

Sick Day Rules – Managing Illness in children with Type 1 Diabetes Mellitus

Reference: 1505

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Purpose

To advise hospital staff about management of intercurrent illness in children and young people (CYP) with Type 1 Diabetes

Intended Audience

Health care professionals looking after children with diabetes. Acute medical team who take out of hour calls from parents of children with Type 1 diabetes

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1. Introduction

Sickness is unavoidable part of everyday life. The body's natural response to illness results in higher blood glucose levels due to the release of stress hormones. During illness, patients will need frequent blood glucose monitoring and often more insulin than usual. Insulin deficiency leads to lipolysis, hepatic fatty acid oxidation and formation of ketone bodies.

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.

What are ketones?

Ketones are produced from the liver when there is a lack of glucose (starvation ketones) and as an alternative energy source when there is a relative insulin deficiency. Blood beta-hydroxybutyrate levels $> 0.5\text{mmol/l}$ is abnormal in children with diabetes. Capillary beta-hydroxybutyrate correlates with other biochemical markers of DKA and is more sensitive than urine testing in reflecting patient's metabolic state before and during treatment. Furthermore, patients are less likely to test their urine than their blood.

We recommend the use of blood ketone testing instead of urine ketone testing during illness.

2. Intended Audience

As above

3. Guideline Content

Patients should be able to manage their blood sugars during intercurrent illness without developing DKA. Every patient should have a copy of the “sick day rules” (which are slightly different for patients on multiple daily injections and insulin pumps). The basic rules/principals for managing illness are below.

If you are not sure or the patient is not responding as expected, ask the consultant on-call for Diabetes.

The general principles of management are the same for all patients:

NEVER STOP INSULIN

Insulin should never be stopped. It is required to utilise glucose and to get rid of ketones. The amount of short-acting insulin/bolused insulin given may need adjusting and extra doses may be needed (see rules below).

MONITOR BLOOD GLUCOSE AND KETONES MORE FREQUENTLY

When unwell, blood glucose levels and ketones should be monitored frequently i.e. every 2 hours during the day and night. In some cases it may be necessary to check the levels more frequently.

KEEP HYDRATED

When unwell, there is an increased risk of getting dehydrated both due to the illness (temperature, vomiting, diarrhoea) and its effect on the control of diabetes (high blood glucose, high ketones). It is therefore important to encourage children with diabetes to drink plenty when unwell.

- Water or sugar-free fluids are most appropriate in the majority of cases even where blood glucose levels are normal or high
- If blood glucose levels are low, drinks containing glucose are required, and eat carbohydrates if possible.
- Avoid carbonated drinks if possible.
- Inform the diabetes team early to seek advice

Treat the underlying condition

INSULIN

- Give additional fast acting insulin every 2 hours if blood glucose is above 8.1mmol/l. (See Table 1)
 - If ketones are less than 0.6mmol/l, give the usual correction insulin dose. If patient is not on an expert meter and family is unaware of their correction dose, this can be calculated by using rule of 100 (see table 3)
 - If ketones are > 0.6 mmol/l, patients will need additional insulin (see Table 1&2).

For children and young people on multiple daily injections (MDI), you will need to calculate their total daily dose (TDD) as described in Table 3 and administer extra insulin as

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suggested in table 3a. Please see Table 3 for calculation of TDD and Table 3a for extra insulin based on TDD. Patients **should not** follow their expert meter advice.

- For pump patients, the key difference is that the insulin pumps have a bolus advisor in the handset which can offer advice about dose of insulin if glucose levels are keyed in. The majority of patients use this facility. If there are any concerns about whether the pump is delivering the insulin, ask for boluses to be given subcutaneously via an insulin pen. Unrecognised leaks are a common problem. If blood glucose readings are not coming down and ketones are static or going up after one correction with the pump, subcutaneous injection should be used for the next correction.
 - Total daily dose for pump patients is basal insulin plus approximate amount they take with boluses in 24hours. Parents are usually aware of the basal rate or can get that information from the pump. Patient's latest clinic letter usually has details of their total daily dose. If you are not able to find TDD, please contact diabetes team or on-call diabetes consultant out of hours. See Table 3 for calculating total daily dose (TDD) and Rule of 100 for correction.
- If ketones are present when blood glucose is <8.1 mmol/l, 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.
- Hypoglycaemia (blood sugar <4 mmol/l) should be treated as per the hypoglycaemia guideline

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1) Sick day rules – Multiple Injections

1 (green)	2 (orange)	3 (red)
Blood sugar ≥ 8.1 Ketones < 0.6	Blood sugar ≥ 8.1 Ketones 0.6-1.4	Blood sugar ≥ 8.1 Ketones ≥ 1.5
Give usual fast acting insulin (novorapid/humalog) for carbohydrates	Give 10% of TDD* as fast acting insulin (see below). Patients should NOT use their expert meter.	Give 20% of TDD as fast acting insulin (see below) Patients should NOT use their expert meter.
Give usual correction dose of insulin for high sugars – patients can use their expert meter if they would normally	If eating/drinking, give the usual fast-acting insulin for carbohydrate portions as well as the 10% of TDD	If eating/drinking give the usual fast-acting insulin for carbohydrate portions as well as the 20% of TDD
Recheck blood sugar and ketones in 2 hours If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice again If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 advice If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice	Recheck blood sugar and ketones in 2 hours If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 advice again If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice	Recheck blood sugar and ketones in 2 hours If the patient has followed column 3 advice twice and ketones are still ≥ 1.5 discuss patient with oncall diabetes consultant. Otherwise: If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 advice If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice

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2) Sick day rules – Pump patients

1 (green)	2 (orange)	3 (red)
Blood Glucose ≥ 8.1 Ketones < 0.6	Blood Glucose ≥ 8.1 Ketones 0.6-1.4	Blood Glucose ≥ 8.1 Ketones ≥ 1.5
Continue with usual insulin basal rate	Increase insulin basal rate to 130% for 2 hours	Increase insulin basal rate to 150% for 2 hours
Give usual correction dose of insulin for high sugars – patients can use their bolus advisor if they would normally	Give a bolus of 10% of TDD. Patients should NOT use their bolus advisor.	Give a bolus of 20% of your TDD. Patients should NOT use their bolus advisor
If eating/drinking give the usual bolus for carbohydrate and additional correction as suggested by bolus advisor	If eating/drinking give the usual bolus for carbohydrate portions as well as the 10% TDD and increase in basal rate	If eating/drinking give the usual bolus for carbohydrate portions as well as the 20% TDD
Recheck blood sugar and ketones in 2 hours If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice again If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 box advice* If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice*	Recheck blood sugar and ketones in 2 hours If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 advice again* If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice*	Recheck blood sugar and ketones in 2 hours If the patient has followed the red box advice twice and ketones are still ≥ 1.5 , ring the oncall consultant for advice. Otherwise: If ketones are < 0.6 and blood sugar is sugar ≥ 8 follow column 1 advice If blood sugar is ≥ 8.1 mmol/l and ketones 0.6-1.4 follow column 2 advice If blood sugar is ≥ 8.1 mmol/l and ketones ≥ 1.5 follow column 3 advice again*

* If after 1 correction ketones are not falling (i.e. the patient has NOT moved down a box), give further corrections by pen with novorapid. This is important as pump failure may be responsible for the lack of improvement. The dose of novorapid is the same as the amount would have been bolused on the pump.

Table 3**How to calculate total daily dose and correction factor based on Rule of hundred**

Calculating Total daily insulin (TDD)
<p>This is all the insulin (short and long-acting) that a patient has a day. It will vary slightly depending on what a patient eats each day. Please see the example below</p> <p>Background – Levemir 20 units at night,</p> <p>Breakfast – typically 8 units, Lunch - typically 12 units, Tea - typically 18 units</p> <p>Snack - 2 units</p> <p>Therefore daily total = TDD= 60 units</p>
<p>Rule of 100 – This is the amount of insulin required to lower blood glucose by 1 mmol/l. It is total daily insulin/100.</p> <p>Example below calculates rule of hundred based on TDD</p> <p>If TDD is 60 units</p> <p>$60/100 = 0.6$ units to lower by 1mmol/l</p> <p>So to drop blood glucose by 5 mmol/l an individual would need $5 \times 0.6 = 3.0$ units of fast acting insulin</p>

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Table 3a.

TDD (Total Daily Dose includes basal & bolus for a typical day)	Sick Day Dose (IN ADDITION to basal & bolus given) of quick acting insulin	
	10%	20%
1-10 units	1 unit	2 units
10-15 units	1.5 units	3 units
15-20 units	2 units	4 units
20-25 units	2.5 units	5 units
25-30 units	3 units	6 units
30-35 units	3.5 units	7 units
35-40 units	4 units	8 units
40-45 units	4.5 units	9 units
45-50 units	5 units	10 units
50-55 units	5.5 units	11 units
55-60 units	6 units	12 units
60-65 units	6.5 units	13 units
65-70 units	7 units	14 units
70-75 units	7.5 units	15 units
75-80 units	8 units	16 units

References

Management of Type 1 Diabetes Mellitus during illness in children and young people under 18 years (Sick Day Rules) endorsed by BSPED, ACDC and the National Children and Young People's Diabetes Network