### **HYPOGLYCAEMIA** • 1/8

#### **BABIES <37 WEEKS' GESTATION**

Management of these babies should follow the guidance below with the following amendments (See Flowchart 4&5)

- Use blood glucose threshold of >2.6 mmol/L (instead of 2.0 mmol/L)
- Continue to monitor blood sugar pre-feed until 4 consecutive values >2.6 mmol/L
- Screen all babies <37 weeks for hypoglycaemia
- Use nasogastric (NG) feeds (see Nasogastric tube administration of feed, fluid or medication guideline) in preference to IV fluids for a well baby who is unable to take sufficient milk volumes orally
- If baby 34–36<sup>+6</sup> weeks unable to tolerate NG feeds, admit to NNU for IV fluids

#### BABIES ≥37 WEEKS' GESTATION

 Follow the guidance below which is based on Identification and Management of Neonatal Hypoglycaemia in the Full Term Infant – A Framework for Practice, British Association of Perinatal Medicine April 2017

#### RISK FACTORS FOR HYPOGLYCAEMIA - TO BE GIVEN RED BLANKET

- Intrauterine growth restriction
- birth ≤2<sup>nd</sup> centile (Table 1) or
- clinically wasted
- · Babies of diabetic mother
- Babies of mother taking beta blockers in third trimester and/or at time of delivery

Table 1: Second centile weights for boys and girls by week of gestation (see <a href="https://www.bapm.org/resources/newborn-early-warning-trigger-track-newtt-framework-practice">https://www.bapm.org/resources/newborn-early-warning-trigger-track-newtt-framework-practice</a>)

| Gestational age<br>(weeks) | Weight (kg) |       |
|----------------------------|-------------|-------|
|                            | 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  |

#### CLINICAL SIGNS SUGGESTIVE OF HYPOGLYCAEMIA

- Presence of ≥1 of the following clinical signs/diagnoses is an indication to measure blood glucose:
- perinatal acidosis (cord arterial or baby pH <7.1 and base deficit ≥-12)</li>
- hypothermia (<36.5°C) not attributable to environmental factors</li>
- suspected/confirmed early neonatal sepsis
- cyanosis
- apnoea
- altered level of consciousness
- seizures
- hypotonia
- lethargy
- high pitched cry
- abnormal feeding behaviour (not waking for feeds, not sucking effectively, appearing unsettled, demanding very frequent feeds) especially after a period of feeding well may be indicative of hypoglycaemia
- jitteriness (excessive repetitive movements of ≥1 limb which are unprovoked and not in response to stimulus) is common and is not by itself an indication to measure blood glucose

#### MEASUREMENT OF BLOOD GLUCOSE

- Accurate measurement of blood glucose level is essential for diagnosis and management of neonatal hypoglycaemia
- A ward-based blood gas biosensor (blood gas machine) should be considered the reference standard for measuring blood glucose

### **HYPOGLYCAEMIA • 2/8**

- All current cot-side devices are prone to inaccuracy, particularly in the range 0-2.0 mmol/L
- If handheld glucometer used:
- confirm low values using an accurate method (blood gas analyser or laboratory sample)
- use only devices conforming to ISO 15197:2013 standard
- Blood samples with high PCV can produce erroneously low results

#### INITIAL MANAGEMENT OF BABY AT RISK OF HYPOGLYCAEMIA

- Provide parents with written information, e.g. <a href="https://hubble-live-assets.s3.amazonaws.com/bapm/attachment/file/53/Identification\_and\_Management\_of\_Neonatal\_Hypo\_glycaemia\_in\_the\_full\_term\_infant\_- A Framework for Practice\_revised\_Oct\_2017.pdf</a>
- Provide red blanket
- Ensure baby kept warm and commence skin-to-skin contact
- Begin care pathway in Flowchart 1
- Ensure baby offered feed within first hour
- Offer breast in response to feeding cues as often as possible
- Do not allow >3 hr between feeds until 2 consecutive blood glucose measurements >2.0 mmol/L
- If baby not showing signs of effective feeding:
- encourage continuous skin-to-skin contact and encourage mother to hand express
- continue to express 8–10 times in 24 hr until baby feeding effectively
- if no colostrum available, discuss with mother and supplement with formula milk 10–15 mL/kg until colostrum available
- If mother chooses to formula feed:
- offer 10–15 mL/kg within the first hour and plan to feed 3-hrly
- when 2 consecutive blood glucose measurements >2.0 mmol/L, demand feed
- Measure blood glucose level before second feed (2–4 hr after birth), or sooner if clinical signs suggestive of hypoglycaemia

