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

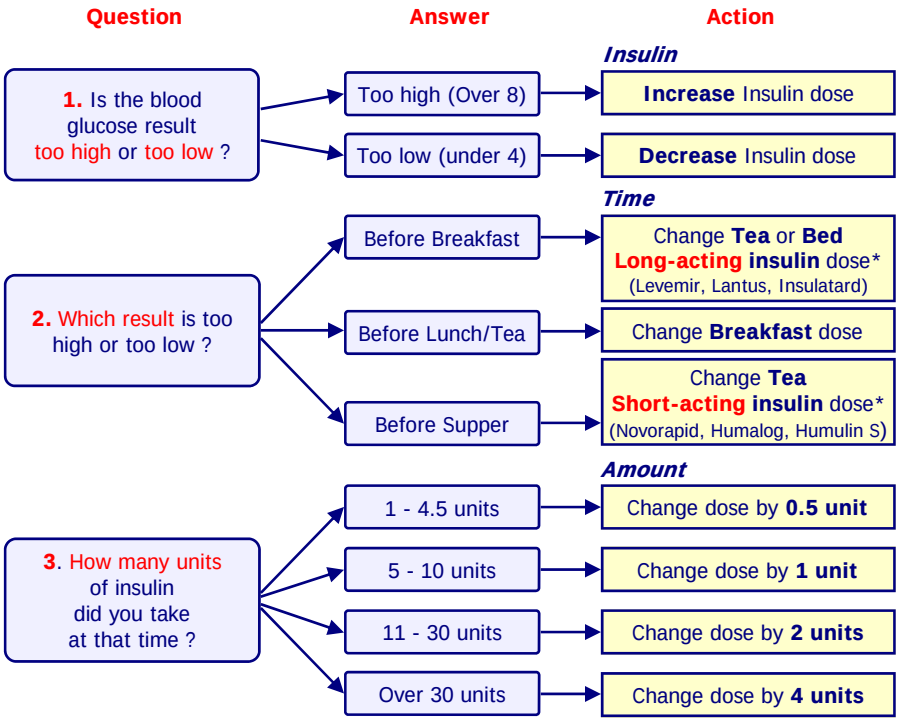
After making adjustments for food, exercise, injection sites, and illness, you then need to think about changing how much insulin to take. Below is a step-by-step guide on how to change your insulin doses safely. Remember, you may need to do this up to twice a week - make a change, and be prepared to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



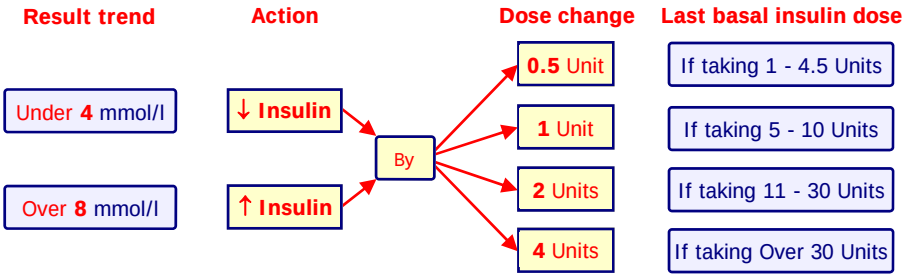
* Or tea-time Mixtard 30 or Humulin M3 if on twice daily mixed insulin.

Example: If on 20 units of Levemir before tea, three high tea-time or 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 dose 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 food bolus doses. 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" and the Table on page I 44 show how much insulin is needed to reduce blood glucose back to the target range of 4-8 mmol/l. A correction dose is given *as well as* any insulin required for the meal (worked out using an ICR)

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

"Correction dose" can be estimated using the "100 Rule" (Page I 21), giving how much insulin is needed to reduce blood glucose 1 mmol/l. It is not exact, but is a helpful guide. The correction dose equals the insulin total daily dose divided by 100.

When urine ketones are moderate or large, or blood ketones are 1 mmol/l or higher Sick Day Rules should be used (Page G 03) instead of using a correction dose.

Correction dose to lower blood glucose 1 mmol/l = Total Daily Dose (TDD) ÷ 100

Step 3: Correct high results with the "100 Rule" (cont)

Adding all insulin taken on a single day (the Total Daily Dose) and dividing by 100 has been suggested to give the insulin dose needed to reduce blood glucose by 1 mmol/l. This is called the "correction factor", or "CF". Knowing how far the blood glucose should fall to be in the 4-8 mmol/l range allows an insulin correction dose to be calculated - just multiply the CF by the blood glucose fall needed - in this case, down to 8 mmol/l* (the top of the target range). This is known as the "100 Rule"[1].

How to calculate a correction dose of insulin

1. What is the insulin total daily dose? - add all one day's bolus and basal doses
2. What is the "correction factor"? - divide total daily dose by 100
3. What fall in blood glucose is needed? - subtract 8 mmol/l* from current blood glucose
4. What is the correction dose of insulin? - multiply CF by fall in blood glucose needed

For example, if someone takes 5 units of basal insulin twice a day, 4 units of bolus insulin with each main meal, and has a blood glucose of 18 mmol/l ...

1. Insulin Total Daily Dose = (5 + 5) + (4 + 4 + 4) units = 22 units daily
2. Correction Factor = 22 ÷ 100 = 0.22
3. Fall in glucose needed = 18 – 8 mmol/l* = 10 mmol/l fall
4. Insulin "correction dose" = 0.22 x 10 = 2 units (approx.)

This 2 unit correction dose (rounded down) should then either be taken on its own, or added to the usual meal-time dose (calculated by ICR).

See "Food For Life" diet book for more ICR details

Some things to remember about Correction doses:

1. Always discuss when and how to use correction doses with your diabetes team - the "100 Rule" is only a guide, and *must* be adjusted to the individual before use.
2. Care should always be used when using large correction doses, as factors other than insulin may be involved - consider trying smaller correction doses at first.
3. Correction doses should not usually be given within 4 hours of each other.
4. Do not use the "100 Rule" if you have frequent or severe hypos.
5. Exercise taken or about to take place lowers blood glucose, *without* extra insulin.
6. If correction doses are often needed, the regular basal and bolus insulin doses are clearly not "correct", and must be adjusted using the guidelines on Page G 02.
7. Sick Day Guidelines (Page G 03) must always be used instead if unwell, moderate or large urine ketones are present, or blood ketones are over 1.0 mmol/l.
8. The table on Page I 44 can be used to match TDD with current blood glucose to calculate the insulin correction dose required. The calculated correction dose of 2 units from the example above is shown by the red arrows in the table below.

TDD	CF	Current Blood Glucose									
		14	16	18	20	22	24	26	28	30	32
10	0.1	0.5	1	1	1	1.5	1.5	2	2	2	2.5
12	0.12	0.5	1	1	1.5	1.5	2	2	2.5	2.5	3
14	0.14	1	1	1.5	1.5	2	2	2.5	3	3	3.5
16	0.16	1	1.5	1.5	2	2	2.5	3	3	3.5	4
18	0.18	1	1.5	2	2	2.5	3	3	3.5	4	4.5
20	0.2	1	1.5	2	2.5	3	3	3.5	4	4.5	5
22	0.22	1.5	2	2	2.5	3	3.5	4	4.5	5	5
24	0.24	1.5	2	2.5	3	3.5	4	4.5	5	5	6

Always discuss with your Diabetes Team before using Correction Doses.
If moderate or large ketones present use Sick Day Rules (Page G 03) instead.

Some (more) useful words ...

- Trigger theory - possible process for development of diabetes, due to inheritance of susceptibility to certain "triggers". In the right circumstances, the immune system damages the pancreas beta cells when exposed to certain triggers. Not proven.
- Type 1 diabetes mellitus - form of diabetes due to autoimmune destruction of insulin producing beta cells, with an eventual total lack of insulin production. Previously called "childhood onset" or "insulin dependent" diabetes.
- Type 2 diabetes mellitus - form of diabetes due to reduced but persisting insulin production, production of less effective insulin, or resistance to its action. Previously called "adult onset" or "non-insulin dependent" diabetes.
- Villi - finger-like projections that line the gut, greatly increasing absorption area.

Working out the insulin Correction dose with the "100 Rule"[1] - matching insulin Total Daily Dose with current Blood Glucose.

Calculate insulin correction doses using the table below (and see Page I 20-21):

1. Work out the insulin Total Daily Dose (add all insulin taken in a 24-hour period).
2. Note the *current* blood glucose result (*not* the planned blood glucose result).
3. Match TDD row with current Blood Glucose column to give the insulin correction dose.
4. Take the correction dose as rapid-acting analogue *in addition* to any planned bolus dose.

TDD	CF	Current Blood Glucose									
		14	16	18	20	22	24	26	28	30	32
10	0.1	0.5	1	1	1	1.5	1.5	2	2	2	2.5
12	0.12	0.5	1	1	1.5	1.5	2	2	2.5	2.5	3
14	0.14	1	1	1.5	1.5	2	2	2.5	3	3	3.5
16	0.16	1	1.5	1.5	2	2	2.5	3	3	3.5	4
18	0.18	1	1.5	2	2	2.5	3	3	3.5	4	4.5
20	0.2	1	1.5	2	2.5	3	3	3.5	4	4.5	5
22	0.22	1.5	2	2	2.5	3	3.5	4	4.5	5	5
24	0.24	1.5	2	2.5	3	3.5	4	4.5	5	5	6
26	0.26	1.5	2	2.5	3	3.5	4	4.5	5	6	6
28	0.28	1.5	2	3	3.5	4	4.5	5	6	6	7
30	0.3	2	2.5	3	3.5	4	5	5	6	7	7
35	0.35	2	3	3.5	4	5	6	6	7	8	8
40	0.4	2.5	3	4	5	6	6	7	8	9	10
45	0.45	2.5	3.5	4.5	5	6	7	8	9	10	11
50	0.5	3	4	5	6	7	8	9	10	11	12
55	0.55	3.5	4.5	6	7	8	9	10	11	12	13
60	0.6	3.5	5	6	7	8	10	11	12	13	14
65	0.65	4	5	7	8	9	10	12	13	14	16
70	0.7	4	6	7	8	10	11	13	14	15	17
75	0.75	4.5	6	8	9	11	12	14	15	17	18
80	0.8	5	6	8	10	11	13	14	16	18	19
85	0.85	5	7	9	10	12	14	15	17	19	20
90	0.9	5	7	9	11	13	14	16	18	20	22
95	0.95	6	8	10	11	13	15	17	19	21	23
100	1	6	8	10	12	14	16	18	20	22	24

Approx. insulin dose needed to return blood glucose to target range

Always discuss with your Diabetes Team before using Correction Doses.
If moderate or large ketones present use Sick Day Rules (Page G 03) instead.

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