



National Policy National Procedure National Protocol National Guideline
National Clinical Guideline

HSE National Clinical Guideline: Management of Paediatric Type 1 Diabetes Patient with an intercurrent illness (Hospital)

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¹ Records the senior management roles involved in the governance and development of the document.

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Topic:

Management of Paediatric Type 1 Diabetes Patient with an intercurrent illness (Hospital)

National Group:

National Clinical Programme for Paediatrics and Neonatology Paediatric Diabetes Working Group

Short summary:

This guideline should be used to provide clear and standardised guidelines for all staff caring for (and advising care givers of) paediatric patients with Type 1 Diabetes (T1D) during intercurrent illness.

Description:

When children with T1D are unwell, their blood glucose levels are often affected. Many illnesses, especially with a fever, raise blood glucose levels as a result of relative insulin resistance due to raised stress hormone levels and this may ultimately result in increased ketone body production. In contrast, children with vomiting and diarrhoea (e.g. gastroenteritis) are at risk of hypoglycaemia because of reduced carbohydrate intake/absorption. This guideline is to improve the management of paediatric T1D patients with an intercurrent illness and is intended for healthcare professionals, particularly those in training, who are working in HSE-funded paediatric and neonatal services. The guideline is designed to guide clinical judgement but not replace it. In individual cases a healthcare professional may, after careful consideration, decide not to follow a guideline if it is deemed to be in the best interests of the child.

³ Records details when a document is reviewed, even if no changes are made.

⁴ Records the document information required for publication on the HSE National Central Repository.

NATIONAL CLINICAL GUIDELINE

TITLE:

Management of Paediatric Type 1 Diabetes Patient with an intercurrent illness (Hospital)

Clinical Design and Innovation

Health Service Executive

Developed by:	The National Clinical Programme for Paediatrics and Neonatology and Paediatric Diabetes	Publication date V0 :	March 2019
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1 Aim of Guideline

The aim of this guideline is to provide clear and standardised guidelines for all staff caring for (and advising care givers of) paediatric patients with Type 1 Diabetes (T1D) during intercurrent illness.

2 Purpose and Scope

- The purpose of this guideline is to improve the management of paediatric T1D patients with an intercurrent illness.
- These guidelines are intended for healthcare professionals, particularly those in training, who are working in HSE-funded paediatric and neonatal services.
- They are designed to guide clinical judgement but not replace it. In individual cases a healthcare professional may, after careful consideration, decide not to follow a guideline if it is deemed to be in the best interests of the child.

3 Background and Introduction

When children with T1D are unwell, their blood glucose levels are often affected. Many illnesses, especially with a fever, raise blood glucose levels as a result of relative insulin resistance due to raised stress hormone levels and this may ultimately result in increased ketone body production. In contrast, children with vomiting and diarrhoea (e.g. gastroenteritis) are at risk of hypoglycaemia because of reduced carbohydrate intake/absorption.

4 Legislation/other related policies

[Model of Care for All Children and Young People with Type 1 Diabetes](#)

5 Glossary of Terms and Definitions

DKA	Diabetic ketoacidosis
T1D	Type One Diabetes
TDD	Total Daily Dose
HCP	Healthcare professional
ED	Emergency Department

6 Roles and Responsibilities

This guideline should be reviewed by each acute hospital senior management team to appropriately plan implementation. This guideline aims to facilitate best practice and standardise the care provided to children in Ireland to ensure that the inpatient care of children admitted to their facility is optimised irrespective of location.

7 Clinical Guideline

7.1 Underlying Illness

7.1.1 Treat underlying illness as usual (respiratory tract infection, urinary tract infection, meningitis etc.)

7.1.2 Remember to use sugar-free paracetamol etc.

7.2 Insulin

7.2.1 Never omit insulin, dose may need to be adjusted see **section 7.6**

INSULIN ADMINISTRATION SAFETY ALERT
<p>INSULIN ERRORS CAN HAVE EXTREMELY SERIOUS CONSEQUENCES</p> <p>*Always act on patient/family/HCP concerns re doses and recheck*</p> <ul style="list-style-type: none"> • Overdoses can cause severe hypoglycaemia, seizures, coma and even death • Under dosage can result in diabetic ketoacidosis.
<p>Please INDEPENDENTLY <u>DOUBLE CHECK</u> doses at each stage-</p> <ul style="list-style-type: none"> • When making up an infusion (an insulin syringe graduated in units to measure insulin must be used) • When infusing via a pump • When administering via pen (pens and cartridges are SINGLE PATIENT USE ONLY)
<p>ALWAYS CHECK PRESCRIPTION:</p> <ul style="list-style-type: none"> • Reconfirm order with the prescriber if unsure/ concerned about the insulin dose • Avoid abbreviations; insulin should be prescribed in units • Do not administer an unclear prescription- Prescription MUST be rewritten • Only use an insulin pen or an insulin syringe graduated in units to measure insulin

