

BEST PRACTICE GUIDANCE FOR USING HEATED HUMIDIFIED HIGH FLOW THERAPY (HHHFT) IN CHILDREN & YOUNG PEOPLE: AN EAST OF ENGLAND APPROACH

Introduction:

Over the past few years the use of HHHFT has increased to support children with respiratory distress and those requiring oxygen therapy, particularly infants with bronchiolitis.

This guidance has been adapted from the North and South Thames Paediatric Networks and retrieval services document. The process collated available guidance documents from the Network regions, alongside the latest evidence base to produce and implement a guideline that will standardise practice across the Networks. The East of England Paediatric Critical Care ODN thanks these colleagues for sharing their work.

Please note that this guidance is to be used in all paediatric areas in conjunction with any condition specific guidance and local escalation policy that may be in place e.g. management of bronchiolitis, management of severe asthma.

The contents for the Guideline are as follows:

Main document: Guideline	Heated Humidified High flow therapy (HHHFT) for children and young people This is advised to be used in colour for visual triggers.
Appendix 1	Set up guide for Fisher and Paykel- Airvo 2
Appendix 2	Set up guide for Fisher and Paykel Inspiration blender
Appendix 3	Delivering nebulisers to patients on HHHFT via Fisher & Paykel devices
Appendix 4	Set up guide for Vapotherm
Appendix 5	References and team credits

Search our website for:

- The EoE HHHFT best practice guidance
- HHHFT educational resource book for nurses
- HHHFT clinical competency for nurses

<https://www.networks.nhs.uk/nhs-networks/east-of-england-paediatric-critical-care>

Heated Humidified High flow therapy (HHFT) for children and young people: An East of England Approach

Indications (not exhaustive)	Contraindications	Cautions
<ul style="list-style-type: none"> High Oxygen requirement Signs of respiratory distress Post extubation if clinically indicated 	<ul style="list-style-type: none"> Nasal obstruction or craniofacial abnormalities Trauma/Surgery to nasopharynx Recurrent apnoeas Respiratory arrest or peri-arrest state Undrained pneumothorax 	<ul style="list-style-type: none"> Drained pneumothorax Upper airway obstruction

Staffing ratios

Staff to patient ratio should be determined based on the assessment of the overall condition of the patient. A validated Paediatric early warning score (PEWS) should be used and other critical care interventions considered. Patient ratios should be adjusted accordingly and flexibility required as condition may change rapidly.

Acuity	Low risk/long term use of HHHFT	Medium risk	High risk
Descriptor	Actively weaning HHHFT or established on HHHFT as a long term therapy Mild or no respiratory distress	Acute phase, some stability established but not able to wean FiO2 below 0.40 currently. Moderate respiratory distress.	Acute initiation phase, severe respiratory distress observing for responsiveness to HHHFT. High PEWS
Nurse ratio	1:4 (1:3 < 2yrs)	1:2 or 3	1:1

Isolation for HHHFT is unnecessary unless condition indicates otherwise. Use of NHSE Infection prevention and control guidance recommended.

Commencing treatment

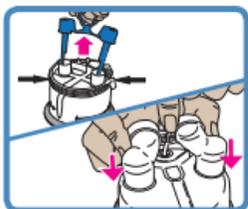
1. **Select interface and equipment** based on local availability and patient age and weight
Note: Interface size should not exceed 50% of nares. If flow rate below cannot be achieved on correct interface then use max flow for interface
2. **On initiation** a competent clinician should observe patient for comfort and compliance. If necessary the flow can be increased to reach recommended range below over a 5 minute period.
3. **Titrate FiO2** to maintain SpO2 ≥ 92 (or alternative patient range)
4. **Escalate or wean.** To avoid rapid deterioration or unnecessary continuation on HHHFT review response to HHHFT and follow escalation or weaning criteria below

<12kg	2 l/min/kg
13-15kg	20-30 l/min
16-30kg	25-35 l/min
31-50kg	30-40 l/min
>50kg	40-50 l/min

