Greater Glasgow & Clyde
Children's Diabetes Service

diabetes best ideas

my health record

This record belongs to:

_____

Always remember to bring these items with you to clinic:

· your blood glucose diary

· this record

· your meter

C/- **Greater Glasgow & Clyde Children's Diabetes Service**
Inverclyde Royal Hospital, Greenock
Royal Alexandra Hospital, Paisley
Royal Hospital for Sick Children, Glasgow

Extra copies: £10 each (to cover production costs).
Additional copies may be printed from the GGC Children's Diabetes Team website:

www.ggc-youngdiabetes.org

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We wish to acknowledge the generous advice and encouragement offered to us both by all our colleagues in the GGC Children's Diabetes Service. Without their tremendous help and support this guide would not have been possible. While they gave us every support, any errors or omissions are entirely our own!
We would also like to thank GF, RM and AM (you know who you are!) for kindly allowing us to use your photographs in the guide.

Finally, our sincere thanks to the ***Yorkhill Children's Foundation*** *for the generous financial assistance provided for the production of both this Patient Held Record and its sister volume, "Food for Life".*

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Extra copies of these pages may be printed from the Diabetes Team website: www.ggc-youngdiabetes.org (in the For Families section)

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At the Start

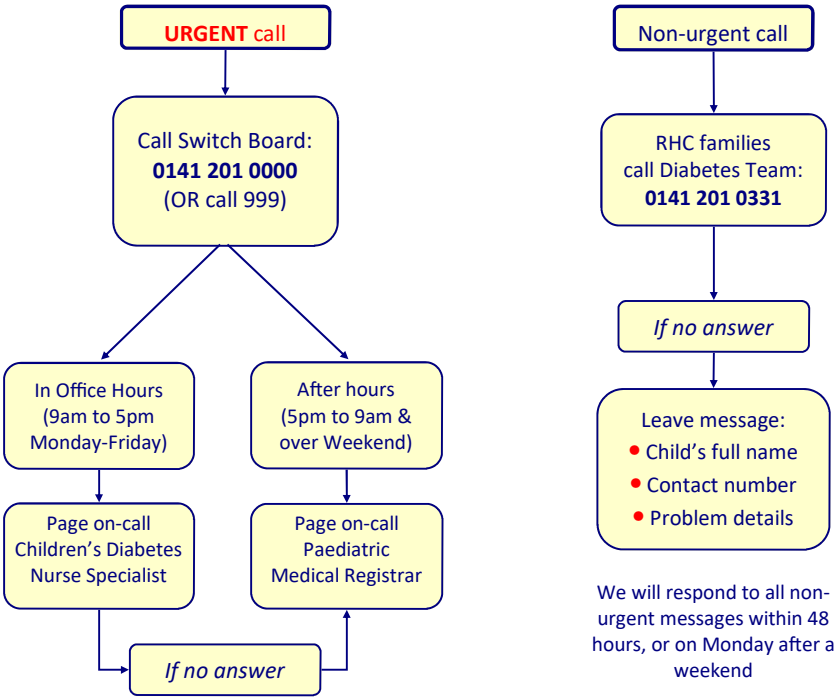
How to contact the Diabetes Team

Our service is the Greater Glasgow and Clyde Children's Diabetes Team. We care for young people with diabetes from the Glasgow and Clyde regions, as well as further those from Oban and on the Western Isles. Local contact details will be provided for you, wherever you may be, but for this in the Glasgow and Clyde region clinics are generally held nearby:

- Inverclyde Royal Hospital, Greenock (IRH) } *Including patients from*
- Royal Alexandra Hospital, Paisley (RAH) } *Argyll & Bute*
- Royal Hospital for Children, Glasgow (RHC) - *Including Western Isles*

Below is a guide on how to get diabetes-related advice. For now, RHC Outpatient clinics and patient reviews are held on Ward 6B of the former Yorkhill Children's Hospital (G3 8SJ), and **NOT** at the new Royal Hospital for Children. However, Emergencies are seen at the new Royal Hospital for Children, 1345 Govan Rd, Govan. Patients usually seen at the Inverclyde Royal Hospital clinic should contact the Diabetes Team or the Switch Board at the Royal Alexandra Hospital, Paisley, as staff are usually based there.

If the call is urgent, call switch-board and ask them to page the Diabetes Nurse Specialist (working hours, Monday to Friday), or the Paediatric Medical Registrar (at any other time). **Non-urgent calls** should be made to the appropriate Diabetes Team, and if no-one is free, leave a message and your call will be returned in 48 hours (or on Monday after a weekend).



We will respond to all non-urgent messages within 48 hours, or on Monday after a weekend

Some useful diabetes-related websites

- www.ggc-youngdiabetes.org - your own team's site
- www.diabetes.org.uk - Diabetes UK official site
- www.mydiabetesmyway.scot.nhs.uk - NHS personal diabetes sites
- www.gfg.diabetesukgroup.org - Glasgow Family Group site

Who are the members of the Diabetes Team?

Scotland has one of the highest national rates for developing diabetes, and almost 100 young people are diagnosed with diabetes in the Greater Glasgow & Clyde area every year. We are one of the largest children's diabetes service in the United Kingdom.

Each team member is a specialist, but we work together closely, and sometimes our jobs overlap! We strive to always provide correct and consistent information, based on this guide, and in its companion, the "Food For Life" book. You may find these books and other information on our web site (www.ggc-youngdiabetes.org). If there is anything you are not certain about, please ask us.

Current members of the diabetes team staff are listed below. However, you may meet any of us at your clinic, wherever it is held. Your team will be involved in your child's care, but each person will have a team of dedicated nurses to co-ordinate this care and to provide long-term continuity.

GGC Children's Diabetes Team

Senior Medical Staff:

- Dr. Rajeeb Rashid (Clinical Lead)
- Dr. Vaiva Kuehne
- Dr. Guftar Shaikh
- Dr. Harcharan Singh
- Dr. Ian Craigie
- Dr. Hilary Pearce
- Dr. Amita Sharma
- Dr. Karen Whyte

Nursing Staff:

- Fiona Lamb (Nursing Lead)
- Audrey Kerr (Young Adults)
- Donalda Clifford (Clinical Support)
- Margaret-Ann Kilpatrick (Clinical Support)
- Laura McPherson (Clyde Team)
- Lynne Porteous (Clyde Team)
- Zoe Valentine (Clyde Team)

- Moira Lynch (North Team)
- Hazel Rogers (North Team)
- Gavin Allison (South Team)
- Lynda Moffatt (South Team)
- Victoria Wilson (South Team)

- Lisa Dobbin (Pump Team)
- Dawn Scrimgeour (Pump Team)
- Denise Stewart (South Team)

Dietetic Staff:

- Kirsty MacLean (Dietetic Lead)
- Janie Devine
- Vicky Law

Secretarial Staff:

- Angela Harrison

We work closely with our Clinical Psychology and Social Work colleagues, and with our Diabetes Teams in Argyll and on the Western Isles. You will be given appropriate contact details if you live in these areas.

A brief introduction to Diabetes

What is Diabetes?

Diabetes mellitus causes high levels of sugar in the body. There are many forms of diabetes, but children nearly always develop "Type 1" diabetes. This occurs when the body makes too little "insulin", a special substance that allows sugar to pass from the blood into most parts of the body, such as the muscles (where it is then used for energy), and the liver and fat cells (where it is stored for later use).

Type 1 diabetes occurs when too little insulin is made for the body's needs.

Food provides the energy we need each day, and this energy is found in three different forms - fat (e.g. butter, margarine and oil), protein (e.g. meat, fish and eggs), and carbohydrate. There are two main sorts of carbohydrate - simple sugar (e.g. sweets, cakes, and non-diet drinks), and starch (e.g. in bread, potatoes, pasta and rice). When starchy food is eaten, these "complex" carbohydrates are eventually broken down into simple sugars. The simplest sugar is called "glucose".

Glucose is absorbed from the food we eat, and carried in the blood to the rest of the body. However, glucose cannot just pass from blood into the cells on its own - it needs a special "key" to open the way, and this key is insulin. Insulin allows glucose to move from the blood stream into the cells. Without insulin, glucose cannot enter the tissues and the amount of glucose in the blood steadily rises.

Type 1 diabetes occurs when someone makes too little insulin for their body's needs. The amount of glucose in the blood stream continues to increase, even while tissues such as the muscles are "starving". Glucose is one of the body's main source of energy, and without insulin glucose cannot be used properly.

The body keeps blood glucose in a narrow range. Excess glucose passes into the urine, which draws in more water. Larger volumes of urine are then passed, and night-time bed wetting may occur. As extra water is lost from the body, the child becomes more thirsty and tries to drink more, but dehydration usually happens anyway. Energy needs are no longer met, and tiredness and lethargy follow. Weight loss occurs as fat stores are used up, and also because the body becomes more dehydrated. All these features result in the symptoms we usually see when someone develops diabetes.

The common symptoms of Diabetes are:

- Passing more urine
- Passing urine more often
- Drinking greater amounts
- Drinking more often
- Losing weight
- Tiredness / lack of energy

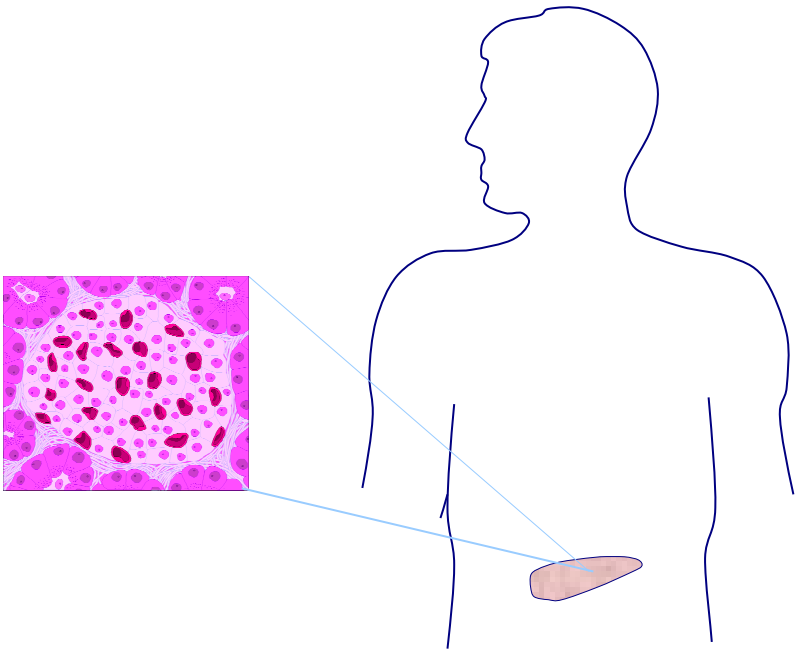
No one fully understands the cause of Type 1 diabetes. Unlike other types of diabetes, it is not due to food, or because someone is overweight. It cannot be treated with tablets, and insulin (usually given by injection) is essential for life. For now, it cannot be cured, but we *can* treat diabetes very well. Your team will help you do just that.

A brief introduction to Diabetes (continued)

What causes diabetes?

Insulin is made in a special gland called the pancreas, which lies behind the stomach, at the level where the lower ribs meet the breast bone. Special cells, known as "beta cells", make insulin and release it into the blood. These beta cells are found in tiny clusters called "islets" - little "islands" - found dotted throughout the rest of the pancreas (most of which makes the digestive juices).

The "immune" system protects us from anything seen as "different" from the body itself, such as germs that cause infection. In "Type 1" diabetes the immune system believes the beta cells do not belong to the body. It then attacks and painlessly destroys them. The symptoms of diabetes occur when insulin production has fallen to about a tenth of its usual amount. Type 1 diabetes is called an "auto-immune" condition because the immune system directly attacks someone's own body..



▲ The Pancreas gland lies behind the stomach, high up in the abdomen, and is the part of the body that produces insulin. Insulin is needed for life, allowing sugar from food to be used for energy or stored for later use. Insulin is produced in "beta cells", found dotted throughout the pancreas in tiny clusters known as "islets".

It is thought that some people inherit a higher risk of developing diabetes, if the right circumstances occur. A "triggering" event is thought to take place (such as a simple virus infection), and this causes the immune system to mistakenly begin attacking the beta cells. The reason only the beta cells are affected remains unknown, despite a great deal of research world-wide. We *are* sure that it is not caused by too many sweets, though!

A brief introduction to Diabetes (continued)

What happens if you have no insulin?

Without insulin, the body can no longer use carbohydrate for energy. Blood glucose steadily rises, but without insulin, glucose cannot enter the cells for use or storage. Of more concern is the production of "ketones". If glucose cannot be used for energy, the body uses fat stores instead. This is all right if only for a day or so, but can cause serious problems if fat is used for energy for many days (such as in diabetes). The use of body fat for energy causes formation of acidic compounds called "ketones". These poison the body, causing a life-threatening condition called "diabetic ketoacidosis".

How common is diabetes?

Diabetes is quite common in Scotland, which has one of the highest rates of Type 1 diabetes in the world. 100 new cases are diagnosed in the Greater Glasgow & Clyde area each year alone. The only places with higher rates of diabetes are Scandinavia and Sardinia. The reasons for this remain unknown. It appears to have something to do with our genetic make-up, but is also related to the environment we live in.

How do you treat diabetes?

Unfortunately, diabetes cannot be cured, as the beta cells that make insulin are permanently damaged or destroyed. The pancreas eventually stops making insulin altogether, and this must be replaced to stay healthy. If swallowed, the body would simply digest insulin as though it were food, breaking it down so it has no effect. It therefore must be given by injection. If your child is very ill, insulin may need to be given directly into a vein through a "drip", along with extra fluid to treat dehydration.

Thinking carefully about the type and amount of food we eat each day is also very important in caring for someone with diabetes. This eating plan is often referred to as a "*diet*", and simply means taking care about the food we eat. Often, this is good idea for the whole family, and everyone soon finds they are eating as healthily as possible!

For how long is a child with diabetes usually admitted to hospital?

Most new patients will be briefly admitted to the ward, the length of stay depending on the age of the child and how unwell they are on arriving at hospital. While diabetes care and education start in the hospital, this continues after discharge, and will cover many important topics in the first month. Parents will probably need to take some time off work to learn all that is needed to care properly for their child.

Can friends or relatives catch diabetes?

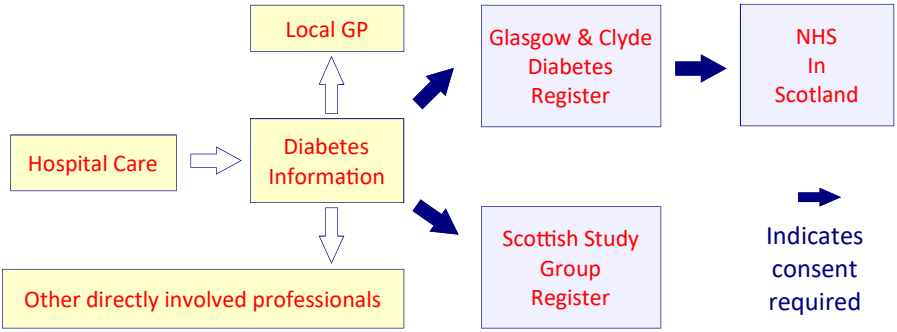
Diabetes is not infectious. However, when a family member develops diabetes, this is a sign that others (brothers, sisters and parents) may also have some increased risk of developing diabetes. About one in ten patients knows a family member with diabetes. However, there is usually no-one else in the family with the condition.

Type 2 diabetes is much more common than Type 1, and many families have an older relative with this condition. Those with Type 2 diabetes usually make *some* insulin, but it is either too little or not as effective as it used to be. Careful diet, and tablets that increase insulin release or effectiveness may be used in Type 2 diabetes. In Type 1 diabetes, however, *no* insulin is made at all, and this requires insulin injections for life.

What we do with your details

When we first meet, we obviously ask questions about you and your current situation. We store these details in the medical notes and our team's own computer records, both of which are strictly confidential. This helps us provide the best care possible. In addition, there are three other places where we would like to keep some of your details, and although also strictly confidential, we need your permission to do so.

This is how information about people with diabetes in Scotland is shared:



Greater Glasgow & Clyde Diabetes Register

To make sure resources are provided where needed, lists, or "registers", of people with diabetes have been set up throughout the United Kingdom. These registers contain basic details and clinical information, are strictly confidential, and are only used for the reasons set out below. If you live in the Greater Glasgow and Clyde (GG&C) NHS area, we would like you to consent for these details to be included on the GG&C NHS Diabetes Register.

It is important to know how many people in the Greater Glasgow & Clyde area have diabetes so resources can be provided where most needed. Keeping some basic health details also ensures the correct services are being provided, and allows GG&C Health Board to monitor progress in reducing diabetes-related problems. One way these details are used is in providing everyone with diabetes in the Greater Glasgow and Clyde area over the age of 11 with special eye screening.

People on the register have their diabetes details recorded, including eye and kidney check information. The information is stored on a highly secure computer, accessible only to a very small number of specially authorised people. It is under the direct control of healthcare professionals who look after people with diabetes in the Greater Glasgow & Clyde area. No identifiable details will ever be provided to anyone else without your permission.

NHS in Scotland Information and Statistics Division

As mentioned above, no other person or group will be given any identifiable details without consent. However, with your permission, we will annually send agreed information to the Information and Statistics Division of the NHS in Scotland. This allows us to monitor the health of people with diabetes in Scotland, ensuring they receive good care and that resources are being used in the most effective way.

What we do with your details (continued)

An example of how this information might be used would be to study kidney function in those with diabetes. Register details could assist research into why such disorders are more common in one area than another, and hopefully help to find ways of preventing such kidney problems. Names are only needed to prevent information duplication (such as that from different health boards), and would be removed once the study is complete.

Scottish Study Group for the Care of Diabetes in the Young

Members of this Group are doctors in Scotland who look after children and young adults with diabetes. The aims of the group are to continually improve the care of young people with diabetes, and to provide professional advice and statistical information to the NHS in Scotland. The register has allowed us to monitor the increasing numbers of children with diabetes in Scotland, and has formed the basis of research that has altered the way we care for these children.

Since 1985, the "SSG" has kept a register of all in Scotland who developed diabetes before their fifteenth birthday. Details recorded include name, date of birth, date of diagnosis, hospital of diagnosis, consultant, family members with diabetes, and address at diagnosis (identifying geographical variations).

As a responsible organisation, the SSG members promise that:

- Information will only be used in the best interests of those with diabetes.
- Every effort will be made to ensure the register is accurate. If necessary, we will regularly cross-check data with information collected for NHS use.
- Personal information will remain entirely confidential. It will not be released to any person or other organisation.
- If asked to contribute information to a national or international study, we will only do so if the study is well-organised, and the results likely to be useful. No information identifying individuals will be provided.
- If we carry out specific research studies, and need more information than we currently keep on the register, we will only do so after discussing the details with you and asking for your further consent. Again, any such further information will be treated with full respect for your privacy.

If you do kindly consent to details being kept on some or all of these registers, we would ask you to record the details for your own records below, and then to complete the form on page S 10, and hand it to a member of your team.

Thank you.

Consent Record

I have consented to information being kept on the following registers:

- Greater Glasgow & Clyde NHS Diabetes Register Yes ☐ No ☐
- NHS in Scotland Register Yes ☐ No ☐
- Scottish Study Group for the Care of the Young Register Yes ☐ No ☐

Diabetes
Best Ideas

Records

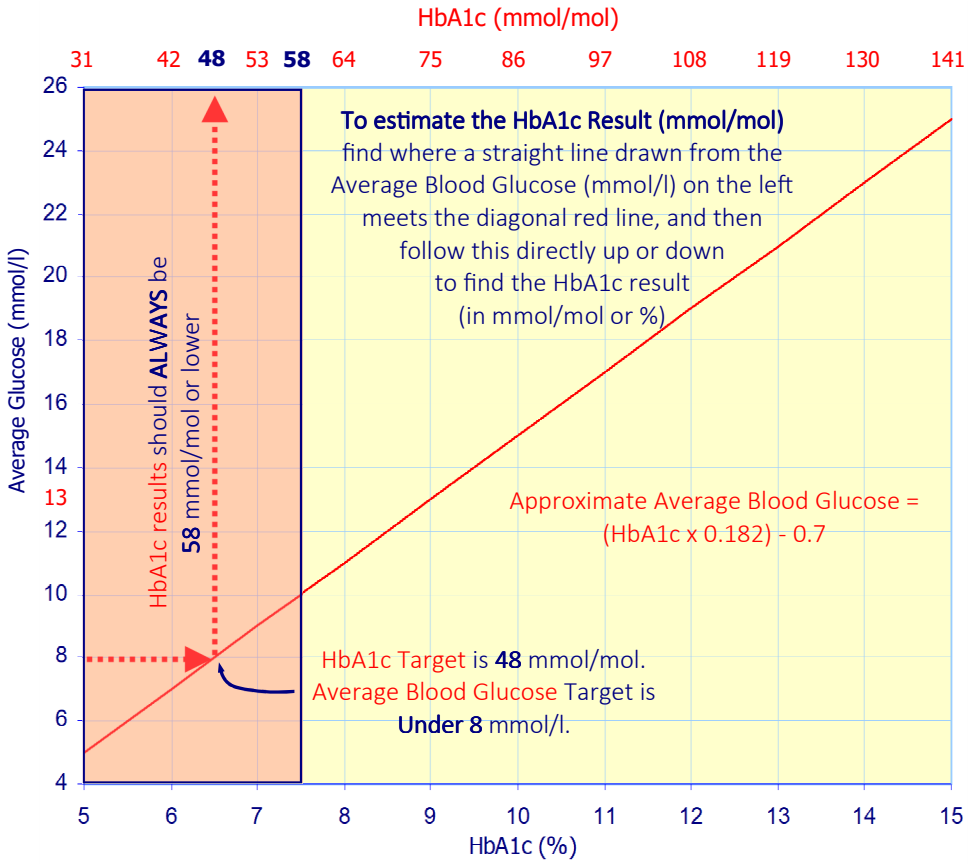
HbA1c and your average blood glucose result

HbA1c, or "glycosylated haemoglobin", is a long-term measure of blood glucose over the last 6-8 weeks. HbA1c increases as the average blood glucose increases, and is usually measured in "mmol/mol", although the older unit of "%" may be used. *Without* diabetes, average blood glucose is 5 mmol/l, and a "normal" HbA1c is from 20 to 42 mmol/mol.

For someone *with* diabetes, HbA1c is measured at every clinic , and the Target HbA1c is 48 mmol/mol. A home blood glucose meter can also be used to assess progress, with a 7-day, 14-day or 30-day "Average Blood Glucose" shown. Doing more tests at different times (including overnight) gives the best results. The Target Average Blood Glucose is 6 mmol/l and below (see graph below), and would also result in HbA1c being on target.

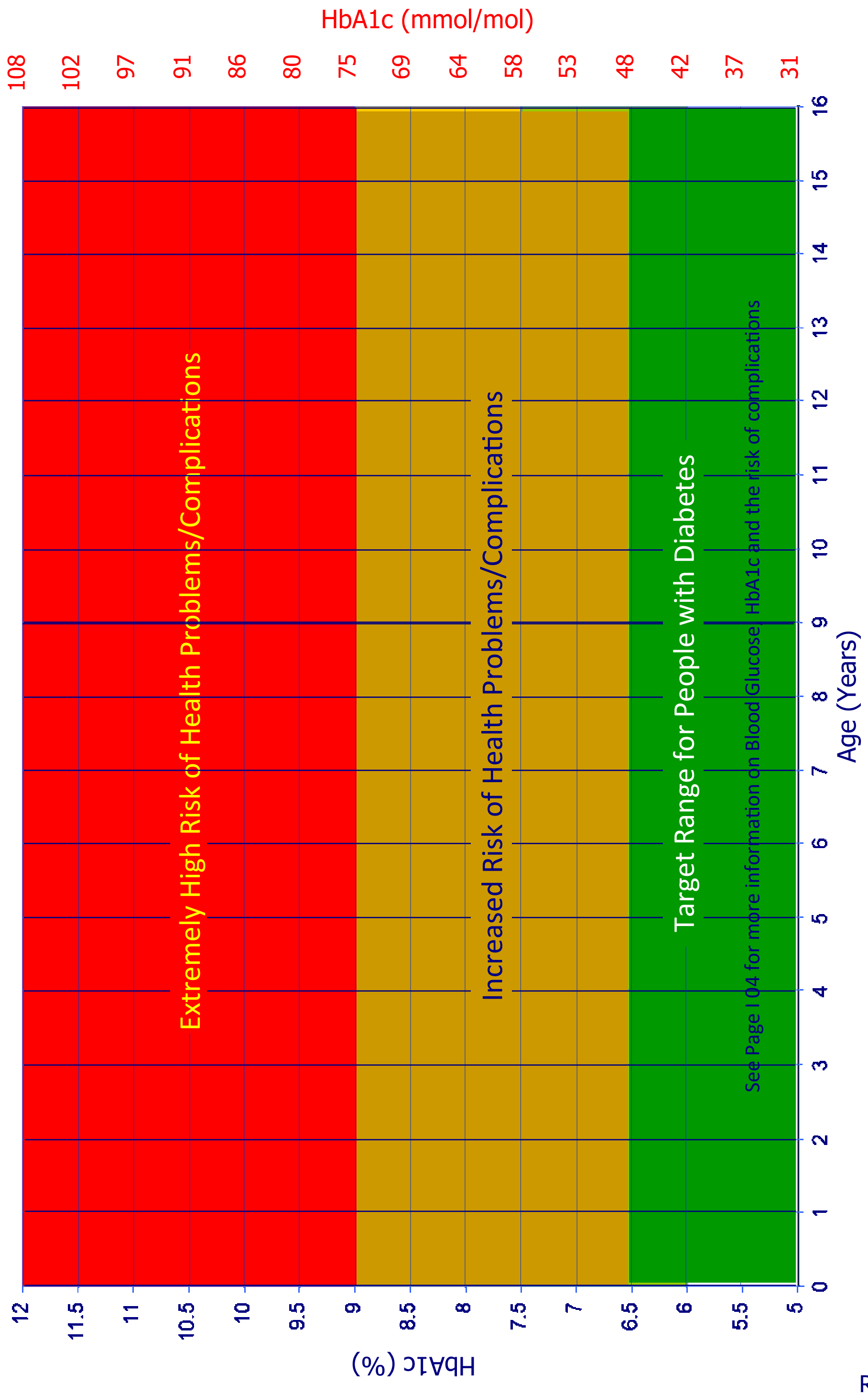
An average blood glucose of 8 mmol/l gives an estimated HbA1c of 48 mmol/mol, and an average blood glucose of 13 mmol/l gives an estimated HbA1c of 75 mmol/mol. The table and graph below may also be used to find these estimates

HbA1c	mmol/mol	31	37	42	48	53	58	64	69	75	80	86	91	97	102	108	113	119	124	130
HbA1c	%	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14
Glucose	mmol/l	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23



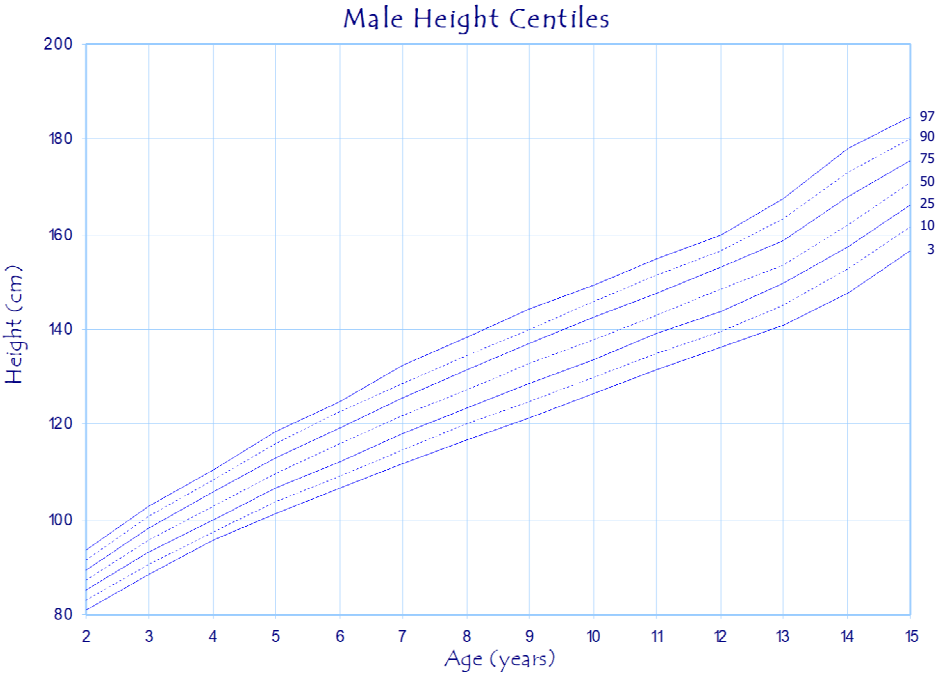
[1] Defining the Relationship Between Plasma Glucose and HbA1c. Curt Rohlfing et al. Diabetes Care 25: 275, 2002

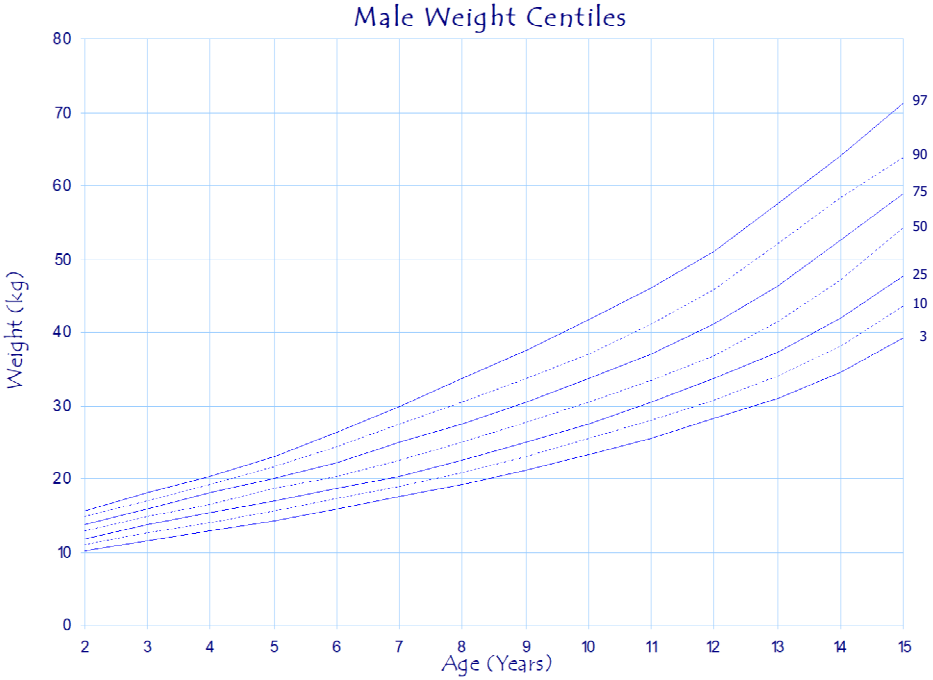
HbA1c and your future health



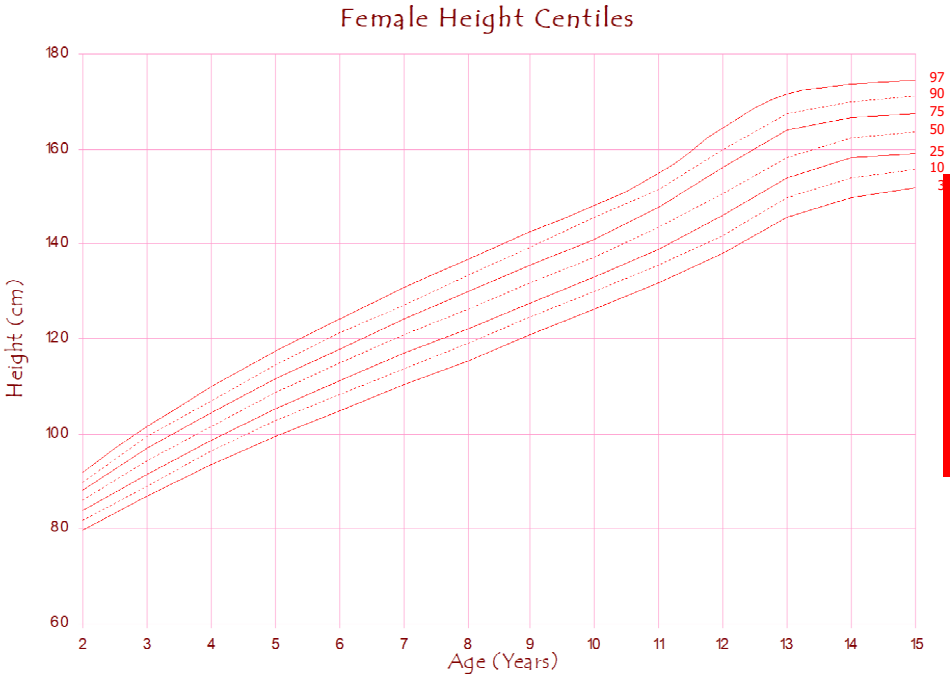
Records

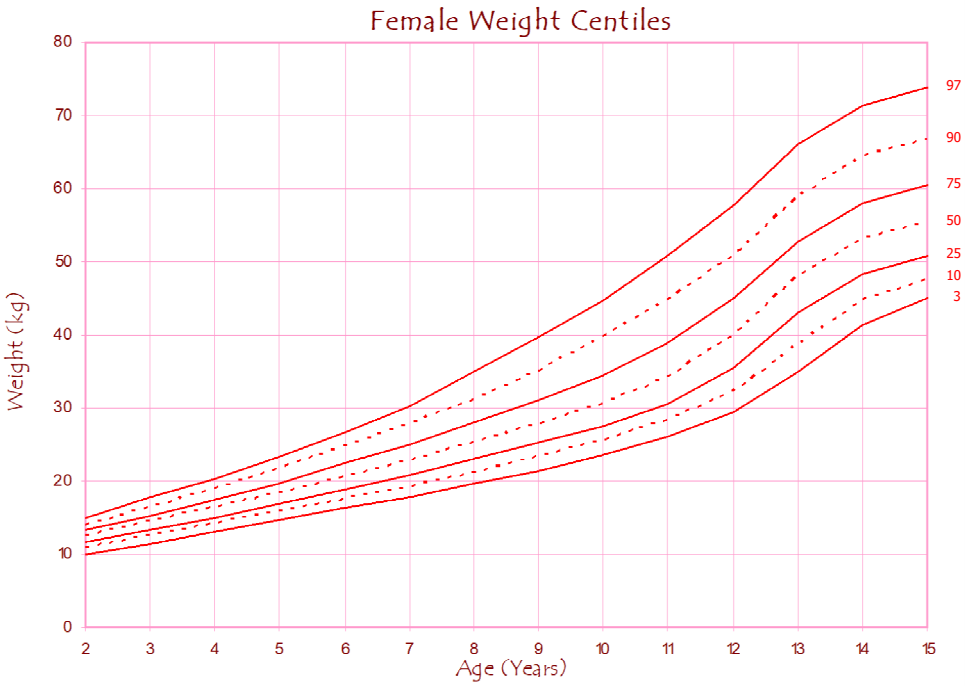
Male Height and Weight Charts





Female Height and Weight Charts



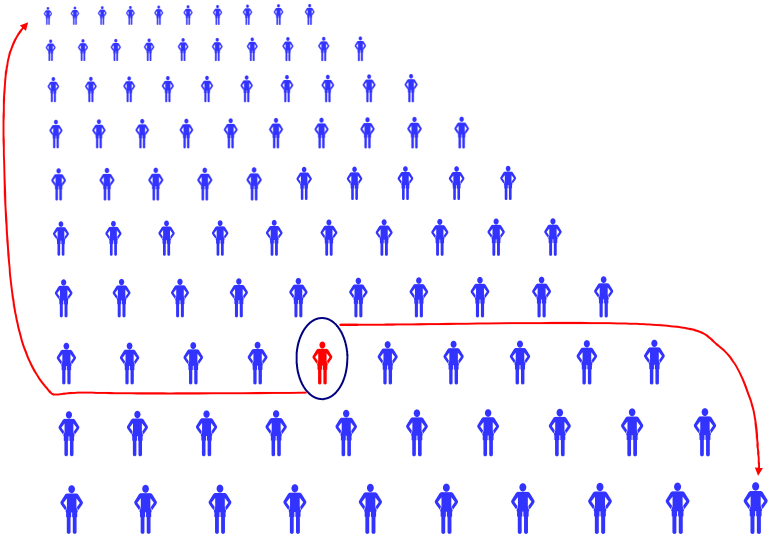


Just what's a "centile" anyway?

An important difference of childhood from adulthood is the steady increase in height and weight known as "growth". Insulin provides energy for normal growth, and the correct amount of insulin provides steady height and weight gain.

Growth charts show how a child's height and weight compares to other children the same age. It is helpful to look at a few measurements taken over time (such as at successive clinic visits). By marking or "plotting" the measurements on a chart it is easier to see whether someone is gaining height or weight, and if this is taking place at a normal rate. These charts are called "centile" charts.

A child's growth can be ranked in comparison to others by looking at the number of children born on the same date who have the same height or weight. An easy way to think about what a centile chart for height shows is to imagine 100 children of the same sex and age ranked in line from shortest to tallest. If 74 children were less tall and 25 more tall than a certain child, then that child would find themselves on the "75th centile". Equally, a centile chart for weight would rank children in order from lightest to heaviest.



▲ In the diagram above, 100 children the same age have been sorted according to their height, from shortest to tallest. The 75th tallest child would have 74 shorter children before and 25 taller children after them. They would therefore be on the "75th centile".

Centile charts compare one child's growth with the growth of another. They can also compare a child's height to their *own* weight. If growth is normal, height and weight should be on the same centile. In the line of 100 children, a normally growing child would stand in the same position, whether ordered by height *or* by weight. 74 lighter children would be behind them, with 25 heavier children in front. Once again, they are on the "75th centile", but this time for weight instead of height.

A child who is on the 75th centile for height, but the 25th centile for weight, is too "light" for their height. If on the 95th centile for weight, they would be too heavy.

Diabetes
Best Ideas

Guidelines

Guidelines

Guidelines

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

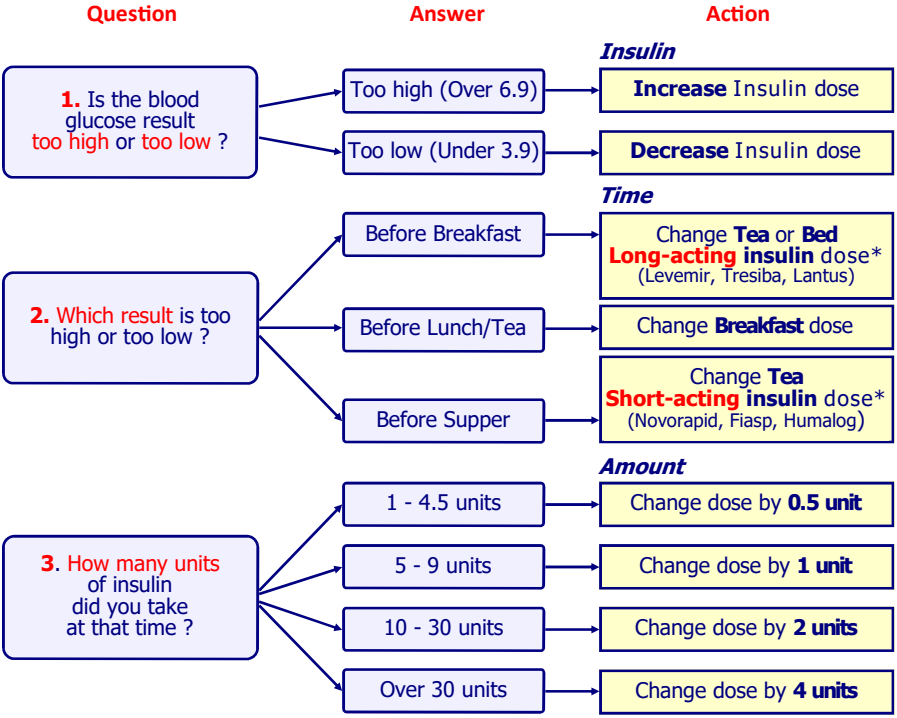
The target range for your blood glucose results is from 3.9 to 6.9 mmol/l - aim to have four out of every five blood glucose results in this range. If three results in a row, at the same time of day, are *not* in the target range, then think about these:

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

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

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

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



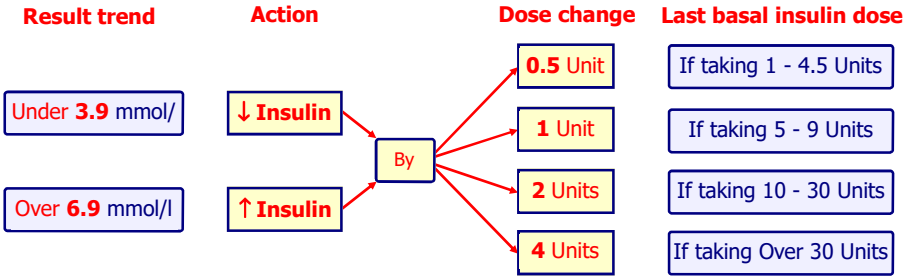
** Or tea-time Humalog Mix 25 or 50, or Humulin M3 if on twice daily mixed insulin*

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

Adjusting Basal-Bolus insulin doses - easy as "123-BCC"!

1. Basal Dose of insulin for long-term, background effect

Basal insulin (Levemir / Tresiba) doses should provide the daily insulin need for all except food. They are adjusted by looking at the trend of before-meal blood glucose results.



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

2. Carbohydrate Dose of insulin for meal-time carbohydrate

- Divide Grams eaten by Carbohydrate:Insulin Ratio to give the insulin dose for food.
  e.g. If eating 50 grams carbohydrate and Carb:Insulin Ratio = 5 g/Unit
  Insulin bolus needed = 50 g ÷ 5 g/Unit = **10 Units**
- A "correct" Carbohydrate Dose should cause a blood glucose result before a meal to remain unchanged 2 hours later.
- If dose too large, blood glucose will fall, and if dose too small, blood glucose will rise.
- Different meals may need different Carbohydrate:Insulin Ratios (e.g. Carb:Insulin Ratio at breakfast often lower than at other meal times).
- Fatty meals slow food absorption, so consider giving insulin bolus *after* food.
- Exercise before or after a meal may need meal-time insulin bolus to be reduced.

3. Correction Dose of insulin for lowering high Blood Glucose

The "100 Rule" suggests the insulin dose needed to return a high blood glucose to target (6 mmol/l). It shows how responsive blood glucose is to insulin - the "Insulin Sensitivity".

- Divide required BG fall by the Insulin Sensitivity to give the required Correction Dose.

Insulin Sensitivity = Blood Glucose (BG) fall per Insulin Unit = 100 ÷ Total Daily Dose
Correction Dose = Blood Glucose fall needed ÷ Insulin Sensitivity
= (Current Blood Glucose - 6) ÷ Insulin Sensitivity

E.g. If current BG 16 mmol/l and Target BG 6 mmol/l, required BG fall = 16 - 6 = 10 mmol/l

If required BG fall = 10 mmol/l and Insulin Sensitivity = 2 mmol/l per Unit,
Insulin Correction Dose bolus = 10 mmol/l ÷ 2 mmol/l per Unit = **5 Units**

A Correction Dose may be given every 3-4 hours, either *combined with* a Carbohydrate Dose or given as a *separate injection* at times when carbohydrate is not being eaten.

Correction Doses help, but it is always better to *prevent* high blood glucose results than to treat them once they have occurred. If three or more correction doses are needed at the same time of day, *other action* to prevent high before-meal results is needed.

When urine ketones are moderate or large, or blood ketones are 1 mmol/l or higher, a Ketone Dose should be used (Page G 07) instead of using a Correction Dose.

Calculating Correction Dose using "Insulin Sensitivity"

Correction Dose Calculation Table

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

1. Use Ketone Dose Guidelines (Page G 07) if blood glucose 14 mmol/l or higher.
2. Use Correction Dose (CD) if blood glucose over 6.9mmol/l, but no/few ketones.
3. Set Target Blood Glucose of 6 mmol/l (lower glucose from current value to 6 mmol/l).
4. Work out insulin "Total Daily Dose" (TDD) by adding all insulin taken in one day, and find column in which TDD is listed.
5. The point where the "Total Daily Dose" column meets the "Current Blood Glucose" row gives the Correction Dose, or "CD" (as rapid-acting insulin analogue).
6. Add Correction Dose to any regular dose of rapid-acting insulin analogue due to be given (such as at meal-time), or give as a separate dose at other times.
7. Do not use a Correction Dose within 3-4 hours of another dose of rapid-acting analogue insulin. Correction doses may be given overnight if necessary.
8. Three or more correction doses at the same time (e.g. before breakfast) in a week suggests an increase in regular doses is needed (e.g. more evening Levemir).
9. CD's of 0.5 unit may be added to meal-time Humalog or Novorapid doses, but 0.5 unit CD's should *not usually* be given separately (less than 1 unit may be inaccurate).
10. Consider correcting as if glucose only 20 mmol/l, even if higher, or halve suggested dose & review effect later, to avoid hypoglycaemia.
11. Round down half unit doses (e.g. 1.5 units) if you have no 0.5 unit insulin pen.

	INSULIN SENSITIVITY (mmol/l fall BG per Unit) with Target Blood Glucose 6 mmol/l															
TDD → (Units)	90+	75-89	60-74	55-59	45-54	35-44	30-34	23-29	18-22	16-17	14-15	12-13	10-11	8-9	8-7	4-5
IS →	**1**	**1.2**	**1.5**	**1.7**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**12**	**15**	**20**
CURRENT BLOOD GLUCOSE (mmol/l) 7-7.9	1	0.5	0.5	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-
8-8.9	2	1.5	1	1	1	0.5	0.5	0.5	-	-	-	-	-	-	-	-
9-9.9	3	2.5	2	1.5	1.5	1	1	0.5	0.5	0.5	-	-	-	-	-	-
10-10.9	4	3	2.5	2	2	1.5	1	1	0.5	0.5	0.5	0.5	-	-	-	-
11-11.9	5	4	3	2.5	2.5	2	1.5	1	1	0.5	0.5	0.5	0.5	-	-	-
12-12.9	6	5	4	3.5	3	2	2	1.5	1	1	0.5	0.5	0.5	-	-	-
13-13.9	7	5.5	4.5	4	3.5	2.5	2	1.5	1	1	1	0.5	0.5	0.5	-	-
14-14.9	8	6.5	5	4.5	4	3	2.5	2	1.5	1	1	1	0.5	0.5	0.5	-
15-15.9	9	7.5	6	5	4.5	3.5	3	2	1.5	1.5	1	1	0.5	0.5	0.5	-
16-16.9	10	8	6.5	5.5	5	4	3	2.5	2	1.5	1	1	1	0.5	0.5	0.5
17-17.9	11	9	7	6	5.5	4	3.5	2.5	2	1.5	1.5	1	1	0.5	0.5	0.5
18-18.9	12	10	8	7	6	4.5	4	3	2	2	1.5	1.5	1	1	0.5	0.5
19-19.9	13	11	8.5	7.5	6.5	5	4	3	2.5	2	1.5	1.5	1	1	0.5	0.5
20 +	14	11	9	8	7	5.5	4.5	3.5	2.5	2	2	1.5	1	1	0.5	0.5

If blood glucose over 14 mmol/l *and* urine ketones moderate or large, or blood ketones 1 mmol/l or higher (or 0.6 mmol/l or higher on a pump), use Ketone Dose and *not* Correction Dose (see G 07).

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

Different patterns of insulin action

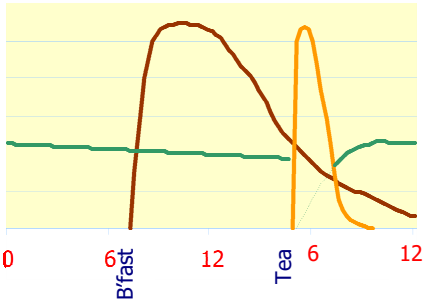
Some insulins work quickly and last only for a short time, while others act slowly and last a long time. Some are mixtures of fast and slow-acting insulins. Examples of different types and brands of insulin are shown below:

- Fast-acting soluble: Actrapid or Humulin S
- Rapid-acting analogue: Fiasp, Humalog or Novorapid (all *very* fast!)
- Intermediate-acting: Humulin I or Insulatard
- Slow-acting analogue: Lantus, Levemir or Tresiba
- Mixed:

Humalog Mix 25	(25% rapid-acting analogue	&	75% intermediate*)
Humalog Mix 50	(50% rapid-acting analogue	&	50% intermediate*)
Humulin M3	(30% fast-acting soluble	&	70% intermediate)
Novomix 30	(30% rapid-acting analogue	&	70% intermediate*)

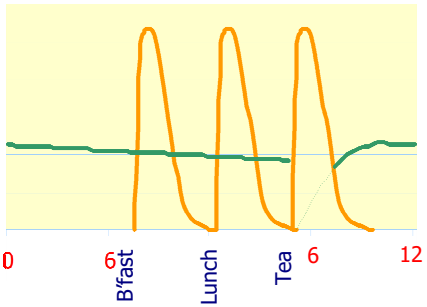
Note: "Humalog" and "Humalog Mix (25 or 50)" are *very* different types of insulin!
* Actually "protaminated analogue insulin"; the effect is the same as that of intermediate insulin. More information on insulins can be found on Pages I 08-I 10.

Guidelines



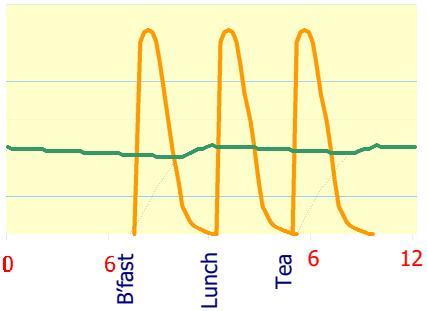
Three daily injections

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



Four daily injections

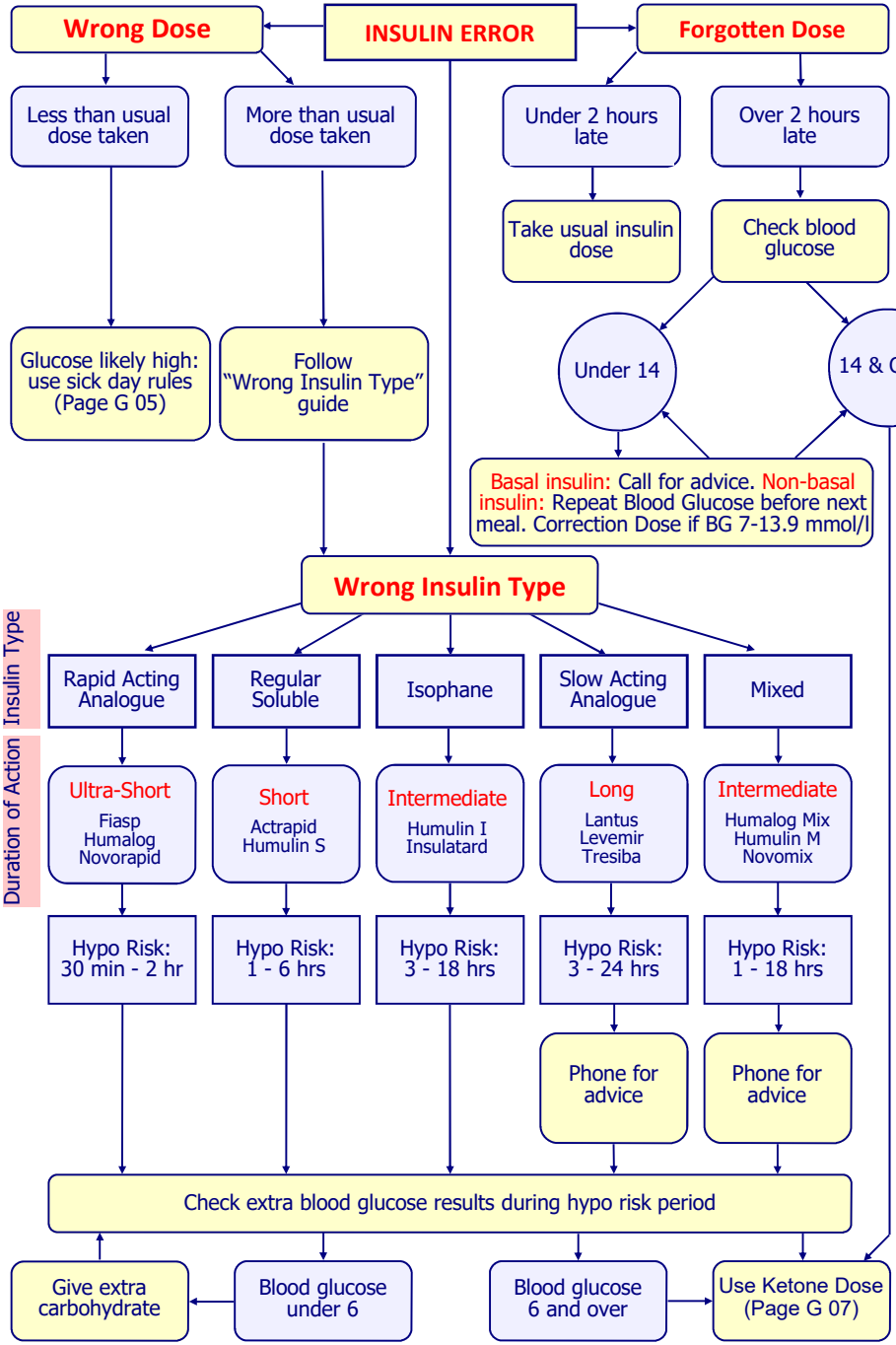
- Rapid-acting analogue before breakfast
- Rapid-acting analogue insulin before lunch
- Rapid-acting analogue insulin before tea
- Slow-acting analogue insulin before tea



Five daily injections

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

What to do if you make a mistake with insulin



Call for further advice if you are worried at any time

! For information on insulins and their actions see page "I 08" in the Information section

Guidelines

How to look after diabetes when unwell

Every child becomes unwell some time. During illness diabetes can become more unstable, with high or low blood glucose results. This can be worrying, but most people can be looked after at home, and you can always call for help if you need it.

Illness causing a low blood glucose

The most common problem causing low blood glucose during illness is diarrhoea and vomiting. Vomiting may make it difficult to keep down enough carbohydrate, and diarrhoea can reduce food absorption. Both make it difficult for blood glucose to stay at a reasonable amount, and so more frequent blood glucose testing is usually needed.

Someone in this situation will probably not feel like eating or drinking properly to increase the blood glucose again. It is often difficult to take the usual meals and snacks, but the same amount of carbohydrate might be taken in a simpler, more easily absorbed form. For example, jelly with sugar in it might be more easily swallowed and kept down than a sandwich or some pasta. The blood glucose will also increase more quickly.

Even if not well enough to eat, children can often take fluids. A day's carbohydrate can be given as sugary drinks, such as Lucozade® (60 ml hourly), non-diet soft drinks (100 ml hourly), or original Ribena® (1 tablespoon diluted in water), and so on. If a child is vomiting or has diarrhoea, it is important to give enough fluid to prevent dehydration, so non-sugary drinks should also be frequently offered. Something light such as a slice of toast or a dry biscuit could be tried if the child is hungry. See Pages 50-52 in the "Food for Life" diet book for ideas on giving carbohydrate when ill.

The body makes ketones when there is too little insulin available for its needs, and **not** because of high blood glucose results. This means ketones may occur even when blood glucose is normal or low. To stop hypoglycaemia, and to allow enough insulin to be given to prevent ketone production, enough carbohydrate must be taken. Never stop insulin, and never stop carbohydrate.

Never stop insulin or carbohydrate during health or illness!

Illness causing a high blood glucose

Illness may have no impact on diabetes at all. On the other hand, a sore throat or a chest infection might cause problems with high blood glucose results because the body often needs *more* insulin when we are ill. The pancreas would normally just *make* more insulin, but when someone has injected insulin, they must increase the dose taken.

Testing for ketones is needed when someone with diabetes is unwell, or their blood glucose above 14 mmol/l. Ketones occur when the body uses fat for energy instead of carbohydrate (sugar). Ketones show the body has too little insulin to remain safe. urine or blood can The urine can be tested, and some meters will also directly measure ketones in the blood. If an increase in ketones is found, this shows that the body urgently needs more insulin. The guidelines on the next page must be followed closely, or the situation can become very serious.

See Also: **Ketone Dose Guidelines** (Page G 07), **Illness, Insulin & Ketones** (Page I 25), and "**Food for Life**" dietary companion guide to this Record

Ketone Doses: if sick or blood glucose over 14 mmol/l

Start

Check blood glucose before meals, before bed, and every 3 to 4 hours overnight

Blood Glucose 14 and over

Blood Glucose 7 - 13.9

Blood Glucose 3.9 - 6.9

Continue usual carbo-hydrate amounts (e.g. as Lucozade®) as well as sugar-free fluids

Check for **ketones** in urine or blood

Urine: Nil, trace, small, or *Blood*: <1 mmol/l (injection) or <0.6 mmol/l (pump)

Consider giving a **Correction Dose** (Page G 03)

Continue giving usual insulin doses at usual times

Fewer than 3

Call for advice

3 times

Count all Ketone Doses given so far

Urine: Moderate (++) or Large (+++, ++++) ketones or *Blood*: 1 mmol/l (injections) or 0.6 mmol/l (pump) & above

If Total Daily Insulin Dose:	Then Ketone Dose is:
1 - 10	1 unit
11 - 20	2
21 - 30	3
31 - 40	5
41 - 60	7
61 - 80	10
81 - 100	13
Over 100	Call

Take this NOW as separate **Ketone Dose** of fast-acting insulin:

Actrapid, Humulin S, Novorapid, Humalog OR *Fiasp*

Repeat every 3-4 hours as needed

Add up all insulin taken on a normal day to find the "Total Daily Dose"

Look up the **Total Daily Dose** in column above

Find matching **Ketone Dose** in column above

Call for advice (See Page S 00 in the "Start" Section for contact details) if:

1. requiring third Ketone Dose of insulin in a row
2. vomiting persists
3. child looks ill (sleepy, dry mouth, sunken eyes), or
4. YOU ARE WORRIED FOR ANY REASON

! For more on ketones and illness, see Page I 25 in the Information section

Print a copy of these **Ketone Dose Guidelines** from www.ggc-youngdiabetes.org and attach to your refrigerator door for handy reference!

Guidelines

Hypoglycaemia

Looking after diabetes relies on balancing the blood glucose *rise* from food with the blood glucose *fall* due to insulin. The body usually makes just enough insulin to match the blood glucose, keeping this in a narrow range. Someone *with* diabetes needs to match the doses of injected insulin with the amount of food (carbohydrate) eaten. The amount of exercise we take is also important.

Blood glucose moves below 3.9 and above 6.9 mmol/l when the careful balance of food, insulin and exercise is upset. A low blood glucose ("hypo") might occur when:

- Not eating enough carbohydrate
- Being late for, or missing, a meal or snack
- Taking too much insulin
- Taking insulin at the wrong time
- Taking the wrong type of insulin
- Taking extra exercise and too little food
- Food not absorbed (e.g. vomiting, diarrhoea)

A "hypo" is defined as a blood glucose less than 3.9 mmol/l and should always be treated

Hypoglycaemia - *What's in a name?*

- *Hypo* - low
- *Glyc* - glucose
- *Aemia* - blood

= "low blood glucose"

A reason can usually be found, but sometimes a hypo may occur without obvious cause. The severity of a hypo is graded by seeing what happens when the low blood glucose takes place. Generally, the lower the blood glucose concentration, the more serious the symptoms will be, and by definition the higher the "grade" of hypo.

Once recovery has started to improve, starchy food such as a sandwich or digestive biscuit should always be given. This helps prevent a further fall in blood glucose. While tempting,

Severity	Symptoms	Treatment

Mild	• Shaky
	• Hungry
	• Pale
	• Headache
	• Stomach Ache
	• Mood Swings
	• "Jelly"/Tired Legs
	• Lack of Concentration
		• Give fast-acting carbohydrate, e.g.
		  • 3 GLUCOSE TABLETS *OR*
		  • 120 ml LUCOZADE® ORIGINAL *OR*
		  • 120 ml NON-DIET COLA or similar
		• Wait 15 minutes and then retest blood glucose
		• If blood glucose still under 3.9 mmol/l:
		  repeat above fast-acting carbohydrate & retest blood glucose after another 10 minutes passes
		• If blood glucose risen to 3.9 mmol/l or higher: give STARCHY CARBOHYDRATE such as
		  • Digestive biscuit
		  • Small sandwich
		  • Snack or meal (if due)

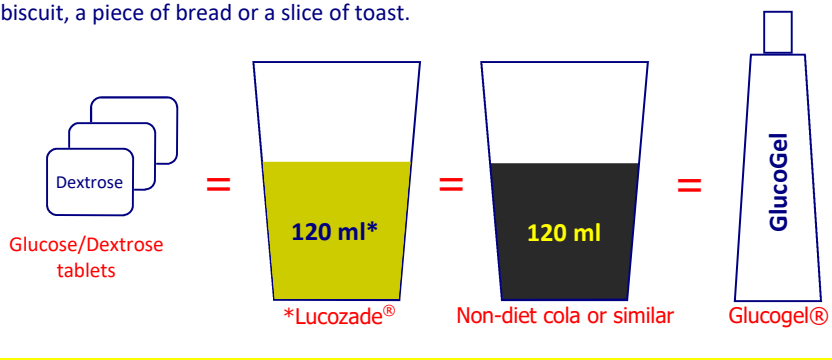
Moderate	• Same as above, *however* • Slightly more confused • Dizziness • Unable to treat self • Too confused to eat/drink • Slurred speech • Unsteady on feet	• Treat as for Mild hypoglycaemia • Consider using GLUCOGEL as fast-acting carbohydrate, instead of Glucose tablets, Lucozade® Original or non-diet drink
Severe	• Not able to take food/ drink • Sleepy/Unconscious • May be fitting	• GLUCAGEN GLUCAGON injection • Call 999 if no or slow response to treatment • See Treatment Section on Page G 11

Mild Hypos

Everyone, whether they have diabetes or not, will have had a mild hypo at some time - perhaps their dinner was delayed, or they were exercising for a while. For someone *without* diabetes, a blood glucose under 3.9 mmol/l reduces insulin release for a short time, and this helps to keep the blood glucose from falling any lower.

Treat mild/moderate hypos with fast-acting glucose, & check blood glucose in 10 minutes. If still low, treat again, but if 3.9 mmol/l or higher, give longer-acting carbohydrate.

People *with* diabetes inject insulin, and from then on this insulin keeps on working, whether the blood glucose was high or not. They should first take glucose that is quickly-absorbed, such as glucose/dextrose tablets, Lucozade®, sugary soft-drink, or Glucogel®. 15 minutes later, once the fast-acting glucose has had a chance to be taken in, longer-acting carbohydrate should follow. This includes more starchy food such as a digestive biscuit, a piece of bread or a slice of toast.



Moderate Hypos

Those on insulin should probably have at least one or two mild hypos a week. More often than this suggests too much insulin is being taken, while too few hypos means insulin doses are too low. A balance between insulin, food, and exercise is the key.

Someone having a moderate hypo may not notice their own symptoms, and so might need to rely on someone else. Glucose is the brain's main source of energy, and a fall in blood glucose can affect it. This is why a moderate hypo often directly alters brain function, causing tiredness, confusion, unsteadiness and slurred speech. Any quickly-absorbed glucose, like glucose/dextrose tablets, Lucozade®, sugary drinks, or Glucogel® should be enough to treat a moderate hypo. Again, slower-acting starchy foods should follow 10 minutes later.

Regular daily review of blood glucose results helps highlight early (problems)

Occasionally, a moderate hypo may seem to happen for no obvious reason. This can be alarming for all concerned. Regular daily review of blood glucose results, insulin doses, food intake and exercise patterns all help to highlight patterns of repeated low readings. The brain can get used to frequent low blood glucose amounts, and typical warning signs may not occur. Instead of being able to stop the blood glucose falling even lower, in this case a severe hypo may happen unexpectedly, without the usual early warning signs mentioned above.

Severe hypos

About a third of all people with diabetes have a severe hypo at some time in their life. This can cause great concern, but generally all recover rapidly and with no long-term harm. The body releases its own glucose from its stores in the liver and muscle.

The brain uses glucose for energy. Severe hypos occur when blood glucose falls so low that the brain starts acting erratically. Agitation, irritability, aggression and loss of consciousness may follow. Sometimes blood glucose falls so low that a convulsion, or fit, occurs. This can be very frightening to anyone present, but fortunately long-lasting problems are extremely rare. Complete recovery is expected, but even so, a severe hypo can be very alarming, and should of course be avoided whenever possible.

Carbohydrate is stored by the liver, for times when energy needs cannot be provided by food (such as when sleeping overnight). If blood glucose falls very low, the body makes chemical "messengers", known as hormones, to try to once again increase the blood glucose. Insulin is a hormone, but works to *reduce* the amount of glucose in the blood. Glucagon, however, is another hormone made in the pancreas, and works in the opposite way – releasing the body's glucose stores. Just like insulin, glucagon is made in the islets of the pancreas (in "alpha cells", and not insulin's "beta cells").

Glucagon works mainly by making the liver release its stores of glucose

Glucagon can be injected in times of emergency. Everyone with diabetes should have glucagon at home. It comes in an orange box, called a "GlucaGen®" kit.

Why do Severe Hypos occur?

Severe hypos rarely happen for no clear reason. Here are some reasons they occur:

- A missed snack or meal, especially if blood glucose results are already low.
- Insulin given at the wrong time – for example, the morning insulin dose given at tea-time (consult the insulin errors guideline on Page G 03 for further advice).
- Long periods of activity after taking too little carbohydrate and/or too much insulin. Strenuous exercise can lower blood glucose for up to 24 hours, so exercise should be planned. Frequent, regular blood glucose testing is always helpful. Cutting insulin doses before and after exercise might also be useful.
- Diarrhoea and vomiting may cause food to not be absorbed properly. This is one of the reasons extra blood glucose testing during illness is so useful.
- Those old enough to drink alcohol legally should know that it lowers blood glucose by slowing glucose release from liver stores. Extra food before, during and after drinking alcohol is recommended. Extra testing is also sensible, along with a form of diabetes identification. Symptoms of low blood glucose may be mistaken for having had too much to drink, and this may delay hypoglycaemia treatment.

When to give a GlucaGen® Injection

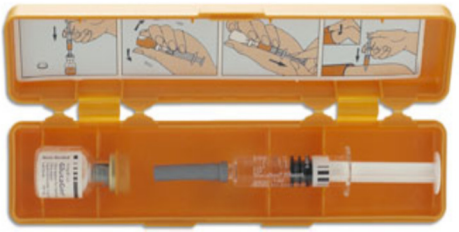
- If the child is being extremely difficult and refusing sugar by mouth.
- If the child is unconscious.
- If the child is fitting.

Please let the Diabetes Team know if you have had to deal with a severe hypo so we can provide you with support and advice, and hopefully prevent further episodes.

Giving a GlucaGen® injection

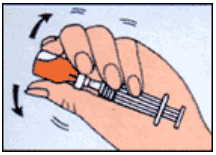
Along with insulin, the pancreas also produces glucagon. While insulin stores glucose in cells and causes blood glucose to fall, glucagon releases glucose from the body's stores, and so increases blood glucose. It can be given to treat a severe "hypo".

"GlucaGen®" is the name of the glucagon stored at home for emergencies. It comes in a kit (shown below), and should be stored in the refrigerator. The expiry date should be checked every so often, to make sure an in-date kit is always available.

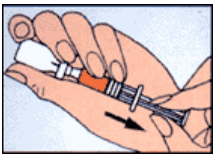


Treatment of a Severe "Hypo"

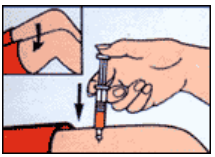
1. Place person in the recovery position (Page G 12) and check time.
2. Prepare GlucaGen® Injection as shown below (illustrations courtesy of NovoNordisk):
3. Remove cap and inject water from syringe into bottle.
4. Gently mix water and powder in bottle.
5. Draw back cloudy liquid into syringe.
6. Remove air by holding syringe with needle upwards, tapping side gently, and slowly depressing plunger until a few drops appear at end of needle. This makes 1 ml of GlucaGen®.



If child under 8 years old	inject 0.5 ml (0.5 mg) into front of thigh.	GlucaGen®
If child over 8 years old	inject 1 ml (1 mg) into front of thigh.	GlucaGen®



If there is no sign of recovery after 10 minutes, or if you are worried - call 999



7. Give GlucoGel® (glucose gel) once consciousness and cooperation improves (eyes open, starts speaking).
8. Talking to and reassuring the person helps them to rouse.
9. Once sitting, give person half a cup of Lucozade®.
10. Check blood glucose.
11. If vomiting occurs, wait a few minutes and then continue.
12. After 5-10 minutes, give solid food (e.g. 2 plain biscuits or a sandwich). The delay allows the Lucozade® to be absorbed, and will hopefully avoid further fall in blood glucose.
13. Headache or nausea are common after a severe hypo has occurred.
14. It is common after a hypo to want to sleep. Blood glucose results should continue to be checked every half hourly for the next 2-3 hours.

Please call Diabetes Team next working day to notify them of any severe hypos.

How to place someone in the Recovery Position

1. Position the legs

- Kneel beside the child
- Straighten their legs
- Lift nearer leg at knee so it is bent fully upwards

2. Position the arms

- Place nearer arm across chest
- Place farther arm at right angles to body

3. Roll into position

- Roll child away from you onto their side
- Keep leg at right angles, with knee touching ground to prevent them rolling onto their face

4. Stabilise in position

- Make any necessary adjustments to prevent the child from rolling
- Ensure the airway is open

5. Infant (under 1 year old)

- lay infant face down on an adult 's forearm
- support head with hand
- check infant does not choke or inhale vomit

This procedure should only to be used when there is no possibility of a head or neck injury. If this may have occurred, leave the patient where they are and call for help (999).

How to fill in blood glucose charts

		Insulin Type	Mon	Tue	Wed
			15/2	16/2	17/2
B					
B		Nov	4	4	4
L		Nov	3	3	3
T		Nov	3	3	3
T		Lev	8	8	8
S					
Early morning					
B	High				
R	3.9 - 6.9		4.1	5.1	3.9
E	Low				
2 hrs after meal					
L	High		7.6		
U	3.9 - 6.9			6.1	
N	Low				3.3
2 hrs after meal					
T	High				
E	3.9 - 6.9		4.5	4.8	6.8
A	Low				
2 hrs after meal					
S	High		7.0		
U	3.9 - 6.9			6.9	5.8
P	Low				
2 hrs after meal					
Overnight				6.5	

Why writing results is right!

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

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

1. **Test** your blood glucose at least 3 or 4 times a day - maybe more often. It is also important on some days to test your glucose between meals and overnight (e.g. every 1-2 weeks). More information can help you make better decisions, and more frequent changes to insulin dose.
2. **Record** results in the diary (or on computer) every day! It's easier to see the patterns of blood glucose that way, and you will be able to keep results "on target" more easily and more often.
3. **Think** about your results - if they are low or high, why might that be? Look at "What to do if your results are too high or too low" in the Guidelines section on page G 01 and G 02 of your Record.
4. **Act** on your results. By following the information on the "What to do if your results are too high or too low" page, you will be able to think about some of the most important factors that raise or lower blood glucose results, such as:

- Food
- Exercise
- Injection sites
- Illness
- Insulin

Don't just sit there-do something!

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

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

	Insulin Type	Mon	Tue	Wed	Thu
		15/2	16/2	17/2	18/2
B	HumM3	12	12	12	14
B					
L					
T	Nov	3	3	3	2.5
T	Lev	6	6	6	6
S					
Early morning					
B R E	High				
	3.9 - 6.9	4.6	5.1	5.5	← ①
	Low				
2 hrs after meal					
L U N	High	16.3	12.1	17.9	← ②
	3.9 - 6.9				
	Low				
2 hrs after meal					
T E A	High	13.3	14.4	9.8	← ③
	3.9 - 6.9				
	Low				
2 hrs after meal					
S U P	High				
	3.9 - 6.9				
	Low	3.4	3.6	3.8	← ④
2 hrs after meal					
Overnight			7.5		

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

① Breakfast results are all in the target range of 3.9 - 6.9 mmol/l, showing the insulin dose that affects morning results is the right amount. Therefore, the tea-time Levemir insulin dose of 6 units is appropriate.

② Lunchtime results are high (over 7 mmol/l), and so an increase to the insulin dose that affects lunch-time results is needed. Using our guidelines, the breakfast insulin dose should be increased by 2 units, from 12 to 14 units.

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

④ Finally, the suppertime results need to be reviewed. Each of these results is low (less than 3.9 mmol/l), and so a reduction to the teatime *fast*-acting insulin dose (Novorapid) is needed. A dose of just 2.5 units should be given the following evening.

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

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

Insulin three times a day - which insulin works when?

	Insulin Type	Mon 15/2	Tue 16/2	Wed 17/2	Thu 18/2
B	Mix 25	12 ①	12	12	12
B					
L					
T	Nov	3 ②	3	3	3
T	Lev	6 ③	6	6	6
S					
Early morning					
B R E	High				
	3.9 - 6.[illegible]	4.6	5.1	5.5	
	Low				
2 hrs after meal					
L U N	High				
	3.9 - 6.[illegible]	5.2	6.7		
	Low			3.7	
2 hrs after meal					
T E A	High				
	3.9 - 6.[illegible]	4.5	4.8	6.8	
	Low				
2 hrs after meal					
S U P	High				
	3.9 - 6.9	4.2	5.9	5.8	
	Low				
2 hrs after meal					
Overnight					

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

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

A mixed insulin ① taken before breakfast, such as Humalog Mix 25, changes the results before the next *two* meals - that is, before lunch *and* tea.

Fiasp and Novorapid ② are very rapid-acting insulins. They start working shortly after their injection, and stop working only a few hours later. If taken before tea, Novorapid will have most effect on the bedtime (or "supper") glucose result.

Longer-acting "basal" insulins, such as Tresiba and Levemir ③, take time to start working, but then last for many hours. They are less likely to cause low blood glucose overnight than older insulins. Given at tea, they have most impact on overnight and before breakfast blood glucose results - the day *after* the injection was given.

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

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

Insulin with meals - peaks at dawn and dusk

	Insulin Type	Mon	Tue	Wed	Thu
		15/2	*16/2*	*17/2*	*18/2*
B					
B	*Nov*	*6*	*6*	*6*	*6*
L	*Nov*	*6*	*6*	*6*	*6*
T	*Nov*	*6*	*6*	*6*	*7*
T	*Lev*	*8*	*8*	*8*	*9*
S					
Early morning					
B	**High**	*10.8*	*12.2*	*10.3*	← ①
R	3.9 - 6.9				
E	**Low**				
2 hrs after meal					
L	**High**				
U	3.9 - 6.9	*5.9*	*4.3*		← ②
N	**Low**			*3.6*	
2 hrs after meal					
T	**High**				
E	3.9 - 6.9	*5.4*	*5.6*	*6.7*	← ③
A	**Low**				
2 hrs after meal					
S	**High**	*12.4*	*14.5*	*14.1*	← ④
U	3.9 - 6.9				
P	**Low**				
2 hrs after meal					
Overnight					

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

② & ③ show results at lunch and teatime. These are both in the target range of 3.9 - 6.9mmol/l, and no change to the breakfast-time mixed insulin (Novorapid or Fiasp) is needed.

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

When making an insulin dose change, we suggest increasing or decreasing the amount by about a tenth (10%) of the original dose. This is the basis for the insulin dose-changing guideline on Page G01:

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

This provides a safe but steady change to insulin doses. So, if taking a dose of 40 units of insulin, the dose should be changed by about 10%, or 4 units. If more insulin was needed this would increase to 44 units, while less should see a dose of 36 units given.

However, if only 8 units were currently being given, only a 1 unit change would be needed (increasing to 9 or decreasing to 7 units, as appropriate).

Guidelines

Insulin three times a day - feeling low all day

	Insulin Type	Mon	Tue	Wed	Thu
		15/2	16/2	17/2	18/2
B	HM 25	48	48	48	44
B					
L					
T	Nov	16	16	16	14
T	Lev	22	22	22	20
S					
Early morning					
B	High				
R	3.9 - 6.9		4.0	← ①	
E	Low	3.5		3.6	2.4
2 hrs after meal					
L	High	10.3	← ②		
U	3.9 - 6.9				
N	Low	③ →	2.1	3.7	3.0
2 hrs after meal					
T	High				
E	3.9 - 6.9		5.1		4.1
A	Low	3.8		3.4	← ④
2 hrs after meal					
S	High				
U	3.9 - 6.9				
P	Low	3.7	3.5	3.6	← ⑤
2 hrs after meal					
Overnight					

A blood glucose result less than 3.9 mmol/l is known as a "hypo". Treat with fast-acting carbo-hydrate, test in 10 minutes, and either treat again if still low or take slow-acting carbohydrate if the result is 3.9 mmol/l or higher. Prevent these low results at breakfast ① by cutting the teatime basal insulin dose, from 22 down to 20 units.

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

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

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

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

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

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

	Insulin Type	Mon	Tue	Wed
		15/2	16/2	17/2
B	HM 25	12	12	12
B				
L				
T	Nov	12	12	12
T	Lev	3	3	3
S				
Early morning				
B	H ① →	26.0	23.4	31.1
R	3.9 - 6.9			
E	Low			
2 hrs after meal				
L	H ② →	HI	33.1	28.0
U	3.9 - 6.9			
N	Low			
2 hrs after meal				
T	H ③ →	27.9	25.5	27.4
E	3.9 - 6.9			
A	Low			
2 hrs after meal				
S	High			
U	3.9 - 6.9			
P	L ④ →	3.7	3.6	2.8
2 hrs after meal				
Overnight				

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

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

Maybe the insulin has not been stored correctly, or the insulin pen is faulty, or the injection technique is faulty. Are there other reasons? Are all the injections being taken, or are some being missed out? This is a very dangerous cause of high results.

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

If a blood glucose result is over 6.9 mmol/l then a Correction Dose should be given (See Pages G 23 I 20 - I 23).

If a blood glucose is over 14 mmol/l, or if the person is feeling unwell, a urine or blood test for ketones is needed. Ketones occur when there is not enough insulin present for the body's needs, and can be very dangerous in large quantities. A Correction Dose should be used if there are no or few ketones, but if moderate or large urine ketones or blood ketones over 0.1 mmol/l are found a Ketone Dose will be needed. (See page G 06 - 07 and Page I 25 - 27).

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

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

Insulin three times a day - why lunch testing is helpful

	Insulin Type	Mon	Tue	Wed	Thu
		15/2	16/2	17/2	18/2
B	HM 25	36	36	36 ← ①	
B					HM 50
L					
T	H'log	12	12	12	
T	Lantus	22	22	22	← ②
S					
Early morning					
B R E	High				
	3.9 - 6.9	6.8	5.1	6.7	5.5
	Low				
2 hrs after meal					
L U N	High	13.1	12.5	← ③	
	3.9 - 6.9			6.8	← ⑤
	Low				
2 hrs after meal					
T E A	High				
	3.9 - 6.9			6.4	← ⑥
	Low	2.9	3.6	← ④	
2 hrs after meal					
S U P	High				
	3.9 - 6.9	6.2	5.5	6.0	4.2
	Low				
2 hrs after meal					
Overnight					

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

Even if taking mixed insulin before breakfast (Humalog Mix 25 in this case), a blood glucose at lunch and tea is still useful as it gives information on *each part* of the mixed insulin. The lunch time result gives information on the fast-acting part, while a tea-time result gives information on the slower-acting part of the mixed insulin.

If the lunch-time blood glucose result differs a lot from the tea-time result, then this might mean the *mixture* itself, and not simply the dose, needs to change. Humalog Mix 25 is being used here, but the high results before lunch ③ and the low results before tea ④ suggest more fast-acting followed by less slower-acting insulin would be useful.

Changing to Humalog Mix 50 (with 50% fast-acting and 50% slower-acting insulin, compared to Mix 25's 25% and 75% mix) should allow the blood glucose to fall further before lunch ⑤. The smaller proportion now given as longer-acting insulin (50% instead of 75%) should deal better with the lower result before tea ⑥.

Guidelines

What apart from insulin dose affects blood glucose?

	Insulin Type	Mon	Tue	Wed
		15/2	16/2	17/2
B	HM 25	40	40	40
B				
L				
T	Nov	2	2	2
T	Lev	34	34	34
S				
Early morning				
B R E	High	26.2	← ④	
	3.9 - 6.9		5.4	
	Low			3.6
2 hrs after meal				
L U N	High		11.2	
	3.9 - 6.9	5.3		4.2
	Low			
2 hrs after meal				
T E A	High			
	3.9 - 6.9	6.1		4.2
	Low		3.7	← ③
2 hrs after meal				
S U P	High	11.1	← ①	14.4
	3.9 - 6.9			
	Low		3.6	← ②
2 hrs after meal				
Overnight				

The pattern of blood glucose results is important - knowing this helps keep the results in the target range of 3.9 - 6.9 mmol/l. Regular testing, recording and reviewing of results is the key.

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

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

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

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

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

Write down results every day!

Guidelines

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

	Insulin Type	Mon	Tue	Wed
		15/2	16/2	17/2
B	Nov	6	6	7
B	Lev	12	12	12
L	Nov	6	6	7
T	Nov	7	7	8
T	Lev	10	10	10
S				
Early morning				
B	High			
R	3.9 - 6.9	6.8	5.3	← ①
E	Low			3.6
③ → 2 hrs after meal		14.7		12.9
L	High			
U	3.9 - 6.9	6.4		6.1
N	Low			
④ → 2 hrs after meal		12.3		16.4
T	High	10.2		
E	3.9 - 6.9	② →	6.0	5.4
A	Low			
⑤ → 2 hrs after meal		14.3		12.4
S	High			
U	3.9 - 6.9	6.6	5.3	6.9
P	Low			
2 hrs after meal				
Overnight (2 am)		5.8		6.3

The amount of insulin given as *boluses* each day should usually be the same or even slightly more than the basal dose taken. Here the bolus dose starts at 19 units daily, increasing to 22 units daily. This is similar to the basal dose of 22 units; there is a "1:1" basal to bolus ratio. If the ratio is *not* 1:1 a more careful review might be needed. **Call for advice.**

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

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

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

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

Before meal results such as ① & ② are in the target range (3.9 - 6.9 mmol/l), so the *slow-acting* insulin dose (of Levemir or Tresiba) is appropriate.

Results ③-⑤, taken 90 minutes after meals, are *high*. In particular, they are higher than before-meal results. This shows that the doses of *rapid-acting* analogue insulin (Novorapid) have been too small to reduce the blood glucose to pre-meal amounts, and therefore need to increase. Currently, 6-7 units is taken at meals. Increasing rapid-acting analogue doses by 1 unit each would help.

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

Guidelines

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

	Insulin Type	Mon	Tue	Wed	Thu
		15/2	16/2	17/2	18/2
B	Nov	12	12	12	12
B					Lev 10
L	Nov	8	8	8	8
T	Nov	8	8	8	8
T					
S	Lev ①	18	18	20	10
Early morning					
B R E	High				
	3.9 - 6.9	4.1	5.1		4.0
	Low			3.2	④
2 hrs after meal		8.3	5.3	4.5	6.0
L U N	High				
	3.9 - 6.9	5.6	6.1	6.8	4.2
	Low				
2 hrs after meal		6.5	6.2	8.4	6.3
T E A	②	12.7	11.0	10.9	
	3.9 - 6.9				5.6
	Low				
2 hrs after meal		3.2	6.7	6.9	4.8
S U P	③	16.7	13.0	18.3	
	3.9 - 6.9				6.7
	Low				
2 hrs after meal					
Overnight (2 am)		9.3	6.5	10.6	6.0

Slow-acting analogue insulins may work up to 24 hours. This can vary, though, and some people need two daily doses instead.

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

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

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

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

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

Basal bolus insulin - using correction doses

	Insulin Type	Mon	Tue	Wed
		15/2	16/2 ③	17/2
B	Nov	4	4 + 3	4
B	Lev	10	10	10
L	Nov	4	4	4
T	Nov	4	4	4
T	Lev	10	12 ④	12
S				
Early morning				
B	① →	17.2	14.8	← ②
R	3.9 - 6.9			6.3
E	Low			
2 hrs after meal			6.8	
L	High	15.1		
U	3.9 - 6.9		6.7	6.1
N	Low			
2 hrs after meal		13.5		
T	High	15.3		
E	3.9 - 6.9		6.0	5.4
A	Low			
2 hrs after meal		15.9		
S	High	12.3		
U	3.9 - 6.9		5.3	6.9
P	Low			
2 hrs after meal				
Overnight (2 am)		14.7		6.3

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

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

Next, work out the result aimed for - the target is usually set as 6 mmol/l. Subtract this from the current blood glucose result to give the fall in blood glucose required. If we know the glucose fall caused by 1 unit of insulin, and we know how large a fall is required, we can work out the insulin dose needed to correct the high.

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

The next day, blood glucose is again high at 14.8 mmol/l ②. A fall of 9 mmol/l (14.8 - 6) should reach the 6 mmol/l target. If 1 unit causes a fall of 3 mmol/l, then dividing the Blood Glucose fall required by the Insulin Sensitivity gives the Correction Dose needed:

9 mmol/l fall ÷ 3 (mmol/l per Unit) = **3 Units**

3 units should cause a fall of 9 mmol/l. The correction dose is 3 units of rapid-acting analogue insulin (Fiasp or Novorapid), taken either as a separate dose or added to the meal-time bolus.

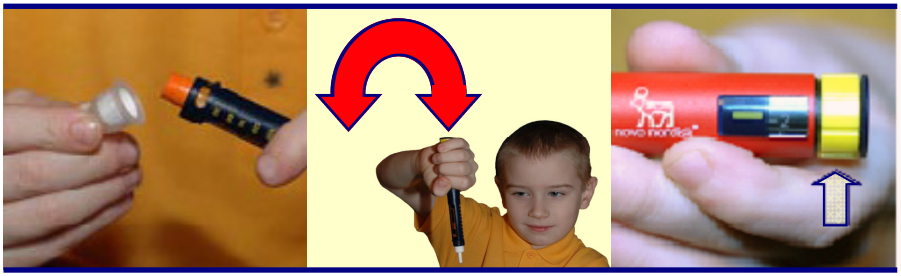
If giving a correction dose, mark this (3 units) separately from the usual bolus dose (4 units at breakfast) ③ by writing "4+ 3" (and not the total "7"). If 3 or more correction doses are used at the same time of day, increase regular insulin doses (such as night time Levemir ④). **See Pages I 20 - I 23.**

How to prepare and give an insulin injection

The following advice is for Novopen 3 and Novopen Junior injection devices, but applies to most other insulin pens, such as the newer Novopen 4 or Lilly HumaPen. On Novopens, needles connect to the insulin cartridge, but on the HumaPen they attach directly to the device itself. Most other pens are similar, but if you use a different one, please contact the diabetes service for more information.

▲ NovoPen 3 & insulin cartridge

▼ HumaPen Luxura



1. Screw new needle onto pen. Remove clear plastic cover, but keep this for later use when removing needle.

2. If using cloudy insulin, rock pen side-to-side 20 times taking care to invert pen completely. Do not shake.

3. Dial up 2 units by turning dial at bottom of the pen.

4. Hold pen with needle upwards. Tap side of pen gently to allow air bubbles to rise to the end of the pen.

5. Remove white inner needle cap. Press plunger to expel air. Repeat Steps 3 to 5 until insulin appears at needle tip.

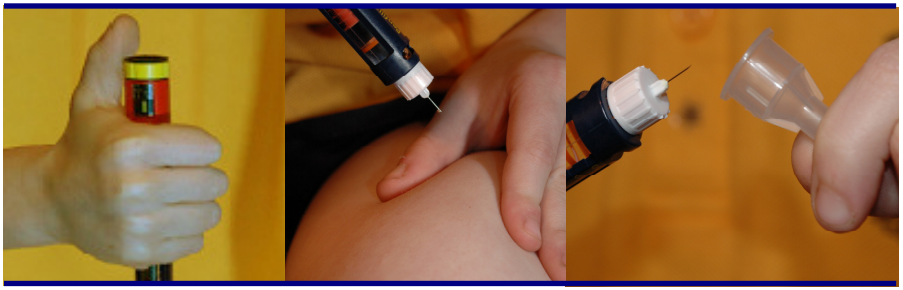
6. Dial up required insulin dose, checking window beside dial carefully for correct amount.
If incorrect dose dialled. Hold both ends of the pen, and gently pull apart to reveal metallic middle section. Press plunger end downwards on a firm surface. This will cancel the dose and return dial to

Guidelines

How to prepare and give an insulin injection (cont)

7. Find where the last injection was given, and aim to inject 2-3 fingers' breadth away from this site. Pinch up a small amount of skin, and do not squeeze tightly as this may cause pain. The pinch should be no more than an inch wide, with the skin in the middle soft. If more, you might inject into muscle, which is more painful and may make the insulin work more rapidly. Regularly change your injection sites.

8. Insert needle straight into skin, not at an angle, with a nice steady action.



9. Press plunger down as far as it will go, and count for 10 to 15 seconds before removing needle from skin. This reduces the amount of insulin that might then leak from the injection site on removing the needle.

10. Let go of skin pinch and remove needle at same time.

11. Carefully replace clear plastic outer needle cap over the needle, and unscrew the needle from the pen.
Do not use white inner needle cap to remove the needle as you could prick yourself with the needle.

12. Immediately dispose of capped needle into sharps bin.

Pens should be stored **without** needle attached. This makes sure a new needle is used each injection, reduces the risk of needle accidents, and prevents leakage between injections.

There is no such thing as a "bad" blood glucose result!

Some points to remember about blood glucose results:

1. There is no such thing as a "bad" blood glucose result! Every blood glucose result gives useful information on how to look after diabetes better.
2. Instead of "bad" or "good" results, it is more helpful to talk about results that are:
   - "on target" (3.9 - 6.9 mmol/l)
   - "low" (under 3.9 mmol/l), OR
   - "high" (over 6.9 mmol/l)
3. Simply testing blood glucose will never change the result - but knowing the result allows sensible choices to be made.
4. Many people are disappointed when they see a high blood glucose result. It is tempting to write down a lower number, or to even ignore the result all together. This may seem easier at the time, but ignoring results won't change them at all - it just hides them away, causing even more problems.
5. Thinking carefully each day about why some results are low or high (food intake, exercise, injection sites, illness and insulin) is very helpful - knowing why results are low or high will help improve them next time.
6. The insulin dose should be changed fairly often if this is the most likely reason for low or high blood glucose readings. Adjusting insulin dose every 3 days (twice a week), or more often on a "basal-bolus" system (e.g. with meals), may be needed.
7. When using a "basal-bolus" system, an blood glucose "8-point profile" should be carried out once or twice a month. This helps make sure the right amounts of basal *and* bolus insulin are given every day.
8. Sometimes knowing what to do after looking at results can be difficult, and this is a good time to call the diabetes team. Waiting until next clinic before making a change delays making helpful adjustment, and will worsen the HbA1c result.
9. A routine for testing, recording and discussing results helps. When someone is old enough to understand that testing is important for looking after diabetes, they should discuss results once a day, every day, at the same time of day (such as before dinner or bed) with their mum or dad, or someone else who can help.
10. Even though modern meters have excellent memories, it is always useful to write down results to see what blood glucose patterns occur. Members of the diabetes team *write down* the results, even with a meter in front of them - it is so much easier to see what is going on!
11. The blood glucose charts provided have been made to help show up any problem blood glucose patterns that might be occurring (too low at breakfast, too high at bed, and so on). They should be used every day.
12. Remember - testing blood glucose is only one part of looking after diabetes - there is little point in testing, and not then using the information to make changes. Keep results in the 3.9 - 6.9 mmol/l range as often as possible for good health.

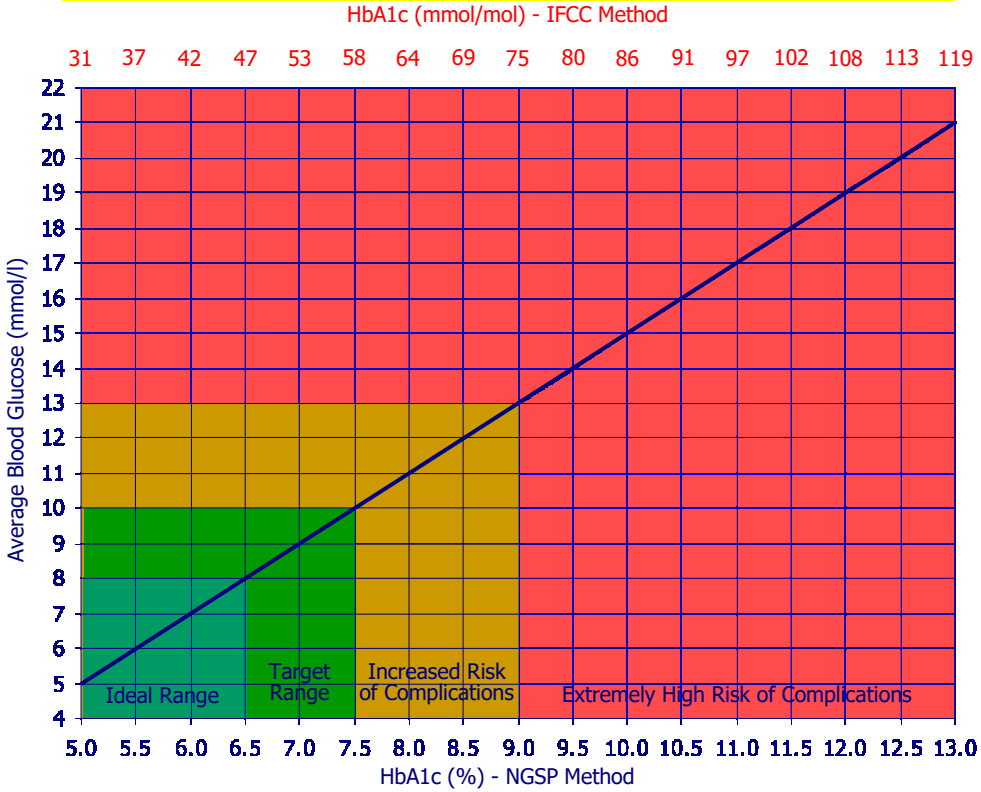
Remember! Always bring the following with you when you come to clinic:

- Blood glucose results - like the ones you keep in this folder
- Blood glucose meter - to compare results, review averages and test meter operation
- Urine specimen - first urine specimen passed on waking in the morning of clinic

Diabetes
Best Ideas

Information

HbA1c, Average Blood Glucose & Complications Risk



Information

Measuring HbA1c - "%" and "mmol/mol" (See Page I 04 for more...)

The Diabetes Control and Complications Trial (or "DCCT" for short) from 1993 conclusively showed how people with diabetes and a long history of high blood glucose results were more likely to develop complications, such as eye, kidney, nerve and blood vessel disease.

Long-term blood glucose control is measured with Glycosylated haemoglobin, or HbA1c. One method counts the percentage of all haemoglobin (see Page I 02-03) attached to glucose ("glycosylated"). Following the DCCT, factors interfering with HbA1c were found. A new method was developed by the National Glycohemoglobin Standardization Program (NGSP), allowing the familiar HbA1c percentage method to still be used.

Since then, another method of measuring haemoglobin glycosylation has been developed by the International Federation of Clinical Chemistry (IFCC). This reports HbA1c as "millimoles per mole", or "mmol/mol", and is now used instead of the earlier "%" method.

The HbA1c of someone *without* diabetes is between 20 and 42 mmol/mol. The best protection from health problems comes from having a healthy HbA1c . The ideal HbA1c for someone with diabetes is less than 48 mmol/mol (average blood glucose under 8 mmol/l), and *everyone with diabetes* should have an HbA1c lower than 58 mmol/mol (average blood glucose under 10 mmol/l). You can estimate the average blood glucose, and make sure of being "on target", by looking at a glucose meter's memory for the last 7, 14 or 30

The HbA1c target for all with diabetes is under **48 mmol/mol** (BG average under 8 mmol/l), & the HbA1c for all with diabetes should be under **58 mmol/mol** (BG average under 10 mmol/l)

Screening tests at clinic

Clinic is a time to learn how well someone's diabetes is coming along, and helps to keep people in good health. These are the tests usually carried out at clinic.

Height and Weight

Insulin is a hormone that helps people grow. Too little insulin slows growth, while too much insulin and an unhealthy diet can cause someone to become overweight. A child's growth may be greatly affected if insulin is not taken in the right amounts. To make sure growth continues healthily, height and weight is checked at each clinic visit.

Some medical problems that affect growth are more common in those with diabetes, such as an underactive thyroid gland, or coeliac disease (See Pages I 31-I32). This is another important reason for recording growth at each clinic appointment.

HbA1c

The "HbA1c" result is gives a very good idea of blood glucose results over the last 2 or 3 months. A simple finger-prick is used, just like checking a blood glucose at home. However, it is *not* a blood glucose test! Blood glucose results are measured in millimoles per litre ("mmol/l"), but an HbA1c is measured in millimoles per mole, or "mmol/mol". The weeks just before clinic affect the HbA1c result the most. The ideal HbA1c is below 48 mmol/mol, and all should have a result below 58 mmol/mol. Lower HbA1c is associated with better future health, and so is used to make better decisions about diabetes care (see Page I 02).

