

Forth Valley Diabetes Team

Insulin Pump Workbook

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Insulin Pump Therapy

In multiple injection therapy, long acting insulin is used as background (basal) insulin and fast acting (bolus) insulin is used for foods.

Insulin pumps only use fast acting insulin. The insulin pump allows you to set a basal rate of insulin, which is delivered continuously throughout a 24-hour period, this can be altered to give you different rates of insulin at different times of day depending on your individual requirements. We programme the pump with 6 basal time blocks over the 24 hour period.

When you eat a meal or snack containing carbohydrate, you need to give a bolus dose of insulin by programming the insulin pump with your blood glucose and carbohydrate intake prior to eating.

Wearing an Insulin Pump

An insulin pump delivers insulin through a small plastic cannula which is a tube inserted under the skin.

There are two types of insulin pump – 'tethered' pumps deliver insulin through a tube which runs from the pump to the cannula inserted under the skin.

Inserting the cannula is similar to taking an insulin injection. After insertion the needle is removed and the plastic cannula remains beneath the skin for 2-3 days before it is changed.

'Patch' pumps do not have tubes, the unit containing the insulin is attached to the skin and controlled through a separate handheld controller.



A cannula or patch pump can be attached to:

- Stomach
- Buttock
- Thighs
- Upper arm

It is best to avoid:

- Waistbands
- Skin folds
- Scar tissue / lumpy areas
- Areas of lipohypertrophy (fatty lumps)
- Tattoos

Comfort & Tube Safety

- Consider where car seat belts would lie
- Tuck the tubing into clothing as this protects it from catching on objects such as door handles!

Other things to consider when changing your infusion set or pod

- Wash your hands before changing your set
- If you use body lotion avoid putting on the area that you wish to use
- Use different sites as lipohypertrophy can develop on a pump too
- If you need to shave or wax the area do so 12 hours before you will insert a set to prevent inserting it into sensitive skin.
- If possible change the set prior to a meal so you are giving a food bolus soon after.
- You must check your blood glucose levels 1-2 hours after inserting a new set so that you know it is working correctly. This means that changing just before bed is not a good idea!

Change the cannula:

- At appropriate time intervals, i.e. every 2-3 days
- If the site is uncomfortable or itchy or the site is red and inflamed
- If there is blood in the infusion set
- If you have high blood glucose and ketones and have given a correction dose by pen

Try to check your cannula site morning and evening to ensure that there are no problems. This will only take a few seconds.

If you have problems with itchy red cannula sites try spraying with Cavilon 3M 'no sting' barrier spray prior to inserting your cannula. This is an alcohol-free liquid barrier film that dries quickly to form a breathable, transparent coating on the skin and is available on prescription from your GP.

Emergency Kit

When you wear an insulin pump, you must be prepared at all times with a backup system that will allow you to give insulin if something goes wrong with your pump.

It is recommended that you should carry the following items when going out:

- Blood glucose meter, finger pricking device and strips.
- Blood ketone meter and test strips
- Spare cannula and infusion set or spare pod
- Spare filled reservoir or insulin vial
- Spare battery if required
- Mealtime insulin pen and needle (in date). Don't leave the needle attached to the pen or the insulin can crystallise and block the needle. Alternatively you can use a disposable syringe and take insulin from your filled reservoir.
- Background insulin pen (if going away for more than 12 hours)
- Treatment for hypoglycaemia
- Emergency contact numbers

Setting your Basal Rates

The basal rate is the rate at which your insulin pump delivers background insulin automatically. It provides the basis for blood glucose stability and is the key to successful insulin pump therapy. The first basal rate always starts at midnight. Other rates can be set depending on your insulin requirements. Each hour can be individualised and once set, should allow you to omit meals and maintain your blood glucose targets.

Establishing an initial basal rate

In general less insulin is required when using an insulin pump because of the way the insulin is delivered. This can be 20- 30% less than your total daily insulin dose.

You will start with one basal rate over the whole 24 hour period and we will teach you how to alter it suit your individual requirements over the first week or two on the pump.

