Title:	**North West Neonatal Operational Delivery Network** **Bronchopulmonary Dysplasia (BPD)** **Framework for Practice**
Reference number	**GL-ODN-25**
Main Author (s)	**Dr Amitava Sur and Members of the BPD Working Group**
Target Audience	**All Local Neonatal Units within the North West Neonatal Operational Delivery Network**
Ratified by:	**Respiratory SIG & SMT**
Date Ratified:	**2nd July 2025**
Review Date:	**1st July 2028**
Version:	**Final**
Document status:	**V2**

NWNODN BPD Framework for practice

Background information

Since 2017 the National Neonatal Audit Programme (NNAP) (1) has been reporting on the incidence of BPD as a key adverse outcome of prematurity. Whether reported as a composite of BPD/death or isolated incidence, the data shows a gradual increase in incidence of BPD across the UK despite advances in neonatal care and increase in preterm survival. This triggered the British Association of Perinatal Medicine to publish a framework of practice in 2023 for reducing BPD (2).

The North West Neonatal Operational Delivery Network (NWNODN) has the second highest incidence in the composite of BPD/death in the last NNAP report (2023 data, published November 2024) with an incidence of 45.7% compared to a national mean of 31.5%, which indicates a positive treatment effect.

This document is based on the BAPM BPD framework principles, with additional information specific to the NWNODN to support better practices across the region with input from wider MDT experts in the form of a task and finish group. Much of the document will signpost towards already existing resources in the ODN or guidelines from regional units which the group have reviewed and found relevant for potentially adapting to meet the needs of NW units who currently don't have any guidance in place.

Basic concepts

The pathobiology of BPD is complex and influenced by various pre and post-natal factors. While it is now established that inflammation of the lungs is the final common pathway, BPD is the clinical expression of developmental plasticity, and a constant process of lung injury and repair. A detailed discussion regarding pathogenesis of BPD is beyond the scope of this document, but a visual summary might help readers appreciate the complexity and requirement of multi-pronged strategies. Below is a "timeline" in to indicate variables that might impact on the process of lung development from preconception through the neonatal course.

The chart is taken from the BAPM BPD Toolkit with the European RDS guidelines also taken into consideration. https://pmc.ncbi.nlm.nih.gov/articles/pmid/36863329/

Physiological principle	PERINATAL OPTIMISATION		REDUCING LUNG INJURY AND OPTIMISATION OF ORGAN SYSTEMS	
Positive impact	1. Female sex 2. Ethnicity	1. Antenatal steroids 2. Appropriate place of delivery 2. Optimal delivery room practices 3. Early surfactant 4. Intrapartum antibiotic prophylaxis	1. Early Caffeine 2. Early NIV 3. LISA 4. Volume targeted ventilation 5. Early extubation 6. Exclusive MBM 7. Early hydrocortisone	1. Open lung strategy 2. Optimal nutritional and metabolic bone status
Negative impact (not necessarily causal)	1. Maternal smoking 2. Fetal growth restriction (IUGR) 3.Chorioamnionitis 4. Ethnicity 5. Genetic predisposition	1. Place of delivery 2. Staff skill 3. Incomplete course/ No ANS 4. Hypothermia	1. Sepsis, VAP 2. Barotrauma (from high pressures), Volutrauma (from high volumes) and atelectotrauma 3. Persistent hs-PDA 4. Delayed enteral nutrition, poor growth	
Modifiable factors			1. Early respiratory practices (NICE respiratory guideline) 2. Early MBM (BAPM MBM toolkit) 3. MDT involvement in collaborative management	1. PEEP focus 2. MDT involvement in collaborative management, discussion with respiratory team 4. Role of pharmacotherapy- steroids/ diuretics

Practice elements

Aligning with the BAPM toolkit,

the NWNODN will aim to outline best practice interventions based on 5 core elements or strategies

Core elements	
1	**Perinatal Optimisation:** To look at interventions in the antenatal period and around time of delivery which can ensure an optimal start
2	**Early Respiratory support strategies:** Outlining approaches around early respiratory care which have been shown to potentially minimise lung injury.
3	**Optimizing care of other organ systems which might positively impact respiratory outcome** Facilitating and optimising aspects of fluid and nutrition, cardiovascular management, to impart a positive impact on the overall outcome
4	**Pharmacological interventions:** To discuss use of medications / therapeutic modalities which have been shown to reduce incidence of BPD or mitigate lung injury
5	**Multi-disciplinary team and parental voice discussions:** Conversations with parents, involvement of allied health professionals and other specialists around care, psychological support

Key recommendations around these core elements and evidence – recommendations modified for NWNODN practice (refer to the chart on page for timeline of interventions)

Core Strategy	Key interventions	Level of evidence / recommendation	Supporting resources
Perinatal Optimisation	• Optimal place of delivery – infants born at GA <27 weeks should be ideally delivered in a tertiary neonatal unit (NICU) • Any infant born <34 weeks should receive full course of ANS within 1 week of delivery • Clamping of cord should be delayed by at least 1 minute • Maintaining thermoneutral range (36.5-37.5 degrees)	Although there is no strong causal evidence linking these to reduction of BPD, their impact on overall outcome is significant and these are strongly recommended	BAPM Antenatal & Peripartum toolkits Perinatal Optimisation Pathway | British Association of Perinatal Medicine Optimisation Parent leaflet https://www.neonatalnetwork.co.uk/nwnodn/wp-content/uploads/2023/10/32429-OPTIMISATION-LEAFLET-A5-V1-003.pdf NWNODN Preterm guideline
Early Respiratory Strategy including delivery room (DR) interventions	• Infants born in NICUs ≥25 weeks and LNUs ≥27weeks should ideally be transitioned to CPAP if breathing spontaneously and stable hemodynamically (HR >100). (Considerations- full course of ANS, lack of maternal sepsis etc.) • CPAP pressures can be safely titrated from 6-8cm H20 • If a spontaneously breathing baby with no risk factors is on CPAP 7-8cm H2O requiring>40% fiO2 and /or has evidence of significant respiratory distress at 10 minutes after birth in the DR, they should	High quality evidence, strongly recommended	European RDS Guideline https://pmc.ncbi.nlm.nih.gov/articles/pmid/36863329/ NWNODN Consensus statement on early respiratory support (See appendix 1) DR CPAP Best Practices (See appendix 2)

	be intubated by appropriately skilled personnel.		
	Early surfactant (<2 hours) should be administered for infants requiring endotracheal intubation in delivery room AND in infants who have been on CPAP with FiO2>0.3 on PEEP> 6 cm H2O • If a spontaneously breathing infant has transitioned successfully to unit on CPAP and requires surfactant (FiO2 >30% within 2 hours of life) – LISA should be the preferred method if expertise available. • For LNUs, LISA should be reserved for ≥27 weeks, infants <27 weeks should be intubated under control in the unit for transfer to tertiary unit.	High quality evidence, strongly recommended. Moderate quality evidence, strongly recommended	Local unit guidelines
	Supplemental oxygen during resuscitation should be controlled using a blender. Recommended initial FiO2 settings are *FiO2 of 0.30 for infants <28 weeks GA ,0.21–0.30 for those 28–31 weeks, and 0.21 for 32 weeks of GA and above.*	Moderate quality evidence, strongly recommended	NLS Guidance Newborn resuscitation and support of transition of infants at birth Guidelines | Resuscitation Council UK
	Mechanical Ventilation: **Minimising Lung Injury** • Volume targeted ventilation (VTV) should be the preferred mode of invasive ventilation when using conventional MV in the neonatal unit. *Optimal tidal volumes in the early RDS phase range from 4-6ml/kg.*	High quality evidence, strongly recommended	NWNODN VTV framework https://www.neonatalnetwork.co.uk/nwnodn/wp-content/uploads/2025/01/GL-ODN-24-VTV-framework.pdf

	• If intubated in the delivery room use volume targeted mode if it is available in transport ventilator. • High frequency oscillatory ventilation (HFOV) should be considered early if high pressures are being required to generate volumes, OR *As an alternative initial mode of ventilation as a lung protective strategy, especially in extremely preterm infants born <24 weeks gestation and pulmonary hypoplasia*. Use of volume targeting with HFOV (HFOV-VG) has been shown to reduce CO2 variability. • Permissive hypercarbia: Modest degree of hypercarbia with PCO2 <8.5kpa can be tolerated initially to facilitate weaning of ventilation maintaining pH > 7.22	Low quality evidence, recommended based on level of unit and experience	HFOV guidelines from Tertiary units.

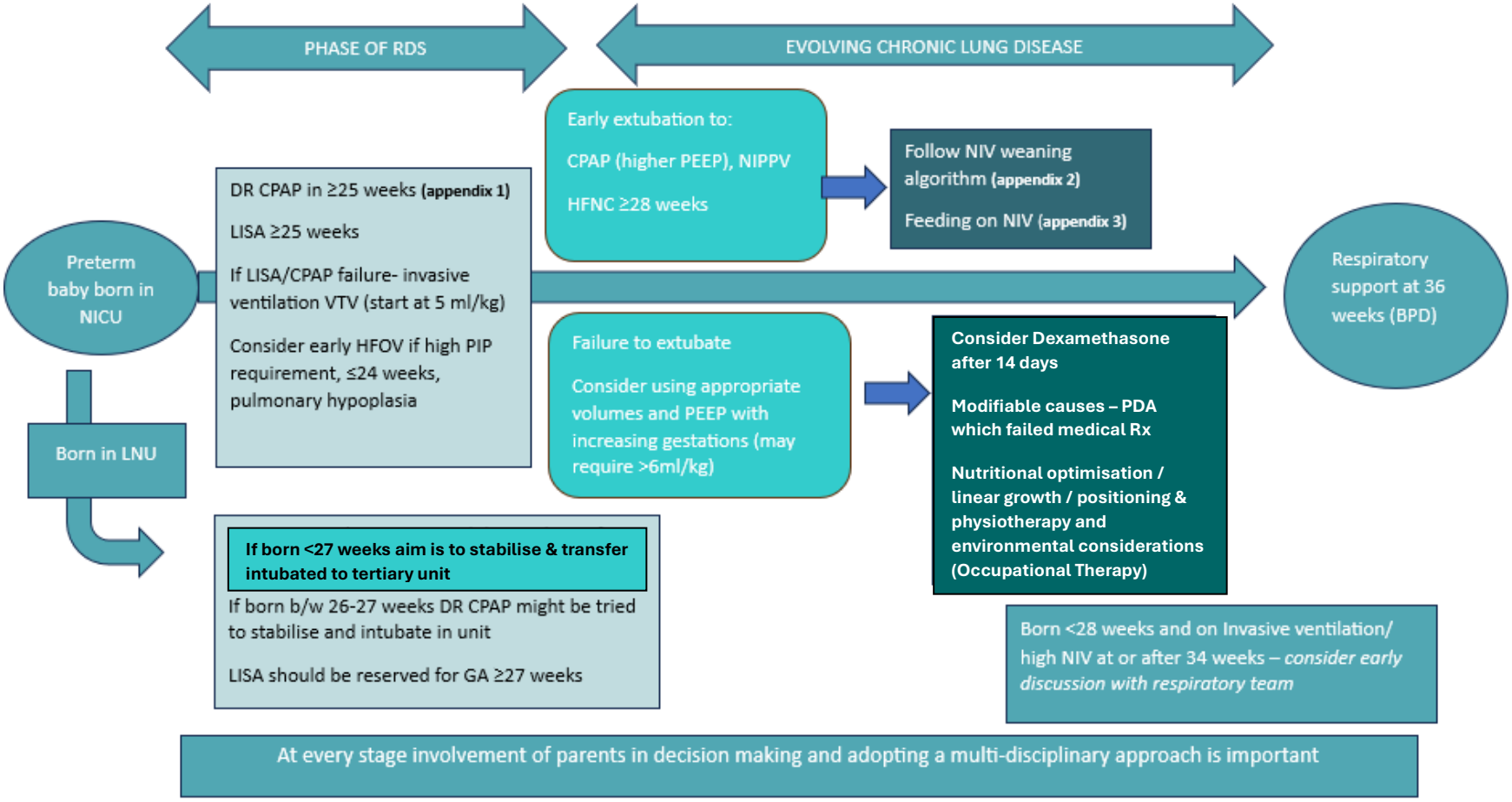
	<u>Non-invasive ventilation (NIV):</u> **Early Respiratory Support** • CPAP/NIPPV(where available) should be used for primary respiratory support for all preterm infants who do not need mechanical ventilation • HFNC can be used as primary respiratory support in >28 weeks with no difference in mortality or BPD - In more premature infants, especially <26 weeks GA, CPAP is recommended to prevent intubation • Early extubation to NIV modality of respiratory support should be attempted for gestational ages >24 weeks if invasively ventilated after birth. *Development of local extubation guidelines /checklist can improve success of extubation* **Preventing Extubation failures** • Units which are experienced in using Synchronised or non-synchronised forms of Non-invasive positive pressure ventilation (S-NIPPV, NS-NIPPV) should use it as the preferred mode of extubation *if available* to prevent reintubation. *For units extubating to CPAP higher CPAP pressures upto 8 cm H2O might be cautiously tried to prevent intubation after surfactant administration*	High-Quality evidence strongly recommended. Low Quality of Evidence High-Quality evidence strongly recommended based on resource and experience.	Local CPAP guidelines Local HFNC weaning guidelines Weaning chart – see appendix 3 Local NIPPV & SNIPPV guidelines

Optimising care of other organ systems	Exclusive and early feeding with mother's own expressed breast milk (MOM) is strongly recommended In absence of mother's own milk (MOM), donor breast milk (DBM) should be recommended as the alternative	High quality of evidence Moderate to low quality evidence but strong recommendation in absence of MOM	NWNODN enteral feeding guidelines Nutrition support document See appendix 5
	In absence of alternative evidence, recommended parenteral and enteral intakes of macronutrients, minerals and vitamins with early optimised parenteral nutrition should be targeted as per ESPGHN guidance		
	Routine attempts at PDA closure cannot be recommended. However carefully selected infants, with echocardiographic and clinical evidence of hemodynamically significant duct, who are at risk of being ventilated beyond 10-14 days might benefit from therapy.	Moderate quality evidence Low quality evidence	
Pharmacological interventions	Caffeine should be started early, ideally within first 24 hours	High quality of evidence	Optimisation measure / GIRFT recommendation / Saving Babies Lives (SBL) Element 5
	Post natal corticosteroids: 1. Dexamethasone: Consider the use of Dexamethasone in preterm infants at high risk of BPD who are 14 days or older and still need invasive ventilation +/- high FiO2. 2. Hydrocortisone: Optimisation bundles recommend considering the use of early low-dose prophylactic Hydrocortisone, when not associated with indomethacin and systemic steroids, on preterm infants born below 28 weeks of gestation on day 1 of life based on a large RCT.	Moderate to low quality evidence Moderate quality evidence Based on safety concerns with risk of spontaneous intestinal perforation and late onset sepsis in gestational ages <24 weeks the NWNODN are not routinely recommending it, and it is up to individual units	Local guidelines

