

What to do if your results are too high or too low

The target range for your blood glucose results is from 4 to 8 mmol/l - aim to have four out of every five blood glucose results in this range. If three results in a row, at the same time of day, are *not* in the target range, then think about these:

1. **Food** - time of day, amount and type of food eaten
2. **Exercise** - time of day, amount of activity, and food taken before activity
3. **Injections** - time of day, times before meals, and if injection sites are healthy
4. **Illness** - see "Sick Day" guidelines

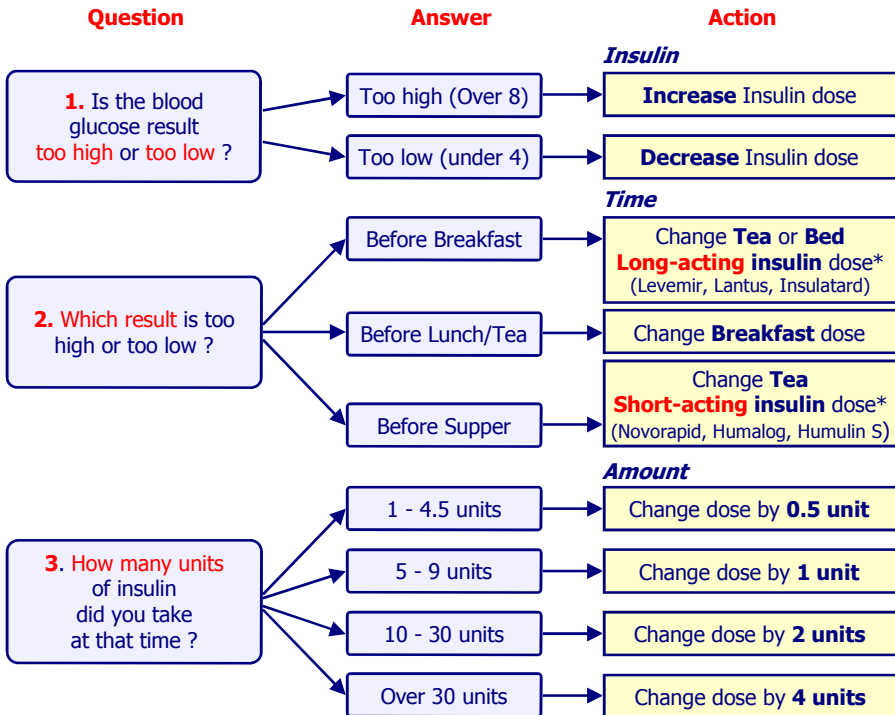
After making adjustments for food, exercise, injection sites, and illness, you then need to think about changing **how much insulin to take**. Below is a step-by-step guide on how to change your insulin doses safely. Remember, you may need to do this **up to twice a week** - make a change, and be prepared to make another change in three days.

How to adjust your insulin if taken two or three times daily

To change the insulin dose, you will need to know:

1. Whether to **increase or decrease** the insulin dose
2. **Which dose** of insulin to change
3. **How much** to change the insulin dose by

You can find the answers by asking the following three questions:



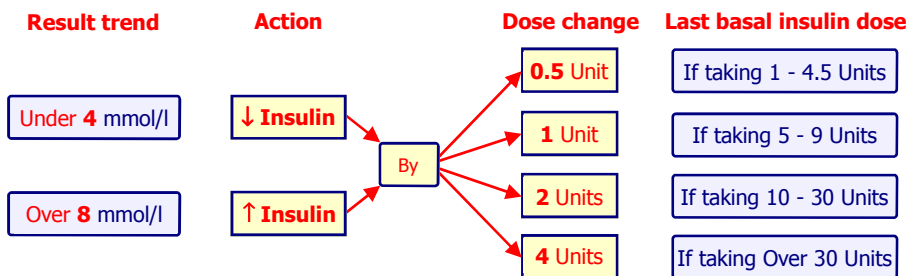
* Or tea-time Humalog Mix 25 or 50, or Humulin M3 if on twice daily mixed insulin

Example: If on 20 units of Levemir before tea, three high breakfast results suggests we should increase the tea-time Levemir dose by 2 units, up to 22 units. First, make sure diet, exercise, injection sites, and illness are not reasons for the high result.