Response to treatment			
●	●	●	
Sustained response to HHHFT Nursing ratio 1:4 (1:3 < 2yrs)	Response to HHHFT Nursing ratio 1:2 or 3 if cohort is ward level	Unresponsive to treatment	*Red Flags for immediate escalation
Wean FiO2 to 0.3-0.4 (depending on patient)	Moderate respiratory distress continues and/or FiO2 > 0.40-0.6	In 1st hour: ↓	Immediate escalation
↓ Halve the flow rate ↓ If no clinical deterioration is seen after 4 hours HHHFT can be discontinued (or as soon as 1 hour if paediatric consultant confirms)	↓ Re-assess ECC's** and continue on current HHHFT settings until ready to wean ↓ Continue to observe for any deterioration or red flags*	<ul style="list-style-type: none"> Re-assess ECC's** Ensure paediatric consultant has reviewed Discussion with retrieval service Discussion/review with anaesthetic reg Closely observe for any red flags* ↓ After 2nd hour or with any red flags:	Monitoring and patient management Coloured dots refer to corresponding patient acuity
↓ Restart at weaning flow rate if stopping HHHFT not tolerated	<ul style="list-style-type: none"> Consider NIV or IMV Prepare patient, team and family for intubation 	<ul style="list-style-type: none"> Any apnoeic/bradycardic episodes Increasing respiratory distress after HHHFT commenced Clinically tiring PEWS indicates immediate escalation to resus team FiO2 > 0.60 	**Essential Care Considerations (ECCs)
Patient transfer If patient transfer is required then a suitable risk assessment tool such as the STOPP tool should be used. Where portable HHHFT is not available a senior clinician should assess the appropriate oxygen delivery based on direct patient assessment.			<ul style="list-style-type: none"> Optimised positioning (e.g. head elevation) Consider referral for physiotherapy assessment Secretion clearance if indicated and safe to do so Consider feeding regime alteration according to risk and underlying disease. <ul style="list-style-type: none"> High risk should be NBM with IV fluids Med risk should be assessed before feeding and fed with caution Psychosocial support, clear communication, play and distraction Minimal handling/cluster cares Blood gas analysis not essential and acidosis a late sign of failure

Heated Humidified High flow therapy (HHFT) for children and young people

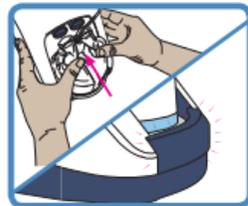
An East of England approach - Appendix 1 Set up guide for Fisher and Paykel Airvo 2



INSTALL WATER CHAMBER

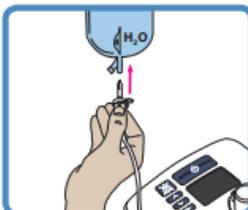
Remove the blue port caps from the chamber by pulling the blue tear tab upwards then remove the bracket holding the water supply tube.

Fit the supplied adapter over the two vertical ports on the chamber and push on fully then clip the water supply tube into position.



Fit the water chamber to the unit by pressing down the finger guard and sliding the chamber on, carefully aligning with the blue chamber port ends.

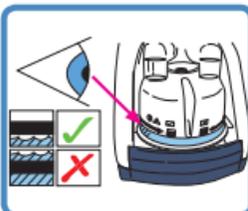
Push the chamber on firmly until the finger guard clicks into place.



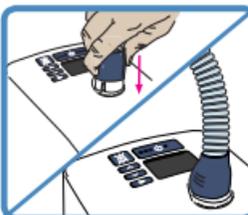
CONNECT WATER BAG

Attach the sterile water bag by pushing the bag spike into the fitting at the bottom of the bag, and attach to hanging bracket above the unit. The chamber will now automatically fill to the required level and maintain that level until the water bag is empty.

To ensure continual humidification, always ensure that the water chamber and/or water bag are not allowed to run of water.



