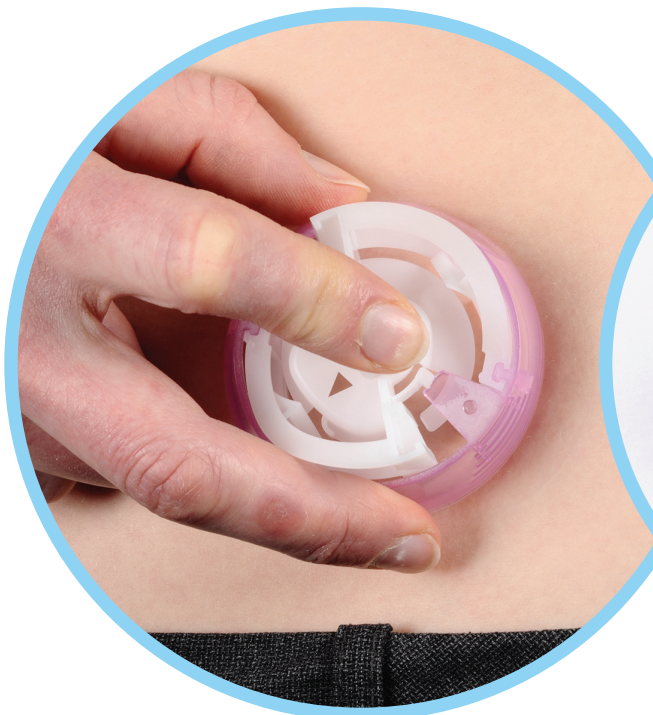


Introduction to Insulin Pump Therapy

What is an insulin pump and how does it work?

- An insulin pump is a small electronic device which provides a continuous infusion of very fast acting insulin (Novorapid or Humalog) into the subcutaneous tissue (under the skin). It is designed to deliver insulin in a way more similar to the pancreas of a person without diabetes, than insulin injections.
- The pump is programmable and the settings can be changed if required by activating the on-screen menus (patients/parents are trained how to change the settings).
- Insulin is delivered through an infusion set from the pump, and a short plastic cannula which is changed every 2-3 days using a needle insertion set (see the picture below).
- All patients require a continuous infusion of Novorapid or Humalog which act as basal (or background) insulin and there may be several different basal rate settings over the course of the day.
- Insulin boluses are required, in addition to the basal insulin, when carbohydrate-containing foods/drinks are consumed. The bolus is given through the pump, and the settings for the amount of insulin required for carbohydrate are pre-programmed into the pump.
- An insulin bolus is also required when the blood glucose reading is high and the amount of insulin required (correction factor) is programmed into the pump.



Who is eligible for insulin pump therapy?

- a) For **adults and children 12 years and older** the reasons for requiring a pump are:
- If attempts to reach target haemoglobin A1c (HbA1c) levels with multiple daily injections result in the person having 'disabling hypoglycaemia'.
 - If HbA1c levels have remained high, above 70 mmol/mol, with multiple daily injections despite the person and/or their carer carefully trying to manage their diabetes.
- b) For **children aged less than 12 years**, pump therapy is recommended as a possible treatment for all children. The NICE guidelines advise that children who use insulin pump therapy should have a trial of multiple daily injections when they are between the age of 12 and 18 years.

What does starting on insulin pump therapy involve?

Starting an insulin pump requires a big commitment and takes more time and effort than managing diabetes with injections. If you put in the time and effort it can allow flexibility and good blood glucose control. It is not an easy option!

The commitment includes:

- Frequent blood glucose testing (minimum of 8 tests per day).
- Keeping a daily written diary of blood glucose results and events.
- Very accurate carbohydrate counting.
- Regular communication with the diabetes team and clinic attendance.

If the HbA1c before starting pump therapy is above 58 mmol/mol, a drop by 7 mmol/mol should be expected. This needs to be maintained.

What happens if I become/my child becomes unwell when on insulin pump therapy?

It is vital to understand the increased risk of developing diabetic ketoacidosis when using insulin pump therapy, and be able to manage sick days appropriately. The usual 24 hour advice line will not be able to offer advice for adjustment of pump settings. It may be necessary in these circumstances to return to insulin injections. This may be the case if admission to hospital is required due to illness with high blood glucose readings and high blood ketones.



The insulin given through the pump is very fast acting insulin, therefore progression to ketoacidosis can occur within four hours if you/your child are not receiving insulin from the pump.

What other equipment is required?

A computer is required to download pump data, to review blood glucose readings and pump settings. These downloads are emailed to the diabetes team before clinics.

What happens if the insulin pump is damaged?

You should insure the pump on your home insurance policy. In addition, there is a company warranty.

How long would it take to start insulin pump therapy?

The clinical need and assessment of suitability will be the deciding factors for progressing through the pre pump process. If it is agreed that a patient needs pump therapy then an assessment of priority is required. An urgent requirement, e.g. diabetes in a baby, will take priority.

There is a waiting list for insulin pump therapy. People are started on pumps in groups of three, depending on their age. The diabetes team can give you guidance as to how long you would be expected to wait for an insulin pump.

What happens if insulin pump therapy is not working well?

The pump remains the property of NHS Lothian. You will be asked to sign an agreement to return the pump if it is not being used appropriately.

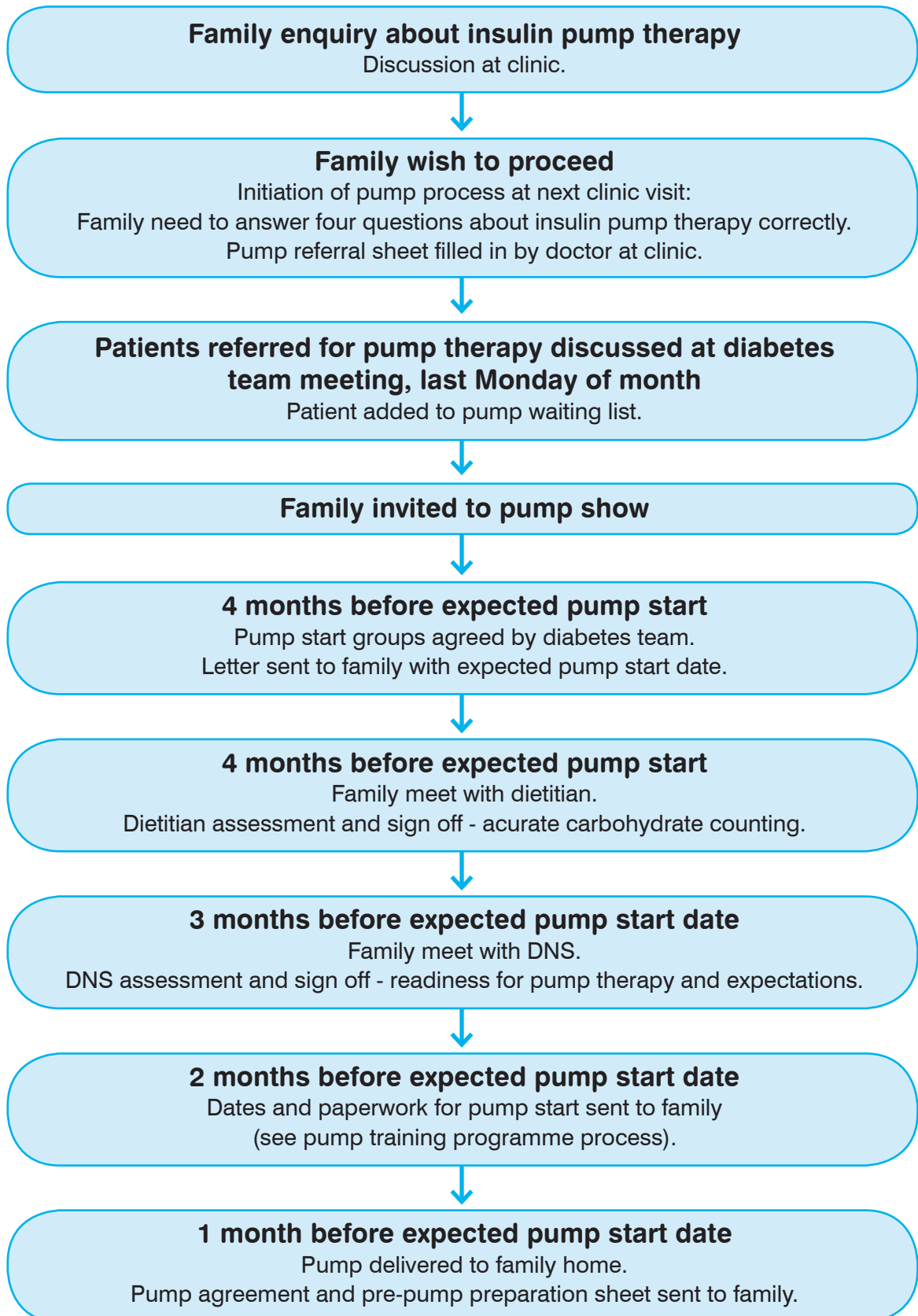
Some people experience difficulties with insulin pump therapy. The diabetes team will support you with any difficulties, however if you/your child decide that you would prefer not to be on insulin pump therapy, you can convert back to insulin injections. The pump would then be taken back by NHS Lothian.

What do I do if I/my child would like to try insulin pump therapy?

If you are interested in insulin pump therapy please discuss with the diabetes team at your next clinic visit.

Pre Insulin Pump Process

If you are interested in insulin pump therapy, this is the expected process following your initial enquiry.



Insulin Pump Start Process

Week 1

Children under seven years of age

Groups of three families

Visit 1 – Parents attend RHSC for insulin pump education

Visit 2 – Parents and children attend RHSC for insulin pump 'saline' start

Children over seven years of age

Groups of three families

Visit 1 – Parents and children attend RHSC for insulin pump education and insulin pump 'saline' start

Week 2

Groups of families attend for review of progress following insulin pump saline start, and 'go live' insulin pump insulin start

Telephone on call advice and daily follow up phonecalls from diabetes team

Week 3

Family phone DNS on Wednesday to review BG readings and progress

Week 4

Beginning of week - Family send in insulin pump downloads for previous two weeks

Downloads to send:

- Device settings
- Quick view summary
- Log book diary
- Modal day by hour

End of week – Families attend RHSC for group review and education session with diabetes team

Week 8-10

Review appointment in Wednesday afternoon diabetes review clinic

Pump downloads for previous two weeks to be sent to diabetes team on Monday before clinic

Top Tips When Starting on an Insulin Pump

Use this section as a guide following your/your child's pump start date. When more experienced with insulin pump therapy, you will find more detailed information in the 'Day-to-Day Insulin Pump Management' section.

1. When should BG readings be checked?

Aim to check a BG reading before and 2 hours after carbohydrate intake. Initially, also check BG approximately 3 hourly overnight e.g. midnight, 3am and 6am.

Remember to repeat a BG reading 1 hour after any significant pump event e.g. set change, treating a hypo, pen correction for high blood glucose/ketones.

BG readings should be recorded on the daily record sheets, along with carbohydrate intake and insulin doses for the first week after the pump start. Following this, you can change to the Medtronic daily diary, however you may prefer to continue using the daily record sheets for longer.

2. What should I/my child eat and drink following the pump start?

Aim to eat three meals per day. A small snack, covered with a bolus, between meals is optional. Ideally there should be at least 2 hours between meals and snacks initially, to assess the insulin to carbohydrate ratios.

3. How does the pump calculate a bolus insulin dose?

The pump is programmed with your insulin to carbohydrate ratios, correction factor, and blood glucose targets. The pump can therefore work out how much bolus insulin is required. There is also a safety feature which prevents an over bolus of insulin. All these features are combined in the pump software. The bolus function is called the 'bolus wizard'.

4. When should an insulin bolus be given?

Bolus wizard should be used to calculate an appropriate insulin bolus for all carbohydrate intake. Aim to give an insulin bolus 10 minutes before meals (up to 20 minutes before breakfast), for the carbohydrate which you know you/your child will eat. If more carbs than expected is consumed, bolus for the additional carbs as it is taken.

