

## Paediatric Diabetes Sick Day Management/ Hyperglycaemia and Ketosis in the Community

(including advice for missed insulin doses and converting from pumps to injections)

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This is the most current version and should be used until a revised document is in place		

### Key Amendments

Date	Amendment	Approved by
March 2019	New document	Paediatric QI Meeting
19 <sup>th</sup> Nov 2020	Document extended for 1 year	Dr J West/Paediatric QIM
26 <sup>th</sup> March 2021	Document reviewed and approved for 3 years	Paediatric Guideline Review meeting

### Introduction

This guideline is aimed at giving consistent advice to families of children and young people with Diabetes. It is used by the Paediatric Diabetes Specialist Nurses (PSDN's) in the community and other members of the diabetes team. It is also for use by the medical staff on the paediatric wards at the Alexandra Hospital and Worcestershire Royal Hospital for out of hour's advice when the diabetes team members are unavailable and may also be used by Orchard Service if the individual has appropriate skills.

The Paediatric Diabetes Specialist Nurses in Worcester, Kidderminster and Redditch work Monday - Friday and are covered by nursing colleagues in periods of absence for telephone support only. Support from Orchard service on discharge may be required, mainly for the Newly Diagnosed.

**When out of hours advice is given, please leave a message on the relevant answer phone below to ensure prompt follow up occurs on the next working day.**

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Home management of illness, hyperglycaemia and Ketosis involves parents in the care of a potentially serious condition and the Paediatric Diabetes Team must have good knowledge and understanding of the family's ability to manage this at home. Treatment of any underlying illness should be the same as for a child without diabetes.

**It is essential that the family can obtain help and support when needed and that the Team can maintain regular contact through the day if necessary.**

Parents will have written information on how to manage illness episodes and are advised **never to omit insulin**. They are encouraged to make early contact with the Team for advice and also advised to increase blood glucose monitoring, to test urine or blood for

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ketones, rest if ketones are present and to drink plenty of fluids. (See page 8 of this document for appendix 2, 3 and 4 parent advice leaflets (For advice on Twice daily insulin, Multiple injections and, and one for Insulin Pumps users).

### Competencies Required

Paediatric Diabetes Nurse / Orchard Service Nurse with appropriate qualification or experience in diabetes.

Ward nursing staff with appropriate experience in diabetes.

Evidence of attendance at diabetes update days

Paediatric Medical staff.

### Patients Covered

Children and adolescents with diabetes across Worcestershire County

### Illness Hyperglycaemia and Ketone Management on BD or Basal Bolus Insulin Regimen

Parents are always advised to contact the Paediatric Diabetes Nurse or, out of hours, the ward when their child becomes ill to seek early advice on insulin adjustment. However they are encouraged to do so **IMMEDIATELY** when their children complain of:

- Polyuria and/or thirst.
- Abdominal pain, nausea and vomiting.
- Blood glucose is 14mmol/l or over and ketones are present in the blood of above 0.6mmol/l and they are unsure what to do.

### Hospital referral should be made if:

- Fluids are not tolerated or regular vomiting/hypoglycaemia
- Blood ketones above 1.5 mmol/l or large urine ketones are not improving after 4-6 hours of home advice.
- Blood glucose continues to rise despite giving extra insulin
- Parents or Paediatric Diabetes Specialist Nurse are not happy to continue home management.
- The child is getting dehydrated (vomiting, not drinking, not passing urine, dry lips, and sunken eyes).
- There is any change in the child's response/conscious level or respirations.
- On admission to hospital on call consultant paediatrician should be contacted if the Paediatric Registrar is unable to advise.

### Insulin Requirements

In illness, a high blood glucose with or without ketones is an indication of a need for more insulin due to a stress hormone response and increased insulin resistance, which can be given as Actrapid, Humalin S, Humalog, Apidra or NovoRapid in preference, or their normal Mixed insulin if this is what is available. Careful monitoring to reduce blood glucose levels and ketones are required to prevent ketoacidosis and hospital admission.

The majority of patients now have the facility to blood ketone monitor. Blood ketone testing is preferable as it can provide a more accurate picture of ketosis to base treatment decisions

on and will normalise much more quickly after appropriate treatment. It can therefore potentially prevent hospital admissions and late hypoglycaemia due to over treatment.

- Extra insulin required can be worked out by giving 0.1units/kg or identifying the child's total daily dose of insulin. To do this add up **all** the doses of insulin over the day but **do not** include any extra given to treat hyperglycaemia. An extra percentage of the total daily dose can then be given dependant on ketone and blood glucose levels as **shown in the summary table on page 11 of this document**. Most parents on a multiple injection regimen will be used to correcting high blood glucose levels by using their child's insulin sensitivity factor as a matter of course, however they may need support in increasing this amount during illness.
- A blood glucose level of 14mmol/l or above with or without ketones can indicate a lack of insulin. A normal or low blood glucose with ketones indicates starvation ketones which usually will be below 3 mmol/l.
- Ketone levels may increase slightly (10-20%) within the first hour after giving extra insulin but after this period it should decrease.
- If child is not eating or vomiting and blood glucose is below 14mmol/l then glucose drinks will be required as discussed below.
- When a child is in the "**Honeymoon or Remission Phase**" and unwell there may be a need to increase insulin doses from 0.5u/kg per day to 1unit/kg per day very quickly.
- For those **children with low dosage requirements or adolescents with insulin resistance** calculate extra insulin requirements using the total daily dose and percentage method.

### **Illness Hyperglycaemia and Ketone Management on an Insulin Pump**

An insulin pump uses rapid acting analogue insulin and will be set to deliver a basal rate over 24 hours to suit the individual. At time of carbohydrate consumption the child will give a bolus using their insulin to carbohydrate ratio to work out how much is needed, for example many will start on 1 unit insulin for 10g carbohydrate.

The key points for management are the same for pump users as for those on injections. However, because there is no depot of long acting insulin there is an increased risk of diabetic ketoacidosis if hyperglycaemia and/or ketones are not dealt with promptly.

If the blood glucose level is above 14mmol/l for any reason then pump users & medical staff should **use table on page 10 for advice on doses**. To aid & simplify self management skills in managing hyperglycaemia, the table of advice uses the young person's normal corrections set into the pump, but then considers also increasing the basal rate temporarily. All families will be able to set up a temporary basal rate.

### **Dietary Management**

Dehydration can be caused by hyperglycaemia, fever, excessive glycosuria and ketosis. During illness, dietary requirements remain unchanged but, owing to nausea or loss of appetite may need to be given in liquid or light diet form and spread out through the day. If not eating, starvation ketones can be produced when there is a low to normal blood glucose level so it will be important to replace the carbohydrate.

- Examples of alternatives are jelly (not sugar free), fruit juice or fruit smoothies made with yogurt or ice-cream.

- As a guide, sugary carbohydrate should be given as 50ml Lucozade Energy, 100ml Cola/ Ribena, 2 teaspoons of sugar in a drink, 3 Dextrosol tablets or the equivalent every 45 minutes until more starchy alternatives are tolerated. Parents soon learn what suits their child in this situation.

Extra fluids are also required and should be given as water or no added sugar squash on top of replacement carbohydrate. Dioralyte or equivalent electrolyte solution should be considered if at risk of dehydration. As soon as fluids are well tolerated a light diet should be introduced. If not tolerating diet by the evening, parents need to monitor blood glucose 1-2 hourly through the night.

### **Diarrhoea and Vomiting**

Vomiting can be caused by the illness itself e.g. gastroenteritis, hypoglycaemia or from ketosis.

Malabsorption during episodes of sickness and diarrhoea may lead to a fall in the blood glucose levels and there is often difficulty in maintaining adequate carbohydrate intake and hydration. These problems may lead to the need for reduction in the insulin dosage.

- The amount of insulin reduction will depend on the degree of hypoglycaemia, vomiting and/or diarrhoea. 2- 4 hourly blood glucose monitoring is essential to assess control so that the insulin dosage can be returned to normal as soon as the blood sugars begin to rise.
- Insulin doses can be reduced by 20% - 50% dependent on the overall picture in many cases. Most children with gastroenteritis need to have their insulin dosage reduced by 25%. Some need a bigger reduction, and only a few need less.
- Check ketone levels regularly to check the child is taking in sufficient carbohydrate to prevent starvation ketones if blood glucose level low to normal.
- If hypoglycaemia occurs due to diarrhoea and vomiting sugary carbohydrate should be given as 50ml Lucozade Energy, 100ml Cola/ Ribena, 2 teaspoons of sugar in a drink, 3 Dextrosol tablets or the equivalent every 45 minutes until more starchy alternatives are tolerated. Parents soon learn what suits their child in this situation.
- Any extra fluids should be given as water or no added sugar squash on top of replacement carbohydrate. Dioralyte or equivalent electrolyte solution should be considered if at risk of dehydration. As soon as fluids are well tolerated a light diet should be introduced. If not tolerating diet by the evening, parents need to monitor blood glucose 1-2 hourly through the night.
- The child should be admitted to the ward if at risk of dehydration, or parents unable to manage hypoglycaemia safely at home.
- Children can sometimes remain hypersensitive to insulin for a while after the illness has subsided so it is not unusual to require reduced doses for sometime after the event.

### **Forgotten / Missed Insulin Doses**

**BD insulin** – the forgotten dose of insulin should ideally be given as soon as possible. It may be necessary to delay the next injection to avoid an overlap of the insulin doses leading to hypoglycaemia. If time elapsed since the missed injection makes it impracticable to give in

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relation to when the next injection is due – a dose adjusted for hyperglycaemia as detailed earlier will be necessary at the next injection time. Parents should be encouraged to test for ketones if blood glucose above 14mmol/l and increase blood glucose testing to 2-4 hourly as necessary.

**Basal Bolus** – NovoRapid/Humalog/Apidra should be given as soon as possible when the missed dose is realised. Insulin should be given for the carbohydrate eaten only. If the next meal is imminent an injection can be given including a correction bolus for any hyperglycaemia and carbohydrate intake to be consumed at the next meal (should be given more than 15 minutes before food intake).

**Basal Bolus** – Lantus/ Levemir can be given as soon the missed dose is realised. It may be necessary to adjust the timing of the next day injection if a delay of more than 2 hours has occurred (to prevent hypoglycaemia caused by the 2 doses overlapping). If usually given in an evening and injection has been missed overnight, give 2/3 of normal dose that morning. Hyperglycaemia can be corrected using fast acting insulin at each meal time throughout the day. Normal insulin doses can then be resumed that evening.

### **Follow up Routine**

Parents must be aware that they may bring their child to the ward at any time after discussion with the medical staff if they are struggling to cope or if they are unhappy about their child's condition.

1. The PDSN or Medical staff out of hours must maintain frequent contact with the family to ensure the episode is resolving safely.
2. Parents must monitor blood glucose and test for ketones frequently.
3. Parents must be given clear guidelines about when emergency contact may be necessary.
4. During the night extra blood glucose tests may be necessary.
5. Support and frequent contacts should continue until the blood glucose levels are more settled.
6. The PDSN/Medical staff must assess the cause of hyperglycaemia / ketones to aid further treatment and education needs:
  - Illness-need to contact GP.
  - Omitted or incorrect dose of insulin.
  - Rebound hyperglycaemia from a hypoglycaemic event.
  - Recent poor control/poor injection sites.
  - Incorrect dietary management.
  - Incorrectly stored/out of date insulin.