Adjusting Basal-Bolus insulin doses - easy as "BBC"!

1. Basal insulin dose for long-term, background effect

Basal insulin (Lantus or Levemir) doses are adjusted by looking at the trend of before-meal blood glucose results every three days or so:



If blood glucose results are HIGH just before a once daily basal insulin is taken, simply increasing the dose may not help. A second basal insulin dose might be needed.

2. Bolus insulin dose for carbohydrate at meals

Use the "Insulin:Carbohydrate Ratio" to work out bolus doses for food. Remember:

- A "correct" bolus dose should cause a blood glucose result taken 90 minutes after insulin injection and food to return to the same value (usually within 2 or 3 mmol/l) as just before eating.
- Divide "correct" insulin dose by the number of carbohydrate "exchanges" eaten to calculate "Insulin:Carbohydrate Ratio" (ICR) - Units per 10 g carbohydrate.
- Different meals may need different ICR's (e.g. breakfast ICR is often higher).
- ICR may need to be reduced for larger meals (e.g. more than 50g carbohydrate).
- Fatty meals slow food absorption, so consider giving bolus insulin *after* food.
- Exercise before or after a meal may need meal-time bolus insulin to be reduced.

3. Correction boluses for high blood glucose results

The "100 Rule" (Page I 21) recommends how much insulin is needed to return a high blood glucose to the target range of 4-8 mmol/l. It suggests how responsive blood glucose results are to a single unit of insulin - the "Insulin Sensitivity". An insulin "Correction dose" can be estimated by dividing the required fall in blood glucose by the Insulin Sensitivity (IS).

IS: $100 \div \text{Total Daily Dose (TDD)} = \text{fall in blood glucose due to 1 unit of insulin}$
Divide required fall in blood glucose by Insulin Sensitivity to give Correction Dose

A correction dose is always given *as well as* any insulin required for the meal (worked out using an ICR); either combined or as a separate injection.

Correction doses are helpful, but it is always better to *prevent* high blood glucose results than to treat them once they have happened. If three or more correction doses are needed at the same time of day, *basal insulin dose* should probably be increased to prevent high before-meal results and reduces the need for correction.

When urine ketones are moderate or large, or blood ketones are 1 mmol/l or higher Sick Day Rules should be used (Page G 07) instead of using a correction dose.

Calculating correction doses using "Insulin Sensitivity"

Correction Dose Calculation Table

It is usually not too difficult to work out a correction dose - just divide the fall in blood glucose needed by the Insulin Sensitivity. However, to make it easier to find a correction dose, or simply to use as a "double check" of your own calculation, the following table gives suggested correction doses for a range of Total Daily Doses and current blood glucose results. Just use the following instructions:

1. Measure blood glucose and use **Sick Day Rules** (Page G 07) if over 14 mmol/l.
2. If no, trace or small ketones only present, find blood glucose result in "Current Blood Glucose" columns.
3. Work out insulin "Total Daily Dose" (TDD) by adding all insulin taken in one day (including rapid-acting, slow-acting and mixed insulins), and find TDD listed in the column on the far-left of the table.
4. The point where the "Current Blood Glucose" column meets the "Total Daily Dose" row gives the **Correction Dose**, usually taken as rapid-acting insulin analogue (Humalog or Novorapid).
5. Add **Correction Dose** to any regular dose of rapid-acting insulin analogue due to be given (such as at meal-time), or simply give as a separate dose at other times.
6. Do not use a correction dose within 4 hours of another dose of rapid-acting analogue insulin. Correction doses may be given overnight if necessary.
7. Always discuss **Correction Doses** with the **Diabetes Team** before first using them.

TDD	IS	Current Blood Glucose											
		10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32+
10-11	10	-	-	-	-	1	1	1	1.5	1.5	2	2	2
12-13	8	-	-	-	-	1	1	1.5	1.5	2	2	2	2.5
14-15	7	-	-	-	-	1	1	1.5	1.5	2	2	2.5	2.5
16-19	6	-	-	-	1	1.5	1.5	2	2.5	2.5	3	3.5	3.5
20-24	5	-	-	1	1.5	2	2	2.5	3	3.5	4	4	4.5
25-29	4	-	1	1.5	2	2.5	3	3.5	4	4.5	5	5	6
30-39	3	-	1	1.5	2	3	3.5	4	4.5	5	6	6	7
40-49	2.5	-	1.5	2	3	4	4	5	6	7	8	8	9
50-59	2	1	2	3	4	5	6	7	8	9	10	11	12
60-69	1.7	1	2	4	5	6	7	8	9	10	12	13	14
70-79	1.4	1	3	4	5	7	8	9	11	12	14	15	16
80-89	1.3	2	3	5	6	8	9	11	12	14	16	17	19
90-99	1.1	2	4	5	7	9	10	12	14	16	18	19	21
100+	1	2	4	6	8	10	12	14	16	18	20	22	24

e.g. If blood glucose currently 18 mmol/l and Total Daily Dose 50 units, the Correction Dose would be 5 units of insulin. This dose of Humalog or Novorapid would either be taken separately or added to any meal-time dose of rapid-acting insulin due to be taken.

Remember that the 100 Rule is a guide only, and caution should be used when a large correction dose is suggested. A smaller dose at first might be better. Giving three or more correction doses at the same time (such as before breakfast) in a single week suggests an increase in regular doses is needed (e.g. more evening Levemir).

If moderate or large ketones are present use Sick Day Rules (Page G 07) instead.

¹The "100 Rule" is based on work by Dr. Paul Davidson, Director, Diabetes Treatment Center, Atlanta, Ga, USA.

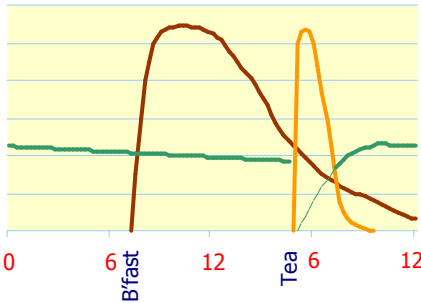
Different patterns of insulin action

Some insulins work quickly and last for only a short time, while others act slowly and last a long time. Some are mixtures of fast and slow-acting insulins. Examples of different types and brands of insulin are shown below:

- Fast-acting soluble: Actrapid or Humulin S
- Rapid-acting analogue: Apidra, Humalog or Novorapid (all *very* fast!)
- Intermediate-acting: Humulin I or Insulatard
- Slow-acting analogue: Lantus or Levemir
- Mixed: Humalog Mix 25 (25% rapid-acting analogue & 75% intermediate)
Humalog Mix 50 (50% rapid-acting analogue & 50% intermediate)
Humulin M3 (30% fast-acting soluble & 70% intermediate)
Novomix 30 (30% rapid-acting analogue & 70% intermediate*)

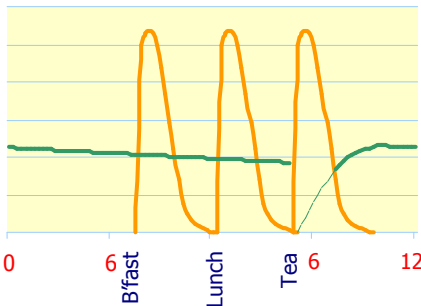
Note: “Humalog” and “Humalog Mix (25 or 50)” are *very* different types of insulin!

* Actually “protaminated analogue insulin”; the effect is the same as that of intermediate insulin. More information on insulins can be found on Pages I 08-I 10.



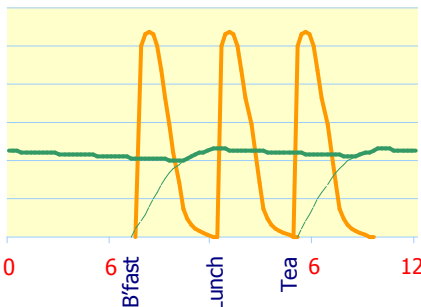
◀ Three daily injections

- Mixed insulin before breakfast
- Rapid-acting analogue insulin before tea
- Slow-acting analogue insulin before tea



◀ Four daily injections

- Rapid-acting analogue before breakfast
- Rapid-acting analogue insulin before lunch
- Rapid-acting analogue insulin before tea
- Slow-acting analogue insulin before tea



