Paediatric Intensive Care Unit

Heated Humidified High Flow Nasal Cannula Treatment (HHHFNC) UHL Childrens Intensive Care Guideline

Staff relevant to:	Medical, nursing and allied health professional staff using HHHFNC treatment delivered via Vapotherm or Hamilton ventilator at PICU/CICU & East Midlands Congenital Heart Centre.
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Written by: Reviewed by:	J Vujcikova J Vujcikova
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Contents

1. Introduction and Who Guideline applies to

Heated humidified high flow nasal cannula treatment (HHHFNC), otherwise called as High flow oxygen therapy (although it can deliver high flow air), delivers heated (35-38 C°) and humidified gas at high flow rates that generate positive airway pressure. When used at flow rates of 1 - 2 L/kg/min it acts as a bridge between low flow oxygen therapy and CPAP - continuous positive airway pressure.[1]

The use of HHHFNC has been associated with:

- improvements in washout of nasopharyngeal dead space
- oxygen delivery
- positive pharyngeal pressure which helps to reduce work of breathing and prevent pharyngeal collapse (positive pharyngeal pressure is determined by flow and the ratio of the prong/nostril fit and whether or not the mouth is closed)
- reduced energy expenditure
- reduced need for intubation[1,2].

There is some limited evidence for improved lung mucociliary clearance and for some reduction in obstructive apnoea (as inspiratory flow is supported when patient flow is limited) associated with use of HHHFNC. [1,2]

This guidance can be used as an aid and learning tool by medical, nursing and allied health professional staff using HHHFNC treatment delivered via Vapotherm or Hamilton ventilator at PICU/CICU & East Midlands Congenital Heart Centre.

Related documents:

For Children not requiring HDU level of care please see – Humidified High Flow Nasal Cannula Oxygen Therapy UHL Childrens Hospital Guideline C5/2018
For children admitted to ED please see - Humidified High Flow Nasal Oxygen (HHFNO) UHL Paediatric Emergency Department Guideline C68/2019
For NNU patients please see – High Flow Nasal Cannula Oxygen UHL Neonatal Guideline C32/2015

2. Guideline Standards and Procedures.

2.1 INDICATION

• moderate to severe acute viral bronchiolitis
• weaning from invasive or non-invasive (CPAP, BIPAP) ventilation
• consider in respiratory distress of other origin, e.g.
  - congenital heart disease
  - acute asthma / pneumonia, etc.

CLINICAL PARAMETERS SUGGESTING NEED FOR HHHFNC

• tachypnoea or RR >60/min
• moderate to severe work of breathing
• need for > 2L/min O2 via nasal prongs or >60% headbox O2
• occasional or mild apnoeas or bradypnoea despite supplemental oxygen

2.2 CONTRAINDICATION

• Nasal obstruction / upper airway anomalies (choanal atresia, tracheoesophageal fistula)
• Life threatening hypoxia, respiratory arrest or unstable cardiorespiratory status
• Trauma (maxillofacial, suspected base of skull fracture / chest)
• Pneumomediastinum and pneumothorax if not drained

Proceed with caution:
• Decreased level of consciousness
• Recent oesophageal or gastric surgery
• Foreign body aspiration

2.3 SIDE EFFECTS AND MONITORING

• pressure sores (rare, less frequent than NCPAP, better cutaneous tolerance with fewer skin lesions reported)
• pneumothorax and pneumomediastinum in association with inappropriate prong size that occludes the nostril lumen (>1/2 of the diameter of the nostrils)
• gastric distension (nasogastric tube is mandatory with high flow)

2.4 EQUIPMENT

VAPOTHERM: Sterile water, circuit (high flow/low flow), nasal cannula, Oro/nasogastric tube

VAPOTHERM	CANNULA	CIRCUIT DETERMINES OPERATIONAL FLOW RANGE	TIP OD
NEONATE	**1 – 8L/min**	**LOW FLOW CIRCUIT (1-8L/min)**	**1.5 mm**
INFANT(cca<4kg)	**1 – 8L/min**	**LOW FLOW CIRCUIT (1-8L/min)**	**1.9 mm**
PAEDIATRIC SMALL (cca 4 – 10kg)	**1 – 20L/min**	**HIGH FLOW OR LOW FLOW CIRCUIT (depends on flow target)**	**1.9 mm**
PAEDIATRIC/ ADULT	**5 – 40L/min**	**HIGH FLOW FLOW (5-40L/min)**	**2.7 mm**
ADULT	**5 – 40L/min**	**HIGH FLOW FLOW (5-40L/min)**	**4.8 mm**

