HUMIDIFIED HIGH FLOW NASAL CANNULA THERAPY: ADMINISTRATION DURING RETRIEVAL USING NETS N2012 ICU MODULE

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Respiratory distress and respiratory failure are one of the most common conditions presentations in childhood (68% of NETS Retrievals and Transfers were for Respiratory problems in 2013) requiring retrieval.[1] Various modes of oxygen delivery and respiratory support are used at NETS to provide these therapies during retrieval.
- Humidified High Flow Nasal Cannula (HHFNC) 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 nasopulmonary bronchoconstriction reflex triggered by cold air.
- HHFNC therapy is being used in neonatal intensive care units as an alternative to NCPAP and therefore NETS can be asked to transfer neonates receiving this therapy. However the use of HHFNC as a primary therapy from birth requires further research [1,2]. NETS will only transfer patients already established on HHFNC therapy.
- F&P Optiflow RT330 circuit and Optiflow nasal cannula are obtained from the referring hospital. (NETS continue using the patients already applied nasal cannula and circuit).
- N2012 series ICU module is specific to NETS and is used for the transport of babies weighing 6kgs or less requiring a crib.
- The maximum gas flow of 2L/kg/min may be administered for transport with a maximum total flow of 12L/min before needing to consider CPAP. The size of the nasal cannula for preterm and neonatal patients limits the delivery flow to 8L/min maximum.
- The circuit (excluding heater wire and temperature probe) is disposable and for single patient use. The reusable heater wire and temperature probe are sent to Inhalation Therapy for cleaning.

Approved by:	SCHN Policy, Procedure and Guidelines Committee	
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Team Leader:	Staff Specialist	**Area/Dept**: NETS

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CHANGE SUMMARY

- N/A- new guideline

READ ACKNOWLEDGEMENT

- Clinical staff working at NETS where Humidified High Flow Nasal Cannula therapy is used, are to read and acknowledge this document they understand the contents of this guideline.

1 Purpose

- Describe the indications and procedure for using Humidified High Flow Nasal Cannula (HHFNC) therapy using the retrieval specific N2012 ICU module.

  Respiratory illnesses are the most common conditions presentations in childhood (68% of NETS Retrievals and Transfers were for Respiratory problems) requiring retrieval. [1] Various modes of oxygen delivery and respiratory support are used at NETS to provide these therapies during retrieval.

- 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]

  There has been a major change of practice in respiratory support for critically ill children with the increasing use of HHFNC therapy.[3]

- HHFNC therapy 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. HHFNC therapy delivery produces some positive distending pressure, resulting in an increased functional residual capacity, promoting alveolar gas exchange and CO_2 elimination.[2]

- HHFNC therapy 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]

- HHFNC therapy improves oxygenation in moderate to severe respiratory distress by preventing airway collapse caused by thick mucus plugging, thus improving gas exchange. [7,10]

- HHFNC therapy is being used in neonatal intensive care units as an alternative to NCPAP and therefore NETS can be asked to transfer neonates receiving this therapy. However the use of HHFNC as a primary therapy from birth requires further research.[12] Nets will therefore only be transferring neonates already established on HHFNC therapy.

2 Definition of Terms

N2012 series ICU transport module – NETS retrieval ICU system for infants 6kg or less

Hypoxaemia – Low arterial oxygen tension (in the blood)

Hypoxia – Low oxygen level in the tissue

SpO_2 – Arterial oxygen saturation measured via pulse oximetry

SaO_2 – Arterial oxygen saturation

FiO_2 – Fraction of inspired oxygen concentration (%)

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

$PaCO_2$ – Carbon dioxide in arterial blood

HHFNC - Humidified High Flow Nasal Cannula

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

Absolute Humidity – The actual amount of water a gas can hold at a designated temperature

Relative Humidity – The percentage of water vapour the gas is holding, in comparison to the maximum it can hold at that temperature

3 Indications

To classify as 'High Flow', the total flow rate must be ≥ 1 L/kg/min.