Use bolus wizard to ensure correction boluses are given when appropriate, every time the BG is >6 mmol/L, throughout the day and night. If there is active insulin, bolus wizard will take this into account, and calculate the amount of correction required.

5. How do I manage hypoglycaemia on a pump?

Give fast acting glucose as you would have done previously. BG should be re-checked after 10-15 minutes.

If the repeat BG is <4 mmol/L, repeat the hypo management.

There is no need to give extra 'free' carbohydrate when the BG has risen to >4 mmol/L while using an insulin pump, as all the insulin in the pump is very fast acting insulin.

Any additional carbs consumed should be covered with insulin as indicated by the bolus wizard.

If there are two separate episodes of hypoglycaemia within one hour, set a temporary basal rate of 50% (see 'Management of hypoglycaemia on an insulin pump' flowchart on page 19).

Repeat the BG one hour after the hypo has been successfully treated, or sooner if you are concerned.

If the BG is >6 mmol/L within two hours of treating a hypo, you should not give a correction bolus. If eating additional carbs, enter a BG of 6 mmol/L to the pump, it will then only bolus for the carbohydrate.

If the BG is >6 mmol/L more than two hours after treating a hypo, use bolus wizard to calculate a correction bolus.

6. How do I manage high blood glucose readings >14 mmol/L on a pump?

The insulin given through the insulin pump is very fast acting insulin, therefore ketones can develop rapidly if there is any interruption to insulin delivery.

Immediate action is required if the BG is >14 mmol/L, initially by checking for ketones. See the 'Management of Hyperglycaemia' and 'Insulin Pump Therapy During Intercurrent Illness' flowcharts.

Hyperglycaemia can occur for many reasons. It is important to check:

- There is no leakage from the infusion set or cannula.
- The cannula has not become dislodged.
- The cannula and insertion set has not been worn for more than 72 hours.
- There are no large air bubbles in the infusion set.
- The correct basal rate is set.
- The correct bolus dose has been given (check bolus history).
- The cannula is not inserted into a lumpy site.
- The pump is working properly (do a 'self test').

7. Can the insulin pump be disconnected?

The insulin pump can be disconnected for short periods, e.g. showering, dressing, data download. Aim to keep this time as short as possible, not longer than one hour.

Small children are often on ultra low basal rates, which will be delivered at set times.

e.g. 0.025 units/hour - this will be delivered as a bolus on each hour (00:00, 01:00, 02:00 etc).

0.05 units/hour - this will be delivered as a bolus of 0.025 units on each half hour (00:00, 00:30, 01:00, 01:30 etc).

Therefore do not disconnect the pump at these times.

8. What if I think there is a problem with the pump?

Treat a high BG following the 'Hyperglycaemia' flowchart (page 20).

Do a self test. If the problem persists, contact the Medtronic helpline.

If the pump has failed, you will need to revert to insulin injections, using your pre pump start insulin doses.

9. How do I manage activity following the pump start?

The expectation is that the pump start week will initially be a 'quiet' week. We will encourage a gradual increase in activity to normal levels after the first few days.

When there is planned exercise, set a temporary basal rate (70% of the usual basal) starting 60 minutes before and continuing until 60 minutes after the planned exercise. A temporary basal rate can be cancelled at any time.

If there is unplanned exercise, additional carbohydrate is required, just as you have done previously, to prevent a hypo. A temporary basal rate may still be required if exercise is moderate and lasts longer than 30 minutes. The effect of a lower basal rate takes up to an hour to have any benefit, which is why the extra carbs is needed at start of exercise.

Day-to-Day Insulin Pump Management

1. What are the blood glucose (BG) targets while on pump therapy?

The blood glucose target should be set at 5-6 mmol/L on the pump, to allow bolus wizard to correct to this target.

Generally, BG readings before meals and before bed of 4-8 mmol/L are acceptable, and would not prompt a change in basal insulin rates.

Two hours after a meal, a BG of <9 mmol/L is acceptable.

If the BG 2 hours after a meal is above target, increase the insulin to carbohydrate ratio (ICR) by approximately 10-20%. You will therefore making minor adjustments regularly.

For example, if you were using 1 unit: 13 grams, change to 1 unit:11 grams.



Once stable, checking BG before and 2 hours after meals as an 8 point profile is the ideal daily profile.

2. When should insulin boluses to cover carbohydrate be given?

Give the bolus to cover carbohydrate 10 minutes before the meal (or up to 20 minutes before breakfast), for what you know will be eaten. This will result in optimal blood glucose control.

Bolus for any additional carbs as soon as it is eaten (without entering a repeat BG).

Remember that insulin is absorbed more quickly by the effects of exercise and heat. Do not wait 10-20 minutes before eating if immediately after a hypo.

3. How do I know if the basal rates need to be adjusted?

We suggest that you perform a basal rate review every 4-6 weeks. Review only one time interval per day.

If blood glucose is 4-8 mmol/L before a meal or at bedtime, omit the next meal and snack (or give a carb free meal/snack) and check BG every two hours. For an overnight basal review, have a light low fat meal at 5pm, then nothing afterwards.

The BG should stay within 2 mmol/L of the original BG reading.

Carry out the basal rate review process from:

- a) Before breakfast to before lunch
- b) Before lunch to before tea
- c) Before tea to after bedtime
- d) Overnight

If the blood glucose levels rise or fall by more than 2 mmol/L, make adjustments to the basal rates two hours before the rise or fall.

While performing a basal rate review, do not give a correction bolus unless the BG is >14 mmol/L, so that you can see the basal pattern clearly.

We suggest the following changes, based on total daily dose of insulin (TDD):

TDD	Adjustment
TDD less than 10 units	make adjustments by 0.025 units per hour
TDD 10-20 units per day	make adjustments by 0.05 units per hour
TDD 20-40 units per day	make adjustments by 0.1 units per hour
TDD greater than 40 units per day	make adjustments by 0.2 units per hour



Document the basal rate review readings, the date and any changes made in the diary.

Example

TDD of insulin on pump: 15.6 units per day

Overnight basal review

1800 – Light meal, 30g carbs eaten, bolus given via bolus wizard.

Time	Basal rate (units/hour)	Blood glucose (mmol/L)
18:00	0.25	5.4
20:00	0.45	7.3
22:00	0.45	12.1
24:00	0.3	12.2
02:00	0.3	11.8
04:00	0.3	9.4
06:00	0.3	9.2

Rise in BG >2 mmol/L at 22:00, so increase the basal rate 2 hours before this rise.

TDD 15.6 units per day, so change basal rate by 0.05 units per hour.

New basal rate at 20:00 = 0.45 + 0.05 = 0.5 units per hour.

4. Which insertion sites should be used, and how often do they need to be changed?

Cannulas can be sited in the abdomen, thighs, hips or tops of buttocks. There is usually too little fat on a young child's abdomen to use this as an insertion site.

The cannula needs to be re-sited every two or three days.

If you see the BG trend rising coming up to the third day, then you will need to re-site the cannula every second day. This is more common in younger children.

Aim to re-site the cannula before a meal so that you can be sure the set is working.

Avoid re-siting the cannula before bed, as it will take some hours to see a rising BG if there is a problem with the new insertion site and the basal insulin is not infusing.



Remember to rotate insertion sites – lumpy sites remain a common problem.

5. What is insulin sensitivity and what should it be set as?

This is the same as a 'correction factor'.

Review the total daily dose of insulin (TDD) in utilities. Divide this number into 100.
This is your insulin sensitivity.



Insulin sensitivity = 100 divided by TDD

For example:

TDD = 21 units

Insulin sensitivity = 100 divided by 21 = 4.7

1 unit of insulin reduces the BG by 4.7 mmol/L

This can be adjusted for different times of the day, e.g. overnight may be 1 unit lowers by 6 mmol/L.

6. What is active insulin, and what should it be set as?

Active insulin is the bolus insulin which has been delivered to your body, but has not yet been used. The active insulin setting means the duration of insulin action, or how long a bolus of insulin will remain active in the body for after it is given. This is usually set as 3 hours.

This can only be checked if you are confident that the basal rates are correct.

You can assess the active insulin profile with a bolus: check a BG before a meal, if the BG is in target, eat a low fat meal with known carb content, using bolus wizard to give a normal bolus.

Check the BG hourly for up to 5 hours after the meal. Do not eat or drink any snacks or carbohydrate containing liquids, and do not partake in any exercise over this period.

Review how long it takes for the BG to come back to the pre meal level (+/- 2 mmol/L). If it comes back to range in 3 hours, active insulin should be set as 3 hours on the pump. If it takes a longer or shorter time to come back to range, the active insulin can be adjusted accordingly.

7. What are composite boluses?

Square wave: the bolus is given evenly over a period of time (set from 0.5 – 8 hours).

This is useful for high fat meals, low glycaemic index (GI) foods, or extended meals (e.g. buffets). A high BG before the meal needs to be corrected with a separate normal bolus.

Dual wave: this is a combination of an immediate normal bolus, followed by a square wave bolus.

This is useful for meals with both rapidly and slowly absorbed carbs. When setting up a dual wave bolus, you set both the percentage of insulin given by normal and square wave bolus, and the time the square wave is given over. A high pre meal BG can also be corrected with a dual wave bolus.

e.g. 50% normal bolus 50% square bolus over 4 hours.

See the example: [Medtronic handbook \(page 98/99\)](#)

Exercise and Activity on Insulin Pump Therapy

Keep a record of what you do, as you will learn what best suits you/your child with time and experience.

When should I check a BG?

Check a BG before exercise

Aim for a BG 6 - 8 mmol/L before exercise.

If the BG is 4 - 6 mmol/L, give a small 'free' carbohydrate snack before exercise (i.e. do not cover this with a bolus).

If the BG is above 8 mmol/L there are two options:

1. Give a correction bolus, and then give extra free carbs free (see below). This is the best option if the BG is >10 mmol/L.
2. Do not give a correction bolus, and don't give additional free carbs for brief/moderate exercise. This is the best option if the BG is 8 - 10 mmol/L.

If the BG is >15 mmol/L with ketones - don't exercise.

Follow the 'Hyperglycaemia' flowchart (see page 20).

If the BG is >15 mmol/L without ketones – it is still ok to exercise, e.g. just after a meal when reduced insulin was given in preparation for exercise.

Check BG at least hourly during sport

This may need to be more frequent soon after starting pump therapy to learn your/your child's own response.

Check BG after sport

Consider replenishing energy stores with additional carbs (see exercise management section).

How do I manage mild to moderate activity?

Mild or brief activity

If exercise is brief and mild, do not alter the basal rates, and do not remove the pump. Some people find they need a small amount of additional carbs, e.g. 0.25g of carbs per kg of body weight per hour of activity.

Planned moderate activity

If exercise is planned, you should set a temporary basal rate. The reduced basal rate should start 60 minutes before the exercise, and continue for at least 60 minutes after the exercise. This may need to be tailored according to the response in blood glucose. We advise starting with a 30% reduction (i.e. set as 70% temporary basal), but this can vary from 10-50% reduction.

Example 1

The sun has just come out so you are going to take your child to the playpark, hopefully for about 1 hour if it stays dry. Your child weighs 20kg. Their BG is 6.3 mmol/L before you leave home.

While at the park your child will be doing moderate exercise.

Moderate exercise, so need 0.5g/kg/hr of carbs,
i.e. $0.5 \times 20 \times 1 = 10\text{g}$ per hour (or 5g for 30 minutes) without a bolus!

This can be adjusted with experience and depending on your child's activity level while at the park.

Example 2

Your child has football training from 3.30pm till 4.30pm. You set a temporary basal rate starting at 2.30pm (60 minutes before football training begins), with a 30% reduction (set as 70% temporary basal). You set this for 3 hours (i.e. 60 minutes before, 60 minutes during, and 60 minutes after football).

You test your child's BG just before you leave and it is 9.8 mmol/L. This is above target, but you do not give a correction bolus, as you know he has had less insulin for the last 60 minutes. You check his BG after 30 minutes of football and it is 6.8 mmol/L, so he has a drink of water.

Just at the end of football training, your child's BG is 4.6 mmol/L. You leave the temporary basal on for another 60 minutes, and plan to check a BG at this time.

Unplanned moderate activity

If exercise is unplanned, or the duration/intensity is unknown, the only option is to take additional carbs at the beginning of and during exercise. You should also set a 70% temporary basal at the beginning of the activity, for the expected length of activity, and 60 minutes afterwards. This can be cancelled at any time, for example if the period of activity does not last as long as expected.

If exercise is moderate, consume additional carbs. Approximately 0.5g of carbs per kg of body weight is needed per hour for moderate activity. Do not bolus for this carbs, if you have not set a temporary basal rate 60 minutes prior to activity starting.

Altering bolus insulin with moderate exercise

If exercise is within 2 hours of a meal, the bolus insulin can be reduced. This is helpful for planned exercise of known intensity and duration. It avoids the need for extra carbs on a full stomach. Work out how much carbs is needed for the exercise. Subtract this amount of carbs from the amount due to be eaten at the meal, then bolus for the remaining amount of carbs.

e.g. You weigh 30kg, and you are going to exercise (moderately) for one hour.

Moderate exercise, so you need 0.5g/kg/hr of carbs i.e. $0.5 \times 30 \times 1 = 15\text{g}$ of carbs per hour.

You are about to eat a meal containing 75g of carbs.

You subtract 15g of carbs (for exercise) from 75g i.e. $75\text{g} - 15\text{g} = 60\text{g}$.

You bolus for 60g of carbs.

How do I manage strenuous activity?

Check a BG before exercise

The BG before strenuous exercise must be 5-15 mmol/L, ideally 5-10 mmol/L. The higher limit would only be acceptable if you have eaten carbs without a bolus, or with a reduced bolus, or used a reduced temporary basal rate in preparation for exercise.

Set a temporary basal rate

Consider a temporary basal e.g. 30-70% reduction (set as 70% to 30% temporary basal rate), beginning 60–90 minutes before, and continuing 60-90 minutes after strenuous exercise.

A period of 4-8 hours of temporary basal rate (50-70% of usual basal rate) may be required following exhausting/prolonged activity, due to the risk of delayed hypoglycaemia.

Consume additional carbohydrate

This may be required in addition to setting a temporary basal rate. You need about 1g of carbs per kg of body weight per hour of exercise, and this would not be covered with a bolus. Experience will be gained by recording BG's during and after exercise. If taking any additional carbs, use a reduced bolus e.g. 50% less than would usually be given.

Reduce the bolus insulin after exercise

The bolus insulin for a meal after strenuous exercise can also be reduced by 30-70%, depending on the activity – see the 'Exercise and Sport section' for details.



Check BG regularly during and after strenuous exercise. Recording BG's, pump settings and carbs intake will help to guide management of future exercise sessions.

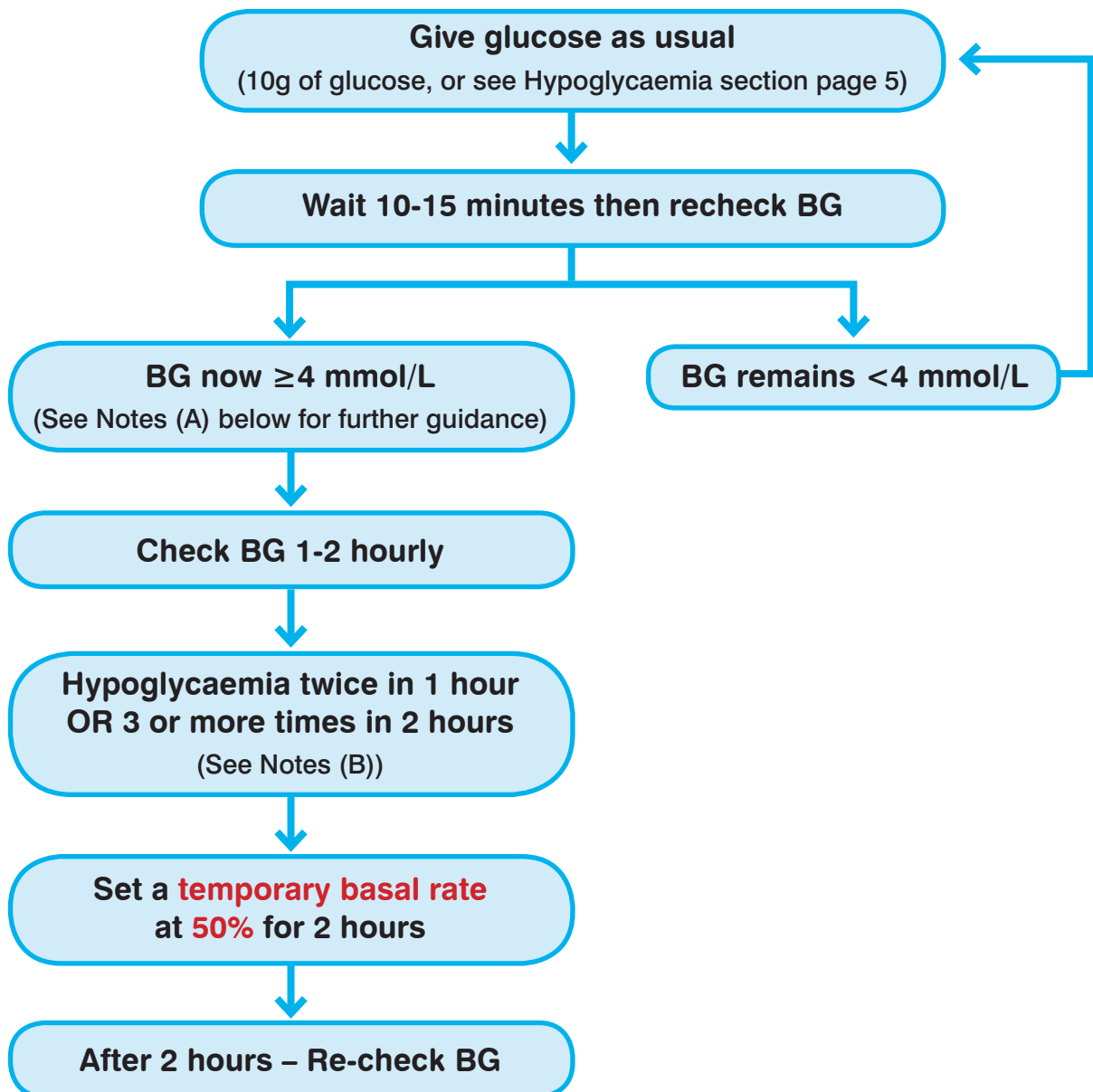
Can I remove the pump during exercise?

You can disconnect the insulin pump during sport if required, for example, for contact sports, or during strenuous activity that you know has previously resulted in hypoglycaemia despite a temporary basal and additional carbohydrate.

Pumps can be disconnected for up to one hour. You must check a BG during exercise if the pump is disconnected.

With experience, longer sessions off the pump can be managed. Please discuss this with the diabetes team, as further individualised information is available.

Management of Hypoglycaemia BG <4 mmol/L



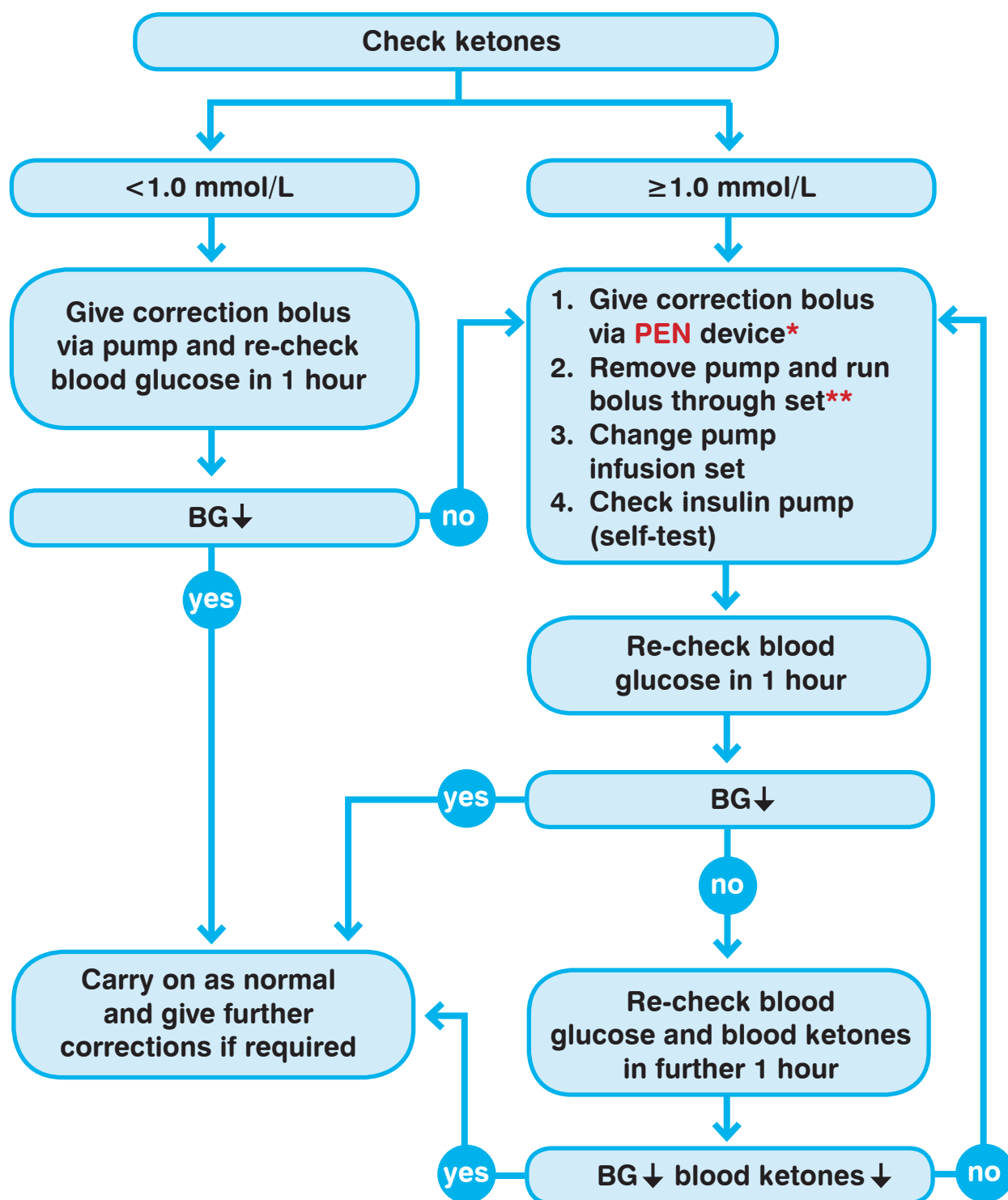
Notes (A)

- On an insulin pump, once BG >4 mmol/L a snack is not essential.
- If giving food give an insulin bolus for carbs using current insulin: carbs ratio using bolus wizard.
- Bolus may be given after food if poor toleration/vomiting anticipated.
- Do not give a correction for BG >6 mmol/L for 2 hours after hypo treatment. If BG >6 mmol/L then input 6 mmol/L into the pump to ensure a correction is not given.

Notes (B)

- Consider reason behind frequent hypoglycaemia, i.e. intercurrently unwell, exercise-related, or there is a pattern of hypos developing.
- If there is a pattern then consider taking action, i.e. seek medical advice if unwell, consider looking at the exercise management routine or consider making alterations to basal rate settings.

