# B: Practical Skills

## B1: Glucose meters

Blood glucose meters help you to keep an accurate idea of your blood glucose levels; they are a key part of your diabetes management. Your diabetes team will discuss the different types to suit your style.



The Optium Neo meter will check glucose and ketones (blue strips for glucose and purple for ketones). The Accu-Chek Aviva Expert meter will help calculate insulin doses based on your current blood glucose level, carbohydrates to be eaten and correction dose required. There are many other meters around but avoid buying a new meter as your diabetes teams will provide them. Meters must be compatible with diasend to be downloaded at clinic, which not all meters are. Examples of other meters are shown below but discuss with your diabetes nurse which is the most suitable meter for your individual needs.


When you come to clinic bring all your meters as we will download them and go through the results with you. Explore your meter and look at your average blood glucose readings. Make sure your time and date is correct on the meter. You can also download some meters onto diasend from home if you wish, ask your diabetes nurse for more information.

Do not forget to order new batteries from the company and take some spare on holiday.

**Glucose and Ketone test strips:** These are different ones for each meter so it is important your GP prescribes the correct strips. You will need at least 5 per day and some spare. Your diabetes nurse will inform the GP of the type of strips you will require. To test blood ketones you will need different strips, this can only be done on certain machines.


For your meter to keep accurate results it is important to use it properly and keep it clean. You will also been shown how to test your meter with control solution.

## B2: Blood Glucose testing

**Procedure for testing / supervising blood glucose test**

Equipment needed: Blood glucose meter, test strips, finger-pricking device, lancet, sharps bin and cotton wool or tissue.

1. Ensure child washes their hands and dries them thoroughly. (If hands are cold, run them under warm water or shake them to warm them up).
2. Insert new lancet or advance the fastclix lancet as taught.
3. Insert test strip into, or advance test strip from, blood glucose meter.
4. Prick the side of the finger (it is less painful than the finger tips) and wipe away the first drop of blood with cotton wool or tissue.
5. Squeeze a small drop of blood by milking the finger from the base to the tip.
6. Hold the test strip to the blood and allow the strip to suck up the blood. The meter will beep or the display will start counting down when enough blood is received.

7. After a few seconds the blood glucose level should appear on the screen. (If an "error" appears on screen this may be due to insufficient blood sample therefore repeat the test. If problem persists, refer to meter reference guide or contact parents for advice).
8. Dispose of lancet and test strip as taught.
9. Record blood glucose result.

There are many different types of blood glucose meter, each requiring a slightly different method of use. The above is only a guide; always perform/supervise the test as taught by the children's diabetes nurse specialist.

**Testing tips:**

- Make sure your hands are clean before you begin. Use water rather than wet wipes (wet wipes contain glycerine that could alter the result).
- Prick the side of the finger, not the middle, or too close to a nail. Using the side is less painful.
- Use a different finger each time and a different part; this will hurt less.
- If you don't get much blood, hold your hand down towards the ground. This should make more blood flow to the fingers.
- Make sure your hands are warm – if they are really cold it's hard to draw blood, and finger-pricking will hurt more.

**When to test:**

- Before all main meals (breakfast, lunch and tea) - this allows you to correct your blood glucose by adjusting your dose if you are too high or too low.
- Bedtime, to make sure you are not too high or low before bed.
- If you are unwell - this is essential. You may need to check every 2 hours and give extra insulin if high to avoid DKA.
- In relation to episodes potentially associated with hypoglycaemia, e.g. increased exercise or alcohol ingestion.
- If suspected hypoglycaemia - check to confirm. If unable to get to meter quickly treat first then test.
- If your blood glucose has been high (greater than 8mmol/l) in the daytime and you have given a correction dose, retest within 2-4 hours to see that your glucose level has returned to normal.

## B3: Insulin Pens

These hold 3 mls of insulin (300 units) either in cartridges or as disposable pens. Your diabetes team will advise on the best pen as it depends on the type of insulin and whether you need 0.5 unit doses or large doses.


Make sure you have a spare pen and choose different colours for the rapid and long acting insulin so you do not get muddled.

**Needles**

These are attached to the pen and are very fine so that it reduces any discomfort to a minimum - some people do not even feel them. They should only be used once and certainly not for more than a day before discarding. For children and teenagers the 4 mm needle is recommended.

It is important to be careful with needles and dispose of them safely in the special needle bin.

**Needle bins**

These can be obtained from your GP but usually have to be collected by the council when full.


## B4: Injection techniques and Insulin Delivery

Giving injections to your child may seem very worrying at first. Remember you are not alone, your Diabetes Nurse or a member of the ward team will be there with you at first until you feel you can manage this without their help. By using the following guidelines every time, it will soon become part of your daily routine.


**Insulin**

- Check that the insulin you are to use has not passed its expiry date. Once insulin is in use, it lasts for four to six weeks and may be stored at room temperature. Unopened insulin must be stored in the fridge.