Calculating your basal rate:

- On average, how many units of quick acting insulin are you injecting in 24 hours?
 e.g. 18 units
- 2. How many units of background insulin are you injecting in 24 hours? e.g. 22 units
- 3. Add both together to give your pre pump total daily dose e.g. 40 units
- 4. Take for example 25% off pre pump total daily dose. This is now your total daily pump dose
 e.g. 75% of 40 units = 30 units
- 5. Divide your total daily pump dose by 2 to give your total basal rate in 24 hours e.g. 30 ÷ 2 = 15
- 6. Divide by 24 to give an hourly basal rate
 e.g. 15 ÷ 24 = 0.625 units per hour (round down to 0.6 units per hour)

Calculating your insulin to carbohydrate ratio

You should already have an insulin to carbohydrate ratio (ICR). This may need to be altered when you move onto pump therapy. This is a general guide for working out your ICR although your diabetes team may decide to continue your present ICR when you commence pump therapy:

Working out your ICR:

- Calculate your total daily pump dose (as documented on previous page) e.g. 30 units
- 2. Divide this into 400 e.g. 400 ÷ 30 = 13.3 round this to 13

This means you will need approx 1 unit of insulin for every 13g carbohydrate.

My starting insulin to carbohydrate ratio:

I need to take 1 unit of insulin forg of carbohydrate.

Calculating your insulin sensitivity factor (correction dose)

A correction dose is how much 1 unit of insulin will reduce your blood glucose level by.

Working out your correction dose:

This is a general guide and may need to be adjusted

- 1. Calculate your total daily pump dose e.g. 30 units
- 2. Divide this into 130 e.g. 130 ÷30 = 4

This means that 1 unit of insulin will reduce your blood glucose level by approximately 4mmol.

A more accurate way of working out your correction dose is to use your Libre. When your blood glucose is above target, but is relatively stable, and you have no active insulin on board, take a bolus of 1 unit and see how much this drops your blood glucose by. This will indicate what your correction dose/insulin sensitivity factor will be.

My correction dose is: 1 unit of insulin will reduce my blood glucose bymmol/l.

Calculating insulin pump settings



Insulin to CHO ratio = 400 ÷ adjusted pump TDD =..... Therefore 1 unit of insulin is required for everyg of CHO

Insulin sensitivity = 130 ÷ adjusted pump TDD =

Therefore 1 unit of insulin will reduce your blood glucose by mmol/l

Adjustment of Basal rates

For the best blood glucose control you have to have the right basal rate at all times.

We set the pump up with 6 basal rate segments of four hours – midnight to 4am, 4-8am, 8am-12pm, 12-4pm, 4-8pm and 8pm to midnight. This allows us to adjust the basal rate at 6 opportunities throughout the day and allows you to have a basal rate tailored to your requirements.

Once your basal rates are correct you will experience:

- Blood glucose levels within target throughout the day.
- Flexibility for example you can delay or skip meals without fear of hypoglycaemia.
- Better control lower HbA1c levels.

Signs that your basal rate is too high

 You go low a lot (blood glucose levels below 4 mmols/L) especially if you skip a meal or overnight.

Signs that your basal rate is too low:

- You have lots of high blood glucose levels (blood glucose levels above 10 mmols/L) especially when you have a long gap between meals for example in the middle of the night.
- You have to give a lot of correction boluses to correct high blood glucose levels.

You can check your basal rate:

- If any of the problems occur as listed above.
- If your HbA1c is rising.
- If your lifestyle changes and you are unhappy with your blood glucose levels

How to check your overnight basal rate:

- Eat a light meal no later than 7pm. Do not take any more food or drink (containing carbohydrate) and do not correct bloods unless hypo or high. If you need to correct your blood glucose then abandon the basal rate check for the night.
- Check your overnight glucose by scanning (Libre) at bedtime and then 7 hrs later. The Libre holds 8hrs of data so running more than 7hrs between scans risks losing information.
- Once you have your 7hr scan you can then eat breakfast.

How to check your daytime basal rate:

- The check must start at least four hours after the last meal and bolus insulin.
- Check one time block at a time
- Miss the next meal *(*breakfast, lunch or tea) and do not bolus insulin
- Check and record your glucose by scanning at least every two hours until next meal.
- Stop the check if your blood glucose drops below 4mmol/L or rises above 14 mmols/L.

Adjustment of insulin:

- When the check is complete, decide whether the basal rate needs adjusting.
- Your blood glucose should stay within 2mmol/L of your bedtime reading. If your blood glucose has stayed within this target range then the basal rate for that period does not need adjusting.
- If your blood glucose goes over the target range then the basal rate will need to be increased.
- Increase the insulin rate on your pump for the time block during which your blood glucose rises (e.g. if the blood glucose reading at 6pm increases, then the basal rate will need to be increased between 4-8pm). Increase the rate by a small amount initially, it is unusual to increase it by more than 0.1 unit per hour.
- If your blood glucose falls more than 2mmols/L then you may need to reduce the basal rate
- If your basal rate has been adjusted then it is important to recheck it within the next few days.
- Download your new rates onto Diasend/Glooko or write down the new basal rate on the chart provided and date it in case your pump fails. This provides a record if the pump has to be reprogrammed.

Do not hesitate to seek advice from your diabetes team if you are uncertain about what to do.

Other things to consider:

When your insulin pump settings are being determined it is important that you **do not** perform any unusual or strenuous activity unless it is an activity that you undertake every day.

What happens if my weekday activities are different from my weekend activities?

Insulin pumps have a feature that allows you to set different basal patterns to meet your individual daily, weekly or monthly needs. Your diabetes team will give you advice regarding how and when to do use this feature.

Checking insulin to carbohydrate ratios (ICR)

Factors to consider when checking your ICR:

- It is important that the blood glucose level is in range between 5-8 mmol/L.
- The fast acting insulin dose must be taken at least 4 hours previously, to ensure no active insulin is present (4 hours is how long your insulin is active for)
- Only check your ICR when you know your basal rates are correct
- Only check when you are well
- No alcohol should have been consumed within the last 24 hours and no strenuous exercise
- Avoid eating a high fat/high carb meal. For example pizza, macaroni cheese, chippy (these foods take longer to digest as the fat slows down digestion and can cause your blood glucose levels to rise after 4 hours)
- Avoid snacking within the 4 hour period of checking your ICR

How to check if your ICR is correct:

- 1. Check your blood glucose before your meal
- 2. Calculate the carbohydrate in your meal accurately. It is best to eat something that you know the carbohydrate is accurate in, for example a shop bought sandwich.
- 3. Put the carbs into your pump, app or PDM and deliver your bolus.
- 4. After 2 hours check your blood glucose again. If your blood glucose is within 2mmol of your pre meal result, your ICR is correct. If your blood glucose result is more than 2mmol higher or lower than your pre meal blood glucose you may need to alter your ICR.
- 5. Look for patterns in your blood glucose results and base any changes to ICR on patterns in blood glucose results. **Don't change your ICR based on one reading.**



Examples of how to check and change ICR:

ICR 1:10g	Breakfast			
Blood glucose before meal	5.0mmol			
carbohydrate	42g			
Fast acting insulin taken	4.2 units			
Blood glucose 2 hours after meal	6.2mmol			
Both readings are within target range so ICR at breakfast looks correct. No changes are required.				

ICR 1:10g	Lunch
Blood glucose before meal	4.8mmol
carbohydrate	50g
Fast acting insulin taken	5 units
Blood glucose 2 hours after meal	10.2mmol

This shows a rise in blood glucose readings. ICR may need to be decreased to 1:8 (1 unit of fast acting insulin for every 8g carbs) Using 1:8 would mean taking 6 units of fast acting insulin (50 ÷ 8 = 6). Before changing your ICR continue to monitor blood glucose readings and check for patterns/trends.

ICR 1:10g	Evening meal
Blood glucose before meal	6.8mmol
carbohydrate	70g
Fast acting insulin taken	7 units
Blood glucose 2 hours after meal	3.7mmol

This shows a drop in blood glucose levels. You may need less insulin, ICR may need to be increased to 1:12 (1 unit of carbohydrate for every 12g carbs). This would mean taking 6 units of fast acting insulin (70 + 12 = 6). Before changing your ICR continue to monitor blood glucose readings and check for patterns/trends.

Checking your ICR:

Date	ICR =	Meal:
	Blood glucose before meal	
	carbohydrate	
	Fast acting insulin taken	
	Blood glucose 2 hours after meal	

Food Bolus Doses

Until we can determine the insulin pump settings that will work best for you it can help to eat meals in which it is easy to calculate the amount of carbohydrates.