7.3 Monitoring

7.3.1 Monitor blood (or sensor) glucose and blood ketone levels more frequently (every 2-4 hours including through the night)

7.3.2 Paracetamol *may* falsely elevate sensor glucose values in patients using the

Medtronic Guardian 4 sensor so additional blood glucose checks are required

- 7.3.3 During acute illness, target blood glucose range remains 3.9-10 mmol/L and target blood ketones is <0.6 mmol/L.
- 7.3.4 Hourly blood (or sensor) glucose checks may be required if blood glucose levels are borderline low (4-5 mmol/L) and/or child is vomiting
- 7.3.5 Blood ketone levels should be monitored if blood (or sensor) glucose level >14 mmol/L and when vomiting is present (irrespective of glucose value)
- 7.3.6 Blood ketone levels should be checked intermittently during intercurrent illness even when blood glucose levels are not raised.
- 7.3.7 If patient is using a pump please also see **section 7.7**

7.4 Fluids

- 7.4.1 Fluid requirements are generally increased during intercurrent illness associated with fever, hyperglycaemia and/or vomiting
- 7.4.2 Fasting or poor carbohydrate intake is associated with ketogenesis

7.5 Poor appetite or vomiting

- 7.5.1 Meals may be replaced with easily digestible foods or sugar containing fluids.
- 7.5.2 It may be useful to alternate sugar free fluids (for hydration) one hour with sugar containing fluids (which contain carbohydrate like regular (non-diet) 7UP) next hour (guided by blood or sensor glucose levels).

7.6 Insulin adjustment

7.6.1 General considerations:

- Do not stop insulin in illness although the dose may need to be adjusted, increased or decreased if child is not eating or is vomiting
- **The presence of ketones increases insulin resistance (i.e. the same dose of insulin will have less effect on blood glucose levels when ketones are present).**
- Therefore when ketones are present, children may **require additional insulin supplements or corrections (using fast acting insulin ONLY). These are termed “correction boluses”.**
- As fast acting insulin action peaks between 60-90 minutes after administration, correction doses are not generally recommended more often than 2 hourly (allow 4 hours between correction doses if correcting for high glucose levels without high ketones levels (i.e. ketones < 0.6 mmol/L)

- **Elevated ketone level with normal to low blood sugar** level may indicate insufficient carbohydrate intake and should improve after taking carbohydrate e.g. food or sweetened fluids

7.6.2 Correction Boluses (see also Insulin Adjustment Table on page 6)

- **Calculate the Total Daily Dose (TDD):** This refers to the usual total number of units (of all insulin) that the child normally is given per day (i.e. fast acting and long/intermediate acting insulins added together).

Example: 12 year old boy on multiple daily injections:

Usual doses are Novorapid 8 units pre breakfast, lunch and dinner (three times daily) and 26 units Lantus pre bed

TDD = 50 units (8+8+8+26)

- **Calculate the “correction” boluses (of fast acting insulin) as a percentage of TDD.**

Example: This boy is unwell but going to eat breakfast and will require a 10% TDD correction (see insulin adjustment table below)

TDD = 50 units (8+8+8+26)

Correction Bolus as a % of TDD

5% of TDD is 2.5 units 10% of TDD is 5 units

The usual pre breakfast insulin dose is 8 units **PLUS** 5 units (correction dose) = **13 units of insulin**

- After advising patients to have correction bolus, it is very important to monitor and recheck blood glucose and ketones levels every 2 hours until normal.
- It may be necessary to repeat extra correction in 2 hours if Ketones > 1.5 mmol/L or in 4 hours if blood glucose high but ketones 0.6-1.0 mmol/L
- If ketone levels have not normalised (< 0.6 mmol/L) or continue to rise after 2 corrections have been given, the patient likely needs to be assessed in ED