- Ensure that you give the injection in accordance with the insulin type and the manufacturer's instructions. Novorapid, Apidra or Lispro is to be given as a bolus and is usually injected 5-15 minutes before food. Long acting or basal such as Detemir or Glargine insulin is given at a set time of the day and is not related to food. Your Diabetes Nurse will advise you on what you should do.

- Premixed insulin such as Novomix 30 requires mixing by gently rocking the pen backwards and forwards about 20 times *(refer to manufacturer's instructions if you are unsure).*

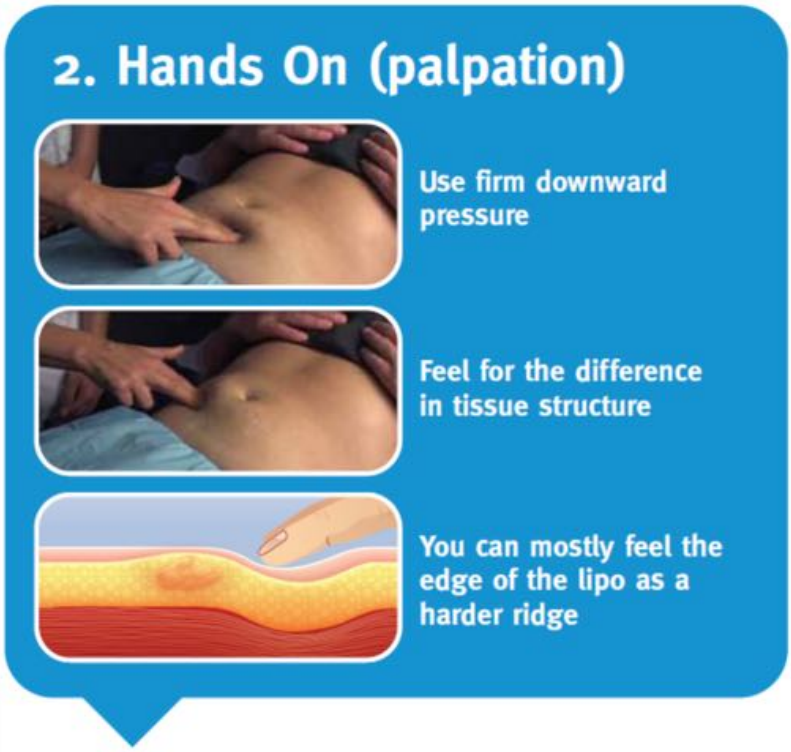
 

**Injection technique and rotation**

- Observing the nurse perform the first injection will enable you to see the correct technique, the sites and also how to support your child during the procedure.
- Injecting your child for the first time can be difficult both because it is a new skill but also because it can feel at odds with your usual role of protecting your child. These feelings are normal and some people find it useful to remind themselves how much better you are making your child feel by giving them the insulin which their body needs.
- Please talk to one of the CYP diabetes nurses if you would like further ideas for managing injection times, Talking through and involving children in a way that is appropriate for their age, distraction techniques and using soft toys for role play are some of the strategies which can help.
- It is important to move around the injection area and to change sites as fatty lumps (lipos) can develop if you keep using the same area. These lumps can affect the absorption of the insulin and lead to swinging blood glucose levels and poor control. The best place to inject is the upper area of your buttocks, but abdomen, upper arms and thighs are also options.
- If you are unsure ask the diabetes team to help and advise you.
- Remember to regularly check injection sites for lipos as:

**"Lips can cause Hypos".**

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**Injection sites**

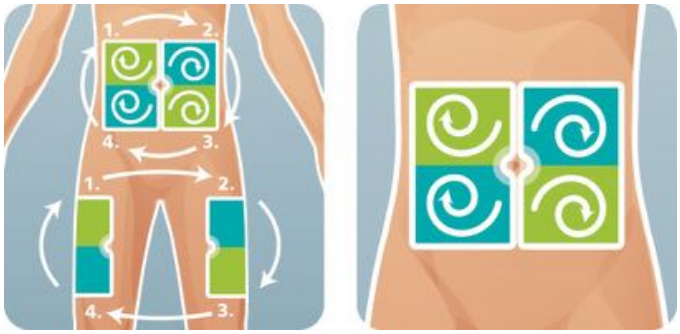
The preferred site is the top of the buttocks. This area has the most subcutaneous (fatty) tissue which means insulin is less likely to be injected into the muscle. Injecting into the muscle can be more painful and insulin is absorbed quickly and unpredictably.

If your child is about to do some activity or exercise such as running or football, insulin injected into the legs will be absorbed very quickly.

