High Flow Nasal Cannula Therapy

Management of the paediatric patient receiving high flow therapy

Purpose

The aim of this guideline is to ensure safe and effective use of High Flow Nasal Cannula (HFNC) therapy for children with acute respiratory illness through:

- Appropriate placement in inpatient areas with trained staff
- Support for decision making in relation to initiation, continuation and weaning of therapy and escalation of concerns

Scope

This guideline applies to all CHQ staff caring for children receiving HFNC therapy for an acute illness outside of the Paediatric Intensive Care Unit (PICU) setting. Children with chronic respiratory failure or who are palliative will have individual HFNC therapy management plans documented by their Medical teams that may be outside the scope of this procedure.

- The decision to initiate HFNC therapy must be made in consultation with the treating Physician
- PICU, Patient Flow and relevant staffing (PFSU-Nurse Manager & Safety CNC) are to be informed that a patient is to be initiated on HFNC therapy.
- Outside normal business hours the Safety CNC to be notified of HFNC therapy initiation.
- Any patient who does not exhibit signs of clinical stabilisation within 2 hours of commencement of HFNC therapy to be reviewed by the PICU service.
- Any patient who does not exhibit signs of clinical stabilisation with 4 hours of commencement of HFNC therapy to be considered for transfer to the PICU.
Definition of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFNC</td>
<td>High Flow Nasal Cannula (also known as high flow nasal prong) therapy; is the delivery of humidified air at a flow rate of 2 L/kg/min up to 25kg. Paediatric patients &gt; 25kg have maximum flows of up to 50LPM delivered via nasal cannula. Table 1 outlines weight specific flows further. High flow therapy can be delivered with or without added oxygen.</td>
</tr>
<tr>
<td>FiO₂</td>
<td>Fraction of inspired oxygen which is the percentage of oxygen delivered eg. 25%</td>
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<tr>
<td>CPAP</td>
<td>continuous positive airway pressure delivered via a nasal mask</td>
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</tbody>
</table>

Introduction

- High flow nasal cannula (HFNC) therapy is used to provide a humidified continuous flow of gas that matches the inspiratory flow of the infant or child providing a continuous positive pressure similar to that achieved with nasal mask continuous positive airway pressure (nCPAP). Oxygen therapy can be added into the flow and used as an adjunct to HFNC therapy and can be titrated to the child's oxygen requirements to keep saturations ≥92%. Inspired oxygen is prescribed by clinicians as a percentage to maintain saturations ≥92%; Through the HFNC circuit; oxygen can be delivered to a maximum of 50% in ward areas. In the Department of Emergency FiO₂ can increase to a maximum of 60% for 30 minutes in consultation with the PICU team.
- Weaning of oxygen occurs prior to weaning of HFNC therapy and is directed by the treating physician.

The aims of HFNC therapy are to:

- Provide respiratory support and improve ventilation by assisting opening distal airways and alveoli; improving gas exchange
- Reduce mucosal resistance and increases tolerance to therapy through humidification
- Reduces inspiratory resistance seen as a reduction in work of breathing

Guideline

Clinical Indications for HFNC therapy

- The prevention of, or relief from, respiratory distress due to diseases such as bronchiolitis or pneumonia
- Respiratory support to infants and children with chronic lung disease
- Continuing hypoxemia (SpO₂<92%) in children with moderate to severe respiratory distress with acute lower respiratory tract infection despite the use of low flow oxygen therapy.
- Patients in respiratory distress who exhibit signs of increasing oxygen requirements in order to prevent further deterioration.
- Respiratory distress from congestive heart failure
Exclusions for HFNC therapy ward placement

- Critically ill with immediate need for NIV/Intubation
- Apnoeas requiring NIV/Intubation
- Blocked nasal passages/choanal atresia
- Upper airway obstruction
- Craniofacial malformations
- Trauma/surgery to nasopharynx
- Pneumothorax
- Cyanotic congenital heart disease
- Decreased level of consciousness
- Oncology patients
- Foreign body aspiration- suspected or confirmed
- Any patient with known lung disease or other conditions that have not been discussed with either the Respiratory Consultant or the treating Paediatrician.

Complications from HFNC therapy

- Gastric distension
- Pressure areas
- Blocked HFNC due to secretions
- Pneumothorax

Initiation of HFNC therapy: Emergency & Inpatient Units

Initiation of HFNC therapy in response to clinical indications must be ordered by the treating medical officer in consultation with nursing teams to ensure appropriately trained staff is available (see Placement of Children receiving HFNC therapy)

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**ALERT**

Nasogastric tube placement should be encouraged in infants- children less than 3 years prior to initiation of HFNC therapy for GIT decompression and remain insitu for the duration of therapy.