An insulin bolus is required for all meals and snacks which contain 5g of carbohydrate or more in order to counteract the anticipated rise in blood glucose levels.

Types of Food Bolus

There are four main ways of delivering a food bolus with your insulin pump.

Normal or Standard bolus

• The complete insulin dose is delivered immediately like an insulin injection

Split bolus

- Insulin is administered before eating and again 1-2 hours later using the standard bolus function
- Administer a percentage of the total calculated bolus dose as the first bolus and then give the remainder of the calculated dose as the second portion of the bolus.
- Don't forget to deliver the second part of the bolus!

Extended or Dual wave Bolus

- Administer a percentage of the total calculated dose immediately.
- The rest of the calculated dose is extended over a set time interval of 30 minutes to 8 hours depending on the composition of the food and your individual response.

Extended or Square wave Bolus

- A calculated dose of insulin is delivered over an extended period of time (such as 2 hours).
- Not often used in its own right but it is sometimes useful for prolonged meals such as buffets, or popcorn at the cinema.

Measuring the success of a bolus

- As a guide, you could expect your 2-hour post-meal blood glucose to be no more than 2.0 mmols/L higher than the starting value. However this very much depends on what you have eaten!
- It is difficult to assess and refine bolus doses if the basal rate is not set correctly.

Factors to consider when making a decision regarding a food bolus:

- The size of the meal and how it is served
- Fat and protein content
- Glycaemic index

Size of meal

- A combination bolus may be used for meals containing a large amount of carbohydrate. Up to 5 units of insulin can be given using a normal bolus, for higher doses a bolus can be administered via the extended bolus function
- A split bolus may also be required for restaurant meals that are served as a number of courses over a prolonged period of time.

Fat content

Fat slows down the speed of digestion by 'holding' food in our stomach for longer. Fat, therefore, slows down the time taken for carbohydrate to be digested and absorbed into your blood as glucose. In addition we now know that high fat meals require additional insulin for the effect that the fat itself has on your blood glucose, these meals may require 20-30% more insulin than that which is required for the carbohydrate alone.

High fat meals will usually require a split or combination bolus.

Meals which are high in fat would include: Fried chips Takeaway burgers Battered or crumbed fish or chicken Pizza Fried breakfasts Cheese sauce Some Indian and Chinese foods Roast dinners

Glycaemic Index

The Glycaemic Index (GI) refers to how quickly carbohydrate is digested and absorbed into the blood as glucose.

Carbohydrate foods which break down quickly during digestion and release glucose into the blood very quickly have a *high* GI and carbohydrates which break down slowly and release glucose into the blood more slowly have a low GI.



A table of GI of commonly eaten carbohydrate food can be found in Appendix 3.

Meals that have a high GI will probably require a standard bolus as the carbohydrate is quickly absorbed into your blood as glucose

e.g. White or wholemeal bread in a sandwich or as toast. Mashed potatoes Breakfast cereal such as Cornflakes, Rice Krispies Rice Cakes

Meals with a low GI may require a split or combination bolus as it takes longer for the carbohydrate to be absorbed into your blood as glucose.

e.g. Pasta (especially if served with a high fat cream or cheese sauce) Dishes containing pulses and lentils Indian curries with Basmati Rice Pizza

Extension times and percentage split for extended boluses

As a starting point try an extended bolus of 70% delivered upfront and 30% extended, try extending a bolus for: -

- 2 hours for general foods, e.g. potatoes & bread.
- 2 4 hours for porridge/ pasta / rice based meals.
- 4 8 hours for large or fatty foods e.g. pizza/ Chinese takeaway
- Extension times for different food types will require individualisation. The best way to determine the best split and extension time is to test your blood glucose levels frequently after eating the food. It is often a case of trial and error but it is worth the extra effort particularly with foods which you eat regularly.

• As necessary increase the extended portion of the bolus in 30-minute intervals until the desired effect is achieved. This cannot be done effectively until the basal rate has been refined.

Blood Glucose Monitoring

During the first few days of insulin pump therapy it is recommend that you check your blood glucose levels every 2 hours during the day and every 3 hours during the night.

You may have to check more frequently if your blood glucose levels fall outside your target range.

We usually use blood glucose checks when setting the pump up but as soon as we are happy with your pump settings you can use your Libre if preferred.

You must check by fingerprick or Libre at least 6 times throughout the day. But the more you check and the more you tell the pump, the more stable your blood glucose will be.

Hypoglycaemia

Hypoglycaemia (blood glucose of less than 4mmol/L) can occur when using an insulin pump for the same reasons as when injecting insulin by pen.

The three most common causes of hypos are:

- Too much insulin.
- Under-estimation of carbohydrate content of food.
- More physical activity than planned.

Causes Specific to Insulin Pump Therapy:

- Infusing insulin through "lumpy sites" (lipohypertrophy).
- Basal rate setting is too high.
- Accidentally setting the temporary basal rate too high.
- Failure to cancel or reduce a set temporary basal rate.
- Tubing primed while still attached to your body.
- Related to your bolus dose of insulin:
 - Miscalculation of a bolus.
 - Under or over extension of the bolus dose.
- Over correction of an elevated blood glucose level.

Treatment of hypoglycaemia

Hypos should be treated with the 'Rule of 15' just like you did on injections. The table below shows some examples of 15g treatments:

Food	15g CHO is found in:		
Glucose/dextrose tablets	4-5		
Pure fruit juice	150 ml		
Cola/lemonade-type fizzy drink (not diet)	150 ml		
Jelly Babies	3		
Jelly Beans	10		
Fruit Pastilles	6		

Unlike when using injections when you are using a pump you do not need to give an additional carbohydrate snack when your blood glucose is back above 4mmols/L. If you do eat then you should enter this carbohydrate into your pump and take the insulin for it.

You do not need to suspend the pump.

Illness and Diabetic Ketoacidosis (DKA)

When you are ill, your body becomes more resistant to the insulin you are taking so you may require more. In addition, you will produce stress hormones that will cause your glucose levels to rise.

In this situation it is useful to use your temporary basal rate, you can increase you insulin up to 200% of your normal rate to cope with higher blood glucose levels.

Managing High Blood Glucose Levels when using an Insulin Pump

High blood glucose levels are managed differently with an insulin pump. With injections or pumps there are several reasons why your blood glucose levels can rise such as illness, missed insulin, stress or anxiety. Other things to consider when you are using a pump are:

- Have you eaten carbohydrate foods and have forgotten a bolus?
- Are your basal rates correct?
- Has your infusion set been in place for longer than 2-3 days?
- Is the infusion site sore or red?
- Is there any air in the tubing?
- Is the reservoir empty or is your pump suspended?

If your blood glucose levels are 14 mmols/L or above you should do the following: -

- Check your cannula site to ensure that it ok
- Check for ketones in your blood

Blood ketone result	Action	Then
0-0.6mmols	Usual correction by pump. Check pump is still attached and functioning	Re-check blood glucose in 1 hour
More than 0.6	Usual correction by PEN. Check pump is still attached and functioning	Re-check blood glucose in 2 hours
More than 1.5mmols	Correct by pen- use double your usual correction. Troubleshoot pump and CHANGE infusion set /POD and site Consider using temporary basal and increase to 130% Ensure you are drinking at least 100mls water/sugar free juice/hour	Re-check blood glucose in 2 hours Continue to correct blood glucose and increase basal rate by 30% every 2 hours
	Replace meals with lighter snacks Treat underlying illness If vomiting/abdo pain seek urgent hep	until targets are met

Implications of Ketone Levels

High ketone and glucose levels can make you unwell and dehydrated very quickly. In the absence of sufficient insulin, the body's cells cannot use glucose for energy. The cells will switch to an alternate energy source and body fat will be broken down to supply the necessary energy. This rapid breakdown of fat can cause the buildup of ketones. Diabetic Ketoacidosis can occur very quickly if ketones are not dealt with. If your blood glucose levels are raised and you have blood ketone levels above 1.5 m.mols/L you may have to take **double** your correction dose.

What is your correction dose?

My correction dose is.....