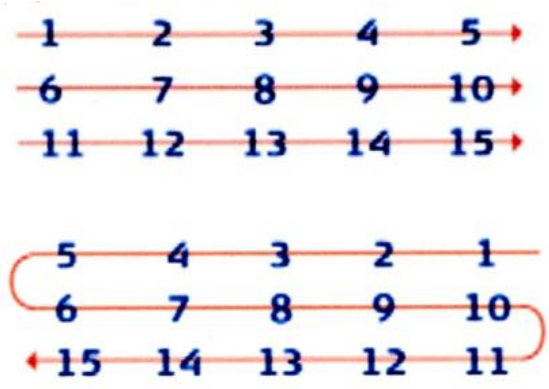
**Site rotation pattern suggestions**

There are a several rotation methods (see below) that help to prevent excessive use of one injection site and ensure the ideal absorption of insulin and will reduce the risk of lipo's.

Rotation between sites and within sites



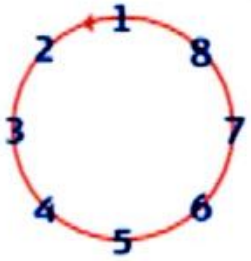

"Keyboard method" useful for abdomen and thighs




"S method" useful for abdomen and thighs

"Clock method" useful for hips and buttocks




**Injection Technique**

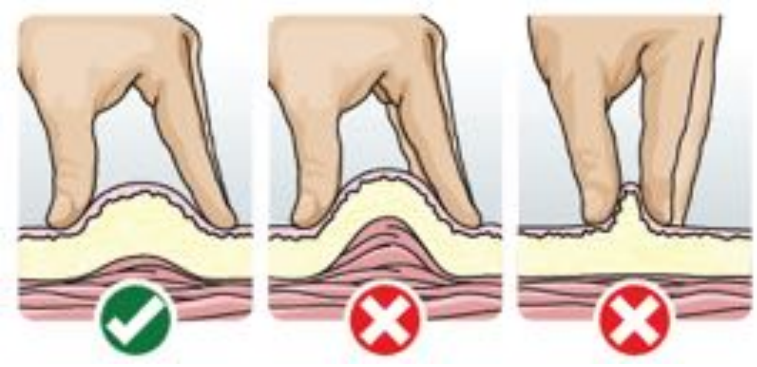

Children under the age of seven will usually need someone to do the injection for them. If your child needs an injection to be administered for them by a member of staff (school or hospital) or a carer, then a safety needle (BD Autoshield 5mm) is required to prevent needlestick injuries.


At all other times use of the shortest needle possible is recommended and these currently are 4mm in length.

Talk to the CDNS about coping and distraction techniques which may help. If you have already tried these strategies an appointment with the diabetes team psychologist may help.

- Remove the pen cap
- Attach a new pen needle
- Prime the needle with 2 units of insulin, holding the pen with needle upright
- Once a drop of insulin has been seen, the pen is ready to use. If a drop of insulin has not been seen - repeat the procedure
- Dial the number of units calculated
- Choose the injection site and lift a wide skin fold. This helps to hold the skin steady and avoids injecting into the muscle. A lifted skin fold is recommended for all ages but especially 2-6year olds.



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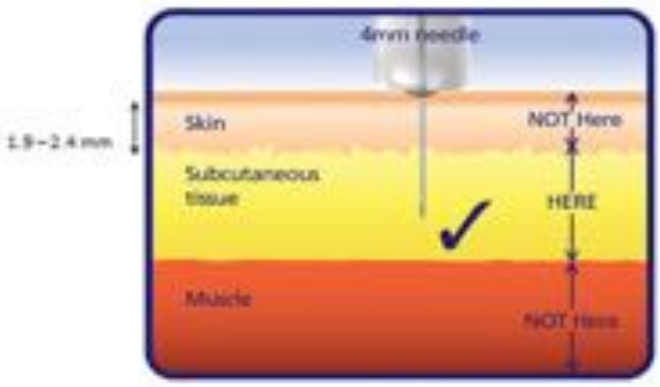
- Inject the pen device needle at 90$^{o}$ and press the button/plunger as far as it will go. The dial will reset back to zero to indicate that the dose has been administered




- Count to 10 before removing the pen device to reduce insulin leakage
- Following the injection, remove the pen needle from the pen using the outer cover (do not try to replace the inner needle cover) and discard carefully in the sharps container
- Replace the pen cap on the pen device
- Always remove your needle after every injection to minimise the risk of accidental injection and prevent re-use of a blunted needle which will be more painful and cause more trauma to the skin.
- Remember that fast acting bolus insulin should be injected into a different site to long acting basal insulin.

Your Diabetes Nurse will help you with the above and will be able to advise you in the first few days following diagnosis.

**Safety devices**

Recent European legislation requires that if a safety needle exists, those caring for a person requiring an injection should use this device to protect themselves from a needlestick injury and exposure to blood borne infections.

As the shortest available safety needles are currently 5mm in length, the risks to the healthcare workers or carer need to be balanced with the risk of intramuscular injection and subsequent hypoglycaemia or glycaemic variability.