◀ Five daily injections

- Slow-acting analogue before breakfast
- Rapid-acting analogue before breakfast
- Rapid-acting analogue before lunch
- Rapid-acting analogue before tea
- Slow-acting analogue before tea

How to fill in blood glucose charts

	Mon	Tue	Wed
Date ▷	15/2	16/2	17/2

B	HM 25	12	12	12
B				
L				
T	Nov	3	3	3
T	Lev	6	6	6
S				

B	Over 8			
R	4 - 8	4.1	5.1	5.5
E	Under 4			

L	Over 8			
U	4 - 8	7.6	6.1	
N	Under 4			3.8

T	Over 8			
E	4 - 8	4.5	4.8	7.8
A	Under 4			

S	Over 8			
U	4 - 8	7.1	7.9	5.8
P	Under 4			

2 am

		7.5		
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Why writing results is right!

Blood glucose charts are **for you** to use! It is much easier to look at the pattern of blood glucose results when they are written down in front of you, rather than stored in your meter's memory.

Some meters have software for your home computer that set out your results on the screen, but whether you write them down by hand or use your home computer, you need to remember to:

1. **Test** your blood glucose at least twice a day - maybe more often.
2. **Record** results in the diary (or on computer) **every day!** It's easier to see the patterns of blood glucose that way, and you will be able to keep results "on target" more easily and more often.
3. **Think** about your results - if they are low or high, why might that be? Look at "What to do if your results are too high or too low" in the Guidelines section on page G 01 and G 02 of your Record.
4. **Act** on your results. By following the information on the "What to do if your results are too high or too low" page, you will be able to think about some of the most important factors that raise or lower blood glucose results, such as:

- Food
- Exercise
- Injection sites
- Illness
- Insulin

Don't just sit there - do something!

You will have to **take action** if you expect to see your results change - just testing, or even writing them down, is not enough. Only acting on the results will help.

Insulin three times a day - up, up in the day...

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	HumM3	12	12	12	14
B					
L					
T	Nov	3	3	3	2.5
T	Lev	6	6	6	6
S					

Here are results for someone taking insulin three times a day. If food, exercise, injection sites and illness have been thought about, then the insulin dose will probably need adjustment.

① Breakfast results are all in the target range of 4-8 mmol/l, showing the insulin dose that affects morning results is the right amount. Therefore, the teatime Levemir insulin dose of 6 units is appropriate.

② Lunchtime results are high (over 8 mmol/l), and so an increase to the insulin dose that affects lunch-time results is needed. Using our guidelines, the breakfast insulin dose should be increased by 2 units, from 12 to 14 units.

③ The breakfast dose of insulin affects both lunch *and* teatime results. Teatime results are also high, but the increase to the breakfast dose of insulin should also reduce these blood glucose results as well.

④ Finally, the supertime results need to be reviewed. Each of these results is low (less than 4 mmol/l), and so a reduction to the teatime *fast-*acting insulin dose (Novorapid) is needed. A dose of just 2.5 units should be given the following evening.

Remember: only change insulin dose *after* thinking about other factors such as:

- food intake
- exercise
- injection sites, and
- illness.

B	Over 8				
R	4 - 8	4.6	5.1	5.5	← ①
E	Under 4				
L	Over 8	16.3	12.1	17.9	← ②
U	4 - 8				
N	Under 4				
T	Over 8	13.3	14.4	9.8	← ③
E	4 - 8				
A	Under 4				
S	Over 8				
U	4 - 8				
P	Under 4	3.9	3.6	3.8	← ④

Insulin three times a day - which insulin works when?

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	HumM3	12	12	12	14
B					
L					
T	Nov	3	① 3	3	3
T	Lev	6	② 6	6	6
S					

B	Over 8				
R	4 - 8	4.6	5.1	5.5	
E	Under 4				

L	Over 8				
U	4 - 8	7.2	6.7		
N	Under 4			3.7	

T	Over 8				
E	4 - 8	4.5	4.8	7.8	
A	Under 4				

S	Over 8				
U	4 - 8	7.2	7.9	5.8	
P	Under 4				

Insulin usually acts on the blood glucose taken **before the next meal or snack**.