Blood Pressure

A blood pressure check is common at any medical clinic, and is especially important for those with diabetes. Poor blood glucose control over a long time may cause kidney problems, which in turn may increase blood pressure readings (See Page I 29).

Urine sample

The first urine specimen passed in the morning can be tested for protein, a possible early sign of kidney problems. There are many reasons to find protein in urine. While the clinic urine test is simple and inexpensive, it is not only found with diabetes-related problems. Further tests may be needed to see what, if any, problem exists.

Eye test

Poor diabetes control can cause eye problems. Yearly appointments for photos of the back of the eyes ("retinal images") are arranged for those over 11 years of age to help find early eye problems. Of course, prevention is always better than cure!

Feet

Foot care is important for those with diabetes. If 12 years or older, you may have a foot examination at clinic. You will make more friends if your feet are clean!

Other tests

More detailed tests may be needed after a "screening" check. Screening aims to find problems as early as possible, when they can be dealt with more easily. Blood tests taken every year or so look for conditions more often seen in people with diabetes, such as thyroid and adrenal gland problems, and coeliac disease (See Page I 31-I 32).

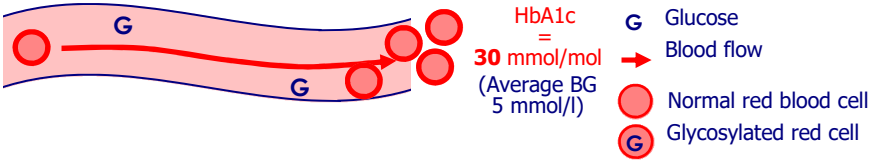
HbA1c - the blood test checked at clinic

A small blood sample is taken at every clinic, the same way a blood glucose result is checked at home - with a finger prick. However, this test does *not* measure glucose. Instead, it measures something called "haemoglobin".

"Haemoglobin" is found inside red blood cells (RBC), and helps carry oxygen around the body. The term is usually shortened to the letters "Hb". Any haemoglobin made after birth is called "adult" haemoglobin, and abbreviated to "HbA". When HbA combines with glucose, a particular "sugary" form of haemoglobin is formed; "glycosylated haemoglobin" or "HbA1c". Once formed, the HbA1c glucose-haemoglobin bond is unbreakable, and lasts as long as the red cell itself - usually about 3 or 4 months.

The HbA1c "target" for people with diabetes is 48 mmol/mol or lower.

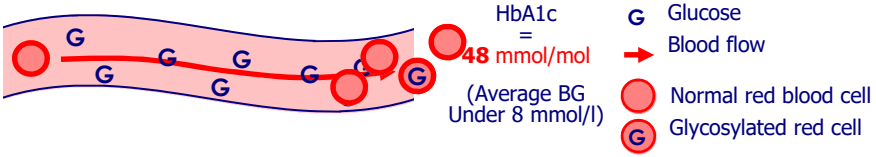
Glucose enters red cells as they move through the blood. If someone *does not* have diabetes, they will have 20-42 mmol/mol of glycosylated haemoglobin. This occurs when the average blood glucose is about 5 mmol/l.



▲ Red blood cells and **normal** blood glucose results

- In those *without diabetes* the chance of haemoglobin combining with glucose is low.
- Those with normal blood glucose results have an HbA1c of about 20-40 mmol/mol.

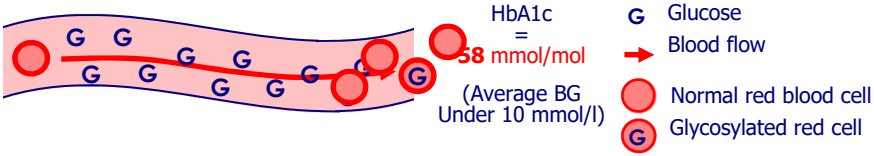
When someone has diabetes, even with the very best care, there is usually more glucose in their blood than in the blood of someone *without* diabetes. They will therefore have more chance for glucose and haemoglobin to form HbA1c.



▲ Red blood cells and **diabetes "on target"** blood glucose results

- The chance of red cell haemoglobin combining with glucose is very slightly increased.
- Those with diabetes & an ideal blood glucose have an HbA1c less than 48 mmol/mol.

An HbA1c closer to the result of someone without diabetes will give better overall health, and so an **HbA1c target of 48 mmol/mol** is set for all those attending the diabetes clinic. This occurs when the average blood glucose is less than 8 mmol/l.



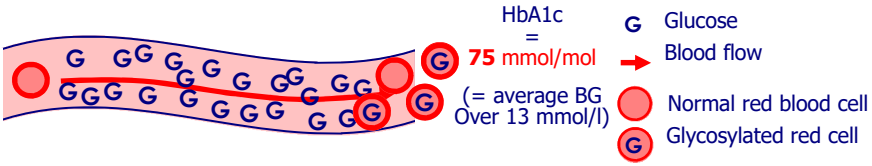
▲ Red blood cells and **diabetes "on target"** blood glucose results

- The chance of red cell haemoglobin combining with glucose is slightly increased.
- Everyone with diabetes should have an HbA1c less than 58 mmol/mol.

Information

HbA1c - the blood test checked at clinic (continued)

If blood glucose results are high overall, HbA1c will also increase. A high HbA1c result is strongly linked to an increased risk of serious health problems later in life, including damage to nerves and small and large blood vessels (Pages I 30). An HbA1c above 58 is unhealthy, and over 75 mmol/mol gives a much higher risk of developing complications.



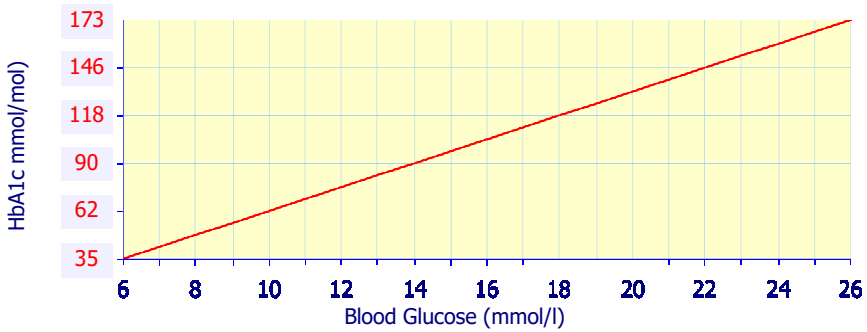
▲ Red blood cell and **high blood glucose** results

- The chance of red cell haemoglobin combining with glucose is very high.
- Too much carbohydrate or taking too little insulin causes high blood glucose results.
- Those with diabetes and unhealthy blood glucose have an HbA1c above 58 mmol/mol.

As average blood glucose rises into double figures, HbA1c rises above 58 mmol/mol. This chance of developing complications also increases. HbA1c results 75 mmol/mol or higher are very dangerous, because of a very large increase in complication rates. Other life-threatening conditions such as Diabetic Ketoacidosis (DKA) are also much more likely, needing hospital admission and intensive care (See Page I 26).

The aim of diabetes care is the lowest possible HbA1c result while avoiding hypoglycaemia

Blood glucose readings and HbA1c are directly related. As the *average* blood glucose rises, so does the HbA1c. A falling HbA1c indicates lower blood glucose results.With diabetes, while a lower HbA1c suggests lower blood glucose results, this may be due to having many *low* blood glucose results. The risk of hypoglycaemia may increase, and so the aim is to achieve the lowest HbA1c result while avoiding frequent or severe "hypos".

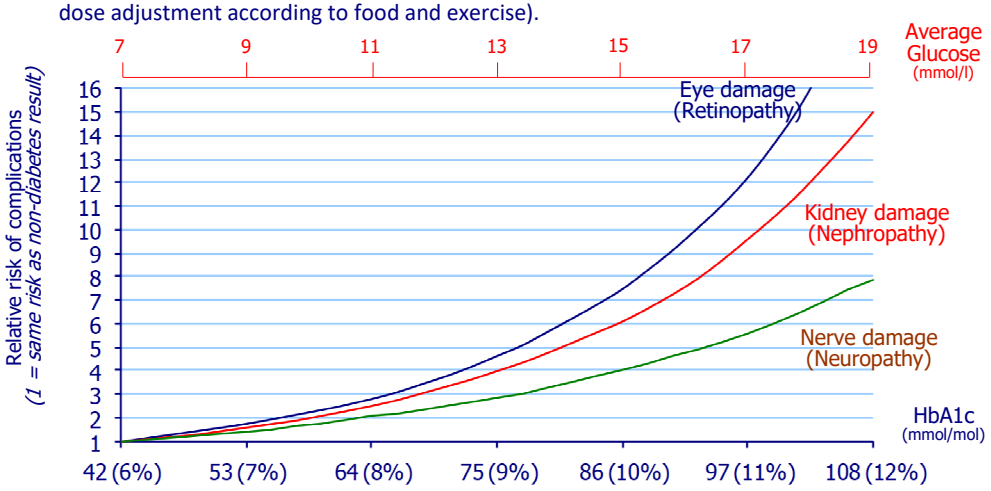


▲ As average blood glucose concentration rises, more glucose binds to haemoglobin, and more HbA1c is formed. There is a direct link between blood glucose and HbA1c (see R 00), and if one of these is known, the other can be found by looking at this graph, or by using the graph shown inside the first page of the Blood Glucose diary.

HbA1c and the risk of complications - the "DCCT"

High glucose concentrations increase HbA1c results, and high HbA1c results greatly increase the risk of complications. This was shown in a 10 year study of 1440 people with Type 1 diabetes, called the "Diabetes Control and Complications Trial". First published in 1993, the DCCT clearly showed that high HbA1c results were directly linked to earlier, more severe, and faster developing complications.

Everyone taking part in the DCCT was given either "standard" treatment (twice daily injections, attending clinic several times a year, and diabetes team contact as needed), or "intensive" treatment (three or more injections daily or an insulin pump, 3 or 4 daily blood glucose tests, more frequent clinic visits, planned diet and exercise, and insulin dose adjustment according to food and exercise).



[1] Diabetes complications. The importance of glucose control. Skyler JS. End & Met Clin NA. 1996 v25 n2 p243-254

Information

The graph shows the link between HbA1c and progression of health problems seen during the DCCT. If someone *with* diabetes has an HbA1c of 42 mmol/mol, their risk of diabetes-related health problems progressing is *the same* as for someone *without* diabetes (a "relative risk" of 1 - there is "one times" the chance of a problem). As HbA1c rises, so does the risk of problems. Once HbA1c reaches 108 mmol/mol, the risk of retinopathy worsening is literally "off the scale" - eye damage is extremely likely.

Risk of kidney disease progressing as HbA1c/blood glucose rises (from DCCT)

- HbA1c 42 mmol/l - 1 times the (same) risk as for someone without diabetes
- HbA1c 75 mmol/l - 4 times the risk compared to someone without diabetes
- HbA1c 86 mmol/l - 6 times the risk compared to someone without diabetes
- HbA1c 108 mmol/l - 15 times the risk compared to someone without diabetes

Those on "intensive" treatment on average had an HbA1c over 20 mmol/mol lower than those using "conventional" therapy. They had a *much lower chance* of health problems (complications) such as retinopathy (eye disease), nephropathy (kidney disease), and neuropathy (nerve damage - see Page I 28) worsening. Hypo number and severity also increased, but newer insulins and pumps probably makes this less of a problem today.

The DCCT was stopped 4 years early because the message was so clear - lower blood glucose results massively reduce the risk of worsening complications later in life.

Different types of diabetes mellitus

The Greek term "diabetes" means "to pass through", while "mellitus" is Latin for honey. Together, they describe the feature common to a range of medical conditions - the production of large amounts of sugary urine (or "honey"). Ancient doctors actually tasted urine to confirm the diagnosis - fortunately testing methods have moved on since then!

The term "diabetes mellitus" simply describes a symptom, and (not the) cause.

Just as finding a fever does not point to the underlying cause, so finding glucose in the urine does not indicate the type of diabetes responsible. The term "diabetes mellitus" only describes a *symptom*, and does not suggest the underlying cause.

Young people usually develop one type of diabetes (Type 1), but there are actually a number of different forms. A different process causes each type, but all have increased blood glucose concentrations in common. The higher blood glucose in turn causes thirst, frequent passage of large volumes of urine, weight loss and lethargy.

Type 1 diabetes mellitus

Type 1 diabetes mellitus is by far the most common form of diabetes in the young. Previously known as "childhood onset" or "insulin dependent" diabetes, these terms have been replaced by the more general "Type 1" - not only can the condition occur in adults, but other forms of diabetes may also depend on insulin for treatment.

In Type 1 diabetes, the body's defences attack the beta cells that make insulin. The "immune system" acts as though the beta cells are no longer part of the body, and destroys them. No insulin is made, and diabetes and ketoacidosis will occur (Page I 24).

Insulin is needed for life - you can't survive without it! The *only* way to treat Type 1 diabetes is to replace the insulin that the body no longer makes. Insulin needs to be given by injection or with an insulin pump, as if swallowed it fails to work. Inheritance plays some part in developing Type 1 diabetes, but having a relative with diabetes is by no means the only factor. Those with a family member with Type 1 diabetes are slightly more likely to develop the condition, but other factors must also be involved.

Insulin is needed for life … the only way to treat Type 1 diabetes is (with) insulin

One suggestion is the "trigger" theory. In this, the *possibility* of developing diabetes is inherited, but only in the right circumstances. Exposure to a trigger would also be necessary. This then would cause the immune system to attack the sensitive beta cells. Despite a vast amount of research, the trigger or triggers remain unknown. Certain viruses are prime suspects, but other substances may be involved as well or instead.

Other theories have also been suggested, including some that focus on reduced exposure to foreign materials, or "allergens". This might explain why the western world is affected, but Type 1 diabetes in the tropics remains relatively uncommon. Unfortunately, no single theory has been proved so far, and the search goes on.

Type 1 diabetes mellitus is by far the most common form of diabetes in the young

Different types of diabetes mellitus (continued)

Type 2 diabetes mellitus

Although Type 1 diabetes is the most likely form of diabetes in children, it is not the most common overall. Only about one in ten of those with diabetes have Type 1 - far more have "Type 2" diabetes. Type 2 diabetes used to be known as "adult onset", or "non insulin-dependent" diabetes. These terms are not really suitable, though, as the young are now developing Type 2 diabetes in greater numbers, and some adults with Type 2 diabetes depend on insulin injections.

There are a number of causes of Type 2 diabetes. The body may not make enough insulin, or may release it too slowly after a meal to be effective. The insulin may also either not work properly, or the body might have become "resistant" to its action. Being overweight is the main cause of insulin resistance, with more insulin being needed to have the same effect. The beta cells are continually stimulated to make large amounts of insulin, and finally fail to work properly, no longer able to make enough insulin for the body's needs. Type 2 diabetes follows.

In contrast to Type 1 disease, in those with Type 2 diabetes the pancreas continues making insulin - it may be in smaller amounts, or in a less effective form, but insulin is produced all the same. This feature, and the fact that ketoacidosis is much less likely to occur, are major differences between the two main forms of diabetes. Tablets that either cause the pancreas to make more insulin, more rapidly, or help the body use its own insulin better, can therefore be very effective in Type 2 diabetes. Type 2 diabetes differs to Type 1 diabetes treatment, where insulin *must* be taken to survive. This may lead to confusion. When an older family member is known to have diabetes, but does not need daily insulin injections, they almost certainly have Type 2 diabetes.

... in those with Type 2 diabetes the pancreas continues making insulin

There are three main stages in treating Type 2 diabetes. The first is to ensure a healthy diet is eaten, with small quantities of simple carbohydrate and fat. This may be enough to give reasonable blood glucose results and a healthy body weight. The second step is to take tablets, which are usually divided into treatments that either stimulate the pancreas to make more insulin, or else make the body respond better to any insulin produced (they are *not* tablets of insulin). Finally, insulin may be required, either on its own or in with one or more of the tablets used.

Some particular ethnic groups are more likely to develop Type 2 diabetes than others, and those with this condition very often have relatives with the same form of diabetes. Inheritance clearly plays a very important role. In contrast, people with Type 1 diabetes usually have *no* other family members with the condition.

Older family members are more likely to develop Type 2 diabetes, and many people will have a grandparent who is "diet-controlled" or "takes tablets". This may lead to the mistaken idea that Type 2 is a less serious form of diabetes. The risks for developing complications are as high, and perhaps even higher, for someone with Type 2 diabetes. Monitoring and caring for Type 2 diabetes are therefore just as important as with any other variety.

Different types of diabetes mellitus (continued)

Monogenic Diabetes

Children inherit features from their parents' "genes". Type 1 and Type 2 diabetes are "polygenic", resulting from the effect of many genes. However, some rare forms of diabetes are "monogenic", involving just one gene. Each form of "monogenic diabetes" causes a different problem with how the body handles glucose. Although only a handful have been identified so far, more forms of monogenic diabetes are likely to be found as our understanding of inheritance grows. As some forms of monogenic diabetes do not need insulin, and were thought similar to "adult onset" or "Type 2" diabetes except for occurring at an early age, the term, "Maturity Onset Diabetes of the Young" (MODY) was used. Other monogenic diabetes includes transient or permanent neonatal diabetes, usually found in those under 6 months old.

Steroid-induced diabetes mellitus

Steroids are chemical messengers, or "hormones", that carry out different tasks. One such task is preparing the body to deal with stress or illness, and glucose is released from stores into the blood to provide energy. Insulin would normally also be released in greater amounts to ensure this extra glucose is made available to the body's tissues.

Large amounts of steroid may be too great for … beta cells to make enough insulin

Some conditions require large amounts of steroid to be given, either by tablet or by injection (e.g. prednisolone, dexamethasone or hydrocortisone). The beta cells may not be able to make enough insulin to deal with the blood glucose increase, and so high blood glucose results usually follow. This can sometimes be dealt with by eating sensibly, but insulin injections may be needed until the steroid treatment has stopped.

Syndromes

Some inherited conditions also cause diabetes. Trisomy 21, or "Downs' Syndrome", is one. Others include Prader-Willi, Laurence Moon Biedl, and DIDMOAD syndromes, Huntington's chorea, and some glycogen storage diseases. Their management may be different, depending on the syndrome and individual needs of the patient.

Secondary Diabetes

Other medical conditions may affect the pancreas gland, too. In haemochromotosis, for example, iron is laid down in the body's organs, and the damage caused to the pancreas results in diabetes.

Cystic Fibrosis Related Diabetes (CFRD)

Cystic fibrosis is an inherited condition affecting the lungs and pancreas. While other forms of diabetes directly damage the insulin-producing beta cells, CFRD involves the whole pancreas. It is usually only diagnosed in adolescence or early adulthood, as the production of insulin falls. A healthy diet may help restore normal blood glucose results, but insulin is often needed to improve lung function, weight gain, and resistance to infection. The Diabetes Team and the CF Unit work closely together to make the diagnosis and start the appropriate treatment for CFRD as early as possible.

Insulin onset, peak and duration of action

Insulin was first discovered in the early 1920's. Before then, diabetes could not be treated. Insulin was then taken from cow and pig pancreases, but practically everyone now is treated with specially manufactured human insulin.

From the earliest days of treatment, insulin has been changed slightly to alter when it starts working, when it reaches a peak of action, and how long its effect will then last. These changes give more flexibility to how we treat diabetes.

Different types of Insulin

- Regular human insulin: Identical to that made by the human pancreas, this is also known as *soluble* or *normal* human insulin. Regular human insulin is fast-acting, but from the time of its injection it still takes at least 30 minutes to start working. It is usually given 30 minutes before eating to allow it to have its effect, and usually lasts from 4 to 6 hours. Examples include Humulin S and Actrapid.
- Isophane insulin: This is regular insulin combined with "protamine", a substance which delays absorption from the injection site. Onset, peak and duration of action are all slowed. Protamine makes isophane insulin cloudy, in contrast to more recent long-acting insulins, which are clear. Examples of isophane insulins, (also known as *NPH* or *protamine* insulins) include Insulatard and Humulin I.
- Rapid-acting insulin analogues: These clear insulins are adapted so they are very rapidly absorbed. They start working almost immediately, and are ideal just before eating. In fact, they peak so rapidly that in some situations they may be better given *after* meals. Rapid-acting analogues do not last as long as regular human insulin, so they usually given with a long-acting insulin. Examples include Humalog (insulin lispro), Fiasp and Novorapid (insulin aspart) and Apidra (insulin glulisine).
- Slow-acting insulin analogues: These insulins are designed to last a long time. Also called *basal* insulins, they may be given once or twice daily to keep a steady amount of insulin acting between meals and overnight. Unlike isophane insulins, these longer-acting insulins have no steep rise and fall, or "peak", in their action. Lantus (insulin glargine), Levemir (insulin detemir) and Tresiba (insulin degludec) are examples.
- Mixed insulin: Also known as *biphasic* insulin, mixed insulins combine the rapid onset and peak of action of fast-acting insulin (regular or analogue) with longer-lasting isophane insulin. Often taken in the morning by school children, they continue working throughout the day. The isophane insulin effect peaks around lunch-time, and so avoids the need for an injection then. Examples include Humulin M, combining isophane and regular insulin, and Novomix and Humalog Mix, combining isophane insulin with rapid-acting analogues.

Description	Action Type	Onset	Peak	Duration
Rapid-acting analogue	Ultra-short	5 - 10 mins	30 mins - 1 h	2 - 3 h
Regular	Fast / Short	30 mins	1 - 3 h	4 - 6 h
Isophane	Intermediate	1 - 3 h	4 - 6 h	8 - 12+ h
Slow-acting analogue	Slow / Long	3 - 4 h	-	18 - 24+ h
Mixed	Mixed	Depends on insulin types/amounts in mix		

Using blood glucose results to change insulin doses

Recording blood glucose results helps in managing diabetes. Writing down results may not seem very exciting, but looking at patterns of glucose results, and seeing how they respond to diet, exercise and insulin makes caring for diabetes much easier.

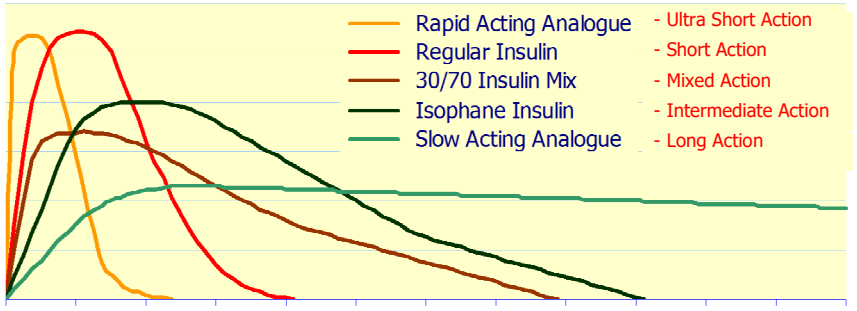
Blood glucose testing is vital because, along with knowledge of how and when injected insulin works, the doses of insulin needed to give good diabetes control may be worked out. As mentioned often in this guide, good diabetes control is needed to maintain good health, now and in the years to come.

good diabetes control is needed to maintain good health

For someone without diabetes, a "normal" blood glucose result when fasting is under 6 mmol/l. For children *with* diabetes, a target of less than 7 mmol/l (in four out of every five tests) helps maintain good diabetes control, while hopefully avoiding too many "hypos". Any results of 7 mmol/l and above are too high and, over a long period of time, may cause harm, particularly to small blood vessels throughout the body.

Too much insulin for the body's needs causes blood glucose concentrations to fall. Hypoglycaemia symptoms appear below 3.9 mmol/l (page G 08). Finding when "hypo" events occur most often allows planning of exercise, insulin timing, doses, and so on. If "low" or having symptoms of hypoglycaemia, extra carbohydrate will be necessary straight away, whatever action is taken to prevent this occurring in the future.

High and low blood glucose results have a significant impact on the life of someone with diabetes - both in the short-term and the long-term. Blood glucose results should be reviewed daily, and ideally should be between 3.9 and 6.9 mmol/l most of the time. If at a certain time of day, three results in a row are *not* in the 3.9 to 6.9 mmol/l range, action is needed to find out why, and then to make any necessary changes. Recording results without taking appropriate action makes future problems much more likely.

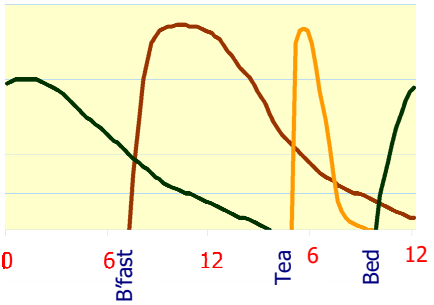


Insulin Action Profiles (recorded in hours from time of injection)

Above is a graph showing the different features of a variety of insulin types. Knowing how long a particular insulin takes to start working, when it is likely to reach its peak of action, and how long its action is likely to last, all help in planning the doses needed to keep blood glucose results in the target range. Looking after diabetes is very much easier when this information is known, understood and used every day.

! For more information on changing insulin doses, see "G 01 -02" in the Guidelines section

Different patterns of insulin use

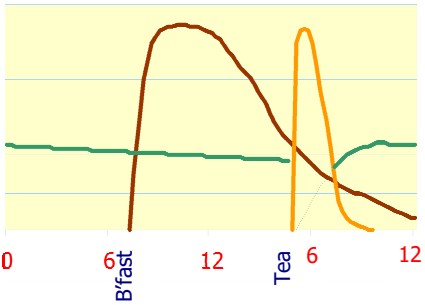


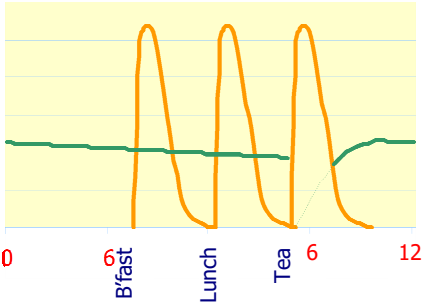
Three daily injections

- Mixed insulin before breakfast
- Rapid-acting analogue insulin before tea
- Intermediate isophane insulin before bed

Three daily injections

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



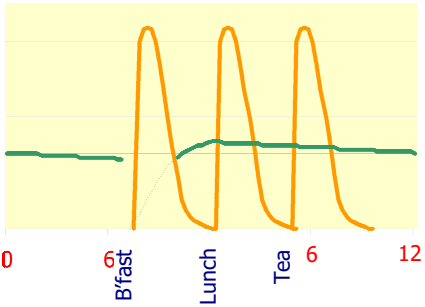


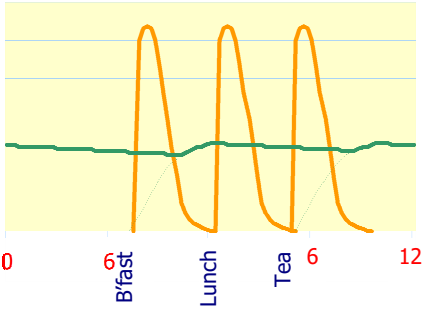
Four daily injections

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

Four daily injections

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





Five daily injections

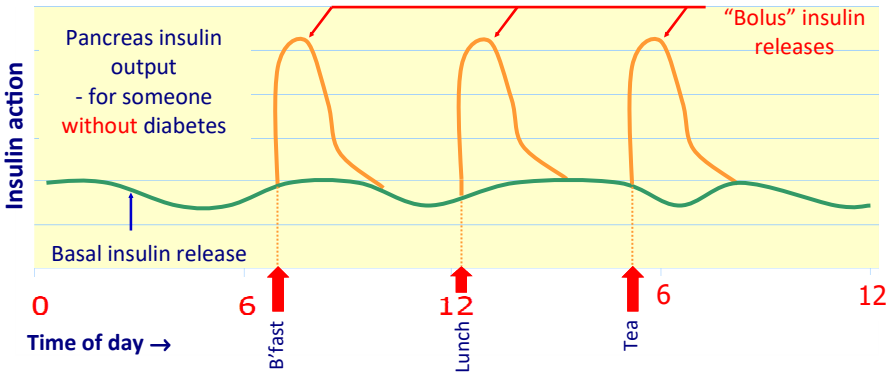
- Slow-acting analogue before breakfast
- Rapid-acting analogue before breakfast
- Rapid-acting analogue before lunch
- Rapid-acting analogue before tea
- Slow-acting analogue before tea

Information

Basal-Bolus insulin system

What is a "basal-bolus" system?

For someone without diabetes, the pancreas releases insulin *between* meals at a steady pace. This is known as a "basal" rate. A meal of carbohydrate causes the pancreas to make a burst of insulin, called a "bolus". Diabetes treatment aims to match this "basal-bolus" release of insulin as closely as possible.



▲ **Pancreas release of steady basal and mealtime bolus insulin without diabetes**

Insulin may be altered so it is either absorbed slowly and steadily, or very rapidly. It then enters the blood stream and passes around the body, just as if released from the pancreas itself. More injections are usually needed in such a "basal-bolus" system, but despite this there are many advantages. Knowing how the insulins work, and how to adjust them, will give the best chance of excellent results.

Some advantages of a basal-bolus insulin system...

- More like the body's own pattern of insulin release.
- More lifestyle flexibility, with frequent change of insulin dose depending on:
  - carbohydrate eaten.
  - activity levels.
  - illness.
- More flexible timing of meals and snacks.
- Less carbohydrate needed for between-meal and before-bed snacks.
- Insulin may be given *after* meals (useful if unsure how well a child will eat).
- Reduced risk of hypoglycaemia (especially overnight).
- "Correction" doses given more easily if blood glucose results high.
- Flexible timing when travelling (very useful when crossing time zones).
- Basal insulins more consistent as more steadily absorbed than isophane insulins.

Description	Action Type	Onset	Peak	Duration
Rapid-acting analogue	Ultra-short	5 - 10 mins	30 mins - 1 h	2 - 3 h
Isophane	Intermediate	1 - 3 h	4 - 6 h	8 - 12+ h
Slow-acting analogue	Slow / Long	3 - 4 h	-	18 - 24+ h

Basal-Bolus insulin system - Basal insulins

Basal insulins in the background - Tresiba and Levemir

Basal insulin analogues include "Tresiba" (insulin degludec) and "Levemir" (insulin detemir). Both last up to 24 hours after injection. Also known as slow- or long-acting analogue insulins, Lantus and Levemir are the background insulins needed to keep the blood glucose steady at all times for all except food. If someone with diabetes was not to eat for a prolonged period, a basal insulin would keep their blood glucose steady during fasting. They take several hours to begin working, and are given once or twice daily.

Basal insulins … are needed to keep blood glucose steady at all times for all except food.

Basal analogue insulins also have little or no "peak" of action - they produce a fairly steady effect on blood glucose, right until their effect wears off. They are therefore less likely to cause overnight hypoglycaemia. Smaller bed-time snacks may be taken than when using isophane insulins, while still avoiding overnight hypoglycaemia.

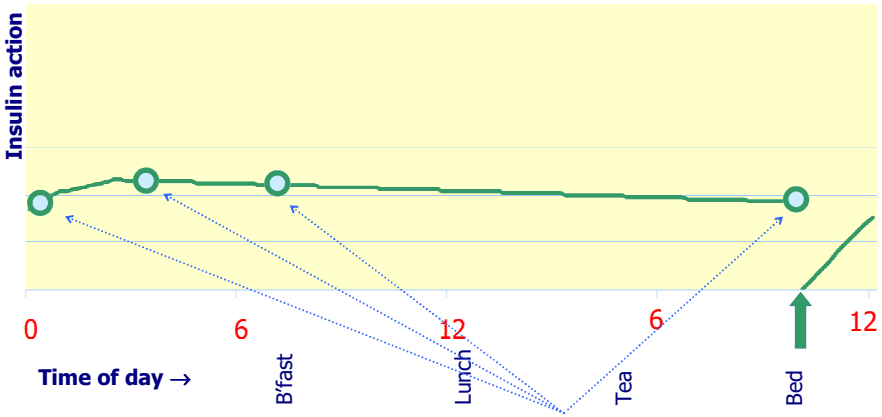
Tresiba and Levemir are usually given once a day to start. As their action fades 18-24 hours after injection, the actual time they are given is important - a blood glucose rise may occur as their effect wears off. This can be useful, such as in young children, who may need only small amounts of insulin. However, for others two basal insulin doses may be required each 24-hour period.

Basal insulins may be given once or twice a day … and have little or no peak of action.

Apart from their speed of action, it is important to remember that basal insulin analogues are entirely clear. In contrast, older isophane insulins are cloudy. It is very important not to confuse rapid-acting and basal insulin analogues, as they appear identical, but have very different actions. Do not worry if you confuse them, but turn to Page G 03 for advice. Always call for guidance if you are concerned.

