HYPOGLYCAEMIA MANAGEMENT IN PAEDIATRIC DIABETES

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Hypoglycaemia occurs most commonly in patients with diabetes treated with subcutaneous insulin therapy, insulin pump therapy or oral hypoglycaemic agents. This includes Type 1 diabetes, Type 2 or Monogenic (MODY) diabetes treated with insulin or oral hypoglycaemic medication, steroid induced diabetes treated with insulin and cystic fibrosis related diabetes (CFRD) treated with insulin.
- Hypoglycaemia **needs to be treated immediately**.
- Hypoglycaemia is defined as a capillary, arterial or venous Blood Glucose Level (BGL) **< 4mmol/L**.
- Treatment and management of hypoglycaemia will be dependent on the individual child's clinical presentation.
- The BGL of an inpatient should be tested pre and 2 hours post meals and at 12 MN and 3AM
- This Practice Guideline ***does not*** apply to Neonatal Hypoglycaemia.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st March 2020	**Review Period**: 3 years
Team Leader:	Nurse Manager	**Area/Dept**: Endocrinology

Date of Publishing: 4 February 2021 10:26 AM Date of Printing: 4 February 2021

CHANGE SUMMARY

- Policy extended to cover all types of paediatric diabetes treated with insulin administration or oral hypoglycaemic medication
- Adjustments made to amount of carbohydrate required for treatment of hypoglycaemia
- Addition of section regarding Sensor Augmented Pump Therapy
- Tittle change. Previous title: Hypoglycaemia Management in Type 1 Diabetes.

READ ACKNOWLEDGEMENT

- All Nursing and Medical Staff caring for children and adolescents with Diabetes (including Type 1 diabetes, Type 2 diabetes, MODY, steroid induced diabetes and Cystic Fibrosis Related Diabetes) should read this document.
- The implementation of this revised document will be conducted via routine ward in-services and bi-annual nurses diabetes workshop.
- Local Managers of Departments and Clinical Units to use discretionary means in relation to staff education.

TABLE OF CONTENTS

1 Introduction

Hypoglycaemic episodes need to be recognised and treated **IMMEDIATELY** in children and adolescents with diabetes. Nursing staff will ensure measures are taken to prevent further hypoglycaemic episodes from occurring.

This practice guideline applies to children and adolescents with all types of diabetes, who are treated with subcutaneous insulin therapy, insulin pump therapy or oral hypoglycaemic agents. Neonatal hypoglycaemia is not discussed in this guideline.

2 Expected Outcome

The nurse and/or medical officer will be able to:

- Identify a hypoglycaemic episode and initiate appropriate patient management.
- Determine the cause of the hypoglycaemic episode.
- Take action to reduce frequency of hypoglycaemic episodes.
- Educate patient (if age and developmentally appropriate to do so) and family regarding prevention and treatment of hypoglycaemia.
- Document all episodes of hypoglycaemia

3 Patients wearing a Continuous Glucose Monitoring system (CGM)

A continuous glucose monitoring system (CGM) is a small, self-inserted sensing device worn on the body. CGM transmits interstitial glucose levels to an insulin pump screen, or receiver device (eg. smartphone) about current sensor glucose status. Graphs and trend arrows show the direction of glucose values and rate of change, providing users with additional information to help with their diabetes management. It is important to note that the sensor measures the interstitial glucose level, not the blood glucose level.

The guidelines for hospitalised patients are:

1. Sensor glucose values via CGM cannot be used for clinical decisions while an inpatient (e.g. insulin administration, dose adjustment and hypoglycaemia management). In these instances, a blood glucose level is required (finger prick) using a standard hospital glucometer. Exceptions to this need to be approved by the endocrinology team.
2. Remove the sensor and transmitter from the patient before Magnetic Resonance Imaging (MRI), Computed Tomography (CT) scan, or high-frequency electrical heat (diathermy) treatment. The transmitter should never be discarded and kept with the patient at all times, even when not in use.

