Trust Clinical Guideline for the Management of Hypoglycaemia in Infants born Preterm <37+0 weeks

Document Control:

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Version	Date	Author	Reason/Change
V1.0	12/11	P Muthukumar	To originate document
V2.0-7.0	01/13-03/18	P Muthukumar	Superseded
V8.0-8.1	05/18-01/20	P Muthukumar	Reloaded as joint guideline with JPH
V9	09/23	P Muthukumar & S Harvey	Updated to include dextrose for moderate, asymptomatic hypoglycaemia and to change frequency of observations as per neonatal observation pathway and BAPM updates No longer a joint guideline with JPUH as they are not undertaking the same practice change as us (Kaiser)

Previous Titles for this Document:

Previous Title/Amalgamated Titles	Date Revised
CA2036	Not applicable

Distribution Control

Printed copies of this document should be considered out of date. The most up to date version is available from the Trust Intranet.

Consultation

The following were consulted during the development of this document:
Consultant Neonatologists, Infant Feeding Team, Practice Development Midwives, Practice Development Neonatal Nurses

Monitoring and Review of Procedural Document

The document owner is responsible for monitoring and reviewing the effectiveness of this Procedural Document. This review is continuous however as a minimum will be achieved at the point this procedural document requires a review e.g., changes in legislation, findings from incidents or document expiry.

Relationship of this document to other procedural documents

This document is a clinical guideline applicable to Norfolk and Norwich University Hospitals; please refer to local Trust's procedural documents for further guidance, as noted in Section 5.

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Contents Page

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Quick reference A - Feeding plan for <u>Breastfed</u> infants at risk of hypoglycaemia

Quick reference B: Feeding plan for Formula fed infants at risk of hypoglycaemia

Quick Reference C: Management of the infant admitted to NICU with hypoglycaemia <1.5mmols or symptomatic (see algorithm)

Quick Reference D: Buccal Dextrose Gel

Indications

- Blood glucose 1.5-1.5mmol/L in preterm infant with no abnormal clinical signs
- Infants ≥ 35 weeks' gestational age and younger than 48 hours after birth

Notes

- Must be used in conjunction with a feeding plan
- For preterm babies with severe hypoglycaemia (BG <1.5mmol/L) use oral dextrose gel only as an interim measure while arranging for urgent medical review and treatment with IV glucose

Dose

- Use 200mg/kg dextrose gel (0.5 mLs/kg of 40% dextrose gel), up to two doses given 30 minutes apart per episode of hypoglycaemia and a maximum of six doses of buccal dextrose gel in 48 hours.

Weight of Baby (Kg)	Volume of Gel (mls)
1.5-1.99	1.0
2.0-2.99	1.5
3.0-3.99	2.0
4.0-4.99	2.5
5.0-5.99	3.0
6.0-6.99	3.5

Method of administration

- Draw up correct volume of 40% dextrose gel (Glucogel®) using a 2.5 or 5mLs oral / enteral syringe
- Dry oral mucosa with gauze, gently squirt gel with syringe (no needle) onto the inner cheek and massage gel into the mucosa using latex-free gloves
- Offer a feed preferably breast milk, immediately after administering dextrose gel
- Repeat blood sugar measurement as requested
- Repeat oral dextrose gel if baby remains hypoglycaemic according to flow chart

- Up to 6 doses can be given over a 48-hour period but any more than one dose should be discussed with the neonatal team, and it is advisable for the baby to be examined before the 3rd dose is administered.

Quick Reference E: Intravenous dextrose concentration.

Flow rate of 10% dextrose (mL/kg/day)	Infusion rate (mg/kg/min)
40	2.77
60	4.16
80	5.55
100	6.94
120	8.33
130	9.03
140	9.72
150	10.42

How to calculate mg/kg/min from mL/kg/day for any concentration of glucose:

Formula: Rate (mL/kg/day) / 144 x glucose% = mg/kg/min

How to make up any concentration of glucose in any volume:

Desired volume = V mL

Desired concentration of glucose = D%

Lower concentration of glucose = L%

Volume of lower concentration of glucose to add = LV mL

Higher concentration of glucose = H%

Volume of higher concentration of glucose to add = HV mL

Formula: HV = V (D-L) / (H-L)
LV = V – HV

Add HV mL and LV ml to get V ml of D%

1. Introduction

1.1. Rationale

Definitions of hypoglycaemia remain controversial but for the purposes of this guideline, and for consistency, the operational threshold for management of hypoglycaemia in a preterm neonate is defined as: ***plasma glucose less than 2.6mmol/L*** measured using a reliable method i.e., laboratory glucose measurement or point of care testing device.

Hypoglycaemia whether symptomatic or not may cause both short-term and long-term clinical sequelae. Prolonged or recurrent periods of hypoglycaemia can lead to neurocognitive impairment, although exactly how low the level must fall and for how long have not been clearly determined; the risk of injury is likely to depend on an infant's ability to produce alternative fuels and that cannot be presumed nor easily measured. Differentiating what is physiological from what may be pathological therefore is difficult and determining the optimal management can be challenging as the evidence base for best practice remains limited.

This guideline aims to form part of an integrated pathway for the management of glucose control in the newborn and is designed to be used in conjunction with other documents relating to feeding, thermo-neutral care and the care of vulnerable groups of newborns.

1.2. Objective

- Improve patient safety through appropriate care at the appropriate time
- Improve the parent and newborn experience
- To reduce the incidence of hypoglycaemia through active management of preterm infants at risk
- To provide guidance on the management of hypoglycaemia in the preterm infant at risk
- To promote the nursing of mother and baby together where safe and feasible and to minimise the admission of babies to neonatal units for medical interventions
- To promote breastfeeding and to support mothers in their feeding choices

1.3. Scope

This guideline covers all babies born preterm <37+0 weeks gestation, being cared for within maternity services and NICU at NNUH.

1.4. Glossary

The following terms and abbreviations have been used within this document:

Term	Definition
AF	Artificial Formula
ANNP	Advanced Neonatal Nurse Practitioner
BAPM	British Association of Perinatal Medicine
BAT	Breastfeeding Assessment Tool
BG	Blood Glucose
BOAT	Bottle Feeding Assessment Tool
DHM	Donor Human Milk
EBM	Expressed Breastmilk
KAISER	Neonatal Observation Pathway
NEWTT2	Newborn Early Warning Trigger and Track
NICU	Neonatal Intensive Care Unit
POC	Point of Care
TC	Transitional Care

2. Responsibilities

P Muthukumar and S Harvey: responsible for reviewing and updating guideline, auditing and monitoring compliance to guideline.

3. Processes to be followed:

3.1. Measurement of glucose levels

In the Newborn, it is important to be able to measure glucose levels accurately whilst using a minimal amount of blood and to be able to obtain results quickly. Therefore, measurement of glucose levels in most units is provided by one of a variety of commercially available “Point of Care” (POC) glucose monitors.

Devices that do not correct for haematocrit or bilirubin have more risk of inaccuracy. Standalone local laboratory devices or glucose biosensors incorporated into blood gas analysers help to balance the benefits of POC testing with the accuracy of laboratory analyses.

3.2. Identifying infants at risk.

Any infant born Preterm < 37^{+0} weeks with no other risk factors

Any infant born preterm <37^{+0} weeks and has the following other risk factors:

- Intra-uterine growth restriction [IUGR], birthweight 2nd centile or below
- Infants of diabetic mothers
- Infants of mothers taking beta-blockers in the third trimester and / or at time of delivery
- Perinatal acidosis (cord arterial or infant pH <7.1 and base excess ≥ -12mmol/L)

Measurement of blood glucose concentration should be performed for any infant who has one or more of the following diagnoses or clinical signs:

- Perinatal hypoxia-ischaemia
- Suspected or confirmed early onset sepsis
- Known or suspected Pituitary / adrenal insufficiency, inborn errors of metabolism**
- Hyperinsulinism (e.g., congenital hyperinsulinaemic hypoglycaemia, Beckwith-Wiedemann syndrome, islet cell adenoma)
- Hypothermia (<36.5°C) not attributed to environmental factors (see section d)
- Cyanosis
- Apnoea
- Altered level of consciousness
- Seizures
- Hypotonia
- Lethargy
- Jitteriness
- High pitched cry
- Abnormal feeding behavior (not waking for feeds, not sucking effectively, appearing unsettled and demanding very frequent feeds), especially after a period of feeding well may be indicative of hypoglycaemia, this should prompt a full clinic

**Babies with a family history of Medium-Chain Acyl-CoA Dehydrogenase Deficiency [MCADD] should be referred to a senior paediatrician before birth and managed according to: Trust Guideline for the Management of Newborns with a Family History of MCADD [Medium-Chain Acyl-CoA Dehydrogenase Deficiency] Trustdocs ID 8463

3.3. Management of infants at risk

Management of infants at risk should start with a focus on preventing hypoglycaemia. Parents should be provided with verbal and written information (see patient information leaflet in related documents) that explains why their baby is receiving extra support and blood glucose monitoring and the signs that could indicate that their baby is becoming unwell.

3.3.1. At delivery:

- Place the baby in skin-to-skin contact with the mother after birth and cover with a hat and warm blanket.
- Remind parents of the benefits of breast milk for preterm babies and encourage uninterrupted skin-to-skin contact, leading to a first breast feed within an hour of birth, but with ongoing observation to ensure the baby remains well during this time.

- If a baby does not feed within the first hour, support the mother with expressing. Teach hand expressing in combination with double pumping. Give any colostrum obtained via a syringe. If EBM not available, then DHM / formula should be given at a volume of 8-10m/kg initially. This should be discussed with parents and documented in the notes.
- For mothers choosing to feed infant formula, offer 10-15mls/kg in skin-to-skin contact within an hour of birth and using the elevated side lying technique.
- Any baby showing signs of illness or reluctance to feed will require further observations ± medical review.
- If you have any clinical concerns or queries, contact the Transitional Care Nurse, Neonatal Tier 1 or Neonatal Tier 2 via Alertive.
- Support mothers to recognise early feeding cues and signs of effective attachment. Reassure mothers that it can be normal for these signs to be delayed or absent in a preterm infant and that babies may need waking for feeds. Early feeding cues include rapid eye movements, mouth and tongue movements, turning head side to side, sucking on hands.

3.3.2. Ongoing Standard Care should include:

- Observe carefully for feeding cues.
- Feed the baby responsively i.e., when feeding cues are apparent, and at least 3 hourly for the first 24 hours [if the baby can feed more frequently this is preferable]. If an effective feed is not achieved the mother should be encouraged to express and offer EBM, aiming for volumes over 1ml wherever possible. Strategies to optimise the milk ejection reflex should be employed to enable optimum volumes.
- If no colostrum / EBM is available and after discussion with the mother in view of clinical indication, consider supplementing with formula milk (10-15ml/kg initally) until colostrum is available. Offer formula in the elevated side lying technique. Formula will be required in larger volumes than colostrum as it is possible that the baby's ability to utilize ketone bodies may be limited by the use of infant formula.
- BAPM 2023 suggest offering 10-15ml/kg AF initially. If further supplementary feeding with formula is required, this should increase with the baby's age:
- **For formula fed, late preterm babies we recommend the following volumes:**
    - **0-24hrs old – 60mls/kg/day**
    - **24-48hrs old – 90mls/kg/day**
    - **48-72hrs old – 120mls/kg/day**
    - **72-96hrs old – 150mls/kg/day**
- If formula is introduced as a supplement, support the mother to resume breast milk feeds as soon as possible. For the period the mother is expressing she should see increasing volumes of colostrum/ milk expressed day by day.[9]

- Continue to encourage skin to skin contact to promote breastfeeding and thermoregulation.
- A full set of observations (including level of consciousness) should be performed following birth at: 1 hour and 2 hours old; then 2 hourly until 12 hours old and 4 hourly until 24 hours old, as per the Kaiser protocol. These should be documented on the NEWTT2.
- Pre-feed blood glucose [BG] measurements should be started before the second feed i.e., within 4 hours of birth [but not before 2 hours of age unless the baby is symptomatic of hypoglycaemia]. Pre-feed BG estimations should then be checked regularly until they are maintained ≥ 2.6mmol/l for a minimum of 3 consecutive feeds. BG estimations should not usually be taken more frequently than 3-hourly even if feeds are taken more frequently.

3.4. Symptomatic hypoglycaemia:

Clinical detection of hypoglycaemia is potentially difficult and unreliable as many babies with hypoglycaemia demonstrate no clinical signs and, even when present, the clinical signs of hypoglycaemia are non-specific. If a baby demonstrates clinical signs suggestive of hypoglycaemia **this is a medical emergency** and needs urgent action to treat the blood glucose level and the underlying cause.

The **symptomatic baby needs urgent admission to a neonatal intensive care unit**. It is important that the clinical condition of the baby is clearly recorded in the notes along with the management plan.

Recognised symptoms and signs of hypoglycaemia include:

- Abnormal feeding behaviour especially after a period of feeding well
- Jitteriness – repetitive, unprovoked movements of one or more limbs*
- Lethargy and/or hypotonia
- Feeding difficulties [poor suck, refusal to feed]
- Irritability and or tremor
- Apnoea and cyanotic episodes
- High pitched cry
- Difficulty maintaining body temperature/hypothermia
- Coma and/or seizures

** Jitteriness (tremulousness) refers to a high-frequency, generalised, symmetrical tremor of the limbs which are unprovoked and usually relatively fast. Jitteriness is not always due to hypoglycaemia but is a very common and important indicator of potential hypoglycaemia. Many babies will appear jittery on handling.*

It is therefore important to be sure that this movement is not simply a response to stimuli. Unlike seizures, jitteriness can usually be stopped/controlled by holding the limb firmly e.g., Baby's arm held close to baby's chest. **Excessive or persistent jitteriness requires investigation.**

3.5. Treatment of symptomatic or severe [BG <1.5 mmol/L] hypoglycaemia

- The following treatments should be introduced in sequence [with repeat BG estimation 1 hour after each intervention] until BG ≥2.6 mmol/L:
    - Insert IV cannula and give:
        - 2.5 mls/kg bolus of 10% dextrose followed by
        - 10% dextrose infusion at standard fluid rate for gestation, birth-weight and postnatal age
        - Consider IM glucagon 200micrograms/Kg [this may be repeated x1 if the response to the initial dose is adequate and hypoglycaemia recurs] or 40% dextrose gel 200mg/kg massaged into the buccal mucosa can be given while i.v. access is obtained
    - Increase 10% dextrose infusion rate by 2mgs/kg/minute by increasing h volume of the concentration of glucose. If central venous access available [umbilical vein or percutaneous long-line] increase to 12.5 or 15% dextrose
    - Where hypoglycaemia persists despite the above measures [including a glucose infusion rate ≥8mg/kg/min] consider investigations for hyperinsulinism and perform investigations as mentioned in the following section.
- Once BGs have risen to ≥2.6 mmol/L continue to monitor BGs regularly [hourly initially, then less frequently when BGs are consistently satisfactory or 3 consecutive values]
- Enteral feeds as described in the algorithm

3.6. Treatment of asymptomatic persistent moderate [BG 1.5-2.5 mmol/L] hypoglycaemia

- If BG remains 1.5-2.5mmol/L on 2 consecutive occasions, despite adequate feeds and dextrose administration, inform Neonatal Team and admit to NICU for further review and management.
- Insert IV cannula and give 10% dextrose infusion at standard fluid rate for gestation, birthweight and postnatal age. If BG does not respond institute other interventions as detailed in section 3.5.

3.7. Investigation of Hypoglycaemia

If hypoglycaemia is severe [<1.5 mmol/L] or persistent [<2.6 mmol/L despite IV dextrose infusion at the normal rate of 8 mg/kg/min] then it is important to perform further investigations for possible metabolic and endocrine causes.
Following investigations must be done in these babies *during* the time of hypoglycaemia

- Blood glucose, insulin, cortisol, growth hormone, fatty acids, ketone bodies, carnitine, acyl carnitine profile, amino acids, ammonia, and lactate.
- Urine ketones and organic acids

- Consider evaluation for early onset sepsis

The results of these investigations and the possible need for additional tests should be discussed with a specialist in paediatric metabolic medicine and / or paediatric endocrinology

4. Training & Competencies

- Training required for Blood Glucose Monitor – POC monitor.
- Hypoglycaemia update eLearning package

5. Related Documents

Management of Late Preterm Infants (aged 36+0 to 36+6 weeks) and over 2.2kg being cared for in Maternity Services Trust docs ID 15605 Trust Docs

Trust Guideline for the Management of Newborns with a Family History of MCADD [Medium-Chain Acyl-CoA Dehydrogenase Deficiency] Trustdocs ID 8463

Patient Information Leaflet - Protecting your Baby from Low Blood Glucose Trustdocs Id: 14967

NEWTT2 NEWTT2_Track_and_Trigger_revised_June23.pdf (amazonaws.com)
Management of neonatal sepsis risk and observation pathways in the postnatal period Trust Docs (nnuh.nhs.uk)

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21. Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant – A Framework for Practice October 2017
22. Early Postnatal Care of the Moderate-Late Preterm Infant – BAPM Framework for Practice; March 2022

7. Audit of the process

Compliance with the process will be monitored through the following:

Key elements	Process for Monitoring	By Whom (Individual / group / committee)	Responsible Governance Committee / dept	Frequency of monitoring
A) All preterm infants identified as "at risk" for hypoglycaemia should: • Have a documented care plan • Have first feed within 60 minutes of birth • Have a pre-second feed blood glucose estimation within 4 hours of birth	Clinical Audit	Infant Feeding Team	Maternity / Neonatal	Triennial

B) All preterm infants with symptomatic hypoglycaemia or blood glucose <1.5 mmol/l should: • Be admitted to NICU urgently • Receive intravenous dextrose according to the schedule outlined in this guideline	Clinical Audit	NICU	Neonatal	Triennial

The audit results are to be discussed at maternity clinical governance meetings to review the results and recommendations for further action. Then sent to Neonatal Clinical Guidelines Committee who will ensure that the actions and recommendations are suitable and sufficient.

8. Equality Impact Assessment (EIA)

Type of function or policy	Existing			
Division	Women's and Children's	**Department**	Maternity and NIVU	
Name of person completing form	Sophie Harvey	**Date**	26/01/2023	
Equality Area	**Potential Negative Impact**	**Impact Positive Impact**	**Which groups are affected**	**Full Impact Assessment Required YES/NO**
Race	Not relevant	Not relevant	Not relevant	Not relevant
Pregnancy & Maternity	Not relevant	Not relevant	Not relevant	Not relevant
Disability	Not relevant	Not relevant	Not relevant	Not relevant
Religion and beliefs	Not relevant	Not relevant	Not relevant	Not relevant
Sex	Not relevant	Not relevant	Not relevant	Not relevant
Gender reassignment	Not relevant	Not relevant	Not relevant	Not relevant
Sexual Orientation	Not relevant	Not relevant	Not relevant	Not relevant
Age	Not relevant	Not relevant	Not relevant	Not relevant
Marriage & Civil Partnership	Not relevant	Not relevant	Not relevant	Not relevant
EDS2 – How does this change impact the Equality and Diversity Strategic plan (contact HR or see EDS2 plan)?	Not relevant			

- **A full assessment will only be required if: The impact is potentially discriminatory under the general equality duty**
- **Any groups of patients/staff/visitors or communities could be potentially disadvantaged by the policy or function/service**
- **The policy or function/service is assessed to be of high significance**

IF IN DOUBT A FULL IMPACT ASSESSMENT FORM IS REQUIRED

The review of the existing policy re-affirms the rights of all groups and clarifies the individual, managerial and organisational responsibilities in line with statutory and best practice guidance.