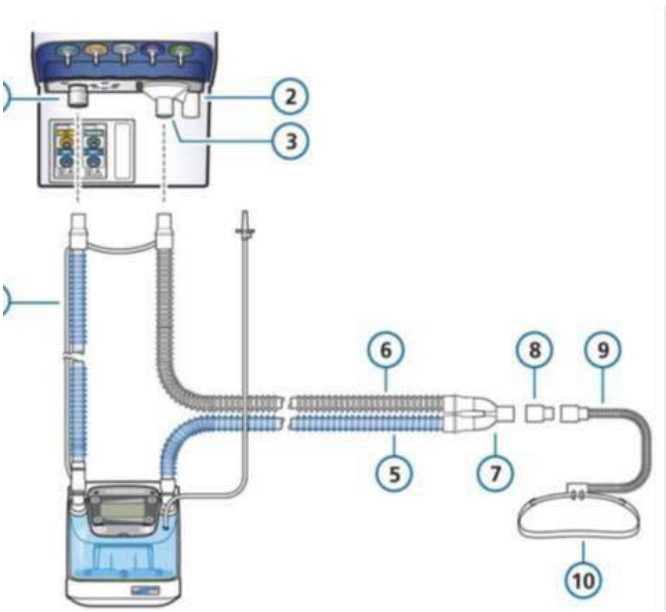
http://www.vapotherm.com/next-generation-disposable-patient-circuit/

HAMILTON (Version 2.6)

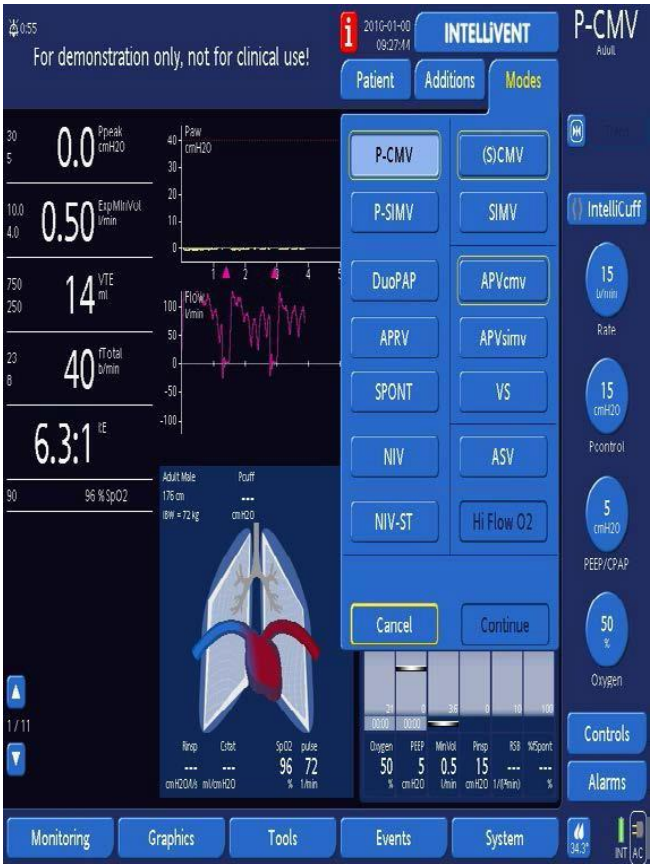
Flow 1 - 60 L/min (neonatal 1 - 12 L/min)

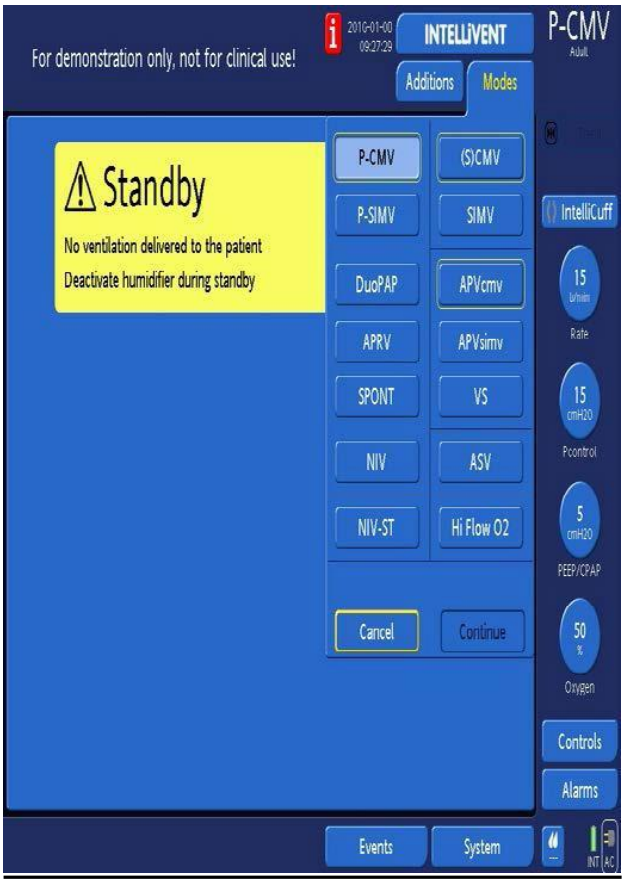
Single or double limb breathing circuit; flow sensor not necessary, flow is measured internally.

Nasal cannulae: neonatal (flow max 4 L/min); size S, M, L (flow up to 60L/min).

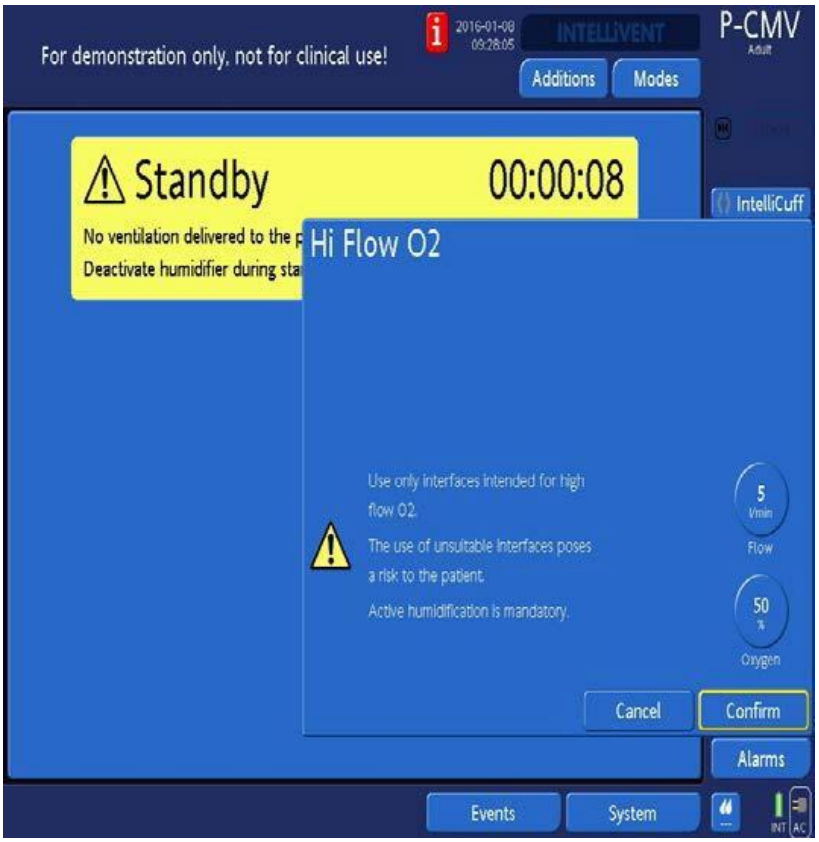


1. To patient
2. From patient
3. Expiratory valve membrane/ valve
4. Inspiratory limb to humidifier
5. Heated inspiratory limb with temp to patient
6. Expiratory limb
7. Y-piece (integrated with breathing
8. Adapter
9. Nasal cannula
10. Attachment strap





High flow mode can be only activated from Standby.



Pressure is measured on ventilator side. Pressure alarm is adjustable from 30 – 60 cmH2O. Auto will set pressure to 30cmH2O

Default setting for H900 is invasive mode. Adult/Paediatric: 15 1/min, FiO2 50%.

Neonatal: 1 1/min, FiO2 40%.

2.5 INITIAL SETTING

1. Ensure humidifier unit reaches temperature before connecting to a patient otherwise flow will be poorly tolerated.
2. FiO2 to achieve SpO2 92-97% (target SpO2 may be lower in children with congenital heart disease or chronic lung disease). Usually start with FiO2 60% (unless cardiac or other reason for individualised FiO2 target) and titrate up or down to maintain saturation target, wean quickly if target SpO2 achieved. If need for more than > 60% FiO2 (more than 60 min) or unable to maintain saturations above 92% (or target), the patient requires medical review and escalation.
3. Flow – start at 6L/min (or 1 L/kg/min) and increase up to target flow over a few minutes to allow patient to adjust (occasionally due to the clinical situation it might be necessary to start on max flow rate).
4. Recommended maximal flow:

<10kg 2L/kg/min

>10kg 2L/kg/min for the first 10kg + 0.5L/min for each kg above that with max flow 40L/min on Vapotherm (Hamilton delivers up to 60 L/min) (round down to nearest available flow; 15kg patient should get max 22L/min)

