HUMIDIFIED HIGH FLOW NASAL PRONG OXYGEN ADMINISTRATION IN ED AND WARDS – SCH

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- This policy is to support the practice of Humidified High Flow Nasal Prong Oxygen [HHFNP0_2] Therapy for acute purposes only and is to be used in conjunction with the HHFNPO_2 SCH Flowchart.
- A maximum gas flow of 2L/kg/min may be administered on wards with a maximum total flow of 25L/min. Increased flows require discussion with Admitting Consultant and CICU with consideration for care escalation and transfer.
- A Children's Intensive Care Unit [CICU] consult is to be initiated if there is any clinical concern at any time, or if no improvement in clinical condition after 1hour on 2L/kg/min or O_2 greater than 60% is required to maintain SpO_2 greater than 95%.
- For patients on greater than 1L/kg/min, High Acuity medical and nursing should be considered and discussed with admitting consultant and nursing team leader.
- Continuous monitoring of SPO_2 and hourly observations are required including documenting O_2 and total oxygen and air flow in L/min on the Standard Paediatric Observation Chart (SPOC).
- Weaning is commenced under medical consultation when the child's clinical condition is improving and all parameters are within the white or blue zone of the Standard Paediatric Observation Charts (SPOC).
- The circuit (excluding heater wire and temperature probe) is disposable and for single patient use only.
- Complete circuits must be replaced every seven days.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st March 2016	**Review Period**: 3 years
Team Leader:	Clinical Nurse Consultant	**Area/Dept**: Acute Respiratory SCH

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Other relevant policies:

Humidified Low Flow Oxygen on the Ward - SCH

Nasopharyngeal Aspiration - SCH

Nasopharyngeal and Oropharyngeal Suctioning - SCH

Pulse Oximetry (SCHN)

Oxygen therapy and delivery devices (SCHN)

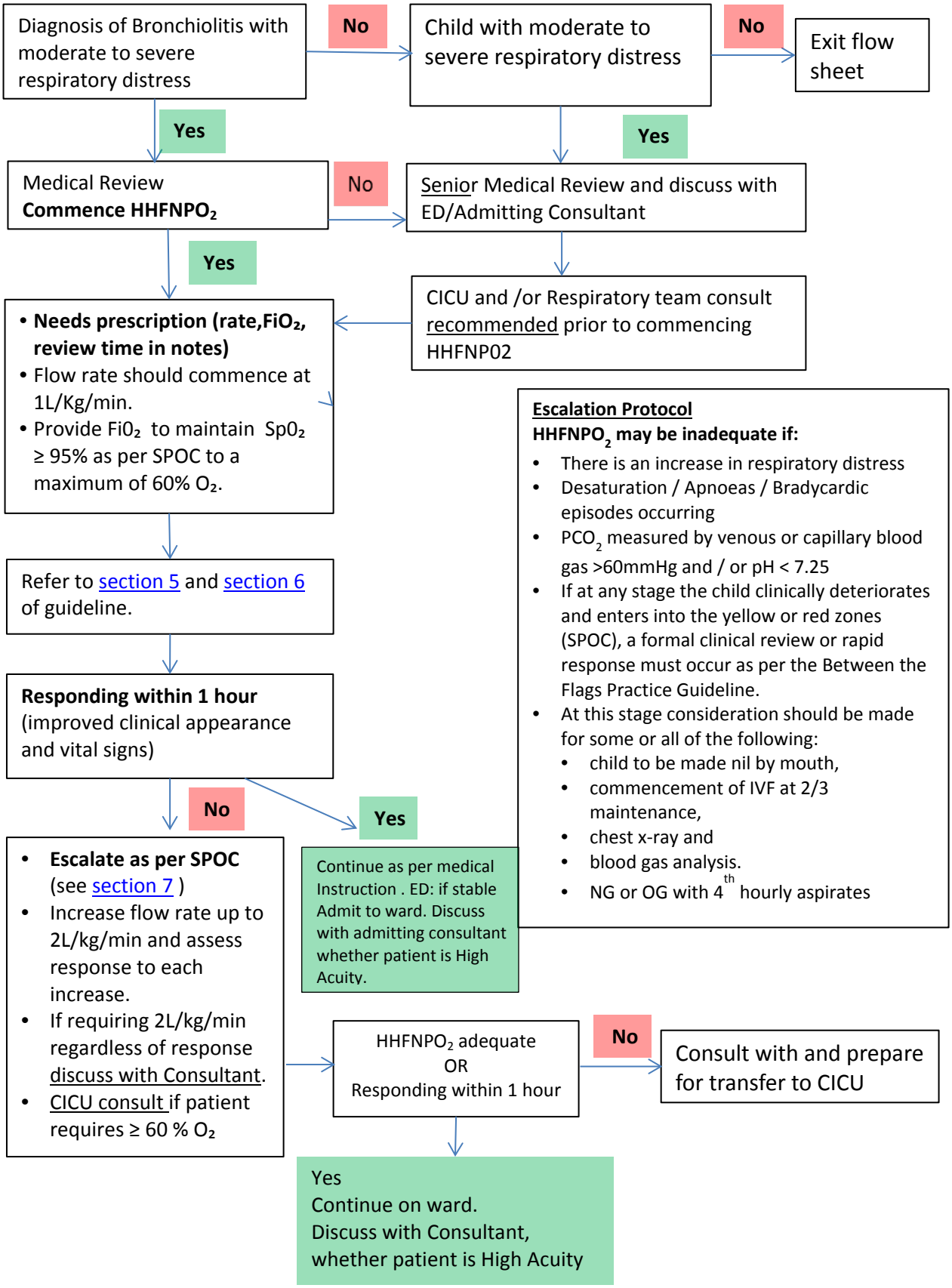
CHANGE SUMMARY

- Use of guideline supported by Humidified High Flow Nasal Prong Oxygen Therapy ($HHFNPO_2$) SCH flowsheet.
- Flow Rate increased and allowed up to 2L/kg/min on the wards.
- Administration of oxygen measured as O_2 via a blender only.
- Nasogastric Tube is required for a child on $HHFNPO_2$ > 1L/kg/min.
- A 15L or 30L flow meter is attached to the blender for correct flow administration.
- Patients should be transferred with portable oxygen & air at appropriate O_2 and not on 100% oxygen

READ ACKNOWLEDGEMENT

- Clinical staff working in Wards and or ED where Humidified High Flow Nasal Prong Oxygen is administered are to read and acknowledge this document.

Flowchart: Humidified High Flow Nasal Prong Oxygen Therapy ($HHFNPO_2$) - SCH



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1 Purpose

- Breathing cool dry gases can produce deleterious effects to the respiratory tract such as mucosal damage, reduced ciliary motility, decreased mucous production, bronchospasm and nasal discomfort[2].
- Humidified High Flow Nasal Prong Oxygen ($HHFNPO_2$) has been demonstrated to deliver effective oxygenation, attributed to the continuous washing of exhaled gas from the upper airways resulting in a reduction in anatomical dead space. $HFNPO_2$ delivery produces some positive distending pressure, resulting in an increased functional residual capacity, promoting alveolar gas exchange and CO_2 elimination. [2]
- $HHFNPO_2$ delivers gas under optimal humidification conditions. This emulates the balance of temperature and humidity that occurs in healthy lungs, maintaining mucociliary clearance and inhibiting a naso-pulmonary bronchoconstriction reflex triggered by cold air. It is also shown that by administering warm, humidified inspiratory gases, the energy demand on the sick infant is reduced, not having to condition the inspired air during a severe illness. [2]
- The mainstay of treatment for infants with respiratory distress is supportive therapies including oxygen delivery, hydration, assistance with secretion clearance and rest.
- $HHFNPO_2$ improves oxygenation in moderate to severe respiratory distress by preventing airway collapse caused by thick mucus plugging, thus improving gas exchange. [7]

2 Definition of Terms

Hypoxaemia – Low arterial oxygen tension (in the blood)

Hypoxia – Low oxygen level in the tissue

SpO_2 – Arterial oxygen saturation measured via pulse oximetry

O_2 – Concentration of Oxygen expressed as a percentage. (%)

PaO_2 – Oxygen tension in arterial blood, used to assess the adequacy of oxygenation

$PaCO_2$ – Carbon dioxide in arterial blood

$HHFNPO_2$ – (Humidified) High Flow Nasal Prong Oxygen

Humidification – The addition of heat and moisture in a gas. The amount of water vapour that a gas can carry increases with temperature.

3 Indications for Humidified High Flow Nasal Prong Oxygen

3.1 Indications for Use

- Infants with Bronchiolitis with moderate to severe distress.
- $HHFNPO_2$ may be considered for use in children with moderate to severe respiratory distress other than bronchiolitis, if they are determined to have a ventilation deficit rather than hypoxaemia. As this is not supported in the literature, this should ONLY occur in consultation with the admitting consultant. CICU and /or Respiratory team consultation is recommended prior to commencing $HHFNPO_2$ in this group.

4 Contraindications & Precautions

4.1 Contraindications

- Maxillofacial trauma
- Nasal obstruction, e.g. choanal atresia, nasal polyps, adenoids.
- Presence of suspected base of skull fracture
- Reduced level of consciousness
- Life threatening hypoxia
- Foreign body aspiration
- Open Chest wound / Chest trauma

4.2 Proceed with Caution:

- Chronic respiratory insufficiency
- Congenital heart disease
- Pneumothorax
- Neonates

5 Instructions for use

- $HHFNPO_2$ is to be initiated after consultation with the Medical Registrar, Fellow or Consultant in ward areas & Emergency Registrars & Staff specialists in ED.
- $HHFNPO_2$ is commenced at a flow rate of 1L/kg/min. If higher flow rates are required discuss with Admitting Consultant.
- Provide O2 to maintain SpO_2 ≥95% in accordance with the SPOC, titrating to patient's SpO_2 to a maximum O2 60%.

5.1 Nasal Prong Size Selection

The following codes should be used as per the current manufacturer's instructions and should be utilised as a rough guide when selecting nasal cannula. Nasal cannula selected to fit 2/3 size of nostril.

Cannula Code	Approximate Weight Range	Minimum flow	Maximum Nasal Prongflow (L/min)	Duration of Use
OPT314 Neonatal	1-8kg	1L/min	8L/min	7 days
OPT316 Infant	3-15kg	1L/min	20L/min	7 days
OPT318 Paediatric	12-22kg	1L/min	25L/min	7 days
OPT942 Small Adult	20kg and above	10L/min	50L/min	7 days

5.2 Components Required for Setup

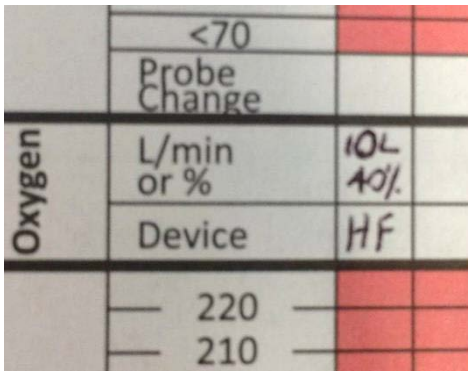
1. **Humidifier circuit**.
   Infant Respiratory Care System RT330 – use with neonatal/ infant / paediatric size cannula

   Adult Breathing Circuit Inspiratory System RT202 – use with adult size cannula
2. Nasal Cannula – see sizing guide Section 5.1 above
3. Humidifier base (only the MR850 base is compatible with the current circuit)
4. Oxygen Blender: with oxygen and air hoses to connect to wall outlet
   i. 15L Flow meter (attached to Blender)
   ii. Green Bubble Oxygen tubing cut to required size 1x20cm
5. Sterile 1 Litre Water Bag

30L Flow meter (attached to blender) will be required for flows greater than 15L

6 Clinical Care

- Continuous SpO_2.
- Hourly recording of work of breathing, respiratory rate, heart rate and SpO_2 on Standard Paediatric Observation Chart (SPOC). Consider TDS blood pressure and BSL for patients that are NBM.
- **If Blenders in Use:** Hourly recording of total flow rate and O_2 on age appropriate SPOC chart (see picture below) and respiratory observation chart.



- **All Children receiving HHFNP0_2 should have emergency equipment by their bed space, including appropriate size Bag'v'Mask and weight specific emergency drug calculation sheet.**

- Check nasal prong position as dislodgement will result in a loss of provision of oxygen and possible pressure areas.
- Consider a nasogastric tube for patients receiving $HHFNPO_2$ to prevent gastric distension.[10]

- **All patients on > 1L/kg/min $HHFNPO_2$ should be considered for a gastric tube (OGT or NGT)**
- **On 2L/kg/min children should initially be NBM & receive 2/3 maintenance IV fluids and have NGT aspirated 4th hourly.**
- **Oral or NGT feeding can be considered only if the child is stable & respiratory distress is improved with $HHFNPO_2$**

- To prevent nasal secretions blocking the airways, nasopharyngeal suctioning can be undertaken as clinically indicated.[10]
- Patient acuity, and number of patients on >1L/kg $HFNPO_2$ needs to be considered. Additional staffing may be required on a shift to shift basis & can be negotiated with Patient Flow.

7 Escalation Protocol

- All children should have observations documented on an age appropriate SPOC. Escalation protocols should be followed if 'trigger' criteria is reached or if they fall into the additional calling criteria on the reverse of the SPOC[9].
- $HHFNPO_2$ may be inadequate if:
  - There is an increase in respiratory distress
  - Desaturation / Apnoeas / Bradycardic episodes occurring
  - PCO_2 measured by venous or capillary blood gas >60mmHg and / or pH < 7.25
- If at any stage the child clinically deteriorates and enters into the yellow or red zones (SPOC), a formal clinical review or rapid response must occur as per the Between the Flags Practice Guideline.[9]
  http://chw.schn.health.nsw.gov.au/o/documents/policies/procedures/2012-8013.pdf
- Increase flow rate up to 2L/kg/min and assess response to each increase.

  At this stage consideration should be made for some or all of the following: child to be made nil by mouth, insertion of gastric tube (OGT or NGT), commencement of IVF at 2/3 maintenance, chest x-ray and blood gas analysis.

An CICU Review is to be initiated if there is any clinical concern at any time or no improvement in clinical condition within 1hour on 2L/kg/min or O_2 ≥ 60% is required to maintain SpO_2 greater than 95%.

8 Weaning

- Weaning of O_2 can commence when child's clinical condition is improving and all parameters are within the blue or white zone of the SPOC. The total flow rate of oxygen and air should remain unchanged until the O_2 has been reduced.
- Reduce O_2 by 10% and reassess after 1 hour. Continue to wean O_2 by 10% as tolerated to maintain SpO_2 >95%.
- Once O_2 <30- 35%, flows can be weaned. Flows can be weaned by 50%, and then reassessed after 1 hour. e.g. 1L/kg/min reduced to 0.5L/kg/min. If patient develops respiratory distress, return to previous settings and reassess in 3-6 hours.
- As long as the clinical condition continues to improve, reduce the flows by 50% of the total flow every 1-2hours until a total of 2L/min.
- Once on 2L/min of flow, patient may either require a continuation of the weaning process involving low flow oxygen, or alternatively may be clinically well enough to trial room air.
- Once patient receiving ≤ 1L/min oxygen they will need to be put onto non-humidified wall oxygen.
- Continue to monitor and document SpO_2, respiratory rate, heart rate & work of breathing on the SPOC as the oxygen is weaned.
- Notify Medical officer/ initiate appropriate review for clinical deterioration and return to the previous $HHFNPO_2$ settings.
- Respiratory assessment and weaning of therapy can be attended at any time, regardless of the child sleeping or time of day (day or night).

9 Appendix: Set up of Equipment

a) COMPLETE THE FOLLOWING STEPS FOR SET UP OF INFANT CIRCUIT:

1. Connect air and oxygen hoses from blender to wall outlets. (Refer to Picture 1)

- **NB:** There should be a second High Flow oxygen meter attached at the bedside for emergency purposes. If there is not a second oxygen outlet available, a double adapter will need to be utilised (Picture 1).

Picture 1

2. Fit the chamber

Slide humidification chamber onto the humidifier base. Remove blue caps. (Picture 2)

Picture 2

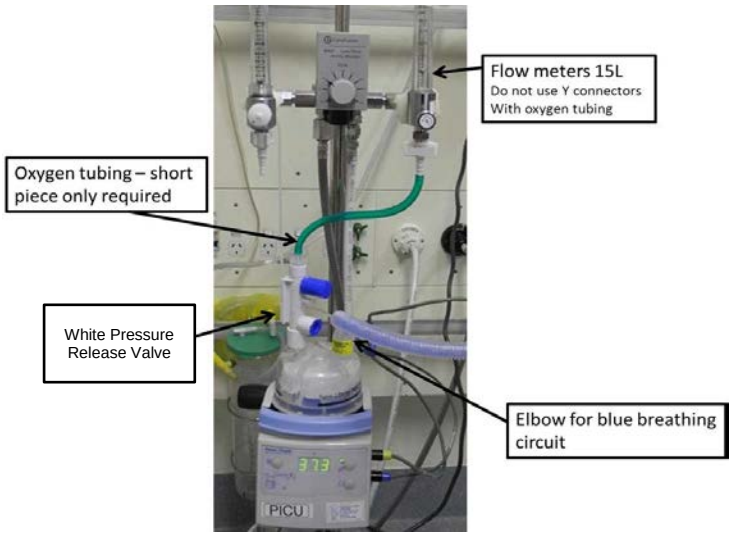
Hang the waterbag

- Hang the water bag from the pole. Unwind the water feed set and spike water bag. To allow the water to run freely, place the water bag as high as possible above the humidifier.

Connect the infant circuit (Refer to Picture 3)

- Connect the white pressure release valve to the humidification chamber.
- Connect green Oxygen tubing to top of white air entrainer (picture 3).
- Connect the elbow of the blue breathing circuit to the humidification chamber.
- Connect correct size nasal prong to connector at patient end of breathing circuit.

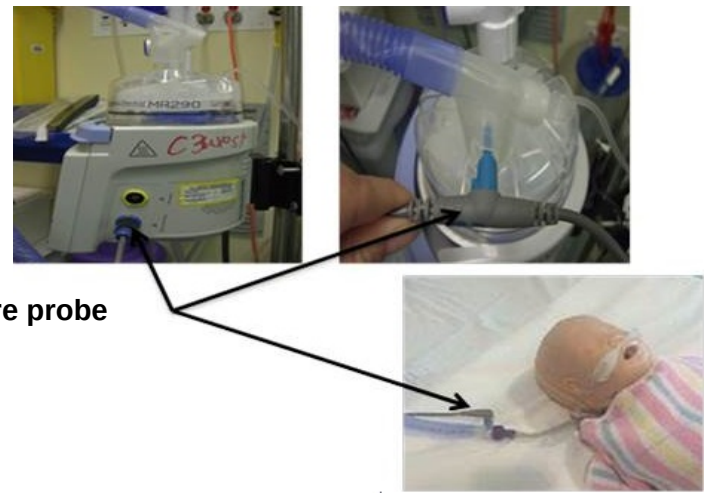
Picture 3



Connect the temperature probe (Refer to Picture 4 below)

- Connect the blue temperature probe plug into the blue socket on the side of the humidifier.
- Insert the other end of the blue probe into the port at patient (distal) end of breathing circuit.
- Insert the double prong temperature probe at the elbow of the blue breathing circuit.

Picture 4

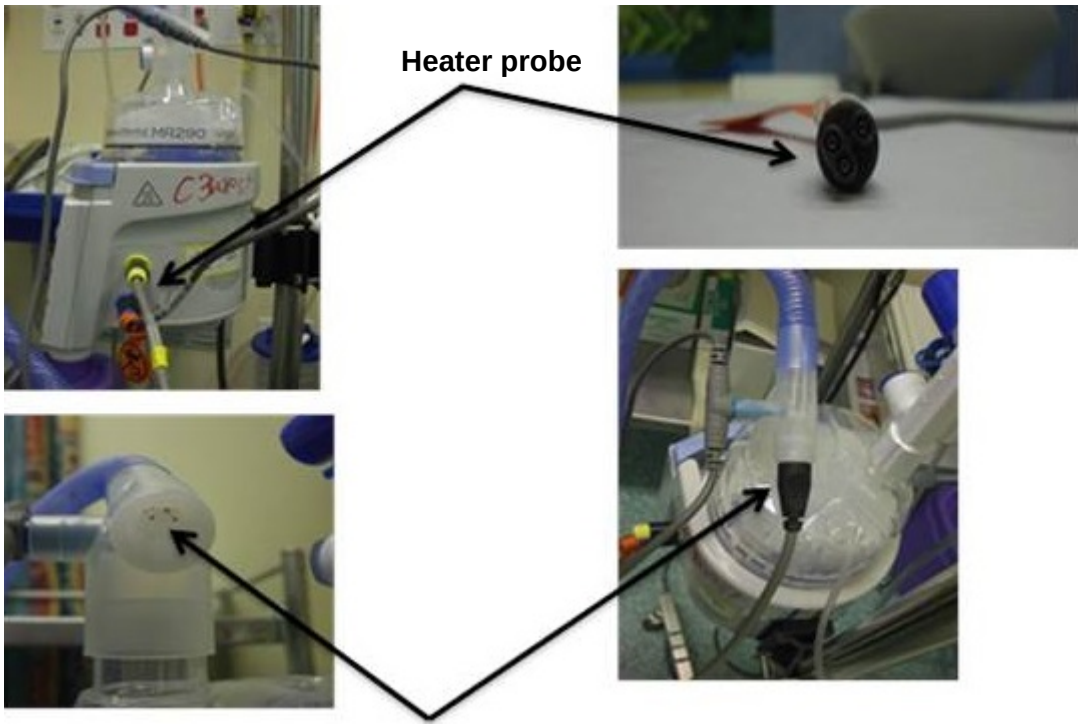


Connect the heater wire (Refer to Picture 5)

- Connect the yellow heater wire plug into the yellow socket on the side of the humidifier.

  Insert the other end into the socket on the breathing circuit elbow above the chamber

Picture 5



Heater probe socket in humidifier circuit

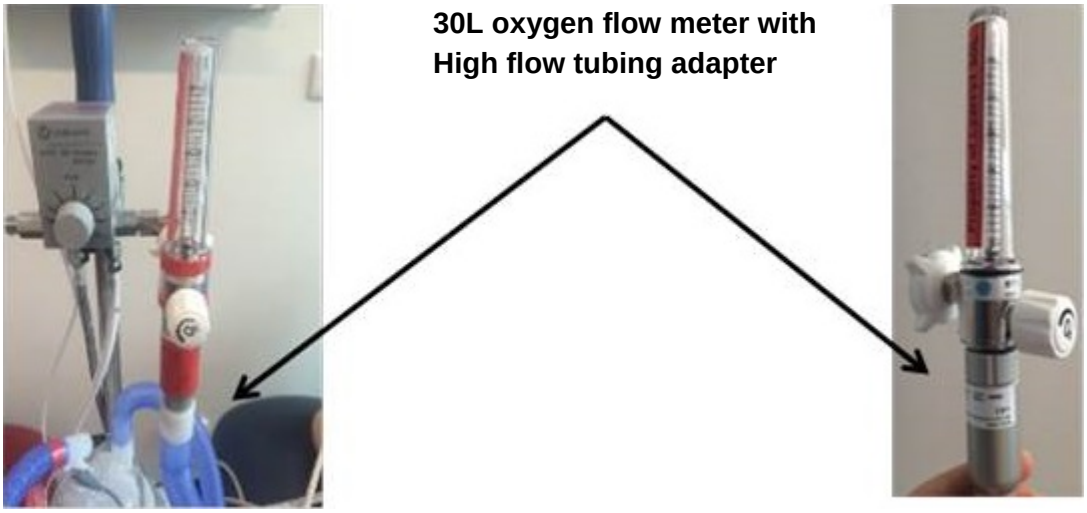
b) SET UP FOR ADULT CIRCUIT (FOR USE WITH FLOWS ABOVE 25L/MIN)

Connect air and oxygen hoses from blender to wall outlets as in Picture 1 of infant set up.

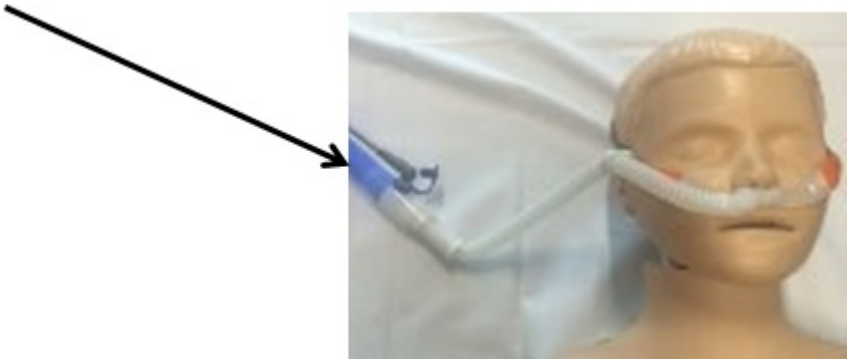
- Slide humidification chamber onto the humidifier base and remove blue caps as in Picture 2 of infant set up

- Hang water bag as in infant set up
- **Connect the adult circuit** (Refer to Picture 6)
  - Connect the elbow of the blue breathing circuit to the humidification chamber.
  - Connect the blue flow tubing to the humidification chamber, then to the adapter on the end of the 30L oxygen flow meter.

Picture 6



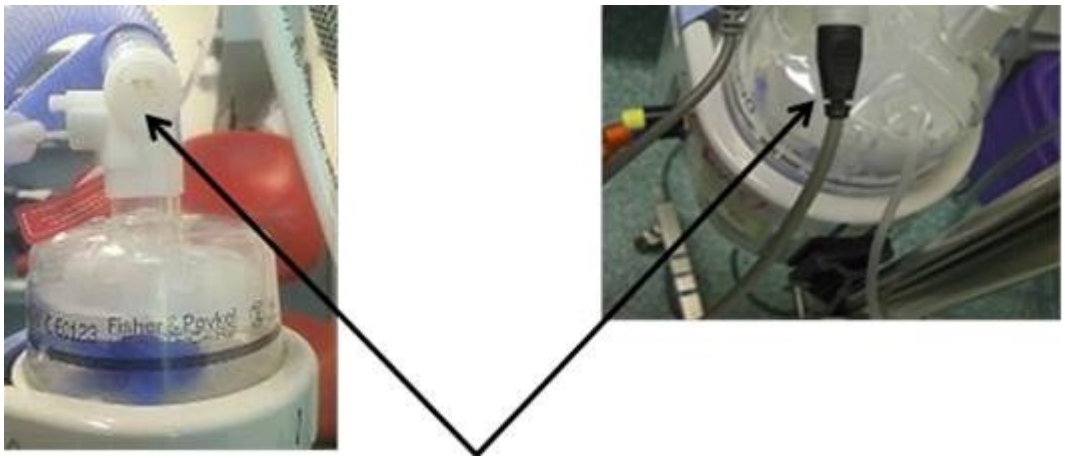
- Connect adult nasal prongs to connector at patient end of breathing circuit.



