

## High Flow Nasal Cannula use in children

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### INTRODUCTION

This document serves as a guideline for clinicians on the use of high flow nasal cannula (HFNC) in paediatric patients while monitored in the high-dependency and intensive care unit of KKH. It does not negate the need for each patient to be individually evaluated, and decisions for appropriate management which deviate from this guideline can be made to achieve the best clinical outcome.

### Definition and Principles of Efficacy

HFNC therapy is a simple system that delivers warm, moist gas at high flows (1-2L/kg/min). The physiological effects of high gas flows include pharyngeal dead-space wash-out, potentially leading to improved CO<sub>2</sub> clearance and oxygenation. There is also decreased nasopharyngeal resistance, leading to improved pulmonary compliance and decreased work of breathing. Variable distending pressures (PEEP) generated as well as an increase in end-expiratory lung volume can also aid in alveolar recruitment. Humidification of the gas also results in increased patient comfort, and may reduce bronchoconstriction from dry cool air, and prevents epithelial injury.

The largest body of research has been with its use on infants with bronchiolitis- there is evidence to suggest its use in decreasing the need for intubation in ED or ICU settings, and safety has been demonstrated for its use in the general ward setting. It has also been demonstrated to decrease median length of stay and total hospital charges in this group of patients.

### KKH High-Dependency and Children's ICU Guidelines on use of HFNC

Patients should only be put on HFNC in a high dependency/intensive care setting with appropriate monitoring, and after consultation with senior staff.

- **Patients who may benefit from HFNC:**
  - Mild to moderate respiratory distress with hypoxemia and who fail to respond to low flow O<sub>2</sub> (1-2L/min) and/or trial of nebulised adrenaline eg.
    - Bronchiolitis (RIS 4 to 8)
    - Pneumonia
  - Post-extubation respiratory support
  - Facilitation of weaning from CPAP
  - Post-operative respiratory failure
  - Heated humidified O<sub>2</sub> with low flows can be used for:
    - Weaning from HFNC
    - Thick secretions or nasal trauma

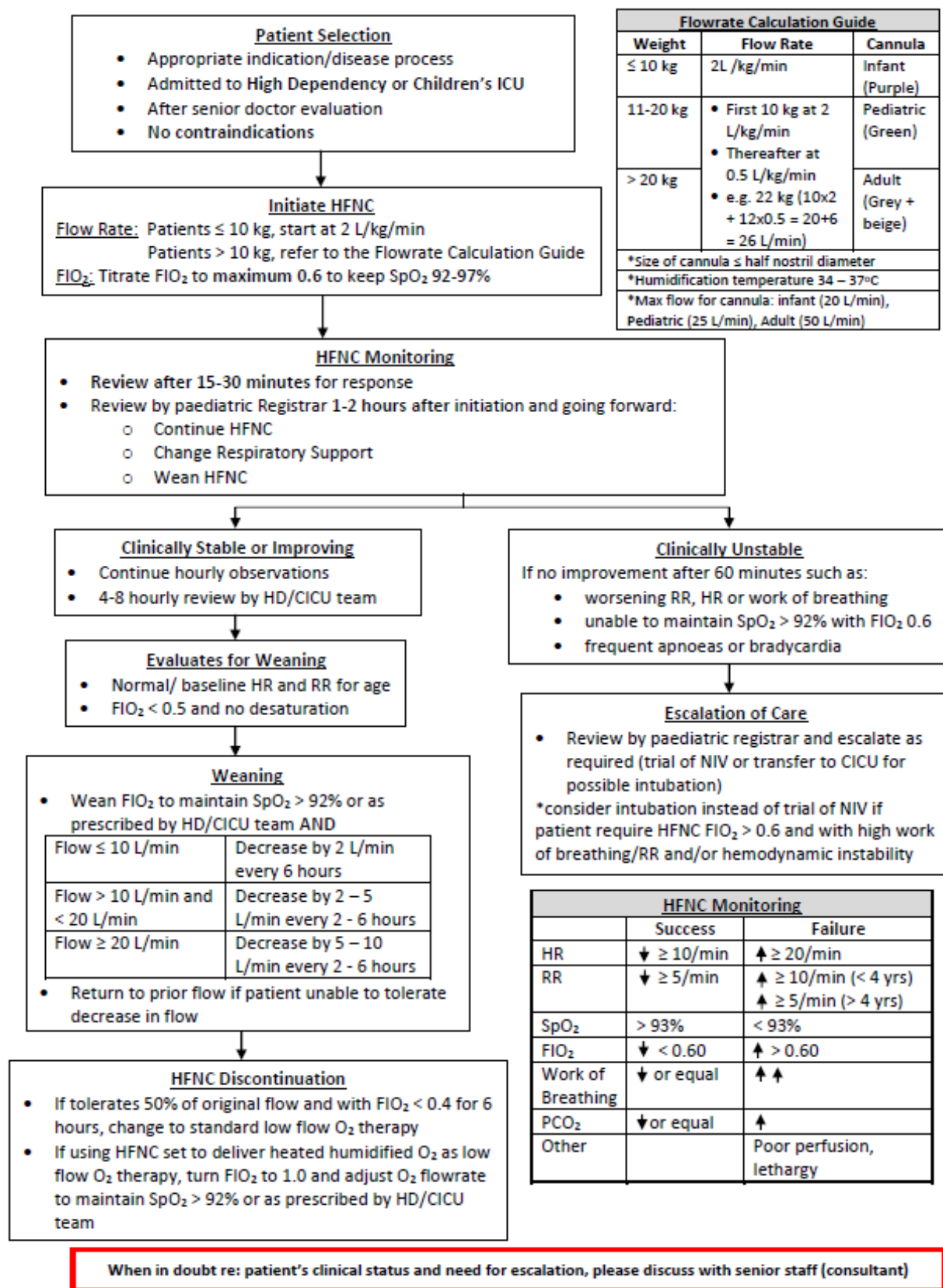
- **Relative contraindications/caution:**

- Patients requiring immediate intubation/ invasive ventilation such as:
  - Severe respiratory distress where intubation is being considered
  - Life threatening hypoxia/apnoeas or haemodynamic instability
  - Decreased conscious levels
  - Upper airway obstruction
- Conditions precluding the use of nasal cannulae include:
  - Have midfacial/craniofacial anomalies e.g. unrepaired cleft palate, choanal atresia
  - Facial malformations or injuries
- Patients with the following conditions and deem to require non-invasive ventilation by the treating clinician:
  - Asthma
  - Chronic lung disease
  - Neuromuscular disorders

**\*Respiratory Index Score (RIS)**

SaO <sub>2</sub> in Room Air						
Resp Index Score (RIS)		0	1	2	3	Score
RR (breaths/min)	< 6 mths	< 40	40-55	56-70	> 70	
	> 6 mths	< 30	30-45	46-60	> 60	
Wheezing		None	End Exp	Insp & Ex with stethoscope	Audible Insp and Exp	
Retractions		None	+	++	+++	
Total Score						

## HFNC Flowchart



### Weaning

Weaning can be started when there is improvement in clinical condition, as evidenced by:

1. Decreased work of breathing
  2. Improvement in respiratory rate
  3. Improvement in tachycardia/perfusion
  4. Ability to maintain oxygen saturations at > 92%
- 
- Wean FIO<sub>2</sub> to maintain SpO<sub>2</sub> > 92% or as prescribed by HD/CICU team
  - For flow ≤ 10 L/min, decrease by 2 L/min every 6 hours
  - For flow > 10 L/min and < 20 L/min, decrease by 2 - 5 L/min every 2 - 6 hours
  - For flow ≥ 20 L/min, decrease by 5 – 10 L/min every 2 – 6 hours
  - Inform Dr if there is change in RR, HR, SpO<sub>2</sub> or work of breathing with reduction in HFNC flows.
  - If patient is able to tolerate 50% of original flowrate and with FIO<sub>2</sub> < 0.4 for 6 hours, change to standard low flow O<sub>2</sub> therapy.  
If using HFNC set to deliver heated humidified O<sub>2</sub> as low flow O<sub>2</sub> therapy to maximise cost savings and/or to optimise secretions clearance, turn FIO<sub>2</sub> to 1.0 and adjust O<sub>2</sub> flowrate to maintain SpO<sub>2</sub> > 92% or as prescribed by HD/CICU team

### Nursing Care

- Set-up:
  - See **Appendix A** for Set-Up of HFNC system
  - See **Appendix B** for proper application of nasal cannula
- Monitoring:
  - Check nasal prong position hourly
  - Check that the oxygen is flowing freely and the tubing is not blocked/disconnected at least hourly or whenever there is a worsening of patient parameters (eg. Increased RR, respiratory efforts or desaturations)
  - Continuous saturation monitoring
  - Hourly monitoring of respiratory rate and heart rate
  - Ensure that there is always water in the humidifier chamber; change a new bottle of 500 mL of sterile water when current bottle is empty
  - Check for water condensate in HFNC circuit regularly. Drain water condensate out of circuit while ensuring that water condensate does not flow back into humidifier chamber. To drain water condensate in HFNC circuit:
    1. line a kidney dish with medicated wipes
    2. tap the circuit to dislodge water condensate trapped in between corrugated grooves
    3. disconnect HFNC circuit from humidifier chamber and drain the water condensate in the kidney dish while at the same time ensure that water condensate does not flow from the circuit back to the humidifier chamber
    4. reconnect HFNC circuit to humidifier chamber



disconnect HFNC  
circuit from  
humidifier chamber  
to drain water  
condensate

- Will need naso-gastric tube insertion to aid with abdominal decompression and enteral feeding
- High flow nasal system to be changed every 30 days

### Complications

Exclude pneumothorax in the event of rapid clinical deterioration

Other complications include:

- Gastric distension
- Pressure injury to the nares

### Special Considerations

- HFNC is not meant to substitute for patients requiring NIV and should not delay intubation in patients who are in severe respiratory distress
- If frequent adjustments in flow are required, it may be necessary to consider other means of respiratory support
- See **Appendix C** for considerations when delivering aerosolised medications to patients on HFNC

