

WESSEX PCCN GUIDELINES FOR THE USE OF NASAL HUMIDIFIED HIGH FLOW OXYGEN IN CHILDREN

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This guideline describes the indications, contraindications and management of paediatric patients requiring humidified high flow nasal cannula oxygen. It does not cover neonates on neonatal units.

Introduction:

Humidified high flow nasal cannulae oxygen (HHFNC or high flow oxygen) is a non-invasive system used to deliver humidified high flow oxygen therapy via nasal cannulae. HHFNC has become widely used in the paediatric population, not only for delivering oxygen therapy but also as a substitute for nasal CPAP.

The warmth and high humidity of HHFNC mean that high flows are usually tolerated. HHFNC can prevent airway insensible water loss, reduce thickened secretions and reduce nasal irritation¹. HHFNC therapy delivers high flow ($\leq 65\text{L/min}$), optimally humidified fresh gas warmed to body temperature with accurately titrated oxygen content (21 – 100%)².

There are several proposed potential advantages to HHFNC therapy:^{4,5,6}

- Reversal of hypoxaemia
- Reduction in the work of breathing
- Improved clearance of secretions
- Reduced need for sedation
- Ability to continue feeding/communicating
- Reduction in the requirement for intubation and PICU

Currently no randomised trials have been performed in children comparing the use of HHFNC oxygen in comparison to either nasal CPAP or low flow oxygen. Studies in neonates have demonstrated that similar levels of positive inspiratory pressure are produced by either HHFNC or CPAP³. These pressures have been shown to vary with nostril size, cannula size and flow rate. It is anecdotally felt that HHFNC is beneficial in older children with respiratory failure. This guideline has been developed using the expert opinion of clinicians and the results of recent review of HHFNC oxygen use in the Wessex Paediatric Critical Care Network (WPCCN).

Indications

HHFNC could be considered for any child with an oxygen requirement / increased work of breathing (WOB)

Care must be taken when using HHFNC in infants with small nostrils as there is a risk of creating a closed circuit which can deliver unpredictable levels of positive pressure.

Suggested indications for HHFNC	Suggested contraindications to HHFNC
Bronchiolitis	Life- threatening hypoxia
Pneumonia	Pneumothorax
Respiratory support following extubation	Nasal obstruction (choanal atresia, nasal polyp)
	Maxillofacial trauma
	Suspected basal skull fracture
	Foreign body aspiration
	Open chest wound/trauma

Starting HHFNC

- A decision to start HHFNC should be made in discussion with a senior doctor (registrar/consultant).
- **Consider a blood gas prior to commencing HHFNC.** The type of blood gas does not matter (capillary/venous/arterial) but it is more useful to use the same sample collection method when repeating blood gases on HHFNC for comparison.
- A spare Oxygen cylinder with non rebreath mask **MUST** be available at the bedside in case of sudden deterioration / emergency.
- Start HHFNC at the following settings⁷

NB: as there is currently limited evidence regarding HHFNC in paediatrics; these guidelines may change as further evidence becomes available.

- Flow rate
- Nasal cannula size will determine max Flow rates.
 - $\leq 10\text{Kg}$ 2 L per kg per minute
 - $>10\text{Kg}$ 2 L per kg per minute for the first 10kg + 0.5L/kg/min for each kg above that (max flow 65 L/min)
 - i.e. $14\text{kg} = 20\text{L} (2 \times \text{first } 10\text{kg}) + 2\text{L} (0.5 \times 4\text{kg}) = 22\text{L}/\text{min}$
 - It is advisable to start the nasal flow at lower levels than required (suggest 1L/min/Kg) and slowly increase to the target flow over a few minutes. This allows the patient to adjust to the higher flow rates. Occasionally due to the clinical situation it might be necessary to start on max flow rate.

- Flow rates can be increased in 2L/min increments to match the child's work of breathing up to the maximum as per the system/cannulae used. It is generally recognised that flow rates should not exceed 2L/Kg/min

- **Oxygen**
 - Oxygen blenders must be used, except when using a system that entrains room air eg. AIRVO
 - We suggest delivering 100% oxygen whilst slowly titrating flow rate up to target.
 - Once target flow is reached oxygen concentration can be titrated to target oxygen saturations.
 - Aim for SpO₂ > 92%, unless there is another clinical condition that dictates different limits – cyanotic heart disease, pulmonary hypertension etc.

Remember – set oxygen concentration is not exact as there will be some entrainment of air at the nose as HHFNC oxygen is not a sealed unit.

- **Humidification**
 - Flow rates used in HHFNC are high and therefore humidification is required to prevent drying of secretions and maintain adequate ciliary function
 - Humidifier target temp 34-37° C according to setup guidelines of product used locally
 - Ensure humidifier unit reaches temperature before connecting to patient otherwise flow will be uncomfortable/poorly tolerated.

Monitoring

- Each patient on HHFNC should be on continuous saturation and heart rate monitoring and must have observations recorded using a local high-dependency PEWS chart.
- At the start of each shift, the HHFNC equipment should be checked
- Be aware that nasal secretions can block cannula so if setting change, check patency
- Hourly circuit observations should include:
 - HHFNC flow rate
 - Oxygen concentration
 - Patency of nasal cannulae & tubing
 - Humidifier settings
- Hourly patient observations should include:
 - Heart rate
 - Respiratory rate
 - Respiratory effort
 - Oxygen saturations

If there is a significant deterioration there must be a senior medical review – please refer to local paediatric observation policy/escalation policy.

- Consider repeating blood gases 2 hours after the initiation of HHFNC or sooner if there is any clinical deterioration.
- In a recent review of HHFNC use in Wessex a blood gas at 2 hours helped to identify those children that subsequently deteriorated. Children who remained acidotic at 2 hours were more likely to deteriorate.

Support on HHFNC

- There are no known contraindications to other supportive treatment whilst on HHFNC oxygen.
- A separate assessment for supportive treatment should be made by the senior clinician in charge of the child's care, this includes feeding if tolerated (oral or nasogastric)
- From observational data nasogastric tube feeds seem to be better tolerated on HHFNC than CPAP. Individual assessment is required.
- Nebulisers can only be used in the Fisher Pykell junior circuits (ie upto 35 kg not adult) but will require a circuit specific adaptor. Please seek advice from your product rep. Note you cannot effectively deliver bronchodilators whilst simultaneously receiving HHFNC. As hi flow will be delivering majority of tidal volume there will be no effective bronchodilator delivery on inspiration. Nasal cannula should be removed & mask nebulisation should be administered.
- Gentle nasal suctioning using a Yanker or wide bore suction catheter may be helpful if the secretion load is heavy. Nasal secretions can block cannula.
- Some patients may require nasopharyngeal suction to clear secretions this should be performed without removing the nasal cannula .

Weaning

- Weaning can be considered when the patient's clinical condition is improving as indicated by:
 - Decreased work of breathing
 - Decreasing oxygen requirement
 - Normalising PEWS observations
- **Initially wean oxygen concentration rather than flow rate⁸.**
- Ensure oxygen saturations are maintained at each reduction in oxygen concentration
- Once oxygen concentration is $\leq 30\%$ begin to wean flow
- Ensure each child has an individualised weaning plan. Suggested weaning regimen:
 - Reduce flow by 2L/min initially and observe the respiratory rate and work of breathing

- If these parameters remain stable continue to wean by 2L/min every hour-until flow is 0.5L/kg/min if >10kg or 5-8L/min if <10kg (see appendix for weaning differences in Airvo and Optiflow)
- When the flow rate is 0.5L/kg/min or 5-8L/min and the FiO₂ 0.3 (30%), the patient can be weaned onto 1-2L/min nasal cannula oxygen
- Alternatively HHFNC units can be used at low flow rates to deliver humidified low flow oxygen, which may be better tolerated than non-humidified low flow and can help with secretion management.
- Maintain 30-minute observations whilst weaning.
- Once off HHFNC then 30-minute observations are recommended until stability assured. These can then become hourly.

If weaning fails and the clinical condition of the child deteriorates, return to the settings used prior to weaning and assess the child to determine cause of failure e.g. positioning, secretion management. There should be a low threshold for medical review if simple manoeuvres do not help.

Transfer

- It is not currently possible to transfer patients on high flow oxygen therapy therefore any child requiring transfer between hospitals on high flow oxygen should be discussed with the SORT team (**023 8077 5502**).

Deterioration and Escalation

- **Consider discussion with SORT (023 8077 5502) and/or your local ITU team for any child deteriorating on HHFNC who requires additional respiratory support.**
- The first steps would be to maximise flow rates and ensure correct cannulas are used (see specific appendices for equipment) and nasal passages are patent.
- Consider for trial of CPAP if available and appropriate.
- Local intubation and ventilation prior to transfer may be required.

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APPENDIX 1

AIRVO 2 SET UP GUIDE

EQUIPMENT REQUIRED

- Airvo machine, adult or junior tubing set (containing heated breathing tube and humidifier chamber)
- Green O2 tubing
- 1L bag water for humidification
- Correct size nasal cannula or tracheostomy connector as required.
- Portable CD oxygen cylinder with face mask and green tubing in case emergency supplementary oxygen is required.
- Ambubag available

SET UP

1. Install water chamber. Fit the supplied adaptor over the two vertical ports on the chamber and push on firmly. Ensure dark blue finger guard clicks into place. (WARNING THE SILVER HUMIDIFIER PLATE GETS VERY HOT).
2. Connect water bag. Check water flows into chamber.
3. Install heated breathing tube. Lift blue sleeve, slide connector onto unit. Ensure metal prongs are connected and push sleeve down to lock.
4. Select appropriate patient interface.
5. Plug in and switch on unit.
6. Check disinfection status. It should have a Green traffic light status. This will be Amber if the unit has been used for patients and will require formal decontamination with designated kit.
7. Warm up will take place. You should see the white dots indicating the summary screen.

SELECTING CORRECT MODE.

In junior mode the Airvo display will show a bird and butterfly.

To change between adult and junior mode press and hold the mode/play key for 5 seconds.

Cannula size	Approx weight	Max flow rates	Oxygen source	mode
Infant	3 - 15 kg	2 - 20 L	Wall flow meter	Junior
Paediatric	12 -22 kg	2 - 25 L	Wall flow meter	Junior
Adult M		10 - 60 L	Airvo flow meter	Adult
Tracheostomy	>3 kg	10 - 20 L	Wall flow meter	Adult
Tracheostomy	>12kg	10-60L	Wall flow meter	Adult

TARGET FLOW SETTINGS (BLUE)

<10kg 2L/kg per minute

>10kg 2L/kg per minute for first 10kg + 0.5L/kg for each kg above that max 60L

Titrate as clinical condition indicates but do not exceed max flow rate for weight/cannula size.

The flow rate may need to be increased gradually to enable patient to tolerate the flow.

HUMIDIFIER TEMPERATURE (RED)

Junior mode = 34°C

Adult mode = 37°C (This may be reduced to 34°C if warmer temperature is not tolerated).

Facemask interface = 31°C

ALTERING PARAMETERS

- Press the mode/play button to view target settings.
- Select desired parameter e.g flow. If parameters need altering press and hold the up and down arrow buttons for 3 seconds to unlock the setting.
- Use the arrow buttons to set required value.

CONNECTING SUPPLEMENTARY OXYGEN.

The Airvo must be turned on before connecting an oxygen supply.

A maximum flow of 60L of oxygen can be delivered via the inlet port on the back of the unit.

Junior mode – Attach a high flow meter to a ward wall oxygen port behind bed. Connect green oxygen tubing from wall flow meter to the oxygen port on Airvo.

Adult mode- Plug white oxygen cable into wall oxygen port. Then connect green oxygen tubing from the flow meter on the Airvo to the oxygen port on the Airvo.

OXYGEN 21%- 95%

- Supplementary oxygen can be applied to the Airvo 2. It contains an inbuilt oxygen analyzer to determine the level of oxygen you are delivering to the patient.
- Ensure it is attached to the Airvo correctly for the mode in use.
- Adjust the level of oxygen via the chosen flow meter until the desired oxygen fraction is displayed. It may take the reading a few minutes to settle.
- If the flow rates are altered this may affect your oxygen delivery flow. Adjust accordingly.

CONNECTING PATIENT

- Wait until the 'ready for use symbol' (a white tick) is displayed on the summary screen. Connect patient interface to heated breathing tube.
- Whilst in use the 'ready for use' screen saver will be launched (a white tick). To read settings press the mode/play button to review or change settings.
- Patient's requiring Airvo or optiflow should be nursed in an area that allows adequate nursing supervision and they should receive hourly observations and saturation monitoring.
- The heated tube and chamber Airvo sets need to be changed every two weeks and patient interfaces once a week.

Weaning

- As with Optiflow O2 MUST be weaned first
- Flow rates can be reduced once O2 is at 30%
- Wean flow by 2L then observe Work of breathing (WOB) continuously – document every 15mins.
- If WOB remains stable continue to wean flow
- If WOB increases return flow to previous setting
- When at minimum flow rate 8L/min Airvo therapy can be discontinued. In infants with chronic lung disease weaning flow rates should be reduced to potentially lower rates prior to discontinuing therapy.
- Do not turn off unit until certainty of stability maintained.

Ending Therapy

Allow unit to cool down after therapy as Humidifier plate is **VERY HOT!**

All components are disposable.

Turn Airvo unit off before removing plug otherwise it will beep.

Contact your education facilitator/ Outreach Team to disinfect unit.

DO NOT ATTEMPT TO USE UNIT ON ANOTHER PATIENT IF DISINFECTION HAS NOT TAKEN PLACE.

APPENDIX 2



OPTIFLOW SET UP GUIDE

EQUIPMENT REQUIRED

- Optiflow unit
- Optiflow circuit (tubing, humidifier unit)
- Grey temp lead for Fisher Pykel humidifier (BLUE & YELLOW connectors)
- Green oxygen tubing
- 1L bag of water for irrigation
- Appropriate size nasal cannulae
- Portable O2 cylinder with face mask attached with green tubing
- Ambu-bag available

SET - UP



1. Install water chamber to humidifier.
2. Connect water bag & check water flows into chamber.
3. Attach circuit to top of humidifier
4. Attach appropriate nasal cannula – **see grid below**
5. Attach white section to other humidifier port
6. Insert temp probe into circuit & humidifier unit
7. Attach green oxygen tubing to flow meter and white section on humidifier
8. Insert Oxygen & Air to wall supply
9. Select oxygen on O2/Air blender
10. Select Flow on Flow meter
11. Turn on humidifier – wait for unit to begin warming before applying to patient.
12. ETT icon **MUST** be selected on humidifier for nasal cannulae optiflow
13. **Ensure you have a portable O2 cylinder in case of rapid deterioration to provide supplementary O2.**

STARTING THERAPY




- Secure Optiflow cannula with *Wiggle Pads* to patients face. Ensure cannulae do not fully fill nares.
- SaO₂ / HR must be monitored continuously.

Flow rates should be started and remain at 8 L/min.

for  **Neonate cannula**

- INFANT  & PAEDIATRIC  flow rates:
- **<10kg 2L/kg per min**
- **>10kg 2L/kg per min for first 10kg + 0.5L/kg per min for each kg above that max 25L**
- Do not exceed max flow limit for weight/cannula size
- Flow Rates should be increased in 2L increments to match work of breathing.
- SaO₂ / RR / WOB / HR observations **MUST** be recorded hourly with full PEWS scoring.




Remember – set Oxygen level is not exact as there will be some entrainment of air at the nose as this is not a sealed unit.

Product (cannula size)	Item code	Approx. weight range	Max. Flow Rate (L/min)	Wigglepads
Neonatal 	OPT314	1 – 8 kg	8	OPT012
Infant 	OPT316	3 – 15 kg	20	OPT012
Paediatric 	OPT318	12 – 22 kg	25	OPT012

WEANING

1. Indicated by NO increased work of breathing (WOB) and stable oxygen requirement.
2. Oxygen levels MUST be reduced first.
3. When Oxygen level is at 30% flow rates can be weaned.
4. Wean by 2L / min. continually monitor for signs of increased WOB

If Increased WOB present return to previous settings - REASSESS Determine cause for failure eg. secretions / positioning

5. Continue to wean flow rate down as clinically indicated
6.  wean to 5L/min then consider low flow O₂ via nasal cannula if required. Some neonates may require weaning further especially in history of previous NCPAP/CLD Once 2L / min. achieved consider change to nasal cannulae oxygen.
7.  &  wean to 6-8 L/min then consider nasal cannula / mask O₂
8. ½ hourly observations during weaning.

HOWEVER.....

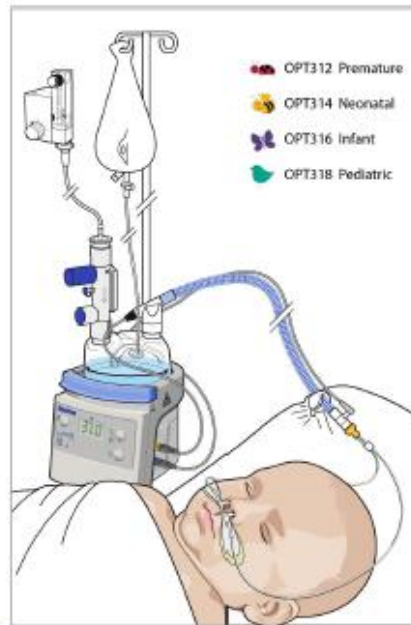
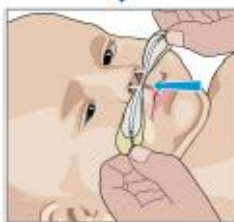
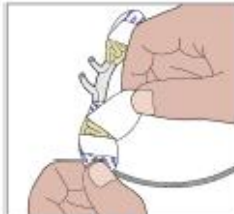
For all age group, Optiflow may continue be used to administer LOW FLOW WARM humidified Oxygen if needed eg. 0.5 – 2L / min especially if secretions are thick.

ENDING THERAPY

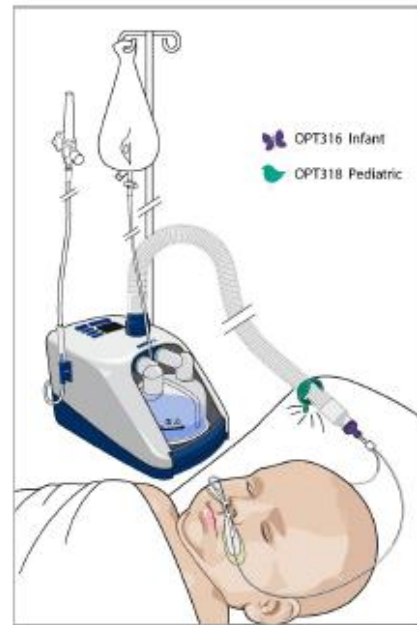
- Leave unit on until WOB has been reassessed as stable
- ½ hourly observations then hourly once stabilised.
- Switch humidifier off – ALLOW TO COOL
- Clean Temp probe with Sporicidal foam/wipe – put in clean bag for next use & leave with Optiflow unit.
- Dispose of circuit and humidifier
- Clean down unit with Clinell wipe – Attach Green Clean sticker.

F&P Optiflow™ junior Nasal Cannula

1 Apply Cannula

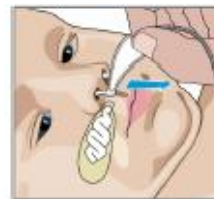


F&P 850™ System



F&P AIRVO™ 2

2 Remove Cannula



3 Replace Wigglepads™



Do Not Reuse **CE 0123 Rx only** Ready for use

Fisher & Paykel
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