Basal insulin - once a day to start …

Tresiba and Levemir are often given before the evening meal or before bed. Insulin is then steadily released overnight and into the following day until the next dose of basal insulin is given. They ideally keep the overnight blood glucose steady, so that the result before bed should be similar to the result overnight (midnight and at about 3-4 a.m.) and on waking. Therefore, overnight and before breakfast blood glucose results are an excellent guide to the correct evening dose of basal insulin.

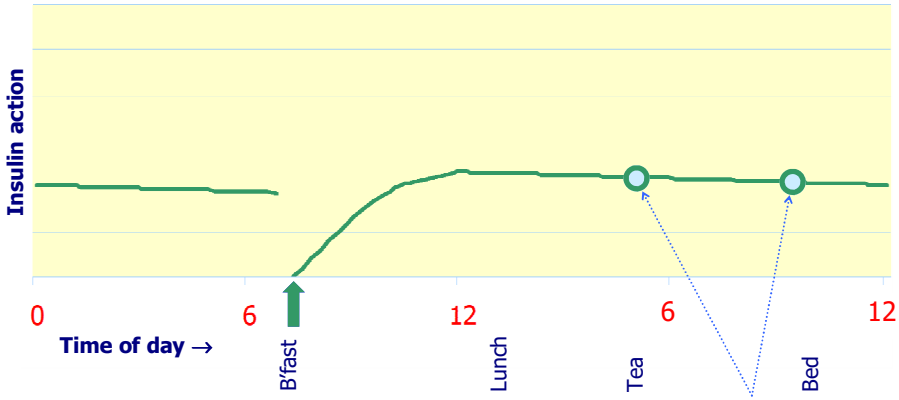


▲ **Basal insulin in evening - adjust using overnight and morning blood glucose results.**

Information

Basal-Bolus insulin system - Basal insulins (cont)

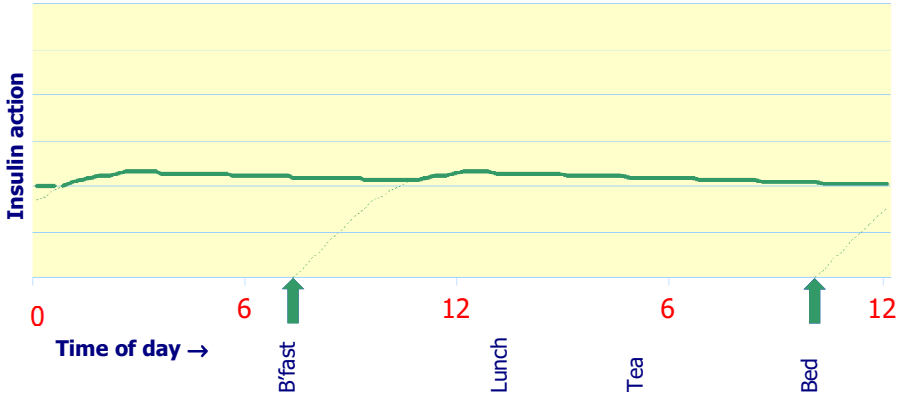
Although said to be effective for up to 24 hours, basal insulins may not actually last this long. Blood glucose will rise as their action fades, and this may be helpful in some cases. For example, young children often have lower blood glucose results on waking. By giving basal insulin at breakfast, the effect should fade overnight, and an increase in blood glucose should occur on waking. This allows more basal insulin to be given, while reducing the risk of overnight hypoglycaemia. Evening before-meal blood glucose results show the effect of a morning's basal insulin dose.



▲ **Basal insulin once daily at breakfast - adjust using evening glucose results.**

Basal insulin - twice a day might be needed …

A single basal insulin dose may not avoid rising blood glucose results later in a 24 hour period. As the effect of insulin wears off, blood glucose concentration may rise. Taking a higher basal insulin dose may simply cause hypoglycaemia at other times. A second dose of basal insulin may help, allowing the effect of one injection to run into the next. The basal insulin effect is extended, rather than simply increased. Using two separate basal doses each day may have other advantages. For example, teenagers often need more insulin overnight due to hormonal activity. More basal insulin can be given in the evening, making more insulin available overnight (see Page G 22).

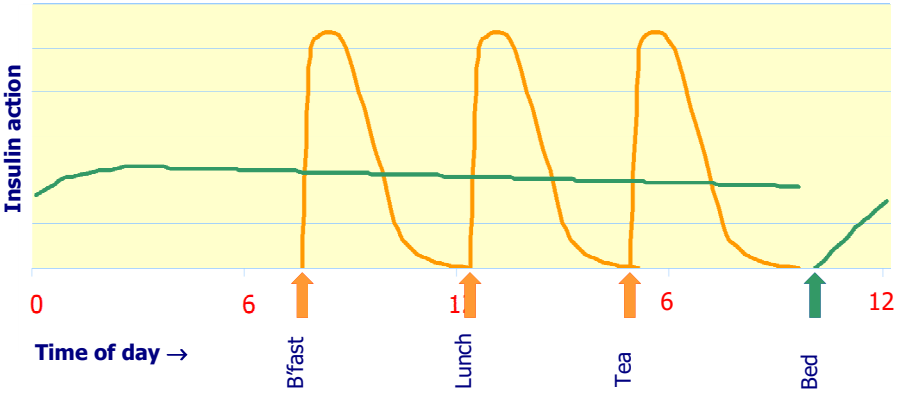


▲ **Basal insulin twice daily at breakfast and evening - extends basal insulin action.**

Basal-Bolus insulin system - Bolus insulins

Bolus insulins at meal times - Fiasp and Novorapid

Eating carbohydrate causes blood glucose to rise. In response, healthy beta cells in the pancreas make insulin, returning blood glucose to the usual range. As Tresiba and Levemir have no peak of action, they cannot quickly reduce blood glucose after meals. Rapid-acting "Bolus" insulin analogues (Humalog, Novorapid, and Fiasp), however, act so rapidly they can closely match the glucose-lowering effect of the body's insulin.



▲ **Basal insulin once daily at bedtime. Bolus insulin with meals.**

Humalog (insulin lispro), Novorapid (insulin aspart), and Fiasp (fast insulin aspart) are examples of rapid-acting insulin analogues. Unlike injected "regular" or "soluble" human insulin (Actrapid and Humulin S), which are given 30-40 minutes before eating, rapid-acting insulin analogues are absorbed and start working almost immediately. They are usually better given directly before food, in some special situations may be given *after* food.

Rapid-acting insulins have an earlier peak of action (30 minutes from injection) and are shorter lasting (2 to 3 hours) than regular human insulin. The blood glucose rise after a meal should therefore be lower, and the risk of becoming hypoglycaemic is also lower.

Slow-acting and rapid-acting insulin analogues should not be mixed, and so two separate injections are needed even if taken at the same time. Each injection should probably also be given in a separate site, such as using one leg for basal insulin and the other for boluses. The table below is a summary of basal and bolus insulins.

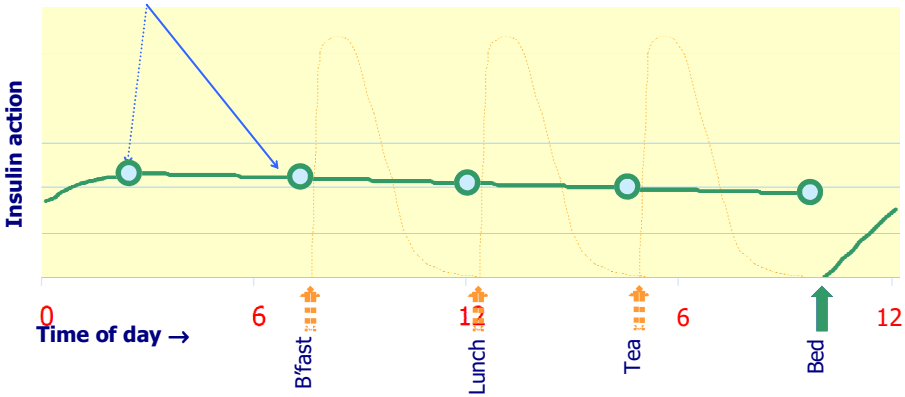
Feature	Basal insulin	Bolus insulin
Action	• "baseline" steadily-acting insulin	• "bursts" of rapid-acting insulin
Duration	• 18-24 hours	• 2-3 hours
Frequency	• once or twice daily	• 3-4 times daily (with main meals)
Glucose effect	• on Before-meal glucose results	• on After-meal glucose results
General effect	• "trends" over a period of time	• immediate changes or "events"
Examples	• Lantus, Levemir	• Apidra, Humalog, Novorapid

Information

Basal-Bolus insulin and blood glucose testing

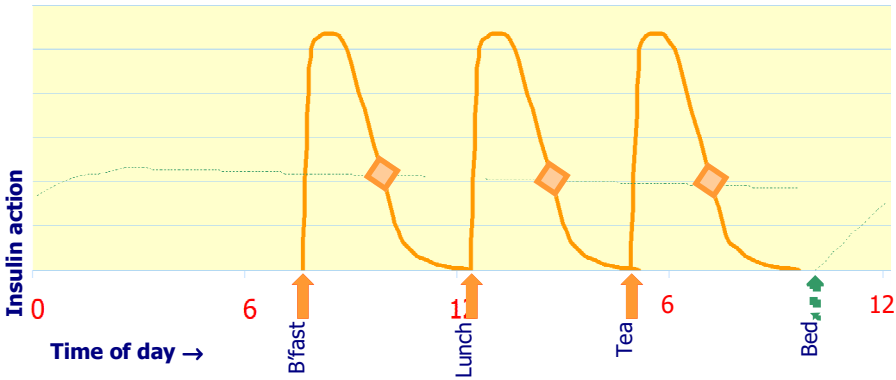
Using blood glucose results to adjust basal-bolus insulin doses

Frequent blood glucose testing allows better planning of insulin doses. Basal insulin has the greatest effect on before-meal, before-bed and overnight blood glucose results, and tests at these times guide us to the correct dose for Lantus or Levemir.



▲ **Before-meal blood glucose tests guide the basal insulin dose.**
Before-meal blood glucose testing mainly records the effect of basal insulin.

In contrast, rapid-acting bolus insulins (Fiasp, Humalog and Novorapid) have most impact in the first couple of hours after injection. Testing the blood glucose *up to 2 hours after* bolus insulin injection shows whether the current dose should change. If correct, then blood glucose results should fall to within 2 mmol/l of the *pre-meal* amount. If an *after-meal* result is high, the bolus insulin dose must increase, and if low, must be reduced.

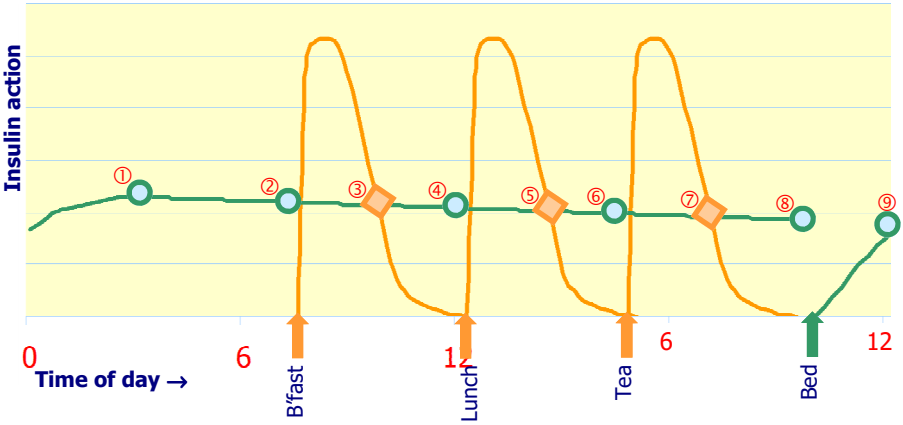


▲ **After-meal blood glucose tests guide the bolus insulin dose.** To check effect of meal-time bolus insulins on blood glucose, test up to 2 hours *after* these injections. This shows how fast blood glucose falls to pre-meal values, allowing bolus insulin adjustment.

If blood glucose tests are carried out before and after main meals, before bed, and also overnight, adjustments to both basal *and* bolus insulin doses would require testing glucose 8 or 9 times a day. When starting a basal-bolus insulin system, these so-called "paired readings" result in an "8-point blood glucose profile", used to adjust bolus insulin doses.

Basal-Bolus insulin and the "8-point profile"

The graph below shows the 8 tests recommended to work out both basal and bolus insulin doses. Fortunately, these are not needed every day, and once rapid-acting bolus doses are established you should only need to check overnight and after-meal tests once or twice a month. Before-meal testing is still important, and if necessary results can be adjusted with "correction" doses of bolus insulin (see Page I 20).



▲ Before *and* after meal blood glucose tests - the "8-point profile" (+ one at midnight!)
To check the effect meal-time bolus insulins have on blood glucose, test approximately 2 hours *after* these are injected. A blood glucose result taken then shows how quickly blood glucose falls again to pre-meal values. This is then used to adjust bolus insulin doses.

Adjusting bolus insulin depending on what is eaten

One advantage of a basal-bolus system is the ability to eat different carbohydrate amounts with each meal. Bolus insulin doses are adjusted to match the carbohydrate eaten, and if we can count the amount of carbohydrate eaten, insulin dose may be adjusted *each meal* to produce on target blood glucose - just as the pancreas would do.

If you can remember how and when the pancreas makes insulin, you are well on the way to understanding how to use the "basal-bolus" system. Many find it the easiest way to look after their diabetes because it simply makes good sense. It may require more injections, but for most the positives far outweigh the negatives.

Bolus insulin doses are adjusted to match the amount of carbohydrate eaten

Long-acting basal insulin affects blood glucose patterns from week to week, over the long -term. In contrast, short-acting bolus insulin affects blood glucose results from meal to meal, in the short-term. Basal insulin affects blood glucose trends over time, while bolus insulin affects individual events, such as meals and exercise.

It is important to understand these differences between "basal" and "bolus" insulins. You should then be able to look after diabetes in most situations. Just three steps are needed to work out the correct doses of insulin:

1. Adjust "trends" with basal insulin.
2. Match food with Carbohydrate Doses.
3. Treat high BG with Correction Doses.

Basal insulin keeps blood glucose steady at all times except after main meals, while **Bolus insulin** keeps blood glucose steady after meals, and corrects high blood glucose results.

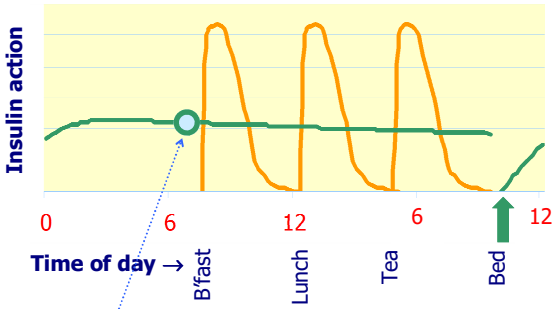
Information

Step 1: Observing blood glucose "trends" and Basal Dose

Step 1 - work out Basal insulin dose first by looking at "trends"

Look at basal insulin doses first. While Fiasp and Novorapid boluses act on after-meal rises in blood glucose, basal insulins such as Tresiba and Levemir deal with the rest of the day. About a half of the day's insulin is usually given as basal insulin.

Several days of before-meal, before-bed, and overnight blood glucose results show the long-term effect of basal insulin. Trends in these results show the most suitable *basal* insulin dose - a before-meal blood glucose result about 8-12 hours after injection of basal insulin should be in the target range of 3.9 - 6.9 mmol/l.



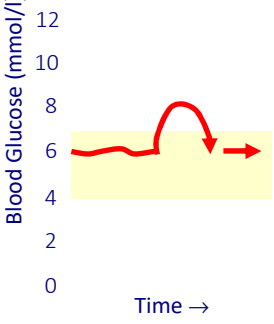
As discussed earlier, the before-breakfast blood glucose result is an excellent guide to the correct bed-time basal insulin dose. In the same way, basal insulin given at breakfast will have most impact on before-tea and before-bed results.

When blood glucose results 12 hours after basal insulin are on target it is essential to see what the blood glucose was *just before* this injection. If usually high, the basal insulin may not be lasting 24 hours. Simply increasing the dose of basal insulin will possibly cause hypoglycaemia 12 hours after injection, so taking insulin to reduce the time of insulin deficiency is helpful. This may be done by taking a second dose of basal insulin, or by taking a dose of rapid-acting insulin in the 3-4 hours before the daily basal insulin dose.

Work out Bolus insulin doses by looking at "events"

When someone *without* diabetes eats carbohydrate, the pancreas releases just enough insulin to match the rise in blood glucose. When someone *has* diabetes, and the pancreas cannot make enough insulin, there are two choices:

1. Eat *fixed* amounts of carbohydrate at meals, and match this with *fixed* doses of insulin.
2. Eat *variable* amounts of carbohydrate, and match with *variable* insulin doses. This option is clearly more flexible.



Bolus insulin injections mimic the rapid release of insulin from the pancreas. The "correct" bolus dose returns blood glucose to an acceptable range *after* eating carbohydrate. It will *also* includes any "correction" dose needed for a high before-meal blood glucose result (to be discussed in Step 3).

Each carbohydrate meal can be thought of as a single "event". Exercise or a single high blood glucose are also other "events" we need to think about. Basal insulin affects "trends" over days and weeks, and Bolus insulin acts rapidly on "events", making changes in minutes and hours.

◀ After-meal blood glucose result returns to 6 mmol/l

Information

Step 2: Carbohydrate:Insulin Ratio & Carbohydrate Dose

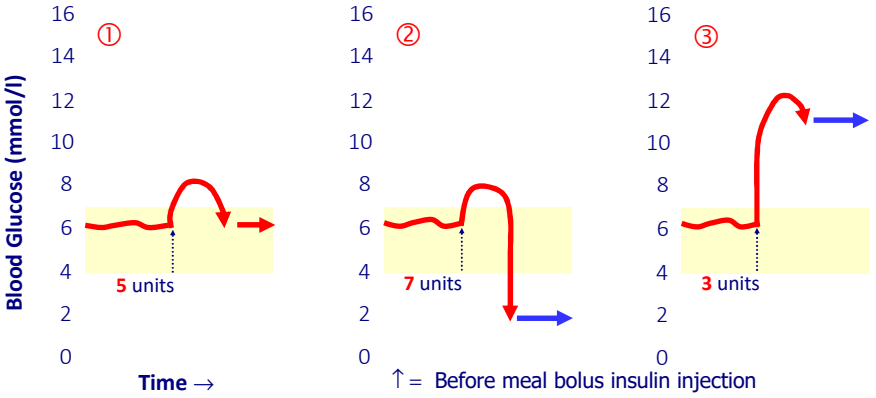
The Carbohydrate: Insulin Ratio (or "Carb to Insulin Ratio")

More insulin is needed when more carbohydrate is eaten. A "Carbohydrate: Insulin Ratio" helps work out the correct insulin dose to be taken for carbohydrate eaten at main meals.

Carbohydrate to Insulin Ratio = Carbohydrate (grams) eaten for each unit of insulin taken

A Carbohydrate: Insulin Ratio works out how many grams of carbohydrate can be eaten for each unit of rapid-acting insulin given. Grams of carbohydrate are counted, an insulin dose given, and blood glucose tested before and after a meal. If these two blood glucose results , called "paired readings", are similar, then the insulin dose matches the amount of carbohydrate eaten. This dose of insulin is the Carbohydrate Dose. If too much insulin is given, blood glucose after the meal will fall, while too little insulin will cause it to rise.

Carbohydrate Dose = Carbohydrate eaten (grams) ÷ Carb to Insulin Ratio (grams/Unit)



In each example above a meal of **50 grams of carbohydrate** has been eaten.

① **5 units** given. Blood glucose 2 hours after the meal with 50 grams of carbohydrate has remained the same as the before meal result. The insulin dose has kept the blood glucose steady, and so matches the amount of carbohydrate eaten. The Carbohydrate Dose is correct. If we then divide the amount of carbohydrate eaten (50 g) *by* the insulin dose that kept blood glucose steady (5 units), a Carbohydrate: Insulin Ratio can be found:

50 grams ÷ 5 units = **10 grams per unit**

We can now use this same Carb: Insulin Ratio to calculate the insulin Carbohydrate Dose for other amounts of carbohydrate. For example:

If eating 30 grams:	30 grams ÷ **10 grams per unit**	**= 3 units required**
If eating 70 grams:	70 grams ÷ **10 grams per unit**	**= 7 units required**

② **7units** given. Blood glucose 2 hours after the 50 grams of carbohydrate meal is much *lower* than the before the meal. The Carb: Insulin Ratio in this case is:

50 grams ÷ 7 units = **7 grams per unit** (approximately).

Too little carbohydrate has been eaten for each unit of insulin given, and so the 7 g/U Carb: Insulin Ratio is too low. A low Carb: Insulin Ratio results in too much insulin being given, and so causes blood glucose to fall. The insulin Carbohydrate Dose is too large.

Information

Step 2: Carbohydrate:Insulin Ratio & Carbohydrate Dose

③ **3units** given. Blood glucose 2 hours after the 50 grams of carbohydrate meal is much *higher* than the before the meal. The Carb: Insulin Ratio in this case is:

50 grams ÷ 3 units = 17 grams per unit (approximately).

Too much carbohydrate has been given per unit of insulin, and so the Carb to Insulin Ratio of 17 g/U is too high. A high Carb to Insulin Ratio results in too little insulin being given, and so causes blood glucose to rise. The insulin Carbohydrate Dose is too small.

- Correct Carb:Insulin Ratio (CIR) causes similar before and after meal blood glucose results
- Low CIR gives too little carbohydrate for the insulin dose, causing blood glucose to fall
- High CIR gives too much carbohydrate for the insulin dose, causing blood glucose to rise

Different meals may need different Carbohydrate:Insulin Ratios. While breakfast might need 6 grams per Unit, lunch and tea may need 10 grams per Unit. (See the example below). It also shows that less carbohydrate was eaten at lunch than at tea. Using the varied Carb to Insulin Ratios, insulin doses were changed to give a smaller insulin dose at lunch, and a larger dose at tea - just as the pancreas would have done.

If eating 20 grams or less, such as for a between-meal snack, an earlier dose of *basal* slow -acting insulin can usually deal with any blood glucose rise. However, if eating more than 20 grams, *bolus* rapid-acting insulin is needed. Main meals usually require a bolus of Fiasp or Novorapid, and so will a large bed-time snack!

Carbohydrate:Insulin Ratios - an example

Meal	Carbohydrate	Carb: Insulin Ratio	Calculation	Carbohydrate Dose
• Breakfast	30 grams	6 grams per Unit	30 ÷ 6	= **5** units
• Lunch	50 grams	10 grams per Unit	50 ÷ 10	= **5** units
• Dinner	70 grams	10 grams per Unit	70 ÷ 10	= **7** units
• Supper	40 grams	15 grams per Unit	40 ÷ 15	= **3.5** units

Other factors may affect how much bolus insulin is needed, and these include:

1. Fatty meals Fat slows carbohydrate absorption, so a fatty meal (such as fish and chips or pizza) will slow blood glucose rise after a meal. Taking a meal-time insulin bolus *after* a fatty meal might be better to match the delayed blood glucose rise.
2. Larger meals Carbohydrate: Insulin Ratios (CIRs) s may need to be reduced for large amounts of carbohydrate. A CIR of 7 g/unit may be needed for a 50 gram carbohydrate meal, but if 100 grams were eaten, a higher CIR (e.g. 10 g/unit) may be needed.
3. Exercise Exercise may affect later blood glucose results, and insulin doses should be altered accordingly. Remember that following sustained exercise, even if of low intensity (such as playing golf), basal insulin doses may also need to be cut, particularly any before tea or before bed doses. Contact the diabetes team for more details.
4. Illness If vomiting, basal insulin may help prevent ketone production, especially if small doses of fast-acting insulin are given with small amounts of easily absorbed carbohydrate spread evenly throughout the day (e.g. Lucozade, ice cream, jelly with sugar, etc.) and enough sugar-free fluid to stay hydrated. Refer to the use of a ketone dose of insulin in the illness guidelines on Page G07, and the "Food for Life" diet book.

A Carbohydrate Dose should keep before and after meal blood glucose results steady

Step 3 - making correction doses for high results: the "100 Rule"

Each insulin bolus has two separate parts; one for the food eaten (Carbohydrate Dose) and one for lowering a high blood glucose to the target range (Correction Dose).

A correct Carbohydrate Dose should keep before and after meal blood glucose steady. If a before meal blood glucose was 6 mmol/l, and the Carbohydrate Dose correct, blood glucose 2 hours later should stay about 6 mmol/l. If before meal glucose is 12 mmol/l, the *same* Carbohydrate Dose of insulin should keep the blood glucose 12 mmol/l.

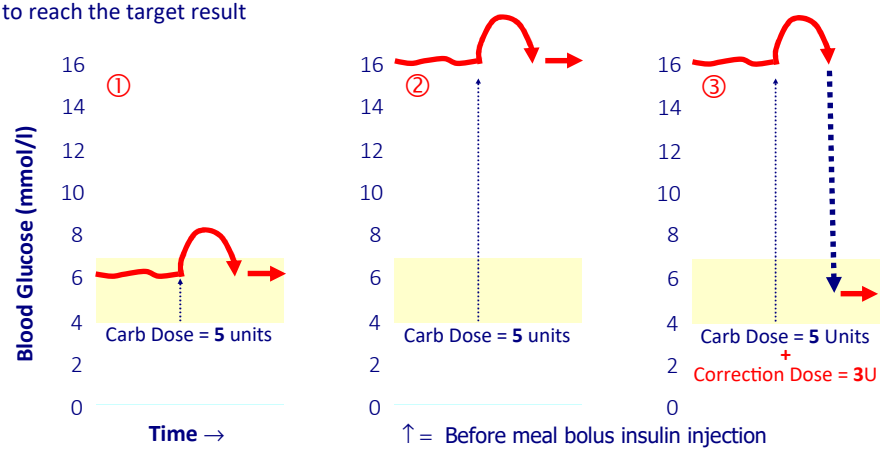
Clearly a blood glucose of 12 mmol/l is high. An insulin Carbohydrate Dose *only* deals with the rise in blood glucose *after* eating carbohydrate. It does not deal with a high *before-meal* blood glucose result. Instead, a Correction Dose of rapid-acting insulin is needed *as well as* the Carbohydrate Dose to return a high result to the Blood Glucose Target of 6 mmol/l.

A Carbohydrate Dose is worked out using a Carbohydrate: Insulin Ratio, but a Correction Dose is calculated using "Insulin Sensitivity", or "IS". This measures how far blood glucose falls given a certain insulin dose, or how "sensitive to insulin" a person may be. A high Insulin Sensitivity means small insulin doses cause a large fall in blood glucose, while a low Insulin Sensitivity means a large insulin dose will cause only a small fall in blood glucose fall.

The "100 Rule"[1] is used to estimate Insulin Sensitivity (IS). Insulin Sensitivity is then used to calculate the insulin Correction Dose needed to lower a high blood glucose towards the target blood glucose of 6 mmol/l. The 100 Rule states that:

Insulin Sensitivity (mmol/l per unit) = 100 divided by Insulin Total Daily Dose (units)
= Expected Blood Glucose fall (mmol/l) for each extra unit of insulin taken

If we know the current blood glucose we can work out how far the blood glucose must fall to reach the target result



Shown above are some blood glucose results for a person with diabetes, using a Carb to Insulin Ratio of 10 grams per unit, and eating a 50 gram meal. Their "Total Daily Dose" of insulin (i.e. all of their bolus and basal insulin) is 33 units of insulin each day.

① Before Meal Blood Glucose Below 7 mmol/l; Carb Dose 5 Units, Correction Dose 0 Units: The before-meal blood glucose result (6 mmol/l) is in the target range of 3.9 - 6.9mmol/l. The Carbohydrate Dose happens to be 5 units, and returns the blood glucose to the before meal result of 6 mmol/l. The Correction Dose of insulin is therefore "0 Units".

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

Step 3: Insulin Sensitivity and Correction Dose

②Before Meal Blood Glucose over 6.9 mmol/l; Carb Dose 5 Units, Correction Dose 0 Unit
The before-meal blood glucose result (16 mmol/l) is high. The Carbohydrate Dose of 5 units keeps the blood glucose steady at 16 mmol/l. The Correction Dose is again "0 Units", and blood glucose remains high, possibly for many hours.

③Before Meal Blood Glucose over 6.9 mmol/l; Carb Dose 5 Units, Correction Dose 3 Units
The before-meal blood glucose result (16 mmol/l) is high. The Carbohydrate Dose of 5 units keeps the blood glucose steady at 16 mmol/l. The Correction Dose of 3 Units (a total bolus of 8 Units) is enough to lower blood glucose towards the target of 6 mmol/l.

Insulin Sensitivity and Correction Doses

Insulin Sensitivity = Blood Glucose fall needed per Unit of Insulin = 100 ÷ Total Daily Dose
Correction Dose = Blood Glucose fall needed ÷ Insulin Sensitivity

This example shows how to work out the Correction Dose needed by someone who has a blood glucose of 16 mmol/l, and takes the following doses of insulin doses each day:

- Novorapid 10 units before Breakfast
- Novorapid 8 units before Lunch
- Novorapid 8 units* before Tea
- Levemir 24 units before Tea

Total Daily Dose:		50 units	
Insulin Sensitivity	=	100	÷ Total Daily Dose
	=	100	÷ 50
	=	2	mmol/l fall of Glucose per unit of Insulin
Blood Glucose fall required	=	16	mmol/l - 6 mmol/l (Target)
	=	10	mmol/l fall
Insulin Correction Dose	=	10	mmol/l ÷ 2 mmol/l per unit of insulin
	=	5	units
Total Bolus Insulin Dose (Tea)	=	8	units Carbohydrate Dose*
	+	5	units Correction Dose
	=	13	units Total Bolus Dose

A Correction Dose is calculated by dividing the required fall in blood glucose by the Insulin Sensitivity (10 mmol/l ÷ 2 mmol/l per Unit = 5 Units). 5 units is therefore the suggested insulin dose needed to lower blood glucose from 16 to the target of 6 mmol/l.

Correction Dose = Blood Glucose fall needed ÷ Insulin Sensitivity

A Correction Dose should always be given as well as any Carbohydrate Dose due at the same time. For example, if the blood glucose test above was taken before tea, then the Correction Dose should be added to the usual meal-time dose of 8 units of Novorapid. A total dose of 13 units would be needed. It can be given on its own at other times, but *not* usually within 4 hours of a previous Novorapid dose.

Correction Doses can also be given when no other insulin is required, such as at lunch for someone on a morning mixed insulin, or even overnight. They should usually not be given in 4 hours of the last dose of Fiasp or Novorapid, to reduce the risk of hypoglycaemia.

Adjusting Basal-Bolus insulin doses - easy as "123-BCC"!

1. **Basal Dose** of insulin for long-term, background effect

- Basal insulin doses (Lantus or Levemir) provide the daily insulin need for all except food. They are adjusted by looking at the trend of before-meal blood glucose results, and especially those overnight and before breakfast, when food has the least impact.
- A "correct" Basal Dose should keep blood glucose steady from bed to 3 a.m. to waking.
- If BG rises overnight then Basal Dose too low: ↑ dose 10% * (e.g. from 10 to 11 units)
- If BG falls overnight then Basal Dose too high: ↓ dose 10% (e.g. from 40 to 36 units)
- * Always test BG at 3 or 4 a.m. before increasing basal insulin dose to make sure this result is *not* low or nearly low (that is, the 3-4 a.m. result should 7 mmol/l or higher).
- * Adolescents often have BG rise after 4 a.m. due to hormones, so we may have to accept higher BG on waking to avoid overnight hypos. If BG at 3-4 a.m. on target, but high on waking, do **not** increase basal dose, but give Correction Dose with breakfast.

2. **Carbohydrate Dose** of insulin for meal-time carbohydrate

- A "correct" Carbohydrate Dose causes before-meal BG to be unchanged 2 hours later.
- Divide Carbohydrate eaten (g) by "correct" dose → Carb: Insulin Ratio ("Carb Ratio").
- Divide Carbohydrate eaten (g) by Carb Ratio (CR) → Carbohydrate Dose.

E.g. If eating 50 grams carbohydrate and Carb:Insulin Ratio = 5 g/Unit
Insulin bolus needed = 50 g ÷ 5 g/Unit = **10 Units**

BG 2 hours after meal	Cause	Carb Ratio	Action	By
↑ more than 2 mmol/l	Too much Carb for insulin dose	Too high	↓ CR	10%
↓ more than 2 mmol/l	Too little Carb for insulin dose	Too low	↑ CR	10%

- Different meals may need different Carb Ratios (e.g. breakfast Carb:Insulin Ratio often lower than at other meal times, and supper Carb: Insulin Ratio often high).
- Fatty meals slow food absorption, so consider giving insulin bolus *after* fatty food.
- Exercise before or after a meal may need meal-time insulin bolus to be reduced.