### **Converting back to insulin injections from insulin pump.**

There may be occasions when patients using an insulin pump may need to convert back to multiple daily injections. This could be due to pump failure, loss of pump or no infusion sets. The following steps should be followed;

## **Medtronic Veo Pump**

### **1. Work out Pump Total Daily Dose:**

- Menu – Utilities – Daily Totals – Daily Average – 5 days =      units.
- Work out **Injection Daily Total** by increasing Pump Total Daily Dose by 25%:
- Pump TDD x 1.25 =                      units

### **2. Divide by 2 to get total background insulin:**

- $\frac{\text{Injection Total Daily Dose}}{2} =$       units
- If two background insulin injections per day split equally, 12 hours apart

### **3. Continue with current carb ratio and sensitivity factor**

Work out your conversion back to injections using your current information:

1. Work out Pump: Total Daily Dose:                      units
2. Injection Total Daily Dose:                      units
3. Background insulin:                      units
4. Current Insulin to Carbohydrate ratio and Insulin Sensitivity Factor

## **Roche Combo Pump**

### **1. Work out Pump Total Daily Dose:**

Handset – menu - highlight pump -press middle button, then left arrow until my data, press tick - keep pressing left arrow until your daily totals- scroll with down arrow to look at previous days

- Daily Average – 5 days =      units.
- Work out **Injection Daily Total** by increasing Pump Total Daily Dose by 25%:
- Pump TDD x 1.25 =                      units

### **2. Divide by 2 to get total background insulin:**

- $\frac{\text{Injection Total Daily Dose}}{2} =$       units
- If two background insulin injections per day split equally, 12 hours apart

### 3. Continue with current carb ratio and sensitivity factor

Work out your conversion back to injections using your current information:

- a. Work out Pump: Total Daily Dose:                      units
- b. Injection Total Daily Dose:                      units
- c. Background insulin:                      units
- d. Current Insulin to Carbohydrate ratio and Insulin Sensitivity Factor

### **Starting back on the pump**

When you start back on the pump after using injections you need to **plan**, taking into account your background insulin and the possible need for a temporary basal rate. **Always start back on the pump in the morning**

Background insulin:

Lantus or Levemir once per day:

- If inject in the **morning**:
  - Miss morning background insulin
  - Have usual quick acting insulin for carbohydrate and correction in the morning starting back on the pump
  - No temporary basal rate is required
- If inject in the **night**:
  - Reduce by 50% the night before
  - Have usual quick acting insulin for carbohydrate and correction on the morning starting back on the pump
  - Put a temporary basal rate of 50% for the first 8 hours

NPH, Lantus or Levemir twice per day:

- Reduce by 25% the night before
- Miss the morning background insulin
- Have usual quick acting insulin for carbohydrate and correction on the morning starting back on the pump

