# Document Control

## Title

**Neonatal and Paediatric High-Flow Nasal Cannula Oxygen Therapy Guideline**

## Author

**Author's job title**

## Directorate

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## Department

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1.2 | Sept 2018 | Amended | Flow chart for Paediatrics update to include Caroline Thorpe ward use

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- Paediatric Speciality Team
- Neonatal Nurses
- Paediatric Nurses

## Approval and Review Process

- Paediatric Speciality Team

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## Local Path

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1. **Purpose**

1.1. The purpose of this document is to detail the process for best practice in the starting, use of and weaning of high-flow oxygen therapy in neonates and paediatrics.

1.2. The policy applies to all clinical staff working with babies, children and young people.

1.3. The High-Flow Oxygen therapy system used in the Special Care Unit in North Devon District Hospital for infants up to 1 month of age (corrected) is Optiflow Junior. This may be used on paediatric HDU patients of this age.

1.4. For patients nursed in PHDU over 1 month of age the High-Flow system to be used is AIRVO 2.

2. **Responsibilities**

2.1. **Role of Consultant Paediatricians**

Ensuring that all relevant medical staff are aware of the guideline and that it is followed.

3. **Abbreviations**

HFNC – High Flow Nasal Cannula

RR – Respiratory Rate

RDS – Respiratory Distress Syndrome

FiO₂ – Inspired oxygen

NCPAP – Nasal Continuous Positive Airway Pressure

PHDU - Paediatric High Dependency Unit

CTW- Caroline Thorpe Ward

PEWS- Paediatric Early Warning Score

SpO₂- Peripheral Capillary Oxygen Saturations
4. Background

4.1. What is High Flow Nasal Cannula Oxygen Therapy

High flow nasal cannula (HFNC) therapy uses nasal cannula to deliver heated and humidified medical gas mixtures at flow rates that match or are higher than the patients normal inspiratory flow rate. Therefore oxygen can be delivered at higher concentrations than is possible by low flow therapy.

4.2. How does HFNC therapy work?

It is suggested that HFNC uses several mechanisms to improve efficiency of ventilation and reduce work of breathing.

- **Washout of nasopharyngeal dead space leading to improved alveolar ventilation** – This is thought to be the primary mechanism, reducing the overall dead space and contributing to more effective CO2 elimination. High Flow reduction of the dead space also affects oxygenation as reduced entrapment of room air means airway oxygen concentration is higher.

- **Reduction in the inspiratory resistance associated with the nasopharynx** – CPAP reduces inspiratory resistance by splinting open the airway while High-Flow Therapy matches/exceeds patients inspiratory flow and eliminates increasing nasopharyngeal resistance caused by its inspiratory distensibility (retraction of the nasopharynx during inspiration significantly increases its volume and thus resistance).

- **Improvement in conductance and pulmonary compliance by supplying warmed and humidified gas** – Cold, dry gas elicits bronchoconstriction and breathing cold, non-humidified gas for only 5 minutes decreases lung compliance and conductance.

- **Reduction in metabolic work associated with gas conditioning** – The nasopharyngeal cavity provides effective warming and humidification to inspiratory gas but this requires a significant amount of energy. Babies on HFNC therapy have been shown to gain weight quicker than on CPAP.
• May provide positive distending pressure for lung recruitment – High gas flow generates positive airway pressure, although unreliably due to factors such as body weight and mouth leaks.

4.3. Potential advantages of HFNC therapy

• HFNC is more comfortable for the patient than low-flow oxygen therapy as the gases are heated and humidified. Compared to CPAP the equipment and tubing is less bulky and also the HFNC therapy does not require creation of a seal and is better tolerated by the patient.

• Reported benefits include a reduction in both ventilation days and re-intubations. As it is non-invasive HFNC also helps reduce ventilator associated pneumonia and other lung injuries.

4.4. Potential disadvantages to HFNC therapy

• Currently there is no way of monitoring the end-distending pressure and therefore there is a theoretical risk of lung over-distension and pneumothoraces.

• The cannula may cause trauma to the nasal mucosa and gastrointestinal distension may occur.

4.5. Contraindications to HFNC therapy

• Airleak (pneumothorax, pneumomediastinum)

• Multi-organ compromise

• Frequent or recurrent apnoea (NCPAP may be considered more appropriate)

• Respiratory acidosis(pH<7.25)

• Multi-organ compromise.
5. Using HFNC therapy

5.1. When should HFNC therapy be started?

- For babies and children with signs of respiratory distress as an alternative to NCPAP in mild/moderate respiratory distress (see PEWS for PHDU patients)
- For neonates with Chronic Lung Disease
- For neonates with nasal trauma from NCPAP
- To wean more slowly from NCPAP
- For neonates requiring >1l/min of oxygen therapy (this should not be given un-humidified via low-flow nasal cannula and high-flow should be commenced.

AIRVO 2 IS ONLY TO BE USED ON BABIES WITH BRONCHIOLOITIS ON CT WARD
Guide to Respiratory Distress for neonates and children:

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Nasal Flaring, subcostal recession</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderate</td>
<td>Head bobbing, Intercostal recession, inspiratory or expiratory noises, Tracheal Tug</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>Sternal recession, Exhaustion, Impending respiratory arrest</td>
</tr>
</tbody>
</table>

Also consider tachypnoea, grunting and cyanosis as per PEWS age related charts and neonatal observation charts and/or NEWS charts.

Patients that may benefit from HFNC are those with an increased respiratory rate, signs of mild / moderate respiratory distress and/or increasing oxygen requirements, with no contraindications. Flowchart in Appendix Figure 1 can be used to make this decision.

A senior doctor (ST3+ Registrar or a Consultant) should review the patient prior to initiating HFNC therapy and a clear plan documented in the notes.

5.2. How should HFNC therapy be initiated?

Select appropriate sized nasal prongs for both neonates and paediatric patients. These should not occlude more than 75% of the nares.

<table>
<thead>
<tr>
<th>Maximum Flows</th>
<th>Cannula Type</th>
<th>Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Litres</td>
<td>Premature (red)</td>
<td>Optiflow Junior</td>
</tr>
<tr>
<td>8 Litres</td>
<td>Neonatal (yellow)</td>
<td>Optiflow Junior</td>
</tr>
<tr>
<td>20 Litres</td>
<td>Infant (purple)</td>
<td>AIRVO 2</td>
</tr>
<tr>
<td>25 Litres</td>
<td>Paediatric (Green)</td>
<td>AIRVO 2</td>
</tr>
</tbody>
</table>

**The nasal Cannula must be used only on machines stated above**
**For neonates on Optiflow Junior:**

- Patients should initially be managed according to the flowchart in Appendix 1
- Approximately 6L/min (between 5-8L/min)
- A lower flow rate of 5L/min may be sufficient for smaller babies while higher rates up to 8L/min may be more suitable for larger babies.

Set the initial FiO2 with the aim of maintaining saturation targets for appropriate gestation.

<table>
<thead>
<tr>
<th>Gestation</th>
<th>Alarm limits with O2 administration</th>
<th>Alarm limits in Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 36 weeks</td>
<td>90-95</td>
<td>90-100</td>
</tr>
<tr>
<td>36 weeks and over</td>
<td>95-99</td>
<td>95-100</td>
</tr>
</tbody>
</table>

**For paediatric patients on AIRVO 2 nursed on Caroline Thorpe ward with Bronchiolitis:**

- **Young infants 0-3 months (Under 3kg, use Neonatal Optiflow & PHDU)**
  - Start on 6L/min and FiO2 40%. Wean FiO2 to maintain spO2 92-95%
- **Older Infant 4-11 months**
  - Start on 8L/min and FiO2 40%. Wean FiO2 to maintain spO2 92-95%
- **Pre-school 1-4 years**
  - Start on 10L/min and FiO2 40%. Wean FiO2 to maintain spO2 92-95%

**For paediatric patients on AIRVO 2 nursed in PHDU**

- Patients should initially be managed according to the flowchart in Appendix 3
- 0-10 kg: 2 L/Kg/min
- >10 kg: 0.5/Kg/min for each kg above 10kg (up to 30kg )
- >31kg-50kg suggested flow 40L/min (maximum flow 50L/min)
- >50kg suggested flow 50L/min (maximum flow 60L/min)
• Start flow at 6L/min, increase as tolerated to desired flow

• E.g. 14 kg child would require a flow rate of 10 x 2L + 4 x 0.5L = 22L/min

• If patients requires nebulisers via the HFNC, ensure that flow rate is decreased down, e.g. nebuliser on flow rate 5L/min, reduce flow rate of AIRVO 2 down by 5L/min. Nurse to stay with patient whilst receiving the nebuliser and increase flow rate of AIRVO 2 back up once nebuliser has finished

• NOTE: Alternative settings may be more appropriate in some cases e.g. child with chronic hypoxemia, child with congenital heart disease. These settings, together with a plan of escalation, should be agreed with the consultant responsible and recorded in the medical notes.

5.3. Monitoring and managing a patient on HFNC therapy on CTW and PHDU

There should be continuous oxygen saturation monitoring and consideration of ECG monitoring. The patient should be reviewed at least daily by an ST3+ Registrar or Consultant.

Observe and document the nasal cannula at least hourly to ensure they are in the correct position and for evidence of pressure sores

Perform and record hourly observations including PEWS, flow rate and humidification temperature.

Check and record the water level hourly ensuring that not too much water has drained into the chamber, also check water level in bag Replace the sterile water bag after every 24 hours.

Change tubing and cannula every seven days.

Neonates with signs of deterioration will be discussed with the Tertiary NICU and a plan for treatment documented.

There should be consideration of the need for further investigation and repeat blood gases at intervals dependent on the patient’s clinical picture.

It is likely that enteral feeds will be stopped initially but passage of a nasogastric tube to reduced gastric distension should be considered. Enteral feeds may be introduced if the child’s clinical condition allows.

A neonate requiring high flow therapy should be considered for administration of surfactant.

Weaning of HFNC should be considered at each review.
Infants on high flow therapy (2L/kg for paediatrics) will require High Dependency care at a ratio of 1:2 nursing care.

Patients nursed on CTW on AIRVO will be looked after on a 1:3 nursing ratio.

Any acquired pneumothoraces should be monitored by completing a Datix form in these incidences.

Additional note: All high flow therapy equipment costs are reclaimed.

### 5.4 How should HFNC therapy be escalated?

If oxygen saturations are not satisfactory / appropriate for gestation and FiO2 is >40% alternative support is likely to be needed either CPAP or invasive ventilatory support and on-going care should be discussed with tertiary centres, Derriford NICU, for Special Care neonatal patients and Wales and West Acute Transport for Children (WATCH) for PHDU patients.

### 5.5 How should HFNC therapy be weaned?

There is no consensus of evidence regarding weaning of HFNC. Weaning should be initiated by a senior member of the medical team (ST3+ Registrar or Consultant) and the plan documented in the notes.

Oxygen should be weaned before flow. Oxygen can be weaned to the lowest amount that gives the desired saturations appropriate to gestation for a neonate in the Special Care Unit, or SpO2 > 92% in PHDU.

**PHDU Only** - Wean FiO2 by 5-10% every 4 hours. If SpO2 >92 and respiratory effort stable then continue to wean. When FiO2 25% and baby stable with SpO2 > 94% then switch to low flow oxygen therapy if required.

Consent must be gained from the parent/carer with parental responsibility before the start of commencing HFNC and an explanation for the reasons and benefits of commencing this treatment. Parents/carers must be kept updated throughout the treatment of HFNC.

### 6. Monitoring Compliance with and the Effectiveness of the Guideline

**Standards/ Key Performance Indicators**

**6.1.** Key performance indicators Special Care Unit use:

- BAPM recommendations
- Neonatal Network recommendations
- NICE Neonatal Quality Standards
- NHS Toolkit for High Quality Neonatal Services
- National Neonatal Audit Programme
- NHS Standard Contract for Neonatal Critical Care as their Key Performance indicators on which to base care.
- NICE Bronchiolitis in Children

**Process for Implementation and Monitoring Compliance and Effectiveness**

6.2. Staff are informed of new/revised documentation. There is an expectation that staff are responsible to keep updated on any improvements to practice and deliver care accordingly. Nursing staff are trained and competent in the use of high flow. Verification of competency is stored in folders on ward.

Neonatal data is collected by use of Badger data base Vermont Oxford Network and can be used to generate output for clinical and operational benchmarking. Paediatric HDU data is collected locally and stored by finance department.

Monitoring of implementation, effectiveness and compliance with these guidelines will be the responsibility of the Staff in the Special Care Unit and PHDU. Where non-compliance is found, it must have been documented in the patient’s medical notes, reviewed by the medical team and reported by Datix.

Any incidents will be investigated and actions plans made. Learning will be discussed at ward and Paediatric Team meetings. Further discussion and reviews may occur at Directorate meetings, Maternity Patient Safety and Governance meetings. Learning and action plans are cascaded at these meetings and improvements implemented. Key findings and learning points will be disseminated to relevant staff.
7. References


- Holme N, Harrison C. Should we be using high flow therapy on the neonatal unit? Infant 2012. 8 (6) 172-178


- High Flow Nasal Cannula Therapy Paediatric, Clinical Guideline Plymouth Paediatric High Dependency Unit 2017
8. Appendix 1: Decision to start HFNC therapy in Special Care Unit

Any signs of respiratory distress or oxygen requirement?

Doctor to review within 30 minutes and consider:
1. The cause of respiratory distress
2. The need for respiratory support

Respiratory support needed?

Obtain blood gas and consider need for chest X-ray immediately or at 4 hours as appropriate

Contraindication for HFNC therapy?
- Airleak (Pneumothorax, Pneumomediastinum)
- Multi-organ compromise
- Recurrent or frequent apnoea

Consider alternative support and discussion with tertiary centre (Derriford NICU)

Optimise current management

Commence HFNC according to guidance
9. Appendix 2 Initiating Optiflow Junior HFNC therapy in Special Care Unit

Attach oxygen saturation recording, and select appropriate sized nasal prongs

Set initial flow rate to 6L/min*

Set initial FiO₂ to maintain saturations:
- 95-99% in neonates >36w
- 90-95% in neonates <36w
  (if in air up to 100% for all)

If respiratory picture settled and normalised gas – senior review and try to wean. Oxygen should be weaned before flow. Oxygen can be weaned to the lowest amount that gives the desired saturations appropriate to gestation. When FiO₂ 25% and baby stable with appropriate SpO₂ then switch to low flow oxygen therapy if appropriate.

If oxygen saturations are not satisfactory in >40% FiO₂ or other cause for concern eg. respiratory effort, for senior review and consider alternative support

* A lower flow rate of 5L/min may be sufficient for smaller babies and up to 8L/min for larger babies
10. Appendix 3: Initiating AIRVO 2 HFNC therapy on CTW and PHDU

Prior to starting AIRVO 2 HFNC, if evidence of

- Respiratory acidosis (pH < 7.25)
  - Recurrent apnoea’s
  - Pneumothorax
- Multi-organ compromise
- Clinical instability or concerns

May not be suitable for HFNC: Urgent senior medical review, inform ICU & WATCH

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AIRVO 2 IS ONLY TO BE USED ON BABIES WITH BRONCHIOLOITIS ON CAROLINE THORPE WARD (CTW)

11.1.

Respiratory observations from the Paediatric Early Warning Score (PEWS) are used to decide when to start High Flow (see Figure 2). This is known as the Respiratory PEWS. A Respiratory PEWS of three or more should be considered for High Flow, see section 6 for location.

**Figure 2**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Possible Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate</td>
<td>Age-specific rates</td>
<td>0,1,2,4</td>
</tr>
<tr>
<td>Oxygen Saturation (in air)</td>
<td>&gt;95%, 92-94%, &lt;91%</td>
<td>0,1,4</td>
</tr>
<tr>
<td>Respiratory Distress</td>
<td>None, mild, moderate, severe</td>
<td>0,1,2,4</td>
</tr>
</tbody>
</table>
11.2 Flow chart for CTW and PHDU

**START POINT: CTW**
Respiratory PEWS score three or more (figure 2)

Inform senior medical team, for review within 30 minutes

Senior medical decision to commence HFNC, inform PHDU nurse (does not require blood gas at this point)

**START POINT: PHDU**
Set flow rate at 2L/kg for first 10kg + 0.5L/kg for each kg after

If requiring > 40% request urgent senior medical review (within 15 minutes)
Increase FiO2 to 50% if SpO2 less than 92%. Inform HDU nurse for escalation and admit to HDU

If under 3kg use neonatal Optiflow and nurse in PHDU
0-3 months- start on 6L/min & FiO2 40%
4-11 months- start on 8L/min & FiO2 40%
1-4 years- start on 10L/min & FiO2 40%, Once settled wean FiO2 to maintain SpO2 92-95%, regular senior reviews

Senior medical team review after 20 minutes

If SpO2 > 92% continue HFNC

If SpO2 <92% increase FiO2 to 50% and request urgent senior review within 15 mins and inform ITU & WATCH

For CTW & PHDU
Regular review & consider weaning FiO2 if SpO2 >92%
12. **Appendix 4: Approach to weaning AIRVO 2 HFNC in PHDU**

Oxygen should be weaned before flow

When clinical condition improving indicated by:
- Decreased work of breathing
- Normal or improved respiratory rate
- Return to normal cardiovascular parameters

Once FiO₂ 25% and child stable with SpO₂ > 94% then switch to low flow oxygen therapy if required

Wean FiO₂ by 5-10% every 4 hours
If SpO₂ >92% and respiratory condition improving then continue to wean

Monitor in PHDU for 4 hours after stopping to ensure no further use of AIRVO 2 is needed