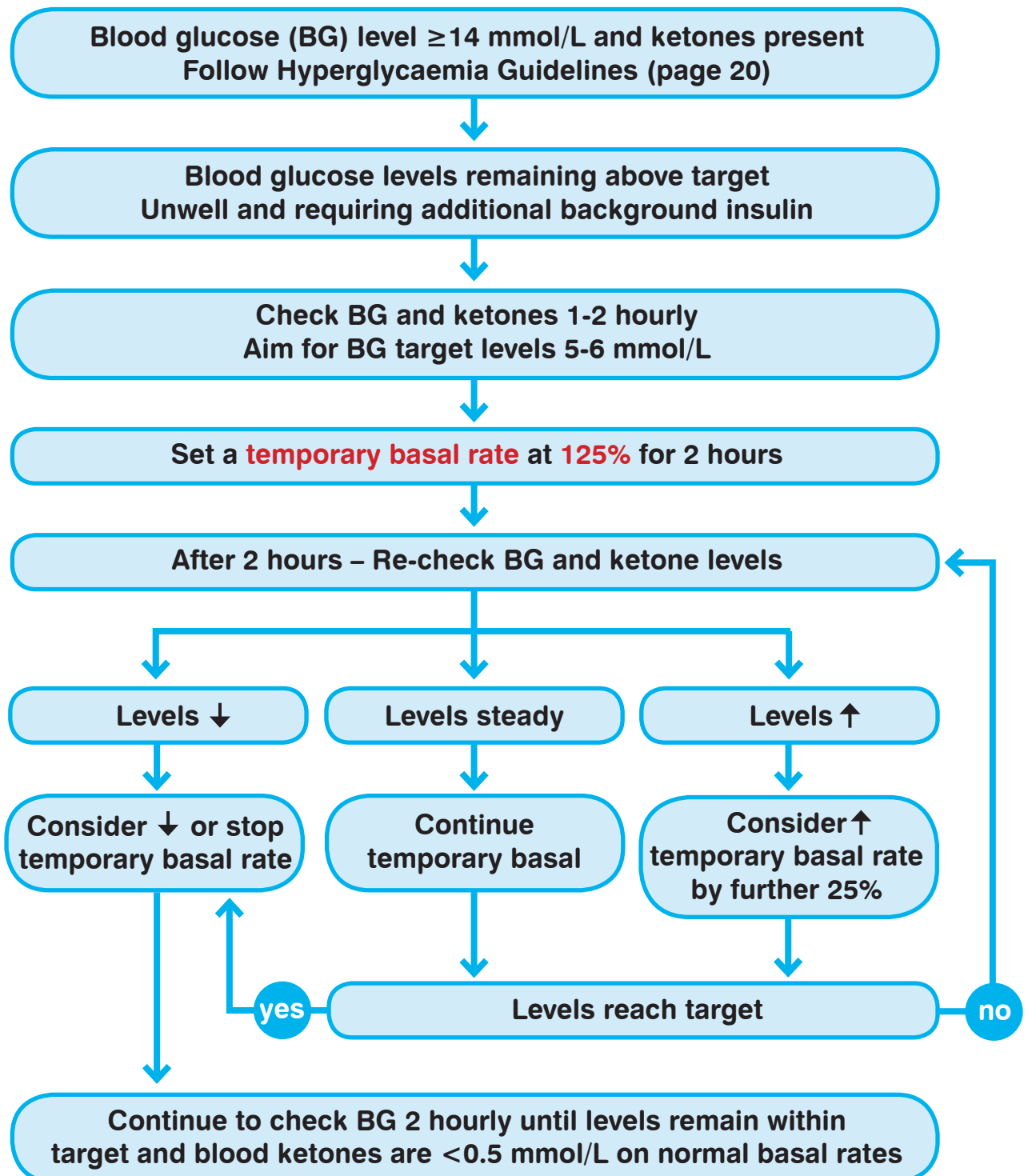
Management of Hyperglycaemia BG ≥ 14 mmol/L



* Correction bolus via pen: Give as per the 'Sick Day Management' flowchart. You need to know the total daily dose (TDD) of insulin (in utilities menu on pump). You will require a 10% or 20% (of TDD) correction depending on your blood glucose and blood ketones.

** Once you have given the pen injection, disconnect the pump and set the pump to deliver the same bolus dose given by pen injection. Allow this to run through the tubing and discard it (e.g. into the sink/onto the floor), before reconnecting the pump. This means that the correction dose will be shown on the pump downloads, and included in the pump's active insulin calculation.

Insulin Pump Therapy During Intercurrent Illness



Notes

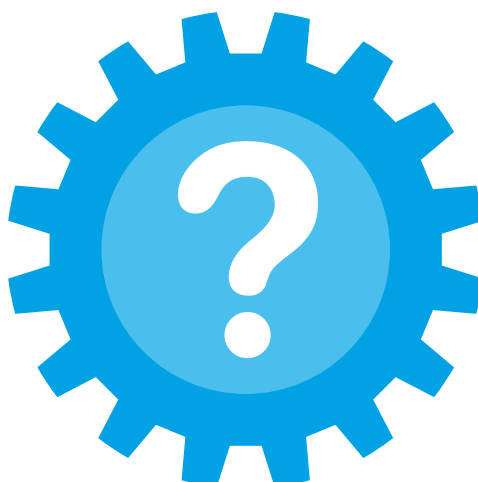
- Ensure plenty of sugar-free fluids if the blood glucose is high.
- Ensure adequate carbohydrate intake.
- An insulin bolus must be given to cover carbohydrate content of food and fluids.
- If managing to eat, the bolus insulin dose may need to be increased temporarily e.g. if usually using insulin to carbs ratio 1 unit:10g, change to 1 unit:8g.

What can cause a pump to stop delivering insulin?

- The battery can run out – this will not happen without warning and you have been supplied with spare batteries.
- The pump can be dropped.
- The pump can be disconnected by accident.
- Insulin can leak out of a giving set if it is not connected properly.

What do I do if I suspect a pump problem?

- Check a blood glucose reading.
- If the BG is >14 mmol/L, check for ketones and follow the hyperglycaemia/intercurrent illness flowchart.
- Change the infusion set.
- If a technical problem with the pump is suspected, run a 'self-test'. (Do this if the pump has been dropped).
- If this does not resolve the problem, remove the pump and switch to subcutaneous insulin injections by basal bolus regimen.
- Contact pump company for technical help.



General advice

It is expected that the information given when you commence the insulin pump will allow you to manage problems that arise relating to diabetes.