Table 1-Insulin Adjustment Table

Blood Ketones	Blood glucose				
	< 5.5 mmol	5.5 – 10 mmol	10 – 14 mmol	14 - 22 mmol	> 22 mmol
<0.6		No action	Extra insulin at next meal if re-mains high	5% extra of TDD	10% extra of TDD
0.6 - 0.9	Starvation ketones. Carbs needed	Starvation ketones. Carbs needed	5% extra of TDD	5-10% extra of TDD	10% extra of TDD Repeat if needed
1.0 - 1.4	Starvation ketones. Carbs needed	Starvation ketones. Carbs needed	5-10% extra of TDD	10% extra of TDD	10% extra of TDD Repeat if needed
1.5 - 2.5	High starvation ketones. Carbs needed. May need IV glucose Risk of ketoacidosis Check hourly	High starvation ketones. Carbs needed. <i>plus</i> 5% extra of TDD	10% extra of TDD	10% extra of TDD	10% extra of TDD Repeat after 2 hours if Ketones remain high Likely require assess in ED
> 2.5	Very high starvation ketones. Carbs needed. May need IV glucose	High Starvation ketones. Carbs needed. <i>plus</i> 5% extra of TDD	10% extra of TDD	10% extra of TDD	10% extra of TDD Assess in ED
> 3	There is an immediate risk of ketoacidosis with ketones > 3. Insulin needed urgently. The child very likely requires evaluation in the Emergency Department (ED).				

TDD = Total Daily Dose

7.6.3 Long acting insulin

- Long acting insulin (Lantus, Levemir, Tresiba) or intermediate acting insulin (Insultard) can be continued at usual dose.
- Doses may need to be modified where illness persists for more than 24 hours.

7.7 Pump Patients

7.7.1 The key points of sick day management are the same for pump users as for those on injections but pump patients deserve special mention as they use only rapid acting insulin with no depot of long acting insulin. Diabetic ketoacidosis (DKA) can therefore develop rapidly in pump patients in the setting of either inter-current illness or interruption of insulin delivery.

7.7.2 In a patient on a pump with blood or sensor glucose >14 mmol/L and ketones ≥ 0.6 mmol/L, it should be assumed that the pump is not delivering insulin (See flow-diagram in *Appendix 1*)

7.7.3 The correction bolus dose of insulin (or 10% of TDD discussed above) should be

administered by s/c insulin pen (not through the pump). How to calculate TDD from various pump models is outlined in *Appendix 2*.

- 7.7.4** A full set change should be performed (reservoir, infusion set and cannula) and the pump checked to ensure it is working appropriately.
- 7.7.5** Experienced pump users can often manage diabetes during intercurrent illnesses associated with hypoglycemia or hyperglycaemia through a variety of methods.
- 7.7.6** Hybrid closed loop systems are used by the majority of insulin pump users and depending on the model used, incorporate customisable or temporary glucose targets, illness profiles and in some cases, methods of intensifying or reducing insulin delivery in certain situations.
- 7.7.7** A smaller proportion of pump users use an ‘open loop’ pump, with or without an automated basal suspend facility. Open loop pump users can adapt to hypoglycaemia or hyperglycaemia by using temporary basal rates to reduce/increase insulin delivery-based on blood glucose readings while still avoiding ketosis.
- 7.7.8** These adjustments may require support from the hospital team unless the parents are experienced and competent. Ongoing close monitoring (as above) is required to ensure that the adjustments are working. If the pump adjustment strategies are not maintaining blood glucose in target range without ketosis, the child with diabetes and an intercurrent illness can be managed with s/c or IV insulin and IV fluids as per standard care until stabilised.
- 7.7.9 Patients that use Pump Bolus Wizard or Bolus Calculator Meters or Apps**
- Remember that Pump Bolus Wizard or Bolus Calculator Meters or Apps which use a correction or sensitivity factor will **UNDERESTIMATE** the insulin needed when ketones are elevated as the calculator works on the basis of blood glucose levels alone
 - Additional fast acting insulin given by injection (see dose adjustment table) to correct ketones will not be accounted for as active insulin, by your pump, app or meter, when it calculates the next dose of insulin.
 - You may have to override the suggested dose of insulin if less than 3 hours have elapsed since you injected the correction dose as residual insulin in your circulation, which is still working, will not be counted.
 - Ongoing monitoring of blood glucose levels and ketones is required to ensure that dose adjustments are appropriate.