	3. Inhaled corticosteroids/ budesonide: Very low-quality evidence exists possibly indicating that late use of inhaled corticosteroids MIGHT reduce use of systemic steroids and reduce extubation failure rate. *Can be recommended based on individual preference for weaning off from NIV*	Cannot be routinely recommended	
	Use of diuretics in selected patient cohorts with radiological/ clinical evidence of pulmonary oedema can be considered for short-term improvements in pulmonary mechanics and reduction of oxygen requirement. *If used they should be reviewed within 7-14 days*	Low quality evidence, recommended based on clinical picture	
Multi-disciplinary input and parental involvement for collaborative approach	Early involvement of interdisciplinary care teams can potentially improve outcome and alleviate associated co-morbidities	All these interventions are strongly recommended where the resources are available	**AHP supporting documents – See Appendix 5** SLT- The BPD Feeding Journey Physiotherapist – Positioning on respiratory support Dietician – Nutrition for babies on respiratory support Positioning-and-Handling-Guideline-2023-Final.pdf The 5-step dialogue – See appendix 6 Parent Leaflet under development during 2025 Occupational Therapy – Impact on Co-occupations. See appendix 5.
	Weekly nutrition focused ward rounds		
	Support from experienced neonatal physiotherapy team (if available) should be sought for collaborative management of the ventilated infant		
	Support from experienced Speech and Language therapy (SALT) team should be sought for risk assessment for oral feeding on respiratory support.		
	Parents should be involved as partners in care, supported and provided adequate information while their preterm baby is on respiratory support		
	Occupational Therapists play a key role in supporting sensory regulation, neurodevelopment, and parental engagement in care		

Timeline for interventions

There are multiple interventions which used or adopted individually or as a bundle have been shown to be effective in reducing BPD, however it is important that the right clinical context and right time is selected, and to understand that the preterm lung is in a state of dynamic evolution and the timepoints that we define to delineate disease process are at best arbitrary. Each intervention should be based on clinical and radiological correlation.

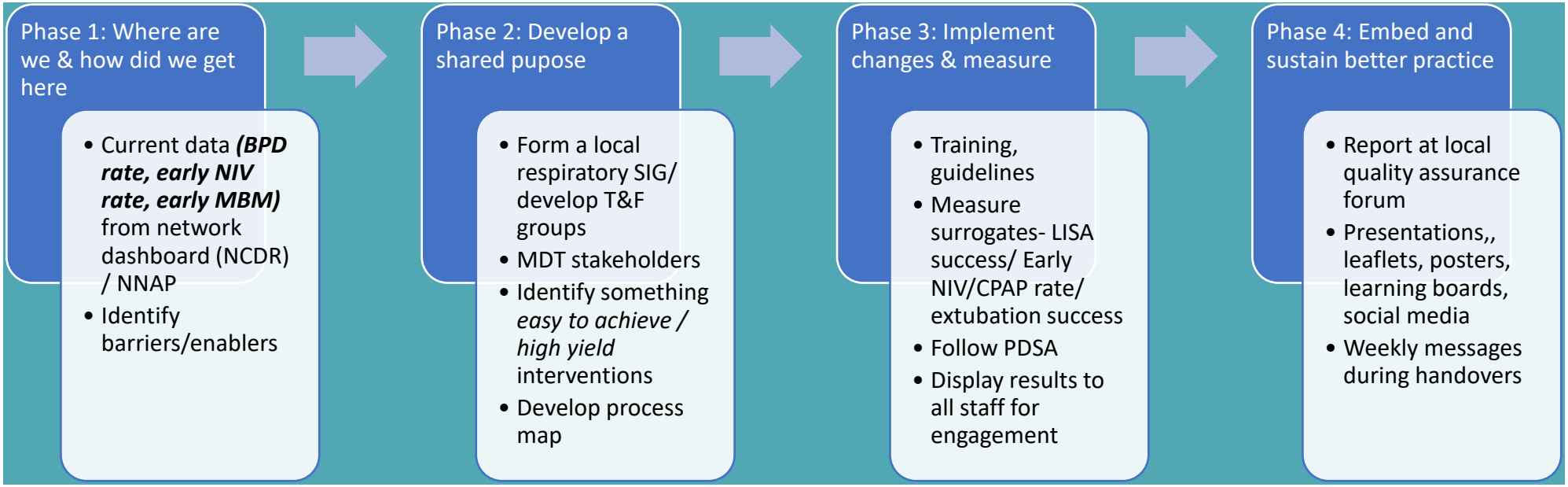


The importance of Neurodevelopmental, trauma-informed family-integrated care (NTFiCare)

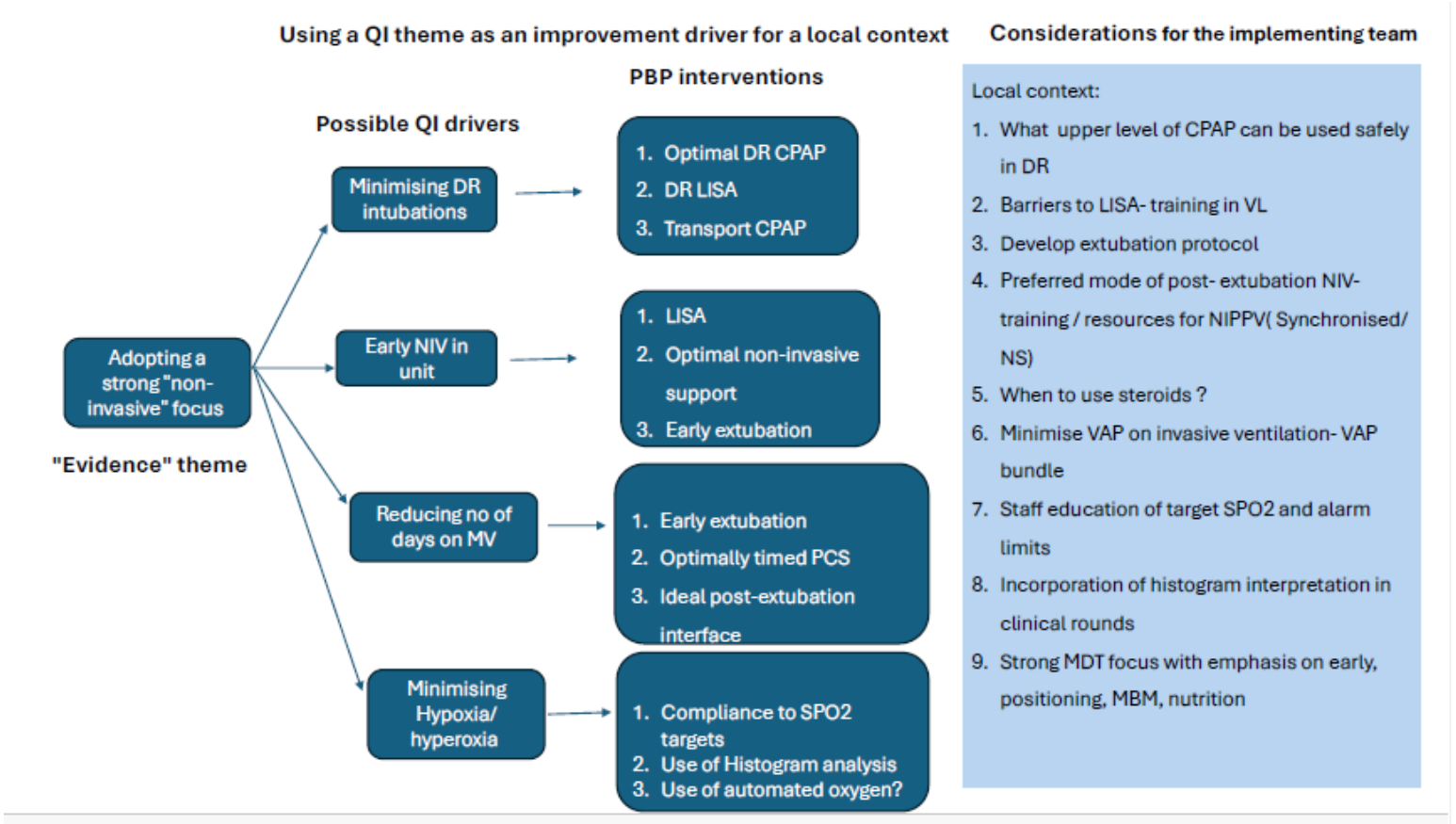
NTFiCare is essential for infants with BPD, due to the complex and prolonged nature of their neonatal journey. These infants often experience repeated invasive procedures, prolonged respiratory support and environmental stressors that can disrupt brain development and attachment. A trauma-informed approach recognises the infant's vulnerability and prioritises minimising stress, optimising non-pharmacological strategies, supporting self-regulation, and promoting positive sensory experiences.