Specific Pump Management for Hyperglycaemia (high blood glucose levels)

- Aggressively manage elevated blood glucose levels during times of illness. If raised blood glucose levels are allowed to continue diabetic ketoacidosis can develop.
- Correct high blood glucose levels (above 14 mmols/L) using your usual correction ratio providing you do not have ketones.
- If your blood glucose levels are particularly high (even if ketones are not present) you may find that your usual correction ratio will not reduce blood glucose levels as efficiently as it would under normal circumstances.
- Double a calculated correction dose if you have blood ketones of 1.5 mmols/l or more.
- Use the temporary basal rate to increase your basal rate up to 130% and recheck your blood glucose level in 2 hours time. (1 hour if ketones are present in order to ensure blood glucose levels are dropping).
- If there has been no significant improvement in your blood glucose result give the next calculated bolus dose using a pen or syringe and increase the temporary basal rate up to 160%. You are also advised to check pump function and ensure that there is no problem with the infusion set. Change your cannula into a different site.
- Continue to correct high blood glucose levels and further increase the basal rate in 30% increments on a 2 hourly basis until blood glucose targets are achieved.
- Once your illness starts to resolve blood glucose levels will begin to drop. When blood glucose trends are generally 4-5 mmol/L reduce the basal rate by 30% providing that the result was not preceded by the administration of a correction dose within the last 2 hours. Continue to do this in 30% increments in response to blood glucose trends until you have returned back to your usual basal rate.
- Keep well hydrated. Try to identify cause of high blood glucose level and seek treatment if necessary.
- Contact diabetes team if high glucose and ketones levels persist.
- Contact GP/Accident and Emergency Dept/NHS 24 if you are vomiting as dehydration may occur.

Conversion Back on to Insulin Injections

In an emergency situation it may be necessary for you to convert back onto insulin injections.

In case you are unable to recall information from your pump it is recommended that you should always keep a written record of your up to date pump settings – you will need your total amount of basal insulin, your insulin to carbohydrate ratio and your correction dose.

How to calculate your starting background dose

Take your total daily dose of basal insulin and add 20% to this amount.

If you take Lantus: take this total amount of insulin

If you take Levemir: divide this amount by two and take that amount twice a day.

How to calculate your food doses

Using your insulin to carbohydrate ratio – take the grammes of carbohydrate you are eating and divide by the amount of your ratio. Eq:

Insulin to carbohydrate ratio is 1:20g

Carbs in meal is 80g so 80/20 = 4 units of insulin.

If you need to add on a correction:

Insulin sensitivity factor is 1: 2mmols/l

Blood glucose is 10.3 and target is 6mmols – difference in 4.3mmols/l

4.3/2 = 2 units

Physical Activity and Exercise

FAQ's

Also see exercise video on website

How does exercise affect blood glucose levels?

Insulin is produced when the concentration of glucose (a simple form of sugar) in the body increases, such as after eating. Insulin stimulates muscle and fat cells to absorb the glucose they need as fuel for their activities. If you are fasting, your muscles burn fat for energy while after eating, your muscles burn glucose for energy.

During exercise, excess glucose, stored by the muscles in the form of a starch called glycogen, is used first for energy. Your body burns glycogen for energy most often during short bursts of exercise, such as a quick sprint or a run to catch the bus. As the exercise continues, your muscles take up glucose at almost 20 times the normal rate. With prolonged exercise, free fatty acids (from the breakdown of fat) become the major substance for muscle energy production.

Where do the fuels come from and what is the role of insulin?

Glucose originates mainly from the liver while free fatty acids originate from the breakdown of fats (triglycerides) in fatty tissue. Insulin levels are usually lower during exercise, allowing more glucose to be released by the liver. However, during exercise, insulin is more effective at stimulating your muscles to take up glucose. Therefore, the overall balance is that blood glucose levels don't change much during exercise.

Why do glucose levels rise in some people with diabetes but fall in others, despite similar exercise patterns?

Acute Effect

In the person, whose diabetes is well controlled, exercise may lower glucose levels since he or she has enough insulin and liver glucose production is suppressed. In the person whose diabetes is poorly controlled, he or she does not have enough insulin, so liver glucose production is unbalanced and muscle glucose uptake is diminished. This results in an increase in glucose levels and may even lead to ketosis. Prolonged strenuous exercise (exceeding 80% of your maximum capacity) may also lead to elevation of your blood glucose.