HHFNC may be utilised for patients during transport with the following indications:

- Respiratory distress with documented hypoxemia and moderate to high oxygen requirements e.g. Bronchiolitis, pneumonia (paediatric population), respiratory distress syndrome and apnoea of prematurity (neonatal population).
    - **NB** Bronchiolitis severity:
        - **Moderate Bronchiolitis** – Increased work of breathing during feeding, feeds may decrease but total intake is more than 50% of normal, mild to moderate respiratory distress with some chest wall retractions & nasal flaring, oxygen saturations 90-95% in room air.[5]

- **Severe Bronchiolitis**:
  - Reluctant to feed with intake less than 50% of normal (feeding may worsen coughing and increase the work of breathing and tachycardia).
  - Moderate to severe respiratory distress with marked chest wall retractions, nasal flaring and grunting +/- apnoeic episodes.
  - Oxygen saturations less than 90% in room air or less than 92% with appropriate oxygen therapy. [5]

- Continuation of respiratory support therapy in infants already established on HHNC requiring transfer to another unit.
- Maximum weight 6kg (limited to neonatal N2012 series transport module)

4 Contraindications & Precautions

4.1 Contraindications

- Nasal obstruction (e.g. choanal atresia, large polyps)
- Children requiring intubation for airway protection e.g. for reduced conscious level
- Life threatening hypoxia (it is not a replacement for intubation and ventilation)
- Maxillofacial trauma
- Presence of suspected base of skull fracture

4.2 Proceed with Caution:

- Chronic respiratory insufficiency
- Congenital heart disease
- Pneumothorax

5 Instructions for use

- HHFNC therapy can only be used if the patient has already been started on this respiratory support therapy. Owing to limitations with the retrieval pack weight constraints the HHFNC circuits and cannulae are unable to be carried by NETS.
- Only use if the patient is showing improvement in their condition. The patient requires consideration for escalation in respiratory support therapy if there is no improvement in vital signs or work of breathing within one hour of commencing HHFNC treatment or if requiring FiO_2 above 60% to maintain SpO_2 >95%.
- HHFNC oxygen therapy is commenced at a FiO_2 of 30-35%, titrating to patient's SpO_2 to a maximum FiO_2 60%.

5.1 Components Required for Setup

1. N2012 series ICU transport module (Picture 1)
2. Air and oxygen hoses connected to wall outlets
3. Humidifier circuit. Infant Respiratory Care System RT330 – use with preterm/neonatal/ infant size cannula.
4. Nasal Cannula – see sizing guide Section 5.2 below
5. Humidifier base (only the MR850 base is compatible with the current circuit- Picture 1)
6. Flow meter / Blended gases (in-built on neonatal module – Picture 1)
7. Green Bubble Oxygen tubing cut to required size 1 x 40cm
8. Sterile bottled Water for irrigation

Picture 1

5.2 Nasal Cannula 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.[3]

Cannula Code – appropriate size	Approximate Weight Range	Minimum Flow	Maximum Nasal Prong Flow (L/min)	Duration of Use
OPT312 Premature	< 2kg	0.5L/min	8L/min	7 days
OPT314 Neonatal	1 - 8kg	0.5L/min	8L/min	7 days
OPT316 Infant	3 - 6kg	0.5L/min	20L/min	7 days

6 Setup of Equipment

6.1 Fit humidifier chamber

- Slide humidification chamber onto the humidifier base on N2012 series neonatal system
- Remove blue cap.

6.2 Fill humidifier chamber

- Use sterile bottled water for irrigation to fill the chamber to the level line indicator.
- Leave the water feed line with spike cover firmly attached as this filling line is not attached to a water bag during transport.

6.3 Connect the circuit (Picture 2)

- Connect the white air entrainer to the humidification chamber.
- Connect green Oxygen tubing to top of white air entrainer.
- 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 2

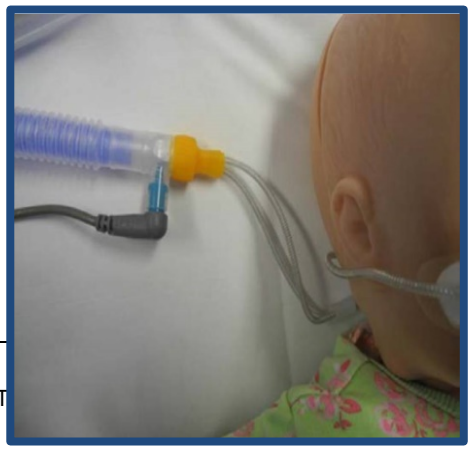
6.4 Connect the temperature probe

- Connect the blue temperature probe plug into the blue socket on the side of the humidifier. (Picture 3)
- Insert the two-pronged temp probe plug into the socket on the elbow of Optiflow circuit. (Picture 4)
- Insert the other end of the blue probe into the port at the patient end of the Optiflow circuit. (Picture 5)

Picture 3

Picture 4

Picture 5



6.5 Connect the heater wire (Picture 6)

- 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 back of the Optiflow circuit elbow above the chamber.

Picture 6

6.6 Turn humidifier on (Picture 7)

- Turn humidifier on by pressing button on lower right hand side of humidifier.

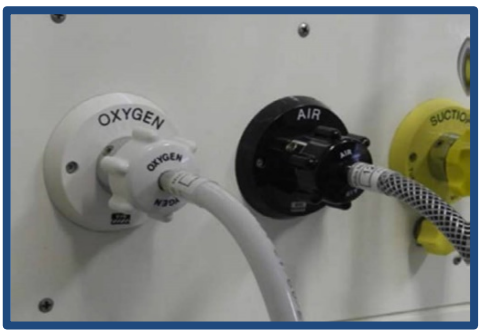
  Ensure ETT mode (37 degrees) is selected (default setting when turned on) as highlighted by the green light next to button on top right hand side of humidifier. (picture 7)

Picture 7

- 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 13 – Troubleshooting).

6.7 Connect air and oxygen hoses from N2012 system to wall outlets (Picture 8)

Picture 8



6.8 Set blender and gas flow meter (Picture 9)

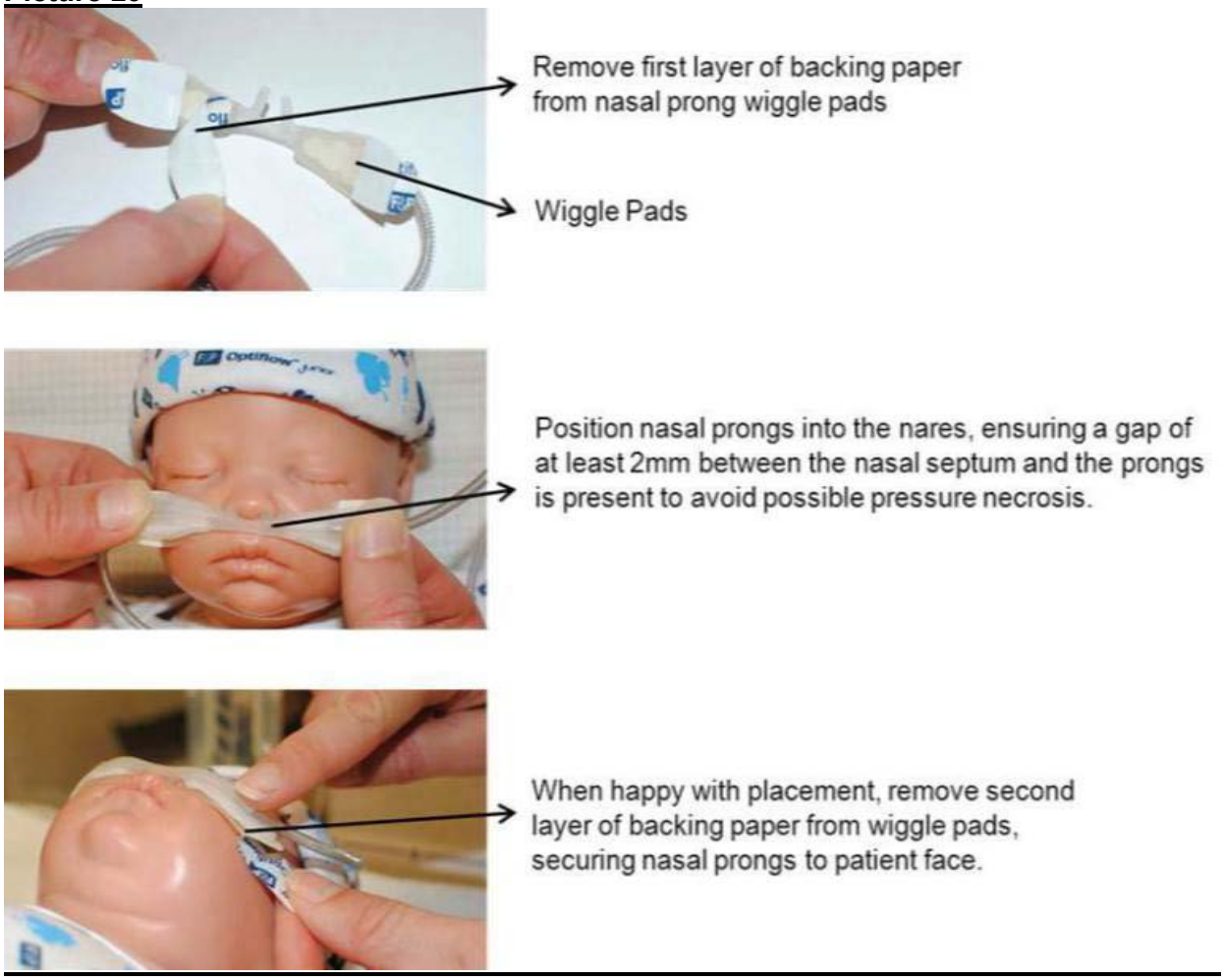
- Set blender to desired FiO_2 (21%-100%)
- Dial up flow meter – starting flow 2L/kg/min to a maximum of 20L /min through infant prongs.
- Check for gas flow exiting through prongs.

Picture 9

7 Nasal Cannula – securing on patient (Picture 10)

1. Prepare Skin - Ensure infant's face is clean and dry.
2. Remove First Wigglepad Tabs - Without touching the adhesive, remove the first backing tabs from Wigglepads, leaving the second backing tabs in place as shown in picture below.
3. Place the cannula, ensuring nares are not occluded by prongs.

Picture 10



8 Clinical Care

- Continuous monitoring and 15 minutely recording of skin colour, respiratory rate, heart rate SpO_2 and hourly recording of BP on the vital signs observation chart.
- 15 minutely observations of flow rate, FiO_2 and recording of cannula position - It is especially important to check nasal cannula position as dislodgement will result in a loss of respiratory support.

- Hourly observation of humidifier water level and refill as required.
- If the patients' clinical state deteriorates the patient should be assessed for consideration of escalation of respiratory support (see Failure Criteria below).
- A gastric tube must be in situ for degassing the stomach. Aspirate air regularly. If using a NGT secure with tape above or below the nasal cannula onto the face; avoid taping over the nasal cannula so that they remain easily removable with hook and loop tape.
- Nasal care & secretion clearance – administer 0.9% saline drops PRN in conjunction with regular nasal and oral suctioning is recommended.

9 Failure Criteria

HHFNC may be inadequate if:

- There is an increase in respiratory distress or chest appears hyperinflated.
- Episodes of desaturation / apnoea / bradycardia occur.
- pCO_2 measured by venous or capillary blood gas >60mmHg and / or pH < 7.25.
- Oxygen requirement of greater than 60%.

10 Rapid clinical deterioration

- Bag and mask CPAP or manual breaths can be applied while the nasal cannula remain insitu, however the nasal cannula are easily removed with the hook and loop tape attachment and the wiggle pads can remain on the face.
- Notify the NETS consultant
- Exclude pneumothorax in the event of rapid deterioration.

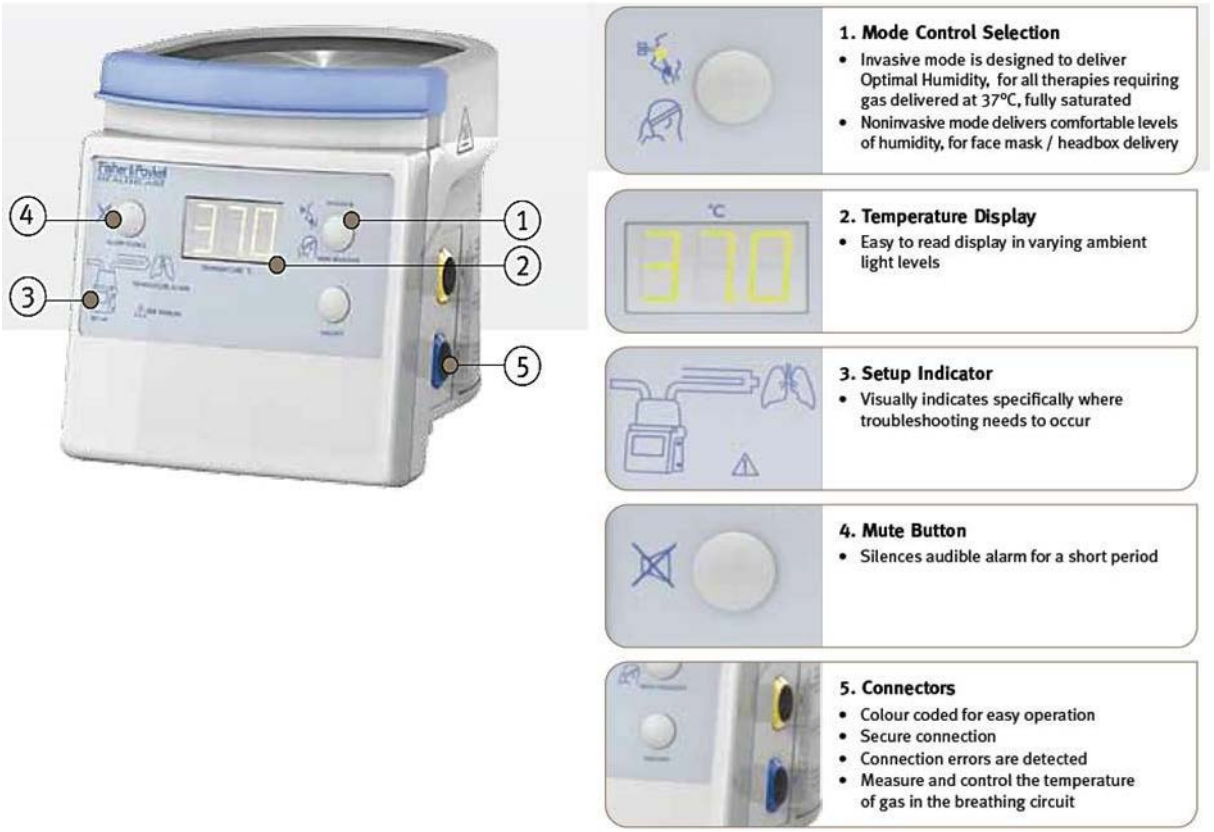
11 Cleaning

- The circuit including humidification chamber is disposable and should be discarded if the infant does not continue on the same circuit at the receiving unit. (NB circuits should be changed every 7 days of patient use).
- The heater wire and temperature probe are reusable and should be sent with the appropriate documentation to inhalational therapy department at CHW for cleaning.
- The humidifier and blender will require cleaning along with the neonatal ICU module which is undertaken by NETS following the cleaning and restocking guideline.