3. Remove the sensor and transmitter from the patient prior to surgery. Medical and nursing staff are required to continue blood glucose monitoring (finger prick) using a standard hospital glucometer during surgery to guide clinical decisions.
4. CGM has not been evaluated or approved in persons on dialysis or in critically ill patients. It is not known how different medical conditions or medications common to the critically ill population may affect performance of CGM. Sensor glucose levels may be inaccurate in critically ill patients. Medications containing paracetamol/acetaminophen can give a false high reading and there is limited data about the effect of other medications on CGM accuracy.
5. In some circumstances, following team discussion and with the approval of the treating endocrinologist, CGM may be used in the hospital setting to provide information in addition to finger prick blood glucose levels. In these situations, the frequency of finger prick blood glucose monitoring should be stated by the treating endocrinologist and the decision to use CGM should be reviewed at least daily and also at the addition of any new medications or change in clinical situation.

4 Definition of Hypoglycaemia

Hypoglycaemia is defined as a capillary, arterial or venous Blood Glucose Level (BGL) <4mmol/L.

- Hypoglycaemia occurs most commonly in patients with diabetes treated with subcutaneous insulin therapy, insulin pump therapy or oral hypoglycaemic agents.
- Hypoglycaemia in children with diabetes is not uncommon but needs immediate treatment.
- In practice, hypoglycaemia can be felt by the patient at varying BGLs and the initiation of treatment by the nurse should be immediate.
- A child may be asymptomatic of hypoglycaemia even with a level below 4mmol/L. Any child who is asymptomatic with a level below 4mmol/L should be treated immediately.

Note: Clinical observation is essential: Children may be unaware of their hypoglycaemic symptoms and therefore may or may not be able to communicate them.

- The rate at which the BGL falls may influence the development and recognition of symptoms.
- Younger children are at increased risk of hypoglycaemia due to their reduced ability to communicate their needs.

5 Clinical Features of Hypoglycaemia[1]

Note:

- Signs and symptoms vary considerably between individuals.
- Clinical features are divided into autonomic and neuroglycopaenic symptoms.

5.1 Autonomic symptoms

Autonomic symptoms are caused by increased activity of the autonomic nervous system triggered by a rapid fall in BGL.

5.2 Neuroglycopaenic symptoms

Neuroglycopaenic symptoms occur as a result of decreased glucose to the brain.

Autonomic symptoms	Neuroglycopaenic symptoms
Tremor Palpitations Tingling around the mouth Sweating Tachycardia Hunger Irritability Nervousness Pallor	Dizziness & unsteady gait Difficulty concentrating Difficulty hearing Visual Disturbances Change in mood Slurred Speech Confusion Weakness Drowsiness Loss of consciousness Seizure Problems with short term memory

5.3 Other symptoms

- **Behavioural symptoms**:
  - Irritability, erratic behaviour, mood changes, nightmares, tantrums and inconsolable crying.
    Note: Patients may exhibit symptoms when their blood glucose falls, but remains within or above the normal range.
- **Non-specific symptoms**:
  - Hunger, headache, nausea and tiredness.
    These symptoms can be associated with low, high or normal blood glucose levels.

6 Nocturnal Hypoglycaemia

- Nocturnal hypoglycaemia may be asymptomatic and does not necessarily disturb sleep patterns.
- Signs that nocturnal hypoglycaemia may be occurring include:
  - nocturnal sweating,
  - restlessness,
  - nightmares
  - seizures and
  - complaint of headache on awakening.

The BGL of an inpatient should be tested routinely pre and 2 hours post meals and at approx. 12MN and 3AM OR at any time there is a clinical suspicion of hypoglycaemia. The 12MN BGL should be ≥ 5.0mmol/L. The 3AM reading should be ≥4mmol/L

7 Mild to Moderate Hypoglycaemia[1,2] – Treatment

(Refer to flowchart)

- Treatment of hypoglycaemia needs to be initiated IMMEDIATELY.

- Treatment should not be delayed if symptoms are present and blood glucose monitoring cannot be performed immediately.

- If the child has symptoms and the BGL is normal then treatment should also be given. In this situation, continue to monitor the child's BGLs closely; the child must also cease activity until asymptomatic.

- Treatment aim is to use a quick acting carbohydrate of 0.3 g/kg as outlined below.

Note:

- Autonomic and neuroglycopaenic symptoms can occur in mild to moderate hypoglycaemia.
- If the child has a compromised conscious state or is unable to swallow, refer to Severe Hypoglycaemia – Treatment below.
- If a patient is nil-by-mouth or refusing oral treatment, give IV glucose as per Severe Hypoglycaemia – Treatment below.

7.1 Infant (3-12 months of age) hypoglycaemia management

Step 1:

- Give 15mL of Glucose Polymer solution (eg. CarbPlus Solution (CHW) or Polyjoule Solution (SCH). Recipe listed below) or 60ml of fruit juice if Glucose Polymer solution is not available or refused.

  [Note: This volume may need individual adjustment by the Endocrine team once post treatment response assessed]

Step 2:

- Give infant a breastfeed or bottle.

Step 3:

- Retest BGL in 15 -20 minutes. If child remains hypoglycaemic repeat treatment and call Endocrine team.

RECIPE: Glucose Polymer Syrup Please order from **Formula Room** as required.
50% w/v solution
50 grams of Glucose Polymer powder + water added up to 100 mL.
15 mLof this solution will provide 7.2 g of carbohydrate.

7.2 Child age 1 to 5 years hypoglycaemia management

Step 1:

- Give 60 ml of fruit juice (approx. ¼ cup) (which will provide approx. 7 grams of carbohydrate) or 1 portion pack honey (which will provide approx. 11 grams of carbohydrate) if juice is not available, or refused.

  Note: If the patient uses an insulin pump, or the last insulin injection preceding the hypo was Novorapid or Humalog, skip step 2 and proceed to step 3.

Step 2:

- For patients on Actrapid, Humulin R, or Protophane and the next meal is more than 20 minutes away, give a snack containing approx. 7 grams of carbohydrate (CHO) (equivalent to ½ an exchange of carbohydrate) (see options below) and then proceed to step 3. For example:
  - ½ slice of bread or
  - ½ glass of plain milk or
  - 1 plain biscuit e.g Milk Arrowroot

  [Note: Use milk if patient has Coeliac Disease, requiring a gluten free diet.]

Step 3:

- Retest the BGL in 15 – 20minutes.
  - If BGL is > 4mmol/L – no further treatment necessary. Retest in 2 hours.

- If BGL ≤ 4mmol/L, repeat steps 1 – 3 above.

7.3 Child age 5 years and older hypoglycaemia management

Step 1:

- Give 125ml of fruit juice (approx. ½ cup) or 6-7 small jelly beans if juice is not available (which will provide approx. 15 grams carbohydrate).

  Note: If the patient uses an insulin pump, or the last insulin injection preceding the hypo was Novorapid or Humalog, skip step 2 and proceed to step 3.

Step 2:

- For patients on Actrapid, Humulin R or Protophane , and the next meal is more than 20 minutes away, give 1 snack containing approximately 15 grams of carbohydrate (CHO) (equivalent to 1 exchange of carbohydrate)(see options below) and then proceed to step 3. For example:
  - 1 slice of bread or
  - 1 glass of plain milk or
  - 2 plain biscuits e.g 2 Milk Arrowroots

  [**Note**: Use milk if patient has Coeliac Disease, requiring a gluten free diet].

Step 3:

- Retest the BGL after 15-20 minutes.
  - If BGL > 4mmol/L – no further treatment is necessary. Retest BGL in 2 hours.
  - If BGL< 4mmol/L repeat steps 1 – 3.

8 Severe Hypoglycaemia – Treatment[1]

(Refer to Flowchart)

Treatment of severe hypoglycaemia needs to be initiated IMMEDIATELY.

Treatment should not be delayed if symptoms are present and blood glucose monitoring has not been performed.

Severe Hypoglycaemia in a child or adolescent is defined as an altered state of mental status where the patient cannot assist in their own care, accompanied by a BGL < 4.0mmol/L. The patient is in a semi-conscious, unconscious state or coma. In severe hypoglycaemia children and adolescents can also show signs of acute neuroglycopaenic symptoms such as extreme disorientation and focal or generalised seizures.

The aims of treatment in children and adolescents that experience a Severe Hypoglycaemic episode is to:

1. Restore the BGL to euglycaemia. (aim for a BGL of ≥ 5.6 mmol/L).
2. Avoid any further episodes of Hypoglycaemia especially in children less than 6 years of age.

In these patients, perform the following:

- Ensure the child/ adolescent is safe and maintaining an airway.
- Activate Rapid Response (Refer to the Between the Flags Policy)
- Notify Medical staff **immediately**.

Patients with a pre-existing cannula

- Give slow intravenous bolus of 2 mL/kg of 10% glucose

Patients without a preexisting cannula

- Give Glucagon 0.5 mg-1mg intramuscularly or subcutaneously; in hospital setting Glucagon may also be given as intravenous infusion.
    i. <25kg: ½ vial (0.5 mg = 0.5 mL)
    ii. 25kg: full vial (1 mg = 1 mL)
- Refer to Appendix 2 for instructions on IM Glucagon.

If the patient does not respond within 10 minutes of Glucagon treatment then intravenous bolus of 10% glucose should be given.

- When the patient has responded to IV/SC/IM Glucagon treatment and is able to swallow, 15g of oral carbohydrates must be administered.
- If the patient is unable to eat, maintenance IV fluids containing 5 - 10% glucose should be commenced to prevent recurrent hypoglycaemia. Consult the Diabetes team to guide management.
- The child/adolescent will need close BGL monitoring and observation for recurrent symptoms of hypoglycaemia.

9 Sensor- Augmented pump therapy

Sensor-augmented pump therapy reduces the incidence of hypoglycaemia by suspending basal insulin to prevent hypoglycaemia. It requires the use of an insulin pump and compatible continuous glucose monitor (CGM).

Use of the insulin pump and CGM whilst a hospital inpatient should only occur if the patient/parent are present to competently operate the insulin pump and/or CGM and with the approval of the endocrinology team (refer to hospital policy, “Diabetes Mellitus (Type1): Inpatients Using Insulin Pumps)”.

If the pump suspends, continue in this mode unless the patient expresses symptoms of hypoglycaemia, in which case treat the hypoglycaemia as per protocol above and resume basal insulin.