7.8 Admission is likely to be required when:

- Child is under 5 years
- Vomiting is persistent (>2 vomits especially in young children)
- Blood glucose stays high despite correction dose of insulin
- Hypoglycaemia is persistent
- Ketonaemia is persistent (blood ketones >1.5)
- Child is exhausted, confused, dehydrated or has severe abdominal pain.
- Child is unable to eat or drink
- Parents are exhausted and or unable to cope (may be reflected in frequent phone calls)

Always urgently see any child with diabetes who is vomiting with high blood glucose and ketones.

7.9 Phone advice

If advice is given to parent over the phone:

- Ask parents to call back in 2-4 hours to ascertain that all is well
- Ask parents to contact the ANP or Clinical Diabetes Nurse Specialist the next working day to follow up.

8 Implementation, Revision and Audit

- Implementation via REO of each Regional Health Areas (RHA) and senior management team of each acute hospital
- Distribution to other interested parties and professional bodies
- The guideline development group has agreed that this guideline will be reviewed on **3** yearly basis
- Regular audit of implementation and impact of this guideline through outcome and process measures is recommended to support continuous quality improvement
- It is the responsibility of each unit providing care for children with diabetes and intercurrent illness to audit the unit practise regularly in order to ensure that care in being provided in line with guidelines and that any deviations are clinically justified
- The audit process should be coordinated in each paediatric unit under local paediatric clinical governance and should be taken from a multidisciplinary perspective where appropriate
- Where the audit identifies areas for practise improvement, it is the responsibility of each individual unit to implement changes and re-audit to support continuous quality improvement

9 References

International Society for Paediatric and Adolescent Diabetes (2022) [ISPAD Clinical Practice Consensus Guidelines 2022](https://www.ispad.org/resource/chapter-13-sick-day-management.html?). <https://www.ispad.org/resource/chapter-13-sick-day-management.html?>

Irish Medication Safety Network (2020) Best Practice Guidelines for the Safe Use of Insulin in Irish Hospitals <https://imsn.ie/wp-content/uploads/2020/07/insulin-best-practice- March-2020-with-appendices.pdf>

10 Qualifying Statement

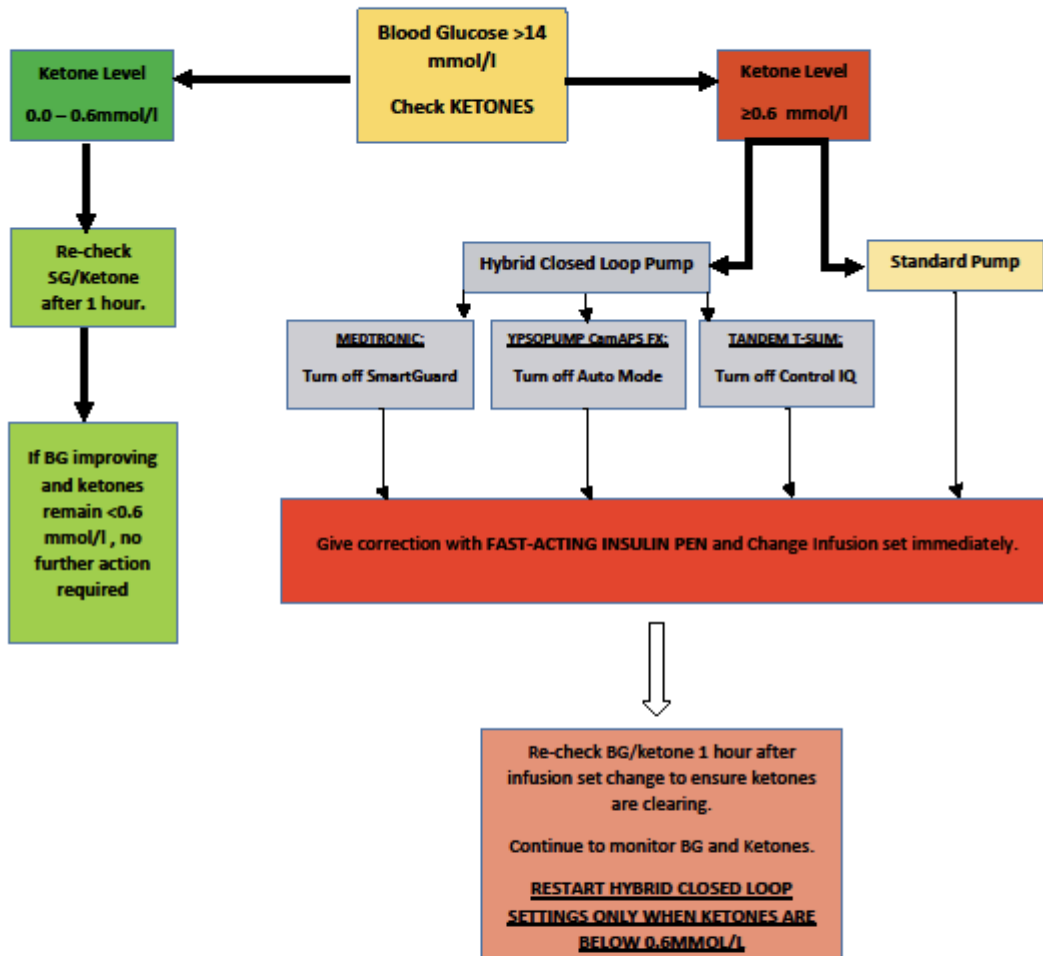
- These guidelines have been prepared to promote and facilitate standardisation and consistency of practice
- Clinical material offered in this guideline does not replace or remove clinical judgement or the professional care and duty necessary for each child
- Clinical care carried out in accordance with this guideline should be provided within the context of locally available resources and expertise
- This Guideline does not address all elements of standard practice and assumes that individual clinicians are responsible for:
 - ✓ Discussing care with the child, parents/guardians and in an environment that is appropriate and which enables respectful confidential discussion
 - ✓ Advising children, parents/guardians of their choices and ensure informed consent is obtained
 - ✓ Meeting all legislative requirements and maintaining standards of professional conduct.