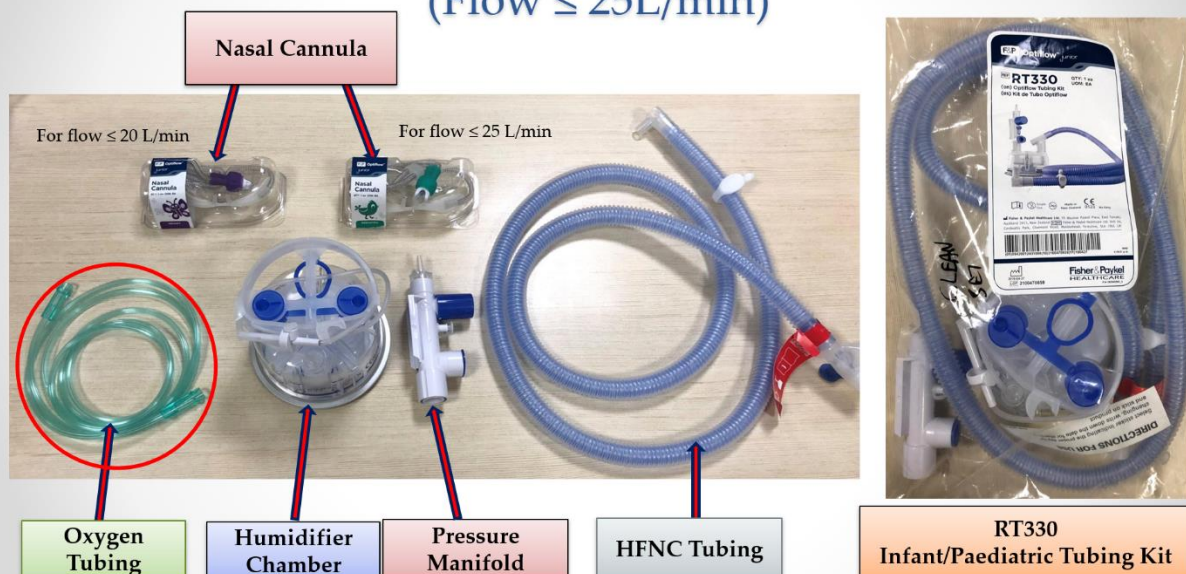
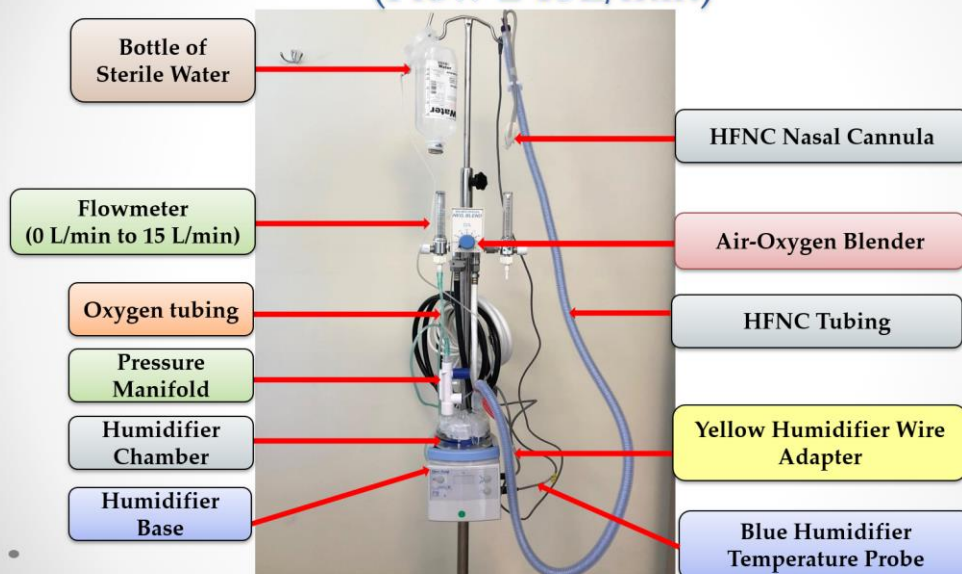
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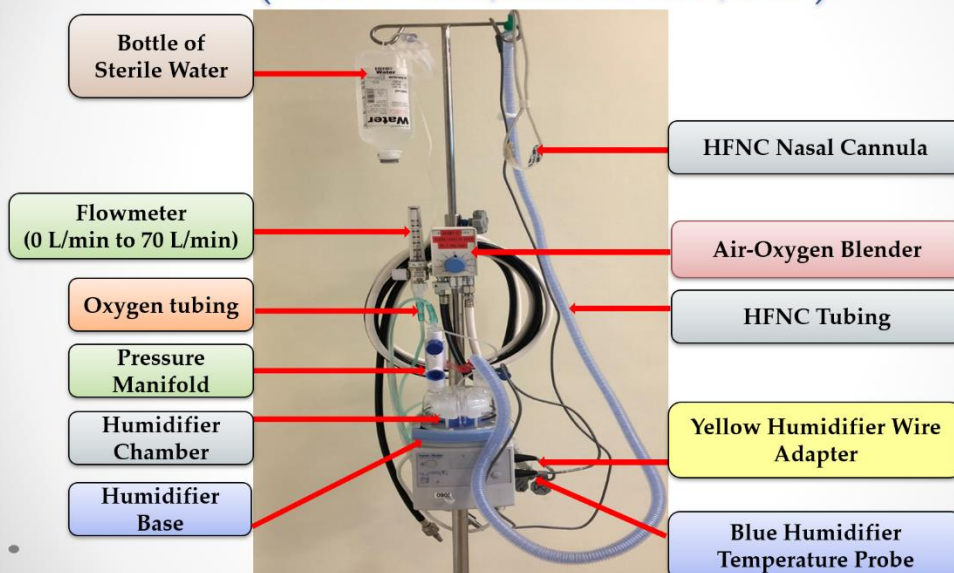
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## Appendix A: Set-up of HFNC System

Requisites for HFNC Set Up  
(Flow  $\leq 25$  L/min)Overview of the HFNC Set Up  
(Flow  $\leq 15$  L/min)

