

E: Diabetes During Illness

E1: Sick Day Rules

Introduction

Blood glucose (BG) comes from two sources:

- From the digestion of food
- Manufactured in the liver by the body itself

Your body will continue to produce its own BG, even when you do not eat. If there is insufficient insulin, the glucose cannot get out of the blood and into the cells.

BG levels will rise **particularly at times of illness** and especially if you have a high temperature. Stress hormones also mean more insulin than usual will be needed to stay in control. This means it is **more important than ever** to monitor your BG and make sure you keep your BG under control.

If your BG is normal but ketones are present, this is more likely to be starvation ketones. Regularly take carbohydrate containing fluids (with insulin) to switch off ketone production and non-sugary fluids to help flush the ketones out of the body.

Hyperglycaemia

Hyperglycaemia generally means a glucose level of 14mmol/l but symptoms may not become noticeable until values are 15-20mmol/l.

The following may specifically cause high blood glucose levels and should be considered when trying to identify the cause:

(N.B. If you have just eaten within the last 90 minutes recheck in 1 hour, as you may not have had enough insulin for the amount you ate).

Increased insulin requirements:

- Infection/ illness
- Growth
- Stress
- Reduced exercise

Infusion/ Injection sites:

- Inflammation
- Insertion/ injection into a hardened / lumpy area

Insufficient insulin:

- Basal insulin too low
- Forgot to give a bolus of insulin
- Too little bolus for the food eaten
- Too much CHO after hypoglycaemia
- Rebound following hypoglycaemia

See key points below for managing high glucose levels:

Key points

- NEVER stop taking your insulin – more than usual may be needed even if you are unwell and not eating as much as usual.
- If you are nauseous or vomiting, this could be a sign of Diabetic Ketoacidosis (DKA) – DON'T DELAY - CHECK Ketones and if present phone the Diabetes team for help
- Test your blood glucose and ketones every 1-2 hours
- More insulin than usual will be needed if ketones are present.
- Correction doses should be given every 2-4 hours until glucose is normal and ketones are less than 0.6mmol/l
- Consider increasing the long acting insulin depending on the illness type and if the duration is likely to be two or more days.
- Replace food with small amounts of carbohydrate containing liquid if not hungry e.g. fruit juice, ice cream, yoghurt, sugary drinks
- Don't forget water or sugar free drinks are needed too.
- Contact the Diabetes team **URGENTLY** if your child is vomiting or you are at all unsure.
- Contact your GP for general care of the illness. If medications are prescribed, it is a good idea to request a "Sugar free" type. If not, the amount contained is negligible and can be corrected when you give your next insulin dose.

Seek advice from the Diabetes team early if you are uncertain what to do.

Key Point: If you think your child has a temperature or is developing an intercurrent infection (e.g. sore throat, chickenpox etc.) it is more important than ever to monitor glucose levels and to correct high levels.

Levels of blood ketones - Traffic light alert

Less than 0.6 mmol/l	0.6 - 1.5 mmol/l	Greater than 1.5 mmol/l
Green (okay)	Amber (warning)	Red (needs taking care of)
No action	Correction via pen and more frequent monitoring	As for Amber PLUS Urgent medical assistance

Signs & Symptoms of DKA –Urgent advice is needed if:

Ketones in the blood are over 1.5mmol/l

Vomiting and unable to keep anything down

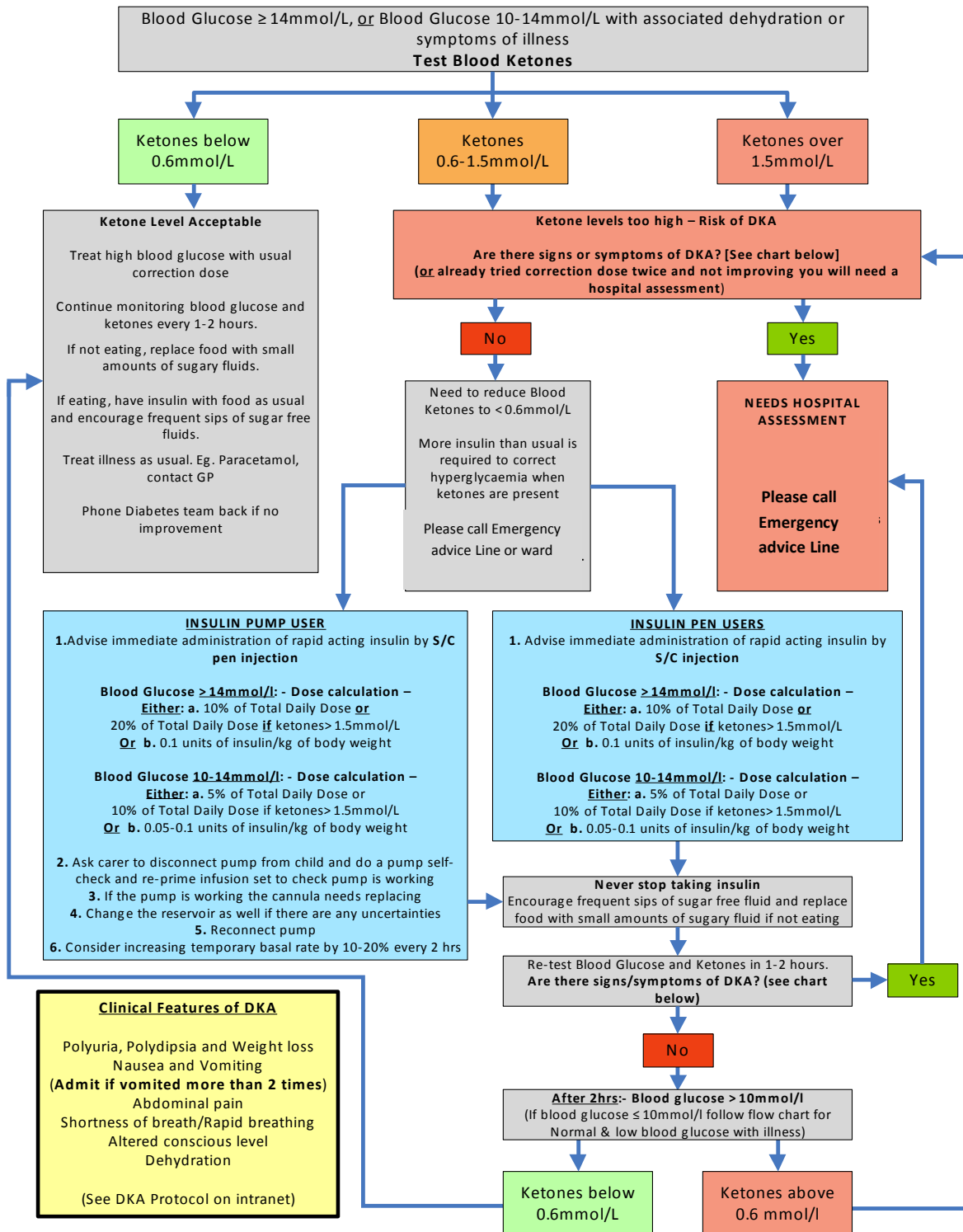
Abdominal pain

Feel drowsy with heavy laboured breathing

Breath smells of pear drops

The flow charts below are for reference about 'Sick day Rules'. Please contact the diabetes team or emergency line/ward out of hours for advice as well. See contact details for telephone numbers or call ambulance. Do not sit at home, seek advice.