#### SUBSEQUENT MANAGEMENT

Based on first blood glucose result, place baby on 1 of the following care pathways:

#### First pre-feed blood glucose ≥2.0 mmol/L

- Continue to follow Flowchart 1
- Check blood glucose before third feed (≤8 hr after birth)
- if ≥2.0 mmol/L no further blood glucose measurement required. Observe feeding for 24 hr in hospital and complete at least one breastfeeding assessment before discharge (see **Breastfeeding** guideline)
- if <2.0 mmol/L follow Flowchart 2</li>

#### First pre-feed blood glucose 1.0-1.9 mmol/L and no abnormal signs

- Follow Flowchart 2
- Buccal dextrose 40% gel 200 mg/kg (0.5 mL/kg of 40% gel) may be used as part of feeding plan
- use 2.5 or 5 mL oral/enteral syringe
- dry oral mucosa with gauze, gently squirt gel with syringe (no needle) onto inner cheek and massage gel
  into mucosa using latex-free gloves
- offer a feed (preferably breast milk) immediately
- · repeat blood glucose measurement as requested
- if baby remains hypoglycaemic repeat buccal dextrose 40% gel (see Flowchart 2)
- maximum 6 doses in 48 hr
  - discuss with neonatal team before giving second dose
  - examine baby before third dose
- Continue to support feeding as above
- After 2 consecutive values >2.0 mmol/L discontinue blood glucose measurement. Observe feeding for 24 hr and complete ≥1 breastfeeding assessment before discharge (see **Breastfeeding** guideline)
- If baby displays clinical signs consistent with hypoglycaemia, or >2 measurements 1.0–1.9 mmol/L, follow **Flowchart 3**

#### First pre-feed blood glucose <1.0 mmol/L, and/or clinical signs consistent with hypoglycaemia

- Follow Flowchart 3
- Seek urgent medical attention and admit to NNU
- Obtain IV access
- Collect blood samples for confirmation of blood glucose and hypoglycaemia screening tests (see Investigations)

### **HYPOGLYCAEMIA • 3/8**

- Review need to screen for/treat sepsis (see Infection in the first 72 hours of life guideline)
- Give glucose 10% 2.5 mL/kg IV and start infusion of glucose 10% at 60 mL/kg/day
- If unable to obtain immediate IV access, as an interim measure whilst awaiting IV access, give either:
- buccal dextrose 40% gel 200 mg/kg (equivalent to 0.5 mL/kg of 40% gel) as detailed above or
- single dose of glucagon 200 microgram/kg IM
- Recheck blood glucose after 30 min and continue to follow Flowchart 3

#### INVESTIGATIONS FOR HYPOGLYCAEMIA

#### **Indications**

- Persistent hypoglycaemia (>2 measurements <2.0 mmol/L within the first 48 hr of life)</li>
- Severe hypoglycaemia (<1.0 mmol/L) at any time
- Signs of acute neurological dysfunction and blood glucose <2.5 mmol/L at any time

#### Investigations

Perform following investigations during the period of hypoglycaemia

- Blood
- glucose
- insulin
- cortisol
- growth hormone
- fatty acids
- ketone bodies
- carnitine
- acylcarnitine profile
- amino acids
- ammonia
- lactate
- Urine
- ketones
- organic acids
- Review need to screen for/treat sepsis (see Infection in the first 72 hours of life guideline)
- Further investigations based on results of initial screen and following specialist advice
- Transient hypoglycaemia, defined as 1 measurement 1.0–1.9 mmol/L within the first 48 hr of life, in baby with no abnormal signs who is feeding effectively, does not require investigation