Connect the heater wire (Refer to Picture 7)

- Connect the yellow heater wire plug into the yellow socket on the side of the humidifier (as with infant circuit)
- Insert the other end into the socket on the breathing circuit elbow above the chamber

Picture 7

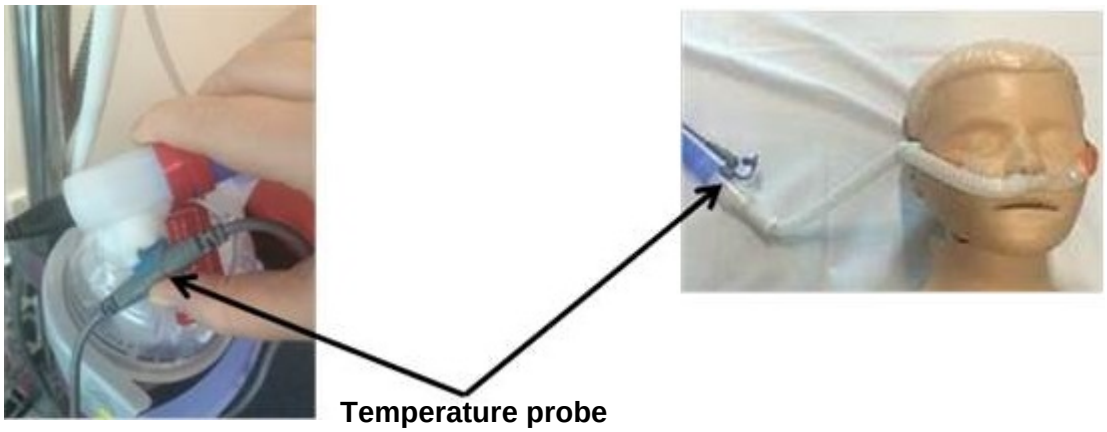


Heater probe socket in humidifier circuit

Connect the temperature probe (Refer to Picture 8 below)

- Connect the blue temperature probe plug into the blue socket on the side of the humidifier (as with infant circuit set up)
- Insert the other end of the blue probe into the port at patient (distal) end of breathing circuit.
- Insert the double prong temperature probe at the elbow of the blue breathing circuit.

Picture 8

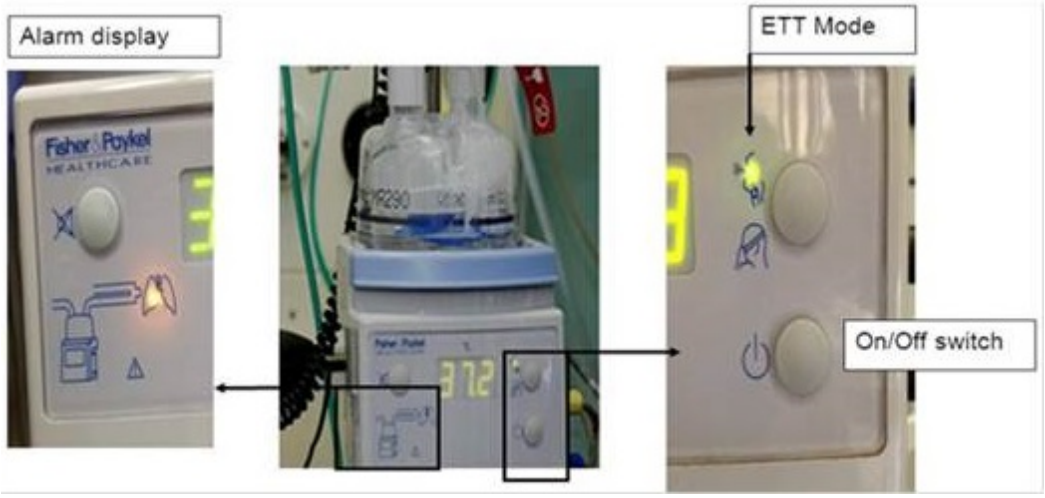


Temperature probe

Turn on Humidifier to start warming

- Ensure Humidifier base is plugged into red mains power (there is no battery backup)
- Turn humidifier on by pressing button on lower right hand side of humidifier
- ETT mode (Refer to picture 9) should be selected by default. However if not, press and hold upper right button until humidifier base beeps twice. ETT mode is indicated by the green light indicated in picture 6**.** Temperature range for humidifier is 35-40 degrees. (Please note: the temperature is measured at the end of the blue breathing circuit. There is a heat loss of 3 degrees from the connection of the nasal prongs to what is delivered to the patient. This is due to the prongs not having a heater coil).
- The system is ready when the temperature has reached mid 30's (can take up to 30 minutes to reach optimal temperature).
- If system alarms, a light will appear on the front of the humidifier indicating where within the system the error is occurring. (Refer to section 12 – Troubleshooting).
- Ensure that the humidifier is positioned lower than the patient.

