Prevention of Neonatal Hypoglycaemia

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1.0 Introduction

Nationally, hypoglycaemia is a leading cause of term admissions to the neonatal unit, and in 2016 NHS improvement and British Association of Perinatal Medicine developed a framework for practice to address the variation in practice that occurred in the Identification and management of hypoglycaemia in the new-born in order to promote safe practice that avoids unnecessary separation of mother and baby.

After birth, a baby's blood glucose falls in the early postnatal period and in the healthy term infant the brain is protected by elevated levels of lactate, ketone bodies and an enhanced ability to use these metabolites. As the healthy term infant is protected in this way, it is not appropriate to measure blood glucose levels in normally grown, healthy term infants, nor to react if moderately low levels are encountered. Babies who are born prematurely, who have significant growth impairment or in whom some aspect of glucose metabolism is disturbed may not produce ketones and may therefore be at significant risk of hypoglycaemia and of suffering damage because of it.

2.0 Objective

This guideline has 3 main aims:
To describe the care required to prevent or reduce the likelihood of hypoglycaemia occurring in at risk infants.
To describe the correct method of Identifying hypoglycaemia in neonatal patients
To describe the correct management pathway of hypoglycaemia in neonatal patients

3.0 Scope

This guideline is for the use and reference of all staff looking after new-born infants within the trust, inclusive of Paediatric, Neonatal and Maternity staff. The Hypoglycaemia boxes on ANPN and BBC are to be checked and stocked by Maternity team. (see Appendix 4+5)

4.0 Main Guideline

4.1 Definition of Hypoglycaemia

The exact definition of hypoglycaemia in a new-born infant is unclear and has been the subject of much discussion. Recommended practice for new-born infants at Barnsley Hospitals NHSFT is as follows:
Healthy term infants who have a birth weight above/on the 2nd centile should not have blood glucose measured
In infants who are at risk of hypoglycaemia the cut-off for intervention to raise blood glucose should be a pre-feed blood glucose level of less than 2 mmol/L

For babies admitted to the neonatal unit with confirmed or suspected persistent hyperinsulinism a blood glucose threshold of greater than 3.5 mmol/L is recommended, not because they require a higher level but because a more rapid fall can be anticipated and high insulin levels stop the utility of alternative fuels – ketone and lactate
Any neurological signs in association with a blood glucose of less than 2.5 mmol/L should initiate urgent investigation and treatment
Normal glucose utilization rates are 4-6 mg/kg/min. Infants in high-risk groups frequently require 610mg/kg/min. Hyperinsulinism should be considered in babies requiring greater than 8 mg/kg/min and babies requiring greater than 10 mg/kg/min usually have a pathological basis for their hypoglycaemia.
Glucose requirement in mg/kg/min = ml/h x Glucose% in fluid / weight x 6
Or use the calculator at http://nicutools.org/MediCalcs/Glucose.php3 which will tell you the glucose requirement based on IV fluids and milk feeds.

4.2 How to measure Blood glucose in a neonate.
The hand-held Blood glucose measurement machines are not accurate at measuring glucose levels below 2.8 mmol/L. Because of this these should not be used to measure the blood glucose level of a neonate. Blood glucose should be measured using the capillary gas samples, selecting only glucose measurement from the manual selection tab. (Fig 1). These can be found on the
NNU, Birthing centre, Children's ward, and ANPN ward. These should be the reference standard for measuring blood glucose based on their speed and accuracy. Samples should be taken from a warm, well perfused heel prick or free flowing venous sample.

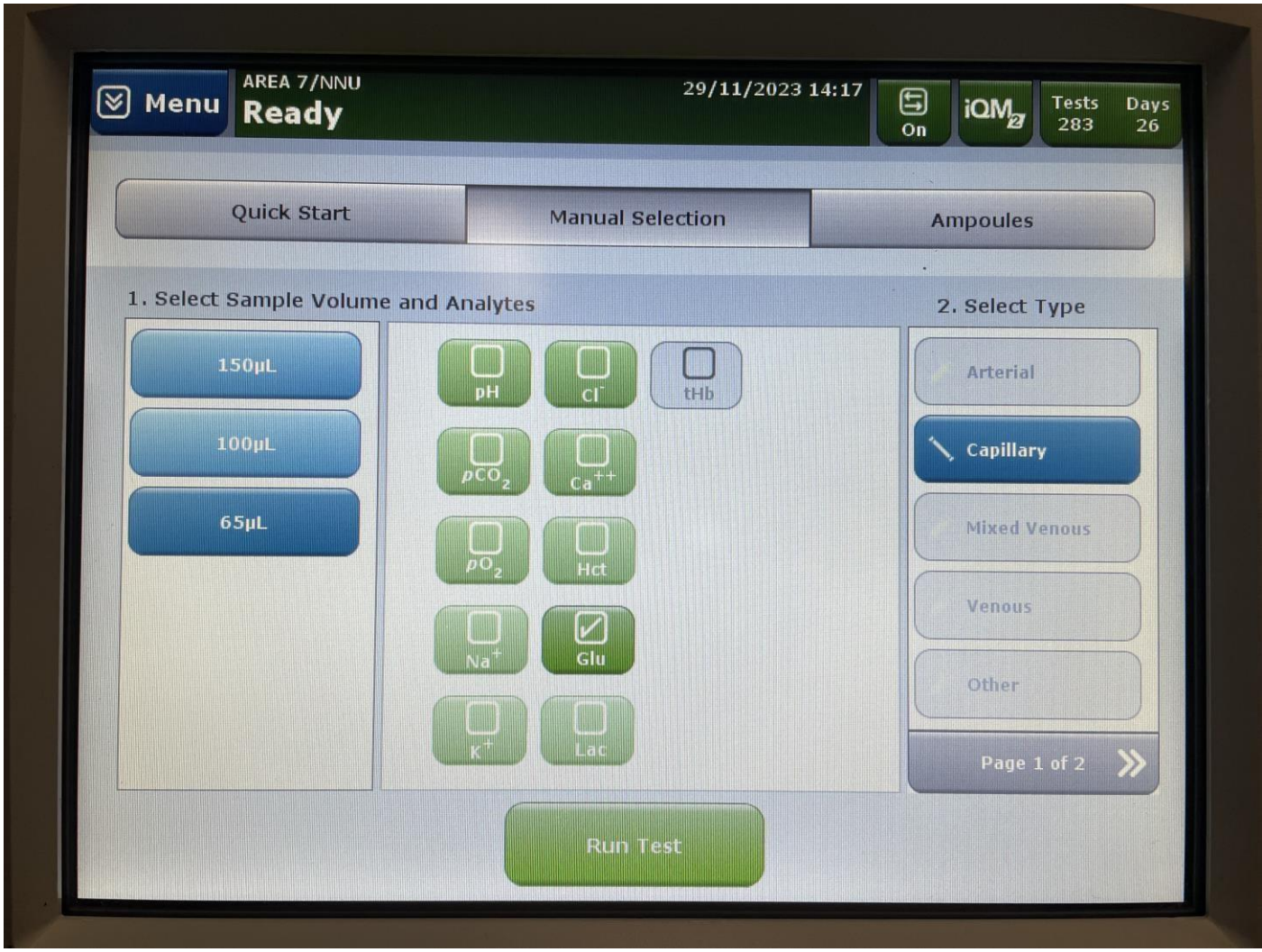


Figure 1: The blood gas machines on NNU and ANPN have a specific selection that says "glucose only". If this option is unavailable, click manual selection and deselect all parameters except Glucose. This will give you a specific glucose level only and not a full blood gas.