3. **Correction Dose** of insulin for lowering high Blood Glucose

- A "correct" Correction Dose causes a high BG to return to the target range in 2-3 hours.
- The "100 Rule" suggests the insulin dose needed to return a high blood glucose to target (6 mmol/l). It shows how blood glucose responds to insulin - "Insulin Sensitivity".
- Divide required BG fall by the Insulin Sensitivity to give the required Correction Dose.

Insulin Sensitivity = Blood Glucose (BG) fall per Insulin Unit = 100 ÷ Total Daily Dose
Correction Dose = Blood Glucose fall needed ÷ Insulin Sensitivity
= (Current Blood Glucose - 6) ÷ Insulin Sensitivity

E.g. If Current BG 16 mmol/l, Target BG 6 mmol/l, and person takes 50 Units insulin daily,
Required BG fall = 16 - 6 = 10 mmol/l
Insulin Sensitivity = 100 ÷ 50 Units daily, = 2 mmol/l per Unit
Insulin Correction Dose bolus = Required fall in BG ÷ Insulin Sensitivity
= 10 mmol/l ÷ 2 mmol/l per Unit = **4 Units**

- A Correction Dose may be given every 3-4 hours, *combined with* a Carbohydrate Dose or given as a *separate injection* at other times.
- When urine ketones are moderate or large, or blood ketones are 1 mmol/l or higher, a Ketone Dose should be used (Page G 07) instead of using a Correction Dose.

Using Tables to calculate Carbohydrate & Correction Dose

Calculating Carbohydrate Dose using a Table

Although Carbohydrate Dose and Correction Dose can be worked out on a calculator or mobile phone, the following tables may help if no calculator is near to hand.

The first table shows Carbohydrate Ratio (CR) in columns, and the Carbohydrate amount to be eaten in rows. The point where the CR column meets the Carb (grams) row give s the Carbohydate Dose required. For example, if Carb Ratio is 8 g/Unit, and Carbohydrate eaten is 50 g, the Carbohydrate Dose would be 6 units, rounded down to the nearest 0.5.

	CARBOHYDRATE TO INSULIN RATIO (grams per unit) to keep BG steady after meals																	
CR	2·5	**3**	3·5	**4**	4·5	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**
CARBOHYDRATE TO BE EATEN (grams)																		
5	2	**1·5**	1	**1**	1	**1**	**0·5**	**0·5**	**0·5**	**0·5**	**0·5**	-	-	-	-	-	-	-
10	4	**3**	2·5	**2·5**	2	**2**	**1·5**	**1**	**1**	**1**	**1**	**0·5**	**0·5**	**0·5**	**0·5**	**0·5**	-	-
15	6	**5**	4	**3·5**	3	**3**	**2·5**	**2**	**1·5**	**1·5**	**1·5**	**1**	**1**	**0·5**	**0·5**	**0·5**	**0·5**	**0·5**
20	8	**6·5**	5·5	**5**	4	**4**	**3**	**2·5**	**2·5**	**2**	**2**	**1·5**	**1**	**1**	**1**	**1**	**0·5**	**0·5**
25	10	**8**	7	**6**	5·5	**5**	**4**	**3·5**	**3**	**2·5**	**2·5**	**2**	**1·5**	**1·5**	**1**	**1**	**1**	**1**
30	12	**10**	8·5	**7·5**	6·5	**6**	**5**	**4**	**3.5**	**3**	**3**	**2·5**	**2**	**1·5**	**1·5**	**1·5**	**1**	**1**
35	14	**11**	10	**8·5**	7·5	**7**	**5·5**	**5**	**4**	**3·5**	**3·5**	**2·5**	**2·5**	**2**	**1·5**	**1·5**	**1·5**	**1**
40	16	**13**	11	**10**	8·5	**8**	**6·5**	**5·5**	**5**	**4**	**4**	**3**	**2·5**	**2·5**	**2**	**2**	**1·5**	**1·5**
45	18	**15**	12	**11**	10	**9**	**7·5**	**6**	**5·5**	**5**	**4·5**	**3·5**	**3**	**2·5**	**2·5**	**2**	**2**	**1·5**
50	20	**16**	14	**12**	11	**10**	**8**	**7**	**6**	**5·5**	**5**	**4**	**3·5**	**3**	**2·5**	**2·5**	**2**	**2**
55	22	**18**	15	**13**	12	**11**	**9**	**7·5**	**6·5**	**6**	**5·5**	**4·5**	**3·5**	**3**	**3**	**2·5**	**2·5**	**2**
60	24	**20**	17	**15**	13	**12**	**10**	**8·5**	**7·5**	**6·5**	**6**	**5**	**4**	**3·5**	**3**	**3**	**2·5**	**2·5**
70	28	**23**	20	**17**	16	**14**	**11**	**10**	**8·5**	**7·5**	**7**	**5·5**	**5**	**4**	**3·5**	**3·5**	**3**	**2·5**
80	32	**26**	22	**20**	18	**16**	**13**	**11**	**10**	**8·5**	**8**	**6·5**	**5·5**	**5**	**4**	**4**	**3·5**	**3**
90	36	**30**	25	**22**	20	**18**	**15**	**12**	**11**	**10**	**9**	**7·5**	**6**	**5·5**	**5**	**4·5**	**4**	**3·5**
100	40	**33**	28	**25**	22	**20**	**16**	**1**	**12**	**11**	**10**	**8**	**7**	**6**	**5·5**	**5**	**4.5**	**4**

Calculating Correction Dose using a Table

The table below shows Insulin Sensitivity (IS) in columns, and current Blood Glucose (BG) in rows. As IS is based upon the Total Daily Dose (TDD), this is also listed. The point where the IS/TDD column meets the BG row gives the Correction Dose required. For example, if someone takes 40 Units each day, the IS is 2.5 mmol/l per Unit. If the current BG is 15.2 mmol/l, the Correction Dose would be 3.5 Units. This is added to any Carbohydrate Dose.

	INSULIN SENSITIVITY (mmol/l fall BG per Unit) with Target Blood Glucose 6 mmol/l															
TDD ® (Units)	90+	**75-89**	60-74	**55-59**	45-54	**35-44**	30-34	**23-29**	18-22	**16-17**	14-15	**12-13**	10-11	**8-9**	8-7	**4-5**
IS ®	1	**1.2**	1.5	**1.7**	2	**2.5**	3	**4**	5	**6**	7	**8**	10	**12**	15	**20**
CURRENT BLOOD GLUCOSE (mmol/l)																
7-7.9	1	**0.5**	0.5	**0.5**	0.5	-	-	-	-	-	-	-	-	-	-	-
8-8.9	2	**1.5**	1	**1**	1	**0.5**	0.5	**0.5**	-	-	-	-	-	-	-	-
9-9.9	3	**2.5**	2	**1.5**	1.5	**1**	1	**0.5**	0.5	**0.5**	-	-	-	-	-	-
10-10.9	4	**3**	2.5	**2**	2	**1.5**	1	**1**	0.5	**0.5**	0.5	**0.5**	-	-	-	-
11-11.9	5	**4**	3	**2.5**	2.5	**2**	1.5	**1**	1	**0.5**	0.5	**0.5**	0.5	-	-	-
12-12.9	6	**5**	4	**3.5**	3	**2**	2	**1.5**	1	**1**	0.5	**0.5**	0.5	-	-	-
13-13.9	7	**5.5**	4.5	**4**	3.5	**2.5**	2	**1.5**	1	**1**	1	**0.5**	0.5	**0.5**	-	-
14-14.9	8	**6.5**	5	**4.5**	4	**3**	2.5	**2**	1.5	**1**	1	**1**	0.5	**0.5**	0.5	-
15-15.9	9	**7.5**	6	**5**	4.5	**3.5**	3	**2**	1.5	**1.5**	1	**1**	0.5	**0.5**	0.5	-
16-16.9	10	**8**	6.5	**5.5**	5	**4**	3	**2.5**	2	**1.5**	1	**1**	1	**0.5**	0.5	**0.5**
17-17.9	11	**9**	7	**6**	5.5	**4**	3.5	**2.5**	2	**1.5**	1.5	**1**	1	**0.5**	0.5	**0.5**
18-18.9	12	**10**	8	**7**	6	**4.5**	4	**3**	2	**2**	1.5	**1.5**	1	**1**	0.5	**0.5**
19-19.9	13	**11**	8.5	**7.5**	6.5	**5**	4	**3**	2.5	**2**	1.5	**1.5**	1	**1**	0.5	**0.5**
20 +	14	**11**	9	**8**	7	**5.5**	4.5	**3.5**	2.5	**2**	2	**1.5**	1	**1**	0.5	**0.5**

Step 3: Correction Dose calculation table

Some things to remember about Correction Doses

- Use Correction Dose (CD) if blood glucose 7 mmol/l or higher, but no or few ketones.
- Use Ketone Dose Guidelines (Page G 07) if blood glucose 14 mmol/l or higher, or the patient is unwell.
- If frequent Correction Doses are needed, regular basal and bolus insulin doses are clearly not "correct", and should be adjusted using the guidelines (Pages G 02-04).
- If three or more Correction Doses are needed at the same time of day, *other action* to prevent high before-meal results is needed. Prevention is better than cure!
- Do not use Correction Dose within 4 hours of another rapid-acting insulin dose.
- Insulin Sensitivity may vary depending on the meal or time of day (e.g. overnight).
- Add Correction Dose to any regular dose of rapid-acting insulin analogue due to be given (such as at meal-time), or give as a separate dose at other times.
- Use caution if dose large or to be given overnight. Consider giving half suggested dose and reviewing effect after 3-4 hours. More insulin may then be given, if needed.
- Exercise taken or about to take place lowers blood glucose, *without* extra insulin.
- Always test for ketones if blood glucose over 14 mmol/l, and if moderate or large ketones found use a Ketone Dose (Page G 07) instead of using a Correction Dose.

Correction Doses and Mixed Insulin Doses

This example shows how to calculate a Correction Dose when using a mixed insulin before breakfast (e.g. Humulin M3, Humalog Mix 25, or Novomix 30), if a person with diabetes had a blood glucose of 16.2 mmol/l before breakfast, and usually took these doses of insulin doses each day:

• Humalog Mix 25	12 units	before breakfast
• Novorapid	4 units	before tea
• Levemir	8 units	before tea
Total Daily Dose:	24 units	

Insulin Sensitivity	=	100 ÷ Total Daily Dose
	=	100 ÷ 24
	=	4 mmol/l of Glucose per unit of insulin (approx).
Blood Glucose fall required	=	16 mmol/l - 6 mmol/l (Target)
	=	8 mmol/l fall
Insulin Correction Dose	=	8 mmol/l ÷ 4 mmol/l per unit of insulin
	=	2 units

Dividing the blood glucose fall needed (8 mmol/l) by Insulin Sensitivity (4 mmol/l per unit of insulin) gives a 2 unit Correction Dose. This is the suggested dose of Novorapid (*not* Humalog Mix 25) needed to lower blood glucose from 16.2 to the target of 6 mmol/l. It is given as rapid-acting insulin, such as Novorapid or Humalog (*not* Humalog Mix 25).

If blood glucose is high at breakfast (e.g. 16.2 mmol/l) a *separate* dose of bolus insulin should be given (2 units) *as well as* the usual dose of Humalog Mix 25 (12 units). If a high result occurs at lunch, a separate Correction Dose will also be needed. However, if a high blood glucose occurs at tea time, then the usual Novorapid dose may be simply increased (for a total Novorapid dose of 4+2 = 6 units), and no separate injection will be necessary.

Insulin, Illness and Ketones

Just as a car needs petrol to run, so the body needs fuel to keep going. Food is the body's fuel, and the energy comes from the carbohydrate, fat and protein found in food. Glucose is a type of sugar, and is a basic, or "simple", form of carbohydrate.

Muscles generally use glucose for energy, and insulin allows that glucose to move from blood into the muscles. Insulin also helps store glucose in the liver for later use (such as when sleeping overnight). Insulin, then, acts like a "key" to a door, allowing carbohydrate to pass from the blood into muscle and liver.

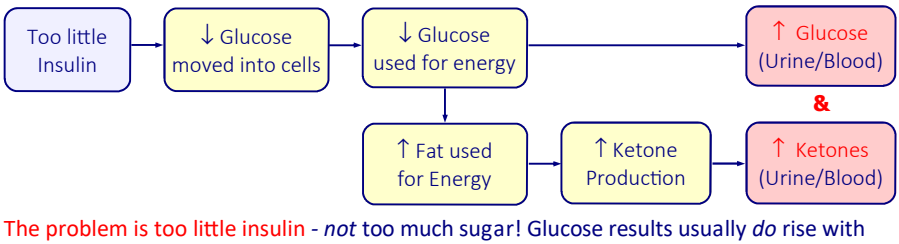
Insulin … acts like a "key" to a door …

There are times when the body can no longer use carbohydrate for energy - there is either not enough glucose available, or not enough insulin to move the glucose into the muscles. Another energy source is used - the body's reserves of fat. For short periods, this is useful. However, using fat for energy produces ketones - acids that poison the body, and cause a person to become very ill. Ketones can be extremely dangerous, and large amounts may even be life-threatening.

When someone is ill (such as with a viral illness, like the 'flu or gastroenteritis) their body becomes "stressed". Steroids are released that help cope with this stress, and these release glucose from the liver to provide extra energy. Steroids also increase fat breakdown for energy, and so also increase ketone production.

… during illness normal daily insulin doses may not be enough …

During illness, someone *without* diabetes simply makes whatever insulin is needed to keep blood glucose normal. Less energy from fat is needed, and fewer ketones are produced. However, if someone *has* diabetes normal daily insulin doses may not be enough to stop fat breakdown and ketone production - this is why more insulin is needed during times of illness or stress.



The problem is too little insulin - *not* too much sugar! Glucose results usually *do* rise with illness, but ketone production is the main concern. Too little insulin usually causes *both* a rise in glucose *and* a rise in ketones. Urine or blood should always be tested for ketones when blood glucose rises above 14 mmol/l, or when someone with diabetes becomes unwell - this is when ketones are most likely to develop. A Ketone Dose is extra insulin taken to hopefully prevent further ketone production.

Even if unable to eat normally, someone with diabetes usually needs *more* insulin to stop ketones forming. If they cannot take enough carbohydrate (as Lucozade®, sugary drinks or ice cream if not eating normally), or take enough sugar-free fluids to avoid dehydration, admission to hospital may be needed. The "Food for Life" diet book has more information on food and drink choices for times of illness.

Diabetic Ketoacidosis - *an avoidable emergency!*

What is it, and how is it recognised?

As discussed on Page I 25, when the body has too little insulin for its needs, fat is used to provide energy instead of carbohydrate. Ketones are produced, which are acidic and poison the body. If large amounts of ketones are made the situation can worsen dramatically. This dangerous situation is known as Diabetic Ketoacidosis, or "DKA". Features of DKA include:

The common symptoms of Ketoacidosis are:

- High blood sugar results (usually)
- Urine ketone results "moderate" or "large" OR
- Blood ketone results 1 mmol/l or higher
- Dehydration
- Vomiting
- Abdominal pain
- Rapid breathing rate
- Sweet smelling breath
- Increasing sleepiness/drowsiness, lack of energy

What usually happens to someone in ketoacidosis?

Extra insulin is needed to stop ketones being made during ketoacidosis. Insulin often has to be given directly into a vein using a "drip". Ketones may cause abdominal pain, vomiting, and affect the normal function of the gut, and so taking fluids by mouth can make a bad situation even worse. Large volumes of fluid are given into the vein, along with insulin, correcting the dehydration that also occurs.

Ketoacidosis is extremely dangerous, and should never be taken lightly. At best it needs careful medical review, and admission to hospital is likely. Severe cases may need intensive care. Severe ketoacidosis can cause permanent brain injury, and may be life-threatening.

"Ketone Dose Rules" aim to increase insulin doses safely before ketones can poison the body. Hopefully at this stage keto*acidosis* can be prevented. Everyone in the family should know when and how to use the Ketone Dose Guidelines (Page G 07), and the hospital can be called if any more information is needed. Extra insulin when ill may prevent the need to come into hospital for treatment.

When most people are first diagnosed with diabetes, they have the basic symptoms of thirst, passing urine more often, feeling tired and losing weight. Some, however, arrive at hospital very unwell, already in ketoacidosis. Features include abdominal pain, dehydration, vomiting, drowsiness, breathing rapidly or with deep breaths, sweet-smelling breath, or drowsiness. This is an emergency situation, and needs urgent hospital treatment with insulin and extra fluids.

Ketoacidosis at diagnosis does not mean someone's diabetes is more severe - it can happen to *anyone* with Type 1 diabetes. It simply shows there has not been enough insulin present to prevent ketones forming. This also means someone who is *not* very unwell at diagnosis has just as much chance of developing ketoacidosis at some stage when they are older as someone needing urgent admission. They may still become very unwell if they do not have the right amount of insulin for their body's needs.

Ketoacidosis is extremely dangerous, and may be life-threatening .

Some common causes of ketoacidosis

The best way to prevent ketoacidosis occurring is to look after diabetes well. Ketoacidosis is unlikely to occur If eating healthily and adjusting insulin doses regularly. Ketones may be made, but the situation rarely progresses to the more serious keto*acidosis*.

If diabetes control is good … ketoacidosis is much less likely to occur ...

Ketoacidosis may happen at the time of first diagnosis, but it is also likely to develop during illness - a vomiting illness or a chest infection, for example. Problems are unlikely if someone's HbA1c is lower than 58 mmol/mol, but the risk of ketoacidosis increases as diabetes control worsens. If a person's HbA1c is 85 mmol/mol or more, the risk becomes very high indeed, and a simple cold may be enough to cause ketoacidosis.

While everyone forgets to take an insulin injection at one time or another, many young people deliberately miss insulin injections. One study in Scotland showed that two thirds of teenagers regularly and deliberately missed one or more injections every day. This means missing insulin is actually *normal* in this age group, although clearly it is not a good way to remain healthy. It certainly increases the risk of ketoacidosis, and is probably the main reason young people with diabetes are admitted to hospital.

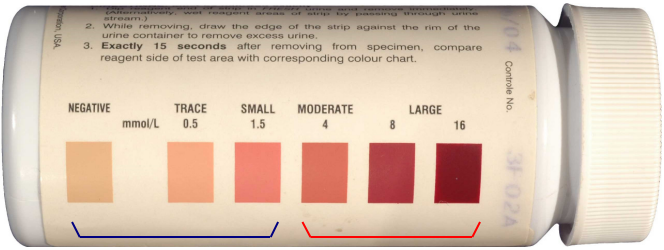
… ongoing parental involvement in diabetes care of the young remains very important.

There are many reasons young people find it difficult to take all their insulin. Some find injections and testing glucose boring, and some find them embarrassing in front of their friends. Others feel badly about the situation, and themselves, when day after day they find high blood glucose results. It may seem easier not to face up to the fact they have a life-long medical condition, and so many deliberately miss some insulin injections altogether. This is dangerous, as ketoacidosis and longer-term complications are much more likely to occur. Even though many teens wish to be fully independent, continued parental involvement in diabetes care remains very important.

Testing for ketones in urine or blood

Ketostix are used to test for ketones in urine, and a special ketone meter can be used to test for ketones in blood. If unwell or blood glucose 14 mmol/l and above, testing for ketones is essential. A urine result of moderate-large ketones, or a blood ketone result over 1·0 mmol/l, is dangerous and should be treated urgently (see Page G07). As those on insulin pumps are very likely to have less insulin in their body at any one time compared to those on injections, they must take action when ketones rise to just 0.6 mmol/l.

1. Dip test strip in fresh urine sample and remove at once
2. Draw edge of strip against container rim to remove urine.
3. At 15 seconds compare strip colour with chart on side of Ketostix bottle.
4. Use "sick day rules" if moderate or large ketones found.



Negative, Trace Moderate or

NEVER DELAY using **Ketone Dose** Guidelines (Page G 07) or seeking advice.
Ketones are a danger sign - Always call if situation not improving *or if worried at any time...*

Complications - the danger of high glucose results

Insulin from the pancreas usually keeps blood glucose between about 4 and 6 mmol/l. For those with diabetes, a target range of 3.9 to 6.9 mmol/l is reasonable - wider than the body's own tight control, but still acceptable. If the blood glucose falls below this, hypo symptoms usually occur. However, above 6.9 mmol/l there may be very few symptoms at all. Changes in the body *do* occur, though - high blood glucose results are just as serious as low ones, and it is probably even *more* important to take high results seriously.

… excess blood glucose causes the body harm.

When blood glucose is high, symptoms such as increased thirst, the need to drink and pass urine more often, lack of energy and weight loss occur. These symptoms are nearly always seen when diabetes is first diagnosed. As the situation worsens, fat may start to be used for energy instead of carbohydrate, and ketoacidosis may also occur. As discussed previously, this is a very serious, possibly life-threatening, situation.

Frequent high blood glucose concentration may … cause complications

Symptoms occur when blood glucose *increases*, and may be found when-ever diabetes control is less than ideal. Someone who has high overnight blood glucose results may find they have to get up from bed to go to the toilet several times. These problems are short-term, and one reason why regular blood glucose testing is so important.

Over months and years, though, excess glucose causes the body harm. Frequent high blood glucose concentration may damage the body. High blood glucose results over time can damage the body's blood vessels. Small blood vessel damage occurs in the eyes, kidneys and nerves, while large blood vessel damage may cause heart attacks, strokes and other serious problems. These problems are called "complications".

The best way to deal with complications is to avoid them altogether, and the *only* way to do that is to *constantly* monitor blood glucose results *and act upon them*. Testing on its own is *not* enough - you either *must act* to keep results in the target range, from 3.9 to 6.9 mmol/l , as often as possible, or dramatically increase the risk of complications developing in later life.

The best way to deal with complications is to *avoid them altogether...*

Some people choose *not* to check their blood glucose results, believing "what they don't know won't hurt them"! No test results might be easier to face than looking at highs or lows all the time, but it also makes it impossible to improve the situation. It is a little like driving a car down the motorway with a blind fold on - you won't see the bumps and turns in the road, but they are there all the same, and you will be much more likely to have a crash! Not knowing about high results will not make the highs go away - it just means you can't do anything to fix the problem.

Many different complications are possible when blood glucose concentrations remain high. These include damage to the back of the eyes (retinopathy), to the kidneys that filter the blood (nephropathy), to the nerves (neuropathy) in our body (especially in the feet), and the blood vessels all over the body (vascular disease). These problems are discussed in

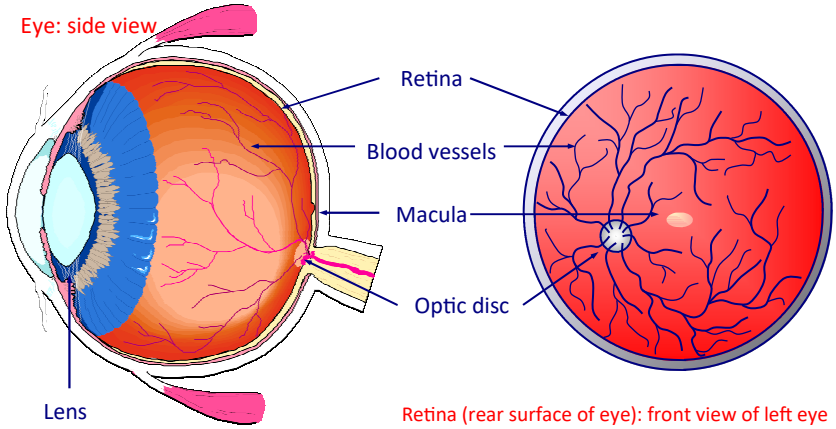
Testing on its own is *never* enough – you *must* ***act*** on the results…

Complications - the danger of high glucose results

Eye Problems

High blood glucose results may affect the eyes in a number of ways. It takes about 4 or 5 years before any damage to the eyes can be detected, and such changes are rare under the age of 10 or 11 years. From then, though, it is important to look carefully for changes to the back of the eye (retinopathy), to the highly-sensitive macula (maculopathy), and to the lens at the front of the eye (cataract). Diabetes eye disease is the most common cause of adult sight problems in the United Kingdom.

▼ Eye: side view



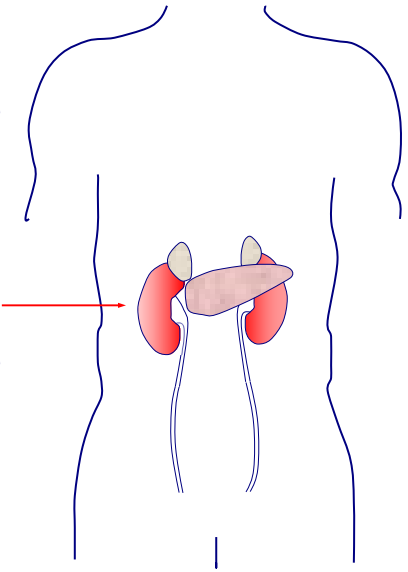
Retina (rear surface of eye): front view of left eye

▲ Diabetes-related eye problems. Small blood vessels lining the inside surface of the eye (the retina) may be affected by a long history of repeatedly high blood glucose results. Screening tests for problems with these blood vessels are important once someone with diabetes turns 10 or 11 years old.

Kidney Problems

A first-morning urine specimen is tested for protein. Kidneys filter waste from the blood, and keep substances such as protein within the body. High glucose levels damage this filter system, and protein may leak into the urine. High blood pressure may also occur.

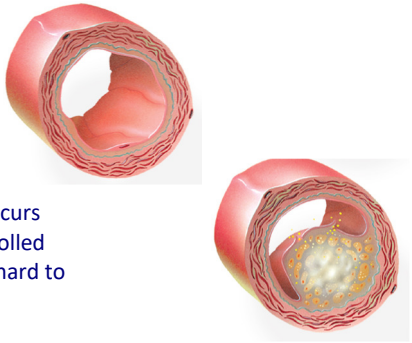
There are many causes of protein in the urine, though, and further testing is always needed. This may be an early sign of any problems, though. As with eye problems, the most common cause of kidney failure in adults in the United Kingdom is poorly-controlled diabetes.



▶ The kidney and renal system. The first sign of kidney problems may be leakage of tiny amounts of protein in the urine. A specimen of the first urine passed on waking up should be brought to every clinic for testing.

Complications - the danger of high glucose results

Large blood vessel disease



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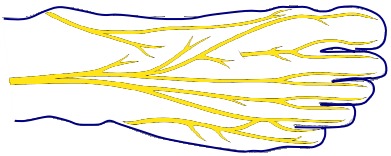
Large blood vessels supply the body with oxygen (from the lungs) and nutrients (from our food). If a diet is high in fat, and little exercise is taken, arteries are blocked ("macrovascular" disease). This leads to heart attacks, strokes, and poor blood supply to the feet and other parts of the body. This process occurs more widely and more rapidly with poorly-controlled diabetes, and is yet another reason for working hard to keep blood glucose results in the target range.

Nerve Problems & Feet

Nerve damage in the arms and legs occurs over many years of repeatedly high blood glucose. When the nerves fail to work properly, they cannot send messages about pain and touch to the brain. Damage is more likely to occur to the feet, for example, if you are not aware of injuring them in the first place.

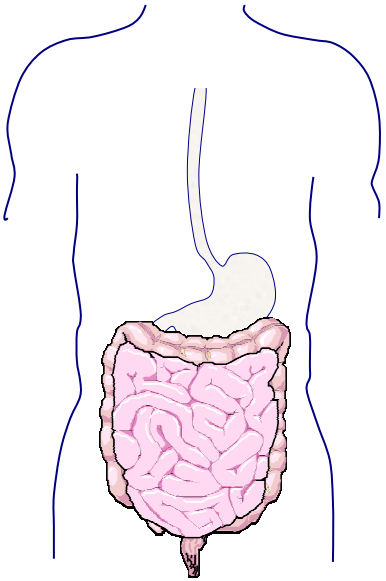


Damage usually only occurs after many years, and is very rare in children and adolescents. We do not usually test for this at clinic, but adult clinics will test for nerve and foot problems very carefully.

Gut Problems

Like the rest of the body, the gut (stomach and intestines) is controlled by nerves. We are not normally aware of the gut working, but damage to these nerves may cause the stomach to empty slowly after a meal, as well as causing other gut problems such as diarrhoea or constipation.

The nerves that control the small and large intestines are part of a larger network, the "autonomic nervous system". Damage to this nerve control system may cause other problems, such as perspiration difficulties, and a loss of the early warning signs of low blood glucose.



▶ The small and large intestines. The gut is largely under the control of the autonomic nervous system. This may be affected by long periods of high blood glucose results.

Information

Other conditions associated with diabetes

Associated medical conditions

Compared to the rest of the population, some medical conditions occur more often in people who have diabetes. The same "auto-immune" process that causes diabetes can affect other parts of the body, causing a number of different problems. These may be relatively minor or possibly quite serious.

These associated conditions are not actually *caused* by diabetes, but they may develop in a similar way, or simply be found more often in those with diabetes. As symptoms may be mild, it is useful to test for them every 1-2 years in clinic. Antibody blood tests are taken - these are substances made by the immune system, and may suggest a problem exists.

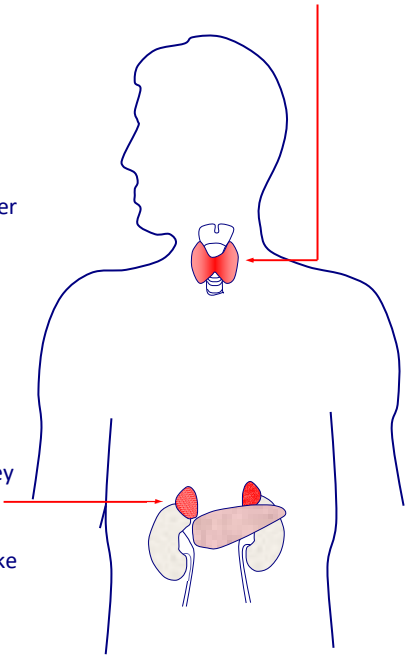
The organs most commonly affected by this "auto-immunity", and the associated medical conditions, include:

- Thyroid gland - hypothyroidism (underactive thyroid gland)
- Adrenal gland - hypoadrenalism/"Addison's Disease" (underactive adrenal gland)
- Small intestine - coeliac disease (gut hyper-sensitivity to gluten)

Thyroid gland disease

The thyroid gland lies in the neck, in front of the Adam's apple, and its task is to make thyroid hormones. These hormones speed up the body's processes - the so-called "metabolic rate". One of these hormones is called "thyroxine".

When the brain notes a fall in metabolic rate, a signal is sent to the thyroid gland ("Thyroid Stimulating Hormone", or "TSH") to make more thyroid hormone. More thyroxine is made, and metabolic rate increases once again. When normal, TSH levels again fall.



Thyroid auto-immune disease usually causes under -activity, or "hypothyroidism". Too little thyroid hormone is made, and the metabolism becomes sluggish. Frequent hypos may occur, as well as weight gain, poor growth, dry skin, dry hair, lethargy, constipation and sensitivity to cold. Thyroxine tablets correct the deficiency.

Addison's disease

The adrenal glands lie just above the kidneys. They make steroid hormones, which adjust the body's balance of salts and help it respond to illness and stress. Steroids act in many different ways and, like insulin, are essential for life.

Just as with diabetes and hypothyroidism, the immune system can mistakenly target and damage the adrenal glands. "Hypoadrenalism" is the medical term for this problem, but it is more commonly known as "Addison's disease", after the doctor who first described it. In Addison's disease, the body fails to produce enough steroids to properly regulate salts

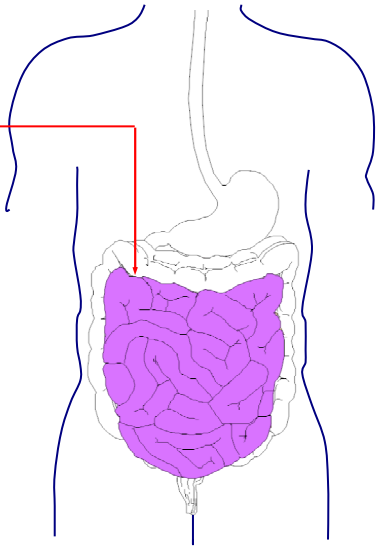
Other conditions associated with diabetes (cont)...

and cope with stress and illness. People with Addison's disease may have episodes of dizziness because of low blood pressure, or have loss of skin colour in some areas, and skin darkening in others, such as the creases of the palms. Just as with hypothyroidism, replacement can be given with tablets. One deals with the salt imbalance (fludrocortisone), and one deals with the stresses of life (hydrocortisone).

Failure to deal properly with a body stress, such as illness, is the major concern of Addison's Disease. This is a medical emergency, and replacement of the missing steroid may be life-saving. Larger steroid doses must taken as soon as the problem is suspected. If vomiting or more seriously unwell, hydrocortisone may have to be given by injection at home, before attending hospital for review or admission.