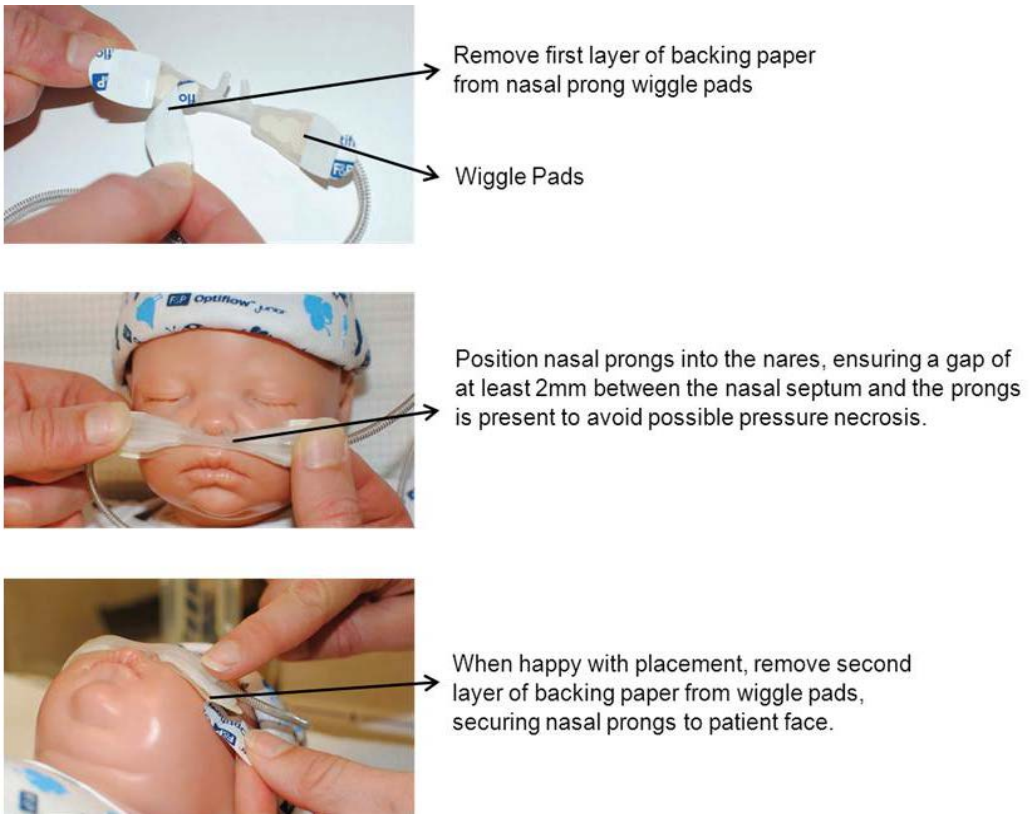
Picture 9



Secure nasal prongs on patient (Refer to Picture 10a and 10b)

- Identify the correct size of nasal prongs required for patient referring to table in Section 5.1. The nasal prong outer diameter should be approximately two thirds the diameter of the child's nares.

Picture 10a Infant and child prongs



Picture 10b Adult prongs

Set Blender and appropriate Flow rate

- Set Flow meter to 1L/kg/min (i.e. 10L for 10kg patient).
- Titrate O_2 to achieve to achieve 30%-60% to maintain SpO_2 equal to or greater **than 95% or as per altered criteria on SPOC.**

10 Appendix 1: Cleaning

- The circuit and nasal cannula are disposable with **exception of the heater wire and the temperature probe** attached to the Humidifier unit. The entire circuit including humidification chamber is for single patient use but should be changed weekly, if a single patient is using it for a prolonged period.
- The humidifier, heater wire and temperature probe are not disposable. The probe can be wiped down with Neutral Detergent cleaning solution after use. Do not immerse the heater base or temperature probe electrical connections in any liquid. If the patient has multi resistant organisms then consider using bleach or sending equipment to CSSD for cleaning.

11 Appendix 2: Transferring Patients Between Departments

- ,Refer to SCHN Transfer and transport of patients within SCHN Hospitals http://chw.schn.health.nsw.gov.au/o/documents/policies/procedures/2015-9052.pdf
- Patients transferring from the Emergency Department must be reviewed by the attending medical officer/consultant after commencement of 2L/kg/min high flow oxygen prior to transfer to C3W or CICU. Priority to review this patient is to be given so as not to delay transfer.
- All children requiring transfer on HHFNPO_2 are to be accompanied by an appropriately educated Registered Nurse.
- The child should be transported in a bed/cot with appropriate equipment and monitoring with a porter.
- HHFNPO_2 must **NOT** be disconnected for transfer. This may lead to an acute deterioration in the patient's condition.
- If the patient is moving to another ward / department the transferring RN should notify the receiving ward prior to transfer that child is on HHFNPO_2 to ensure the bed space is prepared for patient.
- Patient shouldn't be transferred with Observations in the Yellow or Red zones on the age appropriate SPOC **unless** there is a documented plan of care and altered criteria in place post review as per Between the Flags – Clinical Emergency Response System – SCH Procedure[9].

11.1 Transfer Setup

- Child remains in bed / cot.
- Obtain and place portable oxygen and air cylinders in the brackets on the humidified set up pole.
- Disconnect each hose from the wall separately, preferably oxygen first. Connect to the cylinder and ensure it is turned on before the second hose is connected. The blender will maintain a constant flow while this happens, maintaining the possible PEEP factor.

- The humidifier base has no battery backup however will remain warm for approximately 20 minutes after disconnected from mains power.
- Ensure correct flow rate and Fi02 is maintained throughout transfer.
- On arrival to new bed space ensure wall outlets for air and oxygen are set up as per picture

- Disconnect both oxygen and air hoses one at a time, commencing with the oxygen hose from the portable cylinders. Connect to the wall flowmeter (ensure it is running) and then do the same for the air hose. This will ensure the patient is not compromised.

- **The humidifier will be turned off during transit, so it must immediately be plugged into mains power and turned back on once the child it moved into the designated bed space.**

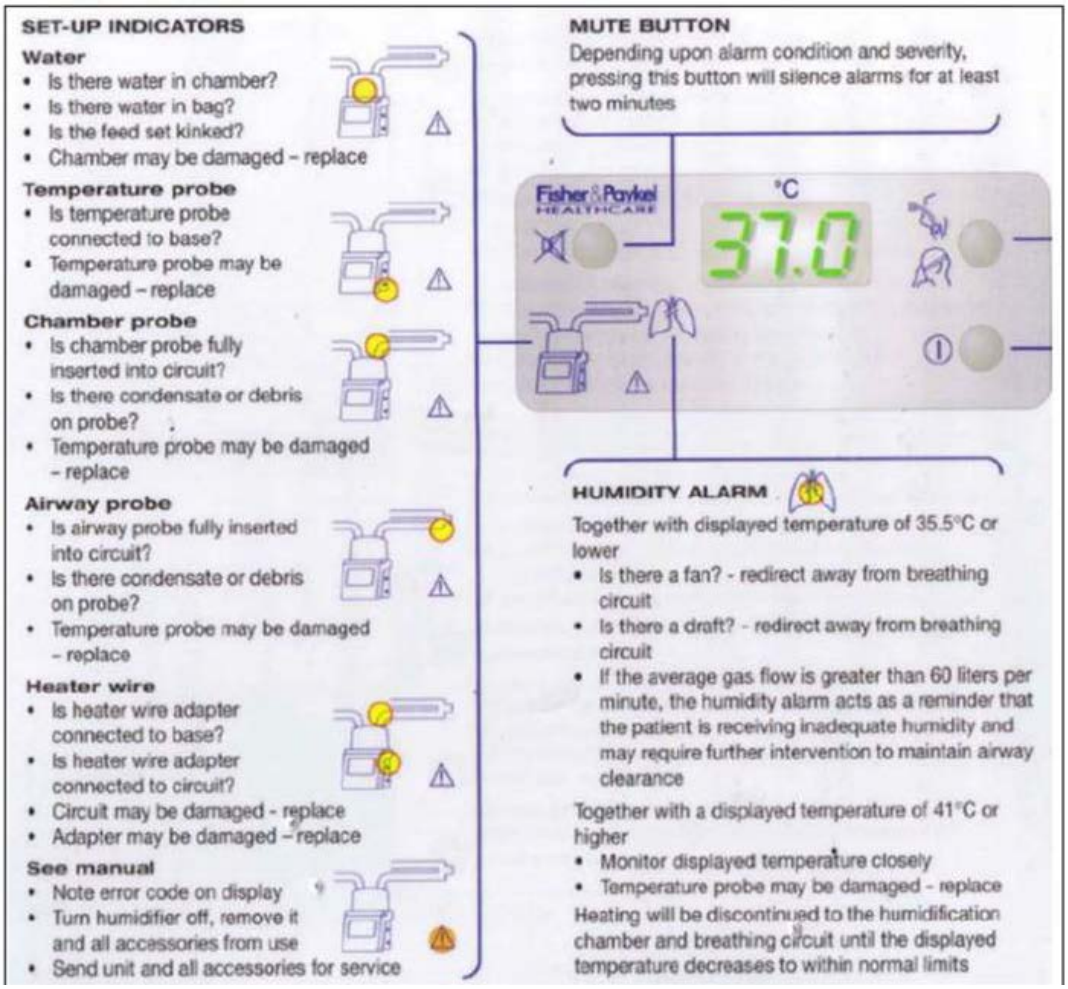
12 Appendix 3:Troubleshooting

12.1 Humidifier Alarms

The humidifier will sound an audible alarm to alert clinical staff to any problems.

A light will illuminate on the setup indicator (See Diagram A below) to indicate where the problem is occurring.

A list of alarm definitions and potential solutions are outlined in diagram B below



N.B If the Temperature or chamber probe are in alarm, disconnect each probe from the water chamber and breathing circuit and dry with paper towel then re-attach. Water accumulation around the temperature probes will cause the probe to read the temperature inaccurately.

- **Low Temperature Alarm:** ensure all connections to the blue breathing circuit and bubble oxygen connections are secure.

13 References

1. Infant and Children: Acute Management of Bronchiolitis. Clinical Practice Guidelines. North Sydney: NSW Health; 2012
2. Dysart K, Miller TL, Wolfson MR, Shaffer TH. Research in high flow therapy: Mechanisms of action. Respiratory Medicine. 2009;103(10):1400-5
3. Fisher & Paykel. Product Guidelines for Optiflow Junior Respiratory Care System RT330. 2011 [cited 2013 4th April 2013]; Available from: www.fphcare.com.
4. Kelsall-Knight L. Clinical assessment and management of child with bronchiolitis. Nursing Children and young People. 2012;24(8):29-34
5. Manley BJ, Owen L, Doyle LW, Davis PG. High-flow nasal cannulae and nasal continous positive airway pressure use in non-tertiary special care nurseries in Australia and New Zealand. Journal of Paediatrics and Child health. 2012;48:16-21.
6. McKiernan C, Chua LC, Visintainer P, Allen H. High flow nasal cannulae therapy in infants with bronchiolitis. The Journal of Pediatrics. 2010;156(4):634-8.
7. Nagakmar P, Doull I. Current therapy for bronchiolitis. Arch Dis Child. 2012;97:827-30.
8. SCHN. Transferring Paediatric Patients and Related Transport Requirements - Practice Guideline. http://chwschnhealthnswgovau/o/documents/policies/guidelines/2006-8105pdf. 2010.
9. SCHN. Between the Flags - Clinical Emergency Response System - CHW. http://chwschnhealthnswgovau/o/documents/policies/procedures/2012-8013pdf.
10. Schibler A, Pham TMT, Dunster KR, Foster K, Barlow A, Gibbons K, et al. Reduced intubation rates for infants after introduction of high-flow nasal prong oxygen delivery. Intensive Care Medicine. 2011;37:847-52.