Sustained Effect

The stored supply of glycogen in your muscles is depleted after 40 to 60 minutes of moderate intensity exercise. After exercise, glucose flow across muscle increases significantly. This may lead to delayed hypoglycaemia.

Management of exercise will need to be individualised. Factors that will affect decisions are: -

- Blood glucose levels
- Type of exercise (anaerobic or aerobic)
- Duration of exercise
- Time of day the exercise takes place
- Competitiveness (adrenaline response)

General principles

- Increased physical activity is managed by eating carbohydrate and manipulating your insulin to carbohydrate ratio and insulin doses in either isolation or in combination.
- The actual strategies that will be required will need to be individualised. A different management plan may be required for different types of exercise.
- Some people who are particularly competitive in nature may find that blood glucose levels may initially rise.
- Remember that a reduction in basal rate will not take effect for half an hour after it has been started.
- Until you are familiar with your response to a particular activity check your blood glucose before, during and after the period of increased activity.
- Pre exercise aim for a blood glucose level of 7-14 m.mol/L
- Check for ketones if your blood glucose is above 14 m.mol/L and don't exercise until it is back in target.
- Do not exercise if you are unwell.
- Avoid alcohol following periods of intense exercise as this can increase the risk of hypoglycaemia.
- Keep extra carbohydrate on hand just in case your blood glucose level drops.
- Keep records of the strategies you have used and your blood glucose response.

Management strategies

Use the following in isolation or in combination:

- Reduce your basal rate by using the temporary basal rate on your pump. Depending on the intensity and duration of the exercise initially try reducing your normal basal rate by 30 50%.
- Consider in relation to your exercise routine and the anticipated response of your blood glucose levels, where you will need to reduce / increase your basal rate.
- If the exercise was undertaken in the evening you may need to reduce your basal rate overnight. Initially try reducing your normal basal rate by 10 20%.
- Use food by eating carbohydrate and omitting an insulin bolus or by using different insulin to carbohydrate ratio. This management strategy may be required before, during or after exercise.
- Consider setting a separate "exercise" basal rate. It is advisable to discuss this with your diabetes team before using a basal pattern other than your standard basal rate.

What do I do about swimming?

You are able to disconnect the pump for up to an hour, occasionally a little bit longer if you are doing active contact sports or if you are swimming.

Travel with an Insulin Pump



FAQ's What preparations do I have to make prior to travelling?

When going on trips, be sure to take extra pump batteries, insulin, pump supplies and an insulin syringe or insulin pen for injections just in case. See the section "Conversion Back On to Insulin Injections" if your insulin pump stops functioning. You should also take your blood testing and ketone monitoring equipment. A good rule of thumb is to take double the amount of supplies that you think you would need.

I'm going on a long haul flight; do I have to make any changes to my pump settings?

Travel across time zones means that you will need to change the clock on your insulin pump when you arrive. You need to make sure your pump knows when you are waking up and going to sleep. Remember to change it back once you are home.

If you are travelling across many different time zones (at least a four hour time difference) set a temporary basal rate at your lowest basal rate for the amount of time that you will be travelling, and take a bolus dose each time you eat. When you arrive at your destination, turn off the temporary basal rate and change the pump clock to the new time.

Is there anything else I should do?

- Check your blood glucose levels every two to three hours whilst travelling.
- You will also need a travel letter from your diabetes team confirming that you use an insulin pump.
- Insulin pumps **must not** be passed through an airport baggage scanner or body scanner and should always remain connected to you.

Holidays



Extremes of temperature can affect blood glucose levels. If insulin becomes too hot or cold it can stop working, which means that your blood glucose levels will rise very quickly. Heat can also make your insulin work more quickly causing unexpected low blood glucose levels.

FAQ's

Are there any special precautions I need to take?

