

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

A Clinical Guideline

For Use in:	NICU, Delivery Suite, Postnatal ward
By:	Medical Midwifery and Nursing staff
For:	Preterm infants who are born <37 weeks gestation on delivery suite, postnatal wards and NICU with potential or actual glycaemic control problems
Division responsible for document:	Women and Children (NNUH)
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If Yes - does the strategy/policy deviate from the recommendations of NICE? If so why?	No deviation

This guideline has been approved by the Trust's Clinical Guidelines Assessment Panel as an aid to the diagnosis and management of relevant patients and clinical circumstances. Not every patient or situation fits neatly into a standard guideline scenario and the guideline must be interpreted and applied in practice in the light of prevailing clinical circumstances, the diagnostic and treatment options available and the professional judgement, knowledge and expertise of relevant clinicians. It is advised that the rationale for any departure from relevant guidance should be documented in the patient's case notes. The Trust's guidelines are made publicly available as part of the collective endeavour to continuously improve the quality of healthcare through sharing medical experience and knowledge. The Trust accepts no responsibility for any misunderstanding or misapplication of this document.

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Objective

- 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

Rationale

Definitions of hypoglycaemia remain controversial but it is nevertheless a relatively common finding in the newborn. 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.

Its aim is to

- Improve patient safety through appropriate care at the appropriate time
- Improve the parent and newborn experience

Guideline

Definition of neonatal hypoglycaemia:

Neonatal hypoglycaemia is controversial. 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.

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.

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However it must be remembered that the common thresholds for the diagnosis of hypoglycaemia in the newborn (blood glucose <2.6 mmol/L) are at the limits of accuracy for many POC glucose analysers.

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.

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
- al assessment and and also consider blood sugar measurement

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**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](#)

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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 Appendix 2) 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.

At delivery:

A clear plan of action for all babies at risk for hypoglycaemia should be agreed with the neonatal team and documented by the midwife in the infant's notes, to include:

- Observation of wellbeing
- A first feed as soon as ready [but always within the first 60 minutes]
- If a mother chooses to formula feed give 10-15mL/kg in the first hour after birth
- Skin to skin contact to be encouraged
- A plan for thermal care to maintain temperature 36.5-37.5°C [dry baby, keep warm and initiate skin to skin contact; apply hat, cover with warm blanket]
- If the baby has not taken a breastfeed within one hour of birth then expressed breast milk [EBM] should be given by cup if available [aiming for a volume of at least 1mL]. If EBM not available then formula should be given at a volume of 4mL/kg [i.e. a 3 hourly amount equivalent to 32mL/kg/day]. This should be discussed with parents and documented in the notes.

Standard Care should include:

- Observe carefully for feeding cues
- Feed the baby responsively ie 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.
- Continue to encourage skin to skin contact to promote breastfeeding and thermoregulation
- A full set of observations (including level of consciousness) should be documented pre-feed [at least 3 hourly] for the first 24 hours in the locally used neonatal observation record sheet.
- 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 ≥ 2.6 mmol/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.

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Normal blood glucose (BG) estimations:

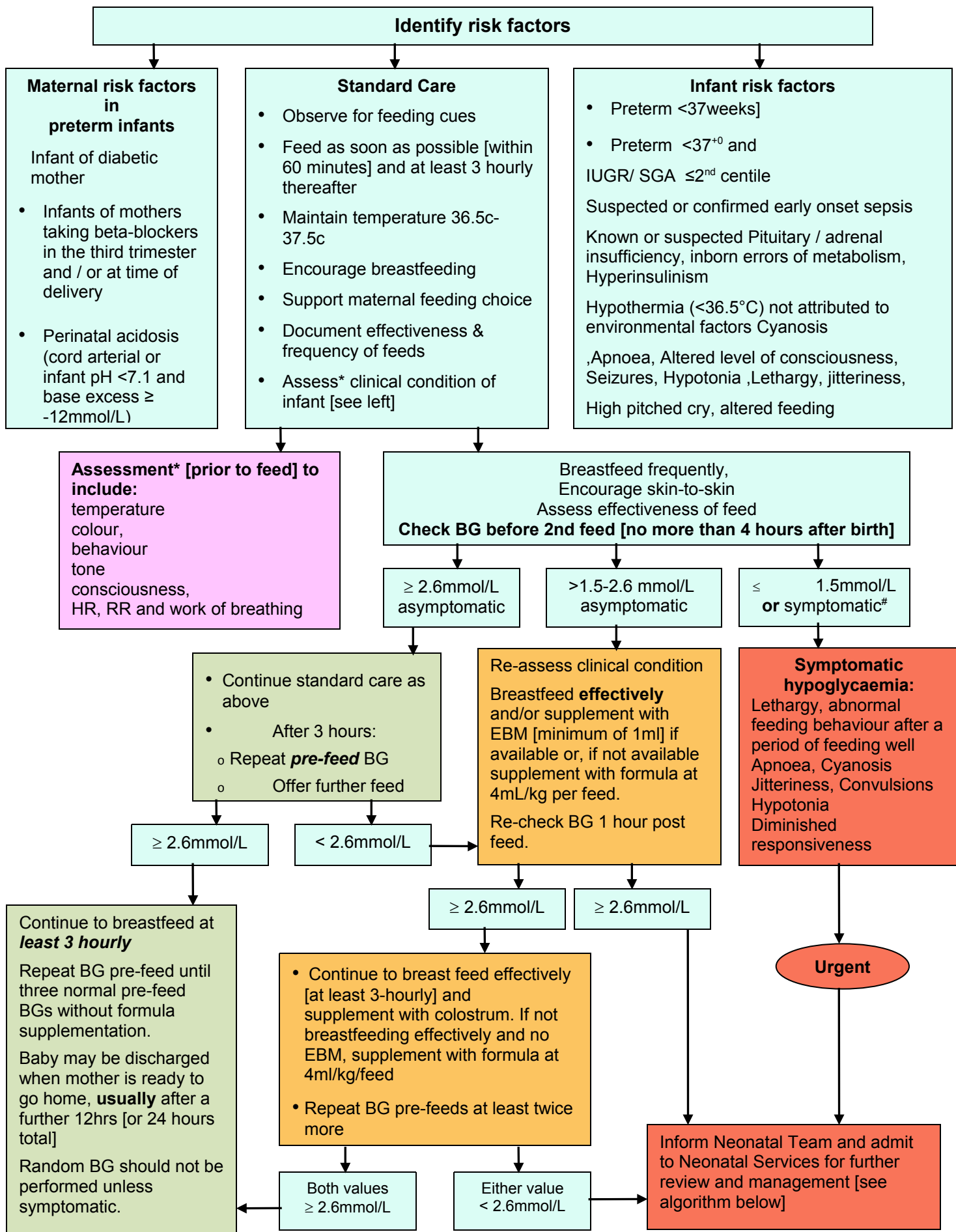
- If 3 consecutive pre-feed BG are ≥ 2.6 mmol/L without formula supplementation:
 - Responsive i.e. baby-led feeding should then be encouraged [aim for a minimum of 8 feeds in 24 hours]
 - BG monitoring may be discontinued.
- Once BG monitoring has been discontinued feeding should be closely observed for a sufficient period of time i.e. usually a minimum of 12 hours more [or 24 hours in total] to ensure feeds are established and effective.
- If the clinical condition or feeding pattern deteriorates then the baby should be reviewed by the Neonatal team and relevant investigations taken [to include a repeat pre-feed BG]
- At-risk infants should be reviewed daily by a paediatrician or ANNP until satisfactory feed pattern and BG values have been established

Asymptomatic hypoglycaemia:

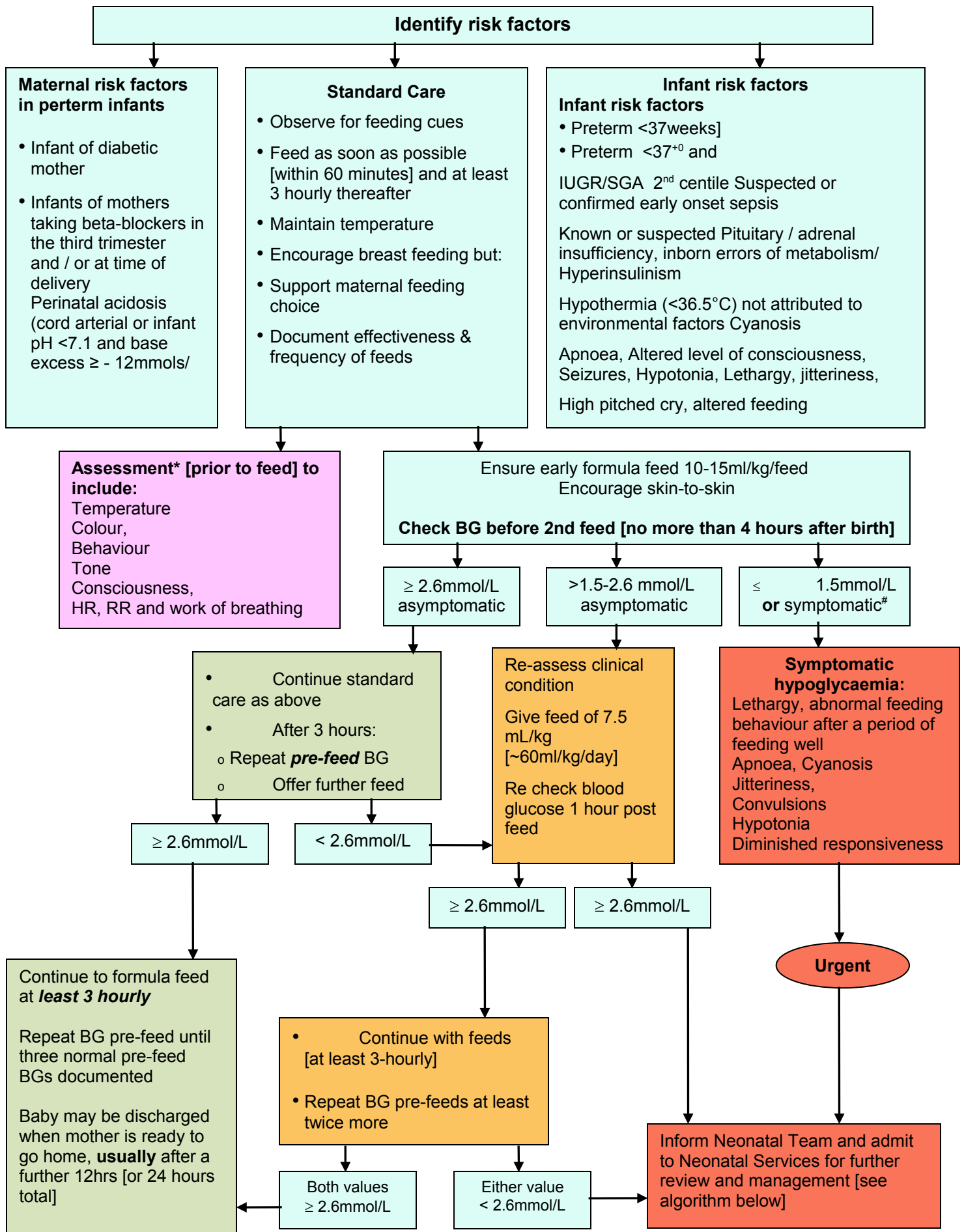
If a baby becomes hypoglycaemic [BG <2.6mmol/L], but remains asymptomatic, follow the appropriate algorithm for breast fed or formula fed babies below

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Feeding plan for Breastfed infants at risk of hypoglycaemia



**Joint Trust Guideline for the Management of Hypoglycaemia in
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Feeding plan for Formula fed infants at risk of hypoglycaemia



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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:

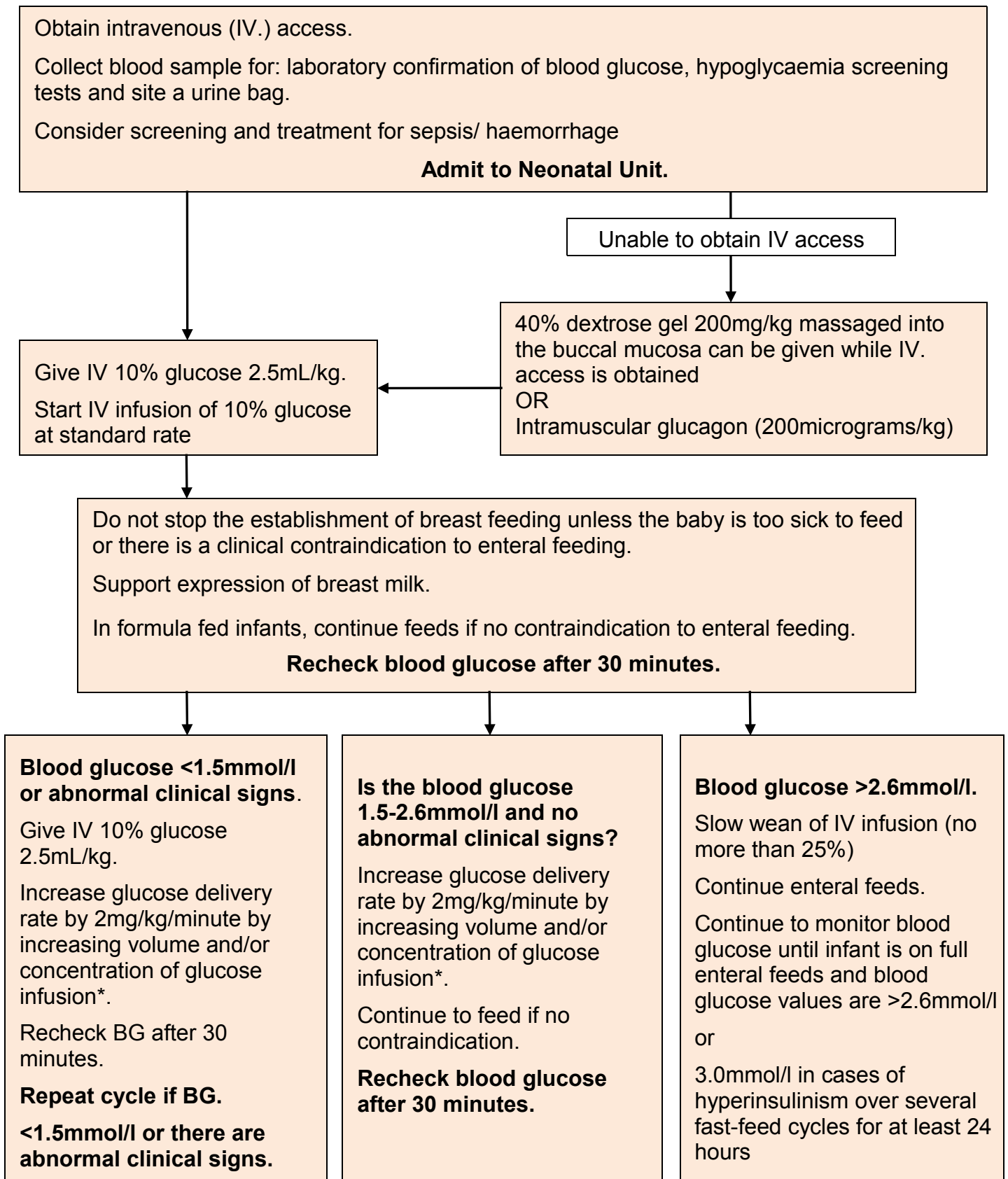
- Abnormal feeding behaviour especially after a period of feeding well
- Jitteriness – repetitive, unprovoked movements of one or more limbs*
- Lethargy and/or hypotonia
- Feeding difficulties [poor suck, refusal to feed]
- Irritability and or tremor
- Apnoea and cyanotic episodes
- High pitched cry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

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



***If glucose infusion rate >8mg/kg/min, test for hyperinsulinism**

See Appendix 2: How to calculate glucose delivery rate in mg/kg/min from ml/kg/day for any concentration of glucose

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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 the 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 ≥ 8 mg/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 for 3 consecutive values]
- Enteral feeds as described in the algorithm

Treatment of asymptomatic persistent moderate [BG 1.5-2.6 mmol/L] hypoglycaemia

If BG has not risen above 2.6mmol/L despite two adequate feeds, then insert IV cannula and give 10% dextrose infusion at standard fluid rate for gestation, birth-weight and postnatal age. If BG does not respond institute other interventions as above

Investigation of Hypoglycaemia

If hypoglycaemia is severe [< 1.5 mmol/L] or persistent [BG < 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

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Summary of development and consultation process undertaken before registration and dissemination

This guideline is drafted by Dr. Muthukumar based on preciously existing guideline while pending further guidance from BAPM in the management of hypoglycaemia in preterm neonates.

In 2020 it became a joint guideline with the James Paget University Hospital.

It is endorsed by the Clinical Guidelines Assessment panel

Clinical Audit Standards

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

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

Distribution list / dissemination method

Hospital intranet

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21. Identification and Management of Neonatal Hypoglycaemia in the Full Term Infant – A Framework for Practice October 2017

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Appendix 1

Parent Information Sheet produced by British Association of Perinatal Medicine

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 hypoglycemia).

Babies who are small, premature, unwell at birth, or whose mothers are diabetic 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 in order 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 done while you are holding 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. During skin-to-skin contact your baby should wear a hat and be kept warm with a blanket or towel.

- **Keep your baby warm**

Put a hat on your baby for the first few days while he / she is in hospital. Keep your baby in skin contact on your chest covered with a blanket and look into your baby’s eyes to check his / her well-being in this position, or keep warm with blankets if left in a cot.

- **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 possible in the first few days**

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, offer your baby a feed. Don’t wait for your baby to cry – this can be a late sign of hunger.

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- **Feed for as long, or as much, as your baby wants.**

To ensure your baby gets as much milk as possible.

- **Feed as often as baby wants, but do not leave your baby more than 3 hours between feeds.**

If your baby is not showing any feeding cues yet, hold him/her skin-to-skin and start to offer a feed about 3 hours after the start of the previous feed.

- **Express your milk (colostrum).**

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 watch the UNICEF hand expression video (search “UNICEF hand expression”). 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.

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 so know your baby best. **It is important that you tell staff if you are worried** that there is something wrong with your baby, as parents' instincts are often correct.

The following are signs that your baby is well:

- **Is your baby feeding well?**

In the first few days your baby should feed effectively at least every 3 hours, until 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 he / she 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 between 36.5 c and 37.5c inclusive.

- **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, they 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. 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. 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.

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- **Is your baby's colour normal?**

Look at the colour of the lips and tongue – they should be pink.

- **Is your baby breathing easily?**

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 continuous period (more than 60 breaths per minute), 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.

Who to call if you are worried

- In hospital, inform any member of the clinical staff.
- At home, call your community midwife and ask for an urgent visit or advice, via MEDICOM on 01603 481222.
- Out of hours, call NHS 111
- If you are really worried, take your baby to your nearest Paediatric A&E or dial 999.

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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 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 he / she is happy that your baby is well, s/he 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 for one or a few feeds only. You should continue to offer breastfeeds and try to express milk as often 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 low after 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 your baby

It is recommended that your baby stays in hospital for 24 hours after birth. After that, if your baby's blood glucose is stable and he / she 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 changes in the colour of dirty nappies and number of wet/dirty nappies. For further information, if you are breastfeeding, see 'Mother's Checklist- how can I tell if breastfeeding is going well' in your postnatal record.

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 he / she 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 he / she shows feeding cues and observe for signs that he / she wants a break. Don't necessarily expect your baby to finish a bottle – let him / her take as much milk as he/she wants.

Once you are home, no special care is needed. 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 at all about your baby.

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%