The CYP diabetes team recommend ward staff

demonstrate to children, young people and families injection technique with a 4mm needle (on a soft toy or similar). Actual administration by the nurse will then be done using the safety device (see picture above). School staff and carers will also be encouraged to use this device. Once your child is able to inject themselves the 4mm pen needle will be used.

## B5: Guide to insulin regimes

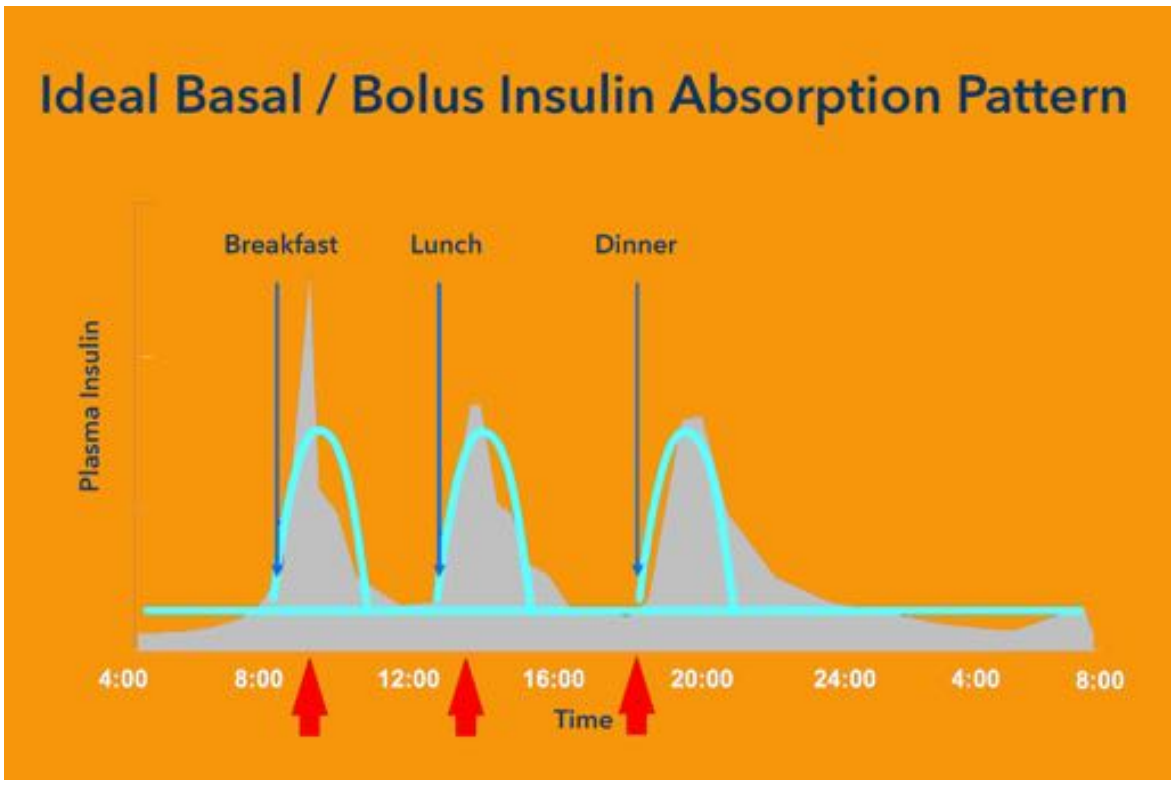
The two most common types of insulin regimes used are Multiple Daily Injections or (MDI) and **Insulin Pump therapy (IPT)** also known as continuous subcutaneous insulin infusion or CSII.

Both of these involve a basal and bolus insulin to be delivered and so are sometimes referred to as "Basal bolus regimes".

**Multiple daily Injections**

MDI involves two different types of insulin - long and fast acting

A combination of fast acting insulin given as a **bolus** with each meal or snack and long acting **basal** insulin usually given once a day.




**Long acting insulin (Basal)**

Long acting insulin such as glargine (Lantus) or detemir (Levemir) is usually given once daily to provide a low level of background insulin (Basal). This long acting insulin provides a steady release to keep the blood glucose level stable throughout the day and night. Long acting insulin has a slower onset time and lasts much longer than the fast acting bolus insulin. It lasts 20- 24 hours and is usually given in the evening but is sometimes given in the morning.

The long acting insulin dose may be split and given morning and evening. Where possible the long acting insulin should be given at a similar time each day.