Check that water flows into the chamber and is maintained below the maximum water level line. If the water level rises above the maximum water level line, replace the chamber immediately.



INSTALL HEATED BREATHING TUBE

One end of the heated breathing tube has a blue plastic sleeve. Life the sleeve and slide the connector onto the unit. Push the sleeve down to lock.



SWITCH ON UNIT

Plug the unit's power cord into the mains power socket. The connector at the other end of the power cord should be well secured to the rear of the unit.

Switch on the unit by pressing the On/Off button for 5 seconds.



CHECK DISINFECTION STATUS

The unit will show you whether it is safe for use on a new patient.

If disinfection is needed then attach supplied red disinfection tubing. This process will take 55 minutes.

To ensure machines are ready to use ensure internal processes encourage disinfection at the end of patient use.

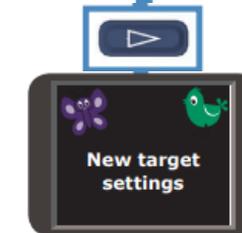


WARM-UP

The unit will begin to warm up. You will see numbers showing the current output dew-point

JUNIOR MODE

If the patient will be using an Optiflow Jnr nasal cannula, you must activate Junior Mode. To activate, hold the Mode button for 5 seconds. The target settings will be changed automatically – shown by the colourful icons on the screen. To deactivate repeat this process.



SELECT PATIENT INTERFACE

The AIRVO 2 can be used with a variety of patient interfaces. Read the separate user instructions for the patient interface that will be used, including all warnings.

Adapted from AIRVO 2 Users Manual

Patient Interface	31 °C	34 °C	37 °C	2 L/min	5 L/min	10 L/min	15 L/min	20 L/min	25 L/min	50 L/min	55 L/min	60 L/min
OPT316	●	●	●	2				20						
OPT318	●	●	●	2				25						
OPT942	●	●	●		10							50		
OPT944	●	●	●		10								60	
OPT946	●	●	●		10								60	
OPT970	●	●	●		10								60	
OPT980	●	●	●		10								60	

CONFIGURE TARGET SETTINGS

Press the Mode button to view target settings – these settings are locked by default. Press the Mode button to move on to the next screen.

****TO CHANGE LOCKED SETTINGS****

Hold the Up and Down buttons for 3 seconds to “unlock” the setting. The lock will disappear and be replaced by an arrow showing the minimum and maximum accessible settings. Press the Up and Down buttons to choose the new setting, and press the Mode button to confirm and “lock”.

TARGET FLOW

You can set the AIRVO2 to flows between 10L/min and 60L/min, in increments of 1L/min (10-25L/min) and 5L/min (25-60L/min). Press the Mode button to move on to the next screen.

OXYGEN

You can connect up to 60L/min of supplementary oxygen from a regulated supply to the AIRVO2.

CONNECT OXYGEN

Connect the output from the oxygen source to the oxygen inlet port on the side of the unit. Make sure you push the oxygen tube firmly onto this connection port.

ADJUST OXYGEN

Adjust the level of oxygen from the oxygen source, until the desired oxygen fraction is displayed onscreen.

Press the Mode button to return to the Summary screen.

CONNECT YOUR PATIENT

Wait until the 'Ready for Use' symbol is displayed.

Remember to disinfect machine at end of patient treatment using red tubing provided.



Heated Humidified High flow therapy (HHFT) for children and young people An East of England approach-Appendix 2 Set up guide for Inspiration Air/O₂ Blender



INSTALL WATER CHAMBER

Remove the blue port caps from the chamber by pulling the blue tear tab upwards then remove the bracket holding the water supply tube.

Fit the water chamber to the unit by pressing down the finger guard and sliding the chamber on, carefully aligning with the blue chamber port ends.

Push the chamber on firmly until the finger guard clicks into place.



CONNECT WATER BAG

Attach the sterile water bag by pushing the bag spike into the fitting at the bottom of the bag, and attach to hanging bracket above the unit.