#### PERSISTENTLY LOW BLOOD GLUCOSE MEASUREMENT

- Defined as >2 measurements <2.0 mmol/L within the first 48 hr of life
- May be the first sign of hyperinsulinism or another metabolic disorder characterised by hypoglycaemia
- If blood glucose concentration remains low (<2.0 mmol/L) on ≥3 occasions in the first 48 hr, despite adequate energy provision and a feeding plan, or a glucose dose >8 mg/kg/min (glucose 10% 115 mL/kg/day infusion) is required, suspect hyperinsulinism
- Babies with suspected or confirmed hyperinsulinism may require non-standard glucose infusions to achieve target blood glucose concentration. See below for advice on making up such an infusion
- If hyperinsulism suspected or confirmed, aim to maintain blood glucose >3.0 mmol/L until insulin levels are known
- Hyperinsulinism confirmed if paired insulin and glucose measurements taken whilst hypoglycaemic give glucose:insulin ratio <0.3, or if insulin >10 picomole/L when glucose <2.0 mmol/L
- If baby suspected of having hyperinsulinism discuss with the national centre for hyperinsulinism at Royal Manchester Children's Hospital
- Give glucose >12.5% infusion via a central line [see Umbilical venous catheter insertion and removal and Long line insertion (peripherally sited) guidelines]

#### Calculation of alucose infusion rate

Glucose infusion rate in mg/kg/min = % glucose x fluid volume in mL/kg/day / 144

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IV glucose concentration

| 17 glacose concentration             |                           |  |
|--------------------------------------|---------------------------|--|
| Flow rate of glucose 10% (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                     |  |

#### 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

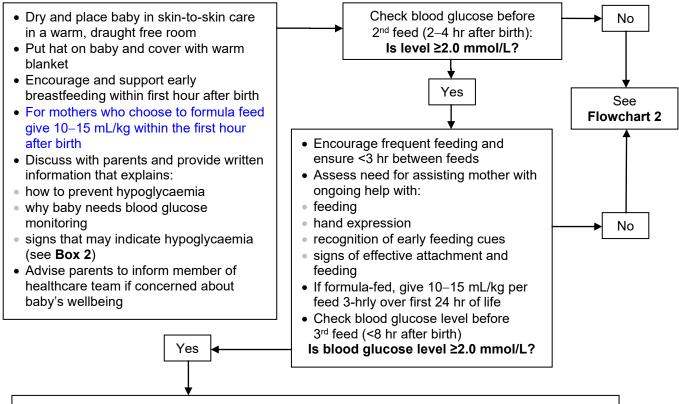
Formula: 
$$HV = V (D-L) / (H-L)$$

LV = V - HV

HV mL + LV mL = V mL of D%

 If >12.5% glucose required, give via a central line [see Umbilical venous catheter insertion and removal and Long line insertion (peripherally sited) guidelines]

Flowchart 1: Management of babies ≥37 weeks at risk of hypoglycaemia



- Continue to support responsive breastfeeding
- ensure mother understands how to assess effective feeding and escalate concerns
- If formula-fed, give 10-15 mL/kg per feed 3-hrly over first 24 hr of life
- No further blood glucose monitoring required unless clinical signs of hypoglycaemia (see Box 2)
- Observe feeding for 24 hr
- · Complete at least one recorded breastfeeding assessment before discharge

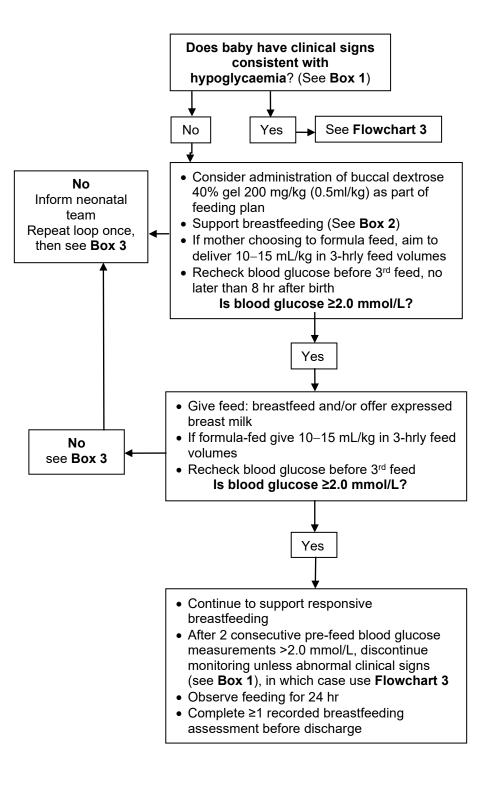
# Box 1: Babies requiring routine blood glucose monitoring

- Intrauterine growth restriction (≤2<sup>nd</sup> centile for gestation, age and sex, refer to BAPM NEWTT thresholds – see **Table 1**) or clinically wasted
- Babies of diabetic mothers
- · Maternal beta blocker use

#### 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

Flowchart 2: Pre-feed blood glucose 1.0–1.9 mmol/L and no abnormal clinical signs in ≥37 weeks



### 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

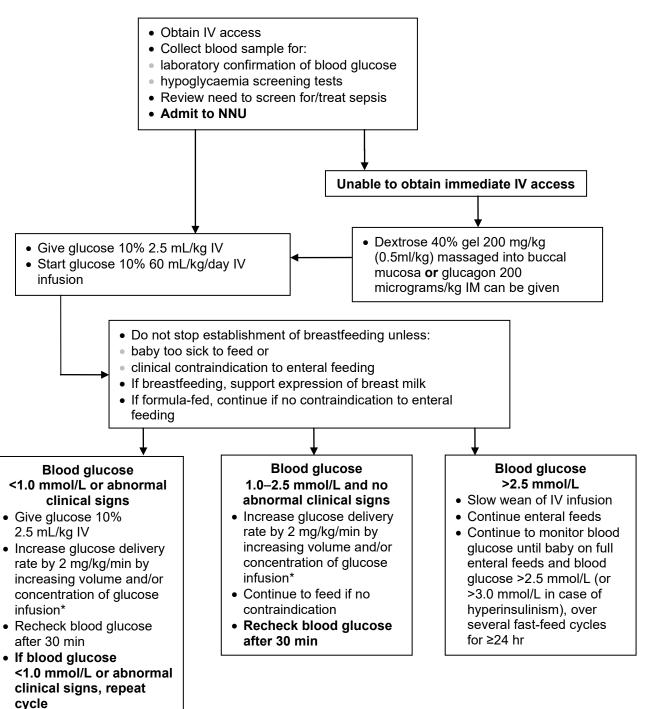
### Box 2: Supporting breastfeeding

- Encourage continuous skin-to-skin contact
- Offer breastfeed and if not feeding effectively teach mother to hand express
- Give obtained colostrum to baby by method suitable to parents
- Continue to encourage hand expression
   ≥8–10 times in 24 hr and support breastfeeding until baby is feeding effectively

# Box 3: If >2 blood glucose measurements 1.0–1.9 mmol/L, inform neonatal team

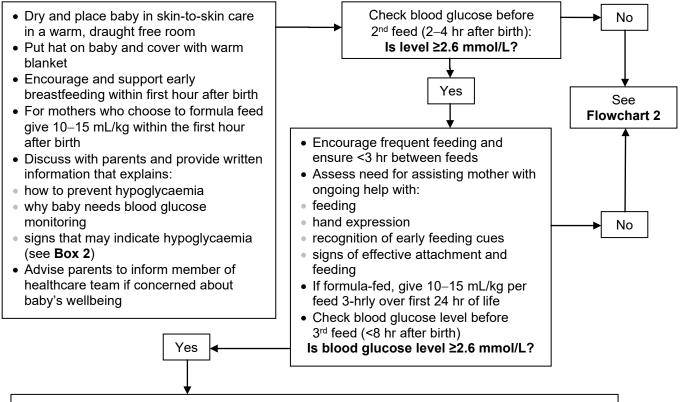
- Investigate for causes of hypoglycaemia, consider sepsis
- Consider increased feed frequency, NGT insertion or glucose 10% IV infusion

Flowchart 3: Blood glucose <1.0 mmol/L and/or clinical signs consistent with hypoglycaemia in all gestations



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

Flowchart 4: Management of babies <37 weeks at risk of hypoglycaemia



- Continue to support responsive breastfeeding
- ensure mother understands how to assess effective feeding and escalate concerns
- If formula-fed, give 10-15 mL/kg per feed 3-hrly over first 24 hr of life
- No further blood glucose monitoring required unless clinical signs of hypoglycaemia (see Box 2)
- Observe feeding for 24 hr
- Complete ≥1 recorded breastfeeding assessment before discharge

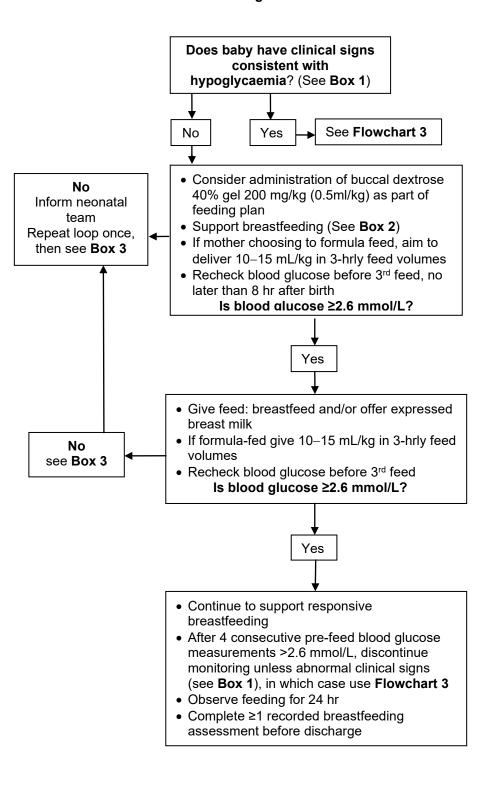
# Box 1: Babies requiring routine blood glucose monitoring

- Intrauterine growth restriction (≤2<sup>nd</sup> centile for gestation, age and sex, refer to BAPM NEWTT thresholds – see **Table 1**) or clinically wasted
- Babies of diabetic mothers
- · Maternal beta blocker use

#### 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

Flowchart 5: Pre-feed blood glucose 1.0–1.9 mmol/L and no abnormal clinical signs <37 weeks



## 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)
- Cvanosis
- Apnoea

### Box 2: Supporting breastfeeding

- Encourage continuous skin-to-skin contact
- Offer breastfeed and if not feeding effectively teach mother to hand express
- Give obtained colostrum to baby by method suitable to parents
- Continue to encourage hand expression
   ≥8–10 times in 24 hr and support breastfeeding until baby is feeding effectively

# Box 3: If >2 blood glucose measurements

### 1.0–1.9 mmol/L, inform neonatal team

- Investigate for causes of hypoglycaemia, consider sepsis
- Consider increased feed frequency, NGT insertion or glucose 10% IV infusion

#### Flowchart 6: Management of reluctant feeding in healthy breastfed infants Birth Dry baby/keep warm • Initiate and maintain skin-to-skin contact for ≥1 hr or until after first feed • Encourage responsiveness with mother · Discuss signs of readiness to feed • First feed in skin-to-skin contact, preferably within 1 hr • For formula-fed babies follow chart but give formula milk instead of colostrum Fed effectively? No Yes 1-2 hr following delivery: Yes 6-8 hr following birth: Maintain skin-to-skin contact • 2<sup>nd</sup> feed completed? • Review in 1-2 hr Fed effectively? · Assess wellbeing of baby and record observations on chart No • If breastfeeding encourage mother to hand express and give small amounts of colostrum to baby Fed effectively? Complete initial breastfeeding assessment Initiate active · Within 6 hr of birth, or once feeding initiated Yes feeding plan† (see No assess: below) · signs of effective feeding pain free maternal concerns breast/nipple damage baby readiness to feed monitor\* (see below) Once baby is feeding successfully breastfeeding assessments as per local guidelines <sup>†</sup>Active feeding plan \*Monitor wellbeing of baby at least 4-hrly • Maintain skin-to-skin contact • Review every 2-4 hr Check any maternal concerns Actively encourage breastfeeding • Offer feeds according to feeding cues ≥8-10 times colour in 24 hr when feeding established tone respiratory wellbeing • If breastfeeding: hand express ≥8-10 times in 24 hr (commence pumping when milk comes in if temperature • alertness/level of consciousness mother chooses to do so) • Continue to give expressed breast milk and number and consistency of wet and actively support until successfully breastfeeding dirty nappies risk of sepsis Avoid teats, dummies and nipple shields • If any signs of illness refer to • Support mother and listen/action any concerns voiced regarding ill-health neonatal team • If any concerns, discuss with neonatal team • If any concerns about possible • See Monitor wellbeing of baby at least 4-hrly hypoglycaemia or ill-health, refer to relevant guideline Continue until feeding issue resolves