Non-invasive Ventilation protocol
For COPD

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Approved by Medical Directorate
**Indications for Non-Invasive Ventilation (NIV)**

NIV is indicated to support and augment ventilation in patients with decompensated ventilatory failure, in patients with known/ suspected COPD, indicated by the combination of both:

- Raised arterial pCO2 (ie >6.0 kPa) demonstrating inadequate alveolar ventilation
- Raised arterial H+ (ie >45 nmol/l) demonstrating acute decompensation

**Important notes**

- This protocol only relates to the use of NIV in decompensated respiratory failure due to COPD
- Other causes of ventilatory failure including excessive sedation, neuromuscular disease, obesity, kyphoscoliosis, and others are excluded from this protocol. This protocol also does not apply to chronic hypercapnic respiratory failure secondary to COPD
- Patients who might be considered for full ventilation in ITU should be discussed with ITU staff (usually the senior ITU trainee on-call) prior to commencing treatment

**Before NIV is commenced**

- Ensure that high-flow oxygen has been withdrawn and SpO2 is maintained between 88% and 92% - and not higher
- Ensure that standard treatments have been prescribed (controlled oxygen, nebulised salbutamol 5mg and ipratropium 500mcg by air-driven nebuliser, prednisolone 40 mg oral, and an antibiotic if appropriate) and ABG rechecked 60 mins later. Many patients will settle without NIV as respiratory rate reduces and tidal volume increases
- Ensure that pneumothorax is excluded with a chest x-ray – this is an absolute contraindication to NIV unless an intercostal drain is in place
- Prior to commencing treatment it is essential to decide and document whether ward-based NIV is the ceiling of treatment or whether escalation of support to intubation and ventilation in ITU would be considered. Discussion with the patient and family on background health status and with the Physician of the Day and the ITU staff may be required.
• The on-call ITU Consultant or Registrar must be made aware of all patients commenced on NIV who would be appropriate for escalation to intubation and ventilation.

• Where there are clinical concerns or uncertainty regarding ceiling of care or appropriateness of NIV this should be discussed with the respiratory consultant or the Physician of the Day within normal working hours, and with the Physician of the Day outwith working hours.

Important note

• The temptation to introduce NIV to a patient as an emergency because of tachypnoea and respiratory distress should be avoided. There is no evidence to support its use before the above measures have been taken. It is less likely to be accepted by a patient in distress.

• There is no evidence for the use of NIV in an obtunded or unconscious patient. It should only be considered if intubation is deemed inappropriate and all reversible causes of CNS depression have been addressed.

Absolute contraindications

• Pneumothorax (unless intercostal drain inserted)
• Facial trauma (burns, injury, surgery)
• Vomiting (risk of aspiration)
• Impending cardio-respiratory arrest
• Inability to protect airway

Establishing NIV on a patient

• The senior medical trainee / ED senior trainee (or Consultant) on call should alert Ward 17/HDU of any patient who might need NIV support to allow planning for a bed on Ward 17/HDU
• The senior medical trainee / ED senior trainee (or Consultant) on call will make the decision to start NIV in a patient who meets the criteria described above – COPD
exacerbation with persistently raised pCO2 and H+ after a trial of standard treatment for 1 hour

- Patients who do not respond to standard medical treatment for 1 hour and remain acidotic i.e. pH <7.35 or H+ ≥ 45 and PaCO2 >6.5 kPa should be commenced on NIV treatment ideally in ward 17/HDU, however, if no bed is available this may be instituted in the ED to allow time for a bed to be created.

- Those patients who present with a pH<7.25 or H+ ≥ 56 should start NIV immediately in the ED if invasive ventilation is not felt appropriate i.e. their ceiling of care would be NIV. There is no need, in these more severely acidotic patients, to wait for 1 hour of standard medical management to be undertaken prior to commencing NIV.

- It is important to remember that NIV is largely ineffective in profoundly unwell patients and prognosis is poor, however, if NIV has been determined as the appropriate ceiling of treatment then it should be tried if the patient is able to tolerate it.

- Those patients deemed for full escalation to invasive ventilation should be referred to ITU for intubation rather than NIV. The ITU team may wish to try a period of NIV in this patient group prior to invasive ventilation; however, this should be done under their supervision.

- Prior to transfer of patients to ward 17/HDU all patients must be reviewed by the on call medical team, usually the senior trainee on call.

- NIV can be delivered in both HDU and ward 17 but patients who are unstable and require more monitoring should be primarily in HDU, also staffing levels within ward 17 may dictate that HDU will be a safer environment for patients on NIV.

- Patients who are given NIV outwith this protocol i.e. for reasons other than acute decompensation of COPD, should be managed in HDU and should be discussed and management agreed with the on call Physician of the Day.

Notes

- NIV machines is not “alarmed” and cannot be used to sustain ventilation in a patient who would be dependent on ventilatory support to prevent apnoea or respiratory arrest.

EQUIPMENT FOR NIV

- NIV machine (Respironics BiPAP Focus®)
- Bacterial Filter
- Correct tubing with whisper swivel exhalation port
• Correctly fitted mask
• Head gear
• Oxygen tubing
• Pulse Oximeter (ideally combined SpO2)

Nursing staff introduction of NIV
1. Explain procedure to patient and obtain verbal consent
2. Record baseline observations on NIV care bundle prior to NIV commencement.
3. Select the mask size using the sizing tool on the bag. Allow the patient to see the mask and hold in place
4. Turn on the ventilator and wait for self-check process to finish.
5. Adjust the ventilator to deliver standard initial settings while asking the patient to hold the mask on his/her face without headgear, and giving gentle support if necessary

<table>
<thead>
<tr>
<th>Standard NIV settings initially</th>
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<tr>
<td>IPAP</td>
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<tr>
<td>EPAP</td>
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<tr>
<td>Back-up</td>
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6. Connect the oxygen tubing and adjust the oxygen flow rate to achieve SpO2 88-92%.
7. When the patient feels comfortable, fit the headgear and minimise leak from the mask by adjusting the straps. Increase the IPAP to 15 cm H₂O, if started at a lower pressure initially, when the patient is accepting the mask
8. Increases the IPAP in increments of 2 cm H₂O to achieve an IPAP of 20-30 cm H₂O over the initial 10-30 minutes depending on patient tolerance. Ideally an initial pressure of 20 cm H₂O should be achieved in this 30 minute initiation period and further increases above this pressure should be guided by arterial blood gas monitoring at 1 hour
9. Increases in EPAP to 6 or 8 cm H₂O could be considered if there is difficulty achieving SpO2 88-92% - usually in a more obese patient
10. Nebulised salbutamol and ipratropium should continue 4 hourly using an air compressor to drive the nebuliser and this will require temporary removal of the NIV mask – unless the new-style mask incorporating an ultrasonic nebuliser is used when NIV and nebulisation can proceed concurrently.

**Monitoring the patient on NIV**

The patient’s response to NIV should be monitored:

- Mask fit, air leak, and patient comfort every 15 mins for one hour, then hourly
- Recording of HR, RR and BP every 15 mins for one hour, then hourly
- Continuous monitoring of SpO2
- Initial ABG at 1 hour after commencing NIV
- Repeat ABG for pCO2 at 4-6 hrs

**Nursing response to monitored parameters**

Clinical improvement should be seen over the following 12 – 48 hours. The following interventions might be required (detailed more fully in the NIV care bundle):

- Excessive air leak might require repositioning of the mask, adjustment of the head-gear, or trial of a mask of different size
- Failure to achieve SpO2 of >87% would need an increase in the oxygen flow rate or a trial of increasing the EPAP pressure above 4 mmHg but not > 8 mmHg
- Rising H+ should prompt an increase in IPAP above 20 mmHg but not >30 mmHg
- Patient distress with high respiratory rate should prompt review by medical staff and consideration of morphine 2.5 mg IV, potentially repeated at 30 mins – a lower RR will allow more time for expiration and improve tidal volume / alveolar ventilation
- Some patients will not tolerate NIV. Patient encouragement by nursing staff might help. If not, document that NIV had to be withdrawn, and continue normal care
Failure / No improvement with NIV

**Failure to Ventilate Adequately**

- **H+ / pCO₂ remains high**
  - ** Cause**
    - Tidal volume is too low
    - RR is too low
    - Excessive Leak
    - Too much O₂ is administered
    - Inadequate time on NIV
  - **Action**
    - Increase IPAP
    - Increase backup RR
    - Ensure adequate mask fit & circuit integrity
    - Ensure satisfactory mask fit & circuit integrity
    - Increase entrained FiO₂ to maintain SpO₂ 88-92%
    - EPAP may be increased to up to 8 cm H₂O
    - Increase duration of NIV

- **pO₂ remains low**
  - **Action**
    - Ensure satisfactory mask fit & circuit integrity
    - Increase entrained FiO₂ to maintain SpO₂ 88-92%
    - EPAP may be increased to up to 8 cm H₂O

**Confusion/Agitation**

- Reassure patient
- Correct hypoxia / hypercapnia
- It may be necessary to hold mask in place/constant supervision initially
- Consider sedation. May use haloperidol (1 mg increments) OR midazolam (1 mg increments)

**Failure to tolerate NIV**

- Ensure satisfactory mask fit & circuit integrity
- Ensure back-up rate is not set high

**Asynchrony**

- Ensure satisfactory mask fit & circuit integrity
- Ensure back-up rate is not set high

**Claustrophobia**

- Reassure patient
- Revert to patient holding mask in place for a while (with nursing support)
Treatment Duration and Weaning

COPD patients will commonly require NIV for 12 hrs – 4 days depending on the rate of improvement. It should be used near-continuously during the first 12 hours with short breaks for comfort, nebulisers, and oral intake. NIV should be withdrawn when the H+ is normalised and the pCO2 has reduced and stabilised. The following guidelines should be adapted to individual circumstances:

**DAY 1:**
- As much time as possible on NIV.
- Short breaks from NIV (for comfort, oral intake, physiotherapy etc) as long as vital signs remain stable.
- Maintain SpO2 88-92% with controlled oxygen by nasal cannulae when off NIV.

**DAY 2:**
- Aim for 16 hours on NIV during 24-hour period (more time off NIV for mealtimes and visiting hours). Continuous NIV overnight.
- Monitor for respiratory distress when off NIV.
- Maintain SpO2 88-92% with controlled oxygen by nasal cannulae when off NIV.

**DAY 3:**
- Aim for 8 hours of NIV during 24-hour period – usually with continuous NIV overnight. Patient may still require NIV for short periods in daytime to alleviate breathlessness.

**DAY 4:**
- Aim for 24 hours without NIV. Closely monitor patient for any signs of deterioration during this time.

**Note**

Patients failing to respond within 3 days rarely do well with continued NIV. Appropriate management might include intubation or symptom palliation and should be discussed with the consultant.