Children > 3 years may require a nasogastric tube if GIT distension is an issue whilst on HFNC therapy

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**ALERT**

HFNC must be delivered by the AIRVO 2™ & Optiflow ™ (Fisher and Paykel Healthcare Systems)

Optiflow Paediatric Nasal cannula (green and purple) should be secured using supplied “Wiggle pads” ensuring a good fit into the nares but not completely obstruct the nares. Optiflow Adult Nasal Cannulas (orange, blue and olive green) can be secured in place using Duoderm on the face and fixomul over the prongs.

AIRVO 2 temperature control will automatically set to 34°C in Junior mode and 37°C in Adult mode
HFNC therapy via the AIRVO 2™ should be commenced as per Table 1

<table>
<thead>
<tr>
<th>Child’s weight</th>
<th>HFNC Flow rate</th>
<th>Max Flow rate</th>
<th>Circuit required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12 kg</td>
<td>2 L/kg/min</td>
<td>Max 25 L/min</td>
<td>Paediatric circuit (Flow 2-25L/min)</td>
<td>Paediatric circuit (Flow 2-25L/min)</td>
</tr>
<tr>
<td>13-15 kg</td>
<td>2 L/kg/min*</td>
<td>Max 30L/min</td>
<td>Adult circuit (Flow 10-60L/min)</td>
<td>Adult circuit (Flow 10-60L/min)</td>
</tr>
<tr>
<td>16-30 kg</td>
<td>35 L/min *</td>
<td>Max 40 L/min</td>
<td>Adult circuit (Flow 10-60L/min)</td>
<td>Adult circuit (Flow 10-60L/min)</td>
</tr>
<tr>
<td>31-50 kg</td>
<td>40 L/min *</td>
<td>Max 50 L/min</td>
<td>Adult circuit (Flow 10-60L/min)</td>
<td>Adult circuit (Flow 10-60L/min)</td>
</tr>
<tr>
<td>&gt;50 kg</td>
<td>50 L/min *</td>
<td>Max 50 L/min</td>
<td>Adult circuit (Flow 10-60L/min)</td>
<td>Adult circuit (Flow 10-60L/min)</td>
</tr>
</tbody>
</table>

(Flow rate for HFNC therapy is the same for all patients regardless of the acute medical condition)
Flow is ordered on the Paediatric Oxygen Medication Chart or as per flow chart above.

### ALERT
**Adult circuit must be used for flows over 25L/min**
Adult circuit has the capacity to deliver 10-60L/min: however the MAXIMUM FLOW in paediatrics is 50L/min

- Initial FiO2 should be set at 0.21 (21% =room air) If SpO2 < 85% : or if SpO2 remains <92% after 10 minutes of high flow therapy then FiO2 should be increased and titrated to achieve SpO2 of ≥92%. FiO2 is adjusted to maintain SpO2 of 92-98% avoiding long periods of hyperoxia with SpO2 of 100%. For any flow rates >25 L/min the flow rates are increased gradually over two minutes and observe how the patient tolerates the flow rates.

- FiO2 should be ordered on the Paediatric Oxygen Medication Chart : FiO2 to maintain saturations 92-98%

### ALERT
The standard HFNC therapy set up for AIRVO 2™ can be connected to two wall flow meters (0-15 and 0-70 LPM maximal flow). Dependent on the required FiO2 and the flow rate specific for the patient, the wall flow meter that allows for greater flow rates up to 70 Litres/min must be used to achieve the desired FiO2.

Specifically when requiring higher FiO2(>45%) on children with >30L/min flow or in any other circumstance when the desired FiO2 cannot be achieved it may be necessary to use a 0-70L/min flow meter and increase the FiO2s with the wall flow meter until SpO2 92-98%

### Monitoring Response to commencement of therapy
Children must receive Continuous SpO2 monitoring. Respiration rate (RR), heart rate (HR) and respiratory effort are be recorded on the Children’s Early Warning Tool (CEWT) hourly or more frequently as indicated by clinical condition.

Medical review of all patients on HFNC therapy outside the HFNC study protocols is required ≤ 4 hours after therapy initiation.
Clinical stabilisation is indicated by:

- The FiO2 required to maintain SpO2 in the target range (92-98%) is ≤ 50%.
- Heart rate reduced by 15 beats per minute (bpm) or to within normal range for that infant/child’s age group
- Respiratory rate reduced by 5-6 resps/min or to within normal range for that infant/child’s age group
- Signs of respiratory distress/effort have improved

The Infant/Child should be reviewed by the PICU service if:

- Within 2 hours of commencement of therapy, the child does not show signs of clinical improvement (decrease in HR, RR, Respiratory Effort) and/or SpO2 are unable to be stabilised in target range (92-98%) for their age group, or
- if FiO2 requirement is >50%,

The infant/child should be transferred to PICU if stabilisation does not occur, or if the FiO2 requirement is >50% (inpatient wards) or >60% FiO2 for greater than 30 minutes (Emergency Department)

Placement of children on HFNC therapy

- Children who have commenced HFNC therapy with FiO2 at ≤50% and whose observations have stabilised: specifically a reduction in heart rate and respiratory rate from therapy initiation can be transferred to the appropriate ward from DEM.
- Children whose FiO2 requirement is greater than 50% or whose observations remain unchanged should remain in the DEM until clinical stabilisation occurs. Consultation with PICU team and consideration of transfer to PICU rather than the ward should occur for these children.

All patients on HFNC therapy are to be placed in the appropriate inpatient area in co-ordination with the relevant NUM, CNC, PFSU nurse manager, Safety CNC and treating Medical team. Any concerns around placement to be escalated to the treating consultant and the Director of Nursing

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**ALERT** Escalation in the Ward /DEM for medical and PICU team review occurs if

- heart rate remains unchanged or has increased since commencing on HFNC therapy
- respiratory rate remains unchanged or has increased since commencing on HFNC therapy
- as per CEWT guidelines – escalate as per total CEWT score
- FiO2 required is > 50% (ward) or 60% (for 30 minutes only) in DEM to maintain SpO2 92-98%

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When children meet criteria for inpatient ward admission/transfer they should be placed in the following areas with a minimum of 2 trained staff available on shift.

- Emergency & Short stay unit
- 9B- Infants less than 12 months
- 9A Overflow from 9B and Children over 12 months who meet criteria for inpatient unit admission
- 10A- Children over 12 months who meet criteria for inpatient unit admission
Staffing requirements in inpatient units

For children requiring HFNC therapy and are placed in inpatient wards outside of PICU, a minimum of 2 staff that have completed the education in Paediatric HFNC therapy (one a Registered Nurse) must be available to provide care for the child each shift. This means that one of the RNs or ENs should at all times be available to care for the patients on HFNC therapy in the ward area. The EN may assist in the care of the patient with HFNC therapy but the RN is the child’s primary caregiver.

 ALERT
 If two staff that have completed the High Flow Nasal Cannula therapy education are unavailable for any shift in an inpatient unit through rostering or redeployment the child should be referred to PICU to ensure patient safety.

Transport from ED to ward or other departments on HFNC

The AIRVO 2™ device does not allow HFNC delivery during transport unless it is connected to power or an external battery. A battery for the AIRVO 2™ is available in DEM and PICU; hence during transport from one department to another the patient needs to remain on HFNC therapy and the AIRVO 2™ connected to the external battery. If the battery is not available there are two options.

The older child requiring Adult Optiflow Nasal Cannula (small, medium and large) can continue oxygen therapy via ‘rabbit ears’ and standard oxygen tubing to wall/cylinder oxygen. If this is unavailable then use standard sub nasal prongs or face mask to administer oxygen to the wall/cylinder oxygen.

The child requiring Junior Optiflow Nasal Cannula (green and purple prongs) can connect the green transport oxygen tubing provided that allows the connection of Optiflow junior and infant nasal cannulas only with wall/cylinder oxygen.

Ongoing Monitoring and Nursing care

• All children receiving HFNC therapy must have continuous Sp02 monitoring
• Respiratory rate (RR), heart rate (HR) respiratory effort, flow rate as per device used and FiO2 are all recorded on the High Flow CEWT
• Gentle suction as required to keep nares clear.
• Oral and nasal care must be performed 4 hourly. Monitor that nasal prongs are in correct position and no pressure areas to nares.

 ALERT: Seek medical review if any of the following occurs:
• Patient is not stabilising as described above
• Degree of respiratory distress worsens
• Hypoxemia persists despite high gas flow
• Requirement for FiO2 >50 in ward areas

 ALERT
 If a high FiO2 is used, oxygen saturation may be maintained in an infant despite the development of hypercarbic respiratory failure. If there is rapid deterioration of oxygen saturation or marked increased work of breathing, a chest x-ray should be done to exclude a pneumothorax. Consider blood gas analysis where clinically indicated.
Once stable on HFNC therapy, the infant/child should be assessed as to whether they can feed.

- Some infants/children can continue to breast/bottle feed, but many require feeding via a nasogastric tube.
- Feeds given via the nasogastric tube can be either bolus or continuous.
- Those infants/children who are stable on HFNC and wish to orally feed - breastfeed/bottle drink and or eat, the HFNC therapy should be reduced to low flow humidified oxygen therapy using the AIRVO2 via the same nasal cannula. This is achieved by decreasing the flow on the AIRVO2 for maximum of up to 20 minutes as per below. On completion of orally feeding/drinking return the patient to their previous HFNC therapy settings.
  - Junior Mode - reduce to 2L/min and increase the oxygen to 100% FiO2
  - Adult Mode - reduce to 10L/min and increase the oxygen to 100% FiO2
- Infants/children who do not clinically stabilize within 2 hours or who do not tolerate NGT feeds should have an I.V. inserted to receive hydration.
- If nasogastric in place aspirate the NGT for air 2-4 hourly to de-vent the stomach

**Weaning of High Flow Nasal Cannula Therapy**

Weaning of HFNC therapy can commence within 4 hours if the child’s clinical condition is improving as indicated by:

- Reduction in respiratory distress including decreased work of breathing and effort
- Respiratory rate reduced by 5-6 resps/minute or to within normal range for that infant/child’s age group
- Heart rate should reduce by 15 bpm or to within normal range for that infant/child’s age group
- FiO₂ required to maintain SpO₂ in the target range should be ≤50%.

Weaning HFNC therapy commences with decreasing the FiO₂ in 5% increments whilst maintaining saturations ≥ 92%

Once the FiO₂ reaches 21% and saturations have been stable ≥92 % for 4 hours, flow can be ceased.

If infant/child desaturates <92 % - resume flow with FiO₂ at 21%

If not maintaining saturations ≥92 % increase FiO₂ until saturations are 92-98%

Once stabilised with saturations ≥92% for at least 4 hours weaning can recommence.

*Seek immediate medical review if any of the following occurs:*

- Patient is not stabilising as described above
- Degree of respiratory distress worsens
- Hypoxemia persists despite high gas flow
- Requirement for FiO₂ >50%
Cleaning

The AIRVO 2 Humidifier requires cleaning and disinfection between patients. Keep the orange disinfection tubing connected post disinfection cycle is complete, to ensure the AIRVO2 does not collect dust inside the equipment.

Follow the instructions in the [Disinfection Kit Manual](#).

Supporting documents

- Please refer to [Fisher & Paykel Airvo2 operating manual](#)
- [Airvo2 App – Free download app](#)

Disclaimer

This Guideline has been written in good faith under the directive of the Medical Division with the understanding that there are limited random controlled studies (published) and therefore limited best practice evidence to support the assumptions for treatment outlined in this guideline. Use of this therapy is at the discretion of the treating physician.

Consultation

Key stakeholders who reviewed this version:

- Juliana Buys, Nursing Director Medical Services
- Marissa Ehmer, Nursing Director Patient Flow and Safety
- Sandi Schilling, CNC Respiratory
- Renee Twomey, CNC Respiratory
- Patricia Wales, CNC Sleep Services
- Donna Franklin, Study Coordinator-Paediatric Critical Care Research Group
- Andreas Schibler, Director Paediatric Critical Care Research Group / PICU Consultant
- Helen Proctor, NUM 10A
- Katie Hyde , NUM 9A
- Karlee Quin, NUM Emergency
- Shari Davies, Nurse Educator Medical
- Gillian Dixon, Nurse Educator Medical
- Lorelle Malyon, Nurse Educator Emergency
- Alan Isles, Director Respiratory/Sleep Medicine
- David Kilner, Respiratory/Sleep Physician
- Jasneek Chawla, Respiratory/Sleep Physician
- David Levitt, Director of Paediatric Medicine
References and suggested reading


8. Audit/evaluation strategy

<table>
<thead>
<tr>
<th>Level of risk</th>
<th>High</th>
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<tbody>
<tr>
<td>Strategy</td>
<td>Monitor implementation of procedure into ward areas. Monitor PRIME clinical incidents.</td>
</tr>
<tr>
<td>Audit/Review tool(s) attached</td>
<td>N/A</td>
</tr>
<tr>
<td>Audit/Review date</td>
<td>6 months post full implementation of guideline, then annually</td>
</tr>
<tr>
<td>Review responsibility</td>
<td>CNC Respiratory</td>
</tr>
<tr>
<td>Key elements / Indicators / Outcomes</td>
<td>Low reported incidents in PRIME specifically related to HFNC</td>
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Guideline revision and approval history

<table>
<thead>
<tr>
<th>Version No.</th>
<th>Modified by</th>
<th>Amendments authorised by</th>
<th>Approved by</th>
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<tr>
<td>1.0</td>
<td>CNC Respiratory</td>
<td>Executive Services Director Nursing Services</td>
<td>Executive Director Nursing Services Director Hospital</td>
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Keywords

- High flow nasal cannula, HFNC, FiO2- oxygen, 70025

Accreditation references

- EQuiPNational Standards (11-15): 12 – Provision of Care