



## Executive Summary

# Management of Type 1 Diabetes Mellitus during illness in children and young people under 18 years (Sick Day Rules)

### SETTING

**FOR STAFF** Medical and nursing staff

**PATIENTS** Children and young people with diabetes mellitus

## Patient group

This guideline is intended for use in managing illness and high blood glucose levels for all children and young people up to the age of 18 years with diabetes mellitus.

## 1. Introduction

Illness generally raises the blood glucose levels and increases the risk of ketone body production due to a relative deficiency of insulin. An increase in counter-regulatory hormone production causes gluconeogenesis and impaired peripheral glucose uptake which in turn leads to hyperglycaemia and hyperosmolality. Insulin deficiency leads to lipolysis, hepatic fatty acid oxidation and formation of ketone bodies.<sup>1</sup> This can result in Diabetic Ketoacidosis (DKA) if adequate insulin and hydration is not maintained. Increased levels of stress hormones during illness contribute to high blood glucose levels. Cytokine release in response to infection can also lead to some degree of insulin resistance.<sup>2</sup>

Diarrhoea and vomiting may reduce blood glucose levels with a possibility of hypoglycaemia rather than hyperglycaemia. Ketones may still be produced in significant quantities even with hypoglycaemia in gastroenteritis<sup>3</sup>.

## 2. Importance of Local 'Sick-Day' Rules

NICE guidelines recommend that children and young people with T1DM should be offered clear guidance for the management of diabetes during periods of illness<sup>4</sup>. Adequate sick day management at home may reduce the risk of progression to DKA and admission to hospital.<sup>4</sup> The use of sick-day rules which include self-monitoring of blood glucose and ketones, and timely administration of supplemental



insulin and fluids leads to reduced hospitalisation and potential cost savings.<sup>5</sup> DKA admissions are associated more with increasing age, high HBA1c, high insulin doses and female sex.<sup>6,7</sup>

### 3. Ketone testing

#### Recommendations –

- We recommend the use of blood ketone testing instead of urine ketone testing during illness<sup>4</sup>.
- All CYP and their families and carers should be provided with equipment to measure blood ketone levels during illness

### 4. Fluid Management

#### Recommendations –

- Advise patients to monitor fluid intake and ensure they are drinking enough fluids to keep well-hydrated
- Once vomiting with high ketones, have a low threshold for admission to hospital

### 5. Out of hours diabetes advice

#### Recommendations –

- All CYP and families should be offered access to 24hr telephone advice. This may be delivered by either members of the diabetes team or other trained healthcare professionals working to an agreed protocol
- Where the initial advice **is being given by** healthcare professionals who are not members of the diabetes team then there needs to be in place a process of ensuring the diabetes team is made aware of this contact
- The out of hours service should be regularly reviewed and audited

### 6. Diabetes Self Management Education

#### Recommendations -

All CYP and their families and carers should be taught what to do when ill (sick day rules) at diagnosis, annually, at transition and opportunistically. This can be done either in 1:1 or group sessions

- All CYP and their families and carers should have written information about
  - what to do when ill
  - how to test blood ketones and interpret results



- when to seek advice from their diabetes team and important contact numbers/addresses of health care team

## 7. General Rules for Managing Diabetes During Illness

### Recommendations -

- **Never stop** or omit Insulin.
  - However doses may need to be reduced or increased and this will depend on blood glucose and ketone levels.
- Check blood glucose more frequently e.g every 2 hours including through the night.
  - This will help distinguish between conditions associated with hyperglycaemia and hypoglycaemia
- Check for blood ketone levels whenever a child is ill, regardless of blood glucose level
  - *Rarely, ketone levels may be elevated even if BG levels are normal, for example in gastroenteritis*
- Give additional fast acting insulin every 2 hours if blood glucose is above target. **(See Table 1)**
  - If ketones are less than 0.6mmol/l, then give the usual correction insulin dose
  - If ketones are between 0.6mmol/l and 1.5mmol/l then advise that patient has 10% of the total daily dose of insulin (TDD), or 0.1 units/kg body weight, as additional fast acting insulin
  - If ketones are >1.5mmol/l then advise that patient has 20% of TDD, or 0.2 units/kg body weight as additional fast acting insulin
- If ketones are present when blood glucose is low, they are called 'starvation ketones' and respond to drinking extra fluids containing sugar. Monitor blood glucose very closely and extra insulin may be required when blood glucose starts rising
- Keep well hydrated by drinking plenty of fluids.
  - Water, or sugar-free fluids are probably most appropriate in the majority of cases where blood glucose levels are normal or high
  - If blood glucose levels are low, drinks containing glucose are required, or take carbohydrates if possible
  - Avoid carbonated drinks if possible.
  - Inform the diabetes team early to seek advice
  - Treat the underlying condition

**TABLE 1**

Negative ketones <0.6mmol/l (Blood)	Small to moderate ketones 0.6 – 1.5mmol/l (Blood)	Moderate to large ketones >1.5mmol/l (Blood)
Take a correction dose (CD) to correct high blood glucose (BG) in addition to normal bolus for carbohydrates eaten	Give <ul style="list-style-type: none"> <li>• 10% of your total daily dose (TDD) of insulin as additional fast acting insulin</li> <li>OR</li> <li>• 0.1 units/kg body weight as additional fast acting insulin</li> </ul>	Give <ul style="list-style-type: none"> <li>• 20% of your total daily dose (TDD) of insulin as additional fast acting insulin.</li> <li>OR</li> <li>• 0.2 units/kg body weight as additional fast acting insulin</li> </ul>
Then: <ul style="list-style-type: none"> <li>• Re-check BG and ketones in two hours</li> </ul>	Then: <ul style="list-style-type: none"> <li>• Monitor fluid intake and ensure you are drinking enough fluids to keep well-hydrated</li> <li>• Re-check BG and ketones in two hours (See below)</li> </ul>	Then: <ul style="list-style-type: none"> <li>• Monitor fluid intake and ensure you ketonuria are drinking enough fluids to keep well-hydrated</li> <li>• Re-check BG &amp; ketones in two hours (see below)</li> </ul>
<p>If your BG is going down that is a good sign but monitor closely throughout the day.</p> <p><b>If BG is increasing but ketones less than 0.6mmol/l:</b></p> <ul style="list-style-type: none"> <li>• Take another correction dose <b>using a pen</b></li> </ul> <p>If ketones 0.5 – 1.5mmol/l, follow <b>orange</b> column advice</p> <p>If ketones &gt;1.5mmol/l, follow the <b>red</b> column advice</p>	<p>If ketones negative follow <b>green</b> column advice</p> <p><b>If BG is increasing but ketones still 0.6 – 1.5mmol/l:</b></p> <ul style="list-style-type: none"> <li>• Continue to give 10% of TDD or 0.1 Units/kg as additional fast acting insulin every 2 hours <b>using a pen</b></li> <li>• Give usual boluses for food</li> <li>• Re-check BG and ketones every 2 hours even through the night!</li> </ul> <p>If ketones increase to &gt;1.5mmol.l, follow the <b>red</b> column advice</p>	<p>If ketones negative follow <b>green</b> column advice</p> <p><b>If BG is increasing but ketones have reduced to 0.6 – 1.5mmol/l, follow <b>orange</b> column advice</b></p> <p>If ketones are still &gt;1.5mmol.l:</p> <ul style="list-style-type: none"> <li>• Give another 20% TDD or 0.2units/kg as additional fast acting insulin every 2 hours using a pen</li> <li>• Give usual boluses for food</li> <li>• Once vomiting with high ketones, have a low threshold for admission to hospital</li> </ul>



## 7.1 Using sick day doses on pump therapy

The same principles of illness management apply to the patients on insulin pumps. Even when unwell, if blood glucose levels are high, standard checks on the pump should be made for occlusions, disconnection, battery failures etc.

Only give correction doses through the pump if blood ketone levels are less than 0.6mmol/l. If blood ketones are higher than 0.6mmol/l, give additional fast acting insulin using an insulin pen. If one correction dose given via the pump has no effect in 1 hour, repeat the correction dose with insulin pen. Monitor blood glucose regularly.

When blood glucose levels are rising in an unwell child needing frequent additional insulin doses, think about using higher temporary basal rates.

## 7.2 Management of infections usually associated with hypoglycaemia eg. gastroenteritis

- Encourage regular small sips of sugar-containing drinks (NOT diet drinks)
- Monitor blood glucose (BG) at least 2 hourly,
- If not taking much orally and BG are in normal/low range, DECREASE usual fast acting insulin whilst illness persists.
- If BG are >10 but <14, give usual fast acting dose of insulin.
- If BG are >14, see above for extra insulin doses
- Once oral intake is tolerated again, give NORMAL dose of insulin
- If not tolerating anything orally and BG are <4, advise attend hospital. If drowsy or reduced conscious level, advise give IM glucagon as follows and dial 999:
  - If age under 12 give 0.5 mg glucagon by IM injection
  - If age 12 or over, give 1 mg glucagon by IM injection
- OR BNF guidance uses body weight
  - 2-17 yrs (body weight less than 25kg) 500micrograms glucagon by IM injection
  - 2-17y body weight >25kg for 1mg glucagon by IM injection
- If then able to tolerate oral intake and BG >4, can go home. If not tolerating anything orally or BG still <4, admit for observation and intravenous dextrose if necessary.



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- If child has been vomiting and not eating, they may have ketones with NORMAL BG ('starvation ketones'). Monitor BG frequently and encourage fluids containing sugar
- If a child has HIGH (>14) BG, with ketones and is vomiting, this is DKA and they should be advised to attend hospital urgently.