Optimisation of the Preterm Infant <34week gestation

University Hospitals of Leicester NHS
NHS Trust

Trust ref:C28/2024

Contents

1) Introduction and Who Guideline applies to Scope

This guideline has been adapted and changed from the previous 'Early Care of Neonates at Risk of Respiratory Distress Syndrome', to focus more widely on evidence-based interventions to optimise early care of preterm infants (antenatal, intrapartum, and neonatal care).

Premature birth is defined as birth before 37+0 weeks gestation. Advances in perinatal care have evolved over time and led to continued improvement in survival and morbidity of preterm babies, with some babies born at 22-23 weeks now surviving delivery and beyond. There is a national drive towards implementing care bundles promoting perinatal optimisation and delivering evidence-based interventions which are supported and monitored by Maternity and neonatal safety improvement programme (MatNeoSIP), Saving Babies Lives version 3, British Association of Perinatal Medicine (BAPM) and National Neonatal Audit Programme (NNAP).

As we increasingly care for more immature and complex preterm infants, it is important to adapt and optimise our early care approach in those infants with greater risk of complications of prematurity. This guideline will focus on infants born between 22+0weeks to 33+6 weeks gestation, and who require adaptions in early management. Recommendations in this guideline are based on the European consensus Guideline on Management of Respiratory Distress: 2022 Update, RCUK NLS guidelines and BAPM antenatal and peripartum optimisation toolkits. The main aim of this guideline is to provide staff working in the neonatal services a framework towards approaching and managing preterm babies.

Aim:
This guideline is to identify evidence-based practice for the management of extremely preterm infants in the delivery room and on admission to NICU in the first 24 hours.

This guideline is aimed at all healthcare professionals involved in care of infants at delivery and on the neonatal unit.

1.1 Key Points:

1	Working in collaboration as a perinatal team to optimise preterm care from antenatal, intrapartum and neonatal care improves outcomes and reduces mortality in preterm infants.
2	RCUK NLS recommends resuscitation/stabilisation of preterm babies: - <28week gestation should be started in FiO_2 0.3 - 28-31week gestation can be started in FiO_2 0.21 – 0.3 Oxygen should be titrated as per response to oxygen saturations.
3	At delivery, spontaneously breathing preterm babies should, where possible, be stabilised early on CPAP to reduce risk of lung injury.

4	Early preterm respiratory care on the neonatal unit includes use of TTV if mechanically ventilated, use of early non-invasive respiratory support and use of surfactant (LISA preferred method if spontaneously breathing on non-invasive respiratory support).
5	Ensure clear documentation of NNAP metrics on admission BadgerNet.

1.2 Related UHL documents:

1. Prematurity Prevention for women/birthing people at high risk of spontaneous preterm labour (Maternity – C4/2020)
2. Preterm Labour – guideline for management in the absence of PPROM UHL Obstetric guideline (Maternity – C7/2014)
3. Guidance for medical staff asked to counsel families at the edge of viability (Neonatal – Nov 2019)
4. Resuscitation of the Newborn infant at birth (Neonatal – B35/2008)
5. Thermal protection of the Newborn UHL (Neonatal - C166/2016)
6. Umbilical cord clamping UHL Neonatal guideline (Neonatal – C56/2021)
7. Less invasive surfactant administration UHL Neonatal guideline (C47/2020)
8. CPAP nursing care (Neonatal – C35/2015)
9. Continuous Positive Airway Pressure (CPAP/BIPAP/SIPPV) use in neonates (C17/2023)
10. Use of Targeted Tidal Volume Ventilation in the Newborn (Neonatal – C34/2013)
11. Management of Oxygen Saturations in Preterm Infants (Neonatal – C129/2006)
12. Caffeine therapy in preterm infants (Neonatal – C12/2012)
13. Treatment of Patent ductus arteriosus in Preterm babies (Neonatal – C14/2007)
14. The insertion and management of a baby with central venous line (CVC) on the UHL Neonatal units (Neonatal – C33/2018)
15. UHL Neonatal Parenteral Nutrition (PN) Guideline (Neonatal – C28/2018)
16. Neonatal Enteral Nutrition Guideline (Neonatal – C105/2005)
17. Use of Donor Breast Milk (Neonatal – C24/2023)
18. Probiotic administration in preterm infants (C47/2018)
19. Antibiotic Guideline for the Early-onset & Late-onset neonatal infection (Neonatal – C54/2019)
20. Cranial imaging in the preterm and term infant (Ultrasound and MRI) (Neonatal – C64/2004)
21. Pain and distress management in neonates UHL NNU Guideline (Neonatal – C13.2010)

Related East Midlands ODN documents:

Understanding Extreme Preterm Birth Information Leaflet
'East Midlands IUT Guideline Dec 2020'.

1.3 Summary of approach: Antenatal care, delivery room management and early on-going management on the neonatal unit:

ANTENATAL ASSESSMENT AND APPROACH

Antenatal Optimisation:

Discuss with obstetric and maternity on aspects of antenatal optimisation before delivery:

1. Have **antenatal steroids** been given and if yes when? (? Within 7 days)
2. Has **magnesium sulphate** been given, if yes then when?
3. Have prophylactic **antibiotics** been given?
4. Any other concerns antenatally?

PERIPrem Passport should be initiated for anticipated preterm labour and followed through after birth.

Antenatal Counselling:

- **Gather Information:** Discuss with obstetric and maternity to gather information to aid risk stratification, including gestation, growth restriction/estimated fetal weight, singleton/multiple, fetal sex and antenatal optimisation aspects.

- **Counselling:** Explore parents understanding and concerns. Counsel around outcomes and risk stratification.

- **Complex antenatal discussions** should be conducted by senior member of the neonatal team and may need to have multiple follow up discussions to allow parents time to process information.

- Clearly **document discussions** and **plan for next review** if required.

- Antenatal discussion of benefit of breast milk and expressing is important.

Collaborative working as a perinatal team (Neonatal, obstetric and midwifery) is vital to ensure optimal preterm care (antenatal, intrapartum and neonatal care).

EARLY DELIVERY ROOM MANAGEMENT

PREPARATION:

Team and allocation of role:

- Ensure appropriate team members present.
- Consultant neonatologist should be informed about preterm deliveries <28weeks gestation and may attend depending on experience of the team and condition of baby.
- Allocate roles for delivery.
- Discuss delivery room management plan with perinatal team.

Equipment:

Ensure necessary equipment available for stabilisation / resuscitation as per NLS including:

- Respiratory support, include saturation monitoring.
- Thermoregulation

Set up resuscitaire for preterm infant:

Initial pressures: 25/5

FiO_2: *<28/40*: 0.3 | *28-31/40*: 0.21 -0.3 | >31/40 0.21

Ensure thermoregulation, clear communication and working collaboratively as a perinatal team.

Optimal cord management:

Deferred Cord Clamping (DCC) should be conducted for at least 60 seconds where possible (no contraindications or need for immediate resuscitation).

Cord intact assessment should be carried out: Assess colour, tone, breathing and where possible heart rate. To assess if stable to complete 60 seconds of DCC.

Early respiratory care:

- Provide stabilisation/resuscitation as per NLS
- If respiratory support needed initial pressures used are PIP 25 and PEEP 5. PIP may need to be increased or decreased depending on response.
- If good respiratory drive, aim to stabilise on PEEP/CPAP
- Intubation may be required if:
  - Apnoea / Poor respiratory drive
  - High / increasing oxygen requirement.
  - Clinical concern

Surfactant: If required consider if suitable for LISA vs intubation

Thermoregulation:

- Environment: Limit drafts, aim delivery room temperature between 25°C – 35°C.
- Prewarm resuscitaire and towels where possible.
- Place hat

Use plastic bag (<32/40 gestation) with radiant heat.

If unable to maintain temperature >36.5°C despite optimal management, consider use of transwarmer.

Check temperature regularly during stabilisation / resuscitation and take appropriate actions to maintain temperature between 36.5°C – 37.5°C.

Post stabilisation:

- Update parents at earliest opportunity.
- Facilitate parental touch / delivery room cuddles where possible.

Ensure stable on transport system respiratory support (If needing respiratory support) and appropriate monitoring in place.

- Maintain thermal control: check temperature pretransfer and act accordingly.
- Use incubator cover to minimise excessive light and noise exposure for transfer.
- Transfer to neonatal unit.

ONGOING EARLY MANAGEMENT ON NNU:

Respiratory care:

Establish on respiratory support on admission to the neonatal unit.

Non-invasive respiratory support:

If preterm infant has adequate respiratory drive, aim to stabiles on CPAP and escalate to NIPPV/BiPAP if indicated.

Mechanical ventilation:

- If intubated, then Targeted Tidal Volume (TTV) is preferred mode of ventilation in preterm infants (lung protective)
- Minimise duration of mechanical ventilation as appropriate and extubate to non-invasive respiratory support.

Consider early surfactant administration, if any:

- FiO_2 >0.3
- Significant signs of RDS
- Worsening respiratory acidosis (pH <7.22 and pCO_2 >8).

NB: consider LISA if spontaneous breathing on NIV.

Gas: Tolerate hypercapnia (aim pH >7.22 and pCO_2 4.5-8 kPa in the first three days of life, then aim pH >7.22 and pCO_2 4.5-10 kPa after day 3).

Medications:

- Vitamin K
- Caffeine (<32/40)
- Antibiotics if indicated (aim to give within 1 hour)
- PN (<30+6/40) to start ideally within 8 hours.

Update parents:

Update parents at earliest opportunity.

Work alongside maternity team to support and encourage mother to express breast milk as soon as possible after delivery.

Documentation:

Ensure clear documentation of admission paperwork including admission examination. Aim to complete date set required by NNAP where possible.

System based summary:

CVS / Vascular access:

- Monitor haemodynamic stability (including HR, BP, urine output and lactate)
- Vascular access:
  - Insert central lines if <30+6weeks gestation or clinically unstable.
  - Aim to insert central lines in a timely manner after admission. If delay in insertion peripheral access should be considered.

Fluids / Nutrition:

- Start PN (<30+6weeks gestation) as soon as possible after birth, ideally within 8 hours. If PN not indicated or no central line, start 10% glucose.
- Colostrum should ideally be given within 6 hours of life (aim within 24hours) and feeds started as per feeding guideline.
- Start probiotics as soon as milk feeds commenced.
- Monitor fluid balance, urea & electrolytes and blood sugar.

CNS:

- Cranial ultrasound scan carried out as per guideline.
- Neuroprotective bundle: Elevate head of bed (15-30 degrees), maintain head in midline position, avoid head down & elevation of legs and show flushes / arterial blood withdrawal.
- Use containment hold and colostrum for painful procedures. Sucrose may be used for babies born >28week gestation.

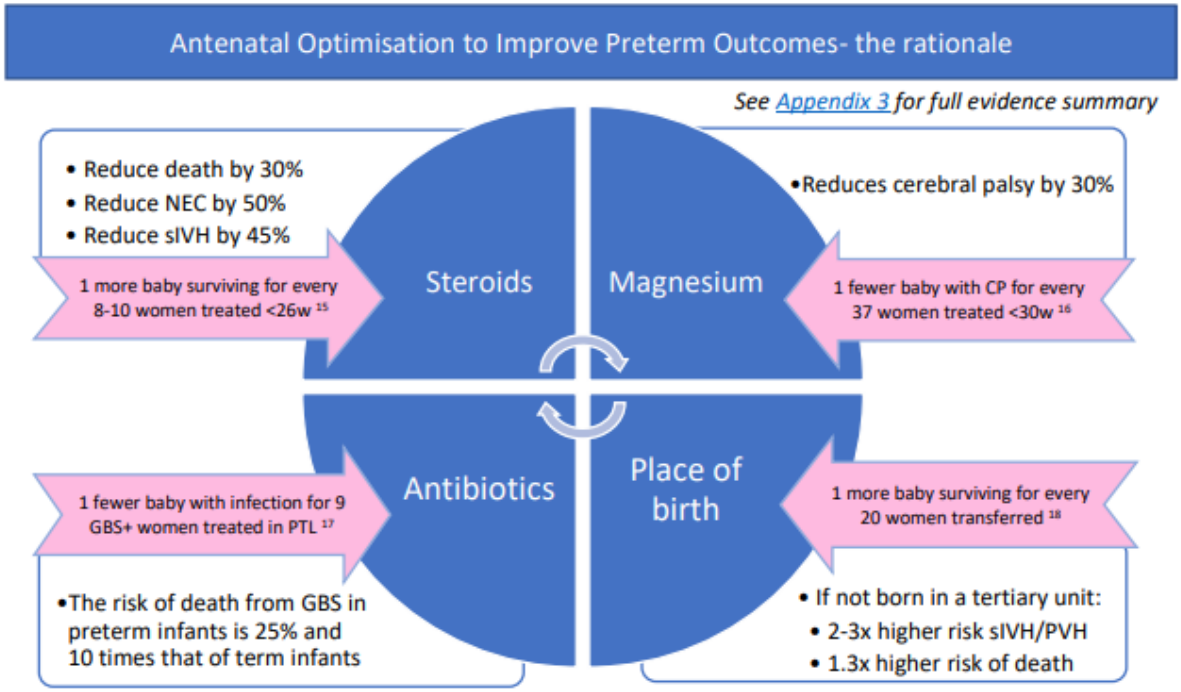
Other:

- Thermoregulation: Humidify incubator and monitor temperature during procedures.

2) Antenatal Care:

2.1 Antenatal optimisation:

Perinatal optimisation is initiated from antenatal care where suspected or confirmed preterm delivery is anticipated. The key aspects as highlighted below by BAPM antenatal optimisation toolkit:



Summary of these key elements as per UHL guidance are highlighted below:

Please refer to Prematurity Prevention for Women at High Risk of Spontaneous Preterm Labour UHL Obstetric Guideline and Preterm Labour Guidance in the Absence of PPROM UHL Obstetric Guideline

Birth in the right place:

- It is important to ensure babies are born in the correct unit for the level of care they may require.
- UHL works in close collaboration with the East Midlands ODN to provide higher levels of neonatal care to units within the south EM network. Please refer to 'East Midlands IUT Guideline Dec 2020'**.**
- Where possible, *in utero* transfers (IUT) to a neonatal intensive care unit (NICU) should be facilitated for women presenting in preterm labour <27week gestation (singleton), <28week (multiple) or birth weight <800g. If a referral is received for an IUT in this group and a neonatal cot is available, a discussion with the delivery suite coordinator and obstetrician may assist with ensuring referrals are accepted where possible.

- *Note:* LGH can provide SCBU level care for babies over 32weeks gestation. Aim to facilitate IUT should a women present in preterm labour before this.

Optimal antenatal corticosteroids:

- Single course of maternal corticosteroids should be offered to women at risk of preterm delivery <34weeks gestation.
- Maximal benefit is achieved if administered between 24hours and 7 days prior to delivery.
- A single repeat course of maternal corticosteroids may be considered by the obstetrician if previous course was more than 7 days and high risk of delivery within 48hours.

Magnesium sulphate:

- Magnesium sulphate is used for fetal neuroprotection for preterm deliveries before 32weeks gestation and should be administered ideally within 24hours from delivery.

Intrapartum antibiotics:

- All women in established preterm labour should receive antibiotic prophylaxis against group B streptococcus before birth.

2.2 BAPM Framework and antenatal counselling

BAPM framework – risk stratification:

The BAPM framework (2019) considers a risk stratification approach to management of preterm birth before 27weeks gestation and can help guide antenatal discussions between the perinatal team and parents. Based on gestation and risk stratification, shared decision making between the perinatal team and parents towards best course of management should take place, i.e., for extremely high-risk deliveries active survival focussed care vs comfort focussed (palliative) care (See appendix 1).

Please refer to BAPM Perinatal Management of Extreme Preterm Birth Before 27 weeks of Gestation (2019) framework.

Antenatal counselling:

For anticipated preterm deliveries (<34weeks gestation), where feasible, antenatal counselling should be provided by a member of the neonatal team. For extremely preterm infants, where complex decision making may be required (i.e., active survival focussed or comfort care decisions) antenatal counselling should ideally be carried out by a senior member of the neonatal team to discuss care options prior to birth, and a clear management plan documented in agreement with the parents.

East Midlands Neonatal Operational Delivery Network provide a parent leaflet on extreme preterm birth, to aide counselling. This is available in various languages and should be used as part of counselling.

Please refer to EMNODN parent leaflet 'Understanding Extreme Preterm Birth Information Leaflet'. **'Guidance for medical staff asked to counsel families at the edge of viability (Neonatal – Nov 2019)'** provides further approach to complex preterm counselling.

Where active survival focussed care is decided, antenatal counselling should include discussion on benefits of breast milk for preterm infants and importance of expressing breast milk to help facilitate early breast milk availability for baby after birth.

2.3 PERIPREM Passport

The PERIPrem passport provides a perinatal care bundle compromising of 10 aspects of care to help optimise outcomes and reduce morbidity and mortality associated with preterm birth. The PERIPrem passport should be initiated antenatally if there are signs of labour (See Appendix 2).

3) Early delivery room management:

The majority of preterm babies require stabilisation and not resuscitation at delivery, to help aid transition to postnatal life.

There are key priorities in management to focus on at delivery of a preterm infant, which need to occur in a timely manner to help optimise outcomes. The key areas that will be discussed in more detail include:

1) Perinatal team and role allocation
2) Thermoregulation
3) Optimal cord management
4) Early respiratory care (airway and ventilatory support) in delivery room
5) Pre-transfer to the neonatal unit

3.1 Preparation for delivery:

For all anticipated preterm (<34week gestation) deliveries the neonatal team should be informed to enable perinatal team discussion prior to birth. Where possible, multi-disciplinary team pre-delivery huddle should take place to ensure appropriate teams are present and discuss delivery room management plan including thermal management, deferred cord clamping (DCC) and where appropriate and possible cord intact stabilisation to give delivery room CPAP.

Key priorities for imminent delivery:

Please refer to **Resuscitation at Birth UHL Neonatal Guideline B35/2008**

- Ensure appropriate team members are present. For preterm delivery <28weeks gestation a consultant neonatologist should be called to be made aware and may attend depending on experience of the team and condition of the infant.

- Prepare equipment:
    - Standard resuscitaire with adequate air & oxygen supply (wall supply if available).
    - Neopuff circuit
    - Size appropriate face mask
    - Suction catheter
    - Hat and plastic bag
    - Stethoscope
    - Thermometer/ servo-controlled temperature monitoring (<32 weeks)
    - Saturation monitor and probe

- For preterm and unwell babies needing resuscitation, further equipment may be needed including equipment for intubation and surfactant administration.

- It is important to allocate roles amongst neonatal team, these may include:
    - Highlight which neonatal team member will assist cord intact assessment to facilitate deferred cord clamping (DCC) if no contraindication.

- Airway management including mask ventilation and potential intubation.
- Assessment of heart rate.
- Place hat and monitoring on baby, ensuring thermoregulation.
- Nomination of scribe for documentation of steps in stabilisation/resuscitation.

3.2 Thermoregulation:

Please refer to **Thermal Protection of the Newborn UHL Obstetric and Neonatal Guideline C166/2016**

Preterm babies are at greater risk of hypothermia and associated complications of morbidity and mortality. For all preterm infants, temperature should be maintained between 36.5°C to 37.5°C after birth and on admission. NNAP reviews admission temperature within one hour of birth in all babies born <34 weeks of gestation.

Ensuring optimisation of thermal management at preterm delivery:

Environment	Delivery room temperature should be aimed between 25ºC - 35ºC. Limit drafts (Close doors/windows and avoid fans directed at baby)
All preterm babies	Pre-warm resuscitaire and towels if possible During DCC, is it important to remember baby is receiving warm oxygenated blood but may need to consider use of warm towels or mother as source of radiant heat. Regularly monitor temperature at intervals during stabilisation/resuscitation and admission. Check temperature before transfer to neonatal unit and act accordingly if out of the normal range (36.5ºC – 37.5ºC)
Preterm babies <32week	Additional thermoregulatory management: - Use of plastic bag (prewarmed if possible) and radiant heater - Do not dry the baby before placing in plastic bag - Dry the head and place hat. - Do not cover the plastic bag with towels when under radiant heat on resuscitaire. - Transfer to neonatal unit, whilst in plastic bag in transport incubator.
Additional support	If unable to maintain temperature >36.5ºC despite optimal management above, consider use of transwarmer. If using transwarmer alongside radiant heater, there is a risk a hyperthermia and it is important temperature is monitored closely to avoid this. For transfer to the neonatal unit, ensure maintenance of good thermoregulatory care. Where available, a transport incubator provides the most stable environment for this.

It is important to monitor temperature regularly around birth, stabilisation, and on admission to the neonatal unit, to ensure that normothermia is achieved and maintained.

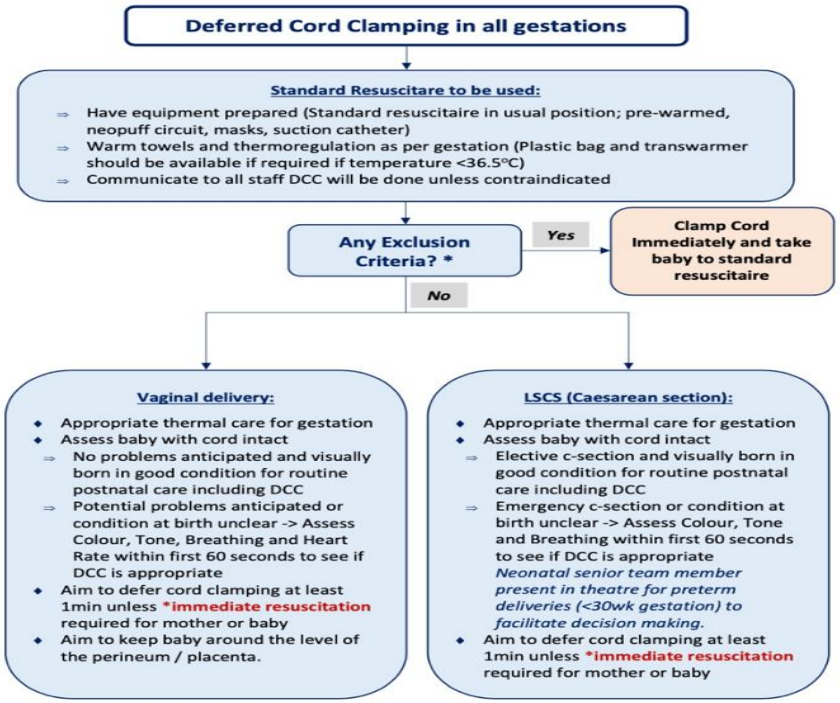
3.3 Optimal Cord Management:

Please refer to **Umbilical Cord Clamping UHL Neonatal Guideline C56/2021**

In line with the current Resus Council UK guidance, where immediate resuscitation or stabilisation is not required and there are no contraindications, then Deferred Cord Clamping (DCC) should be conducted for at least 60 seconds.

Evidence suggests in preterm babies, DCC promotes a smoother physiological transition at birth, may reduce infant mortality and facilitate more haemodynamic stability (less need for inotropes and reduction in need for blood transfusion in the early neonatal period).

For preterm infants, pre-delivery MDT discussion to help facilitate assessment with cord intact should be conducted. Cord intact assessment of breathing, colour, tone (+/- heart rate) should be made to assess if baby is stable to complete 60 seconds of DCC.



3.4 Early respiratory care in delivery room:

Evidence suggests adaptations should be made in early respiratory support for preterm babies at delivery, who are at risk of respiratory distress syndrome (RDS) and lung injury. Most preterm babies requiring gentle interventions to support normal transition and greater focus should be placed on lung protective strategies from the start, which involves:

4) Oxygen concentration and saturations.
5) Use early PEEP to deliver inflation and ventilation breaths.
6) Early CPAP for preterm babies who are spontaneously breathing.

Oxygen concentration and saturation targets in delivery suite:

Some studies have raised concerns about starting extremely preterm infants in air because of poorer recovery from bradycardia and increased mortality in the smallest babies. Presently, it is known that when titrating oxygen, most preterm infants usually receive 30–40% oxygen by 10 min, so it is reasonable to start preterm infants in oxygen until more evidence is available. Resuscitation should be initiated in air, or a low inspired oxygen concentration based on gestational age:

Gestation	Initial inspired oxygen
≥32 weeks	Air (21%)
28-31 weeks	21-30%
<28 weeks	30%

FiO2 should be adjusted as guided by pre-ductal (Right hand/wrist) oxygen saturations. NLS Resus council UK recommendation for oxygen saturation target by age shown below:

Acceptable pre-ductal SpO_2	
2 min	65%
5 min	85%
10 min	90%

Aim to avoid both hyperoxaemia and hypoxia. The target should be to avoid an oxygen saturation below 80% and/or bradycardia at 5 minutes of age, and should prompt a gradual increase in supplemental oxygen, titrated to reliable pulse oximeter saturation readings.

Early PEEP for stabilisation/resuscitation:

Assessment of preterm babies at delivery should follow NLS management with the aim to achieve effective ventilation once stabilised and focus on non-invasive respiratory support where possible.

Starting pressures for preterm infants:	
PIP	25cmH_2O
PEEP	5cmH_2O

If respiratory support is needed, initial inflation breaths should be given using an appropriately sized facemask and resuscitation should follow as per NLS algorithm (See appendix 3). Use of PEEP with provision of inflation breaths reduces the need for ventilation. PIP may need to be adjusted (increased or decreased) depending on clinical response. Ideally T-piece resuscitator (TPR) should be used to deliver adequate PEEP, as self-inflating bags (SIB) do not deliver CPAP effectively.

If spontaneous breathing is established, it is important to focus on maintaining stable PEEP using the facemask.

For babies who remain apnoeic or bradycardic commence stabilisation/resuscitation as per NLS algorithm, with gentle positive pressure lung ventilation.
(Start with peak inspiratory pressure 25cmH_20 and Peak end expiratory pressure 5cmH_2O)

Early CPAP use in delivery suite:

Initiation of early PEEP/CPAP helps maintain functional residual capacity and improves lung compliance. Evidence has shown reduced risk of lung injury and bronchopulmonary dysplasia in spontaneously breathing babies who were started on CPAP rather than intubated in delivery suite.

Preterm infants who have spontaneous breathing at birth should have provision of stabilisation with early PEEP/CPAP of at least 6cmH_20. Stimulation of the infant during stabilisation can help with establishing regular respirations. It is important to maintain mask seal when delivering PEEP to minimise risk of atelectasis. Prior to transfer, use of nasal CPAP from transport incubator or resuscitaire provide alternative options to facilitate stabilisation on CPAP.

Intubation in delivery suite:

Generally, extremely preterm infants are more likely to require intubation at delivery. Intubation in delivery suite should be reserved for babies who do not have a good respiratory drive, do not respond, and remain apnoeic on positive pressure ventilation or have a high oxygen requirement to maintain oxygen saturations in the desired range. However, majority of intubations can be avoided with optimal early respiratory support including early PEEP.

Surfactant in delivery suite:

Surfactant plays an important role in the management of respiratory distress syndrome (RDS) in preterm infants. Surfactant should be given in the delivery suite for preterm infants <28weeks gestation who require intubation at birth or any gestation if clinically deemed to be indicated by senior neonatal team member. Surfactant therapy is discussed in greater detail in the next section.

3.5 Pre-transfer to NNU

Prior to transfer to the neonatal unit is important to:

1) Communicate with parents.
2) Assess for stability for transfer including if on respiratory support, ensure ETT secure if intubated / secure nasal CPAP with adequate seal.
3) Thermoregulation: Check temperature and act as required to maintain good thermal care for transfer.
4) Facilitate delivery room cuddles or parental touch, if possible.
5) Use incubator cover during transfer to minimise excessive light / noise exposure and improve thermoregulation.

7) On-going Care (First 12-24 hours):

Introduction:

Once admitted to the neonatal unit, optimising early care in the first 24hours should focus on key areas mentioned below:

1) Early respiratory management
   - Surfactant therapy
   - Non-Invasive respiratory support
   - Mechanical ventilation, including use of volume targeted ventilation (TTV)
2) Other aspects of early optimisation on NNU
   - Caffeine
   - CVS and Vascular access
   - Fluid management and Nutrition, including early breast milk and probiotics
   - Sepsis
   - Neurology
3) Documentation (NNAP and BadgerNet)

4.1 Early respiratory management on NNU:

The aim of ongoing early ventilation management is to continue to minimise subsequent lung injury. This is supported by use of surfactant, permissive hypercapnia, early stabilisation on non-invasive respiratory support and if mechanically ventilated use of targetter tidal volume ventilation (TTV) and extubation to non-invasive respiratory support as soon as it is appropriate to do so.

Surfactant Therapy:

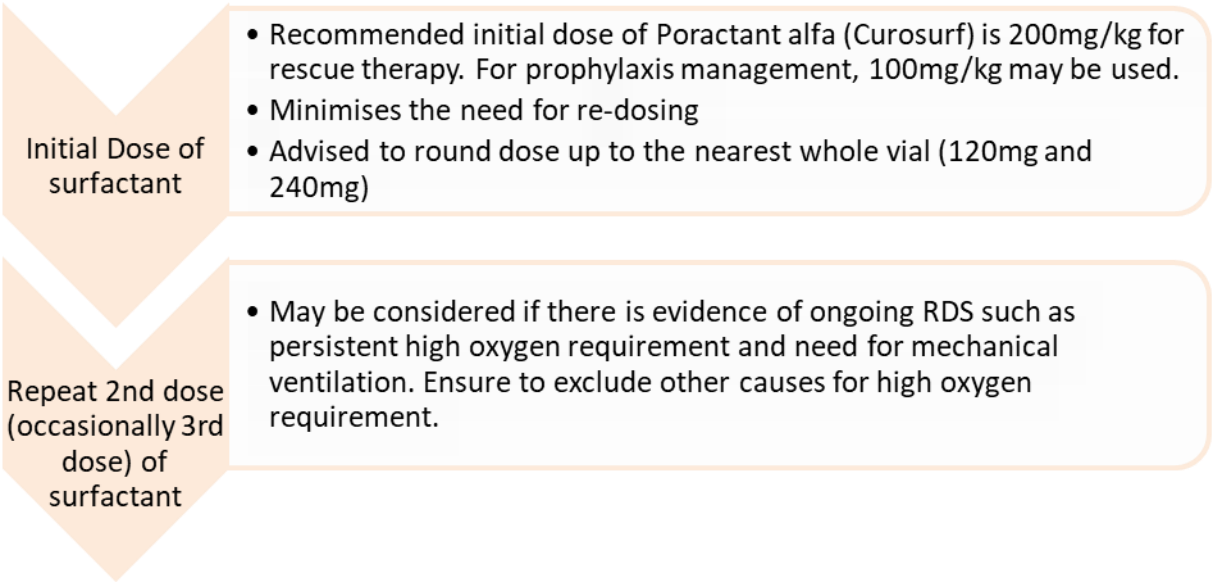
Surfactant therapy plays an important role in the management of respiratory distress syndrome (RDS) as it reduces surface tension and improves lung compliance, thereby reducing the incidence of pneumothorax and Chronic Lung Disease (CLD) and improves survival.

Indications for surfactant treatment:

With greater use of antenatal steroids and use of early initiation of non-invasive respiratory support, there is a move towards using early 'rescue' surfactant for infants with clinical signs of respiratory distress syndrome (RDS) after birth. This aims to avoid mechanical ventilation, if possible, by giving surfactant early when deemed necessary.

Preterm infants can get progression of respiratory distress syndrome, and severity can be assessed by reviewing clinical signs of respiratory distress, FiO_2 requirement to maintain target oxygen saturations and radiological appearance of RDS. Spontaneous recovery usually begins after 48–72 hours of life.

Recommended surfactant dose:



Poractant alfa (Curosurf) surfactant comes in vials of 120mg and 240mg.
Maximum total dose that can be administered is 400mg/kg.

Administration of surfactant requires a clinician experienced with intubation skills. There are various methods of administering surfactant with tracheal intubation being the traditional way. Other methods include less invasive surfactant administration (LISA) which is the preferred mode for spontaneously breathing babies on non-invasive respiratory support, provided that the clinician is experienced with this technique.
Please refer to **Less Invasive Surfactant Administration (LISA) UHL Neonatal Guideline C47/2020)** and **'Intubation guideline'**.

4.2 Methods of surfactant administration;

Less Invasive Surfactant Administration (LISA)

- Surfactant is administered slowly over 2-5minutes using a specialised thin catheter placed in the trachea under direct or video-laryngoscopy.
- The infant should remaing spontaneously breathing on non-invasive respiratory support during the procedure to allow distribution of surfactant.
- This method avoids exposure to positive pressure ventilation.

- *Criteria for LISA:*
  - *Spontaneously breathing infant*
  - *May be used in a baby of any gestational age, but may be most appropriate for stable babies born at ≥27 weeks of gestation*
  - *Signs of respiratory distress syndrome (clinical or radiological) and/or FiO2 >0.3*

- *Premedication:*
  - *Fentanyl 1-2microgram/kg IV (prepare two doses)*
  - *Have available: Atropine 15microgram/kg IV and Naloxone 10microgram/kg IV*

- *Complications: Surfactant reflux, desaturation / bradycardia, apnoea, differential administration*

InSurE

- Delivery of surfactant as with intubation (see above), with aim to extubate immediately or soon after administration of surfactant.
- To consider InSurE baby is required to have good respiratory drive and meets criteria for extubation.
- Aim is to avoid ongoing or prolonged mechanical ventilation, therefore reducing risk of ventilator associated lung injury.

Intubation and Mechanical Ventilation

- Intubate the infant if not already on mechanical ventilation

- Administer surfactant as bolus via endotracheal tube
- Deliver 5x positive pressure ventilation breaths of 2-3 seconds to allow distribution of surfactant in lungs
- Note if surfactant visibly refluxing in ETT, provide positive pressure ventilation breaths as above until surfactant not visible in ETT before giving remainder of the surfactant)

- Ensure to closely monitor and wean ventilatory settings post surfactant adminisration as lung compliance improves.

Post surfactant administration management:

Surfactant has a rapid onset; therefore, it is important to observe the infant closely post administration as the lung compliance improved. If the infant is mechanically ventilated, it may be important to wean PIP and FiO_2. For this reason, use of TTV is preferential if mechanically ventilated.

4.3 Non-invasive respiratory support:

Effectiveness of various modes of non-invasive respiratory support (Continuous Positive Airway Pressure (CPAP), Biphasic Intermittent Positive Airway Pressure (BiPAP) and Non-Invasive Positive Pressure Ventilation (NIPPV)), have been studied for use as primary and post-extubation respiratory support for preterm infants. Use of non-invasive respiratory support may reduce the need for mechanical ventilation or extubation failure in preterm infants at risk of BPD.

Preterm babies <28week gestation, not needing intubation at birth should be started on CPAP and may need escalating to NIV (BiPAP/NIPPV). At UHL, commonly used non-invasive respiratory support in preterm infants includes CPAP, BiPAP and NIPPV.

Please refer to **Continuous Positive Airway Pressure CPAP, BIPAP, SIPPV in Neonates UHL Neonatal Guideline (C17/2023)**

Continuous Positive Airway Pressure (CPAP):

Use of primary nCPAP provides a constant distending pressure, and this has several theoretical advantages including maintaining upper airway splinting, maintenance of functional residual capacity, prevention of end-expiratory airway collapse and facilitation of endogenous surfactant production.

The preterm infant must have adequate respiratory drive and ability to maintain oxygenation to enable CPAP used as the primary mode of respiratory support. Nasal CPAP should be commenced at a PEEP of 5 -8 cmH_20, and oxygen provided to maintain saturations between 91 and 95%. Short binasal prongs or mask interfaces should be sized before using.

Please refer to **Continuous Positive Airway Pressure (NCPAP) UHL Neonatal Guideline (C35/2015)** and **Continuous Positive Airway Pressure CPAP, BIPAP, SIPPV in Neonates UHL Neonatal Guideline (C17/2023)**
On admission, regular assessments should be carried out to ensure that nCPAP continues to be the most appropriate choice and may need escalation of other NIV support. For preterm babies on non-invasive respiratory support with oxygen requirement over 30% and no excessive work of breathing, surfactant should be administered, ideally via LISA.

CPAP Settings: Starting pressures of 6 – 8 cmH20 with flow 8L/Min (range 6 – 10L/min)
Aim to maintain oxygen saturations 91 – 95%

Non-invasive respiratory support failure criteria following early extubation:

- Recurrent apnoea, not improving with stimulation or caffeine (>6 episodes needing stimulation in 6 hours or more than 2 episodes needing Positive pressure ventilation)
- High FiO_2 for >1 hour to maintain oxygen saturations at or above 90%.
- FiO_2 persistently > 30% in preterm infants
- Worsening respiratory acidosis
- May need invasive ventilation, if clinically unstable requiring multi-organ intensive care support

If a preterm infant meets any of the above criteria and LISA is not possible or has not been successful, then intubation and/or surfactant is to be consider.

Please refer to **Continuous Positive Airway Pressure CPAP, BIPAP, SIPPV in Neonates UHL Neonatal Guideline C17/2023**

4.4 Mechanical Ventilation (MV):

Preterm babies may require intubation at birth or in the early neonatal period if unsuccessful in maintaining stability on non-invasive respiratory support. If a baby is intubated at delivery the initial pressures used to deliver mechanical ventilation will initially be PIP 25cmH_2O and PEEP 5cmH_20. Once the baby receives surfactant, it is important to wean the PIP and FiO_2, if possible, as the lung compliance improves and to avoid hyperoxaemia.

On admission to the neonatal unit, the aim of ongoing ventilatory management is to minimise ventilator induced lung injury, allow permissive hypercapnia and early extubation to non-invasive respiratory support. Targeted Tidal Volume (TTV) ventilation has advantages for the neonate with rapidly changing compliance such as the preterm infants (<34 weeks) who have just received surfactant for RDS.

There are various modes of MV, and modes commonly used in preterm neonates include Synchronised Intermittent Mechanical Ventilation (SIMV) and Patient Triggered Ventilation (PTV/SIPPV/PCAC). High-frequency oscillatory ventilation (HFOV) is useful as a rescue therapy in babies with severe RDS not responding to conventional ventilation. Other modes of ventilation may be used as per consultant decision.

On admission to the neonatal unit most premature infants should be started on mechanical ventilation using Targeted Tidal Volume (TTV) as preferred mode. In this mode the PIP and / or inspiratory time are automatically adjusted to deliver set tidal volume, which auto weans pressures used as lung compliance improves. However, if there is a larger leak (>20%), TTV mode may be ineffective.

Targeted Tidal Volume (TTV)	3.5 – 6 ml/kg (starting volume 4.5ml/kg)
Inspiratory time (Ti)	0.35 – 0.4
PEEP	4 - 6cmH_20
Rate	40 – 60 bpm
Flow	6 – 8 L/min
FiO_2	Titrate to maintain oxygen saturations within advised limits.
Pmax (Maximum PIP to deliver TTV)	Initially set at 20-25cmH20 (will need to be based on what pressures baby was using at time of intubation, chest movement and gas exchange assessment. This is generally set at 5-10cmH_20 above the PIP.)

Please refer to: **Oxygen Saturations in Preterm Infants UHL Neonatal Guideline C129/2006)** and **Targeted Tidal Ventilation UHL Neonatal Guideline C34/2013**

Once the baby is stable on MV and spontaneous breathing is present, then MV should be weaned with aim to extubate as soon as safe to extubate onto a form of non-invasive respiratory support (i.e., CPAP or NIV).

Criteria for "extubation readiness" in preterm neonates with RDS as the primary pathology in the first week of life:

- Mean airway pressure (MAP) <10cmH_20 (practically it is difficult to deliver nCPAP pressures above 8cm H_20)
- FiO_2 < 30%
- Rate 30 or less with adequate triggering
- Loaded with caffeine and prescribed regular maintenance dose.
- No identifiable factors that are likely to precipitate rapid reintubation e.g. sedation, anaemia, sepsis.

MV: Targeted Tidal Volume (TTV) is preferred mode of ventilation in preterm infants.
Aim for early extubation as soon as safe to do so.

4.5 Blood gas parameters:

The aim of MV is to ventilate at optimal lung volumes while avoiding over-distension and atelectasis. Acceptable blood gas parameters represent this concept and after the initial period, permissive hypercapnia is acceptable in premature babies.

	First 48-72hours	Day 3 onwards
pH	>7.22	>7.22
pCO2	4.5 – 8.0 kPa	4.5 – 10 kPa

8) Other early management aspects on NNU:

5.1 Use of Caffeine:

Please refer to **Caffeine Therapy in Preterm Infants UHL Neonatal Guideline C12/2012**

Caffeine is commonly used for the treatment for primary apnoea in premature infants. Studies of caffeine therapy in preterm infants have shown decrease in the incidence of cerebral palsy, chronic lung disease, and severe ROP in very low birth weight infants. Caffeine therapy can optimise the success of non-invasive support as it acts as a respiratory stimulant.

Dosage for caffeine citrate:

- Can be given both orally and IV
- Loading dose 20 mg/kg,
- Once daily maintenance dose 5 mg/kg (10 mg/kg once daily if symptoms persist).

Indications for starting caffeine:

- All preterm infants <32week gestation
- Preterm infants >32weeks gestation with apnoea.
- Prior to planned extubation
- Symptomatic of apnoea of prematurity

Stopping caffeine:

- At 33-34week corrected gestation with no concerns of apnoeas.

5.2 CVS and Vascular access:

CVS:

Monitor cardiovascular stability including heart rate, blood pressure, perfusion, lactate and urine output. Hypotension associated with poor perfusion will need

treatment which may consist of volume expansion (i.e., saline bolus or blood products if meeting threshold) or inotropes.

There is no evidence that early assessment and prophylactic treatment of PDA is beneficial. Please follow and refer to **Patent Ductus Arteriosus PDA in Preterm Babies UHL Neonatal Guideline C14/2007**

Vascular access:

In general, preterm infants <30+6wk gestation will require central access for parenteral nutrition (PN).

For extremely preterm or unstable infants the procedures should be performed by appropriately experienced member of the team or under direct supervision to enable timely insertion of the lines and minimise handling. Unless at the discretion of the consultant.

Once umbilical venous catheter inserted, if line bleeding back then antibiotics and 10% dextrose can be given pending confirmation of position on x-ray.

It is vital to ensure adequate thermoregulation measures are undertaken before, during and after the procedure as preterm infants are at high risk of hypothermia.

5.3 Fluid management and Nutrition:

Fluid management:

On admission, IV fluids (10% dextrose) or parenteral nutrition (if central access obtained) should be started as soon as venous access is gained. Preterm infants are at risk of hypoglycaemia in the initial period and require blood glucose monitoring.

Preterm infants can have high insensible losses therefore close fluid balance monitoring with proactive action is important and may require increasing total fluid volume. Blood for urea and electrolytes should be checked at 12 hours of life and monitored thereafter as clinically indicated.

Parenteral Nutrition (PN):

Preterm babies (<30+6week gestation) will not be able to tolerate sufficient oral feeds to meet nutritional needs and will therefore require parenteral nutrition. PN should be started as soon as possible after birth, ideally within 8 hours.

Please refer to **Parenteral Nutrition UHL Neonatal Guideline C28/2018**

Expressed breast milk (EBM):

Breast milk has benefits in promoting physiological microbiome and immunity. It helps promote gut motility, feed tolerance and bonding between the baby and mother.

All mothers of preterm babies born <34weeks gestation, should be counselled, encouraged, and supported to express breast milk within 1 hour after birth at the earliest opportunity and continued thereafter. Colostrum (including buccal colostrum) should ideally be given to preterm babies within 6 hours of life and aim within 24hours. Perinatal teams should work in collaboration to support the mother with expressing. Feeds should be increased as per the nutrition guideline.

Commence trophic feeds with Maternal expressed breast milk MEBM/Donor EBM as per nutrition guidelines in the first 24 hours. If ~~by 24-48hours,~~ no maternal EBM (MEBM) is available then use of donor EBM (DEBM) may be considered as a temporary measure for preterm infants <32weeks gestation or birth weight <1500g. Donor EBM use must be discussed with parents and consent obtained prior to use.

Please refer to **Enteral Nutrition UHL Neonatal Guideline C105/2005** and **Use of Donor Breast Milk UHL Neonatal Guideline C24/2023**

Probiotics:

For babies born <32weeks gestation or birthweight <1500g, probiotics should be started once milk feeds have been started. There is no requirement for minimal feed volume before starting probiotics.

Please refer to **Probiotics Administration in Preterm Infants UHL Neonatal Guideline C47/2018.**

5.4 Presumed Sepsis:

Sepsis is associated with morbidity and mortality in preterm infants. Assessment for risk factors for sepsis is important to help guide decision on starting antibiotics. If preterm baby is screened for sepsis, first line antibiotics should be used as per the antibiotics guideline unless clinical picture suggests need for different antibiotics. Antibiotics should be stopped as soon as possible, once sepsis has been excluded.

Please refer to **Antibiotics for Neonatal Infection UHL Neonatal Guideline C54/2019**.

5.5 Neurology:

Monitoring for IVH:

Preterm infants are at greatest risk of intraventricular haemorrhage (IVH) in the first 72hours of life. Cranial ultrasound scans should be carried out as per the cranial ultrasound guideline.

Please refer to **Cranial Imaging MRI and Head Ultrasound UHL Neonatal Guideline C64/2004.**

Neuroprotective bundle:

Neuroprotective bundle recommends measures to reduce risk of IVH in the first 72 hours of life for babies born <32week gestation or birth weight <1500g.

Measures:
Elevation of the head of the bed (15 – 30 degrees)
Maintain head in midline position
Avoid head down positioning and elevation of legs during nappy changes
Slow Arterial / Intravenous flushes and slow arterial blood withdrawal

Please refer to **'Early care neonatal neuroprotective bundle (further reading)'**.

Sedation / pain management:

For painful procedures it is important to monitor comfort scores and use conservative measures such as containment hold and oral colostrum or sucrose (>28weeks gestation) if colostrum unavailable.

Use of opioids / sedation in ventilated infants should be used selectively when indicated by clinical judgment and evaluation of pain indicators. Routine sedation of ventilated neonates with opiates is not supported by evidence.

Please refer to **Pain and Distress in the Neonate UHL Neonatal Guideline C13/2010.**

9) Early care documentation / NNAP:

Ensure clear documentation of admission paperwork. A senior clinician should meet with parents within the first 24 hours ideally as soon as is practical after admission to discuss he problems and progress of their baby. Details of this discussion should be documented in the medical notes and on badgernet.

Key elements of early preterm care on BadgerNet which are monitored by NNAP include:

- Head circumference
- First examination
- Antenatal steroids
- Antenatal magnesium sulphate
- Deferred cord clamping
- Temperature on admission

- Parental consultation within 24hours of admission by a senior clinician

Other information to be added include maternal antibiotics.

Please review appendix to see where to document above on BadgerNet (See appendix 4).

Research trials:

Neonatal services at UHL are part of various research trials which may alter various aspects early preterm care mentioned in this guideline. Consider recruitment to trials where infant meets suitability criteria.

10) Education and Training

None

11) Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Monitor use of PERIPrem passports and assess compliance to the PERIPrem parameters.				
Clear documentation around decision on respiratory support stabilisation (CPAP or intubation) in the delivery room				
Documentation of key NNAP metrics on admission summary on BadgerNet				

12) Supporting References

1. BAPM Perinatal Management of Extreme Preterm Birth <27 weeks Perinatal Management of Extreme Preterm Birth Before 27 weeks of Gestation (2019). British Association of Perinatal Medicine (bapm.org)
2. *https://www.bapm.org/resources/80-perinatal-management-of-extreme-preterm-birth-before-27-weeks-of-gestation-2019*

3. NICE. Preterm labour and birth. NICE guideline [NG25], Last updated June 2022

4. Resuscitation Council UK. Advanced Resuscitation of the Newborn Infant 2nd Edition. London 2021. ISBN 978-1-903812-40-2

5. Resuscitation Council UK. Newborn Life Support 5th Edition. London 2021. ISBN 978-1-903812-39-6

6. Saving Babies' lives care bundle, version 3; A care bundle for reducing perinatal mortality. (2023). NHS England.
7. *https://www.england.nhs.uk/wp-content/uploads/2023/05/PRN00614-Saving-babies-lives-version-three-a-care-bundle-for-reducing-perinatal-mortality.pdf*

8. Sweet DG, Carnielli VP, Greisen G, Hallman M, Klebermass-Schrehof K, Ozek E, Te Pas A, Plavka R, Roehr CC, Saugstad OD, Simeoni U, Speer CP, Vento M, Visser GHA, Halliday HL. European Consensus Guidelines on the Management of Respiratory Distress Syndrome: 2022 Update. Neonatology. 2023;120(1):3-23. doi: 10.1159/000528914. Epub 2023 Feb 15.

9. BAPM Toolkits: https://www.bapm.org/pages/104-qi-toolkits

13) Key Words

Caffeine, CPAP, Cranial imaging, Donor breast milk, Enteral, Nutrition, Parenteral, Patent ductus arteriosus, Prematurity prevention, Probiotic, Resuscitation, Respiratory distress syndrome, Surfactant, Targeted tidal volume, Thermal protection, Umbilical cord clamping, Viability

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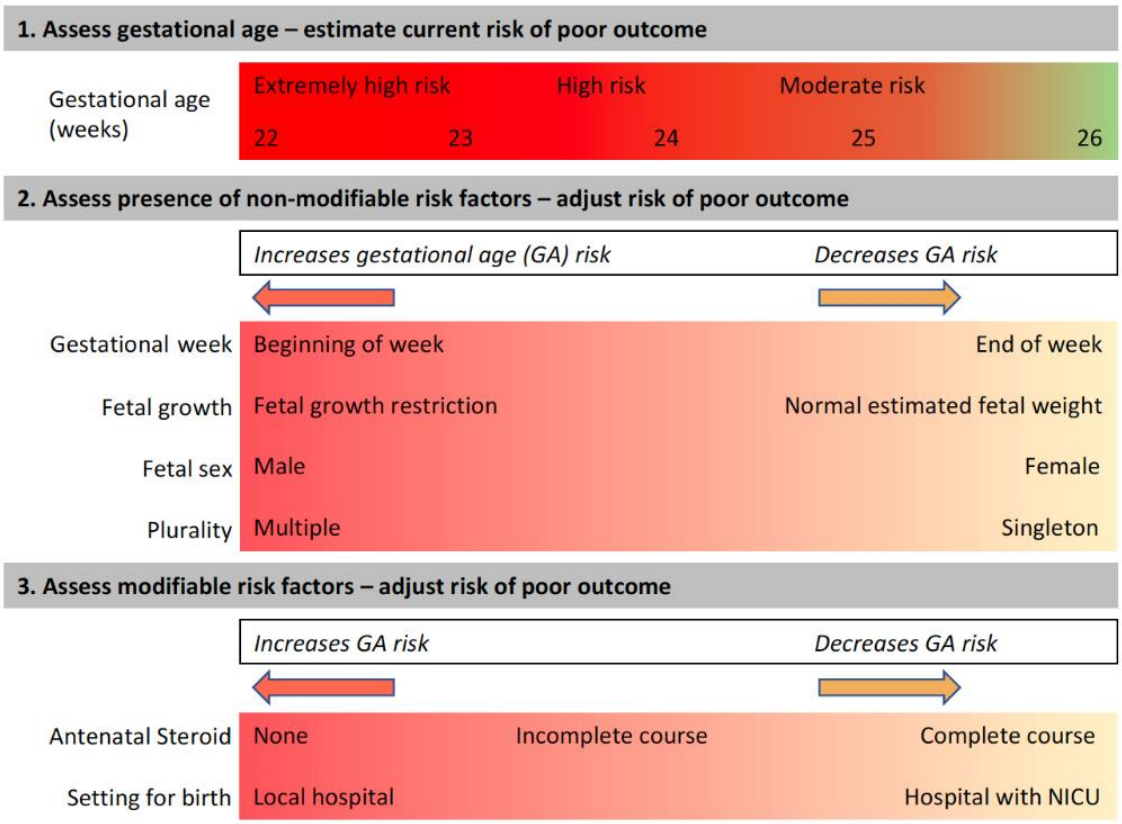
The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

Contact and review details			
Guideline Lead (Name and Title) Avineet Kaur – Neonatal Consultant Clinical guidelines lead – S Mittal -Consultant			**Executive Lead** Chief Medical Officer
Details of Changes made during review:			
Date	**Issue Number**	**Reviewed By**	**Description Of Changes (If Any)**
May 2024	**1**		**New guideline**
February 2025	**1**	**S Mittal**	**Addition made to section 5.3;** Commence trophic feeds with Maternal expressed breast milk MEBM/Donor EBM as per nutrition guidelines in the first 24 hours. Removed time frame of 24-48 hours

14) Appendix 1: BAPM Framework (2019)

Guidance below from BAPM Framework on risk stratification.



Extremely high risk: Babies with a > 90% chance of either dying or surviving with severe impairment if active care is instigated would fit into this category. For example, this would include:

- Babies at $22+^{0}$ – $22+^{6}$ weeks of gestation with unfavourable risk factors
- Some babies at $23+^{0}$ - $23+^{6}$ weeks of gestation with unfavourable risk factors, including severe fetal growth restriction
- (Rarely) babies ≥ $24+^{0}$ weeks of gestation with significant unfavourable risk factors, including severe fetal growth restriction

High risk: Babies with a 50-90% chance of either dying or surviving with severe impairment if active care is instituted would fit into this category. For example, this would include:

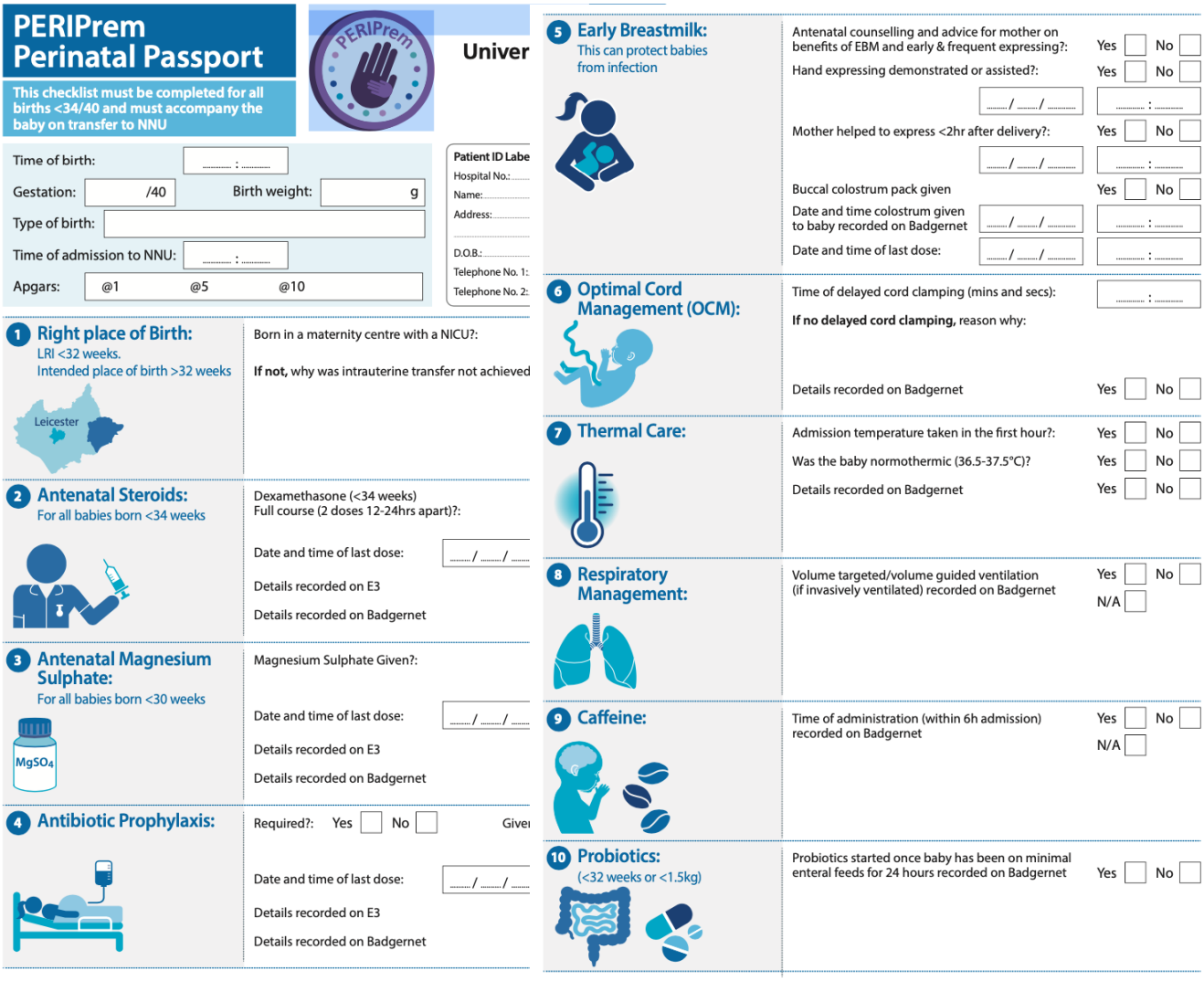
- Babies at $22+^{0}$ - $23+^{6}$ weeks of gestation with favourable risk factors
- Some babies ≥ $24+^{0}$ weeks of gestation with unfavourable risk factors and/or co-morbidities

Moderate risk: Babies with a < 50% chance of either dying or surviving with severe impairment if active care is instituted would fit into this category. For example, this would include:

- Most babies ≥ $24+^{0}$ weeks of gestation
- Some babies at $23+^{0}$ – $23+^{6}$ weeks of gestation with favourable risk factors

Extremely high risk: For babies with an extremely high risk of death or of survival with unacceptably severe impairment despite treatment, palliative (comfort-focused) care would be in the best interests of the baby and life-sustaining treatment should not be offered. There is no absolute indication for paediatric attendance at the birth although for individual families this may be helpful.
High risk: For babies with a > 50% risk of death or of surviving with unacceptably severe impairment despite treatment, it is uncertain whether active (survival focused) management is in the best interests of the baby and their family. Parents should be counselled carefully and parental wishes should inform a joint decision to provide either active or palliative treatment. Ideally, a senior neonatal clinician who has previously met the parents will be available to attend the birth and supervise implementation of the agreed plan.
Moderate risk: For babies with a < 50% risk of death or of survival with unacceptably severe impairment, active management would be in the best interests of the baby. A senior neonatal clinician should attend the birth.

15) Appendix 2: UHL PERIPrem passport



PERIPrem Perinatal Passport

This checklist must be completed for all births <34/40 and must accompany the baby on transfer to NNU

Univer

Time of birth: ..... : .....

Gestation: /40 Birth weight: g

Type of birth:

Time of admission to NNU: ..... : .....

Apgars: @1 @5 @10

Patient ID Labe
Hospital No.:
Name:
Address:
D.O.B.:
Telephone No. 1:
Telephone No. 2:

1 Right place of Birth:
LRI <32 weeks.
Intended place of birth >32 weeks

Leicester

Born in a maternity centre with a NICU?:

If not, why was intrauterine transfer not achieved

2 Antenatal Steroids:
For all babies born <34 weeks

Dexamethasone (<34 weeks)
Full course (2 doses 12-24hrs apart)?:

Date and time of last dose: ...../...../.....

Details recorded on E3

Details recorded on Badgernet

3 Antenatal Magnesium Sulphate:
For all babies born <30 weeks

$MgSO_4$

Magnesium Sulphate Given?:

Date and time of last dose: ...../...../.....

Details recorded on E3

Details recorded on Badgernet

4 Antibiotic Prophylaxis:

Required?: Yes ☐ No ☐ Give

Date and time of last dose: ...../...../.....

Details recorded on E3

Details recorded on Badgernet

5 Early Breastmilk:
This can protect babies from infection

Antenatal counselling and advice for mother on benefits of EBM and early & frequent expressing?: Yes ☐ No ☐

Hand expressing demonstrated or assisted?: Yes ☐ No ☐

...../...../..... ..... : .....

Mother helped to express <2hr after delivery?: Yes ☐ No ☐

...../...../..... ..... : .....

Buccal colostrum pack given Yes ☐ No ☐

Date and time colostrum given to baby recorded on Badgernet ...../...../..... ..... : .....

Date and time of last dose: ...../...../..... ..... : .....

6 Optimal Cord Management (OCM):

Time of delayed cord clamping (mins and secs): ..... : .....

If no delayed cord clamping, reason why:

Details recorded on Badgernet Yes ☐ No ☐

7 Thermal Care:

Admission temperature taken in the first hour?: Yes ☐ No ☐

Was the baby normothermic (36.5-37.5°C)? Yes ☐ No ☐

Details recorded on Badgernet Yes ☐ No ☐

8 Respiratory Management:

Volume targeted/volume guided ventilation (if invasively ventilated) recorded on Badgernet Yes ☐ No ☐ N/A ☐

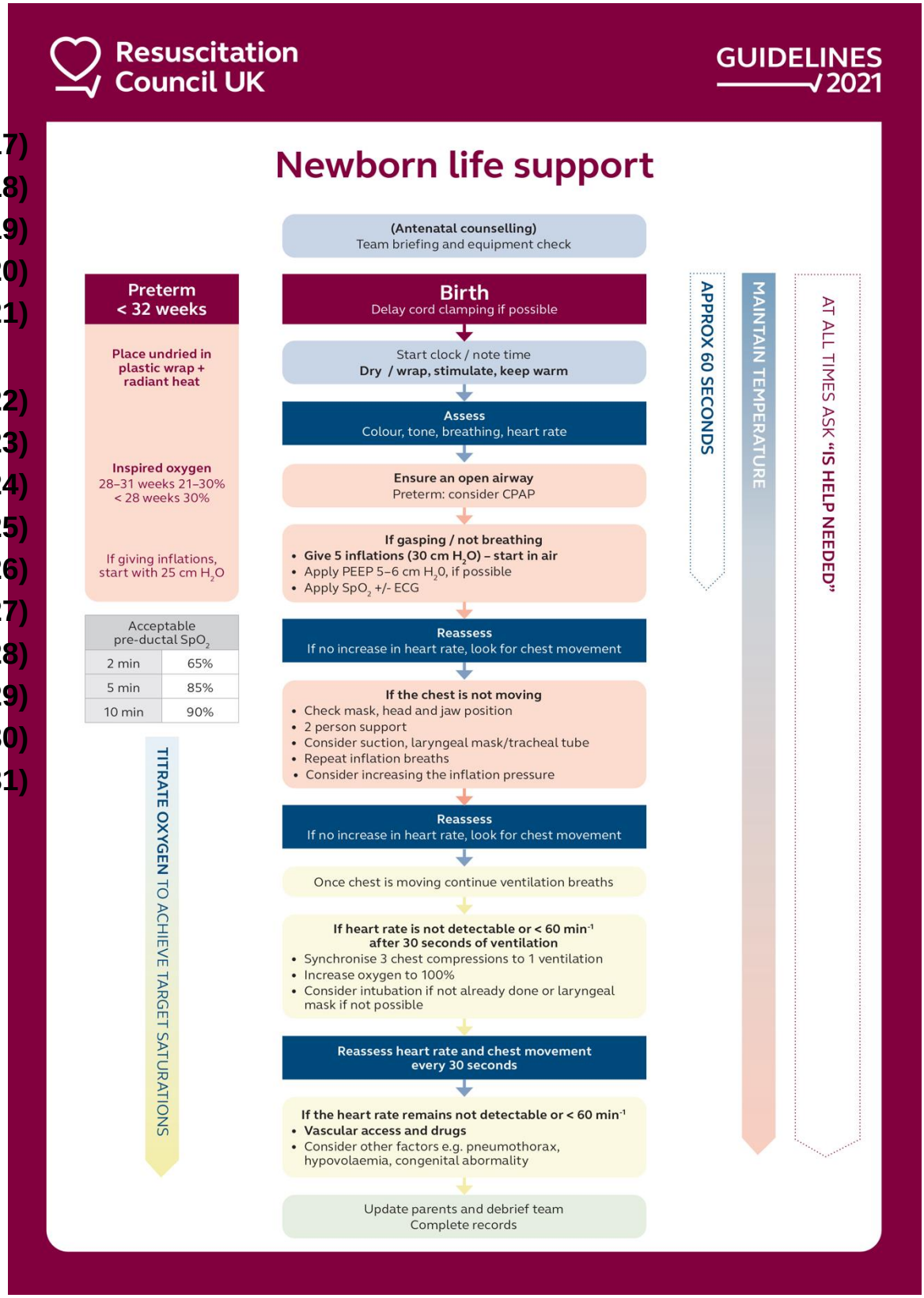
9 Caffeine:

Time of administration (within 6h admission) recorded on Badgernet Yes ☐ No ☐ N/A ☐

10 Probiotics:
(<32 weeks or <1.5kg)

Probiotics started once baby has been on minimal enteral feeds for 24 hours recorded on Badgernet Yes ☐ No ☐

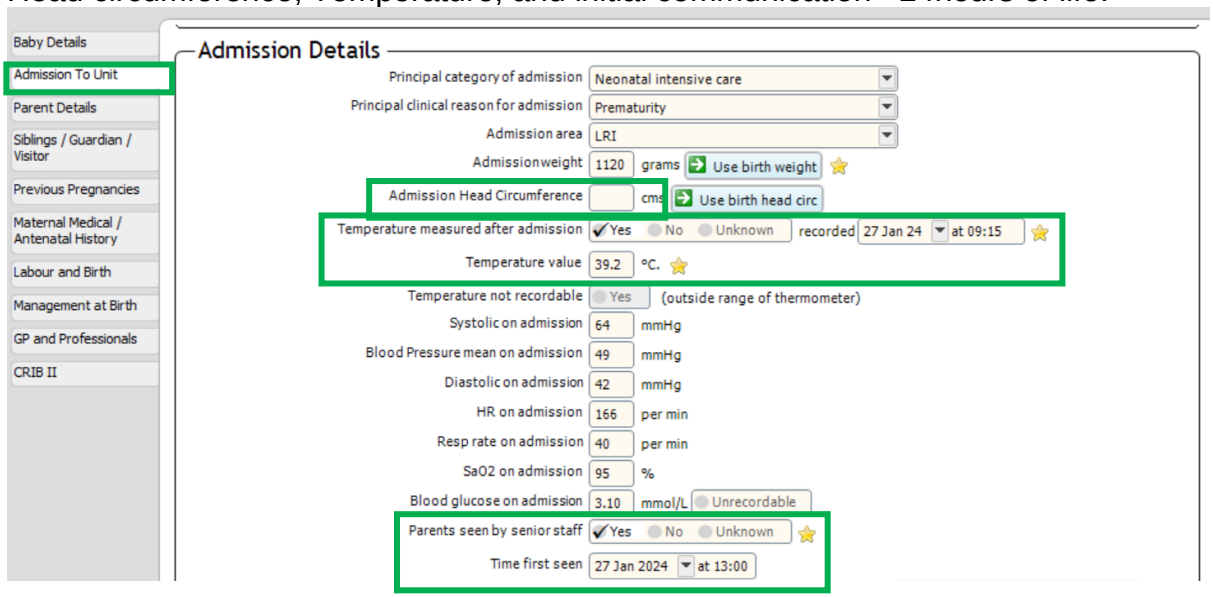
16) Appendix 3: NLS Algorithm



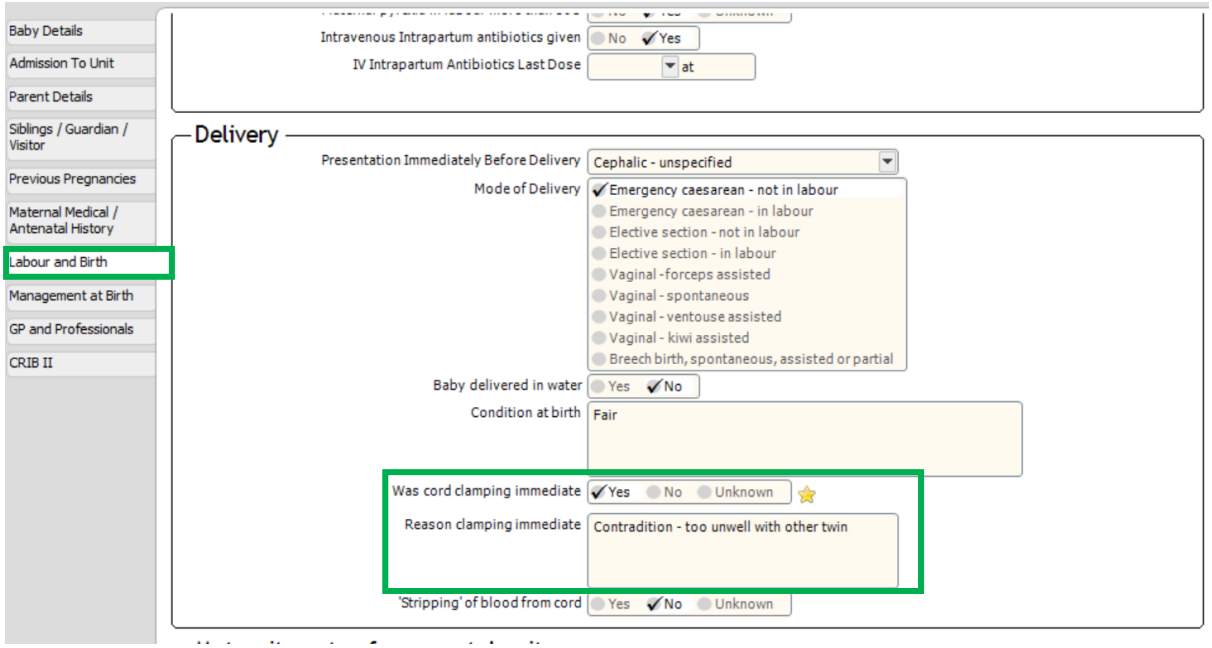
Appendix 4: NNAP documents of BadgerNet

Below are screenshots to highlight where to find the fields to enter NNAP data required on admission BadgerNet:

Head circumference, Temperature, and initial communication <24hours of life:



Deferred cord clamping (If immediate –document reason if possible):



Antenatal steroids and magnesium sulphate:

Admission examination: