Early Care of Neonates at Risk of Respiratory Distress Syndrome

University Hospitals of Leicester NHS Trust

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1. Introduction and Who Guideline applies to

This guideline is aimed at all Health care professionals involved in the care of infants within the Neonatal Service.

1.1 Key Points

- This guideline is designed to give a strategy for the early management of respiratory distress syndrome in preterm infants
- Recommendations from this guideline are based on the European Consensus Guidelines on the Management of Neonatal Respiratory Distress Syndrome in Preterm Infants – 2016 Update

1.2 Related UHL documents

Document	ID Number
Intubation	C13/2007
Targeted Tidal Volume Ventilation	C34/2013
Caffeine Therapy in Preterm infants	C12/2012
Nasal CPAP nursing care	C35/2015
Admission to the neonatal unit	C87/2005
Antibiotics for Early and late onset infection	B14/2009
Feeding & nutrition in preterm infants	-
PDA (baby Oscar update)	C14/2007
Oxygen Saturation Monitoring	C129/2006
Central line guideline	-
Cranial Ultrasound Guideline	C64/2004

1.3 Background

Description of the condition

Respiratory distress syndrome (RDS) is the most common respiratory disorder of premature neonates, especially for those below 32 weeks of gestation, although older neonates with delayed lung maturation of different aetiologies can also be affected. In RDS the structurally immature, surfactant-deficient lung has a tendency to collapse resulting in ventilation-perfusion mismatch leading to hypoxia and hypercarbia. Histologically RDS is characterised by leakage of proteinaceous fluid into the alveoli and hyaline membrane formation (1).

Intervention and Management of RDS

In the last 50 years, management of RDS has changed from supportive care, such as provision of warmth, fluid, calories and oxygen, to a standard care package. This involves administration of antenatal steroids, use of ventilatory strategies that provide lung protection, early elective intubation and surfactant administration, early extubation to non-invasive ventilatory support, allowing permissive hypercapnia, prevention of hyperoxia and better nutrition (22).

2. Section A. Initial management of RDS on delivery suite

2.1 Resuscitation

Ventilation with hypocarbia or hyperoxia has been associated with worse outcomes (2,3). In addition, Bjorkland et al. have shown that large initial inflation breaths result in worsening histology and lowering compliance (4-6). Avoidance of lung stretching is critical in avoiding early inflammatory processes. This can be achieved by limiting the peak pressure used during inflation breaths and by using positive end expiratory pressure (PEEP) to avoid atelectotrauma (7, 8).

Recommendations:
During initial resuscitation/stabilisation

- **Use an appropriately sized mask.**

- **Commence inflation breaths in air – increase FiO_2 according to response during stabilisation (fig 1&2)**
- **Follow NLS resuscitation guideline (appendix, section 4.2) and the UHL resuscitation at birth guideline as well as recommendations in the rest of this document.**

Avoidance of hyperoxia

High inspired oxygen concentration contributes to increased development of Bronchopulmonary Dysplasia (BPD) due to oxygen toxicity caused by free oxygen radicals. The goal of oxygen therapy is to deliver adequate oxygenation to tissues without causing oxygen toxicity. Oxygen for stabilisation and resuscitation should be controlled using a blender and pulse oximetry should be used to titrate this (figs 1&2).

Recommendations:

- **Initial stabilisation/resuscitation should commence in air**
- **Need for oxygen should be guided by the use of saturation monitor, with the aim of achieving saturation levels that correspond to the normal incremental increases in oxygen saturations after birth.**
- Acceptable pre-ductal SpO2 after birth:
  - 2 min 60%
  - 3 min 70%
  - 4 min 80%
  - 5 min 85%
  - 10 min 90%
- **After the initial 10 minutes, oxygen saturation should be maintained between 90 – 95% (Refer to oxygen saturation guideline).**

2.2 Ventilatory management

After the initial resuscitation/stabilisation, the objective of early ventilatory management is to minimise subsequent lung injury. The mode of ventilation used will depend on the ability of the preterm neonate to maintain spontaneous respiration and also their gestation with the most immature neonates more likely to require intubation and surfactant therapy.

There is increasing evidence that preterm neonates can be managed on nCPAP since birth thereby alleviating the need for elective intubation.

Nasal nCPAP provides a constant distending pressure to the lungs which has several theoretical benefits including splinting the upper airway, maintaining functional residual capacity, preventing end-expiratory airway collapse and facilitating endogenous surfactant production (10). See appendix for evidence.

It is key to ensure that when using nCPAP as the primary mode that the infant has adequate respiratory drive and is able to maintain oxygenation (table 1).

Table 1: Criteria for commencing nCPAP in preterm neonates after birth

Essential	Desirable
• **Active preterm neonates with normal tone** • **Spontaneous, regular and well sustained respiratory drive** • **No apnoeas** • **No excessive work of breathing** • **FiO_2 requirement <40% 26^{+0} or <30% <26^{+0}** • **No antenatal history of any congenital anomaly which can compromise airway/breathing**	• Have received complete course of steroids • No history of chorioamnionitis or other perinatal risk factors for sepsis
In preterm neonates not meeting the above criteria, i.e. in preterm neonates without independent, regular, well-sustained respiratory drive, with apnoeas, increase work of breathing or FiO_2 requirement more than 40%, consider early elective intubation (see intubation guideline for further information), administration of surfactant and commence mechanical ventilation (MV). **Preterm neonates born less than 26 weeks of gestation are at the highest risk of RDS and are more likely to have surfactant deficiency.**	

Given the geography of the delivery suite in relation to the neonatal unit if a decision is made to transfer the baby on nCPAP rather than intubated then a 15 minute period of stability needs to be observed prior to transfer. Pay attention to thermoregulation during this period. More immature neonates <26^{+0} weeks are more likely to require intubation and surfactant therapy prior to transfer to the neonatal unit.

Any baby who is transferred to the neonatal unit on nCPAP should be assessed on admission to ensure that this mode of respiratory support is still appropriate and to determine whether mechanical ventilation and surfactant administration is required.

For details on attaching nCPAP and ensuring adequate seal whilst minimising risk of pressure injury (see nCPAP care guideline & education package around use of nCPAP on the transport incubator).

Recommendations:

- ***Be guided by the gestation of the neonate and the clinical condition at birth. Preterm neonates born less than 26 weeks of gestation are more likely to need intubation, mechanical ventilation and surfactant treatment.***
- ***After initial stabilisation, in well, self-ventilating neonates, commence nCPAP using PEEP of 5 cm of H2O and 21% FiO2 using face mask.***
- ***Increase FiO2 gradually to achieve saturations of 90-95%.***
- ***Observe the neonate for 15 minutes on the resuscitaire ensuring adequate thermal control (plastic bag, overhead radiant heater, +/- transwarmer). During this time the baby can be placed onto nCPAP using the transport incubator infant flow driver.***
- ***Use the nCPAP driver on the transport system to transfer neonates from delivery suite to neonatal unit. Set the flow at 8L/min, PEEP at 5- 8cm of H2O***

and FiO2 as required to achieve saturations of 88-95%. (education guide available to demonstrate how to set this up, appendix, section 4.3).

- ***Use an appropriately sized nasal mask or binasal prongs (see guidelines on selection of mask/prongs for nCPAP) to deliver nCPAP on the transport system.***
- ***In clinically unwell babies and those who are not able to maintain independent breathing, intubation should be undertaken by a skilled practitioner following adequate mask inflation of the lungs (see intubation guideline for further information).***
- ***Confirm successful placement of endotracheal tube (ETT) by auscultation and colorimetric CO2 detection and checking of ETT length at the lips.***
- ***Administer the first dose of surfactant with the aim of giving at least (100mg/kg) but rounding up or down to the appropriate full vial. Chest wall movement does not need to be excessive to achieve ventilation particularly after surfactant has been administered.***
- ***Monitor the effects of ventilation by auscultating the heart rate rather than assessing chest expansion. If the heart rate is >100 beats/min then the lungs are being inflated.***
- ***In rare situations despite a well-placed endotracheal tube it may be necessary to use high pressures to "inflate" the lungs. PIP can be titrated stepwise up to 40cm of H20 trialling each increment of 5cm of H20 for 30 seconds to assess the response. Once the lungs are inflated gradually step down the PIP as much as possible.***
- ***Set the transport ventilator to deliver CMV and active PEEP mode, set PIP between 16-18cm of H2O, PEEP at 5 cm of H2O and FiO2 at 21%. Ensure good chest wall movement and increase FiO2 gradually to maintain normal saturations between 90-95%. Wean PIP in case of excessive chest wall movement. Some neonates may require higher pressures so increase if needed.***

Delivery room management according to gestation

All preterm neonates who are active with good tone and with well-sustained, spontaneous respiratory drive should be accessed at birth for suitability for nCPAP. It is likely that those born at less than 26 weeks of gestation may need intubation and ventilation. (Figs. 1 & 2)

2.3. Surfactant therapy

Surfactant therapy plays an important role in the management of neonates with RDS as it helps to reduce surface tension and improves lung compliance thereby decreasing barotrauma and atelectotrauma.

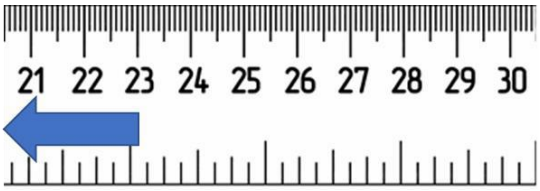
Prophylactic use of surfactant is not indicated for preterm neonates receiving non- invasive respiratory support (CPAP) since birth. If the neonate is intubated at birth for resuscitation and/or stabilisation, surfactant should be given. In neonates failing nCPAP and requiring MV, administration of rescue surfactant is recommended.

Recommendations

- If the preterm neonate is intubated at birth for resuscitation and/or stabilisation, first dose of surfactant (Curosurf 100mg/kg, rounded to 120mg or 240mg) should be given.
- In preterm neonates commenced on nCPAP at birth, early rescue surfactant (Curosurf 200mg/kg rounded to 120mg or 240mg) should be considered if failing nCPAP and need MV.
- A second dose of surfactant should be administered at 8-12 hours if there is evidence of ongoing RDS such as persistent oxygen requirement and need for MV. The need for any further surfactant doses or administration of a second dose prior to 8 hours should be discussed with the duty consultant.
- Post surfactant therapy as the lung compliance improves the PIP and FiO2 should be weaned.

2.4 Gestation-Specific Management

<23 weeks of gestation

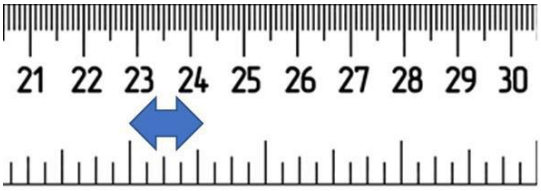


It is not usual to attend deliveries <23 weeks of gestation, but there may be specific instances and these should be assessed on a case by case basis by the duty Consultant.

Suggested situations:

- Uncertainty about gestational age.
- 22-23/40 where there has not been time to have adequate antenatal discussion/counselling.
- To support midwives and parents in the delivery of comfort care.

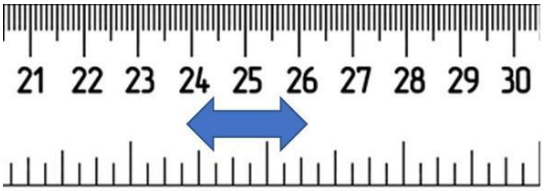
23 - 23^{+6} weeks of gestation



- Place neonate in plastic bag under radiant heater.
- Ensure a senior member of the neonatal team is present. Assess for signs of viability over 1-2 minutes whilst giving inflation breaths using face-mask and T-piece ventilation with PIP 20–25cm of H_2O, PEEP 5 cm of H_2O and FiO_2 of 21%.
- Signs of non-viability; pale, flaccid, no respiratory effort, low heart rate despite face mask ventilation, bruising, gestational characteristics suggesting <23 weeks. **Assessment of viability should be made by experienced doctors.**

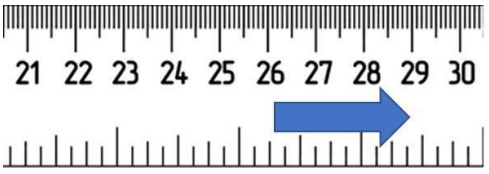
- If heart rate does not improve following inflation breaths and good chest wall movements, discontinue resuscitation, explain the situation to parents and give the baby to parents to hold.
- If the neonate is assumed to be viable, start initial stabilisation as per NLS guidelines. It would be anticipated that these neonates would require intubation.
- The neonate should be intubated, commence gentle ventilation with PIP of 20 cm of H_2O, PEEP of 5 cm of H_2O and FiO_2 of 21%.
- Give the first dose of surfactant after confirming the ETT position (See guidelines on intubation and surfactant administration for further information). Use pulse oximetry to assess saturation and heart rate.
- Increase FiO_2 as required to maintain saturations between 90 – 95%.
- Following surfactant administration, the pressure and FiO_2 should be weaned. Typically, a PIP of 16-18cm of H_2O is usually required.
- A very small proportion of neonates born at this gestation may have well- sustained regular breathing and could be commenced on nCPAP at birth. However, this decision should be made by a senior clinician.
- Chest compressions and cardiac resuscitation drugs are not usually recommended in neonates <25 weeks of gestation where there has been no improvement in heart rate >60 beats/minute despite establishing airway and appropriate airway and breathing management

24^{+0} – 25^{+6} weeks of gestation



- Thermoregulation as above.
- Start initial stabilisation as per NLS guidelines.
- Assess breathing and its sustainability during initial stabilisation.
- If this initial effort is inadequate, then mask ventilation according to NLS guidance should be commenced.
- A very small proportion of neonates born at this gestation may have well-sustained regular breathing and could be commenced on nCPAP since birth. However, this decision should be made by a senior clinician based on the respiratory drive and oxygenation (fig 2).
- It is expected that the majority of neonates will require intubation and MV. This should be performed by a skilled practitioner. Start with PIP of 20 cm of H_2O, PEEP of 5 cm of H_2O and FiO_2 of 21%.
- Following surfactant administration, the pressure and FiO_2 should be weaned. Typically, a PIP of 16-18cm H_2O is ususally required.
- Chest compressions and resuscitation drugs could be considered for neonates >25 weeks provided adequate lung inflation has occurred. Consideration needs to be made regarding the antenatal history and assessment of viability to determine whether this is appropriate.

≥ 26+^{0} weeks of gestation



- Thermoregulation measures as above. For infants <32 weeks place in plastic bag under radiant heater on resuscitaire.

- Preterm neonates ≥ 26^{+0} weeks of gestation with regular spontaneous breathing who are able to maintain saturations between 90 - 95% by 15 minutes of age in FiO_2 < 40% using mask PEEP can be commenced on nCPAP on the transport incubator with PEEP of 5-8 cm of H_20 and FiO_2 of 21 - 40%. Increase FiO_2 gradually to maintain normal saturations

- Use nCPAP driver and binasal prongs or nasal mask on transport incubator to transfer babies to neonatal unit.

- Consider early intubation and rescue surfactant treatment in neonates who show signs of worsening respiratory distress, FiO_2 requirement > 40% and signs and symptoms of nCPAP failure (see below in section 3.2.2). Start with PIP of 20 cm of H_2O, PEEP of 5 cm of H_2O and FiO_2 of 21%.

- Following surfactant administration, the pressure and FiO_2 should be weaned. Typically, a PIP 16-18cm H_2O is usually required.

- Consider chest compressions and resuscitation drugs if the heart rate remains low despite adequate chest inflation unless there have been specific recommendations in antenatal counselling to the contrary.