The chamber will now automatically fill to the required level and maintain that level until the water bag is empty.

To ensure continual humidification, always ensure that the water chamber and/or water bag are not allowed to run of water.

Check that water flows into the chamber and is maintained below the maximum water level line. If the water level rises above the maximum water level line, replace the chamber immediately.



INSTALL BREATHING TUBE & OXYGEN DELIVERY PIECE

Place the wider bore end of the breathing tube into one side of the humidifier as pictured. Place the oxygen delivery piece in the other side of the humidifier as pictured.



INSTALL HUMIDIFICATION CABLES

The circuit requires 3 humidification points to be effective. The F&P humidifier has 2 cables – insert these into the colour-corresponding points on the humidifying. Connect the ends of these cables to the points as pictured.

Note: cables have appropriate length to connect to corresponding point. E.g. longest cable connects next to patient interface point, shortest connects closest to humidifier.



INSTALL OXYGEN TUBING

Attach one end of the oxygen tubing to the appropriate flow meter (dependant on prescribed L/min), and the other to the oxygen delivery piece.

SELECT PATIENT INTERFACE

Optiflow can be used with a variety of patient interfaces (F&P). Read the separate user instructions for the patient interface that will be used, including all warnings.

Connect the appropriate size nasal interface to the end of the breathing tube.



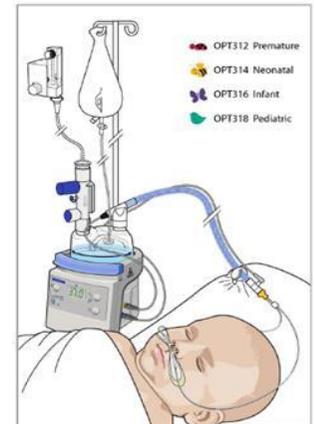
ATTACH OXYGEN AND AIR TUBING & SWITCH ON HUMIDIFIER

Ensure the correct mode of humidification is selected, as many humidifiers automatically set to invasive mode. Consult with humidifier user instructions for more details.

Note: cables have appropriate length to connect to corresponding point. E.g. longest cable connects next to patient interface point, shortest connects closest to humidifier.

PROGRAMME PRESCRIBED SETTINGS

Flow is programmed by the oxygen flow meter whilst oxygen (in %) is programmed by the dial as pictured.



CONNECT YOUR PATIENT

The system will automatically deliver prescribed treatment if programmed correctly.

F&P OPTIFLOW JUNIOR														
OPTIFLOW JUNIOR NASAL CANNULA	ITEM CODE	APPROX WEIGHT (KG)					SPARE WIGGLEPADS							
		2	4	6	8	10	12	14	16	18	20	22		
Premature Size	OPT312	Max. flow 8 L/min												OPT010
Neonatal Size	OPT314	Max. flow 8 L/min												
Infant Size	OPT316	Max. flow 20 L/min												OPT012
Pediatric Size	OPT318	Max. flow 25 L/min												

Heated Humidified High flow therapy (HHHFT) for children and young people

Appendix 3- Delivering nebulisers to patients on HHHFT

For use with regular nebuliser kit

1. Place nebuliser face mask over the top of HHHFT nasal prongs and run at 6-8 litres of oxygen. You need to turn the Airvo machine off or reduce the flow whilst administering the nebuliser.
2. If administering a nebuliser to a child who is under 6 months of age or a predominant nasal breather you will need to remove the Airvo nasal prongs first to ensure adequate administration of the drug. You may wish to still keep the Airvo machine on during this time for ease of continuing HHHFT therapy once reconnected to the nasal prongs afterwards.

For use with Fisher and Paykel nebuliser adapter kit

1. Add nebuliser adapter between patient hose and interface.
2. Connect nebuliser pot and administer directly through the patient interface.
3. This is not licenced for use with Airvo.