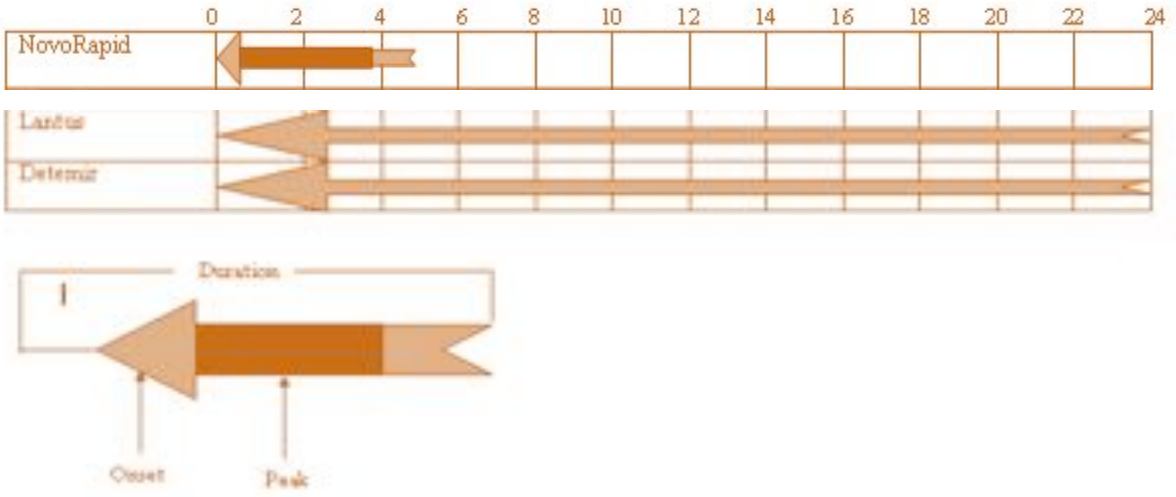
The long acting insulin is required even when not eating or drinking. It is not fast enough to be used for food or corrections.

**Fast/Rapid acting insulin (Bolus)** Fast acting insulin is given for the food eaten and when needed to correct a high blood glucose (BG) level.

Fast acting insulins such as Novorapid, Humalog Lispro or Apidra are absorbed more quickly than basal insulin and last for 3 -5 hours. They are designed to be given before food/drink containing carbohydrate (CHO) to prevent a high blood glucose level or to correct back into the target range (4-7mmols/l).

- The insulin to carbohydrate ratio (ICR) is the calculation used to work out how much insulin to give before each mealtime. Your diabetes team will guide you on what insulin to carbohydrate ratios to use. It is not uncommon to use different insulin to carbohydrate ratio at each meal. Fast acting insulin works best if given 15-20 minutes before food.

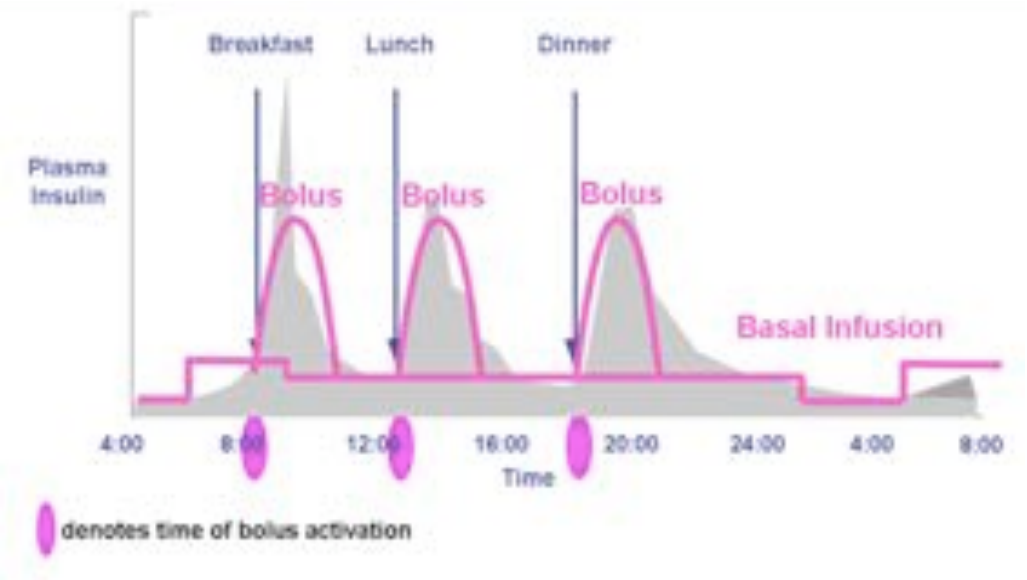
- The Insulin Sensitivity Factor (ISF) or correction dose is the amount of insulin required to bring the BG level back into the target range (4-7). Eg If 1unit lowers the BG level by 5mmols this will be written as 1:5.



## INSULIN PUMP THERAPY

An insulin pump is a pocket size, battery operated device which delivers only fast acting insulin. It is programmed to deliver insulin in small amounts constantly throughout the day to mimic the working pancreas and this is known as the pump basal rate. At mealtimes a bolus of insulin is given by pressing a sequence of buttons to deliver the mealtime bolus after carbohydrate counting and, if needed, a correction dose.

- Long acting insulin is not used in insulin pump therapy
- Comprehensive pump training will be provided if you choose to use this method of insulin delivery.




Multiple daily injections and insulin pump therapy offer intensive management and aim to replicate the workings of a normal pancreas whilst also allowing more flexibility, tiny dose adjustments and more options so that diabetes fits your lifestyle.

### Less intensive regimes

At some points in a person's life a less intensive regime may be needed. Sometimes this is for a short rest period. However as they don't match so closely with normal physiology so they can be more restrictive and less predictable.

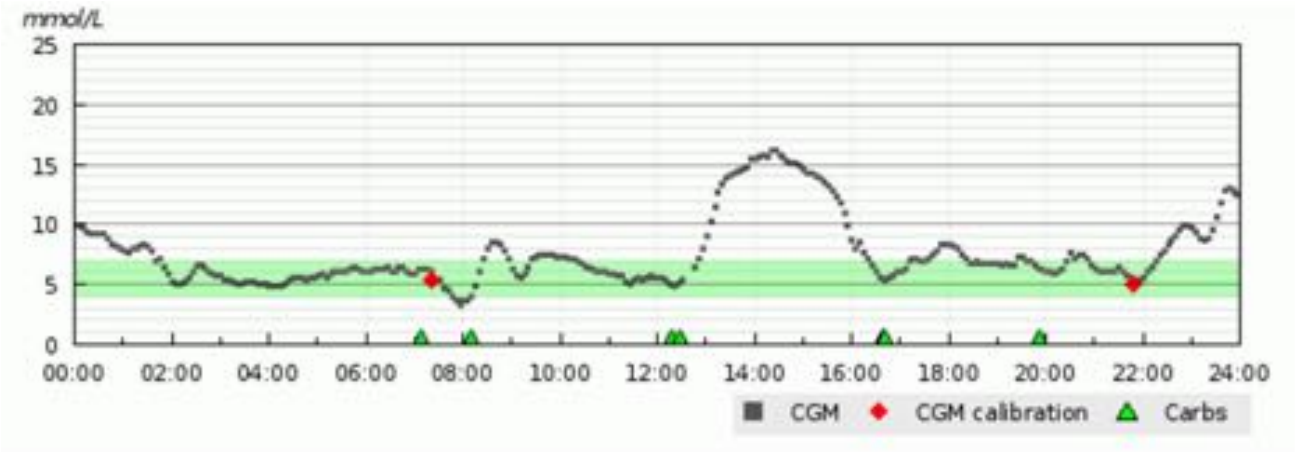
Premixed insulin (Novomix 30, Humalog mix 25, Humalog mix 50) are generally given twice daily in fixed doses. You do **not** carbohydrate count with these insulins. They are generally less flexible and require a more fixed dietary regimen.

## B6: Monitoring and taking control of your diabetes

Your body works best if your blood glucose levels are not too high and not too low. People who do not have diabetes have blood glucose levels that stay between 3.5 and 7 mmol/L. If you have diabetes, good control means aiming to keep your blood glucose levels between 4 and 7 mmol/L before meals and on waking, and between 5 and 9 mmol/l approximately 2 hours after meals most of the time. Careful balancing of your insulin doses, diet and exercise will help you achieve this.

Measuring your blood glucose is the only way of knowing exactly what your levels are. If you go by how you feel, you will only know when you are very low or very high. Without any readings your diabetes team will not be able to help you, so it is important to bring your meter to clinic.




**MEASURING CONTROL EACH DAY**

This can be done at home, school or when out and about by doing regular finger prick tests, with the equipment we will give you. (See blood glucose testing)

It is recommended that you test at least before each meal, before bed and when you feel low (hypo) or unwell. If your glucose level is high (greater than 9mmol/L) it is important to check that it has come back to normal within 4 hours.

The children who obtain excellent control test on average 5 to 7 times each day and achieve 70-80% of their results in the target range.

Extra tests may be needed at other times such as during illness, following a hypo, stressful periods such as exam time or during a growth spurt.

Patterns and trends of blood glucose levels that are too high or too low are more easily identified with regular monitoring.

If blood glucose levels are significantly high (14mmol/L or more) check for blood ketones. If blood ketones are above 0.6mmol/L and rising, immediate action must be taken because you are in danger of becoming seriously ill very quickly. (See sick day rules).

**THE IMPORTANCE OF MEASURING AND MONITORING BLOOD GLUCOSE LEVELS**

The number displayed on the meter tells you how much glucose is in the blood stream at the time that the test was carried out. It is measured in units called millimols per litre.

Recommended blood glucose targets for children with diabetes are:-

| | |
|---|---|
| On waking | 4 to 7 mmol/L |
| Before meals at other times of day | 4 to 7 mmol/L |
| After meals | 5 to 9 mmol/L |
| Before driving | At least 5mmol/L |

The blood glucose result indicates the action you will need to take to manage your diabetes well on a day to day basis.

Insulin doses are adjusted according to patterns and trends of the blood glucose levels to achieve better control.

If the blood glucose level is high e.g. 8mmols/L or more before a meal then additional insulin is recommended. This is called a CORRECTION DOSE.

This extra insulin is added to the food bolus insulin which has been calculated from carbohydrate counting. Within 2-4 hours, or by the next meal, the blood glucose level should then return into the target range. You will be informed of your correction dose ratio by the diabetes team. The correction dose ratio will change over time as you grow.

Looking for patterns and trends of rising or low blood glucose levels, and looking for reasons will give you clues as to the changes required to get back to your target level. Before changing insulin doses you need to consider other things, such as injection sites, rotation, exercise and food (see insulin adjustments and problem solving).

**EQUIPMENT YOU WILL NEED FOR MONITORING BLOOD GLUCOSE AND KETONES**

1. Blood glucose and ketone meter(s)
2. Blood glucose test strips
3. Blood ketone test strips
4. Your finger pricker with lancets.
5. Cotton wool.
6. Blood glucose diary to record the result.

**HOW DO I DO IT?**

See blood glucose testing leaflet

**MEASURING CONTROL AT THE CLINIC**

We will download your blood glucose meter(s) in clinic so that we can look at the results in more detail with you. You may be able to do this yourself at home (see meter downloading) or ask your diabetes team for instructions.

**MEASURING CONTROL IN HOSPITAL**

During any subsequent admissions to hospital staff may need to use hospital blood glucose monitoring equipment rather than your own.

**A LONG TERM MARKER OF DIABETES CONTROL IS THE HBA1C TEST**

This is also a finger prick test carried out at each clinic appointment.

It measures the amount of glucose attached to the red blood cells in the blood over the last 6-12 weeks. The larger the amount of glucose in your blood, the higher the HbA1C result will be. It is measured in mmol/mol.

The recommended HbA1C level is 48mmol/mol or under, anything higher than this means your long term health may be affected. Your diabetes team is there to help you achieve this level. Please ask if you are not 100% sure what to do.

**CONTINUOUS GLUCOSE MONITORING (CGM)**

Continuous glucose monitoring may also be recommended from time to time. This is a way of analysing your glucose results in more detail and can be very informative in assisting with insulin dose adjustment, carbohydrate ratios and exercise management.

## B7: Average blood glucose levels and meter downloads.

**AT HOME**

The HbA1c level effectively represents average glucose levels over a period of 6-12 weeks. A way of monitoring how you are doing between clinic visits is by looking at your average blood glucose levels over 1-2 weeks and you can do this on your glucose meter. The relationship between an average glucose level and HbA1c is shown in this chart below.

| HbA1c(mmol/mol) | Average glucose(mmol/L) |
|---|---|
| 20-42 | 3.8-7 |
| <50 | <8.1 |
| 50-60 | 8.1-9.5 |
| 61-70 | 9.6-11.1 |
| 71-80 | 11.2-12.5 |
| 81-100 | 12.6-15.4 |
| >100 | >15.4 |

In order to meet the national target for an HbA1c of 48mmol/mol or less we would suggest that you aim for a weekly average blood glucose level of 8mmol/L or less (It is important to note that the average blood glucose level is useful only if at least 4 blood glucose tests are done per day). The screenshots below show how you will find average glucose levels on an Accucheck Aviva Expert meter.

It is also possible to look at the percentage of results within target as shown below. The aim is to try and have at least 2/3 of the results between 4-10mmol/L.

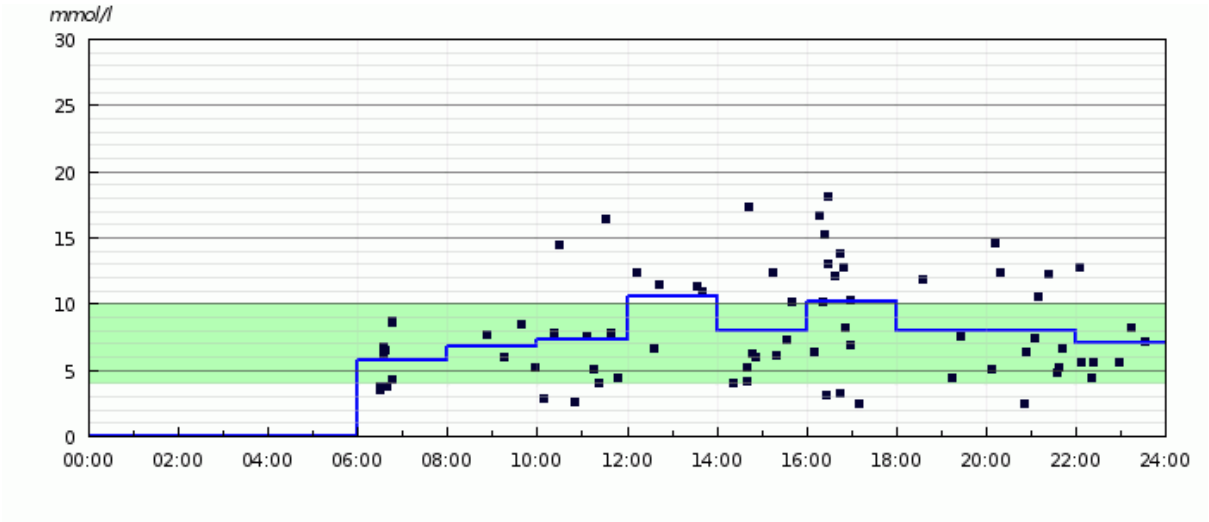
If your blood glucose average is regularly above 8mmol/L or if you are having hypos more than 10% of the time please contact the clinic so that we can help to see if any changes need to be made to insulin doses or timing.

**IN CLINIC**

When you attend your diabetes outpatient clinic you should expect that your meter(s) will be downloaded and then the results discussed with you at your consultation. The same will apply to your pumps if you are on a pump. It is therefore essential that all your meters are brought to clinic and that the time and date is correct on the meter. If you wish to obtain a new meter, then please check with the team that it will download.

The Diasend system is used in many hospitals and enables the downloading of several different meters and the results displayed on the same tables and graphs. Some examples are shown below.

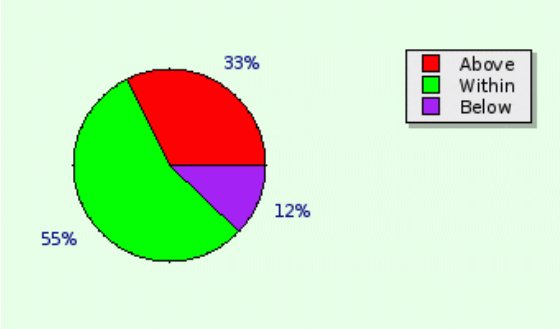
**All blood glucose values over the last month plotted against time, with blue line showing mean (average) value. Note cluster of high levels at lunch time and late afternoon.**



**This is a summary of results showing blood results between 4-10mmol/L in green, above 10mmol/L in red and less than 4mmol/L in blue. This helps to spot any patterns in high or low glucose levels so that appropriate adjustments can be made.**

**Summary of results over the last month: To achieve good control you need at least 60% of your blood glucose levels between 4-10mmol/L and no more than 10% low levels.**




Comparison of results from meter downloads for children with HbA1c less than 58mmol/mol (7.5%) and greater than 80mmol/mol (9.5%). Results were taken over 1 month and at least two blood glucose results had to be recorded every day.

| Parameter (HbA1c) | Less than 58 (7.5%) | Greater than 80 (9.5%) |
|---|---|---|
| Average BG | 8.7 mmol/l | 14.2 mmol/l |
| Average BG 16.00-18.00 hours | 10.0 mmol/l | 14.3 mmol/l |
| Average BG 18.00-20.00 hours | 10.0 mmol/l | 15.8 mmol/l |
| Standard Deviation | 4.6 | 6.8 |
| % in normal range | 57% | 28% |
| % < 4mmol/l | 12% | 7% |
| No of measurements per day | 5.3 | 3.7 |

## B8: HbA1c or Glycated Haemoglobin

HbA1c or glycated haemoglobin is an indication as to what your blood glucose levels have been over the last 6-12 weeks.

**What does it measure?**

Haemoglobin is present in everyone's red blood cells (the Hb of HbA1c). This is what makes your blood red. Glucose sticks to red cells and the more glucose there is around in the blood, then the more red cells have glucose attached. The average lifespan of a red cell is 120 days and therefore if we measure how many red blood cells have glucose attached to them, it gives us a guide to the glucose levels in your blood over the last 120 days (3 months).

**What it does not measure**

This can be the confusing bit. It is not a measure of blood glucose as you would get if you are doing a finger prick and testing your blood with a meter. It does not measure sudden changes in your blood glucose and it will not reflect a single poor day or week.

**What are normal levels and how does it relate to your blood glucose?**

Small blood vessels run throughout the body and get damaged by high blood glucose levels which lead to long-term complications of diabetes such as kidney and eye problems. An HbA1c target level of 48 mmol/mol(6.5%) or lower is ideal to minimise the risk of long-term complications. This requires hard work to achieve, but is worth it. It is important to note that if HbA1c levels are above the ideal target of 48mmol/mol or less, any reduction in HbA1c level reduces the risk of long-term complications. We will support children and young people with Type 1 Diabetes and family members to safely achieve and maintain their individual agreed HbA1c target level.

**How often is it measured?**

We aim to measure HbA1c at every clinic visit, at least every 3 months. If it is above 75mmol/mol (9%), we will arrange more frequent appointments to provide you with additional support.