

Local Guideline



John Hunter
Children's Hospital
CHILDREN, YOUNG PEOPLE AND FAMILIES



Health
Hunter New England
Local Health District

Hypoglycaemia Screening and Management

Sites where Local Guideline applies	Neonatal Intensive care Unit JHCH, Delivery Suite & Post Natal Wards JHH
Target audience:	NICU clinical staff, midwives and medical officers who provide care to neonatal patients
Description	Guideline describing the screening, monitoring and management of hypoglycaemia in the infant
This Local Guideline applies to:	
1. Adults	No
2. Children up to 16 years	No
3. Neonates – less than 29 days	Yes
Keywords	Approval gained from the Children Young People and Families Network on 24/02/15 blood sugar level (BSL), diabetes, glucose, hypoglycaemia, insulin, neonatal
Replaces Existing Local Guideline and Procedure	Yes
Registration Number(s) and/or name and of Superseded Documents	unchanged
Related Legislation, Australian Standards, NSW Health Policy Directive, NSQHS Standard/EquiP Criterion and/or other, HNE Health Documents, Professional Guidelines, Codes of Practice or Ethics:	
<ul style="list-style-type: none"> NSW Health Policy Directive 2007_079 Clinical Procedure Safety http://www0.health.nsw.gov.au/policies/pd/2014/pdf/PD2014_036.pdf NSW Health Policy PD 2005_406 Consent to Medical Treatment http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_406.pdf NSW Health Policy Directive PD 2007_036 Infection Control Policy http://www.health.nsw.gov.au/policies/pd/2007/pdf/PD2007_036.pdf NSW Health Policy Directive PD2011_042 Breastfeeding in NSW: Promotion, Protection and Support http://www0.health.nsw.gov.au/policies/pd/2011/pdf/PD2011_042.pdf HNELHD Maternity and Newborn: Breastfeeding Promotion, Protection and Support PD2011_PCP 1 HNELHD Maternity: Recognition and management of the Infant at risk for Hypoglycaemia CG 12_17 	
Prerequisites (if required)	N/A
Local Guideline Note	This document reflects what is currently regarded as safe and appropriate practice. The guideline section does not replace the need for the application of clinical judgment in respect to each individual patient but the procedure/s requires mandatory compliance . If staff believes that the procedure/s should not apply in a particular clinical situation they must seek advice from their unit manager/delegate and document the variance in the patient's health record.
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This Local Guideline	Yes

contains advice on therapeutics	Approval gained from Local Quality Use of Medicines Committee on 9/10/14
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Note: Over time links in this document may cease working. Where this occurs please source the document in the PPG Directory at: <http://ppg.hne.health.nsw.gov.au/>

RISK STATEMENT

This guideline has been developed to provide guidance to clinical staff in NICU and midwives/Medical Officers in Delivery Suite and Post natal wards to recognize, diagnose and manage infants with hypoglycaemia and ensure that the risks of harm to infants and staff during the procedure are identified and managed.

Any unplanned event resulting in, or with the potential for injury, damage or other loss to infant or staff as a result of this procedure must be reported through the Incident Information Management System and managed in accordance with the Ministry of Health Policy Directive: Incident management PD2007_061. This would include unintended injury that results in disability, death or prolonged hospital stay.

RISK CATEGORY: *Clinical Care & Patient Safety*

OUTCOMES

1	Recognition and diagnosis of infants with symptoms or risk factors associated with hypoglycaemia
2	BSL levels targeted ≥ 2.6 mmol/l to prevent long term neurological damage
3	Infants receive treatment for hypoglycaemia according to the hypoglycaemia flow diagram applicable to late preterm/term infants indicative of screening OR infants in NICU

ABBREVIATIONS & GLOSSARY

Abbreviation/Word	Definition
ACTH	Adreno -Cortico Tropic Hormone
BSL	Blood Sugar Level
CNS	Central Nervous System
IUGR	Intra Uterine Growth Restriction
IV	Intravenous
LGA	Large for Gestational Age
NICU	Neonatal Intensive Care Unit

GUIDELINE

This Guideline does not replace the need for the application of clinical judgment in respect to each individual patient