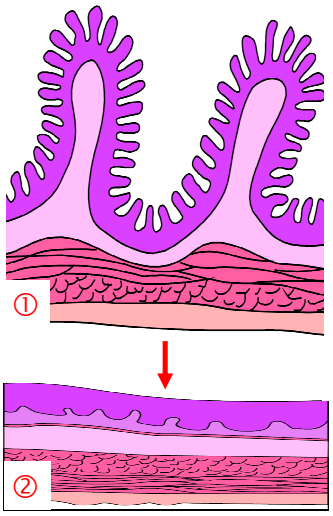
Coeliac disease

Coeliac disease is an increasingly common condition that causes poor absorption of food. Nutrients are absorbed in the small intestine. Some people are very sensitive to a protein called gluten, found in some grains (such as wheat, barley and rye). The body's response to this causes damage to the lining of the gut, and this causes poor absorption of food. Symptoms include abdominal pain, poor growth, and loose, difficult-to-flush bowel motions.



The small intestine is lined by tiny "fingers" called "villi", which greatly increase the area for absorbing food. The body's response to gluten damages the villi, and they become blunted and finally disappear altogether. This is called villous atrophy.

Removing gluten from the diet allows the body to heal, and the villi return. This is the treatment for coeliac disease - avoiding all foods containing gluten. While effective, this needs to be for life. Fortunately, replacement foods are available.



Even small amounts of gluten in the diet can cause symptoms to continue, and more serious problems may occur later in life. Blood tests help diagnose coeliac disease, measuring the antibodies made by the body's response to gluten. As a diagnosis of coeliac disease is life-long, it is important to make certain. This is usually done by looking at a small sample of gut lining (biopsy) taken while under anaesthetic. If a biopsy is suggested, this will be discussed in more detail.

Travel information

With a little forward planning, travel should pose no problems, whether just going into town or on holiday abroad. Some tips include:

- Carry biscuits or sandwiches to cover unforeseen delays.
- A few small packets (each of 1-2 biscuits) are easier to carry than one large packet.
- Always carry a hypo remedy - glucose tablets are convenient.
- As always, if situations are different, check the blood glucose frequently.

Early Starts

- If making an early start, an extra snack after getting up might be needed (especially if everyone is excited!)
- Insulin and breakfast can be given at the usual time, even if this means eating rolls or sandwiches in the car or bus.
- Taking food with you can be easier than finding an eating place at the right times.

Travel Sickness

- Your GP or Diabetes Team can suggest suitable medication.
- Try taking carbohydrate in small, frequent amounts.
- Don't fill up with fizzy diet drinks.

Camping

Meals are often delayed, especially on the first day when the tent is being put up and the cooking items are being unpacked.
Have a snack at the usual meal time (such as a biscuit or a slice of bread) to stop the blood glucose falling too low, and then eat the remainder of the carbohydrate allowance once the meal is ready.

Activity holidays, such as Scout, Guide, School and Diabetes UK camps will usually involve a lot more exercise - and late nights, too! Generally, more carbohydrate is needed, and insulin dose reduction of 10-20% is also a good idea.

Evening Meals

If the evening meal is served much later in the day than usual, swap around the bedtime and evening meal carbohydrate allowances. For example, move the bedtime carbohydrate allowance to the usual evening meal time and have the evening meal carbohydrate at bedtime, so that the meal can be enjoyed.

Travel Abroad

The Diabetes Team will be happy to discuss managing trips abroad. Here are some suggestions to help make your trip as problem-free as possible.

- A Customs letter is available outlining need to carry injection devices and insulin.
- Carry identification e.g. SOS Talisman or Medic-alert.
- Check holiday insurance cover.
- Don't order "diabetic" meals - they may not contain enough carbohydrate.
- Take double the supplies needed, and divide them through your carry-on luggage, as a precaution against loss or breakage.
- Low-calorie drinks are available in most countries. It may be useful to carry low-calorie squash or concentrated low-calorie cola. Dilute this with bottled water.

Travel information (continued)

- A change of climate may change activity levels - hot weather makes some want to swim all day (and need extra carbohydrate), while making others want to sunbathe. To find out the effects on the diabetes, check blood glucose regularly.
- Reduce initial insulin doses 10-20% until the effects of temperature change, extra activity, and altered diet can be assessed.
- When crossing time zones (such as when flying to the United States), insulin dosing should be discussed with your diabetes team. Usually the total daily insulin dose is separated into 4 equal doses, given approximately 6 hours apart - this should provide the insulin required until resuming usual injections.
- Take care of insulin while on holiday. Never expose it to extremes of temperature. Insulin should be neither too cool nor too hot, and never frozen. Never pack insulin into luggage going into the hold of a plane as it will freeze, and become ineffective. When travelling in a hot country, insulin can be carried in a cool bag or in a vacuum flask which has been cooled overnight in a fridge.

Food Poisoning

- Prevention is better than having to deal with this problem - consider food preparation and water sources carefully.
- Drink bottled water (or sterilise local tap water using tablets available at chemists). Use this purified water for brushing teeth. Avoid ice cubes in drinks as they may be made using the local water supply.
- Peel fresh fruit, and avoid raw vegetables washed in local water.
- Follow “sick day” guidelines, and seek medical attention if concerned.

General Points Regarding Air Travel

- When flying across different time zones, you will need to plan the best way to give insulin. An simple plan is to divide the day into four separate six-hour sections, and take insulin at the start of each of these. The insulin is then equally spread over a 24-hour period, and in case of delay or cancellation, this method can simply be continued until arrival at the destination, or until you are back home again.
- The sort of insulin to use is regular soluble insulin (Actrapid and Humulin S), and you may need to obtain this before you travel. These insulins are effective for several hours - usually at least until the next meal arrives! Use the guide on the following page to calculate the dose of fast-acting insulin required.

Reduce insulin doses if more active or local temperature higher when travelling

▲ NovoPen 3 & insulin cartridge

▼ HumaPen Luxura

Working out insulin doses when flying

If travelling abroad discuss your plans with the Diabetes Team at least one month before departure. This allows time to ensure adequate and appropriate planning for the trip.

- Find "time difference" between flight departure and arrival points (in hours).
- If 3 hours or less - take usual insulin at usual times
- If *more* than 3 hours - follow the following plan:

Travel Dose = Total Daily Dose ÷ 4

  - Ask Diabetes Team for a GP letter requesting prescription of:
    - Insulin pen for Humulin insulin - or other suitable insulin delivery device
    - Humulin S (3 ml cartridges) - or other soluble insulin
  - Add together *all* insulin doses taken daily = Total Daily Dose
  - Divide Total Daily Dose by 4 = Travel Dose
  - Give Travel Dose as Humulin S insulin (or other soluble insulin)
    every 6 hours (approximately)
    immediately before meals (do NOT wait 30 minutes)
  - On the day of travel - do NOT take usual insulin doses
- Take Travel Dose every 5 or 6 hours before food, starting at usual breakfast time. This usually fits in well with airline meal plans. One hour earlier or later will make little difference if insulin is taken immediately *before* meals.

Example: Glasgow to Florida - 5 hour time difference

- Normal daily insulin =
  6 units Novorapid before breakfast
  8 units Novorapid before lunch
  8 units Novorapid before tea
  18 units Levemir before tea
- Total daily dose (TDD) = 40 units
- Travel dose = TDD ÷ 4 = 40 units ÷ 4 = 10 units
  - Take travel dose (10 units of fast-acting insulin) before breakfast (e.g. 8 a.m.)
  - Have normal morning snack.
  - Take travel dose immediately before lunch-time meal (e.g. 1-2 p.m.)
  - Have normal afternoon snack.
  - Take travel dose immediately before next meal.
  - Arrive in Florida.
  - Have travel dose before later evening meal.
  - Take large bed-time snack.
  - Have last travel dose approximately 6 hours after last insulin injection given.
  - Next morning restart usual insulin injections - consider reducing doses slightly.

Take regular insulin (such as Humulin S) every 5 or 6 hours

- Always carry snacks, insulin and pens in your hand luggage in case of delays.
- Check blood glucose results frequently and make changes as needed.
- If blood glucose more than 14 mmol/l give extra insulin = Travel Dose ÷ 4.
  e.g Blood glucose = 18.0 mmol/l Travel dose = 10 units
  10 units ÷ 4 = Extra dose Extra dose = 2.5 units
  Total dose = 12.5 units short-acting insulin
- Continue travel doses every 6 hours until start of first full day at destination.
- Restart your normal insulin regimen on start of first full day at your destination.
- Check that your customs letter (in "At the Start" section) is complete (if extra needed, they can be printed from the online version on the Service's website).

Novorapid may also be used, but as its effect does not last as long as Humulin S, it must be given every 4 hours. **Divide TDD by 6** to calculate the 4 hourly Novorapid Travel Dose.

For the young person with diabetes ...

Diabetes results in many different emotions. At times you will feel okay, and other times you may feel unhappy, frustrated and even angry. These feelings are natural, and everyone with diabetes has them at some point. The Diabetes Team are here to help you in any way they can.

You may find some or all of your diabetes care difficult. For example, testing blood glucose and writing the results in your diary can be a real pain at times! It might also be difficult to keep your test results between 4 and 7 mmol/l. Frequently high blood glucose results can make you feel down, and often it is not your fault. If this is the problem, it can be difficult to face up to, and some then write down false results in their diary. You may not feel like writing them down at all. You are better writing down results as they happen, and then thinking of reasons why they might be high. If there is no obvious reason, increase your insulin or contact the team for advice.

You may have developed diabetes when you were too young to be given all the information, and your parents were taught all about it. Perhaps they are still doing some of your care, such as your injections. However, there will come a time in your life when you want to do things yourself, and it will be the same with diabetes. If you don't understand why you look after your diabetes a certain way, it may be difficult for you to look after. Just ask your team – we are always happy to hear from you.

Your diabetes nurse and team will be ... pleased to speak with you at any time

We see two very common problems with young people and their diabetes care. The first is that some find it difficult to give their own injections. You don't need to feel embarrassed if you struggle with this, and it is actually a fairly easy problem to work through with your diabetes nurse. This is usually very effective, and with the support of your family you will soon be giving your own injections.

The second problem is more difficult to manage, and probably even *more* common - missing insulin injections. There are many reasons why someone might choose to "forget" to take their insulin, but this is a dangerous game to play. It often results in that person becoming seriously ill, with admission to hospital or intensive care quite possible. It is also essential to remember that too little insulin may actually be fatal.

In this situation, it is very important for all concerned - the person with diabetes, their family, and the diabetes team - to get together and discuss the problem. It is vital to find the underlying reason behind the problem, as only this will provide a long-term solution be found. Sometimes an admission to hospital is needed if it seems there are problems with taking insulin or checking results. We might also ask our psychologist to help if these problems prove difficult to rectify.

Looking after diabetes needs you to have a certain amount of structure and discipline in your life. Day-to-day living might need a little more routine than it used to. This is difficult for some people - especially if they are particularly active, or if they like eating a certain way. If diabetes doesn't fit in with a person's life-style they will be more likely to rebel - and this usually results in poor diabetes results, with all the problems this will bring. There is a way around most diabetes problems, and if you discuss any problems you are having with your diabetes team, they will work with you to find a solution that is both healthy and you feel capable of putting into action.

Lifestyle issues for the young adult with diabetes ...

Diabetes *does* have an affect on most aspects of your life. People who say otherwise are trying to be kind, but are not terribly realistic. You should become knowledgeable about lifestyle issues that will affect you, and then make reasonable decisions about adjusting either your treatment or your lifestyle so you get the most from your experiences. This section is designed to provide you with some information dealing with such issues, but the path you follow is entirely up to you.

Many of these issues are very important, but only appropriate for the older age group. Parents are free to remove these pages if uncomfortable with any of their content.

Exercise

Exercise is good for all, especially when you have diabetes. Like insulin, it lowers and helps stabilise your blood glucose results. Physical activity also makes you feel fit, look good, improves your circulation and reduces cholesterol and fatty levels in the blood. A little planning helps, and many find a combination of reducing insulin doses and eating a little extra works well.

Remember that strenuous exercise can have an effect on the body for up to 18 hours, and frequent blood glucose testing will tell you if you need to reduce insulin doses later that day, or perhaps before your next exercise session. The only time exercise is not recommended is when blood glucose readings are over 14 mmol/l - there may be too little insulin present to prevent ketone production, with all its associated risks.

If you're a particularly keen sports person, you may wish to discuss your training programme with one of the dietitians on the team.

Puberty

This is a time in everyone's life when they change from being a child into an adult. This happens as glands in the body produce chemical messengers called hormones (such as growth hormones and sex hormones). Puberty begins over a wide range of ages - usually between 10-14 years of age for girls, and 12-16 years of age for boys.

Insulin (another hormone!) and hormones associated with puberty act in opposite ways. Growth hormone, for example, increases the amount of glucose in the blood so it is available for development, while insulin constantly acts to reduce the blood glucose concentration. For those without diabetes, the pancreas simply produces more insulin to cope with this situation. If you have diabetes, you may need to take two or three times more insulin than previously needed to keep blood glucose results in the target range. This is normal, and doesn't mean the diabetes is suddenly worse!

When girls begin their menstrual periods it is a good idea to do more blood glucose tests. Each girl responds individually, and while some find their period has no effect on blood glucose, others may experience high or low results.

Puberty is a time when young people are often under great pressure to "fit in", and not stand out from the crowd. Very often they feel they do not wish to be different, and this can be especially difficult if they have the added pressure of looking after their diabetes (such as eating healthily at set times).

Lifestyle issues for the young adult with diabetes...

Alcohol

As we grow older, social occasions often involve alcohol. If you're sensible and plan a little in advance you can still enjoy a drink with family and friends.

The effects of alcohol may give the same sensation as being hypo, so care is needed. When hypo, the liver usually acts to release stored glucose - if it's busy dealing with alcohol this may not work as well, so hypos can be more sudden and more severe. It is therefore wise to eat before, during and after drinking - have some bags of crisps with your drinks and some cereal and toast when home. Always carry identification.

Smoking

People usually start smoking because their friends smoke, and they think it's a grown up thing to do, or looks cool. Once started, it's very difficult to stop, as people become addicted to the nicotine in cigarettes. One of diabetes' complications is the development of unhealthy blood vessels, usually caused by poor control over several years. Smoking hugely increases the problem, as tobacco also damages these blood vessels. Heart attacks, strokes and blockage of other blood vessels are therefore also more common in smokers - smoking and diabetes is a very dangerous combination.

Drugs

Drugs have different effects on individuals. They have become part of our society in recent years and naturally there is pressure to try them. No one really knows their long-term effects on diabetes, but short-term effects may include a low or high blood glucose, resulting from poor diabetes management and the drug's own side effects.

Sex

You may have talked about sex with your family, and know about it from school, friends, television, and magazines. However when you have diabetes there are one or two extra things you need to know. Sex is exercise, and therefore hypos may occur. Keep some sugar handy, and tell your partner what to do if you become hypo.

You are at the same risk of sexually transmitted disease, so always practise safe sex and use a condom. Thrush is common for people with diabetes, even when not sexually active. Young men should also know that poor diabetes control might affect their ability to have an erection. Poorly controlled diabetes is a common cause of later impotence, and another good reason to control blood glucose well.

Pregnancy

Unstable blood glucose levels pose a risk to an unborn baby. Serious defects, such as heart and spine abnormalities, may occur without very careful blood glucose control. It is vital to carefully plan pregnancy, and contraception is an important consideration for any sexually active female with diabetes. All forms of contraception are suitable, with barrier methods also providing protection against sexually transmitted disease.

Most diabetes services have special "pre-pregnancy" clinics to help achieve the best results possible. If you have diabetes and think you are pregnant, you must find out for certain and get advice straight away. Poor diabetes control may cause problems in pregnancy and delivery. The aim is, as always, the best blood glucose results possible.

Why might it be helpful to see a Psychologist?

Being diagnosed with diabetes usually comes as a great shock. Children and families have to learn a lot about the condition and its treatment. We understand that managing diabetes is not easy, and that there are times when extra support and guidance are needed. The clinical psychologist's role is to help children, young people and their families adapt to the necessary changes in their lives, and to enable them to overcome any difficulties that may be prevent them from coping effectively with their diabetes.

Growing and Learning

After diagnosis, families experience a variety of emotions, such as fear, anger or guilt. Learning about diabetes and its management helps children and parents to adapt; all families go through this period of adjustment following diagnosis. Treatment for diabetes is complex, but most children and young people will adapt well to the necessary changes.

After diagnosis, families experience a variety of emotions … fear, anger or guilt

It is important that children and young people who have diabetes are encouraged to learn how to take care of their own diabetes. Even very young children can share the work of managing diabetes. For example, the chart below suggests what skills, related to giving insulin, that children may be expected to manage at different ages.

Having diabetes, or caring for a child with diabetes, does pose additional challenges and it is not unusual for difficulties to arise. Learning helpful ways to adapt to these challenges and cope effectively lessens stress. The clinical psychologist often works with those who are experiencing stress. We explore their concerns, and enable them to find solutions that help them to stay well and enjoy life.

Age (years)	Skills
4 - 5	Helps pick injection site, holds skin
6 - 7	Pushes down plunger after parent has inserted pen or syringe needle
8 - 9	Gives own injection, with supervision
10 - 13	Measures insulin, rotates injection sites
14 +	Prepares and gives insulin independently

Transitional periods, such as a child starting school or moving to secondary school often require further adaptation, and it is not unusual for families to experience stress at these times. Adolescence is a period of rapid change and teenagers often find it difficult to fit diabetes into their lifestyle. They may stop doing parts of their treatment as they struggle to gain independence from their parents and try to keep up with their friends. Talking openly about these issues helps to reduce conflict and enables young people to learn more adaptive ways to cope.

Learning helpful ways to adapt to challenges … lessens stress

Why might it be helpful to see a Psychologist (cont)?

Seeking Help

Some children and young people do find it difficult adjusting to having diabetes. We know that there are some factors that increase the risk of psychological problems, such as avoidant coping (avoiding difficulties rather than seeking solutions to solve a problem), family conflict, and too much responsibility being placed on the child at too young an age. Lack of communication can also lead to difficulties - both poor communication within families, and poor communication between the family and the members of the diabetes team.

Lack of communication can also lead to difficulties ...

Some children and young people become anxious or depressed, which can make it difficult for them to manage their diabetes or care for themselves properly. They may be finding it difficult to adjust to their illness, or to cope with aspects of their treatment such as continuing a healthy diet plan, or doing injections and blood testing. There may be other stressors in the child's life that makes it difficult for them to cope, too, such as bullying at school or family bereavement.

If you or the diabetes team have concerns about any of these issues a referral can be made to clinical psychology. This would always be discussed with you before proceeding.

Attending Clinical Psychology

If you agree to the referral, a member of the diabetes team will write a letter to the clinical psychology staff, giving a brief description of the areas of concern or difficulty. You will then receive a letter letting you know that you are on the waiting list, followed by an appointment letter.

The first appointment usually lasts an hour, and is an opportunity to tell us what has been worrying you. We like to learn about your family and the issues that concern you, such as family life, school and, of course, diabetes too. We may ask you to complete questionnaires or diaries that help us to understand how these issues affect your life. We discuss all of this with you and together build up a picture of any difficulties or concerns. We are then able to plan a way forward together.

Treatment includes the development of new behaviours and feelings, the learning of ways to increase confidence or solve problems. Some people experience anxiety about doing their injections or blood tests. We may teach practical skills to tackle these difficulties, such as relaxation techniques. Initially families are seen together, but children and young people often benefit from individual sessions with the clinical psychologist.

We understand that looking after diabetes places a lot of pressure on children and families. The goal of treatment is to enable children, young people and families to cope effectively with their diabetes and maximise their quality of life.

The goal is to enable people to cope effectively and maximise their quality of life

Early intervention is best - don't be afraid to ask for help.

Getting ready for an anaesthetic if you have diabetes

A number of children will one day need an arranged operation. Some will need to be admitted for some dental work. Others might need the passing of a small telescope into the stomach to see if they have coeliac disease. To make each of these procedures as comfortable and safe as possible, they will usually be put to sleep with an anaesthetic. Getting ready for an anaesthetic when you have diabetes is not difficult, but it does take a little thought and preparation.

It is very important point to find out when the procedure will take place - either in the morning or the afternoon. You should be told this before coming into the hospital. On the day *before* the procedure, there is usually no need to change someone's diabetes care - meal times and amounts, insulin doses and types, and blood glucose tests should all go ahead as they would on any other day. However, on the day itself, eating and drinking must stop several hours before any anaesthetic. This means we have to take some steps to make sure all goes well.

Getting ready for an anaesthetic … takes a little thought and preparation

If you are having an anaesthetic in the morning …

- Most people are admitted the day before the anaesthetic is scheduled, or very early on the same morning as the procedure.
- Eat, drink and take the usual insulin doses the day before the anaesthetic.
- A small tube called a cannula is inserted into a vein the night before or early on the morning of the anaesthetic. Cream to numb the skin beforehand may be used. A glucose in water "drip" or infusion starts from 8 a.m. to prevent hypoglycaemia.
- No food is allowed after midnight, and no drinks are permitted after about 4 a.m. This is to make sure the stomach is empty before the anaesthetic is given (to help prevent vomiting).
- Slow-acting basal insulin will be given at 8 a.m. on the morning of the procedure.
- You will usually be first to have your anaesthetic, so you can get back to your normal daily routine as soon as possible.
- Insulin may be needed before or just after lunch if this is the first meal taken.

If you are having an anaesthetic in the afternoon …

- Most people are admitted the afternoon before the procedure, but you may be asked to come in early on the day the anaesthetic is scheduled.
- Eat, drink and take usual insulin the day before the anaesthetic.
- A light breakfast at 7.30 a.m. should be the last food taken before the anaesthetic.
- Slow-acting basal insulin will be given at 8 a.m. on the morning of the procedure, as well as a small dose of fast-acting insulin.
- Glucose and water are given as an "infusion" through a cannula after breakfast.
- As with a morning anaesthetic, you will usually be first on the list so you can get back to your normal daily routine as soon as possible.
- On return from the procedure, if allowed to eat and drink you will be encouraged to have something to eat for an evening meal. Insulin will be given to prevent ketones developing.
- Usual insulin doses will be resumed that night, or the following morning.

How to store your diabetes supplies

Insulin and test strips must be stored carefully so they continue working properly. Other diabetes care items may also need careful thought to keep working as normal, and so they do not cause anyone any harm or injury.

Insulin

- Insulin is dangerous when not used properly, or used by someone who has not been trained in its use.
- Insulin in a pen cartridge or bottle remains effective for 1 month at room temperature. Spare cartridges and pens are best stored until their expiry date at the bottom of a refrigerator or on the shelf of the refrigerator door.
- Insulin should never be stored in a freezer - it will not work once frozen.
- Pen cartridges should be changed every month if using only small insulin doses.
- Once a vial (bottle) of insulin is opened it can be used for 1 month. The date the bottle was first opened can be written on the bottle as a reminder of when to change to a new vial.
- Although a pen and insulin cartridges can be stored at room temperature, they must be kept away from direct heat or cold (such as on a window sill, near a heater, or in a car). Store spare cartridges in the refrigerator.
- If you only use short-acting insulin during illness, it should be replaced one month after opening.

Blood Glucose and Urine Ketone Testing Strips

- Test strips should be kept in a cool, dry place (e.g. a cupboard away from heat).
- Always replace the lid on test strip bottles as the strips are sensitive to moisture.
- Once the strips are opened they must be used or replaced within 6 months.

Glucogel and Glucagon ("Glucagen")

- Glucogel can either be kept in a cupboard away from direct heat or in a refrigerator.
- Glucagon ("Glucagen") should be kept refrigerated.

Syringes, Lancets and Pen Needles

- Syringes, lancets and pen needles should be stored in a cupboard, preferably away from any moisture.

Disposal of Equipment

- Test strips may be wrapped in paper and disposed of in the usual household rubbish.
- All 'sharps', including lancets, pen needles, syringes and empty insulin cartridges or vials could injure someone if thrown out in the rubbish. These items should always be stored in the safety container provided — either a "Sharps Bin" or a Safe-Clip device — and brought to clinic for disposal. New bins may be collected whenever you attend clinic.

! Keep all these items out of the reach of young children.

Some useful words ...

- 100 Rule - guide estimating insulin dose needed to correct high blood glucose result.
- 8-point profile - series of eight before-meal, after-meal, and overnight blood glucose tests used to work out basal and bolus insulin doses, usually collected over 24 hours.
- Addison's disease - disease of progressive damage to the adrenal gland, resulting in weight loss, weakness, low blood pressure and darkening (pigmentation) of the skin.
- Adolescent growth spurt - period of time in adolescence when growth, particularly in height, occurs at a very rapid rate. This rapid growth ends on becoming an adult.
- Adrenal gland - gland producing hormones and chemicals used in responding to stress. May also be affected in those with diabetes. Located just above the kidneys.
- Adult-onset diabetes - see Type 2 diabetes.
- Allergens - a substance to which the body is particularly sensitive, triggering an abnormal "allergic" reaction.
- Analogue insulin - insulin specially modified to allow it to be absorbed either more or less rapidly than regular human insulin. This results in either a very rapid onset and short duration of action, or a delayed onset and long duration of action.
- Autoimmune - a process in which the immune system damages the body's organs.
- Autonomic Nervous System - system responsible for monitoring and adjusting the body's automatic processes (such as breathing, sweating, digestion, and so on).
- Basal-bolus system - a system of giving (basal) insulin that works steadily over 24 hours, along with separate doses (boluses) of rapid-acting meal-time insulin.
- Basal insulin - slow-acting, steadily released insulin acting on blood glucose before meals and overnight. Given once or twice daily.
- Beta cells - cells found within the pancreas in clusters known as "islets". They produce and release insulin, and are damaged and destroyed in Type 1 diabetes.
- Biphasic insulin - insulin given as a single injection that has two peaks of action. Also known as "mixed" insulin.
- Bolus insulin - fast-acting, rapidly absorbed insulin, usually given at meal times.
- Carbohydrate - food group providing energy to the body including simple sugars, and more complex starches. Carbohydrate needs insulin to allow it to enter many of the cells of the body, such as those in muscle and the liver.
- Carbohydrate Dose - Rapid-acting insulin dose needed to maintain blood glucose after a meal. Calculated by dividing Carbohydrate amount to be eaten (grams) by Carbohydrate to Insulin Ratio (CIR).
- Carbohydrate:Insulin Ratio (CIR) - ratio of carbohydrate (grams) for each unit of insulin to maintain blood glucose before and after a meal. Also known as "Carb Ratio", or CIR.
- Centile - method of grading a measure (such as height or weight) according to percentages. "75th Centile" defines a measure as 75th out of a potential 100.
- Childhood-onset diabetes - see Type 1 diabetes.
- Complications (of diabetes) - medical problems resulting from the effects of prolonged increases in blood glucose.
- Correction Dose - amount of insulin needed to reduce blood glucose to the recommended target range of 4-7mmol/l. Usually based on Insulin Sensitivity.
- Coeliac disease - medical condition where the small intestine is sensitive to gluten (found in some grains like wheat, barley and rye), and the body's response causes damage. The gut is unable to absorb food normally. Also spelt "celiac" disease.
- Diabetes Control & Complications Trial (DCCT) - study showing the direct link between

Some (more) useful words ...

lower blood glucose results, HbA1c and improved long-term health.

- Diabetes mellitus - medical condition resulting in excess glucose in blood and urine. It is either due to too little or ineffective insulin. The term comes from the Greek *diabetes* ("to go through") and the Latin *mellitus* ("honey").
- Diabetes nurse - health professional specialising in the education and support of people with diabetes and their families.
- Diabetic Ketoacidosis (DKA) - medical emergency due to too little insulin, resulting in inability to use carbohydrate for energy. Fat is used instead, acidic ketones are produced, and person becomes extremely ill. May be life-threatening.
- Dietitian - health professional specialising in education about healthy eating and the best food choices for people with diabetes.
- Exchange - food portion containing 10 grams of carbohydrate.
- Fat - one of three food sources of energy, with carbohydrate and protein. Acts as a store of energy within the body.
- Glucagon - hormone which increases glucose release from liver stores, and balances the action of insulin. Produced in the alpha-cells of the pancreatic islets.
- GlucaGen - glucagon for injection for emergency use in severe hypoglycaemia.
- Glucogel - clear glucose gel, allowing rapid treatment of hypoglycaemia.
- Glucose - basic form of carbohydrate; a simple sugar.
- Gluten - protein found in some grains (e.g. wheat, barley, and rye). The body's response to gluten affects the lining of the gut in some people. See coeliac disease.
- Glycosylation - process when glucose permanently binds to a substance.
- Haemoglobin - chemical in red blood cells that carries oxygen through the body.
- HbA1c - haemoglobin that has been permanently bonded to glucose. Measured as a percentage of total haemoglobin, and rises with increasing glucose concentration.
- Hormone - chemical made by glands (such as the pancreas) affecting a distant part of the body (as insulin allows carbohydrate to enter muscle or the liver).
- Humapen - injection device for Eli Lilly insulins (e.g. Humulin and Humalog).
- Hyperglycaemia - literally "high blood sugar", and describes when glucose within the blood increases above normal amounts (6 mmol/l), and particularly over 10 mmol/l. Usually due to insufficient or ineffective insulin, or excess carbohydrate.
- Hypo - abbreviation for "hypoglycaemia".
- Hypoadrenalism - underactive adrenal gland. See Addison's disease.
- Hypoglycaemia - literally "low blood sugar", if blood glucose falls below 3.9 mmol/l. Usually due to excess insulin, exercise, or insufficient carbohydrate.
- Hypothyroidism - underactive thyroid gland activity, due to autoimmune damage. Results in lowering of body's metabolic rate, and slowing of its activity.
- Hyperthyroidism - overactive thyroid gland, producing excess thyroid hormone.
- Insulin - hormone, or chemical messenger, produced in beta cells of the pancreas. Insulin allows glucose to move from the blood into tissues.
- Insulin Dependent Diabetes Mellitus (IDDM) - see Type 2 diabetes.
- Insulin Sensitivity - fall in blood glucose caused by 1 unit of insulin, and a measure of how well someone responds to insulin. Calculated using the "100 Rule" (100 divided by Total Daily Dose of insulin).
- Islets - microscopic clusters of cells dotted throughout the pancreas gland. Beta cells

(insulin) and alpha cells (glucagon) are two type of cell found in the islets.

- Isophane insulin - insulin, added to a substance called protamine that delays absorption, onset and duration of action. Includes Insulatard and Humulin I.
- Ketoacidosis - see Diabetic Ketoacidosis.
- Ketones - acidic substances produced as the result of using fat for energy.
- Ketone Dose (KD) - dose of insulin, given over and above usual daily insulin doses, during periods of illness, insulin deficiency and increased ketone formation.
- Lipohypertrophy - abnormal increase in fat due to repeated insulin injections into the same location. Causes erratic blood glucose control.
- Macrovascular disease - literally "disease of large blood vessels". Due to diets high in unhealthy fats and cholesterol, and worsened by diabetes. Blood vessels affected include those carrying blood to the heart, kidney, brain, and feet.
- Maturity Onset Diabetes of the Young (MODY) - rare forms of diabetes in young people not requiring insulin. Now known as a form of "monogenic "diabetes.
- Microvascular disease - literally "disease of small blood vessels". Due to long periods of high blood glucose results. Blood vessels affected include those taking blood to the eyes, kidneys, nerves, and other vital parts of the body.
- Mixed insulin - single injection insulin with two peaks of action ("biphasic"). Includes Mixtard, Novomix, Humulin M and Humalog Mix insulins.
- mmol/l - measurement of concentration, or amount of a substance in a certain volume. Abbreviation of "millimoles per litre", and is the usual UK method of measuring glucose amounts within the blood.
- Monogenic diabetes - rare inherited forms of diabetes, some of which do not need insulin. Previously called "Maturity Onset Diabetes of the Young" (MODY) as features were similar to those of "Type 2" diabetes, but in young people.
- Nephropathy - damage to kidneys. Diabetic nephropathy is due to prolonged high blood glucose results, and is a major cause of kidney failure and need for dialysis.
- Neuropathy - damage to nerves. Diabetic neuropathy is due to frequent high blood glucose results, and often causes damage to the feet.
- Non-Insulin Dependent Diabetes Mellitus (NIDDM) - see Type 2 diabetes.
- Novopen - injection device for Novo insulins (e.g. Levemir, Mixtard, Novorapid).
- Pancreas - gland in the abdomen, behind the stomach and high in the abdomen, that makes insulin, glucagon, digestive juices, and other substances. See "islets".
- Protamine - substance added to regular insulin to prolong its duration of action. Humulin I and Insulatard are two insulins formed this way.
- Protein -one of three food sources of energy, with carbohydrate and fat.
- Psychologist - health professional specialising in helping people with diabetes and their families cope with and adapt to life stress such as a diagnosis of diabetes.
- Puberty - period of life when sexual maturity occurs.
- Rapid-acting insulin analogue - insulin modified to increase its speed of absorption and reduce its duration of action. Used as the "bolus" insulin in a "basal-bolus" insulin regimen. Examples include Humalog and Novorapid.
- Recovery position - position for placing a person when they are recovering from a fit or period of unconsciousness. See Page G21 in the "Guidelines" section.
- Register - official list. Consent is requested for the name of all those with diabetes to be included on local Glasgow, national, and study group registers.