Knowing how long a certain insulin works is useful - this helps work out which insulin dose to change when trying to adjust a certain blood glucose result. This is very important if two insulins are taken at the same time.

A **mixed insulin** taken before breakfast changes the results before the next *two* meals - that is, before lunch *and* tea.

Humalog and **Novorapid** ① are very rapid-acting insulins. They start working shortly after their injection, and stop working only a few hours later. If taken before tea, Novorapid will have most effect on the **bedtime** (or “supper”) glucose result.

Longer-acting “basal” insulins, such as **Lantus** and **Levemir** ②, take time to start working, but then last for many hours. They are less likely to cause low blood glucose overnight than older insulins. Given at tea, they have most impact on **overnight and before breakfast blood glucose results** - the day *after* the injection was given.

Clear, “basal” insulins are often given before tea, along with the rapid-acting analogue insulins. Sometimes basal insulin will be given at bedtime instead - this will depend on blood glucose results the following day.

See pages I 08-I 10 for more information on the duration of action for different insulins.

Insulin three times a day - peaks at dawn and dusk

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	<i>HM 25</i>	18	18	18	18
B					
L					
T	<i>H'log</i>	6	6	6	7
T	<i>Lantus</i>	8	8	8	9
S					

① Here the breakfast results are always high. The before tea basal insulin (Lantus/Levemir) changes the breakfast result, and so this dose needs to increase - by 1 unit, to 9 units.

② & ③ show results at lunch and teatime. These are both in the target range of 4-8 mmol/l, and no change to the breakfast-time mixed insulin (Humalog Mix 25/Mixtard 30) is needed.

As results at supper ④ are high, teatime rapid-acting insulin dose (Humalog/Novorapid) should increase from 6 to 7 units.

When making an insulin dose change, we suggest increasing or decreasing the amount by about a tenth of the original dose. This is the basis for the insulin dose-changing guidelines on Page G 01:

- If on 1-4.5 units, increase or decrease dose by 0.5 unit.
- If on 5-9 units, increase or decrease dose by 1 unit.
- If on 10-30 units, increase or decrease dose by 2 units.
- If on more than 30 units, increase or decrease dose by 4 units.

This provides a safe but steady change to insulin doses. So, if taking 46 units at breakfast, the dose should be changed by a reasonable amount - 4 units. However, if just 7 units were given, only a 1 unit change is needed.

B	Over 8	10.8	12.2	10.3	← ①
R	4 - 8				
E	Under 4				
L	Over 8				
U	4 - 8	5.9	4.3		← ②
N	Under 4			3.9	
T	Over 8				
E	4 - 8	5.4	5.6	7.7	← ③
A	Under 4				
S	Over 8	12.4	14.5	14.1	← ④
U	4 - 8				
P	Under 4				

Insulin three times a day - feeling low all day

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	HM 25	48	48	48	44
B					
L					
T	Nov	16	16	16	14
T	Lev	22	22	22	20
S					

B	Over 8			
R	4 - 8		4.0	← ①
E	Under 4	3.5		3.6 2.4

L	Over 8	10.3	← ②	
U	4 - 8			
N	Under 4	③ →	2.1	3.7 3.0

T	Over 8			
E	4 - 8		5.1	4.1
A	Under 4	3.8		3.4 ← ④

S	Over 8			
U	4 - 8			
P	Under 4	3.7	3.5	3.6 ← ⑤

A blood glucose result less than 4 mmol/l is known as a “hypo”. **Treat** with fast-acting carbohydrate, test in 10 minutes, and either treat again if still low or take slow-acting carbohydrate if the result is over 4 mmol/l. **Prevent** these low results at breakfast ① by cutting the teatime basal insulin dose, from 22 down to 20 units.

Remember to eat a bed-time snack, and make sure no other reasons for an overnight hypo occur - such as staying up late the night before. An extra 10 grams carbohydrate is needed for every extra hour someone is awake past their usual bedtime.

Lunchtime results ② are high. An insulin dose increase might seem best, but by waiting three days before acting, and thinking about earlier results on this day and following days, we see that this high result probably follows treatment of the breakfast hypo of 3.5 mmol/l. Always deal with hypos first, preventing treatment or “rebound” highs.