Figure 1: Summary of eligibility criteria for delivery room nCPAP

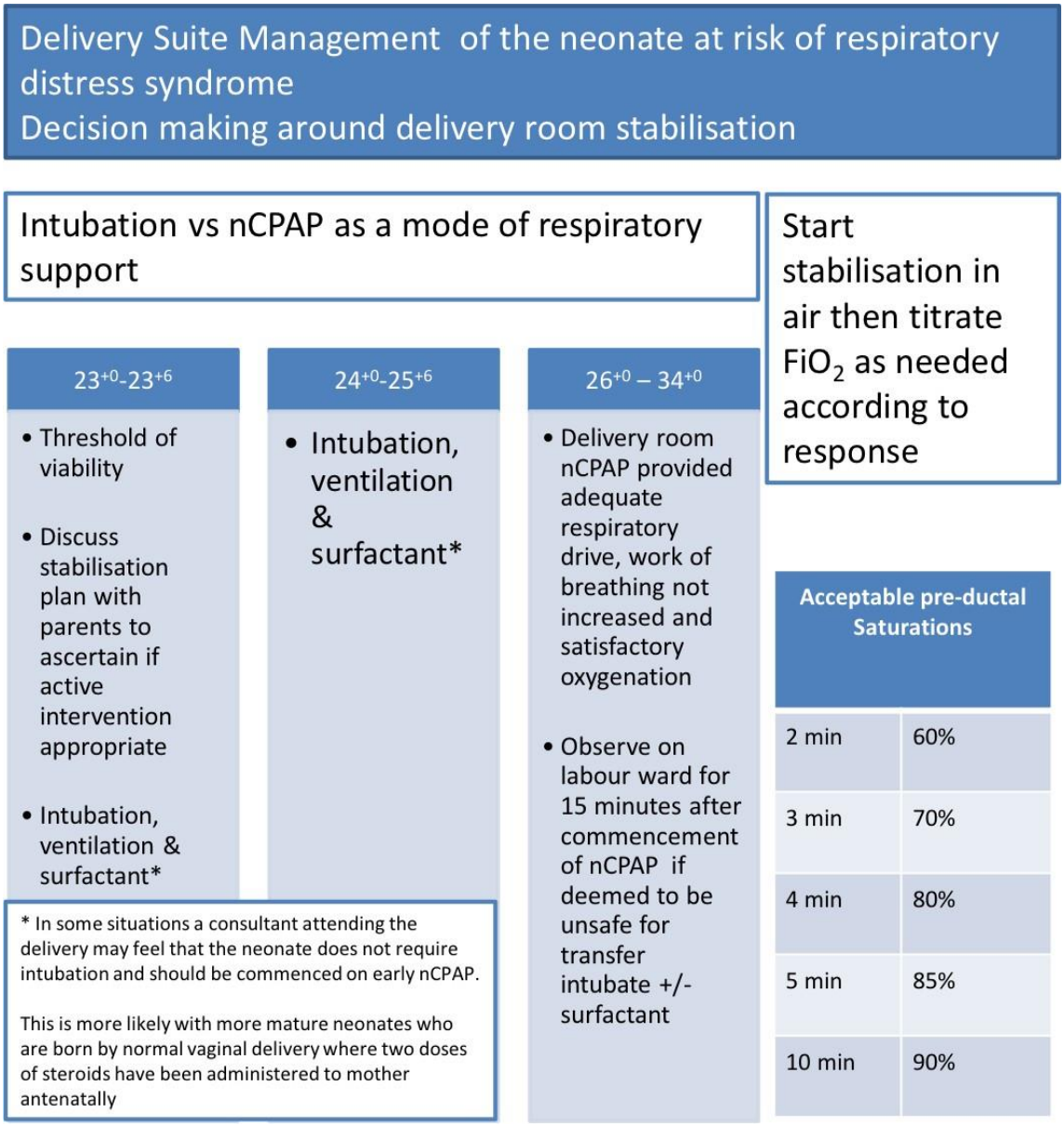
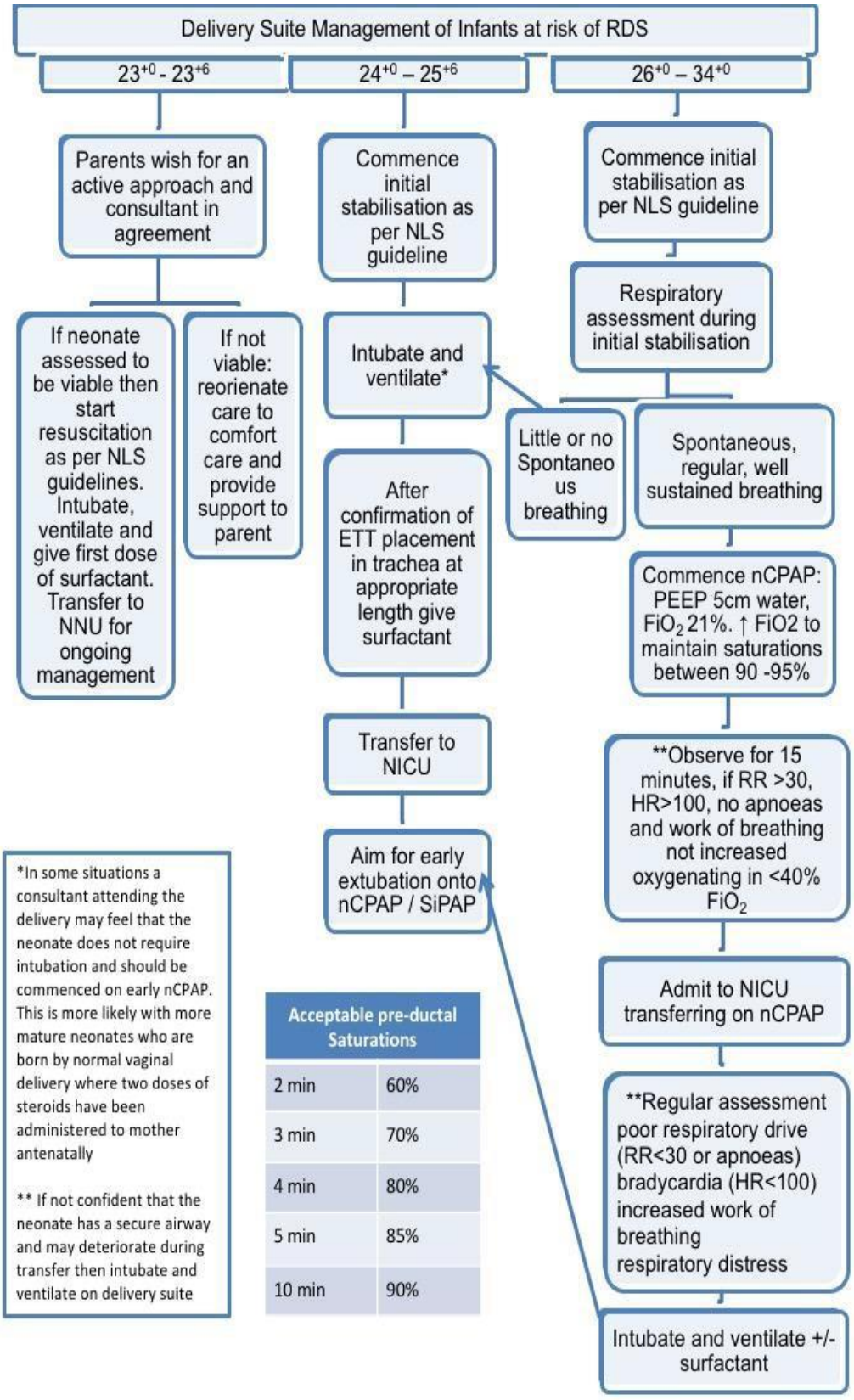