Telephone advice can be obtained during normal office hours by contacting the diabetes nurse specialists (see Contact List).

Please note that advice regarding the management of insulin pumps is not available out-of-hours (i.e. evenings, weekends and holidays).

Should you encounter difficulties that you are not able to solve using the information that has been provided, you should disconnect the pump and revert back to subcutaneous insulin injections.

How do I switch from the insulin pump to insulin injections?

The amount of insulin required by injection depends on the total daily dose (TDD) of insulin on the pump. This information can be obtained from the daily totals menu on the pump (utilities menu).

How do I calculate the dose of insulin required by injection?

Option 1

Find the current total daily **basal** insulin dose in 'utilities - daily totals' menu. Give this as either Lantus/Abasaglar once daily, or divide by two, and give as levemir twice a day.

Find the current **bolus** insulin doses in 'Bolus - bolus setup - bolus wizard setup - review settings'.

Option 2

If the pump has failed and you cannot access the settings, log into your Carelink account and go to 'device settings', to check the most recent doses.

Option 3

If the pump has failed and you cannot access the settings, and you do not have a recent diabetes clinic letter, or a recent pump download, estimate the total daily dose of insulin (TDD) by:

$$\text{TDD} = \text{Weight (kg)} \times 0.8$$

Divide this into 40% basal and 60% bolus. Give the basal insulin as lantus once daily, or divide by two and give as levemir twice a day.

If you do not know the current insulin:carbs ratios, the 60% bolus insulin can be divided by three and given at each meal (Novorapid/Humalog).

Example

TDD on insulin pump	30 units
40% basal	*12 units Levemir 6 units in the morning and 6 units in the evening OR Lantus 12 units once daily.
60% bolus	**Use the insulin to carbohydrate ratio and correction factor from the pump settings at mealtimes. Alternatively 18 units (6 units at breakfast, 6 units at lunch, 6 units at tea).



Additional very fast acting insulin may be required outside of mealtimes as per the Sick Day Management section.

$$* \frac{40}{100} \times 30 = 12 \text{ units}$$

$$** \frac{60}{100} \times 30 = 18 \text{ units}$$



Admission to Hospital While on an Insulin Pump

In some situations it is possible to continue on an insulin pump if you/your child are/is admitted to hospital, however there may be reasons why it is deemed safer to discontinue the insulin pump and switch to subcutaneous injections during a hospital admission.

When is it not possible to continue on an insulin pump in hospital?

In the following situations you/your child must remove the insulin pump and switch immediately to insulin by subcutaneous injection or IV insulin infusion.

- Diabetic ketoacidosis – the pump will be disconnected and insulin and fluids will be started through an infusion into the vein.
- If you/your child are/is drowsy or unconscious.
- If you/your child are/is seriously ill and require admission to the intensive care unit.
- If there is no one continuously present on the ward (parent or carer) to perform all pump care.
- If you/your child have a major psychiatric disturbance.
- If you do not have enough consumables (parents should have all consumables required for the duration of the admission).
- Other situations as determined by the medical staff.



Guidance for In-patients Remaining on an Insulin Pump

Providing there are no contra-indications (as listed above) patients may remain on their insulin pump. It is expected that the parent/carer will be responsible for the management of the insulin pump at all times during the admission.

What documentation is needed for in-patients on insulin pumps?

- We will ask you to sign a form indicating that you will be responsible for managing your child's pump and documenting pump settings.
- We will ask you to document the basal rates, blood glucose, blood ketones, carbohydrate intake and bolus insulin given on daily diary sheets (the same as those used after the pump start).

Who will operate the insulin pump on the ward?

- A parent or guardian must be able to stay with the child at all times during the admission.
- You/your child must operate the pump during the admission.
- You/your child must make any adjustments on the pump.
- The flowcharts for management of hypoglycaemia/hyperglycaemia and sick days will be available on the ward.

What happens if my child needs to have an operation?

The insulin pump may be removed for short procedures (the total time off the pump should not be more than 60 minutes) such as for an MRI or CT scan. If the procedure will take longer than 60 minutes, it may be possible to stay on the pump with guidance from the diabetes team, but it may be necessary to come off the pump and switch to insulin injections or an infusion of insulin into a vein.

Radiology investigations

- The insulin pump must be removed before entering the MRI/CT suite. This is because the magnet in the MRI scanner will cause the pump to fail.

Minor surgery

- Insulin pumps may be used, continuing on a basal rate during fasting periods and the surgical procedure.
- The diabetes team will discuss with the anaesthetist prior to the procedure. Blood glucose will be monitored half-hourly during the procedure.
- Boluses can be given through the pump as usual, once eating and drinking after the procedure.

Major surgery

- The pump needs to be removed and an infusion of insulin through a drip into the vein will be commenced.

Parent/Carer Consent Form

Continuation of insulin pump therapy during in-patient stay

For your child's safety during this admission, we request that you agree to the following recommendations. If you feel that you cannot agree to these recommendations, we would like to treat your child's diabetes with insulin injections and request that you discontinue the use of your child's insulin pump.

As the parent/carers during my child's admission to hospital:

- I am trained to use the insulin pump and will remain in the hospital for the duration of the admission.
- I will manage the insulin pump during the admission.
- I will provide all the equipment, consumables and insulin required for the duration of the admission.
- I will record the pump settings, basal rates, blood glucose, ketones, carbohydrate intake, insulin boluses on the 'insulin pump in-patient record' chart which will be kept in the yellow folder by the bedside.
- I will allow nursing and medical staff to have access to the 'insulin pump in-patient record' at all times.
- I will change the infusion set every 48–72 hours or as required according to the hyperglycaemia or intercurrent illness flowchart.
- If I cannot manage the pump, the insulin infusion pump will be disconnected and insulin injections commenced.

I also understand that the pump may be discontinued and a different insulin delivery given for any of the following:

- Contra-indications (as listed above).
- The request of the consultant responsible for the patient during the admission.
- An x-ray procedure (may include pump removal by tubing disconnect and/or removal of the pump and tubing).

Parent/Carer

Signature..... Print..... Date

Witness

Signature..... Print..... Date