Put a temporary basal rate of 50% for the first 8 hours

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Paediatric Diabetes		Table 1: Sick day advice summary and how to calculate extra insulin required				
Ketones		Blood Glucose (BG)				
Blood Ketones mmol/l	Urine Ketones	<5.5 mmol/l	5.6 – 9.9mmol/l	10 – 14.9mmol/l	15 – 22.9mmol/l	> 23mmol/l
<0.6	Negative/Trace	Do not give extra insulin. May need 25% less insulin	No action	Increase next dose of insulin if BG is still elevated by 5% of TDD or 0.05U/kg	Give extra 5% of TDD or 0.05 U/kg. Repeat 4 hourly if needed Check BG & ketones 2 hourly	Give extra 10% of TDD or 0.1U/kg Repeat dose 4 hourly if needed Check BG & ketones 2 hourly
0.7 – 0.9	Trace/Small	Starvation ketones Extra Carbohydrates & fluids needed	Starvation ketones Extra carbohydrates and fluids needed	Give extra 5% of TDD or 0.05 U/kg. Repeat 4 hourly if needed Check BG & ketones 2 hourly	Give extra 5-10% of TDD or 0.05 - 0.1U/kg. Repeat 4 hourly if needed Check BG & ketones 2 hourly	Give extra 10% of TDD or 0.1U/kg Repeat dose 4 hourly if needed Check BG & ketones 2 hourly
1.0 – 1.4	Small/Moderate	Starvation Ketones Extra carbohydrates & fluids needed	Starvation ketones Extra carbohydrates and fluids needed Give usual next dose of insulin.	Extra carbohydrates & fluids needed Give extra 5-10% of TDD or 0.05 - 0.1U/kg 4 hourly if needed Check BG & ketones 2 hourly	Give extra 10% of TDD or 0.1U/kg Repeat 4 hourly if needed Check BG & ketones 2 hourly	Give extra 10% of TDD or 0.1U/kg Repeat dose 4 hourly if needed Check BG & ketones 2 hourly Advise family to re contact if no improvement
1.5 – 2.9	Moderate/Large	High levels of starvation ketones Extra carbohydrates & fluids needed Recheck BG & ketones 2 hourly	High levels of starvation ketones Extra carbohydrates & fluids needed. Give 5% of TDD or 0.05 U/kg. Recheck BG & ketones 2 hourly	Extra carbohydrates & fluids needed Give extra 10% of TDD or 0.1U/kg 4 hourly if needed Check BG & ketones 2 hourly	Give extra 10% - 20% of TDD or 0.1U/kg Check BG & ketones 2 hourly Repeat dose after 2 hours if ketones do not decrease	Give extra 10% - 20% of TDD or 0.1 U/kg Check BG & ketones 2 hourly If no improvement & ketones have not decreased at 2 hourly review, consider inpatient treatment for DKA
> 3.0	Large	Very high levels of starvation ketones. Recheck BG & ketones 2 hourly Extra carbohydrates & fluids needed	Very high levels of starvation ketones Extra carbohydrates & fluids needed. Give 5% of TDD or 0.05 U/kg. Recheck BG & ketones 2 hourly	Extra carbohydrates & fluids needed Give extra 10% of TDD or 0.1U/kg 4 hourly if needed Check BG & ketones hourly	Give extra 10% -20% of TDD or 0.1U/kg Check BG & ketones 1 hourly. If ketones do not decrease consider inpatient treatment for DKA	Give extra 10% - 20% of TDD or 0.1U/kg Check BG & ketones hourly. If no improvement & ketones have not decreased at hourly review, consider inpatient treatment for DKA.
<p>There is an immediate risk of ketoacidosis if the blood ketone level is &gt;3.0mmol/l. Insulin treatment needed urgently.</p> <p><b>If persistent symptoms after 4-6 hours of advice patient should be reviewed on the ward.</b></p> <p><b>May need intravenous fluids if child cannot eat or drink.</b></p>						

1. TDD = Total daily dose. To calculate add up all insulin doses given on a usual day – do not include extra boluses given for hyperglycaemia
2. High BG & elevated ketones indicate a lack of insulin. Starvation blood ketones usual below 3.0mmol/l
3. Extra insulin preferably given as rapid acting insulin analogue or short acting. If usual mixed insulin is the only available insulin use this.
4. If child vomiting/not eating and BG is below 10-14.9 mmol/l must drink glucose containing fluids every 45 min. (see main policy) in between extra sugar free fluids for hydration
5. Ketone level may increase slightly (10-20%) within the first hour after giving extra insulin but after this period it should decrease

**GUIDE TO MANAGEMENT OF HYPERGLYCAEMIA WITH OR WITHOUT KETONES ON AN INSULIN PUMP**

Blood Glucose	Less than 0.6mmol/l ketones	0.6 – 1.4mmol/l ketones	1.5mmol/l ketones & above
<b>4-5.5mmol/l</b>  <i><b>Top tip:</b> Starvation ketones can occur with a normal blood glucose if not eating enough</i>	Encourage normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios. Encourage sugar free fluids hourly. <b>If experiencing recurrent hypos, set a decreased temporary basal rate for 4-6 hours (20-50% less than usual) and review further if necessary.</b> <b>Seek advice if any vomiting persists or there is difficulty maintaining blood glucose above 4mmol/l.</b>	Encourage normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios using bolus calculator on the pump. Encourage sugar free fluids hourly Re-check glucose & ketones after 2 hours. Repeat steps above if unchanged <b>If still remains unchanged after 4 hours, seek advice</b>	Encourage normal food or carbohydrate alternative as mentioned with insulin bolus <b>BY PUMP</b> as per normal ratios using bolus calculator on the pump. Encourage sugar free fluids hourly Re-check glucose & ketones after 2 hours. <b>If still remains unchanged after 4 hours, seek advice</b>
<b>5.5-10mmol/l</b>  <i><b>Top tip:</b> Starvation ketones can occur with a normal blood glucose if not eating enough</i>	Encourage normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios. Encourage sugar free fluids hourly. Re-check glucose & ketones after 2 hours. <b>Repeat steps above, if unchanged.</b> <b>If still remains unchanged after 4 hours seek advice.</b>	Normal food or carbohydrate alternative as mentioned with insulin bolus <b>BY PUMP</b> as per normal ratios & correction. Encourage sugar free fluids hourly Re-check glucose & ketones 2 hours. <b>Repeat steps above again</b> <b>If no improvement after 4 hours seek advice.</b>	Normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios & correction. Encourage sugar free fluids hourly Re-check glucose & ketones after 2 hours. <b>If no improvement – consider changing the cannula</b> <b>Seek advice.</b>
<b>10-14mmol/l</b>  <i><b>Top tip:</b> If ketones present make sure you rest until they have gone.</i>	Normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios & sensitivity using bolus calculator on the pump. Encourage sugar free fluids hourly Re check blood glucose and ketones after 2 hours <b>Repeat steps above if unchanged.</b> <b>If still remains unchanged after 4 hours seek advice.</b>	Normal food or carbohydrate alternative with insulin bolus <b>BY PUMP</b> as per normal ratios & correction Encourage sugar free fluids hourly Re-check glucose & ketones in 2 hours. <b>If no improvement, Take a correction dose of insulin as per normal ratio &amp; sensitivity</b> <b>BY INJECTION immediately</b> Change infusion set Put an increased temporary basal rate in place for 2 hours to 150% Re check blood glucose and ketones after 2 hours <b>If no improvement – seek advice.</b>	Take a correction dose of insulin as per normal ratio & sensitivity <b>BY INJECTION</b> immediately Change infusion set Put on an increased temporary basal rate for 4 hours to 200% Encourage sugar free fluids hourly Re check blood glucose and ketones after 2 hours <b>If no improvement seek urgent medical advice.</b>
<b>Above 14mmol/l</b>  <i><b>Top tip:</b> Never ignore any pump alarms, always check them out and deal with them immediately</i>	Trouble shoot and resolve any problem with the reservoir, infusion set, site, pump and insulin. Insulin bolus as per normal ratios & sensitivity <b>BY PUMP</b> using bolus calculator on the pump. Encourage sugar free fluids hourly Re check blood glucose and ketones after 2 hours <b>If no improvement in glucose/ ketones after 2 hours consider changing infusion set, seek advice</b>	Take a correction dose of insulin as per normal ratio & sensitivity <b>BY INJECTION</b> immediately Change infusion set Put an increased temporary basal rate on for 2 hours to 200% Encourage sugar free fluids hourly <b>Re-check blood glucose and ketones after 2 hours</b> <b>If no improvement seek urgent medical advice</b>	Take a correction dose of insulin as per normal ratio & sensitivity <b>BY INJECTION</b> immediately. Change infusion set Put on an increased temporary basal rate for 4 hours to 200% Encourage sugar free fluids hourly Re check blood glucose and ketones after 2 hours <b>If no improvement seek urgent medical advice.</b> <b>If ketones have improved but still present, repeat correction dose as INJECTION and re check after a further 2 hours</b>

## References

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