For use with Aerogen nebuliser

1. Select the Airvo Tube and Chamber Kit with Nebulizer Adapter 900PT562.
2. Add in the Aerogen solo chamber into right side of humidification chamber.
3. Insert drug via the port
4. Insert electrical driver into rectangular socket below and once plugged into electrical supply press the blue button on the handset.

The Aerogen Solo chamber can be used on the same patient for up to 28 days.



HHHFT via a Tracheostomy Interface



Tracheostomy
Interface

When using Airvo 2 via a tracheostomy the device should always be in **ADULT** mode and the temperature set at **37 C** unless this is uncomfortable for the patient in which it can be set at 34C. It is essential to ensure the expiration valve on the tracheostomy direct connector interface is always clear of obstruction. When delivering nebulised drugs you can deliver via this through the tracheostomy interface using the Airvo Tube and Chamber Kit with Nebuliser Adapter and Aerogen Solo Chamber (same as the steps outlined above) or simply remove Airvo and deliver the nebuliser via a regular nebuliser kit with a tracheostomy mask run via wall/cylinder oxygen.

Heated Humidified High flow therapy (HHFT) for children and young people

Appendix 4 - Setting up Vapotherm

REMEMBER

Prior to patient connection and at the beginning of each shift check the following:

- Water Level in Sterile Bag
- Flowrate
- Oxygen Percentage
- Temperature Delivery
- Nose/Mouth Care
- Any oral/nasal suction required
- Airway/Child position
- Hunger and Hydration

REMEMBER

Nasal Cannula Change

Every 7 days or sooner if obstructed with mucous.

Vapotherm High/Low Flow Set Change

This is required every 30 days

Ensure the date the set is opened is written on the cartridge)



HVNI Therapy Suggestion for Pediatrics

HVNI - High Velocity Nasal Insufflation

- Adjust the FiO2 quickly to saturation.
- Consider increasing Flow when RR ↑, WOB ↑ or dyspnea
- Set temperature to 37 °C, please consider reducing to 34-35 °C when seeing condensation or discomfort.

Take care not to occlude approximately 50% of the nostrils through the Vapotherm cannula

Weight	Min-Flow	Start Flow	Start FiO2	Cannula
< 4 kg	5	5-8	40%	Infant
4-10 kg	5	8-12	40%	Intermediate Infant
10-20 kg	5	10-20	60%	Pediatric Small
20-40 kg	5	20-25	60%	Pediatric Adult Small
> 40 kg	5	25-40	60%	Pediatric Adult Small

HVNI can be considered to help manage the symptoms:

- Increased WOB, Tachypnea, Dyspnea, increased oxygen demand
- Hypoxemia, Hypercarbia
- Nasal flaring and grunting

These often occur associated with:

- Bronchiolitis
- Pneumonia, ARDS
- Asthma
- Ventilator weaning, nCPAP intolerance, nasal trauma
- Bronchopulmonary Displasia (BPD), Persistent pulmonary Hypertension (PPH)

HVNI should not be used when:

- Insufficient spontaneous breathing ability
- Severely occluded or malformed nares
- Contraindicated in the operating instructions

Quick Set-up Guide Vapotherm Unit on the Paediatric Patient

This is Quick Set up Guide ONLY, please refer to the Vapotherm User Manual for further information or discuss any issues with your colleagues.

THIS IS A HIGH RISK SPECIALIST MEDICAL DEVICE YOU MUST HAVE RECEIVED TRAINING AND HAVE BEEN SIGNED OFF AS COMPETENT IN ITS USE

Ensure you have the following items prior to commencing therapy



1L Sterile Water Bag



Low Flow Set 1-8L (if under 4kgs)

OR



High Flow Set 5-40L (if over 4kgs)



Correct size nasal cannula



Hang sterile water bag from drip stand



Attach O² and Medical Air gas hoses to wall supply



Open the high or low flow set and open all the bags. Take out the silver the cartridge and remove all bungs.



Open and take out the Disposable Water Path (DWP)



Insert Cartridge firmly into DWP.