10 References

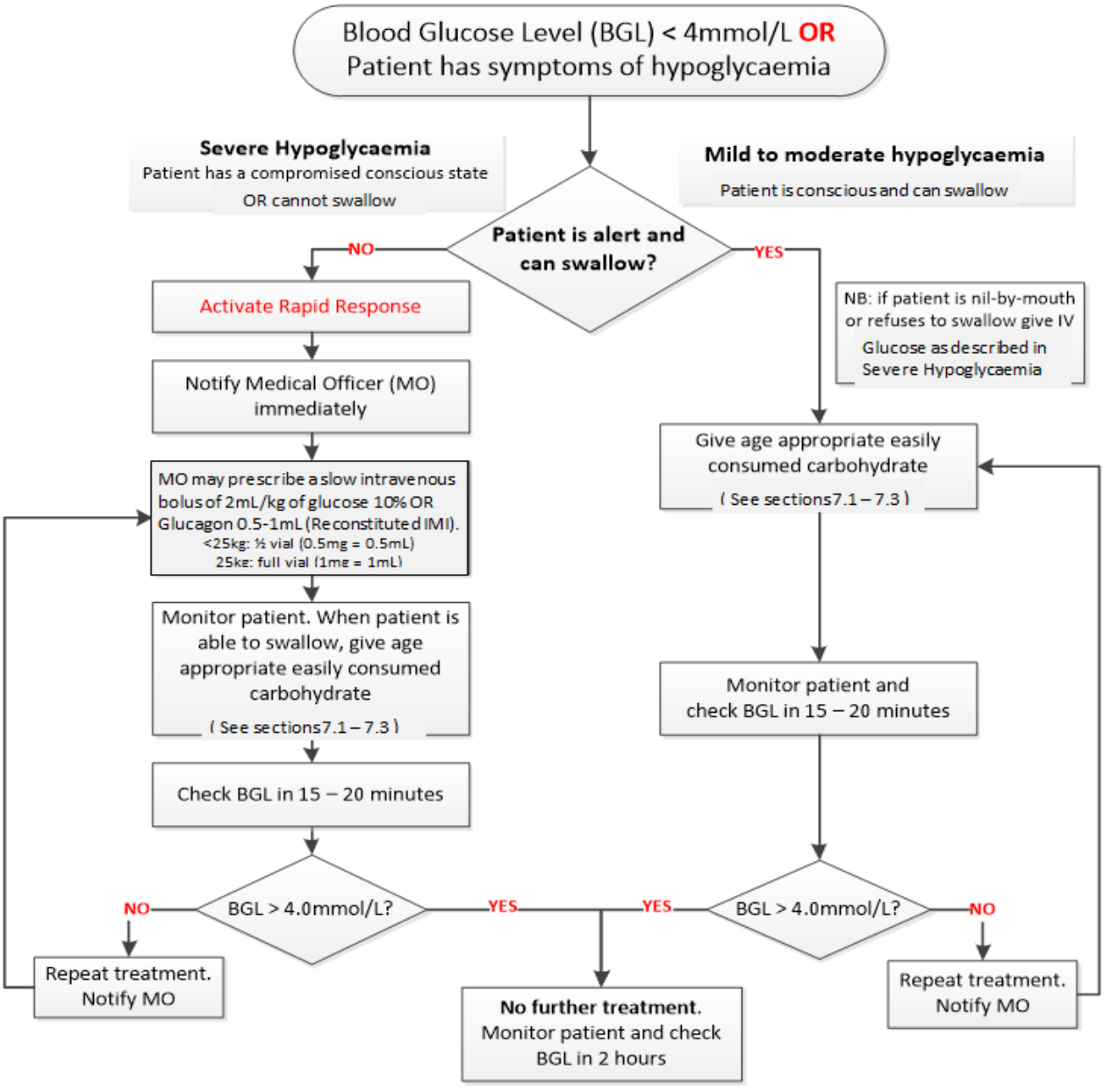
1. Craig, M.E., Twigg, S.M., Donaghue, K.C., Cheung, N.W., Cameron, F.J., Conn, J., Jenkins, A.J., Silink, M., for the Australian Type 1 Diabetes Guidelines Expert Advisory Group, National Evidence-based clinical care guidelines for type 1 diabetes in children, adolescents and adults, Australian Government Department of Health and Ageing, Canberra, 2011.
2. Abraham,M.B., Jones, T.W., Naranjo, D., Karges, B., Oduwole, A., Tauschmann, M., Maahs, D.M., Assessment and management of hypoglycemia in children and adolescents with diabetes, ISPAD Clinical Practice Consensus Guidelines 2018, Pediatric Diabetes 2018: 19 (Suppl. 27), 178-192.
3. Australia Medicines Handbook – Children's Dosing Companion (Acces via CIAP 21st Sept 2020)

11 Appendix 1: Treatment of Hypoglycaemia Flowchart

Symptoms of Hypoglycaemia may include:

- Sweating
- Pallor
- Tremor
- Hunger
- Irritability
- Palpitations/Pounding Heart
- Tachycardia
- Headache
- Tingling of fingers and lips
- Weakness
- Tiredness
- Disturbance of concentration
- Slurred speech
- Visual Disturbances
- Behaviour changes
- Aggressive behaviour
- Confusion
- Loss of consciousness
- Convulsions

(All require BGL to be taken)



12 Appendix 2

Instructions for use of an Intramuscular Injection of Glucagon (IMI)

1. Glucagon should be prepared immediately before use.
2. Wash hands and apply gloves.
3. Snap the plastic cap off the powder vial and inject the solvent from the syringe.
4. Keep the needle in the vial and gently shake the vial until the powder has been reconstituted.
5. Draw the full amount of solution into the syringe and pull the needle out of the vial.
6. Push out air bubbles and ensure the prescribed dose is measured
   (i) <25kg: ½ vial (0.5 mg = 0.5 mL)
   (ii) 25kg: full vial (1 mg = 1 mL)
7. Administer Glucagon (Glucogen™) hypokit as an Intramuscular Injection.
8. Remain with patient and closely monitor, the patient may feel nauseous and vomit post administration.
9. If the patient does not respond within 10 minutes intravenous 10% glucose should be given.
10. When the patient has responded to treatment oral carbohydrates must be given.