## Overview of the HFNC Set Up (Flow > 15L/min to 25L/min)

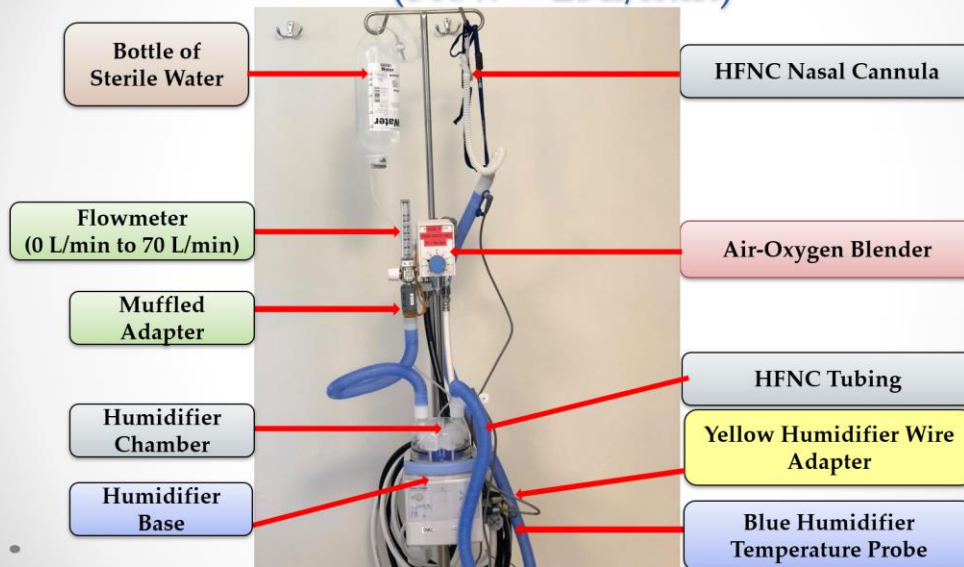


## Requisites for HFNC Set Up (Flow > 25L/min)





## Overview of the HFNC Set Up (Flow > 25L/min)



## Appendix B: Proper application of nasal cannula

## FITTING

## 1 Setup

Set up the gas supply, humidifier and breathing circuit.

## 2 Select Cannula Size

- Prongs should not fill the nares and a **clear gap** should be visible around each prong.
- The sizing chart on the following page can be used as a guide.
- If the infant can fit two sizes, select the smaller size.

## 3 Prepare Skin

Ensure infant's face is clean and dry. Follow your hospital's protocol for skin preparation.

## 4 Connect to Gas Source

Connect the cannula to the gas source.

*Tip: Place hand close to nasal prongs to ensure that there is gas flow exiting the prongs.*

## 5 Remove First Wigglepad Tabs

**Without touching the adhesive**, remove the first backing tabs from Wigglepads, leaving the second backing tabs in place.


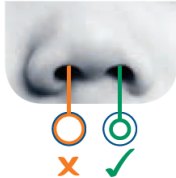



## 6 Place Cannula

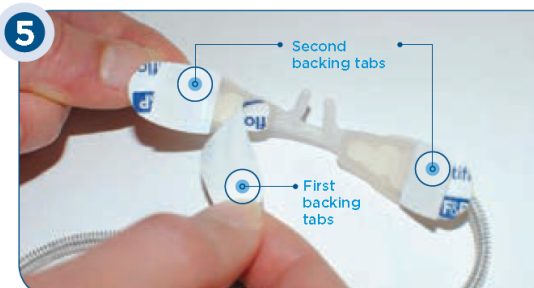
- Once applied, the cannula bridge may move away from the septum as the cheeks relax. Refer to Placement Checks for correct positioning during use.
- Hold the ends of the pads and apply slight tension to the cannula.
- Position the prongs as far into the nares as possible such that the cannula bridge **rests just underneath the septum**.
- Position horizontally across the face and stick Wigglepads onto the cheeks.

## 7 Secure Cannula

Remove the second backing tabs and stick the Wigglepads onto the infant's cheeks. Ensure the Wigglepads are well adhered to the face.

## 2 SELECT CANNULA SIZE

SIZE RANGE	ENSURE GAP AROUND PRONGS
 Premature Size	
 Neonatal Size	
 Infant Size	
 Pediatric Size	



## PLACEMENT CHECKS

### 1 Sensitive Septum

Check that the nasal cannula does not apply any pressure to the infant's septum. Ensure a **slight gap** is visible between the cannula and the septum. Adjust cannula position if required.

### 2 Cheeky Check

- Gently squish the infant's cheeks to check the prong placement in the nares.
- If prongs come out of the nares, adjust cannula further into the nares according to instructions. Repeat the cheeky check.

### 3 Tidy Tubing

Ensure that the baby is not lying on the tubing and that the flow path is maintained.



## CANNULA REMOVAL/ADJUSTMENT

**Always readjust cannula while patient is supine.**

To temporarily remove or adjust the cannula on the Wigglepads:

- Place fingertip on the outside edge of Wigglepad.
- Gently peel the cannula pad away from the Wigglepad starting from the outside and working in towards the infant's nose.
- To adjust, reposition prongs into nares and place cannula back onto Wigglepads.