4.3 Which Babies are at Risk of Hypoglycaemia?

Birth weight on 2nd centile / kg		
Gestational age / weeks	Boys	Girls
37	2.10	2.00
38	2.30	2.20
39	2.50	2.45
40	2.65	2.60
41	2.80	2.75
42	2.90	2.85

Birth weight below the 2nd centile. Please use the table above and NOT the Grow-App™ customised growth charts
Born less than 37 weeks' gestation
Infant of a diabetic mother
Maternal beta blocker therapy in third trimester and/or at delivery

Hypothermia with temperature less than 36.5oC (not environmental) – despite standard preventative measures
Perinatal acidosis (cord pH <7.1)
Babies on antibiotics
Symptoms of hypoglycaemia
Severe rhesus disease with bilirubin approaching exchange transfusion line
Fluid restriction

4.4 Risk Factors for Hypoglycaemia

4.4.1 Poor Glucose Production

Infants born small for dates (less than 2nd centile)
Preterm infants (less than 37 weeks)
Fluid restriction
Maternal beta blocker therapy in the third trimester and/or at delivery • Inborn errors of metabolism

4.4.2 Increased Glucose Demand

Hypothermia (<36.5oC) despite standard preventative measures
Severe rhesus disease (bilirubin approaching exchange transfusion line and requiring admission)
Perinatal acidosis (cord pH <7.1)
Babies on antibiotics

4.4.3 Hyperinsulinaemia

Infants of a diabetic mother
Beckwith-Wiedemann syndrome

4.4.4 Inadequate 'anti-insulin' hormones

Pituitary insufficiency
Adrenocortical deficiency

4.5 Feeding at Risk Babies

Feed within 1 hour of birth
o Breast/expressed breast milk: unlimited access o Formula: aim for minimum of 10-15 ml/kg/feed
Maximum feed interval three hour (from the start of the previous feed)

4.6 Monitoring at Risk Babies

Give parents an information leaflet (see Appendix 1)
Temperature – aim for 36.5oC to 37.2oC
Signs of hypoglycaemia (see section 4.7)
Blood glucose before second feed and pre-feed thereafter using the blood gas machine only.
Post-feed blood glucose measurements are not required.

4.7 Symptoms of Hypoglycaemia

Changes in level of consciousness
Coma, lethargy, stupor
Irritability
Apnoea
Cyanosis, pallor
Feeding poorly after feeding well
Seizures, tremor, jitteriness
Abnormal cry
Hypothermia
Hypotonia, floppy

Note that many of these symptoms are non-specific. Of these the most abused is 'jitteriness'. It is strongly recommended that jitteriness is clearly defined as, for example, 'excessive, repetitive, relatively fast movements of one or more limbs which are unprovoked – not in response to stimuli'. Jitteriness, in isolation, is not an indication to measure blood glucose.

4.8 Use of Hypoglycaemia Screen

Consider performing investigations after 48 hours of life if glucose requirement is more than or equal to 8 mg/kg/min, or before then if blood glucose is persistently less than 1 mmol/L despite optimal treatment
Tests required for hypoglycaemia screen are listed in Appendix 6.

4.9 Approach to Screening and Prevention of Hypoglycaemia

4.9.1 Group 1: Healthy Term Babies

May have low blood glucose in the first two to three postnatal days and are protected by a ketone body response. It is now recognised that:
Routine blood glucose monitoring is not appropriate
Low blood glucose is not a pathological entity
Invasive treatment should not be initiated
Blood glucose should only be measured if there are clinical concerns – excess weight loss, dehydration or jaundice for example – in which case the infant does not fit into the "normal, healthy" category.

4.9.2 Group 2: Any Infant with Neurological Signs

Neurological signs include lethargy, altered level of consciousness, hypotonia and seizures. Whether or not they are in an at-risk group, these infants should have urgent and accurate blood glucose measurement. Thereafter response will be determined by the blood glucose results. In these infants the threshold for treatment would be less than 2.5 mmol/L.
Irrespective of the blood glucose level, any baby with neurological signs must be reviewed urgently by a paediatrician.

4.9.3 Group 3: Any Risk Factors for Hypoglycaemia (see Appendix 1 and 2)

Make sure environment is optimal
Maintain body temperature
o Dry and Place baby in skin to skin in a warm draught free room
o Use a hat and warm blanket to cover baby
o If baby is cold (<36.5°C) consider warming with incubator if unable to bring temperature up with skin to skin contact.
Observe 'wellbeing' with observations using NEWTT chart
Provide parents with verbal and written information (Appendix 1) that explains why their baby is receiving blood glucose monitoring, how the likelihood of hypoglycaemia can be minimised, signs that could indicate their baby is becoming unwell and how to raise concerns.

Early energy provision, within one hour of birth
Where possible, encourage colostrum collection prior to birth.
Breastfeed wherever possible and encourage unlimited access to the breast and responsive feeding. If the infant did not feed effectively hand express straight into baby's mouth, or give expressed breast milk by cup.
If formula fed give a minimum of 5 - 7.5ml/kg feed (40-60 ml/kg/day) within the first hour of birth
Maximum feed interval three hours (from the start of the previous feed)
Measure blood glucose
Measure blood glucose before the second feed (2-4 hours after birth)
Check the next blood glucose pre-feed, 2-3 hours from the previous measurement
Discontinue when two consecutive measurements have a blood glucose greater than 2.0 mmol/L
Recommence if energy intake drops (e.g. poor feeding or vomiting) or infant becomes symptomatic.
There is no need for post-feed blood glucose measurements

4.9.4 Maintain Energy Provision

Encourage frequent feeding, ensuring no longer than 3 hours between feeds. (See appendix 6) Assess the need for helping mother with:
Ongoing help with feeding
Hand expression
Recognition of early feeding cues
Recognition of signs of effective attachment and feeding.
Maternal Breast milk should always be given preferentially before formula if available.
For Women who choose to Formula feed, give 40-60 ml/kg/day as 3 hourly feeds for the first 24 hours after birth. (5 – 7.5ml/kg per feed 3 hourly)
If blood glucose is greater than or equal to 2 mmol/L on two consecutive measurements: Discontinue glucose monitoring but continue to breastfeed wherever possible and encourage skin to skin contact with unlimited access to the breast and responsive feeding.

Continue to support Breast feeding and ensure mother understands how to assess effective feeding and escalate concerns.
Complete at least 1 recorded breast-feeding assessment using local or BFI tool prior to discharge home.
If formula fed give 3 hourly feeds at 40-60 ml/kg/day.
Strict three hourly feeding can be relaxed after 24 hours of age provided that a feeding assessment has demonstrated effective feeding. Infants at risk of hypoglycaemia should not be discharged before 24 hours of age.

4.10 Blood Glucose of less than 2 mmol/L
See appendices 2, 3 and 4 for flow charts as quick reference guides.
Hypoglycaemia Box to be situated on ANPN + BBC – See Appendix 5

4.10.1 Blood Glucose 1.0-1.9 mmol/L with no clinical signs of hypoglycaemia (see Appendices 2, 3, 4, 5 & 6)
Remember: Only take a glucose reading from the gas machine. The handheld blood glucose monitors are not accurate at lower readings.
If Mother Plans to Breastfeed
Give 40% buccal Glucose (see appendix 5 for dose) followed by a breastfeed. Provide active breastfeeding support including teaching the mother to hand express and giving all colostrum to the baby via cup. If no colostrum is available supplement with formula milk at 10-15 ml/kg after discussion with the mother. Repeat blood glucose before the next feed (no longer than three hours after the start of the previous feed)
Buccal Glucose should not be given without a feeding plan (see Appendix 6).
Encourage feeding and expression of milk as per Feeding plan in Appendix 6.
If second pre-feed glucose remains 1.0-1.9 mmol/L repeat step 1 and repeat the blood glucose before the next feed
If more than 2 measurements 1.0 -1.9 mmol/L, inform Neonatal team for review.
Investigate for causes of hypoglycaemia.
Consider Sepsis.
Consider increased feed frequency (2 hourly feeds).
If not tolerating feed volumes orally start NG feeds at the same volume
If tolerating feed volumes start IV 10% Glucose infusion at a rate appropriate for age and gestation based on fluid guidelines (enteral feeds can be continued)
If blood glucose remains 1.0-1.9 mmol/L while on IV fluids – see section below on 'If intravenous infusion being given'
If pre-feed glucose ≥ 2.0 mmol/L continue feeding plan and recheck before next feed.
If 2 consecutive Pre-Feed Glucose ≥ 2.0 mmol/L, discontinue measurements and continue feeding plan. Observe feeding for 24 hours.