12 Troubleshooting

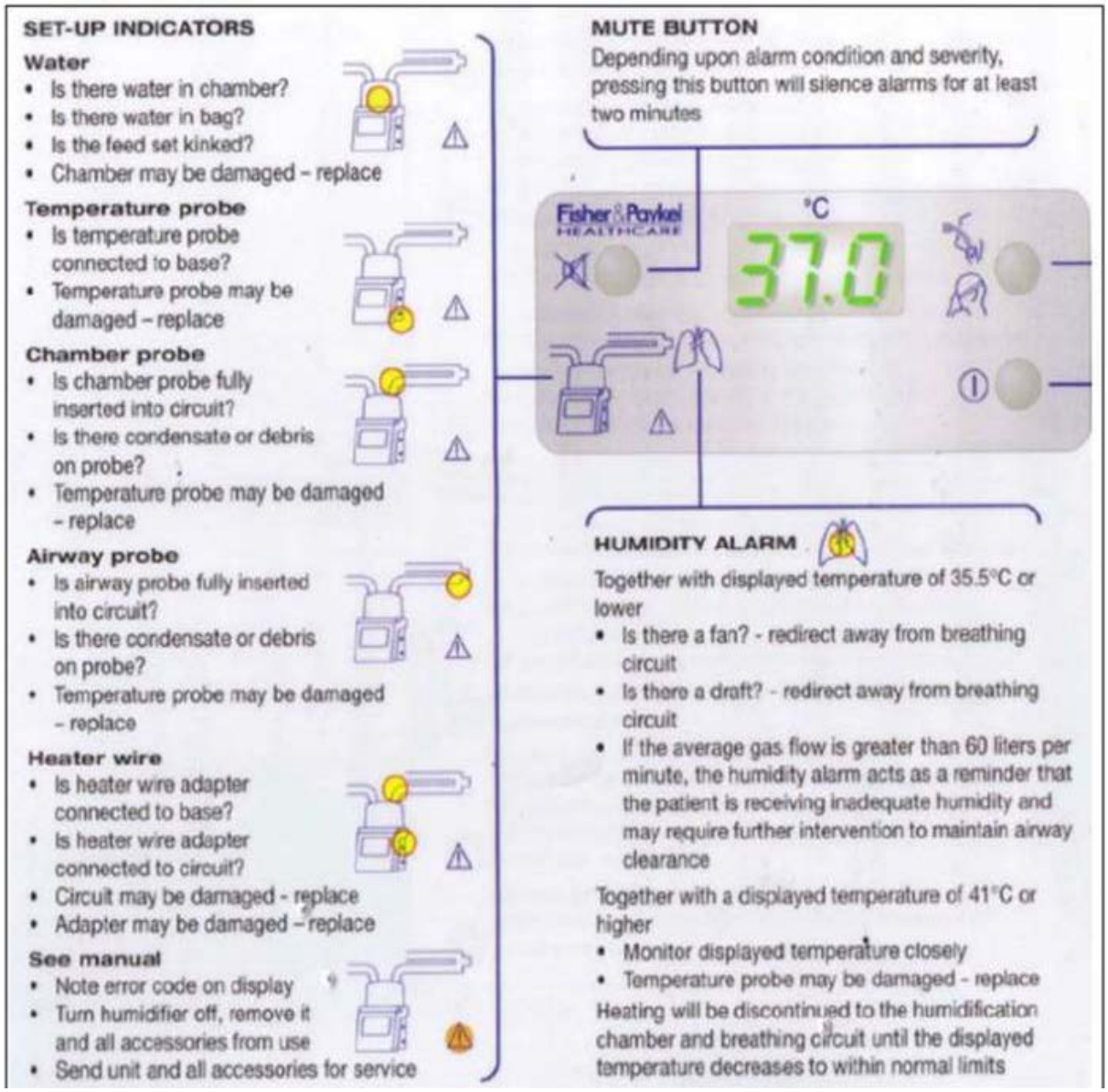
The humidifier will sound an audible alarm to alert clinical staff to any problems.

- 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

3.1 Humidifier Alarms



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

13 References

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