Take out the Oxygen/Air Delivery Tube.



Set flow rate and FiO2 once temp has reached 33°C attach delivery tube to nasal cannula. (For cannula size guidance please see reverse)



Turn on unit at the wall. Then press the run/start button. Machine will beep 10 times then start filling the air/oxygen tube.



Ensure water feed line is clamped then insert into sterile water bag. Unclamp line, squeeze the sterile water bag for about 60 seconds.



Ensure DWP Cartridge is firmly pushed into the base of the Vapotherm Unit. Close door, if door does not close check unit inserted correctly.



Open the housing on the Vapotherm Unit. Insert the DWP Cartridge with the white handle facing you.



Push Delivery tube firmly into the bottom of the DWP.

HEATED HUMIDIFIED HIGH FLOW THERAPY (HHFT) IN CHILDREN & YOUNG PEOPLE: An East of England Approach

Appendix 5 - References and Team credits

With Special thanks to the Pan- London and South East England Heated Humidified High Flow Therapy working group. The following people worked collaboratively over several months to produce the new HHHFT Guidance for London and South East England. This has been shared with the East of England and agreement obtained to adopt it for use across the EoE PCC ODN.

Name	Role	Organisation/ Trust
Project Leads		
Sophia Touzani	Nurse Manager	North Thames Paediatric Network; PCC & SIC
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	Practice Development Nurse	Kings College NHS Foundation Trust
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Dr Padmanabhan Ramnarayan	Consultant for Paediatric Intensive Care and Retrieval	Children's Acute Transport Service (CATS)
Dr Sachin Patil	Consultant Paediatrician & Clinical Lead for STPN - PCC	Medway NHS Trust & Clinical Lead for STPN - PCC
HHFT Working Group members		
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Helen Andrews	Practice Development Nurse	Barking, Havering and Redbridge NHS Trust
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Olwen Cowen	Matron & Deteriorating Patient Lead	Barts Health NHS Trust
Karen Starkie	Retrieval Nurse Co-ordinator	South Thames Retrieval service
Clare Cadman	Nurse Educator	University College London Hospitals NHS Trust
Nicky Baldwin	Nurse Educator	University College London Hospitals NHS Trust
Gemma Parish	Respiratory Nurse Specialist	Homerton University Hospital NHS Trust
Teresa Davey	Network Co-ordinator	STPN
Commissioner and Clinical Director review and Endorsement of Pan London and South East England HHHFT Guideline		
Dr Mamta Vaidya	Clinical Director & Paediatric Intensivist	North Thames Paediatric Network & Barts Health NHS Trust
Dr Hermione Lyall	Clinical Director & Paediatric consultant for Infectious diseases	North Thames Paediatric Network & Imperial NHS Trust
Dr Marilyn McDougall	Clinical Director STPN & Paediatric Intensivist	South Thames Paediatric Network (STPN) Evelina Children's Hospital GSTT
Kathy Brennan	Senior Clinical Networks Manager	NHS England and Improvement
Rachel Lundy	Programme of Care Manager, Women's and Children's	NHS England and Improvement

Policies/ Guidelines/ SOP's for HHHFT from the following Hospitals/ Trusts were reviewed along with the most up to date national and international research and literature during the creation of the Pan London and South East England HHHFT Guidance document to ensure continued promotion of best available evidence and standardisation of practice.

Trust / Organisation
Barts Health NHS Trust
University College London Hospital NHS Trust
Kings College NHS Foundation Trust NHS Trust
Medway NHS Foundation Trust
Homerton University Hospital NHS Trust
Hillingdon Hospital NHS Foundation Trust
Imperial College Healthcare NHS Trust
Barking, Havering and Redbridge NHS Trust
East of England Paediatric ODN
Basildon Hospital - Mid Essex NHS Trust
Chelsea & Westminster NHS Foundation Trust
West Hertfordshire Hospital NHS Trust
Evelina Children's Hospital NHS

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