## WIGGLEPAD REMOVAL/ REPLACEMENT

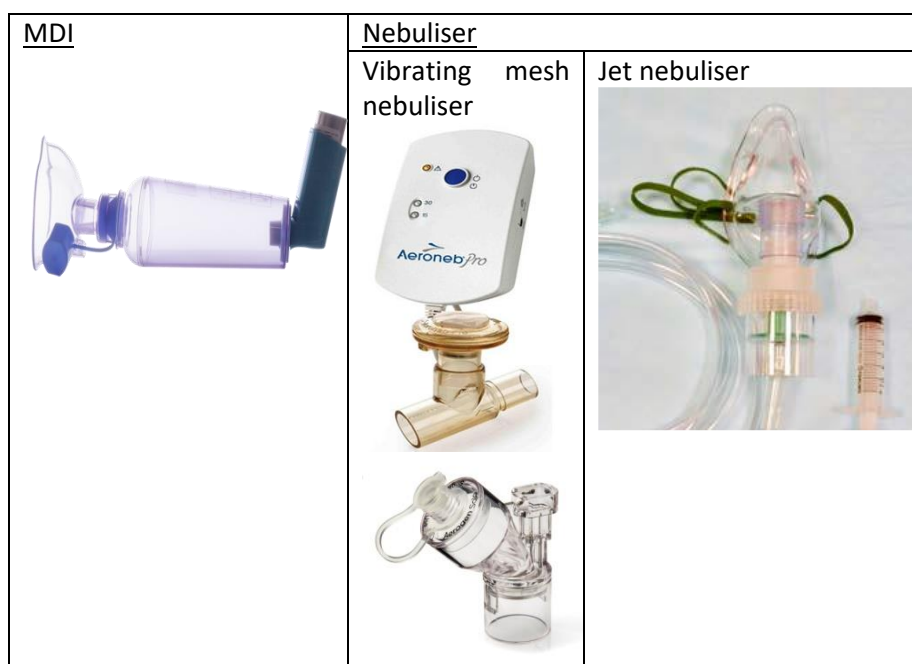
Lift edge of the Wigglepad and using a **wet cloth** wipe the skin and underside of the Wigglepad while gently peeling Wigglepad from face. Refer to sizing chart for Wigglepad spares.

*Note: Attach spare Wigglepad to cannula prior to applying to face.*



### Appendix C: Delivery of aerosolised medications during HFNC

1. Aerosolised medications can be delivered to patients on HFNC via
  - a. MDI
  - b. Nebulisation through
    - i. vibrating mesh nebuliser (only available in CICU)
    - ii. jet nebuliser (available in CICU, HD and GW)



2. Most studies done on aerosol delivery during HFNC are in vitro studies and some studies on adult patients but limited studies in pediatric and infant patients.
3. Available data have shown that:
  - a. Aerosol delivery via MDI is more effective than nebulisation (both jet and vibrating mesh nebulisers)
  - b. For aerosolised medications delivered inline with HFNC circuit via nebulisation:
    - i. Vibrating mesh nebulisers are more effective and delivered 2-3 times more inhaled medications than jet nebulisers
    - ii. Inhaled drug dose was higher when HFNC flow was set below patient's inspiratory flow compared to HFNC flow exceeding that of patient's inspiratory flow
      - Turbulence generated with higher gas flow leads to greater impaction loss of aerosol particles through the cannula and upper airways thereby reducing the dose of aerosol delivered to the patient's lower airways
      - For effective delivery of aerosolised medications, it may be necessary to decrease HFNC flow to 1 L/kg/min
    - iii. For HFNC flow > 1 L/kg/min, nebulisers placed before humidifier delivered more medication compared to nebulisers placed closer to the patient

- iv. For HFNC flow  $< 0.25 - 0.5$  L/kg/min, nebulisers placed closer to patient delivered more medication compared to nebulisers placed before the humidifier
- c. The standard bronchodilator doses delivered via HFNC at 15-35 L/min for adults and 1 L/kg/min for children generated similar clinical response to those delivered with conventional aerosol delivery devices. Further studies are needed to quantify aerosol delivery efficiency in critically ill patients.
- d. Placement of face mask on top of HFNC for delivery of aerosolised medications
  - i. Face mask + MDI delivers more aerosolised medications than face mask + nebuliser (jet nebuliser)
- e. To decrease the dispersion of fugitive aerosol during HFNC therapy, surgical masks can be applied over the nasal cannula



HFNC Protocol v. April 2022

**Aersol Delivery During HFNC**