Humidified High Flow Nasal Cannula Therapy for Children

Guidelines for use and management

Contents

Aim

This guideline describes the indications, management and procedure for the use of humidified high flow nasal cannula therapy (HFNC) in ward areas at Princess Margaret Hospital (PMH).

Background

Humidified high flow nasal cannula therapy (HFNC) offers a form of non-invasive respiratory support as well as a method of delivering air or oxygen and humidification. The high flow system uses nasal cannulae which allow delivery of high flows (up to 60 L/min) of humidified air or oxygen.

The physiological effects of high gas flows include pharyngeal dead space washout, decreased nasopharyngeal resistance leading to improved pulmonary compliance and decreased work of breathing. Variable distending pressures or a positive end expiratory pressure (PEEP) effect may be generated as well as an increase in end expiratory lung volume which can aid alveolar recruitment.

Humidification results in increased patient comfort, and may reduce bronchoconstriction from cold dry air and prevent epithelial injury.

There has been extensive use of HFNC in neonatal practice as a primary means of respiratory support, weaning from ventilation and as an alternative to bubble CPAP, despite a lack of evidence for efficacy or for safety. There is evidence that HFNC is useful in the management of bronchiolitis in infants, however relevant studies have all been conducted within paediatric intensive care units, and there is a lack of evidence to demonstrate efficacy in milder disease or safety in other settings [1, 2].

In adults HFNC has been used in the management of hypoxaemic respiratory failure as a result of a variety of causes, again most studies have been set within intensive care units, and there is a general paucity of evidence to support the level of clinical use[3].

There is one study describing reduced rates of endotracheal intubation with the use of HFNC in children with acute respiratory failure from a variety of causes (including asthma and pneumonia) in the emergency department prior to ICU admission[4].

The major risk associated with HFNC is air leak resulting in pneumothorax and/or pneumomediastinum [5]. These side effects are described only in case reports, so their likelihood in HFNC cannot be determined.

In summary there is evidence that HFNC may be useful in infants and children with hypoxaemic respiratory failure, there is no current evidence to support the use of this therapy in milder disease.

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Key Points

- HFNC is a medically ordered mode of respiratory support.
- HFNC should only be initiated by medical staff with knowledge and experience in its use.

- The widespread usage of HFNC has occurred in the absence of a strong evidence base. This therapy should be used with caution and with an awareness of potential side effects.
- Flow >2 L/min may cause unpredictable PEEP and should be used with caution in neonates.
- If there is prolonged use (>72 hours) of HFNC for respiratory support on a medical ward a Respiratory Medicine Department Consultant should be involved in the care.
- Commence HFNC therapy at flow rate of 1L/kg/min, if flow rates greater than this are required consult the PICU.
- Consider PICU consultation for children who have severe respiratory distress and/or are rapidly deteriorating. The commencement of HFNC therapy for these children does not replace the need for PICU consultation.
- Alteration of flow is a medical decision and must be documented in the patient's notes.
- The humidifier requires a minimum flow of 300 mL/min for RT330 circuit and 6L/min for RT202 circuit to function effectively.[7]
- If there is any deterioration or significant changes in patient condition, escalate care as per 'Action Plan' of the Children's Early Warning Tool (CEWT). Alert the medical team immediately.
- All nursing staff must work within their scope of professional practice. It is their responsibility to know the limits of their practice relating to care of the child requiring HFNC and to seek advice from senior nursing and/or medical staff to ensure the best outcome for the patient.

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Indications

Respiratory distress from bronchiolitis Consider use if hypoxemia and moderate to severe respiratory distress despite standard flow oxygen via head box, nasal prongs or Hudson oxygen mask.

Acute respiratory failure: In addition to bronchiolitis HFNC may be considered in infants and children with acute respiratory failure from other causes, however there is little data to make evidenced based recommendations for its use in conditions other than bronchiolitis.

Weaning therapy from mask non-invasive ventilation or bubble CPAP: There is evidence for this use in the neonatal population, however no studies in children to support recommendation for weaning therapy in this group.

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Contraindications

- Blocked nasal airway e.g. choanal atresia.
- Trauma or surgery to nasopharynx.
- Pneumothorax.
- Base of skull fractures.

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Equipment, Circuit Set-Up, Patient Connection and Cleaning Procedures

Refer to Equipment, Circuit Set-Up, Patient Connection and Cleaning Procedures in the appendix of this document for information on how to set-up and manage the Fisher & Paykel RT 330 and RT 202 oxygen therapy systems.

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Commencing Therapy

- Start the HFNC system at **1 L per kg per minute**.
- Flows of 2L/kg/min have been used in some studies, while some guidelines recommend titrating flow based on work of breathing. There is no evidence to suggest optimal flow, and the above recommendation is designed to be conservative.
- Adjust oxygen fraction via blender to maintain target oxygen saturation.

Note:

- Fisher & Paykel RT 330 (Maximum flow which can be delivered with this system is 25L/min).
- Fisher & Paykel RT 202(Maximum flow 60L/min).

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Monitoring Patient Response

Frequency of Observations

Clinical improvement is usually observed within 2 hours of initiating HFNC therapy [6], therefore close observation, frequent reassessment and documentation of response to treatment is required

- Continuous pulse oximetry monitoring.
- At least hourly respiratory rate/work of breathing/heart rate/SpO_2.
- Consider the use of capillary blood gas at commencement and after two hours of treatment.

Nursing Care and Management

Steps	Additional Information
Check that oxygen is flowing freely and that the tubing/nasal cannula is not blocked at least **hourly.** Replace the nasal cannula if it becomes	A blockage in the tubing may manifest as: • An increase in respiratory effort • Respiratory distress

Steps	Additional Information
blocked with secretions/milk.	• A fall in SpO_2 levels [9]
Check the tubing/nasal cannula for presence of condensation at least **hourly** and empty as necessary by draining back into the humidifier chamber.	Water in tubing/nasal cannula may lead to aspiration.
Check water level in humidifier chamber and replace water bag as necessary.	The flotation device will prevent overfilling.[7]
Check nasal cannula position to ensure no pressure is placed on nasal septum at least hourly.	Ensure weight of circuit is supported to prevent drag on nasal tubing.
Provide nasal suctioning if required.	Nasal secretions can impair the effectiveness of the High Flow Oxygen Delivery System.[10] One side of the cannula can be lifted at a time so that some flow is still provided to child during procedure.
Monitor oxygen saturations (SpO_2) continuously.	Acceptable parameters for oxygen saturations will be recorded in patient notes by Medical Team and should be documented on the CEWT chart. Refer to PNPM 7.2.2.1 Oxygen Delivery Devices.
Adjust oxygen concentration to maintain acceptable SpO_2 levels.	Changes to flow are only made following medical review.
Observe for increased abdominal distension.	There is a risk of abdominal distension due to high flow of gases.

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Medical Review

Medical review is indicated routinely within two hours of commencement or sooner if there is:

- No response to treatment as evidenced by a decrease in FiO_2 and work of breathing.
- Persisting hypoxemia despite high gas flows.
- Increasing respiratory distress.
- Frequent apnoea or bradycardia.

- A rapid deterioration of SpO_2 or marked increase in work of breathing (exclude pneumothorax).

If there is no response to HFNC within two hours, further escalation of treatment may be required (such as non-invasive ventilation, or intubation and ventilation) and consideration of transport to a tertiary centre.

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Weaning of high flow nasal cannula therapy

Wean FiO_2 when clinical condition is improving as indicated by:

- decreased work of breathing.
- normal or improved respiratory rate.

Once child is stable and in FiO_2 of 40%, standard nasal cannula oxygen can be implemented. There is no need to wean flow rate (although this may be considered if flow rates of higher than 1L/kg/min have been instituted). In some individuals it may be useful to continue HFNC even with FiO_2 of less than 40%.

Complications of HFNC

- Gastric distension.
- Pressure injury at the nares.
- Pneumothorax.

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Procedure for managing HFNC during transfer of child between areas

Steps	Additional Information
RT330: Disconnect the circuit from the nasal cannula	
Connect Optiflow™ Junior oxygen tubing (OPT014) to nasal cannula and other end to a portable oxygen cylinder	Refer to PNPM 7.2.2.1 Oxygen Delivery Devices for maximum flows
RT202 nasal cannula cannot be connected to standard oxygen tubing.	Remove high flow nasal cannula and replace with standard nasal cannula connected to a portable oxygen cylinder.

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Documentation

The **medical order** to commence HFNC Therapy or to alter flow must be documented by medical staff in the progress notes of the patient's medical record

The following should be completed by **nursing** staff hourly and PRN

Record appropriate observations and respiratory assessment on CEWT chart.

- Record oxygen percentage setting on blender dial. All recordings related to humidifier and ventilation settings are to be recorded on MR824.04 Ventilation Long Term Observation Chart.
- Record flow rate. (Refer also to PNPM 7.2.2.1 Oxygen Delivery Devices).
- Check and record humidifier temperature. Inadequate humidification can lead to nasal mucosal damage and increased viscosity of airway secretions.[8]

Related policies, procedures, protocols and guidelines

Humidified High Flow Nasal Cannula Therapy for Children. – Paediatric Nursing Practice Manual

Useful resources

Fisher & Paykel Healthcare. Infant Care Therapy Overview: Optiflow™ Junior.

References

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Equipment, Circuit Set-Up, Patient Connection and Cleaning Procedures

Aim

To outline to procedure to deliver humidified high flow blended air/oxygen using the Fisher & Paykel MR850 humidifier and oxygen delivery system to spontaneously breathing infants, children and adolescents.

Key points

- The use of an oxygen blender system for accuracy of flow and oxygen delivery is strongly recommended.
- If an oxygen blender is not available, oxygen fraction will need to be adjusted manually using separate air and oxygen flow meters (the addition of an oxygen analyser in the system with this method is recommended).
- Ensure the cannula size selected is approximately half the diameter of the nares (excessive pressure may be generated if an occlusive seal is formed).
- Humidification is essential to allow delivery of high flows, maintain nasal cilia function and prevent drying of nasal secretions.

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Equipment

- Fisher & Paykel MR850 humidifier base
- Heater wire & temperature probe
- Fisher & Paykel circuit & nasal cannula
  - **RT330** which includes: tubing circuit, humidifier chamber and pressure manifold. (Discard the short blue extension (only to be used for infants nursed in incubators))

    Use only: **Optiflow® Junior** nasal cannula of appropriate size (see chart below)
  - **RT202** which includes: tubing circuit, humidifier chamber; requires dual flow adaptor (rabbit ears). (Discard short blue extension (not used)).

    Use only**: Optiflow®** nasal cannula (S, M, L) (see chart below)
- Air / oxygen blender
- Low flow oxygen meter/ high flow oxygen meter (depending on flow ordered: **30L/min oxygen flow meter available**)
- High flow oxygen meter 0-15L/min at wall socket (**for use in an emergency**)
- 2 way oxygen Y-adaptor
- Green oxygen tubing
- Sterile water for irrigation (1 litre bag)
- IV pole (to attach blender & MR 850 Humidifier)

Additional equipment which may be required

- Second high flow meter and Y-connector for flow rates>15L/min
- Spare Optiflow® or Optiflow® Junior nasal cannula kept at bedside
- Spare wiggle pads (For use with Optiflow Junior nasal cannula only)
- Optiflow® Junior oxygen tubing OPT014 (for use when transferring patients)

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Nasal Cannula Selection

Nasal Cannula for use with **RT330™** Oxygen Therapy System: Guide only

Product	Item Code	Approx. Weight Range	Max. Flow Rate (L/Min)	Spare Wigglepads
Optiflow Junior Nasal Cannula				
Premature Size	OPT312	‹2kg	8	OPT010
Neonatal Size	OPT314	1-8kg	8	OPT012
Infant Size	OPT316	3-15kg	20	OPT012
Pediatric Size	OPT318	12-22kg	25	OPT012

Nasal Cannula for use with **RT202™** Oxygen Therapy System

Type	Size	Flow rate
OPT542	Small	Max 60L/min
OPT544	Medium	Max 60L/min
OPT546	Large	Max 60L/min

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Humidifier System Set-up

Do not set up the HFNC under vents or in a draught as cold air on the circuit will cause increased condensation[7].

Note: Bubble CPAP and HFNC RT330 circuit are **not** interchangeable.

Steps	Additional Information
Before connecting the oxygen hose, add the two way oxygen connector to wall Connect air and oxygen hoses to wall gas supply.	This allows O_2 high flow meter to be available for emergency use.
Attach blender and humidifier base to pole. Ensure humidifier and chamber is positioned lower than the patient.	This allows any condensation to collect in the tubing away from the patient.
Fit water chamber to the humidifier and remove blue caps.	
Hang sterile water bag and connect to water chamber. Ensure bag is positioned at least 50cm above the humidifier chamber.	

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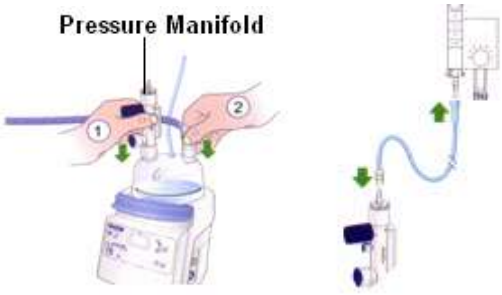
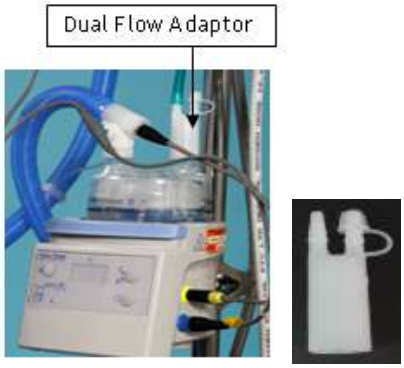
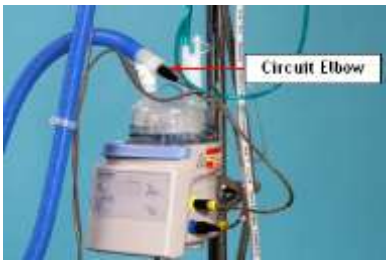
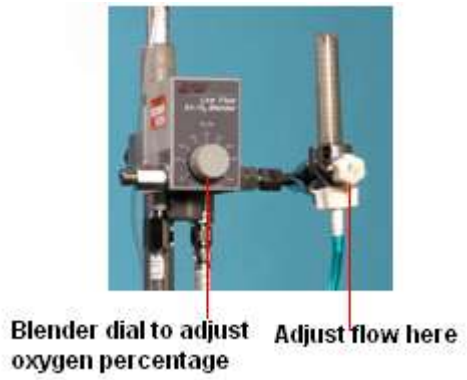
Circuit Set-up for RT330 and RT202

Steps	Additional Information
RT330 set up Connect the pressure manifold to the chamber. Connect one end of oxygen tubing to the pressure manifold and the other end to the blender flow meter. Use a low flow oxygen meter for flows of <2.5 L/min. For flow rates >15L/min use a Y-connector and second oxygen flow meter.	
RT202 set up Connect dual flow adaptor (“rabbit ears”) to the chamber. Connect the elbow of the blue inspiratory circuit to the chamber.	
Attach oxygen tubing to one side of the dual flow adapter and the other to the flow meter. Cap the second port of the adapter. If a second flow meter is required for flow rates >15L/min attach O_2 tubing to the secondary port of the ‘rabbit ears’ and to the second oxygen meter on the blender connector or use a **30L/m flow meter.**	

Steps	Additional Information
Temperature Probe 1. Connect the blue temperature probe plug into the blue socket on the side of the humidifier. 2. Securely insert the blue twin probe plug into the blue circuit elbow above the chamber. 3. Insert the temperature probe into the port at the patient end of the circuit.	**RT330**  **RT202** 
Heater wire 1. Connect one end of the yellow heater wire adaptor plug into the yellow socket on the side of the humidifier. 2. Connect the other end into the blue circuit elbow.	
Set the blender to the required oxygen percentage. Set the flow rate as per medical order.	