Some (more) useful words ...

- Regular insulin - injectable insulin identical to that produced by the pancreas. Examples include Humulin S and Actrapid.
- Retina - light-sensitive layer at the back of the eye.
- Retinal image - photograph of retina taken using special camera to screen for early signs of eye damage. These are reviewed by specialist technicians and medical staff to identify and grade damage to the retina, allowing early treatment.
- Retinopathy - damage to retina. Diabetic retinopathy is due to frequent high blood glucose results, and is a major cause of sight problems.
- Screening - process of looking for early evidence of illness or injury, especially before actual disease has developed. Includes blood tests (for adrenal and thyroid gland autoimmune disease), urine tests (for kidney injury) and eye tests.
- Secondary diabetes - diabetes caused by another medical condition, such as cystic fibrosis or haemochromatosis.
- Slow-acting insulin analogue - insulin modified to prolong duration of action. “Basal” insulins in “basal-bolus” regimens. Examples include Lantus and Levemir.
- Soluble insulin - see “regular insulin”.
- Starch - form of complex, long-acting carbohydrate (e.g. in pasta, rice, potatoes).
- Steroids - hormones released from the adrenal gland, such as in times of stress. May also be given as treatment for certain conditions. Generally raise blood glucose.
- Sugar - form of simple, short-acting carbohydrate (e.g. in table sugar, sweets, non-diet fizzy drinks). Glucose is a type of simple sugar. Others include sucrose (table sugar), fructose (sugar in fruit) and lactose (sugar in milk).
- Syndrome - a medical condition with a certain group of symptoms or features.
- Thyroid gland - gland in the neck producing hormones that control the rate the body functions (“metabolism”). May be affected by autoimmune process.
- Thyroid Stimulating Hormone (TSH) - chemical released by the brain to stimulate the thyroid gland to produce thyroid hormone. In an underactive thyroid gland TSH increases as the brain tries to stimulate the gland to produce hormone.
- Thyroxine - one of the main hormones released by the thyroid gland. In an underactive thyroid gland thyroxine falls as less hormone is made and released.
- Total Daily Dose (TDD) - sum of all insulin taken in a single 24-hour period.
- Travel dose - amount of regular (soluble) insulin to be taken four times in any 24-hour period (i.e. every 5-6 hours) while travelling. Useful for long-haul air flights. Equals Total Daily Dose divided by 4.
- Trigger theory - possible process for development of diabetes, due to inheritance of susceptibility to certain “triggers”. In the right circumstances, the immune system damages the pancreas beta cells when exposed to certain triggers. Not proven.
- Type 1 diabetes mellitus - form of diabetes due to autoimmune destruction of insulin producing beta cells, with an eventual total lack of insulin production. Previously called “childhood onset” or “insulin dependent” diabetes.
- Type 2 diabetes mellitus - form of diabetes due to reduced but persisting insulin production, production of less effective insulin, or resistance to its action. Previously called “adult onset” or “non-insulin dependent” diabetes.
- Villi - finger-like projections that line the gut, greatly increasing absorption area. These are damaged in coeliac disease, causing poor food absorption.

Diabetes
Best Ideas

Quiz

How to use the "Quiz" section

This "Quiz" section has been included so you can test how much you know and understand about diabetes. By learning what you know well, and what you might need to look over once again, hopefully you will feel much more confident about making the right choices when caring for your or your child's diabetes.

It is important to realise that this section is not about "passing" or "failing". It is simply a chance to find out what sections, if any, you would be better reading over again. Remember, if you have any other questions, or feel there is something you wish to understand better, just ask one of the Diabetes Team members - they will be very happy to try to answer any of your queries.

The Quiz is made of a statement, and you then have to choose from three options the one that best completes the sentence. There is only one correct answer for each question. For example:

1. Insulin causes a person's blood glucose to:

   a. increase ☐
   b. stay the same ☐
   c. decrease ☐

A brief introduction to Diabetes - Page S 02

The answer to this question is "c. decrease", as insulin moves glucose from the blood into the cells of the body. The page where the information is listed below and to the right in red, if you need any help with the answers. Remember that there are four sections with information in this Health Record, and the letter before the page number shows in which section the page can be found:

S - At the Start
R - Records
G - Guidelines
I - Information

Check your knowledge and understanding

1. Diabetes mellitus is a condition that causes:

   a. low levels of protein in the blood. ☐
   b. high levels of sugar in the body. ☐
   c. low levels of sugar in the urine. ☐

A brief introduction to Diabetes - Page S 02

2. Glucose provides energy for the body, and is the simplest form of:

   a. Carbohydrate. ☐
   b. Fat. ☐
   c. Protein. ☐

A brief introduction to Diabetes - Page S 02

3. Starchy food, or food containing "complex" carbohydrate, includes:

   a. butter. ☐
   b. eggs. ☐
   c. pasta. ☐

A brief introduction to Diabetes - Page S 02

4. Type 1 diabetes occurs when **not** enough:

   a. sugar (carbohydrate) is eaten. ☐

Check your knowledge and understanding

b. insulin is made for the body's needs. ☐
c. water is drunk each day. ☐

A brief introduction to Diabetes - Page S 02

5. Type 1 diabetes occurs when:

a. the body's immune system destroys the beta cells. ☐
b. someone becomes overweight. ☐
c. there has been too much sugar in the diet. ☐

A brief introduction to Diabetes - Page S 03

6. The part of the body that makes insulin is called the:

a. thyroid gland. ☐
b. liver. ☐
c. pancreas. ☐

A brief introduction to Diabetes - Page S 03

7. When fat is used for energy instead of carbohydrate, the body produces:

a. ketones. ☐
b. proteins. ☐
c. glucose. ☐

A brief introduction to Diabetes - Page S 04

8. Unlike other types of diabetes, Type 1 **always** needs to be treated with:

a. tablets. ☐
b. insulin. ☐
c. diet alone. ☐

A brief introduction to Diabetes - Page S 04

10. The HbA1c target for someone with diabetes is:

a. 48 mmol/mol. ☐
b. 75 mmol/mol. ☐
c. 130 mmol/mol. ☐

HbA1c and your average blood glucose result - Page R 00

11. If a child is growing healthily their height:

a. should be in proportion to their weight. ☐
b. will fall steadily as they get older. ☐
c. should slow down at the start of puberty. ☐

Just what is a centile anyway? - Page R 04

12. For someone with diabetes, blood glucose results should usually sit between:

a. 4.0 - 7.9 mmol/l. ☐
b. 6.0 - 9.9 mmol/l. ☐
c. 3.9 - 6.9mmol/l. ☐

What to do if your results are too high or too low - Page G 01

13. When testing blood glucose:

a. 2 out of every 5 results should be in the "target range". ☐
b. 3 out of every 5 results should be in the "target range". ☐
c. 4 out of every 5 results should be in the "target range". ☐

What to do if your results are too high or too low - Page G 01

14. If 3 results in a row at the same time of day are **over** 6.9 mmol/l, insulin dose should:

a. decrease. ☐

Check your knowledge and understanding

b. stay the same. ☐
c. increase. ☐

What to do if your results are too high or too low - Page G 01

15. Basal Insulin (Levemir or Lantus) provides the daily insulin required for:

a. all but food, keeping blood glucose steady overnight. ☐
b. correcting a high blood glucose result. ☐
c. dealing with the rise in blood glucose after eating carbohydrate. ☐

What to do if your results are too high or too low - Page G 02

16. If blood glucose results are usually high before meals the:

a. before-meal Carbohydrate Dose of insulin should be decreased. ☐
b. amount of carbohydrate eaten should be decreased. ☐
c. Basal Dose of insulin should be increased. ☐

Adjusting Basal-Bolus insulin doses - Page G 02

17. If eating 30 grams of carbohydrate and the Carb: Insulin Ratio is 3 grams per Unit:

a. the Correction Dose needed is 30 Units. ☐
b. the Correction Dose needed is 10 Units. ☐
c. the Carbohydrate Dose needed is 10 Units. ☐

What to do if your results are too high or too low - Page G 02

18. The blood glucose result **2 hours after** a before-meal insulin bolus should be:

a. lower than the before-meal blood glucose result ☐
b. the same as the before-meal blood glucose result ☐
c. higher than the before-meal blood glucose result ☐

Adjusting Basal-Bolus insulin doses - Page G 02

19. "Insulin Sensitivity"

a. is used to work out a Carbohydrate Dose of insulin. ☐
b. should be *reduced* if a smaller Correction Dose is needed. ☐
c. should be *reduced* if a larger Correction Dose is needed. ☐

Adjusting Basal-Bolus insulin doses - Page G 02

20. If too much Novorapid has been taken by mistake, the hypoglycaemia risk lasts up to:

a. 2 hours. ☐
b. 6 hours. ☐
c. 24 hours. ☐

What to do if you make a mistake with insulin - Page G 05

21. If someone with diabetes becomes ill, and feels unable to eat normally, they should:

a. stop taking insulin. ☐
b. test their blood glucose less frequently. ☐
c. take more easily swallowed carbohydrate, such as jelly or sugary drinks. ☐

How to look after diabetes when unwell - Page G 06

22. When unwell, a person's blood glucose result should be checked:

a. less often than normal. ☐
b. as often as normal. ☐
c. more often than normal. ☐

Ketone Doses: if sick or blood glucose over 14 ... - Page G 07

23. Sick day guidance should be followed if the blood glucose is:

a. 14 mmol/l or higher with no ketones (negative ketones) in the urine. ☐

b. 14 mmol/l or higher with moderate ketones in the urine. ☐
c. 10 mmol/l with a small amount of ketones in the urine. ☐

Ketone Doses: if sick or blood glucose over 14 ... - Page G 07

24. If someone taking 50 units of insulin a day has a blood glucose over 14 mmol/l, and large ketones in the urine or more than 1 mmol/l of ketones in the blood, the correct "sick-day" dose of insulin would be:

a. 3 units of Novorapid. ☐
b. 7 units of Novorapid. ☐
c. 7 units of Levemir. ☐

Ketone Doses: if sick or blood glucose over 14 ... - Page G 07

25. A "sick-day" dose of insulin should be given:

a. **as well as** any usual doses of insulin due at the same time. ☐
b. 3 or 4 hours **after** any usual doses of insulin due to be taken. ☐
c. 5 times before calling for medical advice. ☐

Ketone Doses: if sick or blood glucose over 14 ... Page G 07

26. When treating a mild or moderate hypo:

a. Glucagen (glucagon) should be given immediately. ☐
b. slow-acting starchy carbohydrate should be given immediately ☐
c. fast-acting sugar (Glucose tablets, Lucozade) should be given immediately. ☐

Hypoglycaemia - Page G 08 - 09

27. Severe hypoglycaemia:

a. usually happens for no clear reason. ☐
b. should be treated by giving Lucozade or Dextrose tablets. ☐
c. is best treated by giving a Glucagen (glucagon) injection into the thigh. ☐

Severe hypos - Page G 10

28. We suggest every day you test your blood glucose result at least:

a. once. ☐
b. twice. ☐
c. three or four times. ☐

How to fill in blood glucose charts - Page G 13

29. If taking a mixed insulin before breakfast and rapid- and slow-acting analogues at tea:

a. breakfast insulin dose affects the before breakfast blood glucose result. ☐
b. breakfast insulin dose affects the before lunch blood glucose result. ☐
c. tea-time rapid-acting analogue affects the before tea blood glucose result. ☐

Insulin three times a day - up, up in the day... - Page G 14

30. Basal insulins (slow-acting insulin analogues such as Lantus and Levemir):

a. are more likely to cause overnight hypos than older-type isophane insulins. ☐
b. usually take 3-4 hours before they start acting. ☐
c. usually last only 3-4 hours. ☐

Insulin three times a day - which insulin works when? - Page G 15

31. A change to an insulin dose:

a. should always be discussed with the Diabetes Team. ☐
b. should usually be about one tenth (10%) of the original dose. ☐
c. must only be made when attending clinic, 3 or 4 times a year. ☐

Check your knowledge and understanding

Insulin with meals - peaks at dawn and dusk ... - Page G 16

32. If blood glucose is usually high **just before** a once daily basal insulin injection:

a. no change to the insulin dose is needed. ☐
b. the basal insulin dose must be reduced. ☐
c. a second dose of basal insulin might be needed. ☐

Reading results - running out of steam (and insulin!) - Page G 22

33. When giving an insulin injection:

a. usually no pinch of the skin is needed ☐
b. cloudy insulin in a pen should be mixed by rocking it side-to-side 20 times ☐
c. the needle should be kept on the pen until the next injection ☐

How to prepare and give an insulin injection - Page G 24

34. When taking "basal-bolus" insulin, an "8-point profile" of results should be checked:

a. every day. ☐
b. at least once or twice a month. ☐
c. twice a year. ☐

There is no such thing as a "bad" blood glucose result - Page G 26

35. An item that should **always** be brought to clinic includes:

a. blood glucose meter. ☐
b. "Glucagen" injection kit. ☐
c. spare pen needles. ☐

There is no such thing as a "bad" blood glucose result - Page G 26

36. "Hb A1c" is formed when haemoglobin combines with:

a. fat. ☐
b. glucose. ☐
c. protein. ☐

HbA1c - the blood test checked at clinic - Page I 02

37. A very high HbA1c (over 75 mmol/mol):

a. was shown by the DCCT to increase the chance of future health problems. ☐
b. occurs if blood glucose results are usually kept below 7 mmol/l. ☐
c. usually happens if someone has many or severe hypos. ☐

HbA1c and the risk of complications - the "DCCT" - Page I 04

38. Type 1 diabetes mellitus:

a. used to be called "adult-onset" diabetes. ☐
b. can be treated with tablets. ☐
c. is the most common cause of diabetes in the young. ☐

Different types of diabetes mellitus - Page I 05

39. Type 2 diabetes mellitus:

a. is more likely to result in ketoacidosis than Type 1 diabetes mellitus. ☐

Quiz

b. must always be treated with insulin. ☐
c. is the most common cause of diabetes overall. ☐

Different types of diabetes mellitus - Page I 06

40. Rapid-acting insulin analogues:

a. include the insulins "Lantus" (Glargine) and "Levemir" (Detemir). ☐
b. are cloudy insulins. ☐
c. start working 5-10 minutes after injection, and last for 2-3 hours. ☐

Insulin, onset, peak and duration of action - Page I 08

41. Basal insulins:

a. act slowly and steadily. ☐
b. are usually given 3 or 4 times a day. ☐
c. have a peak of action about 1 hour from the time of injection. ☐

Basal-Bolus insulin system - Basal insulins - Page I 12

42. Blood glucose test results:

a. just before meals give most information about the bolus insulin doses. ☐
b. 2 hours after meals give most information about bolus insulin doses. ☐
c. taken overnight give most information about bolus insulin doses. ☐

Basal-Bolus insulin and blood glucose testing - I 15

43. When using blood glucose test results to adjust insulin doses:

a. basal insulins affect "trends" over time, and if necessary should only be adjusted every few days ☐
b. before-meal insulin boluses mimic the slow, steady release of insulin from the pancreas ☐
c. less insulin is needed if more carbohydrate is eaten. ☐

Step 1: Adjust Basal insulin by observing "trends" - Page I 17

44. Checking a blood glucose result 2 hours **after** insulin is given shows whether the:

a. bolus insulin dose before the meal was correct. ☐
b. carbohydrate amount eaten was correct. ☐
c. previous basal insulin dose was correct. ☐

Step 2: Adjust Bolus insulin by observing "events" - Page I 18

45. If a Carbohydrate to Insulin Ratio ("Carb Ratio") is 4 grams per Unit:

a. the correct insulin dose will cause blood glucose to fall below 3.9 mmol/l. ☐
b. a meal of 40 grams of carbohydrate requires an insulin bolus of 10 units. ☐
c. this can be used to calculate a Correction Dose of insulin. ☐

Step 2: Carbohydrate:Insulin Ratio & Carbohydrate Dose - Page I 18

46. "Insulin Sensitivity":

a. is used to calculate how a unit of insulin will cause blood glucose to fall. ☐

b. occurs when someone is allergic to insulin. ☐
c. if set high, causes a larger fall in blood glucose than if set low. ☐

Step 3: Insulin Sensitivity and Correction Dose - Page I 20-21

47. If using the "100 Rule", or the table on Page I 23, to work out Correction Doses:

a. di-viding the total breakfast bolus dose by 100 will give the Correction Dose. ☐
b. a Total Daily Dose of 20 Units, and a current blood glucose result of 16 mmol/l, means a Correction Dose of 2 units is needed. ☐
c. a Total Daily Dose of 20 Units, and a current blood glucose result of 20 mmol/l, means a correction dose of 1 Unit is needed. ☐

Step 3: Correct high results with the "100 Rule" - Page I 20-21 & Page G 03

48. A blood glucose over 14 mmol/l and moderate or large urine ketones (or blood ketones over 1.0 mmol/l) may happen when a person with diabetes:

a. has eaten too much carbohydrate. ☐
b. has a low haemoglobin. ☐
c. lacks enough insulin. ☐

Insulin, Illness and Ketones - Page I 25, and Diabetic Ketoacidosis - Page I 26

49. Long-term health problems (complications) of diabetes are caused by:

a. too much carbohydrate in the diet. ☐
b. high blood glucose results over a long period of time. ☐
c. low blood glucose results over a short period of time. ☐

Complications - the dangers of high glucose results - Page I 28

50. Coeliac disease:

a. can cause weight gain, constipation, and high blood glucose results. ☐
b. is caused by not having enough gluten in the diet. ☐
c. usually requires diagnosis by taking a small gut sample under anaesthetic. ☐

Other conditions associated with diabetes - I 32

51. When flying:

a. in-sulin is best kept in bags checked into the hold of the aeroplane. ☐
b. al-ways order "diabetic" meals. ☐
c. a "travel dose" equals the total daily dose divided by 4, given every 6 hours ☐

Travel information - Page I 33-34, and Working out insulin doses when flying - I 35

52. When storing diabetes supplies:

a. insulin should never be kept in the freezer. ☐
b. urine ketone test strips may be used for 6 years once opened. ☐
c. blood glucose test strips must be disposed of in a "sharps" bin. ☐

How to store your diabetes supplies - Page I42

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Diabetes Care Teaching Record - Family Copy

Subject	Date taught & nurse's signature	Date taught & parent's and/or child's signature	Comments
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Injection devices			
Injection technique and sites			
Testing for Ketones			
What to do if unwell or BG over 14 mmol/l			
Carbohydrate: Insulin Ratios ("Carb Ratios")			
Correcting high BG with Insulin Sensitivity			
Hypoglycaemia			
Severe hypos & GlucaGen® Injection			
Complications			
Young adult issues			

This table records your taking part in teaching of the most important diabetes-related topics. Understanding this information makes it possible to look after diabetes in most situations. Of course, your diabetes team will always be happy to discuss any issues with you, but the more informed you become, the more confident you will be. Use the Quiz section at the rear of the Patient Held Record to test your knowledge and understanding, and if you have any questions, always remember to call and ask.

Dietetic Teaching Record - Family Copy

Subject	Date taught & dietitian's signature	Date taught & parent's and/or child's signature	Comments
Diabetes diet principles			
Food groups			
Carbohydrate Counting			
Food labelling			
Sweeteners			
Hypoglycaemia			
Exercise			
Illness			
Nursery & School			
Eating out			
Food diaries			
Weight management			
Basal-Bolus system			
Carbohydrate: Insulin Ratios ("Carb Ratios")			
Glycaemic index			

Remember there is a quiz section at the end of this book. Use this as a guide as you read the information, or test your own knowledge as you go.

Diabetes Care Teaching Record - Team Copy

Subject	Date taught & nurse's signature	Date taught & parent's and/or child's signature	Comments
What is diabetes?			
Blood glucose testing equipment			
Blood glucose (BG) testing technique			
Insulin types			
Injection devices			
Injection technique and sites			
Testing for Ketones			
What to do if unwell or BG over 14 mmol/l			
Carbohydrate: Insulin Ratios ("Carb Ratios")			
Correcting high BG with Insulin Sensitivity			
Hypoglycaemia			
Severe hypos & GlucaGen® Injection			
Complications			
Young adult issues			

Dietetic Teaching Record - Team Copy

Subject	Date taught & dietitian's signature	Date taught & parent's and/or child's signature	Comments
Diabetes diet principles			
Food groups			
Carbohydrate Counting			
Food labelling			
Sweeteners			
Hypoglycaemia			
Exercise			
Illness			
Nursery & School			
Eating out			
Food diaries			
Weight management			
Basal-Bolus system			
Carbohydrate: Insulin Ratios ("Carb Ratios")			
Glycaemic index			

New Patient Management Plan - 1

Patient Surname: _____

Patient Forename: _____

Hospital No.: _____

CHI No.: _____

Date of Birth: _____

Flat/House No.: _____

Street Name: _____

Area: _____

Town: _____

Post Code: _____

Telephone (home): _____

Telephone (work): _____

Telephone (mobile): _____

Email address (parent): _____

Email address (patient): _____

GP Practice: _____

GP Address: _____

_____

_____

GP Telephone : _____

Date of Diagnosis: _____

Date of Admission: _____

Weight on Admission: _____

School/Nursery: _____

Current Class Year: _____

Contact Teacher: _____

Head Teacher: _____

Named Nurse: _____

New Patient Management Plan - 2

Records

- Social History — *Number of Adults in household* _____

Parents — Married/Civil Partnership: ☐ Cohabiting: ☐ Separated: ☐ Single: ☐ Divorced: ☐

Father — Forename: _____ Age: _____ Surname: _____ Occupation: _____ Ethnicity: _____

Mother — Forename: _____ Age: _____ Surname: _____ Occupation: _____ Ethnicity: _____

Father's Partner — Forename: _____ Age: _____ Surname: _____ Occupation: _____

Mother's Partner — Forename: _____ Age: _____ Surname: _____ Occupation: _____

Siblings — Forename: _____ Age: _____ Forename: _____ Age: _____ Forename: _____ Age: _____ Forename: _____ Age: _____ Forename: _____ Age: _____

- Earliest presentation to Health Care Professional complaining of current symptoms

Type of initial HCP Contact: GP ☐ Nurse/HV ☐ Pharmacy ☐

Date of initial HCP Contact: _____ (approx.)

Time from initial contact to Diag: _____ (Days/Weeks)

Symptoms: Thirst ☐ Polydipsia ☐ Polyphagia ☐ Weight Loss ☐ Lethargy ☐ Polyuria ☐ Nocturia ☐ Noct. Enuresis ☐ Other ☐ _____

New Patient Management Plan - 3

- Family History of Diabetes (record diabetes type if known)

_____

_____

_____

_____

- Family History of Associated Conditions (e.g. thyroid, adrenal, coeliac disease)

_____

_____

_____

_____

- Family History of Other Conditions

_____

_____

_____

- Birth History Birth Wt:_____

  Gestation: _____ wks Location: _____

  Delivery: _____ Problems: _____

- Feeding History

  Breast ☐ Duration: _____

  Bottle ☐ Duration: _____

- Medications / Allergies

_____

_____

- Other Medical Conditions

_____

_____

- Notes: _____

_____

_____

_____

_____

Patient/family consent to data inclusion in Registers

Patient Details (or affix patient identification label)

Patient Surname, Forename: _____

Hospital Number: _____

Address Street: _____

Town: _____

Post Code: _____

Patient Date of Birth: _____

Records

I have discussed diabetes registers with a member of

the Greater Glasgow & Clyde Children's Diabetes Service,

and consent as follows:

(Please tick one box in Part A and one box in Part B)

PART A: Glasgow and NHS in Scotland

I consent to recording my/my child's information in the Greater Glasgow & Clyde Diabetes Register *and* to the NHS in Scotland ☐

I consent to recording my/my child's information in the Greater Glasgow & Clyde Diabetes Register *only* ☐

I DO NOT consent to recording my/my child's information in the Greater Glasgow & Clyde Diabetes Register, nor to the NHS in Scotland ☐

PART B: Scottish Study Group

I consent to my/my child's information being recorded in the Scottish Study Group Register ☐

I DO NOT consent to my/my child's information being recorded by the Scottish Study Group Register ☐

Patient's Signature: _____

Parent's / Guardian's Signature: _____

Date: _____

Customs Letter for Travel

Greater Glasgow & Clyde Children's Diabetes Service

To whom it may concern: **Please retain for future travel**

Dear Sir/Madam,

Re: **Name:** _____

Address: _____

_____

_____

_____

The above-named person has diabetes mellitus, and requires a number of items to be available at all times. These items therefore need to be taken as carry-on luggage, and may include any of the following:

- Insulin pen delivery device
- Insulin pump and spare batteries
- Insulin cartridges
- Blood glucose test lancets
- Glucagon injection kit
- Lucozade (buy in Departure Lounge)
- Insulin pen needles
- Insulin pump tubing and reservoirs
- Blood glucose meter
- Blood glucose test strips
- Glucogel
- Snacks

High or low temperatures may cause insulin to lose its effectiveness, and so this must not be carried in the hold of an aircraft. A family member or friend may also need to carry a second set of items as hand luggage, in case of loss or damage.

Yours faithfully,

Dr. Ian Craigie

Greater Glasgow & Clyde Children's Diabetes Service
Royal Hospital for Sick Children, Glasgow, UK. G3 8SJ.
T: +44 (0)141 201 0000 (Hospital Switch Board)
F: +44 (0)141 201 0407

www.ggc-youngdiabetes.org

Family support - Diabetes UK

The aim of Diabetes UK Parents' and Family Groups is to bring together families who have children with diabetes, and allow them to exchange experiences and support each other. Diagnosis can be emotionally very difficult for the young person and family concerned, with the first few months being a particularly traumatic time. Learning that others have experienced and worked through exactly the same difficulties can be a source of great comfort and encouragement.

The aims of Diabetes UK Family Groups

- Have like-minded parents and children talking to each other
- Stimulate a greater understanding of diabetes, its symptoms and management
- Encourage social interaction
- Offer useful services and friendly advice
- Raise people's awareness of diabetes and its care
- Subsidise organised events
- Raise their own funds

A brief history of the Glasgow Family Group

In the mid-seventies, Dr. Oman Craig of the Glasgow Royal Hospital for Sick Children and Dr. Jim Farquhar from Edinburgh Sick Children's Hospital met at Carlton Terrace in Glasgow to offer support to the parents and carers of children newly-diagnosed with diabetes. This was the start of the Glasgow Family Group.

In May 1977, the Glasgow Area Parents' Group was established, with meetings held at the Royal Hospital for Sick Children, Glasgow. The eight members present thus became the first committee. That group's efforts led to a membership of over 100, and today it totals nearly several hundred families. Guest speakers invited every 1-2 months to talk on relevant aspects of living with diabetes. The first invitations from the group given to parents of newly- diagnosed children, and set out the main aims:

"to bring together parents of children with diabetes,
to exchange experiences and ideas
and help one another".

This is still the main aim of Diabetes UK Family groups today. These groups offer:

- Free membership
- Parents programme
- Children's programme
- Varied activities programme
- Quarterly newsletter
- Books & videos library

If you would like more information on Diabetes UK Family Groups, then simply ask a member of the Diabetes Team, and they will be happy to provide you with details. The website of the Glasgow Family Group is www.gfg.diabetesukgroup.org.

All in the Greater Glasgow & Clyde region are very welcome to join the GFG at any time. Others may have developed their own local groups for support, and this is another excellent way of meeting others in a similar situation. If interested in establishing a formal group, then please feel free to contact Diabetes UK.

Diabetes UK has a Careline for help and advice:	0207	424 1000	(M-F 9-5)
Diabetes UK Scotland:	0141	332 2700	

For My Teacher

Greater Glasgow & Clyde Children's Diabetes Service

A child attending your class has been diagnosed with diabetes. It is not known why people develop diabetes, but numbers are increasing rapidly each year.

In childhood, or **"Type 1" diabetes**, production of a hormone called insulin ceases. Made in the pancreas, insulin is released into the blood when eating carbohydrate. Examples of carbohydrate include simple sugars, as well as more complex forms such as the starches in bread, potatoes, pasta and rice. All carbohydrate is absorbed into the blood stream as sugar, and the simplest such sugar is known as "glucose".

Insulin moves glucose from the blood into the tissues, where it is used for energy (such as in muscle) or stored away for later (in the liver, or in fat). The pancreas, a gland lying in the upper abdomen, makes insulin. For some unknown reason, the immune system of a person with diabetes believes the insulin-producing cells of the pancreas to be different from the rest of the body, and these "beta cells" are then painlessly attacked and destroyed. Over a variable length of time, this results in a total failure to produce insulin. Insulin is essential to life, and must be replaced.

Unfortunately, insulin will be digested if taken by mouth, and so must be given by injection. Insulin is usually given several times a day, and many children may need to have a lunchtime injection. This would usually first be discussed with school staff by either the parents or the diabetes team. Children should check blood glucose results (especially before meals, and if unwell) to ensure good control of their diabetes.

Regular eating is important, and usually consists of three main meals and three snacks each day. Each of these should contain a recommended amount of carbo-hydrate. Exercise is very important, and sensible preparation means children with diabetes should always be able to take part in sporting activities. In this case, extra carbohydrate, agreed with the parents, will help prevent blood glucose falling - a situation called a "hypo" (an abbreviation for "hypoglycaemia").

The blood glucose target range is from 4 to 7 mmol/l. Carbohydrate makes blood glucose rise, while insulin and exercise make it fall. A balance is essential. A child with **high blood glucose results** (especially if 14 mmol/l or more) may pass urine more often, be constantly thirsty, and may also be tired and irritable. While not ideal, there is usually no immediate danger unless the child feels unwell, or there are other signs that concern you. The child's parents should be called if you are worried.

A child with **low blood glucose results** (under 4 mmol/l) will not be unusual. This situation is known as a "hypo", short for "hypoglycaemia" (literally, "low sugar in blood"). Mild hypo signs include feeling shaky, hungry or slightly dizzy, looking pale, concentrating poorly, feeling irritable, or complaining of feeling unwell. A low result can be confirmed using the child's blood glucose meter, and if less than 4 mmol/l must always be treated immediately with fast-acting carbohydrate, like Lucozade® (about 60 ml) or Dextrose tablets (three at a time). 10 minutes later check the blood glucose again, and if under 4 mmol/l repeat fast-acting carbohydrate. If 4 mmol/l or higher, take starchy carbohydrate, such as a biscuit or bread, or the child's snack or lunch if due. This should prevent a further fall. Such treatment will be discussed with you by the child's parents or by a member of the Diabetes Team.

Basic First Aid

1. If the child becomes very drowsy, give Glucogel® or jam (something with sugar in it). Although rare, if the child faints, has a fit, or appears unable to swallow
   - DON'T put anything in the child's mouth
   - DO place the child in the recovery position, and
   - DO telephone 999 for an ambulance.
2. At times blood glucose results may be a little high. As discussed previously, this is shown by increased thirst and going to the toilet more often. If unwell, in the first instance contact the parents, but if unavailable then call the Diabetes Team.

Records

Training for Staff

The diabetes team's website — www.ggc-youngdiabetes.org — has a section dedicated to supporting staff looking after children with diabetes in school. Just go to the "For Schools" page. There you will find a booklet and a number of videos that can be accessed at any time, with information that you will hopefully find helpful on a daily basis.

Of course, staff may feel they require more training than this and the diabetes team can arrange to visit the school to provide this support. We can also draft a Health Care Plan, but this will need to be discussed with the child's family to personalise it to their individual needs.

With a little planning, a child with diabetes should be able to participate in all the activities of his or her peers. This is important psychologically for many reasons. If there are any concerns, then either the child's family or the GGC Children's Diabetes Service will be only too happy to help.

Routine enquiries should be directed to the team based at the address marked below:

GGC Children's Diabetes Service

6th Floor, West Glasgow Ambulatory Care Hospital

Glasgow. G3 8SJ.

T: 0141 201 0331

E: childrenwithdiabetes@ggc.scot.nhs.uk

If call URGENT

↓

Call RHC Switch Board:
0141 201 0000

Ask them to call the Children's Diabetes Nurse Specialist
or
Dial 999 for an ambulance

Produced by the Greater Glasgow & Clyde Children's Diabetes Service

www.ggc-youngdiabetes.org

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