③ These lunch time results are low. Instead of increasing the breakfast dose of insulin, as Monday’s result might have suggested, we actually need to *reduce* it. A 4 unit reduction is required, so the breakfast dose should be cut to 44 units.

④ These low tea-time results should also increase as the dose of breakfast insulin is reduced.

⑤ The suppertime lows should be dealt with by cutting teatime rapid-acting insulin (Novorapid) dose to 14 units.

Insulin three times a day - high by day, low by night

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	HumM3	12	12	12	
B					
L					
T	Nov	12	12	12	
T	Lev	3	3	3	
S					

Quite a few high results here! Before breakfast, this person's blood glucose results are nearly all high, except for those at supper.

①, ② & ③ Each result here is high - some *very* high. An increase to the teatime rapid- and slow-acting insulin doses is needed, but other problems might be causing these very high results.

Maybe the insulin has not been stored correctly, or the insulin pen is faulty, or the injection technique is faulty. Are there other reasons? Are all the injections being taken?

B	Over 8	26.0	23.4	31.1	← ①
R	4 - 8				
E	Under 4				

When trying to work out where a problem might be, it always helps for a parent or other adult to get involved and supervise the pens and injection technique used.

L	Over 8	HI	33.1	28.0	← ②
U	4 - 8				
N	Under 4				

If a blood glucose result is over 14 mmol/l, or if the person is feeling unwell, a urine or blood test for ketones is needed. Ketones occur when there is not enough insulin present for the body's needs, and can be very dangerous if present in large quantities (See page G 06 - 07 and Page I 25 - 27).

T	Over 8	27.9	25.5	27.4	← ③
E	4 - 8				
A	Under 4				

Remember, if such results continue for some time, there are health risks. If struggling with many high results, it is helpful to call the Diabetes Team. It is always better to deal with a possible problem early, rather than waiting until the problem has worsened.

S	Over 8				
U	4 - 8				
P	Under 4	3.9	3.6	2.8	← ④

④ Clearly these results are low. Perhaps too much insulin is being given at tea time to make up for the previous high results. To start with, the Novorapid dose should be cut to 10 units.

Insulin three times a day - why lunch testing is helpful

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	HM 50	36	36	36	← ①
B					HM 25
L					
T	H ^{log}	12	12	12	
T	Lantus	22	22	22	← ②
S					

B	Over 8				
R	4 - 8	7.8	5.1	6.7	5.5
E	Under 4				

L	Over 8				
U	4 - 8			6.4	← ⑤
N	Under 4	2.9	3.6	← ③	

T	Over 8	13.1	12.5	← ④	
E	4 - 8			6.8	← ⑥
A	Under 4				

S	Over 8				
U	4 - 8	6.2	7.5	6.0	4.2
P	Under 4				

This person is taking insulin three times a day - once before breakfast ① and twice before tea ②. However, even though they are only taking *one injection* at breakfast, they are actually having *two doses* of insulin - a mix of **fast-acting** and **slower-acting**, longer-lasting insulin.

Even if taking mixed insulin before breakfast (Humalog Mix 50 in this case), a blood glucose at lunch and tea is still useful as it gives information on *each part* of the mixed insulin. The lunch time result gives information on the fast-acting part, while a tea-time result gives information on the slower-acting part of the mixed insulin.

If the lunch-time blood glucose result differs a lot from the tea-time result, then this might mean the *mixture* itself, and not simply the dose, needs to change. Humalog Mix 50 is being used here, but the low results before lunch ③ and the higher results before tea ④ suggest less fast-acting and more slower-acting insulin would be useful.

Changing to Humalog Mix 25 (with only 25% fast-acting insulin, compared to Mix 50's 50%) should allow the blood glucose to rise before lunch ⑤. The greater proportion now given as slower-acting insulin (75% instead of just 50%) should deal better with the higher result before tea ⑥.

What apart from insulin dose affects blood glucose?

	Mon	Tue	Wed
Date ▷	15/2	16/2	17/2

B	HumM3	40	40	40
B				
L				
T	Nov	2	2	2
T	Lev	34	34	34
S				

The pattern of blood glucose results is important - knowing this helps keep the results in the target range of 4 to 8 mmol/l. Regular testing, recording and reviewing of results is the key.