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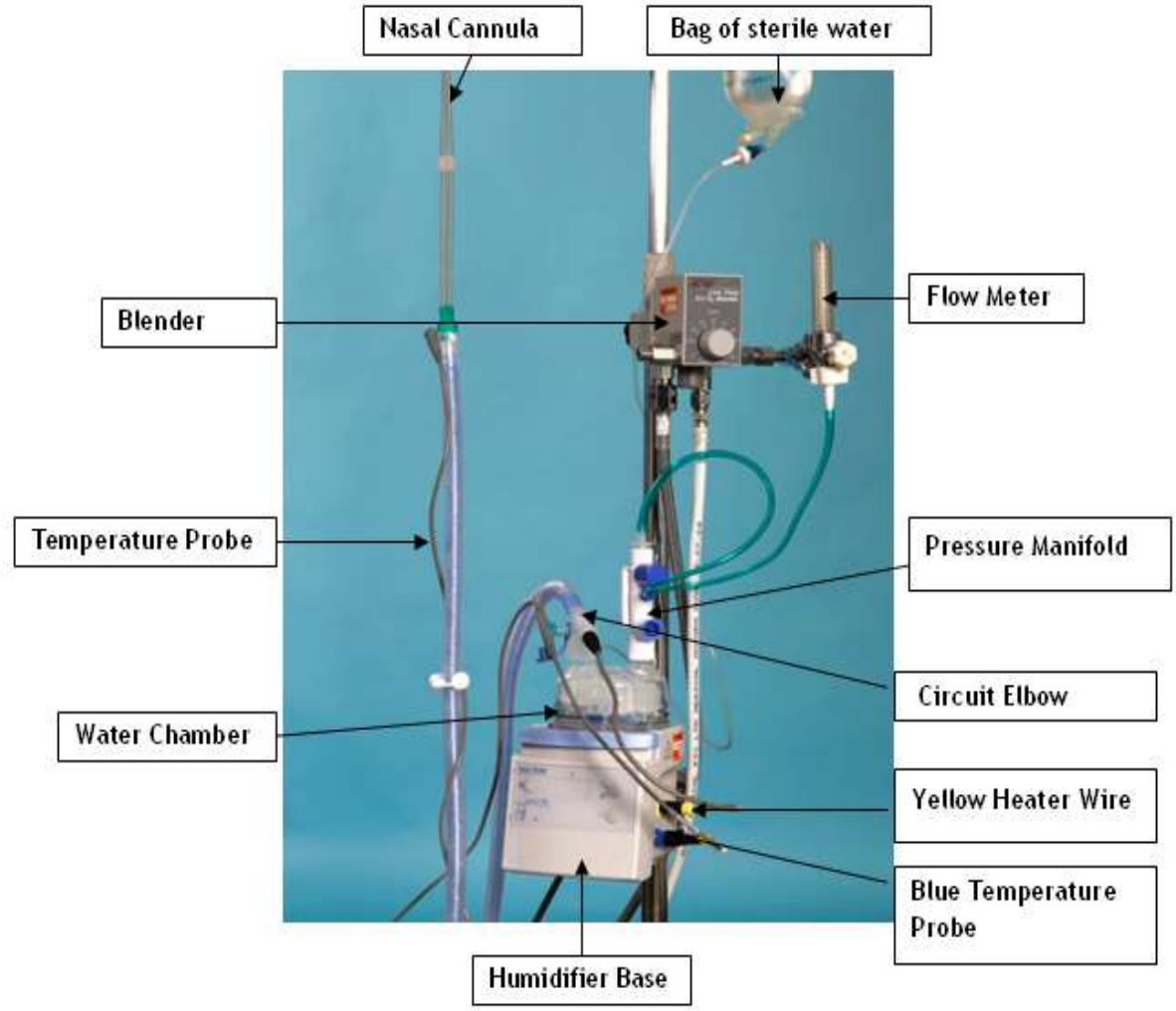
RT330 Set Up Diagram



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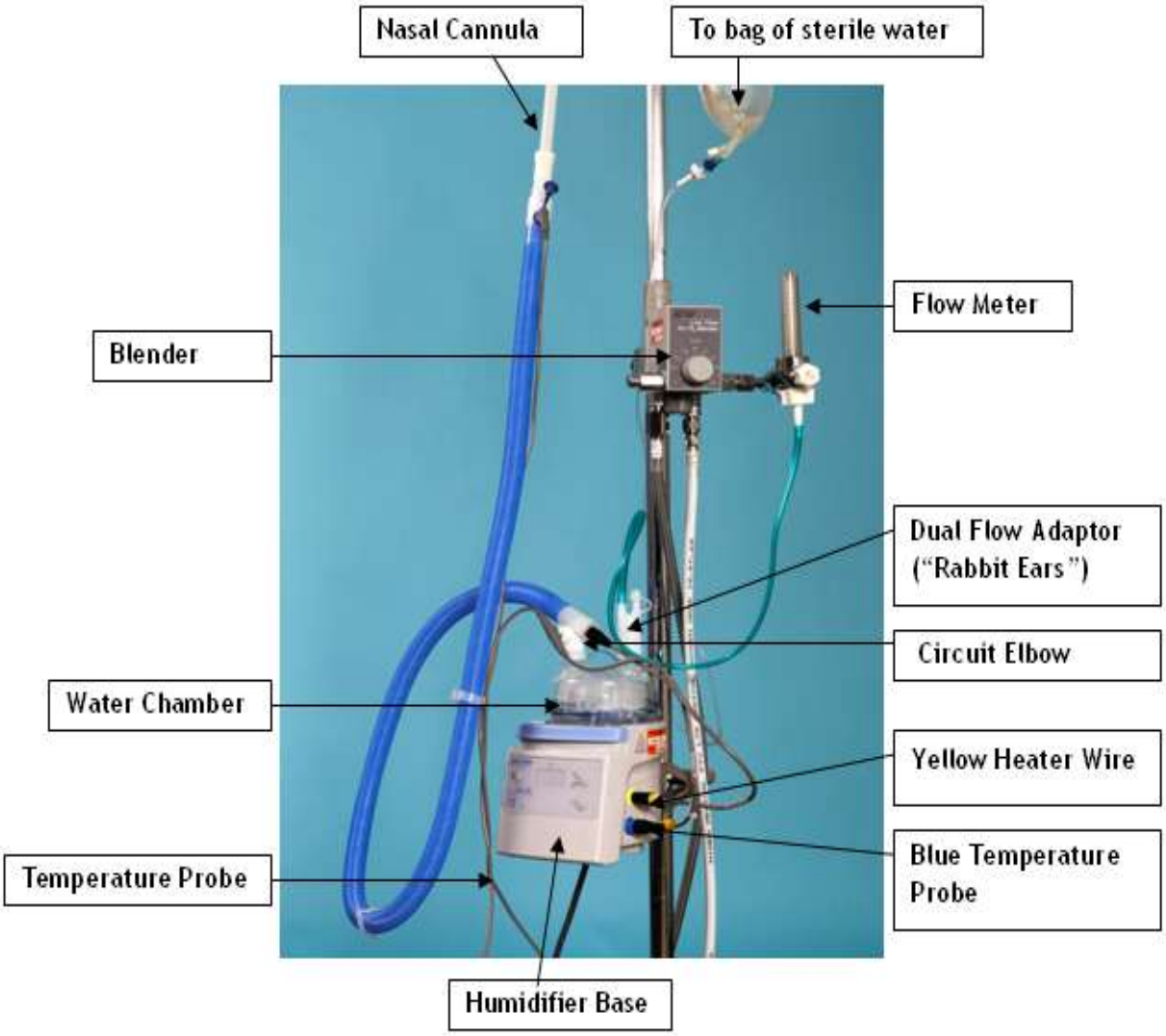
RT202 Set Up Diagram



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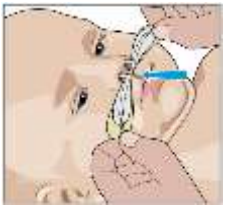
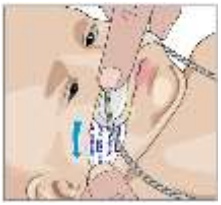
Patient Connection

Steps	Additional Information
Turn the humidifier on. Check default setting is on *Invasive* mode to provide optimal humidification. Temperature readout will fluctuate between 35-40^{o}C to achieve optimal humidity (44mg/L H_2O). Refer to operations guide for alarm information.[1]	
Connect appropriate size nasal cannula to the end of the blue circuit tubing.	**Note:** The nasal cannula prong size should be approximately half the diameter of the nares (no seal should be created).[7] If an occlusive seal is formed between the prongs and nares an excessive pressure may be generated.[8]
Ensure gas is flowing through the cannula prior to attaching to the child.	
Insert the nasal prongs into the child's nares with the prongs curving down. For RT330 system secure to face using adhesive Wiggle pads™ attached to cannula. Ensure at least a 2mm gap to the septum.[7]	 

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Cleaning

Steps	Additional Information
Change circuit monthly or sooner if: • Circuit is visibly soiled • Circuit is mechanically malfunctioning • Circuit is damaged [11] • An acute respiratory infection develops [11]	If HFNC circuit is used intermittently (e.g. nocte only) leave humidifier and flow turned on when not attached to child. The circuit may be possible source of infection.
The RT330 and RT202 circuit and nasal cannula are disposable.	**Not Disposable** • Temperature probe (blue) - Send to HSSD for decontamination. • Heater wire (yellow) - Use a mild detergent to wipe over the cable.

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