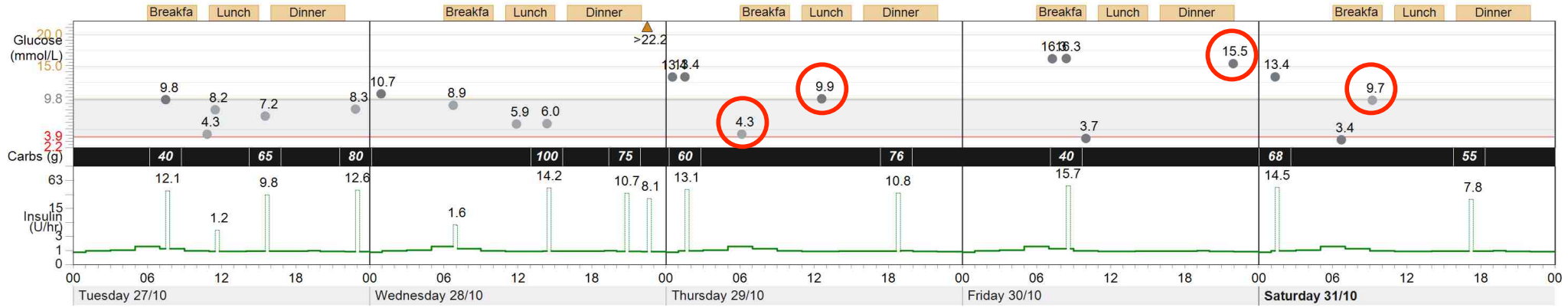




No BG Result checked (Pump unable to deliver Correction Dose)

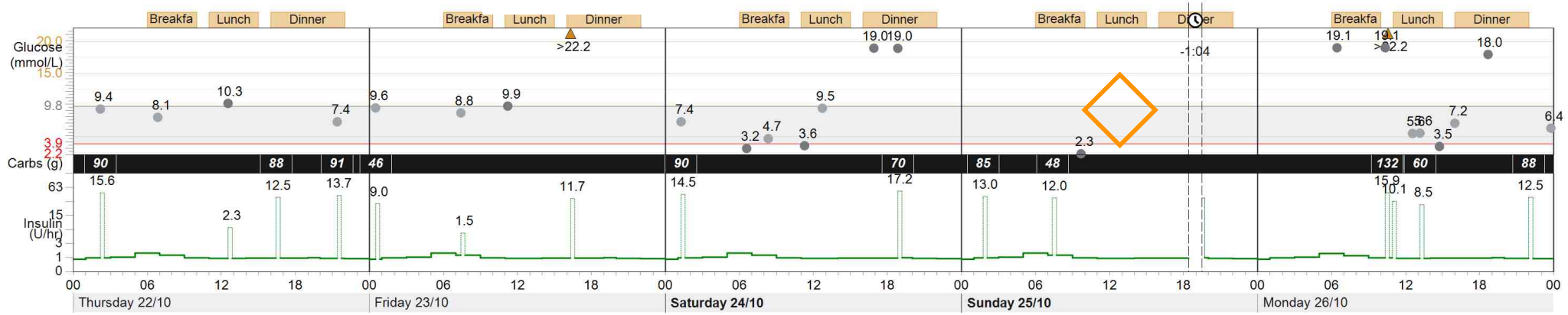
FC 15.8y F

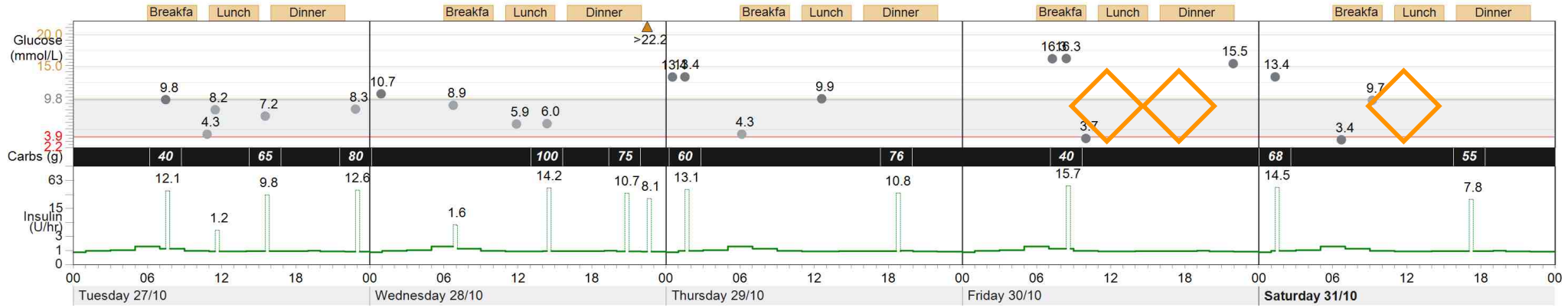


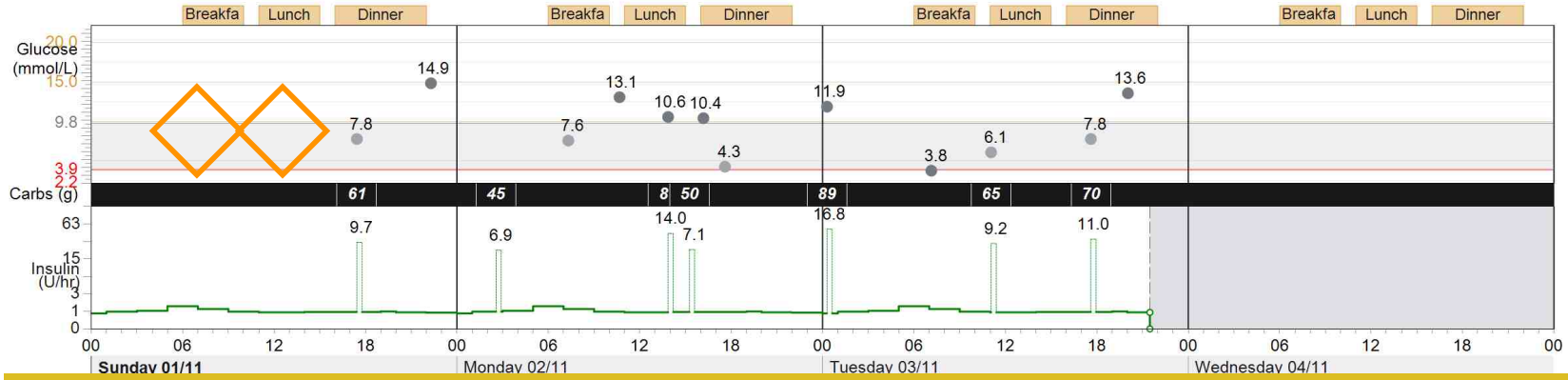


No Bolus given (Pump not delivering *any* Bolus Dose)

FC 15.8y F

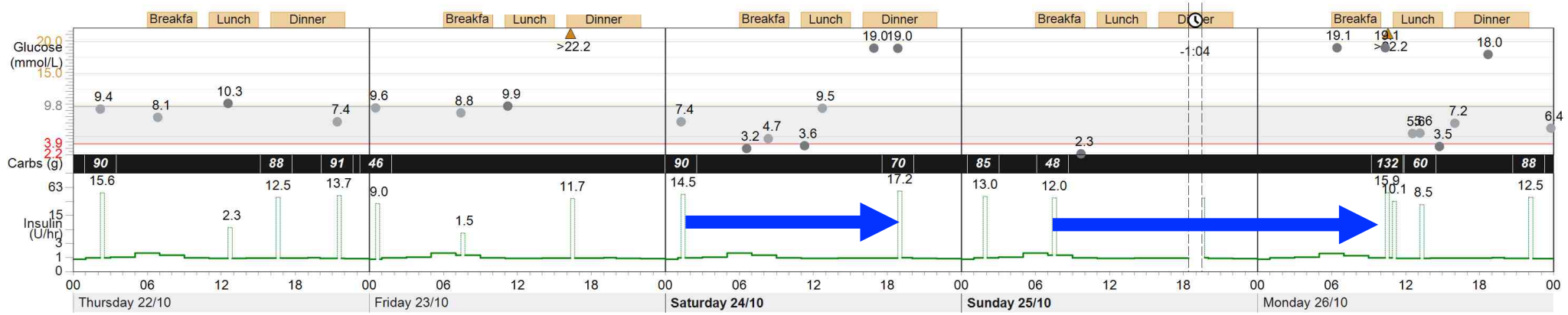


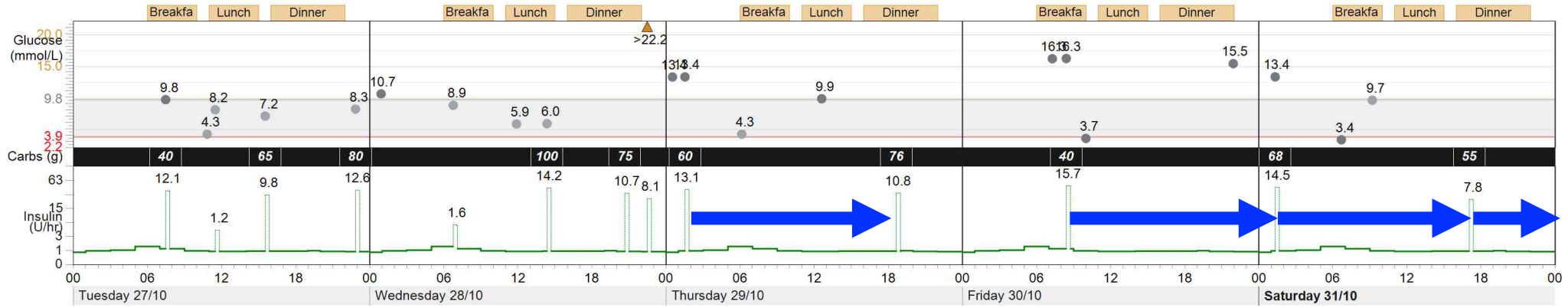


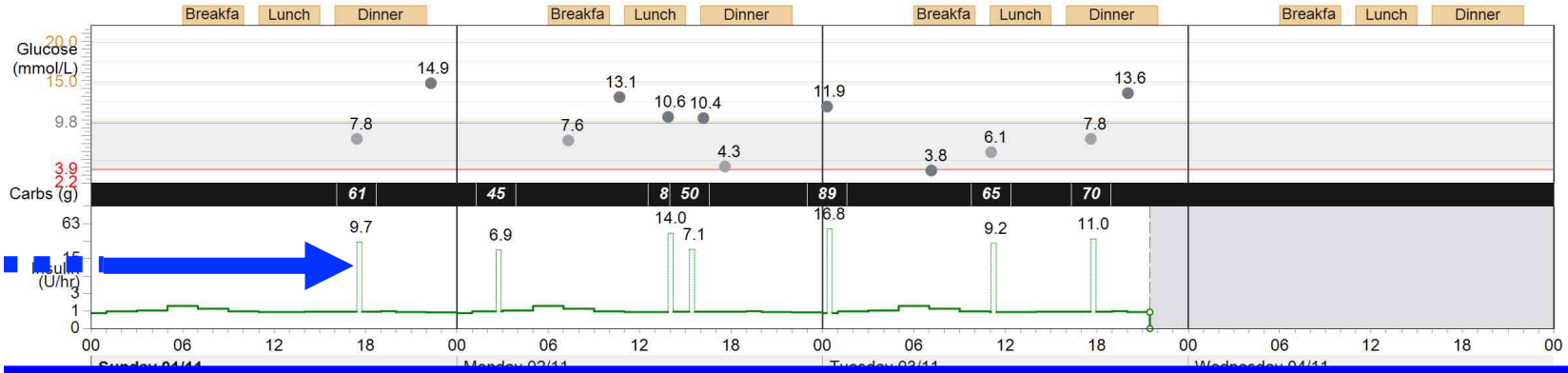


No BG result checked *nor* Bolus Given (Pump not delivering *any* Bolus Dose)

FC 15.8y F

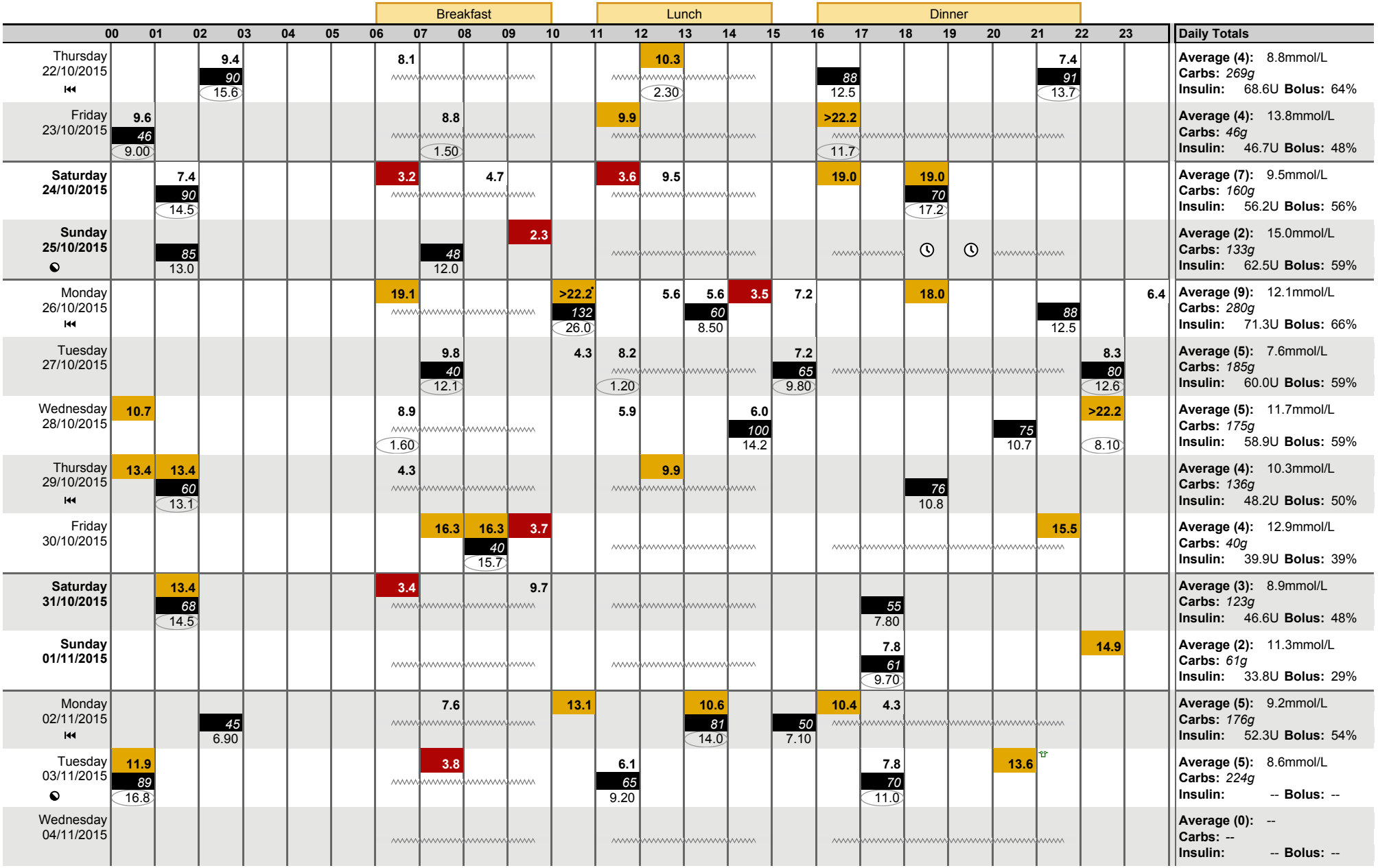




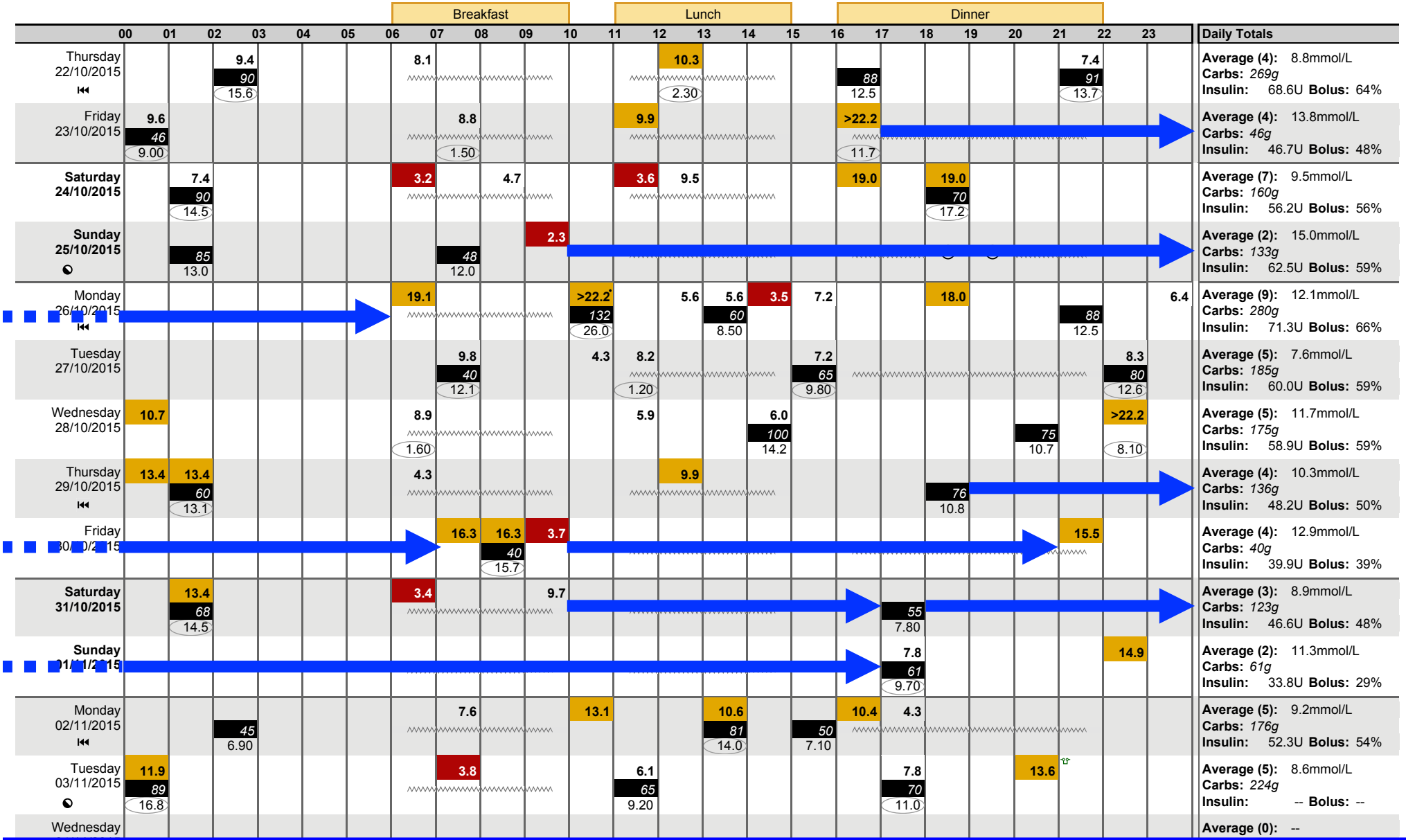


Long Periods with No Bolus Given (with risk of Ketosis/ Ketoacidosis)

FC 15.8y F


Breakfast
Lunch
Dinner
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Daily Totals
Thursday 22/10/2015
9.4 90 15.6
8.1
10.3 2.30
88 12.5
7.4 91 13.7
Average (4): 8.8mmol/L
Carbs: 269g
Insulin: 68.6U Bolus: 64%
Friday 23/10/2015
9.6 46 9.00
8.8 1.50
9.9
>22.2 11.7
Average (4): 13.8mmol/L
Carbs: 46g
Insulin: 46.7U Bolus: 48%
Saturday 24/10/2015
7.4 90 14.5
3.2
4.7
3.6
9.5
19.0
19.0 70 17.2
Average (7): 9.5mmol/L
Carbs: 160g
Insulin: 56.2U Bolus: 56%
Sunday 25/10/2015
2.3
85 13.0
48 12.0
Average (2): 15.0mmol/L
Carbs: 133g
Insulin: 62.5U Bolus: 59%
Monday 26/10/2015
19.1
>22.2 132 26.0
5.6
5.6 60 8.50
3.5
7.2
18.0
6.4
88 12.5
Average (9): 12.1mmol/L
Carbs: 280g
Insulin: 71.3U Bolus: 66%
Tuesday 27/10/2015
9.8 40 12.1
4.3
8.2 1.20
7.2 65 9.80
8.3 80 12.6
Average (5): 7.6mmol/L
Carbs: 185g
Insulin: 60.0U Bolus: 59%
Wednesday 28/10/2015
10.7
8.9 1.60
5.9
6.0 100 14.2
75 10.7
>22.2 8.10
Average (5): 11.7mmol/L
Carbs: 175g
Insulin: 58.9U Bolus: 59%
Thursday 29/10/2015
13.4
13.4 60 13.1
4.3
9.9
76 10.8
Average (4): 10.3mmol/L
Carbs: 136g
Insulin: 48.2U Bolus: 50%
Friday 30/10/2015
16.3
16.3 40 15.7
3.7
15.5
Average (4): 12.9mmol/L
Carbs: 40g
Insulin: 39.9U Bolus: 39%
Saturday 31/10/2015
13.4 68 14.5
3.4
9.7
55 7.80
Average (3): 8.9mmol/L
Carbs: 123g
Insulin: 46.6U Bolus: 48%
Sunday 01/11/2015
7.8 61 9.70
14.9
Average (2): 11.3mmol/L
Carbs: 61g
Insulin: 33.8U Bolus: 29%
Monday 02/11/2015
45 6.90
7.6
13.1
10.6 81 14.0
50 7.10
10.4
4.3
Average (5): 9.2mmol/L
Carbs: 176g
Insulin: 52.3U Bolus: 54%
Tuesday 03/11/2015
11.9 89 16.8
3.8
6.1 65 9.20
7.8 70 11.0
13.6
Average (5): 8.6mmol/L
Carbs: 224g
Insulin: -- Bolus: --
Wednesday 04/11/2015
Average (0): --
Carbs: --
Insulin: -- Bolus: --
> 9.8mmol/L
00 Multiple readings (most extreme shown)
Suspend
Exercise
Partial day
Time change

FC 15.8y F



Long Periods with No Bolus Given (with risk of Ketosis/ Ketoacidosis)

FC 15.8y F

	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)
Thursday 22/10/2015	4			4	3	3		1	1				
Friday 23/10/2015	4			3	1	3							
Saturday 24/10/2015	7			2	2	2							
Sunday 25/10/2015	2			3	2	1							
Monday 26/10/2015	9			4	4	1		1	1				
Tuesday 27/10/2015	5			4	3	4							
Wednesday 28/10/2015	5			4	2	2							
Thursday 29/10/2015	4			2	2	1		1	1	0.3	1	3.4	
Friday 30/10/2015	4			1	1	1							
Saturday 31/10/2015	3			2	2	1							
Sunday 01/11/2015	2			1	1	1							
Monday 02/11/2015	5			3	3	1		1	1	0.3			
Tuesday 03/11/2015	5			3	3	2							22:22
Wednesday 04/11/2015	--	--	--	--	--	--	--	--	--	--	--	--	--
Summary	4.7/day	0m	0.0/day	2.7/day	80.6%	63.9%	0.0%	4	4	0.3U /fill	3	2.1U/fill	0m

"Rewind" required when refilling Insulin reservoir (i.e. when inserting new cannula).

FC 15.8y F

	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)
Thursday 22/10/2015	4							1	1	0.3	1	2.1	
Friday 23/10/2015	4												
Saturday 24/10/2015	7												
Sunday 25/10/2015	2												
Monday 26/10/2015	9							1	1	0.3	1	0.9	
Tuesday 27/10/2015	5			4	3	4							
Wednesday 28/10/2015	5			4	2	2							
Thursday 29/10/2015	4			2	2	1		1	1	0.3	1	3.4	
Friday 30/10/2015	4			1	1	1							
Saturday 31/10/2015	3			2	2	1							
Sunday 01/11/2015	2			1	1	1							
Monday 02/11/2015	5			3	3	1		1	1	0.3			
Tuesday 03/11/2015	5			3	3	2							22:22
Wednesday 04/11/2015	--	--	--	--	--	--	--	--	--	--	--	--	--

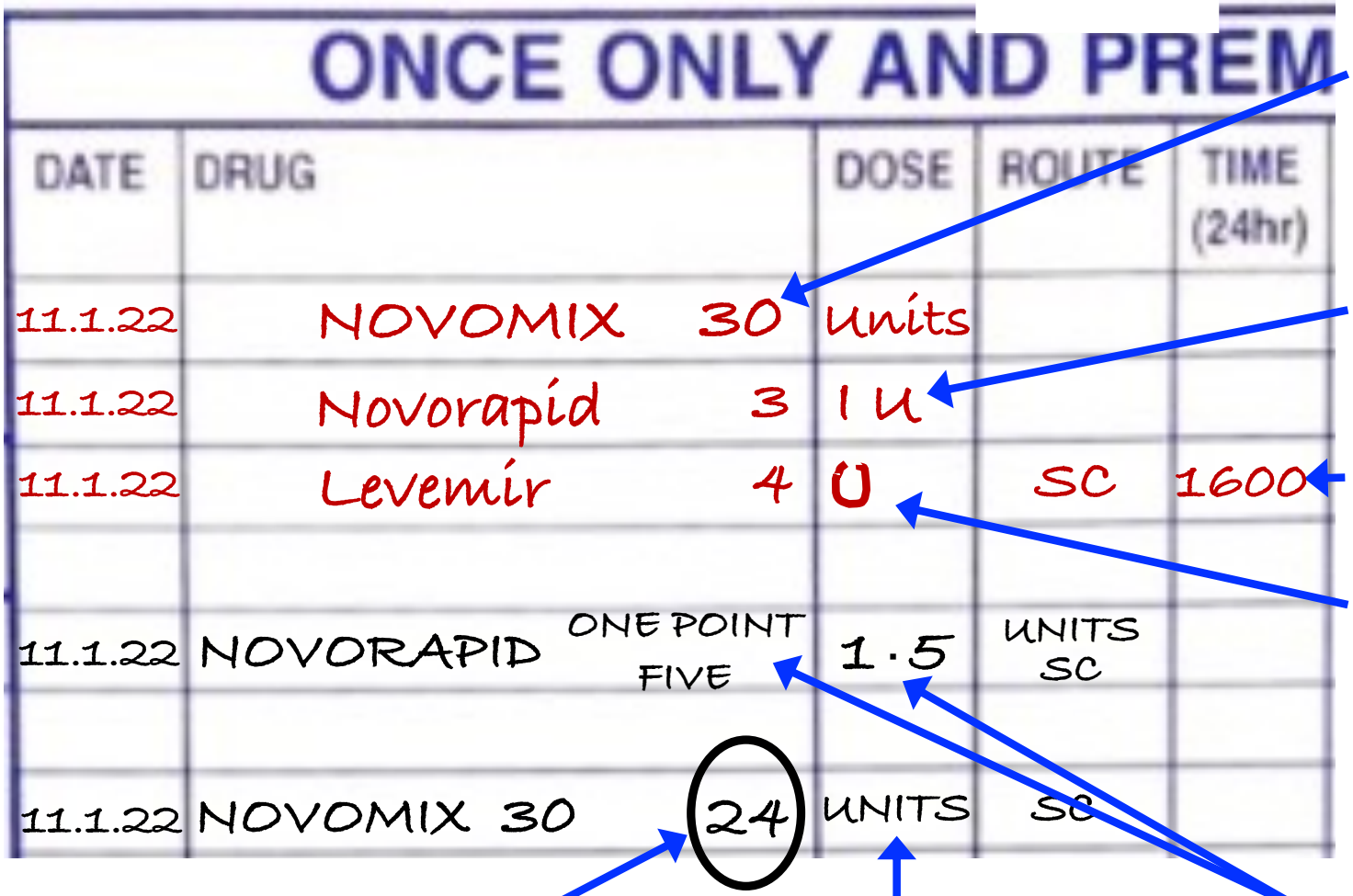
Cannula should be changed no later than *every 3 days* to prevent occlusion and possible ketosis…

1
2
3
4

Consider changing cannula every 2 Days (and no later than every 72 hours…)

Paediatric Insulin Prescribing

Perilous Paediatric Prescribing



ONCE ONLY AND PREM

DATE	DRUG		DOSE	ROUTE	TIME (24hr)
11.1.22	NOVOMIX	30	units		
11.1.22	Novorapid	3	1 U		
11.1.22	Levemir	4	U	SC	1600
11.1.22	NOVORAPID	ONE POINT FIVE	1·5	UNITS SC	
11.1.22	NOVOMIX 30	24	UNITS	SC	

Novomix 30, etc. is an Insulin **Type** *NOT* a **Dose**!

3 International Units or 31 Units?

Use 24 hour clock

4 or 40 Units?

Consider circling dose to separate from Insulin type.

Always write "UNITS" in full; *never* abbreviate

Write Decimalised Doses in **Both** Words **&** Numbers

Proper paediatric prescribing

- if you have not prescribed insulin before always check doses
- always check dosing with another if
  - administering SC insulin
  - preparing IV infusion fluid
- be pedantic with your prescribing
  - use care and deliberation with numbers
  - always write “UNITS”; never “U” or “IU”
  - for small doses use numbers and LETTERS
    - 1.5 (ONE POINT FIVE) UNITS
  - Mixtard 30 or Humalog Mix 25 are types of insulin, not doses!

Intravenous Insulin Infusions

Insulin infusion indications

- Treat ketosis/ketoacidosis - *insulin deficient*
  - insulin infusion rate - *fixed* rate infusion
  - glucose concentration - variable
- Prevent ketosis/ketoacidosis - *not insulin deficient*
  - insulin infusion rate - *variable* rate infusion (sliding scale)
  - glucose concentration - constant
  - e.g. real or potential CHO deficit - fasting/anorexic
    - vomiting illness
    - surgery
    - resolved DKA

Treat ketosis: fixed rate infusion

- Treat/stop existing ketosis
  - Patient - INSULIN DEFICIENT
  - Usually 0.1 U/kg/hr
  - Continues irrespective of blood glucose
  - DO NOT stop or reduce insulin if ketotic!!
  - IF BG's fall while ketotic give more glucose!
- NaCl 0.45% Dextrose 10%
  - 500 ml bag Dextrose 10%
  - 7.5 ml NaCl 30% (10 ml amp)
    KCl as required

Prevent ketosis: variable rate inf.

- Prevent ketosis & maintain normoglycaemia
  - Patient - NOT insulin deficient
    - NOT ketotic! (or only minimally)
  - Insulin adjusted according to current BG
  - Usually matched to maintenance IV fluids
  - NaCl 0.45% / Dext 5%
- A sliding scale is just a prescription (not set in stone!)
  - Adjust according to results (e.g. persistent low BG)
  - If hypo Continue insulin & increase infused Dext.

VRI insulin doses using TDD

- Established patient TDD: 1 unit per kg per day
- Other patients' TDD:
  - Remission phase ("honeymoon"): < 1 unit per kg per day
  - Infant/small child: < 1 unit per kg per day
  - Pubertal/adolescent: > 1 unit per kg per day

Calculating a “Sliding Scale”

Variable Rate Infusion (VRI) = “Sliding Scale”

- TDD = 1 unit per kg per day
  = (1÷24) unit per kg per hour
  = 0.04 unit per kg per hour
  = hourly insulin maintenance rate
- VRI mid-point of should deliver 0.04 units/kg/hour
- IV Dextrose given at maintenance fluid rate (“4,2,1” rule)
- Start with NaCl 0.45% & Dextrose 5% ± KCl
- *May need to increase concentration of infused Dextrose*

Sliding Scale *No. 1* (1 U/ml solution)

- Patient: 30 kg body weight

  28 units of insulin injected daily (~ 1 unit/kg/day)

If Glucose	Infuse solution at	Equivalent to
mmol/l	ml/hr	Units/kg/hr
> 22	3.0	0.1
14 - 22	2.1	0.07
8 - 13.9	1.2	0.04
4 - 7.9	0.6	0.02
< 4	0.3	0.01

↓

& increase concentration of infused dextrose

Sliding Scale *No. 2* (1 U/ml solution)

- Patient: 50 kg body weight:

  50 units of insulin injected daily (= 1 unit/kg/day)

If Glucose	Infuse solution at	Equivalent to
mmol/l	ml/hr	Units/kg/hr
> 22	5.0	0.1
14 - 22	3.5	0.07
8 - 13.9	2.0	0.04
4 - 7.9	1.0	0.02
< 4	0.5	0.01

↓

and increase concentration of infused dextrose

Sliding Scale *No. 3* (1 U/ml solution)

- Patient: 50 kg body weight: Remission Phase ("Honeymoon")

  25 units of insulin injected daily (= 0.5 unit/kg/day)

If Glucose	Infuse solution at	Equivalent to
mmol/l	ml/hr	Units/kg/hr x 0.5
> 22	~~5.0~~ 2.5	0.5 × 0.1 = 0.05
14 - 22	~~3.5~~ 1.8	0.5 × 0.07 = 0.035
8 - 13.9	~~2.0~~ 1.0	0.5 × 0.04 = 0.02
4 - 7.9	~~1.0~~ 0.5	0.5 × 0.02 = 0.01
< 4	~~0.5~~ 0.2	0.5 × 0.01 = 0.005

↓

and increase concentration of infused dextrose

Sliding Scale *No. 4* (1 U/ml solution)

- Patient: 50 kg body weight: Pubertal adolescent

  65 units of insulin injected daily (= 1.3 unit/kg/day)

If Glucose	Infuse solution at	Equivalent to
mmol/l	ml/hr	Units/kg/hr x 1.3
> 22	~~5.0~~ 6.5	1.3 × 0.1 = 0.13
14 - 22	~~3.5~~ 4.5	1.3 × 0.07 = 0.09
8 - 13.9	~~2.0~~ 2.5	1.3 × 0.04 = 0.05
4 - 7.9	~~1.0~~ 1.0	1.3 × 0.02 = 0.025
< 4	~~0.5~~ 0.5	1.3 × 0.01 = 0.013

↓

and increase concentration of infused dextrose

Making an insulin infusion 1

- 1 insulin syringe — 30U, 50U, 100U
- 1 luer-lock syringe — 50 ml
- 1 regular/soluble insulin — Actrapid OR Humulin S
  NOT Novorapid
- 1 bag 0.9% saline — 50 ml+

- *Never* use an ordinary syringe to draw up insulin
- Only use Actrapid OR Humulin S for infusion
- All UK insulin is U100 - 100 units per ml!

Making an insulin infusion 2

- Draw up 49.5 ml 0.9% saline into 50 ml syringe

- Draw up 50 units soluble insulin (Actrapid) into insulin syringe

- Add insulin to 50 ml syringe

This makes a 1 unit/ml solution of soluble insulin

More information

- www.ggc-youngdiabetes.org
- www.bsped.org
- www.childrenwithdiabetes.com
- https://www.ispad.org/page/ISPADGuidelines2018


Thank you!