- If you are wearing your pump on the beach, you will need to keep it out of direct sunlight. When sunbathing put a heavy towel over your pump and tubing and keep it in the shade.
- Try wrapping your insulin pump and the line in a FRIO insulin cool wallet. These are water-activated cool bags that will keep your insulin cool for 24 hours. FRIO insulin cool wallets are available from <u>www.medicalshop.co.uk</u>, freephone 0800 731 6959
- If you are wearing a swimwear think about where you insert your cannula. When it's hot, the tape on your cannula may not stick as well, especially if your skin is sweaty. You may need to put a second piece of tape over the cannula site. Opsite or Tegaderm can by either bought from a chemist or obtained on prescription from your GP.
- Try spraying unscented antiperspirant onto the site before inserting a new cannula. This can help the tape to stick better.
- Disconnect your pump if you have a sauna. This stops the pump being affected by the intense heat.
- In very cold weather try and keep the infusion set tubing inside your clothing. The tubing is very thin and the insulin inside could easily freeze.
- If your pump has a remote control you can use this to give bolus doses if the pump is concealed under thick clothing.
- For winter sports you can wear your pump in a sports harness, which is similar to a tiny rucksack. This still needs to be worn under clothing to prevent the insulin from freezing.

Hospital Admission

FAQ's What happens if I have to go into hospital, is there anything I have to do?

Here are some simple guidelines to follow.

- If your admission is planned, inform your Diabetes Team as soon as you know the date for admission. If it is to a different hospital ask them to contact the appropriate team.
- It is easier but not essential if your procedure can be done first thing in the morning.
- The appropriate medical team will advise you about eating and drinking and if you will have to fast. Remind them you have diabetes and ask them to inform the diabetes team that you are in hospital.
- You may be able to wear your insulin pump throughout the procedure if this is performed under local anaesthetic. It is advisable that you have a venflon (a small cannula) inserted into your hand/arm as a precautionary measure.
- Ensure that your pump has new batteries, a full reservoir, new infusion set and that you have a spare set of each.
- Scanners, e.g. CT scanners, MRI scanners can affect your insulin pump. The pump must, therefore be removed prior to medical scanning for the duration of the procedure and then reconnected.
- If the procedure is carried out under general or spinal anaesthetic intravenous insulin should be commenced and your insulin pump discontinued.
- Make a note of your basal rates in case these are lost from your pump.
- Once you are well enough to manage your pump yourself you can restart your insulin pump.
- When you change back from intravenous insulin onto your insulin pump, the insulin pump and IV insulin should run together for 1 hour before the intravenous infusion is discontinued.

Appendix: Glycaemic Index Table Please note that other tables may give different numbers

Low (up to 55)		Medium (56-69)		High (70 and over)	
Roasted and salted	14	Muesli, non-toasted	56	Mashed potato	70
peanuts				•	
Low-fat yoghurt with	14	Boiled potatoes	56	White bread	70
sweetener					
Cherries	22	Sultanas	56	Gluten-free unsliced	71
				white bread	
Grapefruit	25	Pitta bread	57	Watermelon	72
Pearl barley	25	Basmati rice	58	Swede	72
Red lentils	26	Honey	58	Bagel	72
Whole milk	27	Digestive Biscuit	59	Branflakes	74
Dried apricots	31	Ice cream	61	Cheerios	74
Butter beans	31	New potatoes	62	French fries	75
Fettucine pasta	32	Coca cola	63	Coco Pops	77
Skimmed milk	32	Apricots, in syrup	64	Jelly beans	80
Low-fat fruit yoghurt	33	Shortbread biscuits	64	Gluten-free sliced	81
				white bread	
Wholemeal spaghetti	37	Couscous	65	Rice Cakes	82
Apples/ pears	38	Rye bread	65	Rice Krispies	82
Apple juice,	40	Pineapple, fresh	66	Cornflakes	84
unsweetened					
Noodles	40	Cantaloupe melon	67	Jacket potato	85
White spaghetti	41	Croissant	67	Puffed wheat	89
All Bran	42	Shredded wheat	67	Baguette	95
Chick peas, canned	42	Mars bar	68	Parsnips, boiled	97
Peaches	42	Ryvita	69	White rice, steamed	98
Porridge made with	42	Crumpet, toasted	69		
water					
Lentil soup	44	Weetabix	69		
Oranges	44	Wholemeal bread	69		
Macaroni	45				
Green grapes	46				
Peas	48				
Baked beans in tomato	48				
sauce					
Carrots, boiled	49				
Milk chocolate	49				
Kiwi fruit	52				
Stoneground	53				
wholemeal bread					

Crisps	54		
Special K	54		
Banana	55		
Sweetcorn	55		