Integrating families as active partners in care not only enhances bonding and emotional well-being but also improves developmental outcomes by fostering consistent, nurturing interactions. Embedding these principles into daily care supports both short- and long-term neurodevelopmental health in this high-risk population. It is advised to refer to the 5-step dialogue - appendix 6 and the NW Positioning-and-Handling-Guideline-2023-Final.pdf. A short training video on the importance of the 5-step dialogue can be accessed at https://youtu.be/O7dDyOKHZ3s

Example of a Toolkit approach to BPD reduction in region/ units



QI example: How to use a theme to develop QI initiatives



Appendix 1

NWNODN Criteria for Delivery room intubation & LISA in preterm infants born ≤ 32weeks' gestation

Evidence suggests effective delivery of delivery room CPAP and successful transition of the preterm infant to non-invasive respiratory support has shown to be associated with a reduced incidence of Bronchopulmonary Dysplasia (BPD). (1) However, there is lack of international consensus on criteria/threshold for intubation in the delivery room and most data is available from small single centre QI initiatives using higher static or dynamic PEEP and effective CPAP interfaces.

The following is not meant to act as a formal guideline, rather as a framework of potentially better practices as agreed upon by a MDT of regional stakeholders with the aim of reducing the use of mechanical ventilation and minimising lung injury.

The aim should be for Infants born in LNUs ≥ 27 weeks and NICUs ≥ 25 weeks to transition to CPAP in the delivery room if breathing spontaneously and stable hemodynamically (HR >100).

Considerations for clinical decision making:

- **workforce and level of skill & seniority in staff**
- **administration of optimisation measures, such as a full course of antenatal steroids.**
- **no history of chorioamnionitis**
- **absence of other risk factors like PPROM/ pulmonary hypoplasia**

At NICUs lower gestation babies can be tried on CPAP based on clinical discretion but with an awareness CPAP failure rates increase progressively at GA ≤25 (2).

At LNUs CPAP can still be offered for transition in the delivery room in a stable spontaneously breathing infant, if born between 26-27 weeks. However, intubation should be undertaken for transport and ongoing respiratory support provided in a controlled environment once baby has been transferred to the neonatal unit.

For all infants ≤ 32 weeks' gestation, at all levels of unit:

If a spontaneously breathing infant with no risk factors is on CPAP 7-8 cm H2O requiring >40% -50% FiO2 AND /OR has evidence of significant respiratory distress at 10 minutes they should be intubated by appropriately skilled personnel. *

If a baby can be stabilised on CPAP (i.e. no significant increased work of breathing & appropriate oxygenation) whilst spontaneously breathing, the aim should be to transfer them to the Neonatal Unit for reassessment and decision-making regarding LISA or intubation, as this is a safer environment

Note:

- CPAP pressures can be safely titrated from 6-8cm H2O (3,4)
- Delivery room LISA is still an evolving practice with lack of robust evidence and could be only considered by NICUs based on individual experience/ consensus but preferably not used for the very preterm infants (5)
- GRUNTING (mild) IS NOT considered significant respiratory distress and preterm infants grunt physiologically to maintain FRC, however shallow pattern of respiration, inconsistent drive or apnoea / bradycardia should be considered indications of intubation

If a spontaneously breathing infant born ≥ 25 weeks in a NICU or ≥ 27 weeks in an LNU has transitioned successfully to optimal CPAP of at least 6cm H2O and requires surfactant (FIO2 >30% within 72 hours of life)

OR

Exhibits signs of increasing respiratory distress even with FiO2 <30%

OR

Has demonstrable signs of RDS on lung ultrasound, surfactant should be administered

LISA should be the preferred method if expertise available

Infants born ≤ 27 weeks in an LNU should not be offered LISA to administer surfactant as they will require intubation for transport.

Note: It is recommended that infants born ≤ 28 weeks be offered CPAP before and after performing of LISA (in the immediate few hours after procedure) and not HFNC to provide optimal PEEP.

Based on available evidence, 1 further dose of LISA can be offered if criteria is met within 72 hours. Evidence is not sufficient for >2 courses with higher risks of CPAP failure and in these circumstances intubation and ventilation is potentially the better option. (6)

SCUs should not be offering LISA at present, and the advice guideline followed for all babies <32 weeks gestation, with early escalation and transfer for any infant requiring respiratory support.

Note:

* Evidence is lacking to determine optimal or maximal effective PEEP that can safely be used. European RDS guidelines (2023) recommends using between 6-8 cm H2O.

* No consensus exists on acceptable FiO2 AND Time to intubation – recommendations are based on experiential learning, units should use clinical discretion and develop team consensus.

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Appendix 2

DR CPAP – Best practices

Thank you to Dr Hannah Spierson, Royal Bolton Hospital

The delivery of constant positive pressure to the airway of a spontaneously breathing neonate maintains adequate functional residual capacity within the alveoli to prevent atelectasis and improves gas exchange within the pulmonary circulation. The type of care a preterm baby receives within the first few hours of life can have a significant impact on their long-term outcome including chronic lung disease and death. CPAP with early rescue surfactant is a strongly recommended practice with high certainty of evidence for spontaneously breathing preterm infants.

Only a minority of preterm babies will require intubation in delivery suite.

Refer to appendix 1 for the NW Threshold for intubation Statement

Some babies will 'fail' on CPAP and need rescue intubation, this is expected. It is still good to have tried non-invasive ventilation.

Providing DR CPAP to preterm infants

Equipment:

- CPAP hat – have hats available in various sizes, choose a hat based on baby's estimated size / gestation – a quick reference table is useful to help select correct size without needing to measure the baby's head
- CPAP mask – choose appropriately sized mask *(NB: For infants <28 weeks the standard 50 mm mask might not provide adequate seal- the 26mm mask from F&P is more anatomically suited)*
- Set up resuscitaire - e.g. PIP 25 as per NLS, PEEP should be at least 6cm H20
- If using customised resuscitaire trolley (e.g. Life start) for optimal cord management – set up r-PAP with above pressures

Process – see flow chart on next page

Respiratory support during DCC

Stabilise with facial mask i.e. neopuff / r-PAP to provide PEEP / IPPV as needed

Stimulate during the one to two minutes of optimal cord management (delayed cord clamping)

Thermal care – plastic bag, servo-mattress, transwarmer (refer to unit practices)

Stabilise using DR CPAP nasal mask to provide PEEP / IPPV as needed

Stimulate during DCC

Thermal Care including using DR CPAP hat from birth

Switch to face mask if baby not responding to IPPV via CPAP interface

Ongoing care at delivery

Switch to DR CPAP once baby has established regular respirations and secure in place

Secure DR CPAP once baby has established regular respirations

Escalation of respiratory support

Consider circumstances & history e.g. antenatal optimisation, gestation, size, maternal history (PPROM/chorio) etc. when considering escalation. Skill mix of staff

Agree DR intubation criteria (Refer to NWNODN Intubation statement)

Optimise PEEP e.g. increase in steps to 7-8cm H2O

Consider DR LISA if currently practiced at unit for 25wks & above in NICU and 27wks & above in LNU

Transfer to NICU

Check temperature at specified intervals throughout stabilisation and offer DR cuddles

Transfer baby on CPAP - on resuscitare, in transport incubator etc.

DR CPAP equipment should be kept on and used to provide ongoing NIV in NICU, therefore weigh baby with hat / mask in place. Minimise time off PEEP.

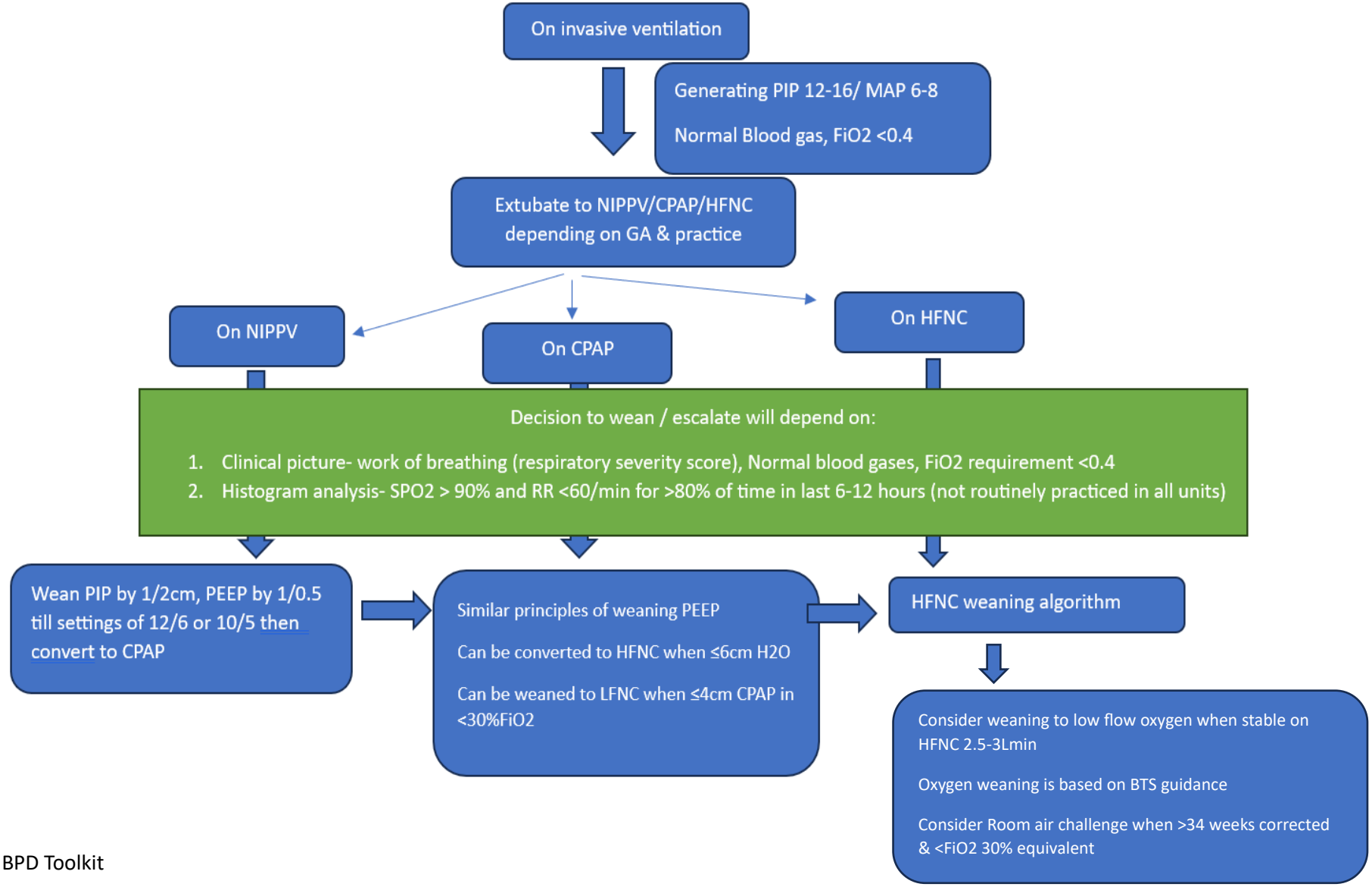
Loading dose caffeine

Early LISA is recommended if criteria for surfactant is met (<2 hours)

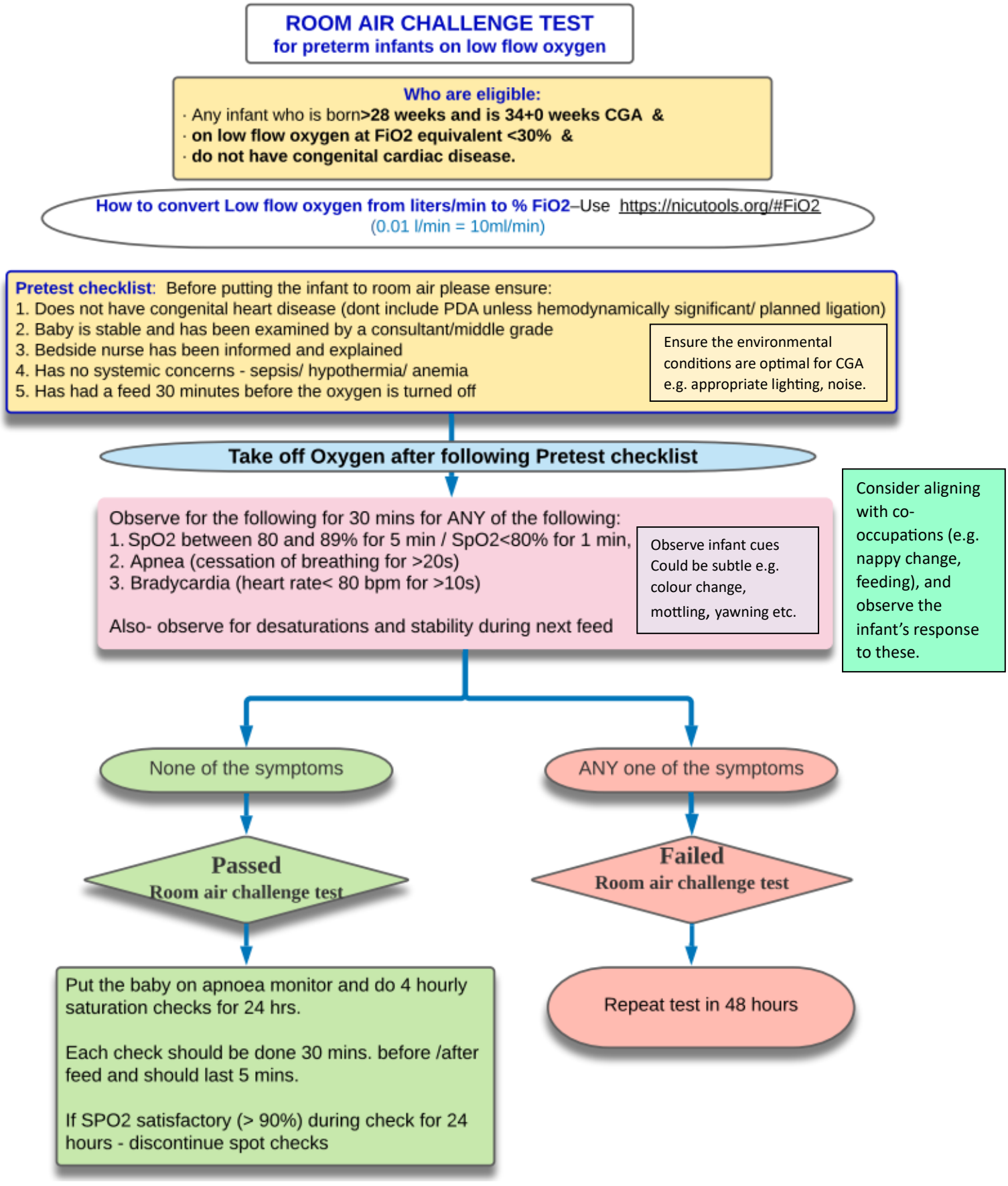
- Agree intubation criteria for use on NICU

Appendix 3 – Extubation & Weaning

Thank you to Dr Amitava Sur, East Lancashire Hospital Trust



Appendix 4 – Example of a room air challenge test (Shared by Burnley NICU)



Appendix 5 – MDT Supporting documentation

Document 1 (SALT)
Document 2 (Physio)
Document 3 (Dietetics)
Document 4 (Occupational Therapy)

References:

BPD Feeding Journey

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Clinical Considerations for the MDT: The BPD Feeding Journey

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This document summarises key considerations when making clinical decisions regarding feeding infants on non-invasive respiratory support. It emphasises the importance of individualised assessment, developmental readiness, collaboration with the Multidisciplinary team (MDT) with families taking the lead role.

It is considered best practice to have assessment by a Speech and Language Therapist (SLT) to identify feeding challenges and create individualised feeding plans. If a SLT review is not possible, the medical team should refer to this document to aid their clinical decisions. This tool should be used alongside guidance from NWNODN Enteral Feeding Guideline 2024 and RCSLT 2023 position paper.

1. Clinical Considerations Within MDT **(*Top considerations highlighted in red)**

• **Medical complexity***:* Consider the severity and symptomatic impact of comorbid cardiovascular, respiratory, neurological, gastrointestinal and metabolic conditions.

• **Physiological stability:** Observations of resting saturations, heart rate and respiratory rate (>60 breaths per minute can impact Suck/Swallow/Breathe (SSB) coordination), alongside the infants' respiratory pattern and effort (e.g. stridor, rib cage flaring, sternal or intercostal retraction)

• **Level of Respiratory support:** There is no universally agreed guidelines regarding flow rate and feeding on HFNC (RCSLT, 2023). Evidence indicates an increased risk of aspiration when orally feeding on CPAP (Ferrara, 2017).

• **Respiratory wean:** Evaluate the impact of the weaning process individually, considering that it may be more appropriate to **only change one variable at a time** (e.g. not changing oral feeding plans on the same day that flow rate is weaned).

2. Considerations of Pre-Feeding Journey

When an infant requires respiratory support and are not suitable for oral suck feeds, SLT will promote:

• Positive oral touch experience, taste, smell

• Non-nutritive sucking on a recently expressed breast / dummy.

• NG rather than OG tube (where possible– consider when CPAP has been weaned)

3. Considerations for Commencement of Oral Trials

• **Complexity of infant**: See Wolf & Glass Risk assessment tool

• Level of respiratory support: Flow rate, weaning, requirement during oral trial

• Physiological stability

• Behaviour and state- at rest, during handling and cares

• Developmental Readiness for suck feeding

• Bottle vs breast: Breastfeeding is infant-led and synchronised with milk flow. Bottle feeding may override infant cues and increase feeding risks.

4. Neuroprotective Trauma Informed Fi-Care Considerations

• Positive oral- sensory motor experiences

• **Responsive cue-based feeding**

• **Quality of suck feed over volume of feed**

• Parental empowerment and confidence

Risk Assessment for oral feeding on HFNC (Wolf and Glass, 2016)

	2	1	0
Full oral feeding prior to HHFNC	None	< 3 weeks	≥ 3 weeks
Medical Complexity	Very complex	Moderately complex	One system only
Respiratory Status	Extremely fragile; high FiO2	Stable with significant support; mod FiO2	Weaning respiratory support regularly; RA
Airway Protection / Aspiration Risk	High risk or known aspirator	Moderate risk	Respiratory status is the only risk factor
Flow Rate (based on corrected age)	< 37 wk: ≥ 4L ≥ 37 wk: ≥ 5L ≥ 2 mo: ≥ 6L	< 37 wk: 2.5 -3.5L ≥ 37 wk: 3.5 – 4.5L ≥ 2 mo: 4.5 – 5.5 L	< 37 wk: ≤ 2L ≥ 37 wk: ≤ 3L ≥ 2 mo: ≤ 4L

Medical Complexity:

***'Minimal*:** One system only - stable infants with prematurity as the sole medical concern, managed with minimal respiratory support

Moderate: includes the characteristics of minimal complexity plus one additional organ system involvement and escalated respiratory support (e.g. History of necrotizing enterocolitis)

Very complex: entails a complicated NICU course with multisystem involvement and the highest levels of non-invasive ventilation (e.g. grade III/IV intraventricular haemorrhage, congenital heart disease, renal disease, airway malformation)

*__Airway risk__: factors include the potential for aspiration, history of feeding intolerance, inability to manage secretions/protect the airway and surgical history, chronological age; CPAP, FiO2, NICU, postmenstrual age' **Smith et al 2024**

SCORING:

Score 0, 1, 2: Low risk; consider oral feeding (if meets general criteria for oral feeding - adequate gest age, appropriate RR, adequate state of alertness and feeding readiness cues)

Score 3, 4: Greater risk; Needs discussion; may be a candidate for therapeutic or limited oral feeding

Score ≥ 5: Highest risk; Not a good candidate for oral feeding

Clinical Considerations for the MDT: Positioning and Handling to Optimise Respiratory Function

Pip Ranson NWNODN Lead Physiotherapist; Lisa Woodward, Clinical Specialist Neonatal Physiotherapist, LNP

Neurodevelopmental Care

Neurodevelopmental care should be embedded in all infant interactions. Evidence shows that optimising this approach improves long-term outcomes.

Refer to the NWNODN Positioning and Handling Guideline for general principles and the importance of the 5-Step Dialogue: https://www.neonatalnetwork.co.uk/nwnodn/wp-content/uploads/2023/11/Positioning-and-Handling-Guideline-2023-Final-1.pdf

Embed the 5-Step Dialogue in all interactions, **prioritising parental touch and involvement** wherever possible.

Note - Respiratory physiotherapy in the neonatal population aims at optimising ventilation though positioning and handling, humidification, correct suction technique, assessment for oxygenation and ventilator settings. Manual techniques (chest wall vibrations and percussion) are often contraindicated and therefore rarely used. This followed reviews in the late 1990s, evidencing the risks out way the benefits in this population.

Handling Infants with Endotracheal (ET) Tube

Before Intervention

- Assess the infant individually: gestation, stability, sleep state, sedation, ventilation mode, airway grade, and attachments.

- Plan team roles in advance, how many people are needed, (the minimum of 2), 1 for airway at all times. Always remember a parent's touch is best where possible.

- Avoid unnecessary ventilator disconnection to prevent lung decruitment and barotrauma (e.g. use closed suction techniques for all ventilated infants, especially those on higher mean airway pressures).

- Use gentle, supportive handling (e.g., wrapping, wide-splayed hands).

- Confirm ETT securement and recorded depth.

During Intervention

- Maintain midline, neutral head and neck alignment (avoid chin tuck >10° or neck extension).

- Assign clear roles to support, 1 person for airway at all times.

- Use slow, gentle movements during all interactions.

- Continuously monitor vital signs and ETT position.

- Respond to infant cues with developmental strategies (e.g., pausing, containment holds, airway adjustments such as suctioning, ventilation and oxygen parameters only when clinically indicated).

After Intervention

- Reassess vital signs and ETT placement.

- Allow time for the infant to settle and recover.

Non-Invasive Ventilation

Apply the same principles as for ventilated babies & ensure a proper seal of the mask/prongs and monitor for air leaks.

Positioning for Respiratory Function

- Prioritise variety and frequency of positions over a 24-hour period, especially in infants with noted volume loss or excess secretions.
- All positions have respiratory benefits and should be used unless contraindicated.
- Encourage frequent skin-to-skin contact.
- Elevate the head of the bed for ventilated infants (check unit-specific guidelines).
- Apply core positioning principles: flexion, midline alignment, symmetry and promotion of normal movement and posture
- Maintain midline head positioning to prevent deformities that may affect feeding, breathing, and neuromotor development.

Clinical Considerations for the MDT: Optimal Nutrition

Juanita Templeton, Neonatal Dietitian, Royal Bolton Hospital & Lynette Forsythe NWNODN Lead Dietician

ODN Feeding Guideline: https://www.neonatalnetwork.co.uk/nwnodn/wp-content/uploads/2024/05/GL-ODN-18-Enteral-Feeding-

Consideration	Clinical Details	Clinical Actions	Evidence source
Energy requirements	Increased energy expenditure due to respiratory distress - 120-150kcals/kg/day	Ensure fortifying breast milk from 100mls/kg.	NWNODN Enteral feeding guideline
Protein requirements	Higher needs for growth and tissue repair 3.5-4g/kg/day	Use breast milk fortifier from 100mls/kg. Monitor growth velocity. May need to consider additional protein supplement. Serum urea can be monitored as a surrogate marker for protein status and values <2 mmol/L might indicate suboptimal intake	NWNODN Enteral feeding guideline
Fluid Management	Early fluid restriction has not been shown to influence the outcome of BPD and is not routinely recommended, but rationalising volume in evolving or established BPD can be beneficial	Adjust based on weight, urine output and electrolytes: monitor for oedema. Maximise nutrition in recommended 120-150mls/kg rather than increasing volume further.	Article: A review and guide to nutritional care of the infant with established BPD https://doi.org/10.1038/s41372-022-01578-0
Micronutrients	Vitamin A (lung healing), Vitamin D (bone health), Iron (anaemia prevention), Calcium/phosphorus (bone remineralisation)	Supplement as needed; monitor levels via bloods, adjust fortification	NWNODN Enteral feeding guideline
Enteral nutrition	Prioritise breastmilk	Start trophic feeds early, fortify breastmilk from 100mls/kg, monitor for intolerance/NEC	NWNODN Enteral feeding guideline
Parenteral nutrition	Use as NICE guidance or if enteral feeding not tolerated	Transition to enteral feeding as soon as possible	NW PN G/L under development NWNODN Enteral feeding guideline
Growth monitoring	Target weight gain 15-20g/kg/d Length measurements weekly Head circumference weekly	Use neonatal close monitoring growth charts. Length gives indication of linear growth. If weight demonstrates an upward trend across centiles to consider reducing nutritional intake	2022 Enteral Nutrition in Preterm Infants: ESPGHAN Position Paper | ESPGHAN
Oxygenation and energy balance	Increased work of breathing consumes energy	Optimise respiratory support to reduce tachypnoea and energy expenditure. Histograms might be a good guide to indicate if baby is persistently remaining tachypnoeic	
Gastroesophageal reflux (GER)	Common in BPD: Impairs feeding tolerance	Use smaller frequent feeds, elevate head during feeds: follow local guidance for management of reflux	Article:https://doi.org/10.3390/ijerph18126245
Multi-disciplinary team	Requires coordinated approach for individualised plans	Weekly Nutrition ward round - neonatologists, dietitians, speech therapists, infant feeding	BPD Toolkit | British Association of Perinatal Medicine
Long term nutrition	Sustained growth and neurodevelopment post discharge	Educate care givers on feeding, schedule follow up growth monitoring with outreach/community services. Dietetic follow up beneficial.	Service and Quality Standards for Provision of Neonatal Care in the UK | British Association of Perinatal Medicine

Clinical Considerations for the MDT: Occupational Therapy (Impact on Co-Occupations)

Authors: Sarah Tandy NWNODN Lead Occupational Therapist and Fiona Pringle Clinical Specialist Neonatal Occupational Therapist, with special thanks to the NWOTP support group

The following is generic best practice advice and different interventions might be suitable for different phases of the neonatal journey. The neonatal MDT should consist of Occupational Therapists to consult with, however in their absence on the unit the following should be considered:

CO-OCCUPATIONS

When engaging in the below co-occupations the additional information should also be considered (boxes to the right)

NAPPY CHANGING
Extra considerations: Side lying nappy changes to avoid diaphragmatic involvement. Consider wrapping upper body to help infant organise self.

BATHING / WEIGHING / SKIN TO SKIN
Extra considerations: Wrapped for transfer in/out to reduce stress, promote thermoregulation and motor stability.

DRESSING
Extra Considerations: Clothing easy to put on and off e.g. larger size, fasten down the middle. Clothing removed down the body vs up and over head to avoid respiratory support.

SLEEP
Why? Sleep is vital for growth and development
Considerations: Has baby got appropriate individualised positional support? Is the *environment* conducive to sleep? Decide the timing and adaption of procedures and cares to protect sleep. Regular skin to skin is shown to improve sleep.

POSITIONING FOR PLAY
Why? Play is the work of infants; it develops foundation skills for life
Considerations: Baby bouncers can be used (based on individualised assessment and not before 40+4 weeks) for short periods of 20 mins, when awake only & alongside regular positional changes e.g. tummy time, side lying, skin to skin & handling.

MODIFYING THE ENVIRONMENT TO OPTIMISE SENSORY DEVELOPMENT

Why?
The NICU environment is stressful for neonates. Creating a calm environment for the infant and their family helps the infant's immature nervous system in regulating stress from environmental triggers, including procedures. Sensory development is an important foundation for the development of all occupations

Considerations:
Take GA into account, consider infants experiences of light, sound, touch, movement (proprioception and vestibular), smell, taste. Responding and adapting to infant cues supports infant parent relationships through attachment and bonding (interoception). Consider impact of busier periods. Creation of protected times. Individualised positioning and optimal handling.

ENERGY CONSERVATION/PACING

Why? Clustering cares heightens stress & doesn't allow for recovery time
Considerations: Observe the baby's behavioural state before starting a procedure or co-occupation for a few moments and provide relationship-based care. Allow sufficient recovery period. Reassure with hand hugs, parental voice and smell. Individualised positioning.

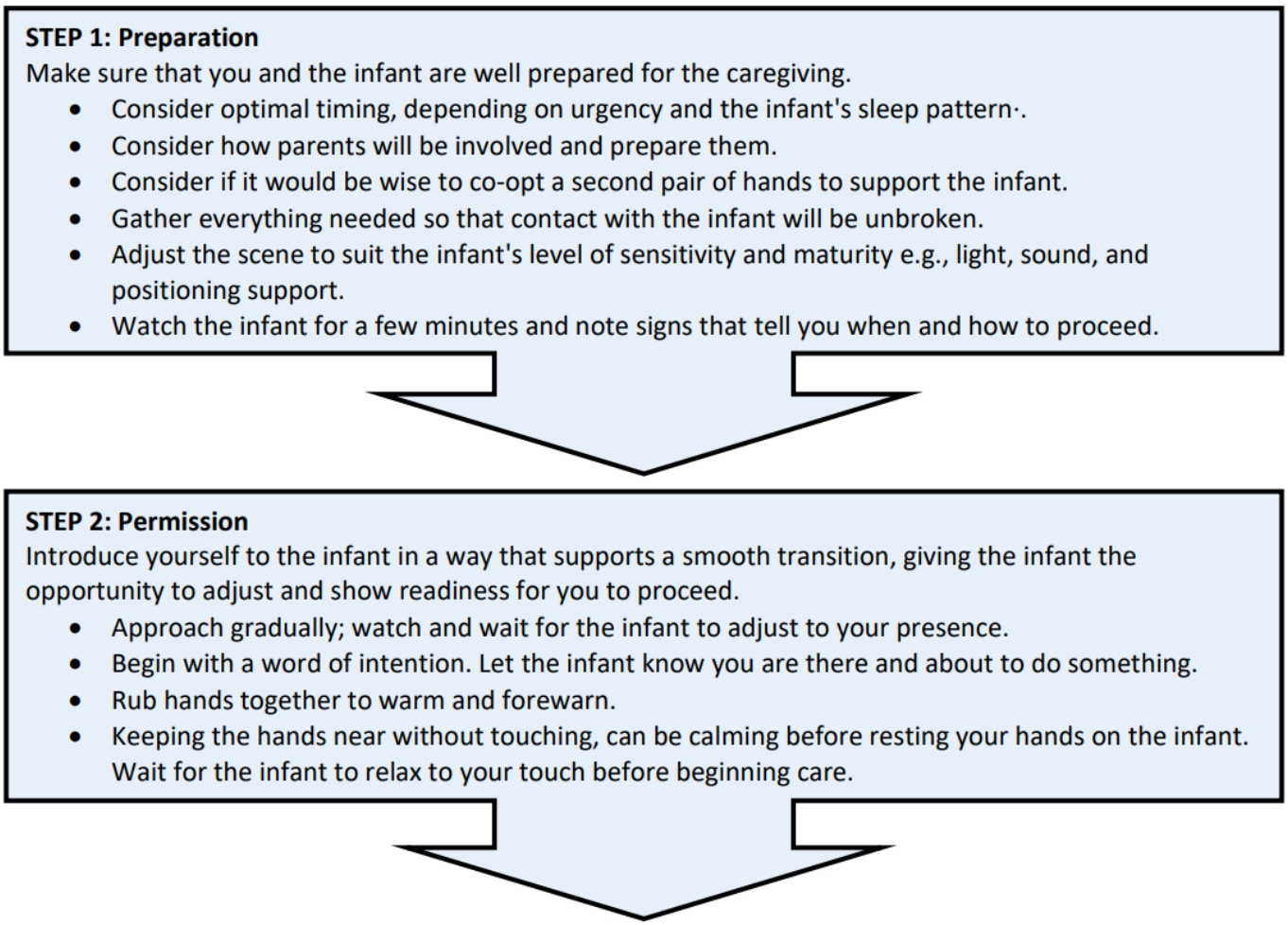
NEUROBEHAVIOUR

Why? Understanding infant cues allows us to work at the infant's pace adapting our approach to accommodate infant needs.
Considerations: Utilise 5 step dialogue (Bond). Observe and respond to autonomic, motor, organisational state and responsiveness cues -awareness of more subtle cues e.g. skin mottling, hiccups, shutdown (These may be observed during painful procedures). Empower parents; they are the expert in their own infant.

Appendix 6 – The 5-step dialogue

The ‘5 Steps' can be applied to all infants, at any stage or their journey through neonatal care and for any caregiving interaction. Their purpose is to:

- Focus on the infant as a unique little person rather than a medical case.
- Maintain the infant's physiological stability and make caregiving safer.
- Create opportunities for caregiver-infant attunement.
- Guide parents to feel confident and effective in caring for their infant.
- Improve consistency in caregiving practices.
- Help to relieve or avoid the infant's stress or discomfort.
- Enhance the infant's sensory experiences.
- Demonstrate respect and humanity.



STEP 3: Connection

Tune your responses to the infant's behavioural signs during the caregiving connection.

- Think of the activity as a dialogue rather than a monologue. You are doing something with the infant rather than to the infant. Answer behavioural signs with your hands and your voice.
- Be aware of your breathing and state of relaxation and how this may affect the infant.
- Let the infant lead the way. Observe and respect signs of sensitivity and efforts to self-regulate.
- Tell the infant what is happening; your voice can help the infant to adjust.
- If the infant reaches a state of quiet alertness pause to enjoy this moment of connection.

STEP 4: Adaptation

Find ways to adapt the activity to suit the infant.

- Allow a moment with a resting hand before moving the infant.
- Pace your interaction with the infant; pause when you see avoidance signs and help the infant to reorganise e.g. with gentle holding, your voice, or a change in position.
- Consider different ways to organise activities to maintain the infant's stability and comfort e.g.: Position, four-handed care, wrapping, sucking, grasping.
- Taking time can save time as the infant may be more stable and settled afterwards.

STEP 5: Completion

- Breaking contact is an important last step
- Tell the infant you have finished before you remove your hands.
- Parting can be very distressing for parents. Suggest they tell their infant they love them and when they will be back.
- Withdraw hands slowly.
- Wait and watch to make sure infant settles.