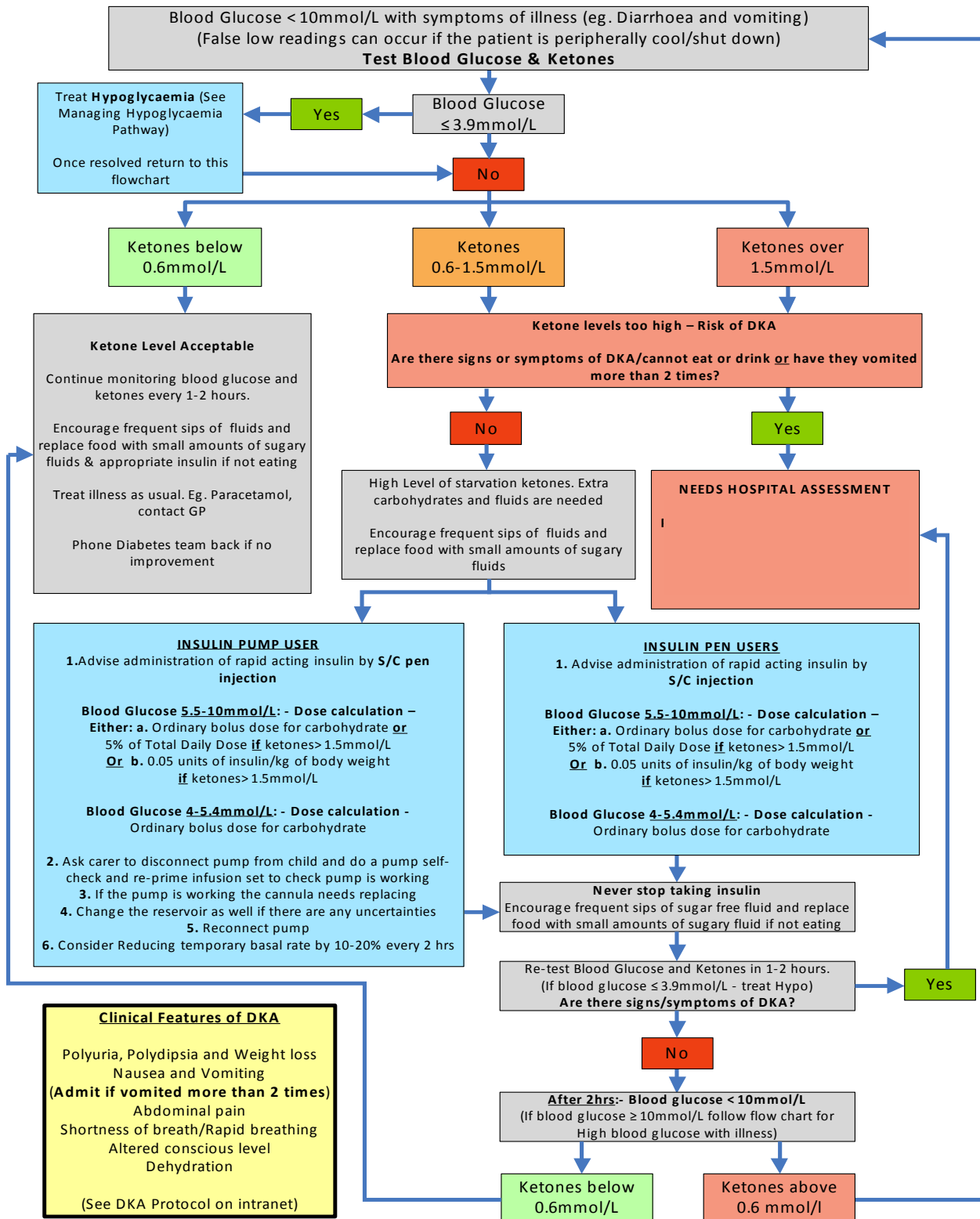
High Blood Glucose Levels and Illness Management for Type 1 Diabetes



Created by Leeds Paediatric Diabetes Team April 2016.

Poster printed by Medical Illustration Services, The Leeds Teaching Hospitals NHS Trust. Job ref: 2010052081/NR

Normal and Low Blood Glucose Levels and Illness Management for Type 1 Diabetes



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E2: Understanding Ketones: how to prevent ketones and avoid DKA

If you starve for more than a few hours, the body will run out of glucose (sugar) stores and will switch to breaking down fats and produce ketones. Ketones smell like pear drops and are found in your breath and urine, which is how the body tries to get rid of them. They are toxic and can make you very ill.

Insulin is important as it acts as a key to allow glucose to move from the blood into the cells, where it is used for energy. If you have diabetes and do not have enough insulin, the body cannot use the glucose and switches to breaking down fats for energy, which leads to ketone production.

If this is not treated, the blood becomes acidic and can lead to diabetic ketoacidosis (DKA) where you will feel very thirsty, start breathing fast and become very dry and vomit a lot.

Situations where large amounts of ketones are produced

Poor diabetic control with high HbA1c:

In this situation, you don't have enough insulin and have high blood glucose levels most of the time. As there is not enough insulin, the glucose stays in the blood stream and can't get into the cells to make them work properly. If you then become unwell, miss insulin or exercise very hard, it can quickly make the situation worse.

Intercurrent illness:

This can be any illness such as flu, tonsillitis or chickenpox. If the body becomes unwell in these situations, it works much harder (equivalent to running very fast) and demands more glucose. Although blood glucose levels rise, the glucose is in the wrong place (in the blood and not in the cells) and the body needs both more glucose and more insulin to deal with the stress of illness.

Starvation:

If you miss food, particularly carbohydrates, the body will naturally form ketones. This will happen more quickly if you are unwell or your diabetes is not well controlled.

Exercise:

Exercise is good for you but if your blood glucose is high and ketones are present, the situation will become worse if you exercise suddenly. The body will demand more energy sources and if there are not enough carbohydrates, more fats will be broken down to form ketones.

How to prevent ketones and DKA

General points:

- Try to eat sensibly and regularly. Although there is no harm in missing occasional meals, in general you should not do this too often. A healthy mixed diet which always contains carbohydrates (CHO) will help to prevent ketones.

- Try not to forget insulin. Those on pumps or multiple insulin injections should try to be accurate with carbohydrate counting and remember to bolus.
- If you test your blood glucose levels regularly, you can correct them if they are high (above 8mmol/L)
- If you monitor your blood glucose levels and they are high (in double figures) a lot of the time, you need to think about changes in your insulin doses. If you are not sure, discuss what action needs to be taken with your diabetes nurse.
- The presence of high levels of ketones makes your insulin work less effectively, this is called insulin resistance. It may be necessary to give increasing doses of insulin or temporarily increase the basal rate if you are on a pump.

Illness:

- Often you do not feel like eating when you are unwell. If this is the case, you must have liquids to match what you would normally eat. This might be Lucozade, milk or fresh orange juice. If you cannot drink, suck glucose tablets instead of the carbohydrates you would normally eat. (3 glucose tablets are usually about 10 grams of CHO). **NEVER** stop taking your insulin if you are not eating.
- You usually need more insulin when you are unwell. Monitor blood glucose levels and take your insulin regularly. For those on a pump or multiple insulin injections, give correction boluses of insulin if your blood glucose is high (8mmol/l or above). For those on twice daily insulin, you may need to increase your normal dose or give some fast acting insulin at lunch.
- If you start vomiting, particularly if you have high blood glucose, are passing a lot of urine, feel cold and breathing fast, you must seek **very urgent** advice and come into hospital immediately.

Ketone monitoring:

- Ketones can be checked in both blood (ketone test strips) and urine (ketostix) but blood ketone testing is more accurate and tells you what is happening now rather than a few hours ago. If you use a pump, you **must** test your blood ketones if your blood glucose is above 14 mmol/l or you are unwell (see chart below).
- If ketones are present, you need to drink plenty of sugar free fluids to flush them out of your body. You also need to eat carbohydrates (or have drinks containing CHO if not eating) with adequate insulin, and correct high blood glucose levels with extra insulin in order to stop ketones from being made. Blood ketone levels above 1.5 mmol/L or urine levels moderate to high require urgent treatment.

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E3: Hyperglycaemia and Diabetic Ketoacidosis (DKA): Basic Guide

(See Ketones and DKA for more detailed advice)

Hyperglycaemia means high blood glucose levels (greater than 8mmol/l), which if untreated and continues to rise in association with increasing ketones can lead to diabetic ketoacidosis. Action must be taken quickly and effectively to prevent DKA occurring.

Diabetic ketoacidosis with dehydration, vomiting and fast breathing is VERY SERIOUS and requires immediate review in hospital. You are more likely to get DKA if:

- Your diabetes control is generally poor and you do not check your blood glucose levels regularly.
- You miss or give insufficient doses of insulin.
- At diagnosis the symptoms of diabetes are not recognised
- You are unwell with a temperature and infection.
- Your insulin requirement is increasing particularly, at puberty when you are growing fast.

What is ketoacidosis?

If there is not enough insulin to convert the blood glucose into energy, the body starts searching for other sources of energy, usually from the body fat. The body burns the fat as fuel and it begins to release chemicals called 'ketones' into the blood, which then appear in the urine. Ketones act as poisons in the body and if they build up to a high level this can be dangerous.

Importantly ketones contribute to '**insulin resistance**' so that you often need more insulin when you have high levels of ketones. Ketoacidosis can take from a few hours to several days to develop but it can be life threatening, so recognising and treating it in the early stages is essential.

Signs that your child may be developing ketoacidosis:

- Raised blood glucose levels
- Ketones in the blood or urine (see blood ketone testing)
- Tiredness
- Smells of ketones (pear drops) N.B. Not everyone can smell ketones.
- If deteriorating and breathing fast (panting) and dehydrated.

Treatment

To prevent or reduce the risk of DKA, increase the frequency of blood glucose testing if the glucose levels start to rise into double figures, i.e. above 14mmol/L.

- Check the blood for ketones using the Medisense Optium meter or if not able to check blood, check the urine for ketones using Ketostix. Remember that Ketostix go out of date 6 months after opening. Always make sure you have Ketostix for holidays and bank holidays.
- A trace or a small amount of ketones may be present if your child has not been eating (e.g. because of a sore throat). Encourage him/her to drink plenty of sugar free fluids and replace food with sugary fluids (see insulin).
- If there is a moderate or large amount of ketones in the blood or urine, more insulin is needed immediately. Please ring one of the diabetes team if you are unsure about how much extra insulin to give. Encourage your child to drink sugar free fluids to help the body get rid of the ketones.
- Check for ketones during periods of stress or illness or if the blood glucose level begins to rise over a period of time, i.e. 2-3 days.
- If test is negative but blood glucose levels are high, it is likely you need more insulin. Increase insulin as advised i.e. 1-2 units working on daytime blood glucose first, leave 2 days and increase again. If your pre breakfast glucose is high this suggests that you may need more basal insulin - if uncertain phone your diabetes nurse.
- If blood glucose continues to rise check blood glucose and ketones every 1-2 hours.
- Never stop the insulin even if not eating. The usual dose may need to be increased or extra fast-acting insulin may need to be given. Please make sure that you have a bottle of fast-acting insulin (e.g. Humulin S, Actrapid, NovoRapid or Humalog lispro). Your diabetes team will have recommended correcting glucose levels over 8mmol/l using a 'correction dose' this is dependent on your age and how long you have had diabetes (**see insulin sensitivity**). Remember to replace your fast-acting insulin six weeks after first using if kept out of the fridge, or if the expiry date has passed if it is kept in the fridge.
- If your child is ill, ask your GP to see him/her in case specific treatment for the underlying illness is required. If she/he is not eating, replace carbohydrate foods with sugary liquids as advised on the illness leaflet. Insulin should be given with the glucose containing drinks together with correction dose. Other non-sugary drinks should also be offered to help the body to get rid of the ketones. Even if your child does not feel like eating it is essential that they have carbohydrate and insulin to be able to get rid of the ketones.
- **Diabetic ketoacidosis:** Vomiting, stomach ache and headaches can occur if ketones are present in the urine. **This can lead to the child becoming confused, very pale, with dull and glazed eyes, dehydrated and cold and becoming drowsy.** It may be that there will not be sufficient blood in the fingers to get a true reading of blood glucose levels. **Hospital admission urgently is required.**
- **Severe Diabetic ketoacidosis:** In severe dehydration finger prick blood glucose levels may underestimate the glucose level, **so it is essential to look**

at your child's symptoms and not just act on the blood glucose level. If there is a large amount of ketones in the blood or urine and the symptoms described above are present, bring your child immediately to hospital or ring for an ambulance. Please inform the ward that you are coming if you have time or the diabetes team will do so if they have spoken to you.

E4: Ketones and Diabetic Ketoacidosis (DKA)

If you have diabetes and become unwell or have high blood glucose levels of 14 mmol/L or more please check for ketones

If the body does not have enough insulin its energy levels will fall, the body stores its energy inside cells as glucose but it needs insulin in the correct amount to do this.

When insulin levels are insufficient the body breaks down fat to produce the energy it needs and chemicals called KETONES are made as a by-product of this process. **Ketones are acids** and if this acid level rises too high this can be very dangerous if you have diabetes.

Ketosis describes the increased level of ketones in the blood. Prompt action is essential to avoid hospital admission and treatment with intravenous insulin and fluids.

Ketoacidosis describes how acidic the blood has become because there is NOT enough insulin in the body.

Ketoacidosis can be dangerous and life threatening and can develop within a few hours, especially for insulin pump users. IMMEDIATE ACTION IS REQUIRED.

Increasing ketone levels affect the function of the heart, lungs, digestive system and brain and in the worst situation can cause coma and death.

Recognizing the signs and treating early is **essential:-**

EARLY Signs that your child is developing ketoacidosis

- Blood glucose level is rising and typically greater than 14 mmol/L
- Ketones are present in the blood or urine (see chart below)
- Confusion
- Tiredness
- Increased thirst
- Becoming dehydrated

LATE signs that your child has developed or is developing ketoacidosis

- Nausea
- Vomiting
- Headache
- Abdominal pain
- Breath smells of acetone /pear drops
- Deep/Sighing breathing * **Seek Urgent Medical Attention**

Ketoacidosis is always caused by insufficient insulin. Please check ketones:

- If your child is acutely ill or feeling unwell
- If the blood glucose has been higher than 14 mmol/L for a couple hours
- If your child feels sick or has vomited
- If your child is feeling under stress
- If you are on an insulin pump you are at greater risk of developing ketoacidosis because you only have a small depot of fast acting insulin and you no longer have any long acting insulin working in the background. Pump users must be more vigilant and test for ketones after any raised blood glucose result that has not been resolved by one correction dose by the pump. For pump users please follow these rules:

Check ketones

Correction dose by pen if the ketones are present

Change your pump to a new site

Check you had not run out of insulin?

Check your old cannulae were not bent?

Check for air in your line?

Confirm ketone level after 2 hours is 0.6mmol/L or reducing

Contact diabetes team if no improvement

Measuring ketones at home using a blood ketone monitor

Ketones can be measured at home by a simple finger prick blood test

We highly recommend the use of the blood ketone monitoring equipment especially if your child is unwell. This result is more accurate than the urine ketone test. The results from this simple finger prick test will tell you if your ketone level is normal or elevated. The higher the result the quicker you need to act. This result can tell you if you have diabetic ketoacidosis. Please refer to the guideline chart below to help interpret the results but if unsure contact your diabetes team for immediate advice.

Delayed treatment for high blood ketone levels can be life threatening. Identifying rising ketone levels early can avert an emergency situation or hospital admission. If identified early and with appropriate advice and treatment from the diabetes team, ketone levels usually decline into the safe range. Managing this may take up to 24 hours and requires extra insulin doses and careful observation of fluid intake and regular telephone contact. Individual assessment is essential and in some cases admission to hospital may be unavoidable.

If your child is unwell please establish if it is the diabetes causing the symptoms from ketone production by checking the blood ketone level. If the blood ketone level is below 0.6mmol/L and the blood glucose is less than 14 mmol/L this indicates the insulin level is fine and it is likely to be some other underlying illness causing the symptoms.

BLOOD KETONE LEVELS - WHAT I NEED TO DO

Think of the results like a set of traffic lights

Green: blood ketones in the normal range

Amber: blood ketones please be careful

Red: blood ketones very high risk of ketoacidosis

Blood glucose level	Blood ketone level	What do I do
Starvation Ketones <i>can occur when the body is starved of glucose for prolonged periods of time. The blood glucose level is usually normal or no greater than 10 mmol/L</i>	<i>Starvation ketones are made from fat just the same but the levels do not usually rise above 1.0 mmol/L</i>	<ul style="list-style-type: none"> ▪ <i>Eat a carbohydrate meal and give usual insulin.</i> ▪ <i>Retest after four hours and the ketones should have gone.</i> <p><i>N.B. It can be normal to have a small amount of ketones in the blood. This is harmless</i></p>
Blood glucose 8-14 mmol/L	Blood ketones below 0.6mmol/L	<p>The ketone level is in the normal range.</p> <ul style="list-style-type: none"> ▪ Give a correction dose to get back to your target blood glucose level if needed ▪ Recheck Blood glucose and ketones in 2hrs ▪ Important to have CHO as usual with insulin.
Blood Glucose 14 mmol/L or more	Blood Ketones below 0.6mmol/L	<p>The ketone level is in the normal range</p> <ul style="list-style-type: none"> ▪ Correction dose is needed for high blood glucose level ▪ Give extra sugar free fluids ▪ Recheck Blood glucose and ketones in 2 hours as the level may improve without any further extra insulin. ▪ If glucose level still high give some extra fast acting insulin as correction dose as per your personal instructions. If ketone level rising see below. ▪ Important to have CHO as usual and appropriate insulin, if not hungry use liquid exchanges. ▪ If unsure contact the diabetes team

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<p>Blood Glucose 14 mmol/L or more</p>	<p>Blood Ketones between 0.6 and 1.5 mmol/L</p>	<p>The ketone level may become serious without extra insulin.</p> <ul style="list-style-type: none"> ▪ Give extra insulin immediately. Pump users to give using a pen injection and re-site pump needle. ▪ Recheck blood glucose and ketones in two hours. If unsure of how much further insulin to give then contact the diabetes team. ▪ Give extra sugar free fluids. ▪ Recall diabetes team in 2 hours with update and for ongoing advice <p>Despite these actions your child could deteriorate very quickly into the high risk category -any signs of nausea, vomiting or abdominal pain seek advice immediately or take to the accident and emergency department</p>
<p>Blood Glucose greater than 14mmol/L</p>	<p>Blood Ketones above 1.5mmol/L is high risk.</p>	<p>The ketone level is high. Your child is at risk of developing ketoacidosis and dehydration. Watch for signs of abdominal pain and vomiting. High ketone levels will mean your child will no longer feel hungry but you MUST</p> <ul style="list-style-type: none"> ▪ Give extra insulin and recheck blood glucose and ketones in one hour. ▪ Contact the diabetes team to advise you on the dose. ▪ Encourage sips of sugary fluids with insulin. ▪ After two hours repeat the dose if ketones have not decreased and take child immediately to the accident and emergency

		department.
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BLOOD GLUCOSE LEVEL MAY OCCASIONALLY BE NEAR NORMAL but USUALLY HIGH	Blood Ketones above 3.0mmol/L is serious Risk	<p>The ketone level is seriously high. Your child needs insulin immediately and a rapid assessment of severity of ketoacidosis. TAKE TO EMERGENCY DEPARTMENT IMMEDIATELY</p> <p>If dehydrated and breathing fast it is very unlikely that further insulin under the skin will work - hospital admission is required. If at night do not wait until the morning but seek advice immediately.</p>
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NEVER stop giving your insulin if you are unwell or have ketones. It is not advisable to exercise if you have ketones and high blood glucose levels.

This section is specifically to explain ketones and its potential effects. Please refer to the illness management leaflet for more specific illness advice or contact team.

URINE KETONE MONITORING (Blood ketone is more reliable and accurate)
Urine ketone checks are best kept for occasional screening if trends of high blood glucose levels occur.

Use a test called Ketostix.

- Ketostix expire after 3 months of opening so to ensure accuracy make sure they are in date.
- Dip the stick into a fresh urine sample then time for 15 seconds.
- Compare the stick against the colour chart on the side of the bottle.
- If the pad does not change colour the result is negative to ketones.
- The darker the colour pad changes the higher the ketone level
- Extra insulin is required for positive ketone test
- Please contact the diabetes team for an assessment and recommendations of treatment.