If Mother Plans to Feed with Formula
Give 40% buccal glucose (see appendix 5 for dose) followed by a feed of at least 10-15 ml/kg and repeat blood glucose before next feed (no longer than three hours after the start of the previous feed).
Buccal glucose should not be given without a feeding plan (Appendix 6).

If second pre-feed glucose remains 1.0-1.9 mmol/L repeat step 1 and repeat the blood glucose before the next feed.
If more than 2 measurements 1.0-1.9 mmol/L, Inform Neonatal team for review.
o Investigate for causes of hypoglycaemia
o Consider Sepsis o Consider increased feed frequency (2 hourly feeds)
o If not tolerating feed volumes orally start NG feeds at the same volume
o If tolerating feed volumes start IV 10% glucose infusion at a rate appropriate for age and gestation based on fluid guidelines (enteral feeds can be continued)
If blood glucose remains 1.0-1.9 mmol/L while on IV fluids – see section below on 'If intravenous infusion being given'
If Pre-feed Glucose ≥ 2.0 mmol/L continue feeding plan and recheck before next feed.
If 2 consecutive Pre-Feed Glucose ≥ 2.0 mmol/L, discontinue measurements and continue feeding plan. Observe feeding for 24 hours.
If Intravenous Infusion being given (See Appendix 8 for how to calculate high concentrations)
Increase infusion rate of 10% glucose as required to maximum of 25% above appropriate daily rate – usually equivalent of one day ahead of normal fluid volume
If infusion rate is at a maximum, increase glucose concentration to 12.5%. Give centrally if access available. Alternatively, in the first instance this can be given via a peripheral IV line and consider siting central access in case higher concentrations are required or for line security. The peripheral IV site must be monitored closely with 15-minute observations of the site and line pressure documented. The IV site must be visible at all times.
If blood glucose remains less than 2 mmol/L despite the above measures, increase dextrose concentration further as required. This must be via a central line.
If blood glucose remains less than 2 mmol/L despite 25% glucose concentration being infused consider glucagon 200 micrograms/kg (MAX 1mg per dose) IV or IM rather than/as well as escalation to 30% glucose and discussion with paediatric endocrinologist urgently.
Measure blood glucose no less frequently than 1 hourly until stability obtained (i.e. > 2mmol/L).

4.10.2 Blood Glucose less than 1.0mmol/L on any Measurement and / or Major Clinical Signs such as Fits or Coma (see Appendix 4)

Remember: Only take a glucose reading from the gas machine. The handheld blood glucose monitors are not accurate at lower readings.
Admit to neonatal unit, Obtain immediate IV access.
If unable to obtain immediate IV access – Give 200 mg/kg 40% glucose gel while gaining access. OR give IM Glucagon (200 microgram/kg)
Take lab sample for accurate blood glucose, hypoglycaemia screen, urine collection bag/cotton wool and send urgently. (Appendix 7)
Give an IV bolus of 10% glucose at 2.5 ml/kg, repeated within 10-20 minutes if signs do not resolve, followed immediately by intravenous infusion at a rate appropriate for age and gestation based on fluid guidelines.

- Regardless of clinical signs, ensure the blood sugar level is repeated within 30 minutes of the bolus

Measure blood glucose no less frequently than hourly until stability obtained (i.e. > 2.5 mmol/L).

Increase glucose infusion volume and concentration as described in previous paragraph to achieve blood glucose greater than 2.5 mmol/L.
If blood glucose remains less than 2.5 mmol/L despite 25% glucose concentration being infused consider glucagon 200 micrograms/kg (MAX 1mg per dose) IV or IM rather than/as well as escalation to 30% glucose and discussion with paediatric endocrinologist urgently. (Regional team in Manchester Royal Hospital).
If there is difficulty establishing intravenous access and the diagnosis is thought to be hyperinsulinism give glucagon at a dose of 200 micrograms/kg (MAX 1mg per dose), IV or IM. If glucagon is given, intravenous access must be obtained and an infusion commenced within 30 minutes (after which all glucose reserves will have been utilised)
Consider other causes of hypoglycaemia e.g. septicaemia
If blood glucose is persistently less than 1.2 mmol/L investigate further (see below) and consider discussion with paediatric endocrinologists. Apply urine bag for sample collection in case this is warranted.
Do not stop establishment of breast feeding unless baby is too unwell or clinical contraindications to enteral feeds.
Encourage expression of Breast milk.
In formula fed infants, continue to feed if no contraindications to enteral feeds.

4.11 When to Investigate Hypoglycaemia

Screening tests should be performed if there is persistent hypoglycaemia of less than 1.2mmol/L despite appropriate management or if glucose requirement remains greater than 8mg/kg/minute after 48 hours of age, unless the underlying cause is clear (e.g. infant of a diabetic mother). It is important that they are performed while the infant is hypoglycaemic or as soon as possible afterwards as they may alter once normoglycaemia is obtained. The following samples should be sent (see Appendix 7 for results table and where to send samples)

4.11.1 Blood Samples

2 x Yellow fluoride heparin tube 1 mL: glucose, lactate, Intermediary metabolites (ketones, fatty acids, 3-hydroxybutyrate),
2 x Brown serum tube 2 ml: Insulin, cortisol, growth hormone
Orange lithium heparin tube 1 mL: Plasma amino acids + Ammonia (please call the lab out of hours before sending)
Single Guthrie blood spot for Acylcarnitines
Blood gas for pH, glucose and lactate

4.11.2 Urine Samples

Amino acids and organic acids 10 mL

4.12 Drug Treatment

If hypoglycaemia is sufficiently severe to warrant drug treatment, further management should be discussed with paediatric endocrinologists.

4.12.1 Hyperinsulinism

Treat to keep blood glucose greater than or equal to 3.5 mmol/L
Early central line to allow delivery of hyperosmolar solutions

If delivery rate exceeds 8 mg/kg/min consider the use of diazoxide + chlorothiazide after discussion with paediatric endocrinologist

5.0 Associated documents and references

British Association of Perinatal Medicine (BAPM) (2017) Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant – A Framework for Practice. Available at: http://www.bapm.org/publications/Hypoglycaemia%20F4P%20May%202017.pdf (Accessed 30 July 2017)
British Association of Perinatal Medicine (BAPM) (May 2023) Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant – DRAFT Framework for Practice. Available at:
https://www.bapm.org/resources/identification-and-management-of-neonatal-hypoglycaemia-in-the-fullterm-infant-birth-72-hours (Accessed 21 December 2023)
Weston PJ, Harris DL, Battin M et al. Oral dextrose gel for treatment of newborn infants with low blood glucose levels. Cochrane Database of Systematic Reviews 2016, Issue 5. Art. No.: CD011027. DOI:
10.1002/14651858.CD011027.pub2
NICU Tools. Glucose Delivery Calculator. Available from:
http://nicutools.org/MediCalcs/Glucose.php3 (Accessed 30 July 2017)

6.0 Training and resources

Blood glucose monitoring should only be taken and processed by appropriately trained and competent staff members using only the blood gas machine in neonatal patients.

7.0 Monitoring and audit

This guideline will require Audit monitoring for the following purposes:

To monitor method of blood glucose measurement in neonatal patients
To monitor if hypoglycaemia screens performed appropriately
To monitor the following of appropriate pathways for at risk infants

8.0 Equality and Diversity

The Trust is committed to an environment that promotes equality and embraces diversity in its performance as an employer and service provider. It will adhere to legal and performance requirements and will mainstream equality, diversity and inclusion principles through its policies, procedures and processes. This guideline should be implemented with due regard to this commitment.

To ensure that the implementation of this guideline does not have an adverse impact in response to the requirements of the Equality Act 2010 this policy has been **screened for** relevance during the policy development process and a full equality impact assessment is

conducted where necessary prior to consultation. The Trust will take remedial action when necessary to address any unexpected or unwarranted disparities and monitor practice to ensure that this policy is fairly implemented.

This guideline can be made available in alternative formats on request including large print, Braille, moon, audio, and different languages. To arrange this please refer to the Trust translation and interpretation policy in the first instance.

The Trust will endeavour to make reasonable adjustments to accommodate any employee/patient with particular equality, diversity and inclusion requirements in implementing this guideline This may include accessibility of meeting/appointment venues, providing translation, arranging an interpreter to attend appointments/meetings, extending policy timeframes to enable translation to be undertaken, or assistance with formulating any written statements.

8.1 Recording and Monitoring of Equality & Diversity

The Trust understands the business case for equality, diversity and inclusion and will make sure that this is translated into practice. Accordingly, all guidelines will be monitored to ensure their effectiveness.

Monitoring information will be collated, analysed and published on an annual basis as part of Equality Delivery System. The monitoring will cover the nine protected characteristics and will meet statutory employment duties under the Equality Act 2010. Where adverse impact is identified through the monitoring process the Trust will investigate and take corrective action to mitigate and prevent any negative impact.

9.0 Glossary of terms.

NNU – Neonatal Unit
ANPN – Antenatal, Postnatal ward
Term infant – Baby born ≥ 37 weeks gestation
BAPM – British Association of Perinatal Medicine
NEWTT – Newborn Early warning Trigger & Track observations.
NHS – National Health Service
NHSFT – National Health Service foundation trust
BBC – Barnsley Birthing Centre
BFI – Unicef Baby friendly Initiative
NG – Naso-gastric
IV – Intravenous
IM - Intramuscular

Appendix 1

Appendix 1. Parent Information Sheet: Protecting your baby from low blood glucose

What is low blood glucose?

You have been given this leaflet because your baby is at increased risk of having low blood glucose (also called low blood sugar or hypoglycaemia).

Babies who are small, premature, unwell at birth, or whose mothers have diabetes or have taken certain medication (beta-blockers), may have low blood glucose in the first few hours and days after birth, and it is especially important for these babies to keep warm and feed as often as possible to maintain normal blood glucose levels.

If your baby is in one of these 'at risk' groups, it is recommended that they have some blood tests to check their blood glucose level. Extremely low blood glucose, if not treated, can cause brain injury resulting in developmental problems. If low blood glucose is identified quickly, it can be treated to avoid harm to your baby.

Blood glucose testing

Your baby's blood glucose is tested by a heel-prick blood test. A very small amount of blood is needed, and it can be taken with your baby in skin-to-skin contact. The first blood test should be done before the second feed (2-4 hours after birth) and repeated until the blood glucose levels are stable.
You and your baby will need to stay in hospital for the blood tests.You will know the result of the test straight away.

How to avoid low blood glucose

- **Skin-to-skin contact**
  Skin-to-skin contact with your baby on your chest helps keep your baby calm and warm and helps establish breastfeeding. Lie in a position where your head and shoulders are raised (not flat on your back). Have baby in a position where you can look into their eyes, and you can check that baby is well in this position.
- **Keep your baby warm**
  During skin-to-skin contact your baby should wear a hat and be kept warm with a blanket or towel. Once you go home from hospital your baby will no longer need to wear a hat indoors. If your baby is in a cot, keep baby warm with blankets.
- **Feed as soon as possible after birth**
  Ask a member of staff to support you with feeding until you are confident, and make sure you know how to tell if breastfeeding is going well, or how much formula to give your baby.
- **Feed as often as your baby wants, but do not leave more than 3 hours between feeds**
  Feed your baby whenever you notice "feeding cues" which include rapid eye movements under the eyelids, mouth and tongue movements, body movements and sounds, sucking on a fist. Don't wait for your baby to cry – this can be a late sign of hunger. Let your baby feed for as long as they want and offer both breasts if you are breastfeeding. If your baby is not showing any feeding cues yet, hold baby in skin-to-skin and offer a feed. To reduce the risk of low blood glucose your baby should have a feed within three hours of the beginning of the last feed. Your midwife will talk to you about when you can move to responsive feeding.

- **Express your milk (colostrum)**
  If you are reading this leaflet whilst you are pregnant you may wish to hand express some colostrum before your baby is born. We suggest you talk to your midwife to discuss if this is the right thing for you and they can talk to you about how to express milk antenatally.
  If you are breastfeeding and your baby struggles to feed, try to give some expressed breast milk. A member of staff will show you how to hand express your milk or watchthe UNICEF hand expression video (search "UNICEF hand expression"). You may also consider using a breast pump alongside hand expressing. If possible, it is good to have a small amount of expressed milk saved in case you need it later, so try to express a little extra breast milk in between feeds. Ask your midwife how to store your expressed milk and for support with using a breast pump if you still need to express milk after the first couple of days.

Don't hesitate to tell staff if you are worried about your baby

If your baby appears to be unwell, this could be a sign that they have low blood glucose. As well as doing blood tests, staff will observe your baby to check he / she is well, but your observations are also important, as you are with your baby all the time and know your baby best. **It is important that you tell staff if you are worried** that something is wrong with your baby. Parents' instincts are often correct.

Signs that your baby may be unwell

- **Your baby is not feeding well**
  In the first few days your baby should feed effectively at least every 3 hours, until their blood glucose is stable, and then at least 8 times in 24 hours. Ask a member of staff how to tell if your baby is attached and feeding effectively at the breast, or how much formula your baby needs.
  If your baby becomes less interested in feeding than before, this may be a sign they are unwell, and you should raise this with a member of staff.
- **Is your baby warm enough?**
  Your baby should feel slightly warm to touch, although hands and feet can sometimes feel a little cooler. If you use a thermometer the temperature should be 36.5^{0}C and 37.5^{0}C inclusive.
  If your baby is cold this can lead to low blood sugar. If they are too hot this can be a sign of infection which can also lead to low blood sugar.
- **Is your baby alert and responding to you?**
  When your baby is awake, he/she will look at you and pay attention to your voice and gestures.
  If you try to wake your baby, he/she should respond to you in some way.
- **Is your baby's muscle tone normal?**
  A sleeping baby is very relaxed but should still have some muscle tone in their body, arms, and legs and should respond to your touch. It can be normal to make brief, light, jerky movements. Ask a member of the team if you are not sure about your baby's movements.
  If your baby feels completely floppy, with no muscle tone when you lift their arms or legs, or if your baby is making strong repeated jerky movements, this is a sign they may be unwell.
- **Is your baby's colour normal?**
  Look at the colour inside your baby's lips and tongue – they should be pink.
- **Is your baby having difficulty with breathing?**
  Babies' breathing can be quite irregular, sometimes pausing for a few seconds and then breathing very fast for a few seconds.
  If you notice your baby is breathing very fast for a longer, continuous period, or seems to be struggling to breathe with very deep chest movements, nostrils flaring or making noises with each breath out – this is not normal. Call the emergency number given to you by your midwife.

Who to call if you are worried

- In hospital, inform any member of the clinical staff.
- At home, call the emergency number given to you by your midwife.
- Out of hours, call NHS 111 or [local number for urgent assessment]
- If you are really worried, take your baby to your nearest Paediatric A&E or dial 999. [Insert local information]

What happens if your baby's blood glucose is low?