2.6 MONITORING THE PATIENT ON HHHFNC

• Continuous HR, RR and SpO2, documentation initially every 15 min then hourly once stable
• Fluid balance
• Blood gases (0, 2 and 4 hour)
• Check and documentation of FiO2, flow, circuit patency, humidifier / bag observations hourly
• Temperature 4 hourly
• Blood pressure 6 hourly unless abnormal
• Blood glucose 6 hourly for fasting infants

RE-ASSESSMENT

Every patient on HHHFNC therapy requires a medical review no later than 1 hour after the commencement of this treatment. As good response to treatment is considered:
• reduction in heart rate by 20% and respiratory rate (evidence suggests possible within first 60 - 90 min)
• reduced frequency and severity of apnoeas
• improved CO2 clearance and pH (respiratory acidosis)
• reduced work of breathing
• reduced oxygen requirement

2.7 WEANING

Commence when mild or no increased work of breathing, normal parameters (HR, RR), saturations > 92% (or target).
1. Reduce FiO2 first to keep SpO2 92-97% (or target) in 10% increments as fast as tolerated to maintain target.
2. If FiO2 < 30% and the child is stable, consider reducing flow by 10-20% every 6 – 12 hours (can be reduced more quickly if indicated – consider consultant review).
3. When flow is 0.5 L/kg/min or < 4 L/min & (FiO2 < 30%) the system can be ceased or switched to nasal cannula oxygen therapy.

2.8 FAILURE - ESCALATE if:

• unchanged or rising heart rate and respiratory rate
• increasing oxygen requirement
• worsening of CO2 clearance or respiratory acidosis
• persistent apnoeas
• unchanged or worsened work of breathing

If the patient is in HHHFNCO2 trial, follow trial protocol for weaning.

2.9 NURSING CARE

1. Check nasal prong position hourly (at a minimum).
    - Dislodgement may be a cause for decreased effectivity of the support.
    - Ensure that a leak is present (nasal prongs should be 1/2 of the diameter of the nostrils) as obstruction of nasal passages create high pressure and may lead to barotrauma (especially neonates).
    - Check pressure areas to nares. Nasal cannula should be wide enough not to "pinch" the nasal septum.
2. Siltape to the facial cheeks where the nasal prong tubing is fixed (a soft silicone perforated tape which helps prevent pressure sores)
3. Saturation probe site change 2 - 4 hourly.
4. Oro/nasogastric tube (NG) is mandatory for all infants on HHHNC. Distended stomach can cause or worsen respiratory distress.
5. Start with NG on free drainage. Aspirate 4 hourly to remove air.

6. Perform oral and nasal care to prevent crusting of secretions.
7. Perform effective nasopharyngeal suction as clinically indicated.
8. Check humidifier water level hourly.

2.10 FEEDING

Review for feeding after stability achieved (usually after 4-6 hours). Most of the infants require NG feeding, some infants may be able to continue breastfeeding.[4] If the patient is not tolerating enteral feeding give iv fluids, usually 2/3 maintenance due to respiratory humidification and risk of Syndrome of inappropriate antidiuretic hormone secretion.

2.11 ADMINISTRATION OF NEBULISERS

• There are no studies on medication delivery via nebuliser mask during HHHNC therapy.
• When there is diagnostic uncertainty (e.g. Bronchiolitis versus bronchoconstriction), the need for nebulisation must be balance against the potential risk of deterioration with the removal of HHHNC.
• The patient requiring administration of metered dose or nebulised medications (Salbutamol) during HHHNC therapy will need to have HHHNC therapy ceased or have the flow significantly reduced to 4 L/min or below during the time of administration.
• Not doing so will prevent the medication from being inhaled as little entrainment of room air by the patient occurs at higher flow rates. Time of aerosol delivery therefore should be minimised by using MDI and Spacer where possible and prescribed flow rate returned as soon as possible.
• There is limited evidence for the use of in line mesh vibration nebuliser adaptor, which shows drug delivery is reduced with increasing flow rates and smaller cannula sizes. [6, 7]

3. Education and Training

Training and raising awareness are on-going processes. On-going awareness is promoted through the induction and continuous bedside teaching. Training is provided for medical staff during lunchtime teaching (Wednesdays) and other sessions, and at junior doctors' induction training. Nursing education supported by the Practice Development Teams and Nursing Educators.

4. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Treatment algorithm followed and documented	Audit	PICU/CICU Consultant	As required	CPM

5. Supporting References

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6. Key Words

Bronchiolitis, Humidified Heated High Flow Oxygen, Hamilton, Respiratory failure.

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

Contact and review details	
Guideline Lead (Name and Title) **Julia Vujcikova - Consultant**	**Executive Lead** **Chief Medical Officer**
Details of Changes made during review: No changes 2023	