<table>
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<tr>
<th><strong>Full Title of Guideline:</strong></th>
<th>B19: Heated Humidified High Flow Nasal Cannula therapy (HFNC) on the Neonatal Unit</th>
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<tr>
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| **Scope (Target audience, state if Trust wide):** | Medical and nursing staff on the neonatal unit |
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| **Changes from previous version (not applicable if this is a new guideline, enter below if extensive):** | Not applicable |
| **Summary of evidence base this guideline has been created from:** | See appendix A |

This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date or outside of the Trust.
Heated Humidified High Flow Nasal Cannula therapy (HFNC)

**Background**

High flow nasal cannula therapy (HFNC) was rapidly adopted nationally and internationally in neonatal intensive care units (NICUs) as a form of non-invasive respiratory support in the last decade, with limited randomized controlled trial (RCT) evidence of its efficacy and safety. More evidence has emerged in recent years on its utility in the neonatal population. The increasing popularity despite the limited published evidence was because it seemed effective as a form of non-invasive support, along with the perceived ease of use to provide care, increased infant comfort, ease in establishing oral feeds, parental and nursing preference.

The concerns over its use have included:

- The unregulated distending pressures which could increase the risk of air leaks
- An unknown impact on chronic lung disease (CLD) rates which some observational studies suggest could be high especially when used in the very preterm population.
- An unknown impact on length of hospital stay.

Additional large RCTs are needed to address questions on the safety and efficacy in extremely low birth weight (ELBW) infants, use during initial resuscitation, and use during transport, the economic impact of HFNC, use in specific respiratory conditions and comparative effectiveness of the different HFNC devices. All the studies considered for this guideline did not report long-term neurodevelopmental outcomes.

HFNC therapy may help the efficiency of ventilation and reduce work of breathing through the following mechanisms:

1. Washout of nasopharyngeal dead space, flushing nasopharyngeal cavity of expiratory gas leading to improved alveolar ventilation.
2. Reduction in inspiratory resistance associated with the nasopharynx by providing flow to support inspiration thereby reducing inspiratory work of breathing (WOB)
3. Improvement in conductance and pulmonary compliance by supplying adequately warmed humidified gas
4. Reduction in metabolic work load associated with gas conditioning.
5. Provision of some positive distending pressure for lung recruitment

Randomised controlled trials in neonates have evaluated HFNC therapy against CPAP as a post-extubation support, as a primary treatment for respiratory distress syndrome; Post – INSURE; and weaning from CPAP.

**Key Points**

- HFNC therapy is increasingly being used as a form of non-invasive respiratory support in neonates, although the evidence base for long-term effects and safety is unclear
- HFNC therapy may reduce work of breathing and improve efficiency of ventilation through a number of mechanisms, many similar to those of CPAP
- Studies, predominantly in the moderate preterm population have shown similar efficacy to CPAP with no increase in important morbidity or mortality
- There is insufficient evidence for its use in the extremely preterm infants (<28 weeks), as a primary support and a weaning form of support
**Indications for HFNC use as non-invasive (NIV) support on the Nottingham neonatal units**

With careful consideration of the evidence base, we are recommending HFNC use in the following clinical settings:

- Stable moderate/late (PMA 34-36+6) preterm infants who still require CPAP support but for whom we are considering initiating suck-feeds
- Infants >30 weeks on low levels of CPAP support who have nasal trauma and would otherwise be mechanically ventilated to allow nasal injury to heal.
- Older Infants with established CLD requiring sustained nasal cannula flow rates of > 1L
- Stable Infants who are near-term or post-term still requiring NIV respiratory support, that could be transitioned to general paediatric care.

**Contraindications**

- HFNC should not be used in infants < 30 weeks unless decision is taken by the attending consultant with reason for use outside of this guidance clearly documented in the medical notes e.g. 29 week infant stable on CPAP 5 cmH2O in FiO2 0.28 with significant nasal injury for whom we would otherwise consider mechanical ventilation to allow nose to heal.
- Should not be used if an infant is acutely requiring > 40% oxygen, is having recurrent apnoeas, has acidosis with pH <7.25 or hemodynamic compromise.
- Infants with upper airway abnormalities such as choanal atresia, cleft lip and palate or tracheoesophageal fistula or infants who have defects in base of skull (risk of pneumocephaly)
- Infants with known air leak syndrome (pneumothorax, pneumomediastinum, pulmonary interstitial emphysema [PIE])

**Considerations at Initial set-up of HFNC therapy**

- Only use heated humidified systems
- Keep it warm – 34-37°C
- Maintain a leak at the nose (use non-occlusive prongs)
- Position tubing down and away from infant to minimise rain out into the airway

**Initiation of HFNC therapy**

Settings of HFNC should be determined by the attending consultant or designate. The following are suggested initial settings, based on flow rates used in the RCTs considered for this guideline.

- Start at 4 – 6 L/min
- Consider starting at the higher flow rate if FiO₂ > 0.30, previous MAP > 7, or with increased work of breathing (WOB).

There is no trial evidence comparing starting flow rates
**Escalating HFNC therapy**

Do not delay in escalating flow

Increase flow for:

- Increased respiratory rate
- Increased FiO2
- Increased WOB

Maximum setting is a flow rate of 8 L/min.

**Change mode of respiratory support (CPAP or MV) if not improving i.e. rising respiratory rate and heart rate, increasing oxygen requirement, apnoeas. Example: Infant on flow rate of 6L/min previously in 0.3 FiO2 now in 0.6, RR increased from 50 to 70/min is tachycardic or with recurrent apnoeas, discontinue HFNC and consider mechanical ventilation in addition to other clinical management e.g. infection screen**

**Monitoring during HFNC therapy**

- All patients on HFNC should have continuous cardio-respiratory monitoring.
- 60 minutes after initiation of therapy the patient should be reassessed to determine the effectiveness of the therapy. The assessment should include a clinical assessment and consideration for a blood gas analysis.

If at the time of reassessment there is an improvement in the clinical status then the patient may continue on this mode of support. If there is no improvement, the respiratory support should be escalated as appropriate with consideration for a blood gas and chest x-ray if not already performed.

**Weaning of HFNC therapy**

Weaning of HFNC therapy should commence when the cause of respiratory insufficiency has begun resolution with infant stable for > 24hrs, FiO2 < 0.30 and normal work of breathing/respiratory rate.

- The approach to weaning is to initially wean FiO2 to < 0.30 before reducing flow rates.
- Review every 24hrs to determine if flow can be weaned or HFNC can be discontinued.
- Infants > 2kg may be weaned more quickly
- Wean by 0.5 – 1 L/min decrements, with smaller decrements in smaller infants and infants with established chronic lung disease.

If at any time during the weaning process the patient’s respiratory status worsens, the FiO2 and flow rate should be increased back up to the previous higher level or consider changing mode of respiratory support.

There are no studies comparing effect of discontinuing HFNC therapy at different support levels. Units that use HFNC vary between 1 -4L/min in levels at which they would discontinue therapy.15

We suggest discontinuing HFNC therapy at 2-4L/min if patient achieves stability criteria above.
Audit Points

1. Appropriateness of starting HFNC e.g. PMA at initiation
2. Duration of respiratory support, need for home oxygen
3. Flow rate at which HFNC was discontinued
4. Age at full suck feeds
5. Complications of HFNC
6. Need for escalation of respiratory support after HFNC
7. Length of hospital stay

Appendix A: Summary of randomized controlled trials (RCT) evidence:

HFNC for neonatal respiratory support

<table>
<thead>
<tr>
<th>Indications</th>
<th>Trials</th>
<th>Key findings</th>
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<tr>
<td>Post-extubation HFNC vs CPAP</td>
<td>3 RCTs N = 590</td>
<td>• Similar efficacy to CPAP</td>
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<tr>
<td></td>
<td>Collins et al, AU J Peds 2013</td>
<td>• Less nasal trauma</td>
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<tr>
<td></td>
<td>Manley et al, AU NEJM 2013</td>
<td>&lt; 32 weeks infants in AU trials</td>
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<td>Liu et al, China Zhonghua Er Ke Za Zhi 2014</td>
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<tr>
<td>Post-extubation and Primary RDS treatment</td>
<td>N = 432, 150 &lt; 32 weeks</td>
<td>• Similar efficacy to CPAP</td>
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<tr>
<td>HFNC vs CPAP</td>
<td>Yoder et al, Utah Pediatrics 2013</td>
<td>• Infants randomized to HFNC stayed on study mode longer</td>
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<tr>
<td>Primary RDS treatment HFNC vs CPAP</td>
<td>4 RCTs N = 1072</td>
<td>• Increased failure with HFNC</td>
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<tr>
<td>Primary RDS treatment HFNC vs NIPPV</td>
<td>Lavizzari et al, Italy JAMA Peds 2016</td>
<td>• Overall intubation rates similar</td>
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<td></td>
<td>Median GA 33 weeks (29-36+6)</td>
<td>• Possibly longer on respiratory support in HFNC group</td>
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<tr>
<td></td>
<td>Kugelman et al, Israel Pediatr Pul 2014</td>
<td>• Less nasal trauma with HFNC</td>
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<tr>
<td></td>
<td>Roberts et al, AU NEJM 2016</td>
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<tr>
<td></td>
<td>Median 32 weeks (28-36+6)</td>
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<tr>
<td>Post-INSURE HFNC vs CPAP</td>
<td>1 RCT N = 123</td>
<td>• Similar outcomes to CPAP</td>
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<td></td>
<td>GA 30-34 weeks</td>
<td>Moderate preterms</td>
</tr>
<tr>
<td>Weaning from CPAP</td>
<td>2 RCTs N = 161</td>
<td>• Off CPAP sooner</td>
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<tr>
<td></td>
<td>Tang et al, AU BMC Pediatrics 2015</td>
<td>• No difference in BPD, NIV support days and O2 days</td>
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<tr>
<td></td>
<td>GA &lt;30 weeks</td>
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<tr>
<td></td>
<td>Soonsawad et al, Thai Neonatology 2016</td>
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<td>&lt;32 weeks</td>
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Appendix B: HFNC therapy in the NICU

Stable Neonates > 34 weeks postmenstrual age with no significant apnoeas, acidosis, FiO2 requirements < 0.40 and no haemodynamic compromise

- Plan to initiate suck feeds
- Nasal trauma on CPAP support
- Nasal cannula O2 flow rates > 1L
- PMA >40 weeks likely to transition home via PICU/paediatrics

- No contraindication to HFNC therapy
- Neonatologist or designate agree to start HFNC therapy

- Start HFNC therapy
- 4-6 L/min (consider higher flow rate if FiO2 > 0.30, previous MAP 7)
- Use heated humidified system
- Use non-occlusive nasal prongs
- Position tubing down and away from infant

Reassessment after initiation of HFNC:
- Assess FiO2 requirement
- RR and HR
- +/- blood gas analysis
- Improvement?

No
- Consider increasing flow rate (max. 8 L/min)
- Consider blood gas and CXR if not already done
- Change mode of support if not improving e.g. Increasing RR, WOB, FiO2 & recurrent apnoeas

Yes
- Continue HFNC therapy
- Patient must be on HR and SPO2 monitoring

- Start weaning after 24hrs of stability
- Wean FiO2 to <0.30 before weaning flow rate
- Wean by 0.5 - 1 L/min decrements
References:
