

# Non-Invasive Ventilation in the Intensive Care Unit



## A Learning Resource for ICU & SHDU Nursing Staff

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January 2022

## Introduction

Non-invasive ventilation (NIV) refers to positive pressure ventilation delivered through a non-invasive interface i.e. nasal mask or face mask rather than using an invasive interface e.g. tracheal tube

*Selecting patients for NIV requires careful consideration of its indications and contraindications*

## Indications

*A trial of NIV may be worthwhile in most patients who do not require emergent intubation and have a disease known to respond to NIV, assuming that they lack contraindications. Conditions known to respond to NIV include*

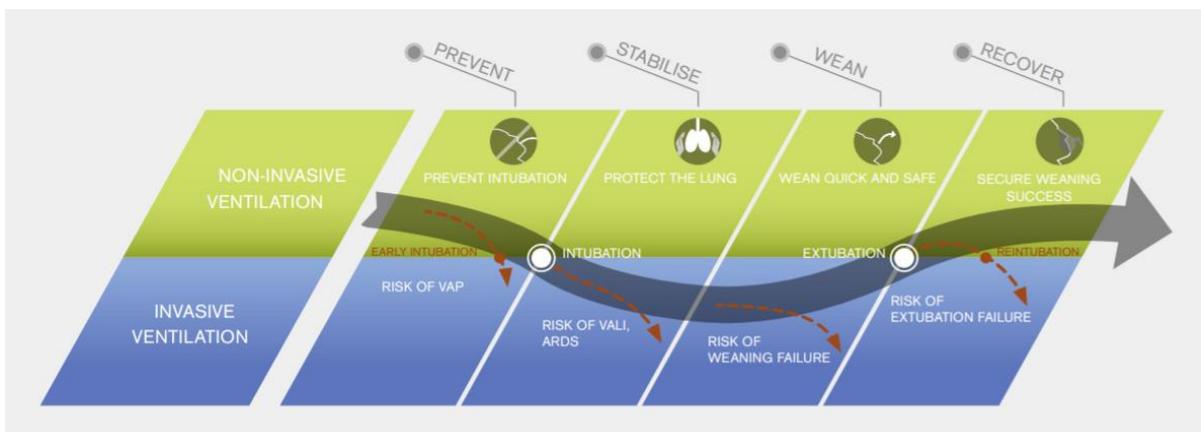
- Exacerbations of chronic obstructive pulmonary disease (COPD) that are complicated by hypercapnic acidosis (arterial carbon dioxide tension > 6 kpa or pH < 7.30)
- Cardiogenic pulmonary oedema
- Acute hypoxaemic respiratory failure
- NIV may also be helpful for preventing post-extubation respiratory failure

## Contraindications

- Cardiac or respiratory arrest
- Inability to co-operate, protect the airway, or clear secretions
- Severely impaired consciousness
- Non-respiratory organ failure that is acutely life threatening
- Facial surgery, trauma or deformity
- High aspiration risk
- Prolonged duration of mechanical ventilation is anticipated
- Recent oesophageal anastomosis – if in doubt seek advice from surgeon

## Considerations

- NIV can be used as a means for avoiding intubation as long as possible and helps to reduce the possibility of patients developing ventilator-associated pneumonia (VAP)
- NIV may also reduce the risk of reintubation and improve the patient's recovery



## Ventilator type

*NIV can be delivered via either the Draeger V500 or V800 ventilator that enables the following*

- A precise concentration of oxygen can be delivered
- High concentrations of oxygen can be delivered
- Large mask leaks and/or patient disconnection are more readily detected
- Better monitoring and alarm features

## Equipment required

- NIV non-vented facemask that includes the blue adaptor
- Draeger V500 or V800 ventilator ready assembled
- Both inspiratory and expiratory hose tubing will be used
- Heated humidification is used

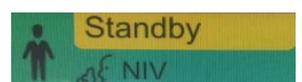


## Interface

- A full face mask is used in ICU patients. Most patients with acute respiratory failure are mouth breathers so a full face mask is preferable
- Some patients may tolerate a nasal mask better – but this may fail in the acute phase
- The full face mask includes the nose and mouth
- Straps hold the mask in place and should be adjusted to avoid excess pressure on the nose or face
- Generally the straps should be loose enough to allow one or two fingers to pass between the face and the strap
- In contrast, if the mask has a loose fit, leakage will occur and air will escape outside it so ventilation is likely to be effective

## Setting up the ventilator

- Power up ventilator and switch on
- **For the V500** → select New Adult
- Select Therapy → then Ventilation
- Touch the **Tube/NIV** tab → select **NIV** and click on rotary dial to confirm
- NIV facemask icon with **orange header bar** appears top left of display screen → see image above
- **For the V800** → select New Patient → click rotary dial to confirm
- NIV facemask icon with **green header bar** appears top left of display screen → see image below



## First-line choice of mode is SPN-CPAP/PS

### Starting up settings for SPN-CPAP/PS mode

- Touch ventilation settings.
- Select SPN-CPAP/PS
- Set appropriate FiO<sub>2</sub>
- Slope = 0.2 seconds
- Peep = 5cm
- PS = 5cm
- Ti max = 4 seconds
- Close screen
- Switch off Apnoea ventilation → go to ventilation settings → then additional settings → then apnoea setting
- Widen all alarm limits
- Touch the start/standby button in the main menu and press start ventilation – confirm with the rotary knob



### Starting up settings for PC-BIPAP mode

- Touch ventilation settings
- Select PC/BIPAP mode
- Set appropriate FiO<sub>2</sub>
- Respiratory rate = 5
- P<sub>insp</sub> = 15
- Peep = 5
- PS = 5
- Close screen
- Switch off Apnoea ventilation – go to ventilation settings – then additional settings – then apnoea setting
- Widen all alarm limits
- Touch the start/standby button in the main menu and press start ventilation – confirm with the rotary knob

## Prior to starting non-invasive ventilation

- Remove the blue cap from the ventilator tubing
- Next connect both the inspiratory and expiratory vent tubing to the blue connector on the tight-fitting face-mask
- Humidification → select mask mode setting. Temperature displayed should approximate **31°C**
- Check patient's current vital signs



Remove blue cap from ventilator → connect y-connector and tubing to the blue adaptor on the facemask

## Some patients may not tolerate mask ventilation due to

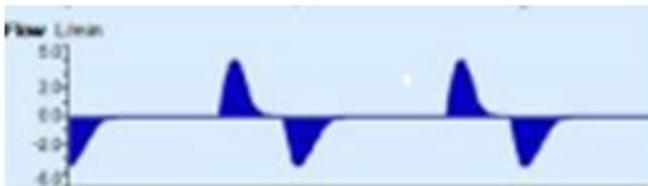
- Anxiety/agitation
  - Claustrophobia
  - Mask discomfort
- } Consider mild sedative as appropriate

## Preparing the patient

- Explain procedure to the patient
- Familiarise the patient with the equipment
- Careful explanation concerning the need for wearing the mask for an extended period of time
- Explain that periods of rest from mask ventilation will be allowed
- Careful explanation about the noise/alarms generated from the machine
- Select a mask that fits comfortably and accurately assembled

## Placing the mask on the patient

- Breathless patients are often already anxious and agitated. Explain the procedure and provide reassurance
- Position straps behind patient's head, centred on occiput. Next hold the mask securely over the patient's face ensuring a firm seal around the bridge of nose and chin areas
- Activate oxygen supply via machine & allow patient time to adjust to the feel of the tight-fitting mask
- Attach and gently tighten lower straps to mask. Ensure the bottom of the silicone seal remains fixed under the chin. Gently adjust top crown straps to remove slack
- Connect the y-connector with ventilator hose tubing (both inspiratory and expiratory hose tubing) to the blue mask
- Allow patient time to adjust and remain with patient until settled
- Observe ventilator display screen for assessment of adequate of tidal volume, respiratory rate, **including inspiratory and expiratory flow** → see image below



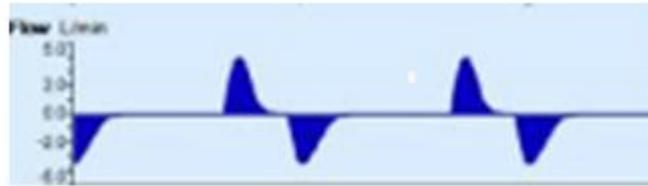
Observe the ventilator display screen for good inspiratory and expiratory flow



The mask should fit comfortably below lower lip and bridge of nose without air leak

## Troubleshooting large leaks

- Gently pull the mask slightly away from the face while the straps are still attached and the ventilator is supplying pressure: this allows the silicone seal to inflate. Replace the mask on the patient's face to improve the seal
- Look at the inspiratory and expiratory flow on the ventilator display screen → see diagram below



- If good flow is observed then this suggests that leaks aren't occurring and ventilator recordings should start to improve
- If leaks occur around the upper half of the mask → gently tighten the upper horizontal straps
- If leaks occur around the lower half of the mask → gently tighten the lower horizontal straps  
However, avoid over-tightening the straps
- If leakage persists → it may be advisable to choose a smaller size of facemask

## Complications

NIV is generally safe. Most complications due to NIV are local and relate to the tightly fitting mask -

- Local skin damage may occur due to the pressure effects of the mask and straps. Cushioning the forehead and bridge of the nose may decrease pressure-related problems.
- Eye irritation, sinus pain or sinus congestion may occur and may require a lower inspiratory pressure. Check the patient's eyes/conjunctivae for signs of irritation.
- Mild gastric distension often occurs but is rarely clinically significant at usual levels of inspiratory pressure. Routine use of a nasogastric tube is not warranted but each patient is individually assessed. A nasogastric tube may be inserted at the discretion of the ICU consultant.

## Observations

- Allow patient time to adjust to the tight fitting mask and provide reassurance
- Observe for good inspiratory & expiratory flow on the ventilator display screen
- Feel around the facemask for any air leaks. Flow may be improved by gently tightening the upper & lower horizontal straps
- Observe rise and fall of chest wall and accessory muscles. Record respiratory rate, O<sub>2</sub> saturations, and tidal volume generated. Observe patient synchrony of respiratory effort with the ventilator.
- Discuss with medical staff appropriate oxygen saturation target. As a general rule aim for oxygen saturations 90 to 95%. However, a lower end parameter e.g. 85 to 95% may be appropriate for specific patient groups e.g. Type 2 respiratory failure
- If oxygen saturations show little improvement → discuss with medical staff regarding increasing FiO<sub>2</sub> and/or increasing level of PEEP
- Obtain arterial blood gas at 30 minutes from starting NIV

## How to tell if NIV is not effective

- This is largely based on how the patient feels and ABG results
- If the patient is getting tired, or ABGs are deteriorating despite optimal settings or increasing ventilator settings, then they will probably need endotracheal intubation and ventilation. It is important to recognise this as soon as possible so that appropriate management can be planned before the patient collapses

**NICE guidance recommends consideration of CPAP** alongside optimised pharmacological and non-pharmacological management strategies (including body positioning) in patients hospitalised with **COVID-19** when:

- They have hypoxaemia that is not responding to supplemental oxygen with a FiO<sub>2</sub> of 0.4 (40%) or more **and**
- Escalation to invasive mechanical ventilation would be an option but is not immediately needed
- It is agreed that respiratory support should not be escalated beyond CPAP

Nasal High Flow therapy (NHF) should **not** be routinely offered as the main form of respiratory support in COVID-19 but may be considered for patients having continuous CPAP when they need

- A break from CPAP e.g. mealtimes
- Weaning from CPAP

## Instructions for Non-invasive Ventilation (NIV) using the Draeger V500 ventilator

*\* Please note if using the Draeger V800 ventilator → refer to the instruction on page 10\**

### Equipment required

- NIV facemask
- Draeger V500 ready assembled
- Both the inspiratory and expiratory ventilator hose tubing will be used
- Bag of sterile water for the humidifier

### Setting up using the V500 ventilator

- Power up ventilator and switch on
- Select New Adult
- Select Therapy → then Ventilation
- Touch the Tube/NIV tab → select NIV and click on rotary dial to confirm
- The NIV facemask icon with orange header bar appears top left of display screen →



### Select ventilator settings

- Select ventilation settings key located in bottom left corner of display screen
- Select SPN-CPAP/PS mode → click on rotary dial to confirm
- Programme in the FiO<sub>2</sub> required
- PEEP → select 10cm → click rotary dial to confirm
- Pressure Support → zero → click rotary dial to confirm
- Check Ti max = 4 seconds
- Check slope = 0.2 seconds
- Check additional settings → flow trigger = 2 litres/min
- Apnoea ventilation → switch off → click rotary dial to confirm
- Alarm limits → widen all alarm limits including apnoea time
- Once the mask is connected to the patient → attach the ventilator circuit to the blue non-vented connector on the facemask
- Press start ventilation → click rotary dial to confirm



**In the event that the patient doesn't tolerate the above settings →  
try temporarily changing the PEEP setting to 5cm and the PS setting to 5cm until patient settles**

## Instructions for Non-invasive Ventilation (NIV) using the Draeger V800 ventilator

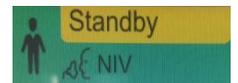
*\* Please note if using the Draeger V500 ventilator → refer to the instructions on page 9 \**

### Equipment required

- NIV facemask
- Draeger V800 ready assembled
- Both the inspiratory and expiratory hose tubing will be used
- Bag of sterile water for the humidifier

### Setting up using the V800 ventilator

- Power up ventilator and switch on
- Select New Patient → click rotary dial to confirm
- Select Adult → then NIV → click rotary dial to confirm
- The NIV facemask icon with green header bar appears top left of display screen →



### Select ventilator settings

- Select SPN-CPAP/PS mode → click on rotary dial to confirm
- Programme in the FiO<sub>2</sub> required
- PEEP → select 10cm → click rotary dial to confirm
- Pressure Support → zero → click rotary dial to confirm
- Check Ti max = 4 seconds
- Check slope = 0.2 seconds
- Check additional settings → flow trigger = 2 litres/min
- Apnoea ventilation → switch off → click rotary dial to confirm
- Alarm limits → widen all alarm limits including apnoea time
- Once the mask is connected to the patient → attach the ventilator circuit to the blue non-vented connector on the facemask → see image above
- Press start ventilation → click rotary dial to confirm



**In the event that the patient doesn't tolerate the above settings → try temporarily changing the PEEP setting to 5cm and the PS setting to 5cm until the patient settles**