Queensland Health

Clinical **Excellence** Queensland

# Early recognition of hyperglycaemia in children under 16 years

January 2021

Accepted clinical resource

RACGP

Improvement | Transparency | **Patient Safety** | Clinician Leadership | Innovation

Queensland Government

| | |
|---|---|
| Document Title: | Early recognition of hyperglycaemia in children under 16 years |
| Publication Date: | January 2021 |
| Document Number: | D3.01-V1-P21-R23 |
| Amendments: | First publication |
| Amendment date: | - |
| Replaces document: | - |
| Author: | Statewide Diabetes Clinical Network, Queensland Health |
| Review Date: | January 2023 |
| Endorsed by: | Statewide Diabetes Clinical Network |
| Contact: | statewide_diabetes_network@health.qld.gov.au |

**Recommended Citation:** Statewide Diabetes Clinical Network, Early recognition of hyperglycaemia in children under 16 years. Document No. D3.01-V1-P21-R23. Queensland Health. 2020. Available from: https://clinicalexcellence.qld.gov.au/

**Early recognition of hyperglycaemia in children under 16 years**

Published by the State of Queensland (Queensland Health), January 2021



For more information contact:
Healthcare Information Unit, Department of Health, GPO Box 48, Brisbane QLD 4001, email statewide_diabetes_network@health.qld.gov.au

An electronic version of this document is available at https://clinicalexcellence.qld.gov.au/

# Contents



# Tables

# Summary: Recognition of paediatric hyperglycaemia can prevent DKA

## Clinical Alerts

- **Children of any age can be diagnosed with type 1 diabetes which is a rare medical condition requiring urgent treatment.**
- One in two children present with Diabetic Ketoacidosis (DKA) before being diagnosed with type 1 diabetes.
- Large majority of children are not diagnosed on the first primary care encounter.
- DKA at diagnosis is a preventable metabolic emergency that is life threatening.
- Risks associated with DKA include cerebral oedema rate 0.5–0.9%, 24% mortality rate and 50% of children have severe neurological sequalae.
- **Delays in assessment and management may occur when clinical focus is diverted to non-urgent investigations such as HbA1c or glucose tolerance tests.**
- Children with hyperglycaemia can deteriorate rapidly into DKA which can be fatal. Whenever suspected, emergency management overrides any non-urgent investigation.
- **Recognise the 4Ts of hyperglycaemia: tired, thinner, thirsty, toileting.**
- **If** one or more **of the 4 Ts is present, do a finger-prick glucose test.**
- **If random BGL ≥ 11 mmol/L or fasting BGL ≥ 7 mmol/L urgently refer to local emergency department** [Refer to Flowchart: Early detection and management of hyperglycaemia by primary care clinicians of children and adolescents under 16 years].

**4T symptoms: Tired, Thinner, Thirsty, Toilet**

**Have a HIGH index of suspicion in children not known to have diabetes with one or more of the 4T symptoms. Exclude type 1 diabetes in children with common illnesses not responding to usual treatment as well as candidiasis outside infancy, sores/wounds that won't heal and constipation related to dehydration from prolonged polyuria/polydypsia that has not been recognised.**

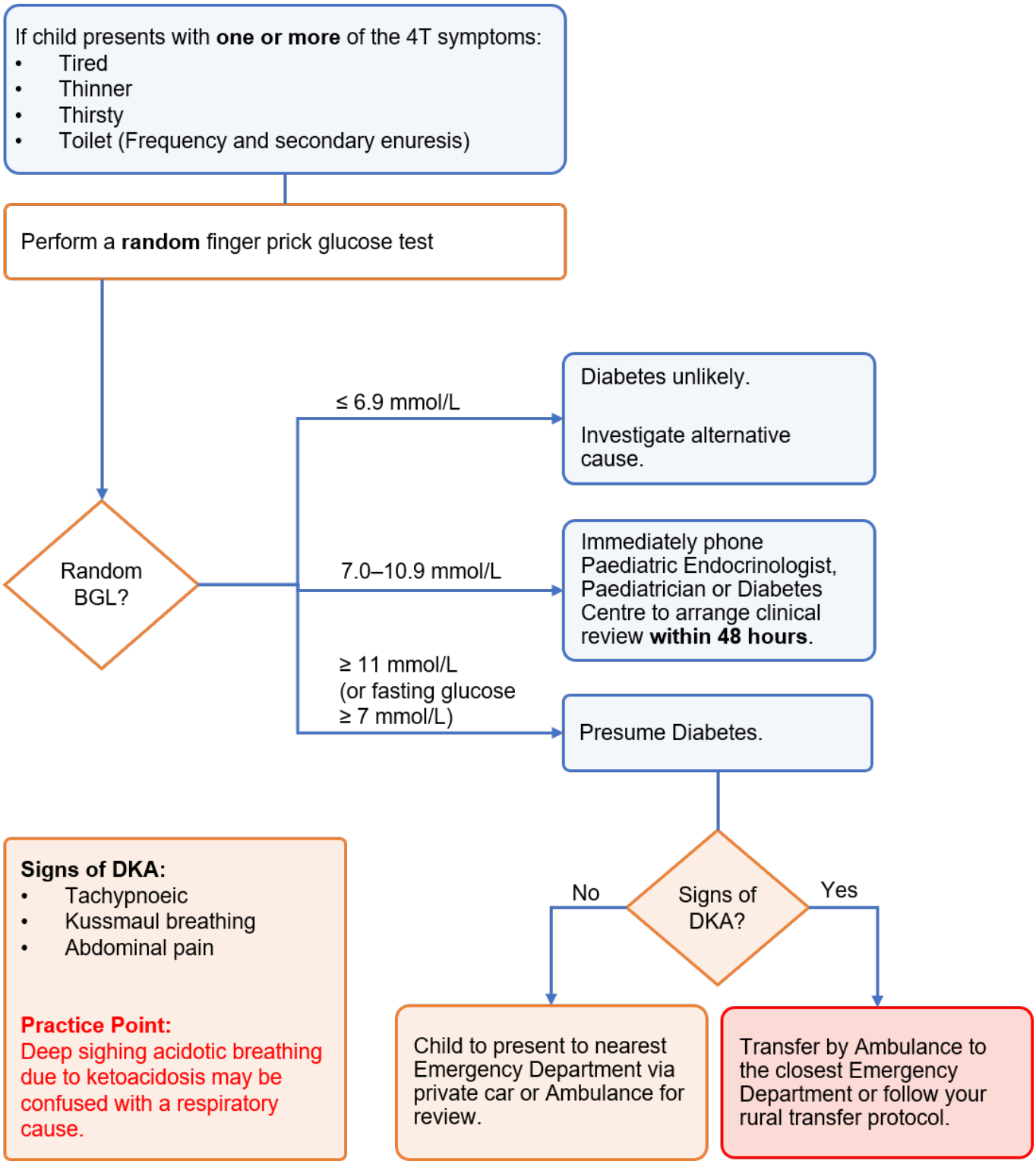
**ACTIONS**

**Perform a random finger prick glucose level test in clinic.**

Before performing a finger prick glucose test, ensure the child's hands are washed with soap and thoroughly dry.

**Refer to the management flow chart for further action.**

# Flowchart: Early detection and management of hyperglycaemia by primary care clinicians of children and adolescents under 16 years




**<** less than; **≤** less than or equal to; **>** greater than; **≥** greater than or equal to;
**BGL** Blood Glucose Level; **DKA** Diabetic Ketoacidosis

Doc No: D3.01-V1-P21-R23 (Queensland Health)

# Context

This document provides primary care clinicians with information to improve early recognition and management of paediatric hyperglycaemia in children not known to have type 1 diabetes. The aim is to prevent Diabetic Ketoacidosis (DKA) at diagnosis by earlier recognition of paediatric signs and symptoms of hyperglycaemia.

The classic symptoms of hyperglycaemia in children can be subtle and masquerade as common childhood conditions such as infections, vomiting and respiratory distress.[2,3] Differentiating the occasional child with a serious illness from the large number with minor undifferentiated illness is challenging for General Practitioners and parents. In a systematic review, two studies reported children had one or more medical consultations in the week before diagnosis of type 1 diabetes. In a UK study, 86% of children were not diagnosed on the first medical encounter.[4] A Queensland review in 2017 reported a state average of 46% of children presenting in DKA at diagnosis.[5]

**Diagnosing hyperglycaemia in primary care is simple and inexpensive with a simple finger prick glucose test. A random blood glucose result greater than or equal to 11 mmol/L is highly suggestive of type 1 diabetes in children under the age of 16 and requires referral for definitive care.[1]**

This position statement integrates with but does not replace existing sick day, ambulance and hospital-based management protocols for children with diabetes.

# Clinical presentations

Clinicians working in primary care play a vital role in reducing preventable DKA at diagnosis of type 1 diabetes through the early recognition of signs and symptoms of hyperglycaemia in children. **Type 1 diabetes is an auto-immune condition requiring urgent commencement of life saving insulin therapy.**

The classic 4T symptoms most commonly manifested with hyperglycaemia are: ***Tired, Thinner, Thirsty, Toilet***

**If there are one or more of the classic 4T symptoms of hyperglycaemia, clinicians should have a high index of suspicion of type 1 diabetes and rule it out of the differential diagnosis.**

## Basic pathophysiology of insulin insufficiency

- **Tiredness**: fatigue and lethargy are related to insulin insufficiency. Normal insulin production allows the metabolism of glucose the body's main source of energy.
- **Thin:** catabolism of muscle and fat become an alternative energy source when glucose is not available. This results in weight loss. Risk groups for DKA at diagnosis coincide with typical ages of growth spurt.
- **Thirsty:** polydipsia is a compensation to eliminate high glucose levels through urination.
- **Toilet:** polyuria results from high levels of glucose excreted via glucosuria. Constipation can also occur in children related to dehydration. Glycosuria may lead to urinary tract infections. Enuresis may occur in a previously toilet trained child.
- **Blurred vision:** increased glucose deposition in the anterior chamber of the orbit.
- **Lack of interest and concentration:** the brain needs glucose which isn't readily available due to inadequate insulin allowing glucose metabolism.

# Clinical assessment of hyperglycemia symptoms

Assessment of the infant, child or teenager with one or more of the 4T symptoms, should include:

- temperature
- heart rate
- respiration rate
- blood glucose level
- charting of weight and height percentile

Clinicians should take parental concerns seriously as often symptoms are vague, and parents are good judges of their child's health.

BGL threshold for prodromal hyperglycaemia in undiagnosed children is ≥11mmol/L because children have a lower threshold for insulin insufficiency. Children under 6 are susceptible to severe metabolic decompensation at diagnosis.[2]

**DKA is an acute, life-threatening metabolic emergency.** If the early symptoms of hyperglycaemia are not recognised children may present with symptoms of ketoacidosis prior to the diagnosis of type 1 diabetes. Children under the age of two are more susceptible to a rapid progression of metabolic decompensation and can deteriorate quickly and develop an altered state of consciousness. **Urgent transfer via ambulance is recommended.**

**Practice point: P**olyuria and oliguria may go unnoticed by parents of infants wearing disposable nappies. Paediatric signs of dehydration include sunken fontanelle, sunken eyes, tachycardia, dry mouth and tongue, oliguria, anuria, constipation. See the reference list for paediatric resources for the assessment of dehydration.6 Assess for sepsis and altered state of consciousness.

**Table 1 Signs of hyperglycaemia plus signs and symptoms of DKA**

| Symptom | Signs |
|---|---|
| • Polyuria/polydipsia<br>• Nausea and or vomiting<br>• Abdominal pain<br>• Weight loss | • Altered consciousness<br>• Kussmaul breathing, rapid respiratory rate<br>• Ketotic breath – smells fruity<br>• Dehydration |

# Management of hyperglycaemia in children under 16

Refer to the flowchart for management actions of diagnosing hyperglycaemia.

**Children with known type 1 diabetes** should have a pre-existing sick day management plan provided by their treating diabetes team. If the clinical condition does not require transfer to hospital, the sick day plan can be actioned with urgent contact with the diabetes team for outpatient support and follow-up. Parents should have received self-management education in following a sick day plan to calculate extra quick acting insulin to treat high blood glucose and blood ketones.[7]

**Type 2 diabetes** in children is less common however increasing rates are seen in children with an elevated BMI; children of Polynesian, Aboriginal and Torres Strait Islander background and offspring of mothers who had Gestational Diabetes Mellitus. The same treatment pathway for hyperglycaemia applies to symptomatic children.

This position statement integrates with but does not replace existing sick day, ambulance and hospital-based management protocols.

**The primary prevention and early detection of high blood glucose levels due to the availability of point of care blood glucose testing in primary care can reduce paediatric rates of DKA at diagnosis of type 1 diabetes.**[8]

# Assessment of DKA

Assessment of DKA should include urgent finger prick glucose level, temperature, heart rate, breathing rate, Glasgow Coma Scale.

**Measurement of blood glucose is critical in the assessment of paediatric DKA.**

**Practice Point:** If the patient is symptomatic of DKA transfer by ambulance to hospital.

It is recommended that primary care practices maintain a glucometer and test strips for point of care capillary blood glucose testing. The availability of this monitoring equipment is vital because of the significant morbidity associated with paediatric DKA presentations in primary care.

**Preferred**
Finger prick glucose level. A level ≥ 11mmol/L highly suggestive of type 1 diabetes.

**Please note:**

- Capillary blood ketones (betahydroxybutyrate) should not delay the diagnosis or treatment as the blood glucose level rises prior to detectable ketones and **the aim is to prevent DKA**.
- Ketones > 1.1 mmol/L indicates a high probability metabolic emergency of DKA.
- Urinalysis may cause delays in dehydrated infants and children. Some children with Type 2 diabetes may have an absence of ketones with hyperglycaemia.

# References


1. International Society for Pediatrics and Adolescent Diabetes (ISPAD) Clinical Practice Consensus Guidelines for 2018, Stages of type 1 diabetes in children and adolescents
2. Quinn M et al. Characteristics at diagnosis of type 1 diabetes in children younger than 6 years. The journal of Pediatrics March 2006
3. Neu A. et al. Varying clinical presentations at onset of type 1 diabetes mellitus in children – epidemiological evidence for different subtypes of the disease? Pediatric Diabetes 2001: 2: 147-153
4. Lokulo-Sodipe et al. Identifying target to reduce the incidence of diabetic ketoacidosis at diagnosis of type 1 diabetes in the UK. Arch Dis Child 2014; 99:438-442
5. Wales J and Yates J. Peer review of rural and tertiary Queensland paediatric diabetes services: A pilot project from the National Health Service. Journal of Paediatrics and Child Health. 55 (2019) 701-706
6. Clinical Practice Guideline: Dehydration, Royal Children's Hospital Melbourne, September 2020 [cited September 2020], available: https://www.rch.org.au/clinicalguide/guideline_index/Dehydration/
7. Sick day management for patients with Diabetes on insulin, Statewide Diabetes Clinical Network (Queensland Health), July 2016 [cited September 2020], available: https://www.health.qld.gov.au/__data/assets/pdf_file/0021/621525/sickday.pdf
8. Pawlowicz M et al. Difficulties or mistakes in diagnosing type 1 diabetes in children? – demographic factors influencing delayed diagnosis. Pediatric Diabetes 2009:10:542-549
9. Desai D. et al. Health Care Utilisation and Burden of Diabetic Ketoacidosis in the U.S. Over the Past Decade: A Nationwide Analysis. Diabetes Care 2018;41:1631-1638.
10. Wolfsdorf, J. et al. Diabetic ketoacidosis in children and adolescents with diabetes. ISPAD Clinical Practice Consensus Guidelines 2009 Compendium. Pediatric Diabetes 2009: 10:118-133.
11. Rewers A et al. Presence of Diabetic Ketoacidosis at Diagnosis of Diabetes Mellitus in Youth: The Search for Diabetes in Youth Study. Paediatrics Vol 121, number 5, May 2008
12. Usher-Smith J et al. Variation between countries in the frequency of diabetic ketoacidosis at first presentation of type 1 diabetes in children: a systematic review. Diabetologia 2012, 55:2878-2894


# Working group members

The Royal Australian College of General Practitioners (RACGP)
Diabetes Specific Interests Network: Dr Gary Deed
Paediatrics Specific Interests Network: Dr James Best
Chair of type 1 working group, Queensland Statewide Diabetes Clinical Network (Queensland Health): Dr Jason Yates
Deputy Chair, Queensland Statewide Rural and Remote Clinical Network (Queensland Health): Dr Konrad Kangru
Chair of Australasian Paediatric Endocrine Group Diabetes Subcommittee: Dr Jerry Wales
Queensland Statewide Diabetes Clinical Network: CDE Bronwyn Buckley


**Funding**
Funding for this guideline was provided by Healthcare Improvement Unit, Queensland Health.

# Appendix

Children without type 1 diabetes, who are at increased risk of developing DKA at diagnosis[9,10,11,12]

- Children not responding to usual treatment of common childhood illnesses
- Under 2 year – have a high degree of metabolic decompensation
- Those aged 4 to 5 years or between the ages 11-13 years
- Children living in a non-English speaking family
- Children from families with lower parental education
- Children living in families with low family income (though 20% of children from the highest income families have DKA at diagnosis)
- Residing in a country close to the equator