In this example, it is actually quite difficult to see any clear pattern in the results. **Apart from illness**, one of these four is a possible cause of erratic results:

Is food the problem? High results at supper ① may follow eating more carbohydrate than the amount of insulin taken at teatime can deal with. The hypo at the same time of day ② suggests insulin dose may not be the main factor involved - this was the same on both days, with very different results.

Are the injection sites healthy? Using the same place to give injections, day after day, causes “**lipohypertrophy**” - lumpy injection sites. Fat increases in the cells under the skin. Insulin injected here is erratically absorbed - sometimes slowly, and sometimes very quickly. Regularly changing injection sites is very important to avoid high and low blood glucose results.

Is exercise being planned? Even with the best before-exercise planning, hypos may still occur. Was this hypo ③ due to too little carbohydrate before sport, for example? It is important to always think carefully about and prepare for games.

Are all injections being taken? It is often difficult to remember to take every injection - the odd very high result ④ may suggest a dose was not taken - for whatever reason.

Write down results every day!

B	Over 8	26.2	← ④	
R	4 - 8		5.4	
E	Under 4			3.6
L	Over 8		11.2	
U	4 - 8	5.3		4.2
N	Under 4			
T	Over 8			
E	4 - 8	7.1		4.2
A	Under 4		3.7	← ③
S	Over 8	11.1	← ①	14.4
U	4 - 8			
P	Under 4		3.6	← ②

Guidelines

Basal bolus insulin - an "8-point profile" in action

	Mon	Tue	Wed
Date ▷	15/2	16/2	17/2

B	Nov	4	4	5
B	Lev	12	12	12
L	Nov	4	4	5
T	Nov	4	4	5
T	Lev	10	10	10
S				

As a slow-acting, basal insulin analogue has no significant peak of action, rapid-acting insulin must be taken before meals. It may seem difficult to work out which insulin is having what effect on blood glucose, but knowing how insulins work helps solve the puzzle!

It is useful to test before and after meals - either as two "paired readings" before and after a single meal, or as an "8-point profile", with four results at the usual times (before main meals and supper), three tests 90 minutes after main meals, and one test overnight (at 2 a.m.).

Slow-acting analogues work steadily. They mainly affect before-meal and overnight results. The usual before-meal results shown at left are reasonable. However, after-meals results tell a different story.

Rapid-acting analogues work as soon as they are given, and mainly work *straight after* a meal. Blood glucose results 90 minutes after Humalog or Novorapid are very helpful. If the correct dose of rapid-acting insulin is taken, after-meal blood glucose results should be much the same as those before the meal (within 2 or 3 mmol/l of each other).

Before meal results such as ① & ② are in the target range (4-8 mmol/l), so the *slow-acting* insulin dose (of Levemir or Lantus) is appropriate.

Results ③-⑤, taken 90 minutes after meals, are *high*. In particular, they are higher than before-meal results. This shows that the doses of *rapid-acting* analogue insulin (Novorapid) have been too small to reduce the blood glucose to pre-meal amounts, and therefore need to increase. Currently, 4 units is taken before meals. Increasing rapid-acting analogue doses to 5 units would be a good start.

An alternative to an 8-point profile over 24-hours is to use **paired-readings**, before and after individual meals.

B	Over 8			
R	4 - 8	7.8	5.3	← ①
E	Under 4			3.8
③ →	B + 90'	14.7		12.9
L	Over 8			
U	4 - 8	7.4		6.1
N	Under 4			
④ →	L + 90'	12.7		16.1
T	Over 8	10.2		
E	4 - 8	② →	7.0	5.4
A	Under 4			
⑤ →	T + 90'	14.3		12.4
S	Over 8			
U	4 - 8	6.6	5.3	7.9
P	Under 4			
	2 am	5.8		6.3

Basal bolus insulin - running out of steam (& insulin!)

	Mon	Tue	Wed	Thu
Date ▷	15/2	16/2	17/2	18/2

B	Nov	12	12	12	12
B					Lev 10
L	Nov	8	8	8	8
T	Nov	8	8	8	8
T					
S	Lev ① →	18	18	20	10

Slow-acting analogue insulins work for up to 24 hours. This varies from person to person, however, and two daily doses may be needed.

In this example, a slow-acting basal insulin is being given once daily, before supper ①. Results before tea ② and supper ③ are almost all high. An increase to the dose of slow-acting analogue basal insulin is needed to bring down these results.

However, there is a problem - although before-meal results towards the end of the day are high, the before-meal results *earlier* in the day ④ are actually much lower. Increasing supertime basal insulin to deal with the higher evening results risks making the overnight and morning results even lower, perhaps even resulting in hypoglycaemia.

Unfortunately, a “four injections” system may not deal adequately with this situation. Instead of before bed, the basal insulin could be given before breakfast. This would probably give lower results before tea and supper, but would cause high overnight and breakfast results. The problem remains, but is just happening at a different time of day.

The main problem here is *not* the dose used, but *how long the insulin keeps working*.

Increasing the dose may not make it last any longer. Instead, giving basal insulin before supper *and* some before breakfast may be the best option. **An extra injection is needed**, but hopefully more even results will follow.

B	Over 8				
R	4 - 8	4.1	5.1		4.0
E	Under 4			3.2	← ④
	B + 90'	8.3	5.3	4.5	6.0
L	Over 8				
U	4 - 8	7.6	6.1	7.8	7.2
N	Under 4				
	L + 90'	6.5	7.2	8.4	7.3
T	Ove ② →	12.7	11.0	10.9	
E	4 - 8				7.6
A	Under 4				
	T + 90'	3.2	7.7	6.9	4.8
S	Ove ③ →	16.7	13.0	18.3	
U	4 - 8				6.7
P	Under 4				
	2 am	9.3	7.5	10.6	7.0

Basal bolus insulin - using correction doses

	Mon	Tue	Wed
Date ▷	15/2	16/2	17/2

B	Nov	4	4 + 3 ^③	4
B	Lev	10	10	10
L	Nov	4	4	4
T	Nov	4	4	4
T	Lev	10	12 ^④	12
S				

B	① →	17.2	16.8	← ②
R	4 - 8			6.3
E	Under 4			
	B + 90'		7.8	

L	Over 8	15.1		
U	4 - 8		6.7	6.1
N	Under 4			
	L + 90'	13.5		

T	Over 8	15.3		
E	4 - 8		7.0	5.4
A	Under 4			
	T + 90'	15.9		

S	Over 8	12.3		
U	4 - 8		5.3	7.9
P	Under 4			
	2 am	14.7		6.3

Correction doses bring blood glucose down and prevent long periods of excess glucose - important for good health.

Most people use the “**100 Rule**” to work out the insulin needed to “correct” a high blood glucose. Dividing 100 by the Total Daily Dose of insulin gives the **fall in blood glucose caused by 1 unit of rapid-acting insulin** (Humalog or Novorapid). This is known as “**Insulin Sensitivity**”.

Next, work out the result aimed for - the upper limit of the target range is usually used (8 mmol/l). Subtract this from the current blood glucose result to give the **fall in blood glucose required**. If we know the glucose fall caused by 1 unit of insulin, and we know how large a fall is required, we can work out the insulin dose needed to correct the high.

In this case, insulin Total Daily Dose is 32 units (4+10+4+4+10), so the Insulin Sensitivity is $100 \div 32$; approximately 3. This means 1 unit of insulin should drop blood glucose about 3 mmol/l. The high results start with a before breakfast result of 17.2 mmol/l ①. No correction dose is given, and glucose stays high all day.

The next day, blood glucose is again high at 16.8 mmol/l ②. A fall of 9 mmol/l (16.8 - 8) should reach the 8 mmol/l target. If 1 unit causes a fall of 3 mmol/l, then 3 units should cause a fall of 9 mmol/l. The **correction dose is 3 units** of rapid-acting analogue insulin (Humalog or Novorapid), taken either as a separate dose or added to the meal-time bolus.

If giving a correction dose, mark this (3 units) separately from the usual bolus dose (4 units at breakfast) ③ by writing “4+ 3” (and not the total “7”). If 3 or more correction doses are used at the same time of day, increase regular insulin doses (such as night time Levemir ④).

See Pages I 20 - I 23.