Figure 2: Algorithm for delivery room stabilisation of preterm neonate



3: On-going management on the neonatal unit

3.1 Temperature control

Maintaining normal body temperature during stabilisation and after admission is important for neonates with RDS. It is recommended to maintain body temperature between 36.5 and 37.5°C (19). Perform initial stabilisation with the baby placed in a polyethylene bag (<32 weeks) under a radiant heater (20). Following stabilisation and transfer to neonatal unit, nurse neonates in incubators with high relative humidity to reduce insensible water losses. For the smallest babies use humidity of 60–80% initially. Promote kangaroo care in stable preterm neonates as it also helps to improve parental bonding.

Recommendation:

- **Maintain core temperature between 36.5ºC and 37.5°C at all times.**
- **For preterm neonates <1000g or 30 weeks, measure temperature on the delivery suite following initial stabilisation. If temperature < 36.5ºC use transwarmer to help normalise the temperature.**

3.2 Ventilatory management

- **Primary nCPAP**

In neonates who are managed using non-invasive mode of ventilation since birth, undertake ongoing assessments to review appropriateness of nCPAP. Consider early intubation and rescue surfactant therapy in preterm neonates who show signs of respiratory failure on nCPAP. Oxygen saturations should be targeted as per the oxygen saturation monitoring guideline.

Failure of early nCPAP treatment:

Neonates with RDS who are managed with early nCPAP need to be closely monitored to ensure that they are not deteriorating to avoid delay in surfactant therapy when indicated. Table 2 lists the criteria for CPAP failure and indication for intubation if it is not possible to optimise the delivery of nCPAP (table 2). Maintain a lower threshold for intubation in neonates with gestation < 26/40 (22). If surfactant is given, administer a rescue dose of 200mg/kg.

Table 2: CPAP failure criteria

- **Chest X-ray showing features of moderate or severe RDS**
- **Apnoea unresponsive to stimulation and methylxanthine treatment**
  >6 episodes requiring stimulation in 6 hours *OR*
  >2 episode requiring positive pressure ventilation
- **High FiO_2 requirement for an hour to maintain saturation at/above 90%**
  FiO_2 >30% in babies <26+0 weeks of gestation *OR*
  FiO_2 >40% in babies ≥26+0 weeks
- **An arterial pH < 7.2 with an arterial pCO2 > 8.0 kPa**
- **Metabolic acidosis not responsive to treatment**
- **Haemodynamic instability with blood pressure low for gestation requiring volume and inotropic support for more than 2 hours.**

Table 3: Suggested MV Strategy if primary nCPAP fails

- **Consider intubation and rescue surfactant therapy and/or short period of MV in neonates managed on nCPAP since birth and showing signs of respiratory failure.**
- **Commence TTV in neonates needing MV. Set the tidal volume 4- 6ml/kg, PEEP 5cm of H_2O, FiO_2 21%, Max PIP 20cm of H_2O. In a baby with stiff lungs the Max PiP may need to be increased to achieve the set tidal volume.**
- **Increase FiO_2 as required to maintain saturations between 90 – 95% (refer to oxygen saturation monitoring guideline).**
- **Consider need for a repeat dose of surfactant depending on the severity of RDS, need for MV and FiO_2.**
- **Consider other modes of ventilation if adequate oxygenation and ventilation not achieved by TTV.**
- **Wean MV and aim for early extubation onto nCPAP/SiPAP.**

- **Mechanical ventilation**

The aim of ongoing ventilatory management is to minimise ventilator induced lung injury, allow permissive hypercapnia and early extubation to nCPAP. Targeted Tidal Volume (TTV) ventilation theoretically may have particular advantages for the neonate with rapidly changing compliance such as the preterm infants (<34 weeks) who have just received surfactant for RDS. The other mode of ventilation commonly used in preterm neonates is Synchronised Intermittent Mechanical Ventilation (SIMV). High-frequency oscillatory ventilation (HFOV) is useful as a rescue therapy in babies with severe RDS not responding to conventional ventilation.

Following MV, the aim is to extubate neonates as soon as possible to nCPAP or Synchronised Positive Airway Pressure Ventilation (SiPAP). SiPAP uses small pressure differences between inspiratory and expiratory phases. A large international, multicentre randomised controlled trial showed no difference in short- term benefit, BPD or death for SiPAP as compared to nCPAP (15, 16).

Recommendations:

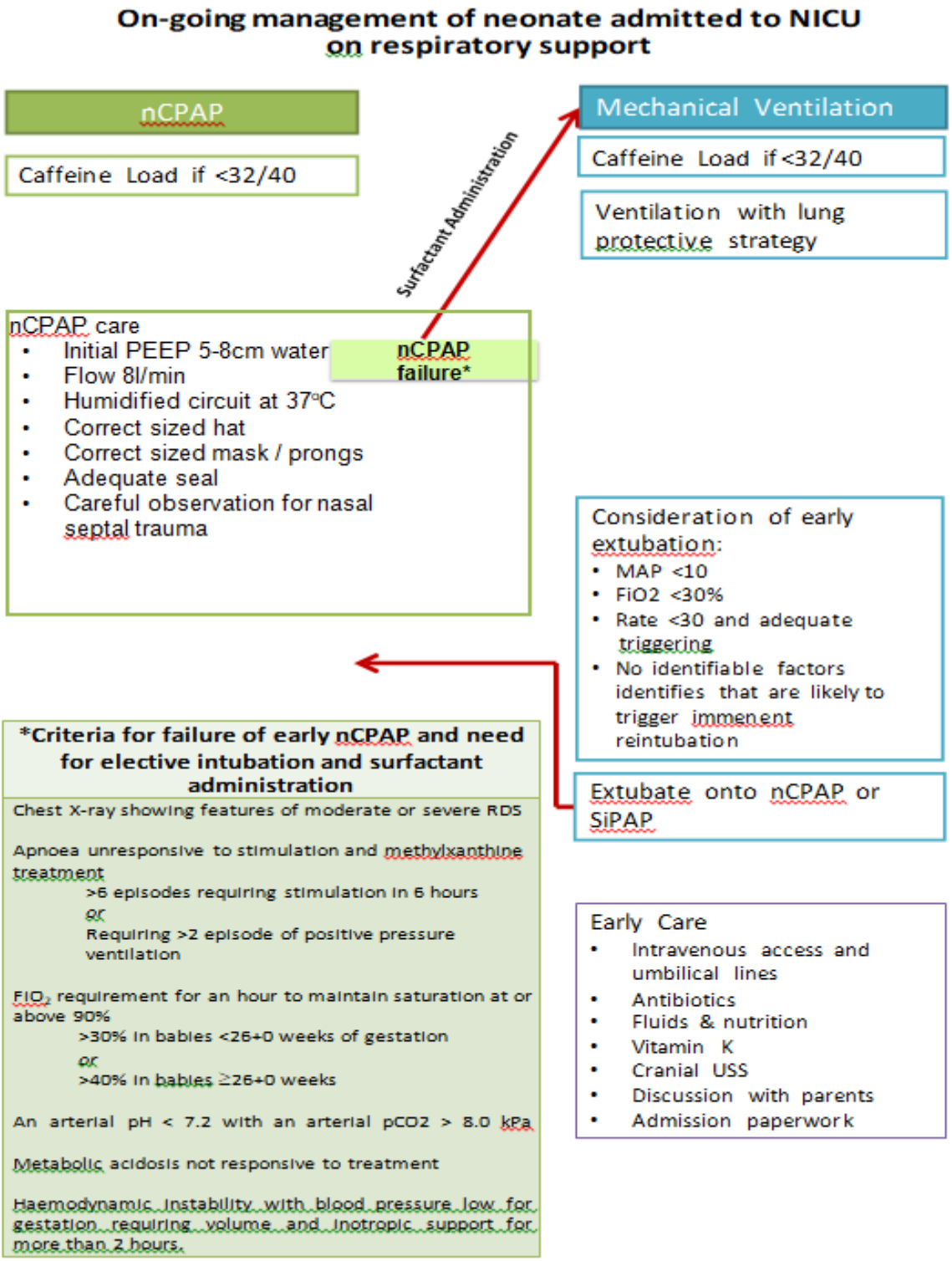
- **Mechanical ventilation using Targeted Tidal Volume (TTV) as preferred mode (refer to TTV guideline)**
- **Early extubation onto either nCPAP or SiPAP if appropriate**

Criteria for "extubation readiness" in preterm neonates <30 weeks with RDS as the primary pathology in the first week of life:

- Mean airway pressure (MAP) <10cm water (practically most neonates receive a nCPAP pressure of 6-8cm 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

In more mature neonates, if RDS is not the primary pathology or the neonate has been ventilated for longer than a week then these "extubation readiness" criteria may need to be adjusted at consultant discretion. The decision to extubate onto SiPAP or nCPAP should be individualised for each baby following discussion with the consultant.

Figure 3: On-going management of neonate on respiratory support



3.3 Further Management

Caffeine Therapy

The Caffeine for Apnea of Prematurity (CAP) study showed that caffeine facilitated earlier extubation with a significant reduction in BPD and neurodisability (17, 18). Although this relationship cannot be assumed to be cause and effect there is good evidence of safety to recommend caffeine routinely as part of a strategy to minimize the need for MV.

Recommendations:

- **Caffeine is strongly recommended for babies with RDS coming off MV and for babies on non-invasive support to reduce risk of apnoea.**
- **The standard dose of caffeine citrate is 20 mg/kg loading and 5–10mg/kg daily maintenance.**

Intravenous access

Early hypoglycaemia is common in preterm neonates. Start a dextrose infusion as a high priority after admission. In preterm neonates <26/40 who have fragile skin consider whether this can be facilitated by insertion of an early umbilical venous catheter rather than peripheral intravenous cannula.

More immature neonates <28 weeks ideally require both umbilical venous catheter and umbilical arterial catheter. An assessment should be made as to whether more mature ventilated neonates require central access and invasive arterial blood pressure monitoring.

Further guidance around umbilical catheters and long lines can be found in the central line guideline.

Fluids and nutritional management

Preterm neonates have very high transcutaneous losses of water and water and electrolyte shift from interstitial to the intravascular compartment. A modest early postnatal weight loss is normal. Regimens with more restricted compared with more liberal fluids have better outcomes, with reductions in PDA, NEC and BPD. Delaying introduction of sodium supplementation until beyond the third day or 5% weight loss will also improve outcome. Introduce feeds on day 1 if clinically stable and gradually increase as tolerated.

Nutrition should be started immediately after stabilisation. Enteral feeding volumes will initially be limited, so parenteral nutrition should be used which results in positive nitrogen balance, reduced time to regain birth weight and enhanced weight gain at discharge. For stable infants, gut priming with breast milk should be started on day 1 and increased as tolerated (refer to enteral feeding guideline). Mother's milk is the preferred option for initiation of feeding; however, if not available then preterm formula may be used.

Recommendations:

- **Commence intravenous fluids in preterm babies with birthweight <1000grams at 100mls/kg/day and in those with birthweight >1000 grams at 50mls/kg/day of 10% dextrose. Change to parenteral nutrition (PN) as soon as central access available to meet the calorie and protein requirement of preterm neonates.**

- **Undertake careful monitoring of fluid and electrolyte balance, 12 hourly as a minimum for the first 72 hours to guide fluid management. Commence sodium only after onset of diuresis.**
- **Commence gut priming on day 1 if clinically stable, preferably with mum's breast milk. If breast milk is not available preterm formula milk (Nutriprem1) may be used.**

Antibiotics

It had been considered good practice to screen neonates who present with early respiratory distress for infection. If screening for sepsis is necessary, then antibiotics should be started empirically whilst waiting for test results, such as negative blood cultures at 36 – 48 hours and normal serial C-reactive protein measurements, before stopping them. Antibiotics should be stopped as soon as possible once sepsis has been excluded.

Recommendations:
- **Start antibiotics in neonates with RDS until sepsis ruled out.**
- **First line antibiotic regimen is benzylpenicillin and gentamicin.**
- **Stop antibiotics as soon as possible after sepsis has been excluded.**
- **Consider screening for ureaplasma urealyticum, if history of chorioamnionitis and ongoing need for MV and/or difficulty with extubation.**

Cranial Ultrasound Scan and Echocardiographic assessment of patent ductus arteriosus (PDA)

Neonates <30 weeks gestation at birth or 1000g should have a cranial ultrasound in the first 24-48 hours (refer to cranial ultrasound guidance).

Symptoms such as blood pressure instability, significant fall in haemoglobin, seizures, cardiopulmonary arrest, metabolic acidosis, persistent apnoeas may be a sign of intraventricular haemorrhage and should prompt a diagnostic cranial ultrasound to be performed.

From May 2017 eligible neonates <29/40 will be approached to participate in the Baby-OSCAR trial. Neonates that are not enrolled in this should have a diagnostic ECHO within the first 24 hours to assess the presence of a PDA and need for targeted ibuprofen therapy as per the PDA guideline.

Communication with parents

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.

4. Education and Training

None

5. Audit criteria

1. Decision-making around use of nCPAP or mechanical ventilation in the delivery room is clearly documented in line with the algorithm (100%)
2. Extubation failure criteria are followed for babies that are admitted to the neonatal unit on nCPAP (100%)

6. Supporting References

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7. Key Words

Respiratory distress, neonates, birth, NLS, CPAP

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) Author: Drs Kamini Yadav, Amy Walker, Joanna Behrsin (written July 2018) Contact: Clinical Guidelines Lead			**Executive Lead** Chief medical officer
Details of Changes made during review:			
Date	**Issue Number**	**Reviewed By**	**Description Of Changes (If Any)**
July/Aug 2018	**1**	Neonatal Guidelines Group and Neonatal Governance Group	**Ratified**
October 2020	**2**	Neonatal Guidelines Group and Neonatal Governance Group	**Reviewed & Ratified**
November 2022	**3**	Neonatal Guidelines Group and Neonatal Governance Group	**Format update and updated NLS algorithm placed in document in line with national guidance.**

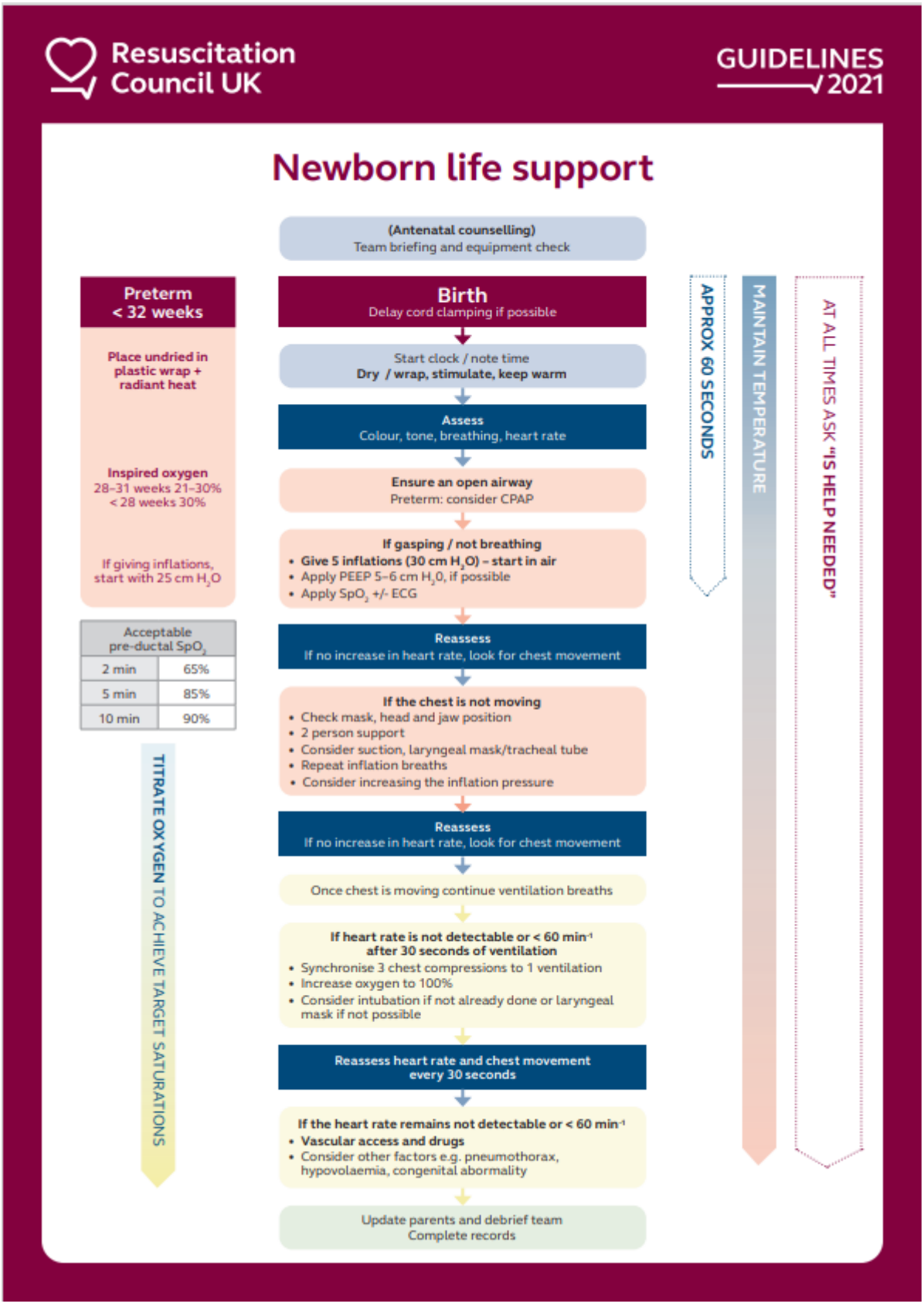
Appendix 1: Evidence Summaries and Glossary

Oxygen saturations: After the first 10 minutes there is a wide variation in the use of target oxygen saturations. Results of NeOProm Collaboration, a prospective meta- analysis of five large randomised trials recommends to avoid low oxygen saturation target levels as it increases the risk of death and at the same time avoid very high oxygen saturation as it increases the risk of ROP, CLD and adverse neurodevelopmental outcome (9).

nCPAP: A Cochrane review has shown that as compared to mechanical ventilation (MV), nCPAP resulted in a small but clinically significant reduction in the incidence of BPD at 36 weeks, RR 0.89, (95% CI 0.79-0.99) and death or BPD, RR 0.89, (95% CI 0.81 to 0.97). There was also a reduction in the need for MV, RR 0.50, (95% CI 0.42- 0.59) and the use of surfactant in the nCPAP group, RR 0.54, (95% CI 0.40 - 0.73). There was no increase in any adverse outcomes such as NEC, IVH, PVL or ROP. The increased risk of pneumothorax seen in some earlier studies was not seen in this meta-analysis (1). Hence there is evidence (A) that CPAP applied prophylactically after birth in a preterm neonate reduces the need for MV, need for surfactant and reduces the risk of mortality and BPD without any increase in short term or long term adverse outcomes (1).

BPD	BronchoPulmonary Dysplasia
nCPAP	nasal Continuous Positive Airway Pressure
ETT	Endotracheal Tube
HFOV	High Frequency Oscillation Ventilation
MAP	Mean Airway Pressure
MV	Mechanical Ventilation
NEC	Necrotising Enterocolitis
PDA	Patent Ductus Arteriosus
PIP	Peak Inspiratory Pressure
PEEP	Positive End Expiratory Pressure
PN	Parenteral Nutrition
RDS	Respiratory Distress Syndrome
SIMV	Syncronised Intermittent Mechanical Ventilation
SiPAP	Synchronised intermittent Positive Airway Pressure
TTV	Targeted Tidal Volume
UAC	Umbilical arterial catheter
UVC	Umbilical venous catheter

Appendix 2: NLS Algorithm



Appendix 3: ANLS Algorithm