If the blood glucose test result is low, your baby should feed as soon as possible and provide skin-to-skin contact. If the blood glucose level is very low the neonatal team may advise urgent treatment to raise the blood glucose and this could require immediate transfer to the Neonatal Unit.

Another blood glucose test will be done before the next feed or within 2-4 hours.

If you are breastfeeding and your baby does not breastfeed straight away, a member of staff will review your baby to work out why. If they are happy that your baby is well, they will support you to hand express your milk and give it by oral syringe / finger / cup / spoon.

If your baby has not breastfed, and you have been unable to express any of your milk, you will be advised to offer infant formula.

In some hospitals the team may prescribe a dose of dextrose (sugar) gel as part of the feeding plan because this can be an effective way to bring your baby's glucose level up.

If you are breastfeeding and advised to give some infant formula, this is most likely to be forone or a few feeds only. You should continue to offer breastfeeds and try to express milk asoften as possible to ensure your milk supply is stimulated.

Very occasionally, if babies are too sleepy or unwell to feed, or if the blood glucose is still lowafter feeding, he / she may need to go to the Neonatal Unit / Special Care Baby Unit. Staff will explain any treatment that might be needed. In most cases, low blood glucose quickly improves within 24-48 hours and your baby will have no further problems.

Going home with baby

It is recommended that your baby stays in hospital for 24 hours after birth. After that, if your baby's blood glucose stable and your baby is feeding well, you will be able to go home.

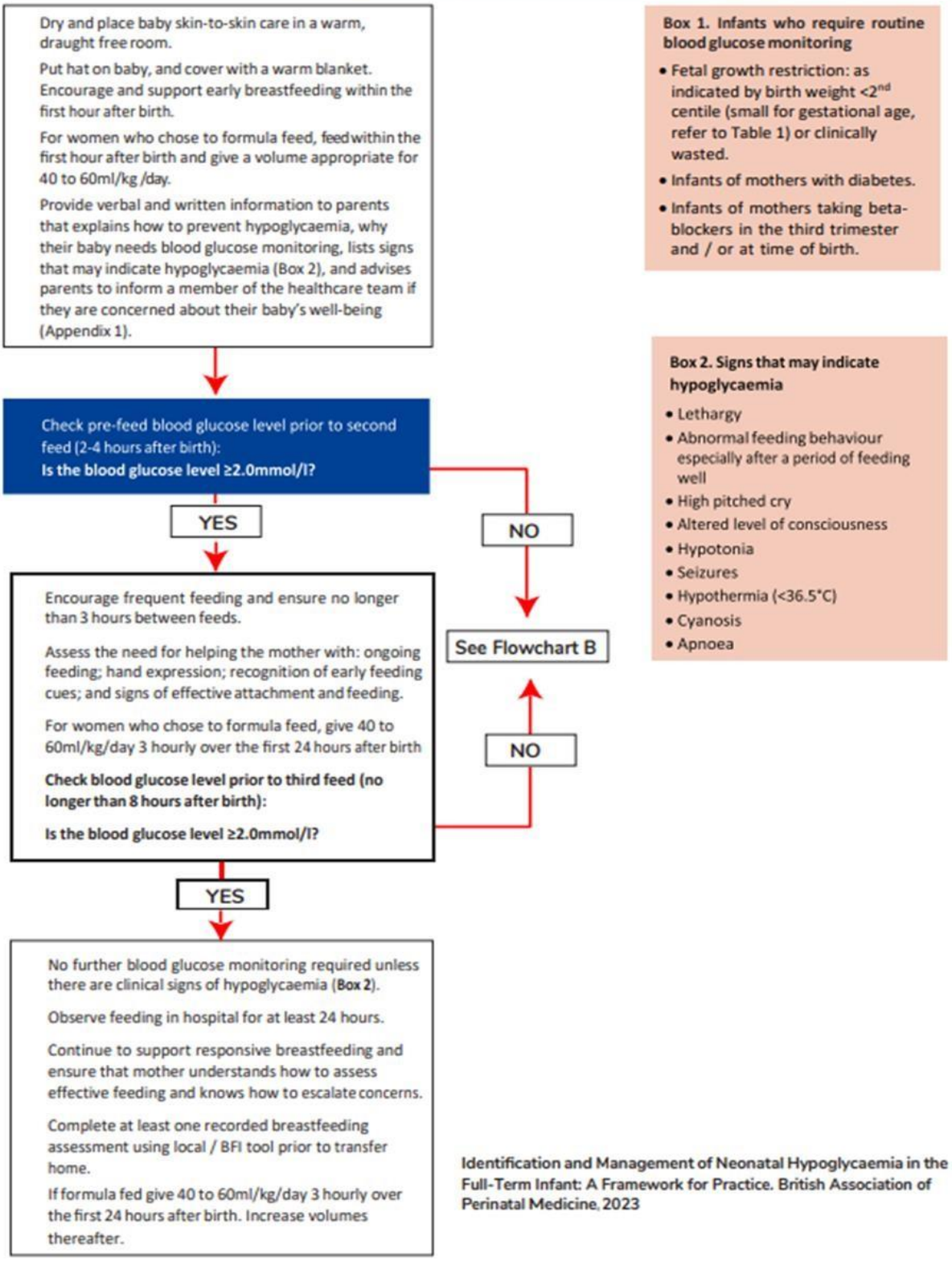
Before you go home, make sure you know how to tell if your baby is getting enough milk. A member of staff will explain the normal pattern of wet and dirty nappies and changes in the colour of dirty nappies. For further information, if you are breastfeeding, see 'How you and your midwife can recognise that your baby is feeding well' (Search 'UNICEF Baby Friendly assessment tool').

It is important to make sure that your baby feeds well **at least 8 times every 24 hours** and most babies feed more often than this. There is no need to continue waking your baby to feed every 2–3 hours as long as your baby has had at least 8 feeds over 24 hours unless this has been recommended for a particular reason. You can now start to feed your baby responsively. Your midwife will explain this. If you are bottle feeding, make sure you are not overfeeding your baby. Offer the bottle when baby shows feeding cues and observe for signs that baby wants a break. Don't necessarily expect your baby to finish a bottle – let them take as much milk as they want.

Once you are home, as with all newborn babies, you should continue to look for signs that your baby is well and seek medical advice if you are worried about your baby.

Appendix 2

Flowchart A. Management from birth - 24 hours of term infants at risk of hypoglycaemia (Box 1)



Box 1. Infants who require routine blood glucose monitoring

- Fetal growth restriction: as indicated by birth weight <2nd centile (small for gestational age, refer to Table 1) or clinically wasted.
- Infants of mothers with diabetes.
- Infants of mothers taking beta-blockers in the third trimester and / or at time of birth.

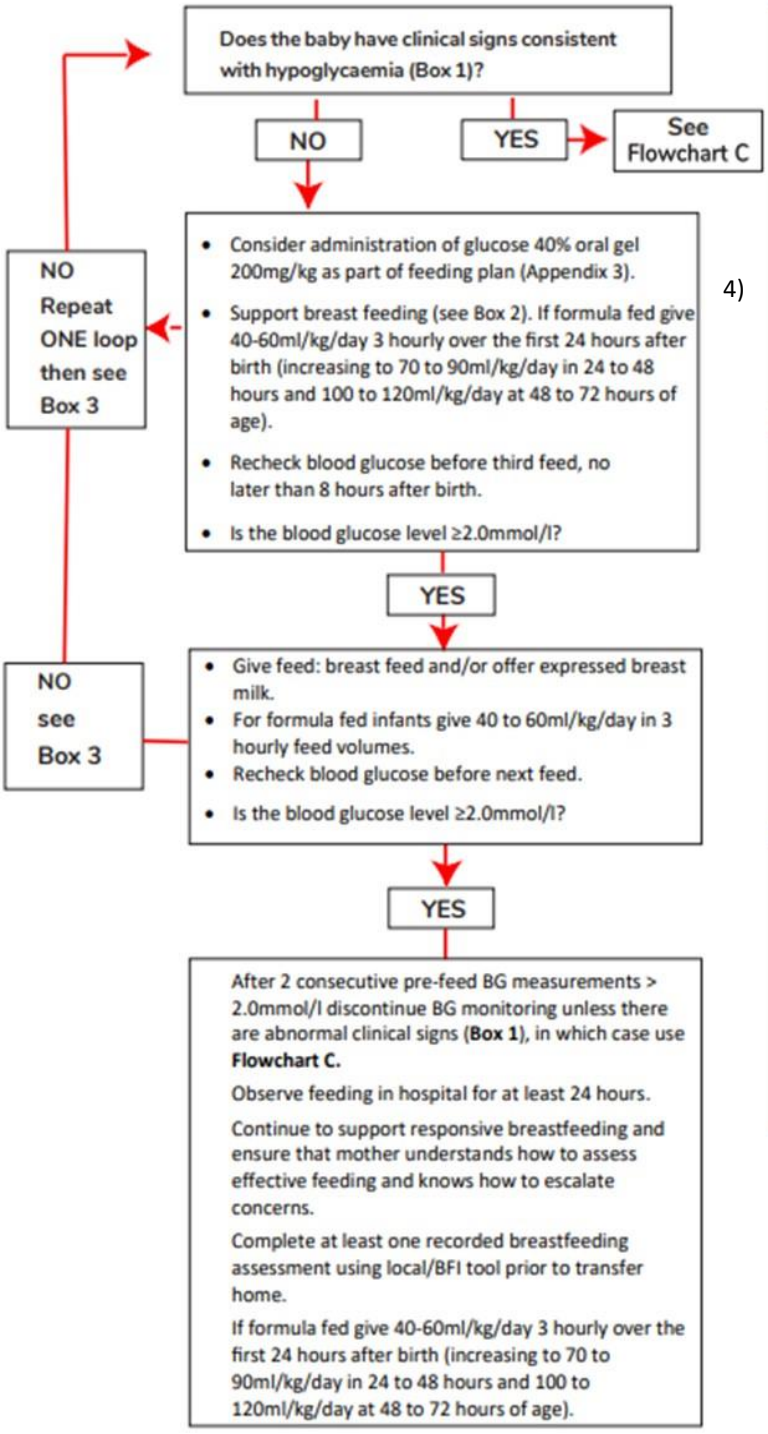
Box 2. Signs that may indicate hypoglycaemia

- Lethargy
- Abnormal feeding behaviour especially after a period of feeding well
- High pitched cry
- Altered level of consciousness
- Hypotonia
- Seizures
- Hypothermia (<36.5°C)
- Cyanosis
- Apnoea

Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant: A Framework for Practice. British Association of Perinatal Medicine, 2023

Appendix 3

Flowchart B. Pre-feed BG 1.0 to 1.9mmol/l and no abnormal clinical signs (birth to 72 hours)



4)

Box 1. Signs that may indicate hypoglycaemia

Lethargy
Abnormal feeding behaviour especially after a period of feeding well
High pitched cry
Altered level of consciousness
Hypotonia
Seizures
Hypothermia (<36.5°C)
Cyanosis
Apnoea

Box 2. Supporting breast feeding

Encourage skin-to-skin contact.

Offer breast feed and if not feeding effectively teach mother to hand express.

Give colostrum obtained to baby by the method suitable toparents.

Continue to encourage hand expression at least 8-10 times in 24 hours and support feeding on the breast until infant is feeding effectively.

Box 3. If more than 2 measurements 1.0-1.9mmol/l, inform neonatal team.

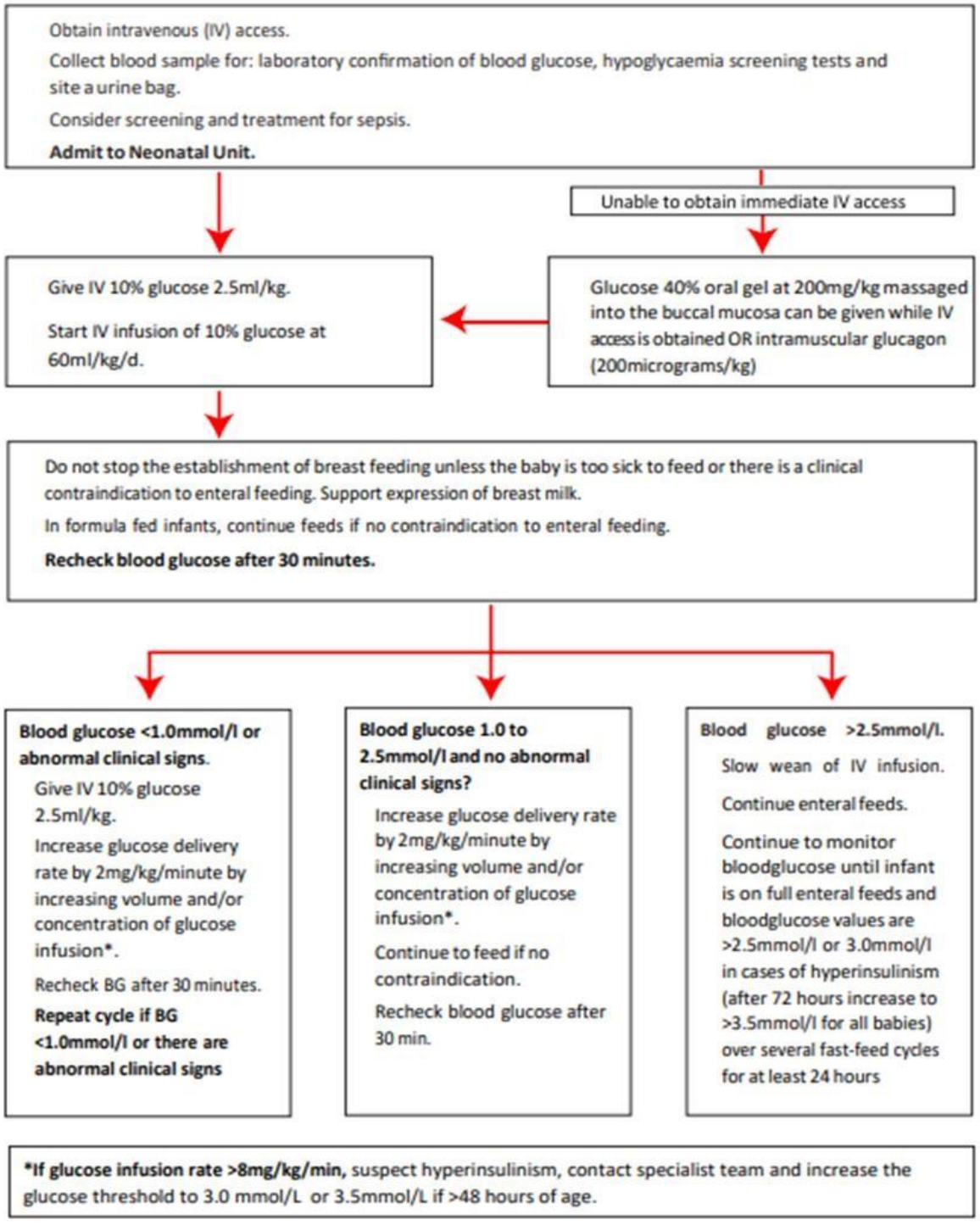
Investigate for causes of hypoglycaemia, consider sepsis.

Consider increased feed frequency, nasogastric tube insertion or IV infusion of 10% glucose.

Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant: A Framework for Practice. British Association of Perinatal Medicine, 2023.