11 Appendices

11.1 Appendix 1 Decision Tree for Ketones on pump therapy



DECISION TREE FOR KETONES ON PUMP THERAPY



11.2 Appendix 2 Sick Day Rules



Type 1 Diabetes Sick day rules

1. Current blood sugar and ketones **AND** last fast acting insulin dose
2. If fast acting insulin given less than 2hrs ago and ketones <3.0mmol/L ring back in 1hr
3. If fast acting insulin given greater than 2hrs ago follow flow sheet in policy
4. Correction dose given every 2hrs, if wanting to eat in between corrections- give insulin for food only

Finding Total Daily Dose on injections

1. Go into MyLife App
2. 3 lines up left hand side of app
3. Reports
4. Change 'Today' to 'last 7 days'
5. Hit Export
6. On first page of report under Insulin Statistics- Insulin/day

All Pumps

1. Set change- DO NOT SKIP STEP
2. All corrections via pens until ketones <0.6mmol/L
3. If ketones 0.6-2.9mmol/L always 10% of TDD. KETONES >3.0- A+E
4. Recheck glucose and give correction every 2 hours until <0.6

Finding Total Daily Dose (TDD) on Pumps:

Medtronic Pump	T: Slim Pump	Ypsomed Pump
1. Menu	1. History	1. Go into pump app on phone
2. History	2. Pump history	2. Hit 3 line up left hand corner
3. Summary	3. Delivery summary	3. Select 'statistics'
4. 14 Days	4. 14 Day average	4. Select 'Generate PDF Report'
5. TDD (Total Daily Dose)=	5. TOTAL INSULIN (Top of screen)	5. On first page- Insulin Statistics- 'Total daily Insulin'

Telling the pump you give a correction via injection

1. Disconnect the pump from the cannula/ patient
2. Go into PUMP - bolus OR knife and fork icon
3. Input/ dial up the amount of insulin that was given with injection and delivered.
4. Once bolus has go through- Reconnect pump to cannula/ patient

11.3 Appendix 3 Acknowledgements

This guideline has been developed by the National Paediatrics and Neonatology Paediatric Diabetes Working Group. The members of this group include medical, nursing and dietetic representatives from paediatric diabetes services. The Diabetes Working Group also wish to thank those who provided input and feedback on draft versions of this guideline throughout development, and those who provided valuable input during the consultation process and revision of the guideline

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11.4 Appendix 4 Approval Process

Paediatric Diabetes Working Group	July	2020
Paediatric Clinical Advisory Group, Faculty of Paediatrics, RCPI	August	2020
National Clinical Advisory Group Lead (NCAGL), HSE	September	2020
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