Hypoglycaemia Screening & Management - 1 Page Summary and Checklist

(Ctrl+Click on **Coloured** words to jump to that section)

Introduction and Rationale

Definitions and Action Levels

Who to Monitor

- All infants with a **Risk Factor**
- All infants with **Symptoms**

When to Start Monitoring

- In intensive Care at 1-2 hours. If done at < 1 hour repeat at 2 hours
- In Special Care at 2-3 hours
- On postnatal ward at 3-4 hours

How Often to Monitor

- Every 3-4 hours, depending on feed frequency, before feeds until levels normal
-
- Then 6-8 hourly depending on feed frequency, for at least 24-48 hours

How Long to Monitor

- Until sugar levels normal for >24 hours
- <34 week & severe IUGR infants in NICU- 12 hourly, until feeds ≥ 120 mL/kg/day
- If weaning off IV fluids 8 hourly until on full feeds or as directed by medical team

Management Principles

- Maintain blood glucose ≥ 2.6 mmol/L.
- Babies > 32 weeks can generally tolerate feeds
- Establish early frequent (2 hourly) feeds in infants at risk – check for frozen breast milk from antenatal expression
- Keep feeds on day 1 < 90-100 mL/kg/day to avoid vomiting
- Increase feed frequency to correct marginally low sugar levels
- Starting IV fluids are 10% glucose
- Concentrations > 12.5% are rarely needed – consult neonatologist
- Calculate glucose intake in mg/kg/min
- Adjust intakes by minimum 2 mg/kg/min
- Fluids > 100 mL/kg/day in first few days can cause fluid overload – monitor
- Benefits of a brief period of formula outweighs potential risks of IV fluid therapy

Diagnostic Tests in Persistent Hypoglycaemia

Treatment of Persistent Hypoglycaemia

Calculating Sugar Intake

Flow Diagrams

- 1) **NICU**
- 2) **Late Preterm Infants** 34-37 weeks

Purpose

This guideline is to provide a uniform evidence-based approach to the management of neonatal hypoglycaemia. Much of the recommendations come from the American AAP Clinical Report on Postnatal Glucose Homeostasis in Late-Preterm and Term Infants (2011) and the UK NICE guideline Diabetes in Pregnancy (2008). As these 2 guidelines are directed towards the more mature group of newborns, a separate flow diagram is prepared for the more immature and sick infants.

Introduction and rationale for managing hypoglycaemia

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Glucose is the major energy source for organ function in the foetus and neonate. The usual minimum rate of glucose utilization is 4-8 mg/kg/min.^{1, 2} The newborn brain depends upon glucose almost exclusively as a substrate for energy metabolism. The cerebral glucose requirements accounts for as much as 90% of total glucose consumption.² Although alternate fuels, such as ketone bodies, lactate and free fatty acids can be used as a substrate for energy production; the newborn's immature counter-regulatory response limits the availability of these substances, especially in premature or sick babies. Thus, the neonate is susceptible to hypoglycaemia when glucose demands are increased or when exogenous or endogenous glucose supply is limited.

Severe or prolonged hypoglycaemia may result in long term neurological damage.^{3, 4} Transient mild hypoglycaemia in healthy, term newborns does not appear to be harmful to psychomotor development at the age of 4 years.⁵

Incidence

The incidence depends on the methods used for checking sugar level or the method of defining hypoglycaemia and the population concerned. It has been reported as high as 67% in some groups.

Definitions

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There is no standard acceptable definition for hypoglycaemia as it is not possible to define a level for a whole population. Each individual will have a different level. We, therefore, use action levels that catch all babies who are hypoglycaemic. These levels are ≥ 2.6 mmol/L.

Hypoglycaemia in newborn can be:-

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Symptomatic (minority)^{1, 2, 10, 11, 12} or asymptomatic (majority)

There are no definitive signs or symptoms that confirm the presence of hypoglycaemia. Clinical features are a guideline for suspecting hypoglycaemia but are not diagnostic of hypoglycaemia.)

Clinical features of symptomatic hypoglycaemia include:

1. CNS excitation

1. Jitteriness, Exaggerated Moro reflex
2. High pitched cry
3. Irritability
4. Seizures – usually implies long standing hypoglycemia¹⁰

2. CNS depression

1. Lethargy

2. Apnoea,
 3. Cyanotic spells
 4. Poor feeding
 5. Hypotonia, limpness or coma.
3. Due to catecholamine response
 1. Pallor
 2. Sweating
 3. Tachycardia
 4. Vasomotor instability
 4. Other clinical signs due to hypoglycaemia
 1. Bradycardia
 2. Hypotension
 3. Heart failure, cardiac arrest

Risk factors for hypoglycaemia in neonates.^{1, 11, 13}

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Maternal conditions

1. Maternal diabetes
2. Intrapartum administration of glucose
3. Pre-eclampsia
4. Maternal drug treatment e.g. terbutaline, propranolol, oral hypoglycaemic agents

Neonatal conditions

1. Prematurity (<37 weeks)
2. Post maturity (>42 weeks)
3. Low birth weight (<2.5 kg),
4. Small for gestational age (<10%ile)
5. Birth weight > 4.5 kg or LGA (>90%ile)-important to plot all babies on a growth chart to assess SGA or LGA
6. Any unwell baby
7. Respiratory distress, suspected clinical infection, perinatal asphyxia (with or without good recovery), temperature instability
8. Infants with intravenous infusions including parenteral nutrition
9. Syndromal abnormalities that can affect glucose, such as Beckwith-Wiedemann syndrome, and certain inborn errors of metabolism
10. Microphallus ,ambiguous genitalia, intracranial abnormalities

Who should be monitored?

All babies who have symptoms or risk factors listed above need blood sugar monitoring.

When to monitor blood glucose in “at risk babies”

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Physiologically, the nadir in blood glucose in newborn takes place at 2 to 3 hours after birth. Hence, this would be an ideal time for screening an asymptomatic “high risk” newborn. Repeat blood glucose levels may be needed every 3-4 hours before feeds until levels are stable.

Very preterm infants and symptomatic newborns need early glucose monitoring, usually within 1-2 hours after birth.

The newborns from the postnatal ward or a special care nursery (late preterm infants, maternal diabetes) should be tested 3-4 hours after birth, as earlier screening (and treatment) does not seem to improve outcomes but only increases treatment.

How frequently to monitor

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Monitor every 3 hours (before every feed) until levels satisfactory and stable then 6-8 hourly until stable for at least 24 hours, often for 36-48 hours.

How long to monitor

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At least 24 hours after the last recorded low blood glucose level. Once stable, most preterm and severe IUGR infants admitted to the neonatal unit will require only once or twice daily pre-feed blood glucose estimation until at least 120 ml/kg or full enteral feeds are reached¹⁷. In babies at ongoing risk, the introduction of suck feeds (breast or bottle) may require increased monitoring.

GENERAL MANAGEMENT RECOMMENDATIONS

- Aim to maintain blood glucose level ≥ 2.6 mmol/L by keeping infant warm and initiating breast feeds within one hour of birth
- Glucose levels should always be interpreted based on the clinical situation, e.g. a sudden decrease in glucose level, but within the normal range, could still mean action is required.
- Always establish early and frequent (breast) feeds in infants with risk factors for hypoglycaemia. Check to see if the mother has stored expressed breast milk from antenatal expressing program.
- In infants with documented severe hypoglycaemia, calculate glucose intake before and after you make any changes, don't 'estimate'. A usual increased intake is in steps of at least 2 mg/kg/min. Document in the notes.
- Normal glucose requirements are 4-6 mg/kg/min for term infants and 6-8 mg/kg/min in preterm infants. Babies with inappropriately high insulin levels will usually require > 10 mg/kg/min.
- Feeds can be increased in frequency, e.g. from 2 hourly to hourly, to correct marginally low blood sugar levels below action levels. **Remember, increasing feed frequency does not increase the glucose intake.**
- Babies over 32 weeks can usually tolerate feeds at normal volumes (60-80 mL/kg/day) and can be increased up to 100 mL/kg/day if necessary. Over 100 mL/kg/day on day 1 will often result in feed intolerance.
- Total fluids over 100 mL/kg/day in the first few days of life may cause fluid overload (including oedema, hyponatraemia, respiratory symptoms etc.) observe carefully if used.
- Babies < 32 weeks usually need some IV fluids but may be able to have some of their daily requirement as feed. Over 32 weeks feeds should be given unless otherwise contraindicated.
- Starting IV fluids are 10% glucose. Concentrations over 12.5% are rarely needed and warrant consultation with fellow or neonatologist. Concentrations above 12.5% require a central line, but don't withhold adequate treatment for severe hypoglycaemia if no long line available.

- Mothers of infants who require treatment for low blood sugar levels, and whose breast milk is not yet available, should be counselled that the benefits of a brief period of formula are considered to outweigh the potential complications of IV fluid therapy.

MANAGEMENT OF HYPOGLYCEMIA

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Symptomatic infants

This is defined in the literature as BSL < action levels *and* symptoms *and* symptoms disappear when glucose is given. One should consider infants with any hypoglycaemia < 2.6 mmol/L and seizures in this definition as well.

Formula for calculating glucose intake

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$$1. \text{ Glucose intake (mg/kg/min)} = \frac{\% \text{ Glucose} \times \text{Volume (ml/kg/day)}}{144}$$

$$2. \text{ Glucose intake (mg/kg/min)} = \frac{\% \text{ Glucose} \times \text{Hourly Rate}}{\text{Weight (Kg)} \times 6}$$

3. Assume term formula or breast milk is 7% and preterm formula 8.5% glucose to calculate intake

Examples of intake in mg/kg/min are in the table below

	Breast milk*	Glucose 10%	Glucose 12.5%	Glucose 15%
30 ml/kg	1.5	2.1	2.6	3.1
60 ml/kg	2.9	4.2	5.2	6.3
90 ml/kg	4.4	6.3	7.8	9.4
120 ml/kg	5.9	8.4	10.4	12.5

*Artificial feed has similar glucose content to Breast milk

Diagnostic tests in hypoglycaemia

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Unexplained hypoglycaemia for more than 24 hours despite an adequate intake (4-6 mg/kg/min for term infants and 6-8 mg/kg/min in preterm infants) needs further diagnostic evaluation with insulin, cortisol, growth hormone and ACTH levels.

Infants with known risk factors for hypoglycaemia due to hyperinsulinaemia (e.g. maternal diabetes) do not usually need further work-up, unless a persistent glucose intake over 12-15 mg/kg/min is required to maintain normoglycaemia.

Persistent hypoglycaemia: further treatment options.

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In persistent hypoglycaemia (> 72 h of more than 12 mg/kg/min intake or over 15 mg/kg/min intake) further treatment options are available. Always discuss with the neonatal consultant on call.

- Diazoxide (2-5 mg/kg every 8 hours) may be used for hyperinsulinaemic conditions. It is usually combined with hydrochlorothiazide (2- 4mg/kg/day in 2 divided doses) to optimize treatment and prevent fluid retention.
- Glucagon bolus IM (200mcg/kg/dose) or infusion (10-20 microgram/kg/hr) is effective if an acute response is needed, e.g. if IV access is delayed in the presence of significant hypoglycaemia.
- Hydrocortisone (approx. 1mg/kg/dose, 3 doses a day²⁶) -for cortisol deficiency conditions¹⁴. The actions are to stimulate the liver to form glucose from amino acids & glycerol, and stimulate the deposition of glucose as glycogen²⁶. There is also diminished peripheral glucose utilisation ²⁶.
- Octreotide (1 microgram/kg/dose, every six hours, titrate upwards until effect, max 10ug/kg/dose every six hours) can be used if the hypoglycaemia is resistant to diazoxide. Most effective in congenital hyperinsulinaemia.
- If all else fails, full diagnostic work up and possible surgical management should be considered.

HYPOGLYCEMIA FLOW DIAGRAM IN NICU FOR: PRETERM INFANTS OR SYMPTOMATIC NEWBORNS

these infants require early BSL monitoring from 1-2 hours of age

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Please read the general management recommendations before interpreting this flow diagram

Glucose ≤ 1.6 mmol/l or symptomatic hypoglycemia < 2.6 mmol/l <i>Severe or symptomatic hypoglycemia</i>	Glucose between 1.7 and 2.6 mmol/l <i>Hypoglycemia</i>	Glucose ≥ 2.6 mmol/l <i>Normoglycemia</i>
<ol style="list-style-type: none">1. If not on IV fluids, initiate intravenous glucose at a minimum intake of 4 (term) or 6 (preterm) mg/kg/min. Do not rely on oral or intragastric feeding to correct severe or symptomatic hypoglycaemia2. Give a bolus of glucose 200mg/kg (2 mL/kg of 10% glucose) at 30 mL/hr.3. If already on feeds or IV fluids, increase the intake by at least 2 mg/kg/min with a minimum of 4 (term) or 6 (preterm) mg/kg/min after the bolus is given4. Recheck blood glucose concentration 30 minutes after intervention is completed, or 1 hour after last glucose (ideally, this should be the same time)	<ol style="list-style-type: none">1. Increase the current intake by at least 2 mg/kg/min2. Ensure a minimum intake of 4 (term) or 6 (preterm) mg/kg/min. Depending on gestational age or severity of risk factors, this can be oral or IV. Oral feeds may be increased in frequency e.g. from 2hrly to hourly, but does not increase the intake3. Recheck blood glucose concentration before subsequent feeds until the value is acceptable (≥ 2.6 mmol/L) and stable	<p>Evaluate any normal glucose level in the context of earlier glucose levels -look at the trend</p>

HYPOGLYCEMIA FLOW DIAGRAM FOR LATE PRETERM AND TERM INFANTS WITH INDICATION FOR SCREENING:

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Indications for screening are late preterm infants (34 to 37 weeks gestation), term SGA and LGA, and infants of diabetic mothers regardless of type. Also consider SGA at 36-37 weeks if <2.5kg OR SGA at 38-39 weeks <2.7kg. Please read the general management recommendations before interpreting this flow diagram.

No hibernation sleep should be offered to this population, feed early and frequent (2-3 hourly)

Symptomatic infants need to be managed according to the NICU Flow Diagram.

BSL is taken before the 2nd breast feed or at 4 hours of age (whichever comes first). Monitoring should continue for 48 hours, or until 3 consecutive normal values 8 hours apart are obtained.

<p>Glucose \leq 1.6 mmol/l or symptomatic hypoglycaemia < 2.6 mmol/l</p>	<p>Glucose between 1.7 and 2.6 mmol/l <i>Hypoglycemia</i></p>	<p>Glucose \geq 2.6 mmol/l</p>
<p><i>Severe or symptomatic hypoglycemia</i></p> <ol style="list-style-type: none"> 1. Consult with NICU staff 2. Immediate complement feed with 10ml/kg of expressed breast milk or artificial feed 3. Arrange for an immediate formal BSL 4. Check temperature and assess baby for symptoms 5. Skin to skin contact while arranging a formal BSL 6. All symptomatic infants will need IV therapy, and most asymptomatic infants with severe hypoglycaemia will need IV therapy 	<ol style="list-style-type: none"> 1. Complement feed with 10 mL/kg of Expressed Breast Milk or Artificial Feed 2. Check temperature and assess baby for symptoms 3. Recheck blood glucose concentration before subsequent feeds until the value is acceptable (\geq2.6 mmol/L) and stable for at least 3 readings 4. Consult with NICU staff if second BSL is below 2.6 mmol/l 5. Keep a feeding chart and record additional fluids given. Record BSL's on SPOC (Standard Paediatric Observations Chart) chart and in baby's notes 	<p><i>Normoglycemia</i></p> <ol style="list-style-type: none"> 1. Establish early and frequent breast feedings and offer skin to skin contact 2. Artificially fed infants offer next feeds at 60 ml/kg/day 3. Recheck blood glucose concentration before subsequent feeds until the value is acceptable (\geq2.6 mmol/L) and stable for at least 3 readings 4. Keep a feeding chart and record additional fluids given. Record BSL's on SPOC chart and in baby's notes 5. Always evaluate any normal glucose level in the context of earlier glucose levels. (look at the trend)

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FEEDBACK

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