Appendix 4

Flowchart C. Blood glucose < 1.0mmol/l and / or clinical signs consistent with hypoglycaemia



Identification and Management of Neonatal Hypoglycaemia in the Full-Term Infant: A Framework for Practice. BritishAssociation of Perinatal Medicine, 2023.

Appendix 5 – Contents of Hypoglycaemia box:

40% Dextrose Gel tubes with a copy of the following instructions + Appendix 5.
Use of buccal glucose gel
Indications
Blood glucose 1.0-1.9mmol/L in infant with no abnormal clinical signs
Infants greater than or equal to 35 weeks gestation and less than 48 hours old

For babies less than 1.5kg please see the Neonatal Formulary for dosing details

Dose
Use 200mg/kg dextrose gel (0.5ml/kg of 40% glucose gel) Store at room temperature.
See chart below for approximate volumes:

Weight of baby (kg)	Volume of gel (ml)
1.5-1.99	1
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

If more than 2 Prefeed Glucose measurements requiring Glucogel, consider NG/IV fluids
A maximum of six doses of buccal dextrose can be given in a 48-hour period

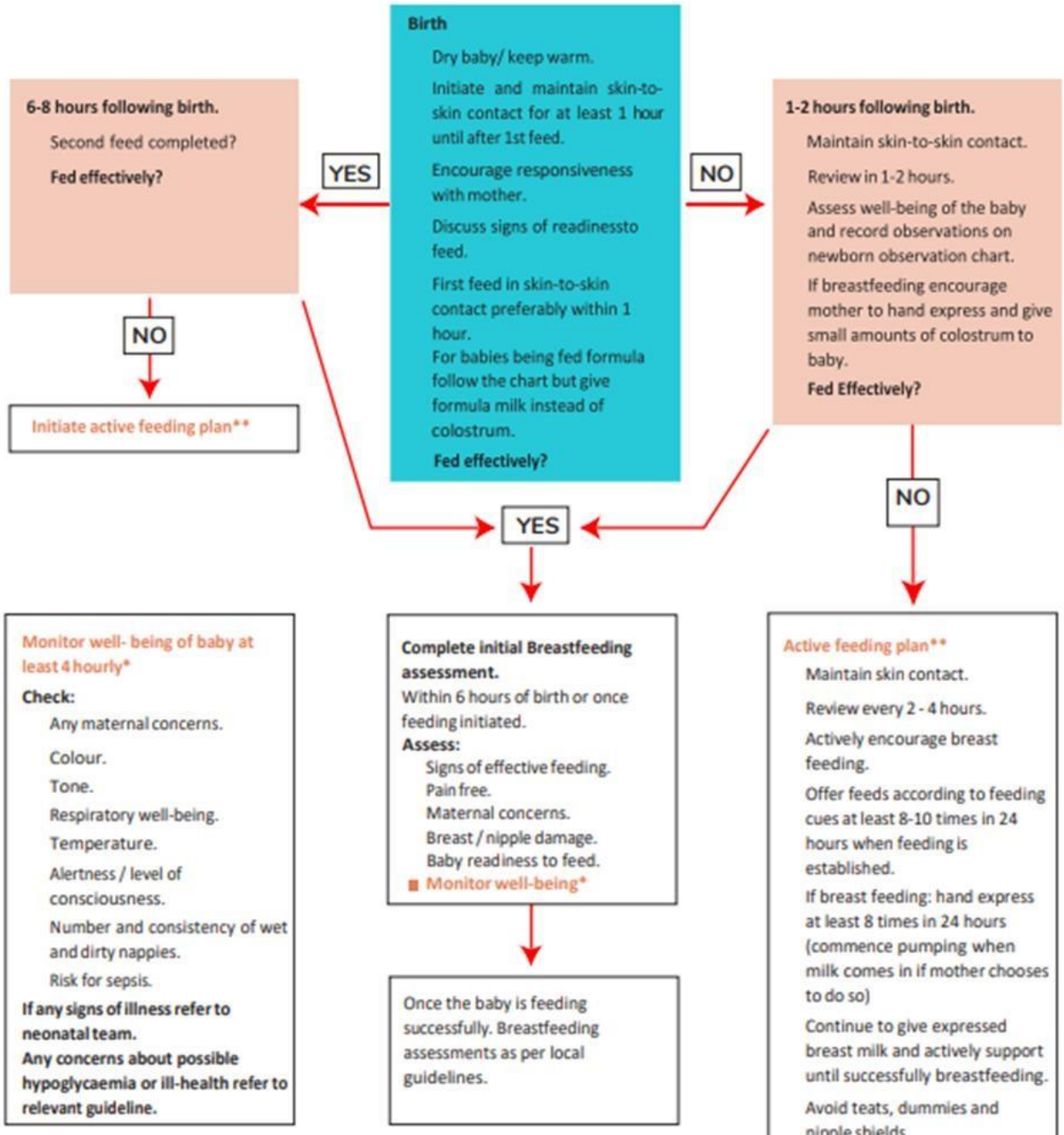
Method of administration
Twist off cap from tube
Squeeze the right amount of gel into a sterile gallipot
Draw up correct volume of 40% dextrose gel in a 2.5 ml oral/enteral syringe
Dry oral mucosa with cotton tipped applicator, gently squirt gel onto the inner cheek with the syringe
(no needle) and massage into the mucosa on the outside of the cheeks
Offer a feed immediately after administering glucose gel (breast/ebm/colostrum or 10 - 15 mls/kg of formula
Repeat blood glucose before the next feed

Notes
Buccal glucose must be given in conjunction with a feeding plan, see Appendix 6.
For babies with blood glucose less than 1mmol/L use buccal glucose gel only as an interim measure if a delay in giving IV dextrose

Give Parent Information Leaflet found in Appendix 1

Appendix 6

Flowchart D. Management of reluctant feeding in healthy term infants ≥ 37 weeks



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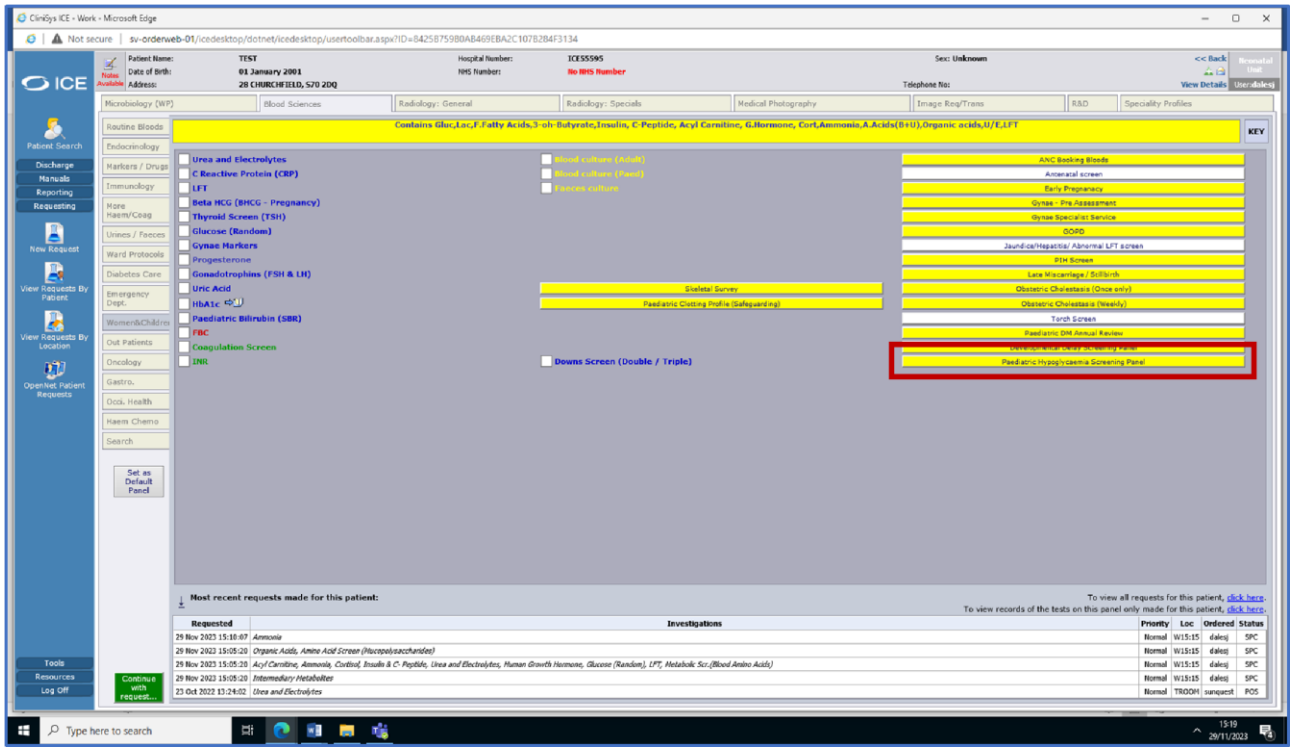
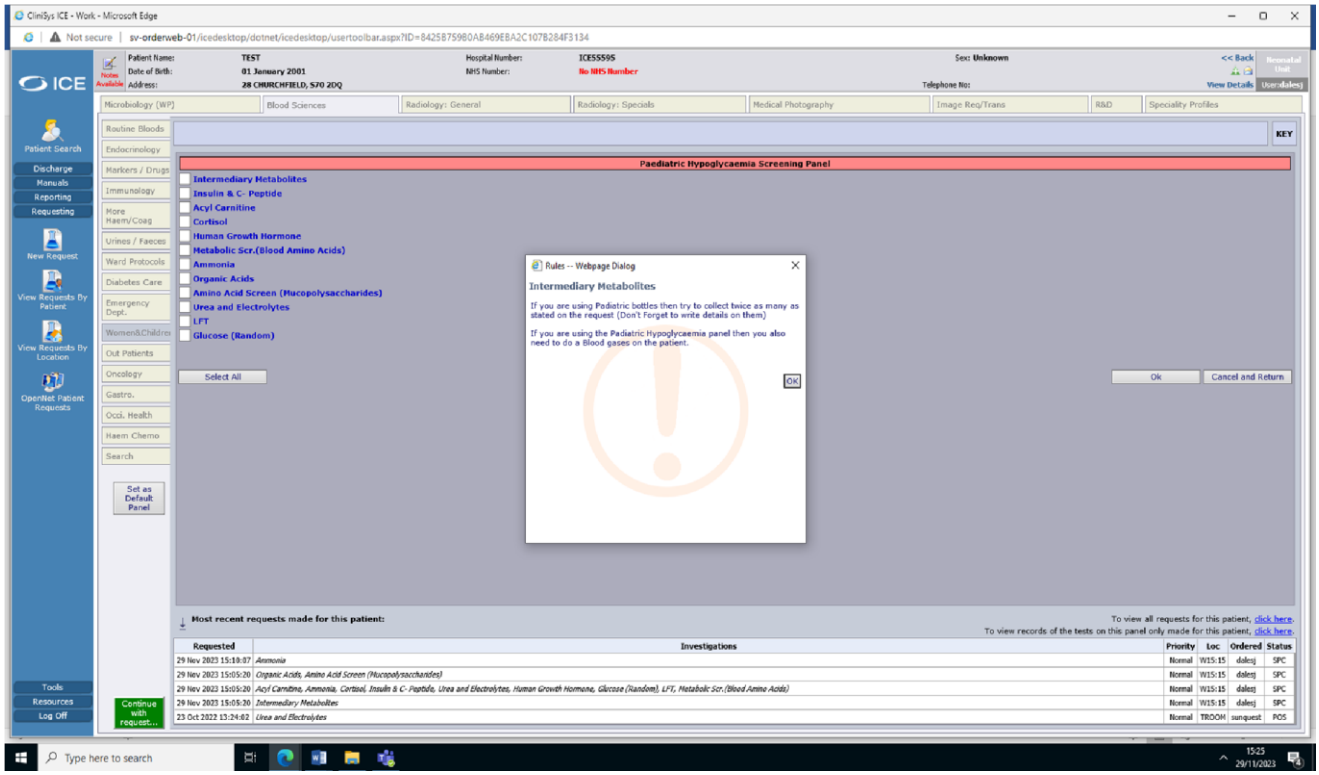
Appendix 7
Investigations for Persistent Hypoglycaemia ("Hypo Screen")

Investigation	Date sent	Result
Glucose (gas)		
Glucose (lab)		
pH		
Lactate (gas)		
Lactate (lab)		
Ketones		
Fatty acids		
3-hydroxybutyrate		
Insulin		
Cortisol		
Growth hormone		
Ammonia		
Plasma amino acids		
Acylcarnitines		
Urine amino acids		
Urine organic acids		

Samples required:
Gas:
Capillary tube to gas machine
Request pH, glucose, lactate
Yellow fluoride tube:
1ml to Clinical Chemistry - Request glucose and lactate
Yellow fluoride tube:
1ml to Clinical Chemistry
Request intermediary metabolites (ketones, fatty acids and 3-hydroxybutyrate)
Brown serum tube:
0.5-1ml to Clinical Chemistry
Request insulin, cortisol and growth hormone
Orange lithium heparin tube:
1ml to Clinical Chemistry
Request plasma amino acids and Ammonia – send in bag of ice immediately and call lab
Single Guthrie blood spot:
Send to Clinical Chemistry (they send to Sheffield Children's Hospital) - Request acylcarnitines
Urine:
10ml to Clinical Chemistry
Request urine amino acids and organic acids

Using ICE to request samples, select the Paediatric hypoglycaemia panel and send two of each paediatric bottles.





Appendix 8
Calculating Intravenous Glucose Concentration

Flow rate of 10% glucose (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/minute from ml/kg/day for any Glucose concentration:

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 used = L (%)
Volume of lower Concentration Glucose to add = LV (ml)
Higher Concentration of Glucose used = H (%)
Volume of higher concentration Glucose to add = HV (ml)

Formula: HV = V x (D – L) ÷ (H – L)
LV = V – HV

Add HV (ml) and LV (ml) to get Desired volume of Desired Concentration of Glucose.

Appendix 9 (must always be the last appendix)
Maintain a record of the document history, reviews and key changes made (including versions and dates)

Version	Date	Comments	Author

Review Process Prior to Ratification:

Name of Group/Department/Committee	Date

Trust Approved Documents (policies, clinical guidelines and procedures)
Approval Form

Please complete the following information and attach to your document when submitting a policy, clinical guideline or procedure for approval.

Document type (policy, clinical guideline or procedure)	Guideline
Document title	**Prevention of neonatal hypoglycaemia**
Document author (Job title and team)	Dr JP Dales SAS Dr Paediatrics Dr K Aucharaz Paediatric Consultant Angela Whelton Neonatal Matron
New or reviewed document	Reviewed
List staff groups/departments consulted with during document development	
Approval recommended by (meeting and dates):	Reviewed at Women's Business and Governance meeting Date: 17/05/2024 Approved at CBU3 Business & Governance Meeting Date:
Date of next review (maximum 3 years)	17/05/2027
Key words for search criteria on intranet (max 10 words)	
Key messages for staff (consider changes from previous versions and any impact on patient safety)	
I confirm that this is the <u>FINAL</u> version of this document	**Name:** **Designation:**

FOR COMPLETION BY THE CLINICAL GOVERNANCE TEAM

Approved by (group/committee):
Date approved:
Date Clinical Governance Administrator informed of approval:
Date uploaded to Trust Approved Documents page: