

Use Of Non-invasive Ventilation In Acute Hypercapnic Respiratory Failure (Standard Operating Procedure)

1. Introduction

Acute hypercapnic respiratory failure results from an inability of the respiratory pump to provide sufficient alveolar ventilation to maintain a normal arterial pCO₂. A pH <7.35 and a pCO₂ >6.5 kPa define acute respiratory acidosis and, when persisting after initial medical therapy, these are used as the threshold values for considering the use of non-invasive ventilatory support.

There are 100,000 admissions per year in England for acute exacerbations of COPD. Around 20% of these will present with, or develop, hypercapnia. The development of acute hypercapnic respiratory failure is an indicator of disease severity and increased risk of death. It is often multifactorial due to infection, mucosal oedema, bronchospasm, sputum retention, excessive O₂ therapy, sedation, pneumothorax, PE, and left ventricular failure.

2. Patients Covered

This policy will provide guidance in delivering non-invasive bi-level positive airway pressure ventilation (BiPAP, NIV) for acute hypercapnic respiratory failure (AHRF).

Continuous positive pressure airway ventilation (CPAP) is outside the scope of this policy; it should not be delivered on the respiratory wards and in normal circumstances only be delivered on the coronary care unit (for pulmonary oedema) or critical care unit.


The resources required to deliver NIV are limited, and risks associated with failure are variable. This guideline is specifically for patients with AHRF due to exacerbations of COPD. Patients presenting with acute hypercapnic respiratory failure due to other causes eg. neuromuscular disease or obesity **must** be referred to intensive care in the first instance. If a decision is taken to treat these patients on Hexworthy or Honeyford, this must be with the agreement of a respiratory or (out of hours) ICU consultant. There are exceptions to this rule; if the patient receives home non-invasive ventilation for obesity hypoventilation, neuromuscular disease, or chest wall disorder then they can be referred to the respiratory high care bay.

It is recognized that a proportion of COPD patients with AHRF will have evidence of pneumonia on their chest radiographs. These patients have a worse prognosis, and where appropriate, these patients can be managed on the respiratory wards, but if their pre-morbid functional level is good (MRC dyspnoea score 1-3, see at the end of document), then these cases **must** be discussed with ICU.

3. Purpose of this policy/procedure

The aim of this policy is to provide guidance for all healthcare professionals involved in the delivery of acute NIV (BiPAP) outside ICU/HDU and to ensure that this is done safely and effectively. This policy has been written in keeping with national evidence-based guidelines and agreed with Emergency Medicine, Respiratory Medicine, and ICU physicians.

4. Definitions / Glossary

The following abbreviations will be used throughout this document: 

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| AHRF | Acute hypercapnic respiratory failure |
| ABG | Arterial blood gas |
| NIV | Non-invasive ventilation |
| BiPAP | Bi-level positive pressure ventilation |
| CPAP | Single-level continuous positive pressure ventilation |
| CCU | Coronary care unit |
| OHS | Obesity Hypoventilation Syndrome |
| PaO ₂ | Arterial oxygen tension |
| PaCO ₂ | Arterial carbon dioxide tension |
| HR | Heart rate |
| RR | Respiratory rate |
| ICU | Intensive Care Unit |

5. Standards and Practice

Emergency department staff to ensure:

1. Rapid clinical assessment of patients with respiratory distress.
2. ABG measurement within 1 hour of arrival to hospital in patients with respiratory distress.
3. Recognition of qualifying blood gas criteria for treatment with NIV.
4. **Starting NIV within 60 min of the blood gas that identifies the need for NIV treatment and 120 min target from door to mask time¹.**

The decision to commence NIV must be made by a senior doctor (ST3 or above). The on-call medical registrar should be informed. The patient's name needs to be added to SALUS requesting Post Take. Once accepted, the medical registrar will refer to Hexworth/Honeyford ward who will go through checklist to ensure the patient fulfils the criteria for admission to a respiratory high care bay.

The NIV Care Bundle (Appendix 1) must be followed, completed, signed by the clinician initiating NIV, and placed in the notes.

No patient should be transferred to Hexworthy or Honeyford on NIV or for NIV unless the NIV care bundle and Treatment Escalation Plan have been completed.

Initiation/Decision making about NIV should only be performed by a healthcare professional who is trained and competent in the set-up of NIV (the individual initiating/involved in decision making/changing setting should have evidence of competency/annual update)^{1, 2}. If a delay is anticipated in starting NIV, as it should be started within 60min of identifying the need, then involve the Acute Care Team when patients are not in the following areas: Emergency Department, ICU, Hexworthy ward, and Honeyford ward. The Acute Care Team are extremely busy and have other clinical commitments, so every effort should be made to transfer to appropriate location as soon as possible. The Acute Care Team can decline to start NIV if all criteria for NIV are not met (see below).

6. Selection Criteria

In 20% of AHRF cases secondary to acute exacerbation of COPD, optimised medical therapy will result in normalisation of arterial pH, without the need for NIV. When a blood gas shows AHRF, a time-limited trial (30 minutes) of standard medical therapy (see below) may be appropriate provided the patient is not in extremis.

Patients should be stratified into 5 groups based on pre-morbid state, severity of illness, reversibility of acute illness, presence of contra-indications, and the patient's preferences:

1. Requires immediate intubation and ventilation
2. Suitable for NIV with escalation to ICU for intubation if required*
3. Suitable for NIV but not for escalation to ICU for intubation
4. Not suitable for NIV but for full active management
5. Symptom control and palliation agreed as most appropriate option

*Patients with significant respiratory acidosis (pH < 7.26) benefit from NIV, but have a higher risk of treatment failure with NIV and increased mortality. Management for this patient group should ideally be in HDU/ICU.

Inclusion criteria for NIV

All should be met:

- COPD diagnosis*
- pH <7.35
- pCO₂ >6.5
- Received maximum medical management in appropriate patients (controlled O₂ aim SpO₂ 88-92%, bronchodilators, steroids, and antibiotics).
- CXR to exclude pneumothorax (shouldn't delay initiation).
- Patient's wishes considered and consent obtained
- Conscious and cooperative (GCS >8)

- Able to protect own airway and no excessive secretions
- Potential for recovery to a quality of life acceptable to the patient** .

*Patients with Obesity Hypoventilation Syndrome, neuromuscular disease, or chest wall disorders should be considered for NIV but **this must be discussed with either a respiratory consultant or intensive care.**

**Initiation of NIV should be carefully considered similar to invasive ventilation. Patients with frailty (Rockwood score 6-9), advanced metastatic cancer (ie for palliation & not for oncological treatment i.e. chemotherapy), dementia, end stage COPD with multiple recurrent admissions with respiratory failure in last 12 months might not be appropriate for NIV. These groups of patients have worse prognosis and higher risk of treatment failure. Starting then withdrawing NIV can cause distress both to family and patients so should be carefully considered before initiation.

Exclusion criteria for NIV (* Absolute contraindications)

- Unable to maintain/protect airway (e.g. GCS < 8 or bulbar disease)
- *Unstable airway (e.g. facial burns/trauma/recent facial or upper airway surgery)
- *Life-threatening hypoxaemia (see below) or imminent respiratory arrest
- *Pneumothorax, unless an intercostal drain is inserted
- *Fixed upper airway obstruction
- *Multi-organ failure or haemodynamic instability (unless in critical care unit)
- Patient unable to co-operate with NIV due to confusion or dementia
- Severe co-morbidity including end-stage pulmonary fibrosis
- *Asthma
- *Pneumonia (unless in ICU)
- *Hypotension SBP <90

NIV should be used with care in the following situations:

- Copious respiratory secretions
- Vomiting
- Bowel obstruction
- Naso-gastric feeding
- Gross bullous lung disease
- Recent upper gastrointestinal surgery

*Patients with any of the above exclusion criteria should be discussed with the consultant responsible for their care, consider intubation and referral to intensive care if appropriate.

NIV is not the treatment of choice in **type 1 respiratory failure** its use in these circumstances may also lead to delay in intubation and worst outcome. **NIV is also not the treatment for metabolic acidosis.**

The following may make patient suitable for referral to ICU and consideration of intubation:

- 1st presentation
- Recent successful wean from ventilation on ICU
- Reversibility of acute illness (includes bronchospasm)
- Frailty score 4 or less
- Good exercise tolerance
- Living independently
- No 'ceiling of care' decisions precluding ICU admission
- pH < 7.25 despite NIV.

7. Escalation of care and consent

In patients with pH < 7.25 AND PaCO₂ > 6.5, escalation of care should be discussed with ICU before or at the time of commencement of NIV, if intubation is deemed to be appropriate (these need to be considered on case by case basis, based on MRC dyspnea score & premonitory state). Initiation of NIV should not be delayed in these circumstances. NIV may be considered as a ceiling of care for some patients. Advice can be sought from the Respiratory Physicians or from ICU if unsure. A decision regarding the patient's further management and suitability for escalation of care, should NIV fail, must be agreed and documented prior/immediately after commencing NIV and a TEP form (Treatment Escalation Plan) completed. The patient's consent should be sought wherever possible

8. Initiating NIV

- Sit patient upright and make comfortable
- Use a total face mask for first 24 hours.
- NIV is delivered through V60 machine.
- Start IPAP: 12 EPAP: 4. **Increase IPAP every 5 minute by 1-2 cm H₂O or can use RAMP option on V60 to achieve target pressure support. Aim to increase IPAP to 20 within 1 hour. No need to increase EPAP unless OHS** (If the patient uses NIV at home, check 'usual' settings and match or increase. A file of patient settings is available on each respiratory ward, and in the respiratory unit drive)
- Ensure oxygen is connected and aim for SpO₂ 88-92%. Target SpO₂ should be prescribed on the drug chart.
- Aim for continuous use of NIV for the first 24 hours, with breaks for nebulized and oral drugs, food, drink, skin and mouth-care.
- If a nasogastric tube is required, a fine-bore tube should be used to minimise air leak.

9. Monitoring NIV

- A registered nurse, competent in NIV Care, should be available continuously for the first few hours of NIV initiation. **A minimum staffing ratio of one nurse to two acute NIV patients must be in place, as recommended in the BTS/ICS Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure³ / BTS Acute NIV quality standards².**
- Continuous pulse oximetry/ECG should occur in patients receiving acute NIV¹.
- All patients treated with acute non-invasive ventilation must have their vital signs recorded at least hourly until the respiratory acidosis has resolved.
- A member of the medical team must review the patient within 1 hour of initiating NIV.
- All patients treated with acute NIV have a routine blood gas performed within 2 hours of starting NIV. Failure of these blood gas results to improve (pH the same or worse/or PaCO₂ the same or worse) should trigger review. See below on optimising NIV/treatment failure
- Review should involve RR, HR, conscious level (AVPU scale), comfort, chest wall movement, ventilator synchrony, mask fit/leak, tidal volume.
- Document ABG and NIV setting on NIV observation chart (see Appendix 2 for NIV observation chart This should preferably be done by the staff nurse responsible for the patient)
- All patients should be reviewed by Respiratory Consultant or Consultant with expertise in acute NIV within 14 hours.
- Daily Consultant review on any patients needing Acute NIV.

10. Optimising NIV

Patients who are improving with NIV in the first 4-6 hours should receive semi-continuous NIV for the first 24 hours. There may be a few exceptions: rapid and significant improvement in patient's status with normalization of arterial blood gas with maximal medical treatment might not need ongoing NIV or NIV was felt inappropriate based on information available after NIV was initiated

- If ABGs improve and PaCO₂ reduces – continue NIV at current settings as tolerated with minimal interruptions.
- If no change, failing to respond or deteriorating – ***follow the troubleshooting guide (Appendix 3)*** to optimise NIV treatment. If the patient continues to deteriorate, an urgent medical review should be sought with consideration of escalation and critical care involvement, if appropriate.

11. Treatment failure

Once treatment has been optimised, failure to reverse acidosis and reduce PaCO₂ levels within 4 hours is a poor prognostic sign and the medical team should review the appropriateness of continuing NIV.

A decision to either escalate to invasive ventilation, or to withdraw NIV and institute palliation, may be made at this time, as discussed and documented on the initiation of NIV.

In exceptional circumstances, NIV may be continued to relieve the symptoms of breathlessness, but should not be initiated for this reason. Opioids and benzodiazepines can be used to alleviate breathlessness in this situation recognizing the dangers of using these drugs.

12. Weaning of NIV

Weaning of NIV should be considered after 24 hours of treatment if ABGs show:

- Normalisation of pH (pH \geq 7.35) **AND**
- Improvement of PaCO₂ (PaCO₂ <6.0)
- General improvement in patient's condition

NIV weaning should always begin during the day and NIV should not be stopped abruptly. Longer breaks should be introduced during the day, initially, with NIV continuing at night until the patient is completely weaned off during the day. At this point, NIV can be weaned overnight if ABGs are still acceptable. Most patients should be weaned within 2-3 days.

Normalisation of PaCO₂ may not be possible in some patients, particularly those who show evidence of chronic hypercapnia on presentation. These patients may need long term NIV. Refer to the Home Ventilation Team.

Following an acute NIV episode, a structured plan for future treatment should be discussed with the patient and/or carer either at the point of discharge from hospital or at subsequent follow-up. Ideally, all patients will be reviewed in clinic by one of the consultants attached to the Home Ventilation Team (Dr Hughes, Dr Ward, or Dr Kathiresan) within 4-6 weeks. This must be documented and a copy of the plan given to the patient and to the patient's general practitioner. The use of acute non-invasive ventilation could act as a flag to consider referral to palliative care services, as this may be valuable for both active symptom control and end of life care.

References

1. BTS Quality standards for Acute NIV in adult (April 2018).
2. Inspiring Change (NCEPOD report): A review of the quality of care provided to patients receiving acute non-invasive ventilation (July 2017).
3. BTS/ICS Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults March 2016.

Medical Research Council dyspnoea scale for grading the degree of a patient's breathlessness

1. Not troubled by breathlessness except on strenuous exercise
2. Short of breath when hurrying or walking up a slight hill
3. Walks slower than contemporaries on the level because of breathlessness, or has to stop for breath when walking at own pace
4. Stops for breath after about 100 m or after a few minutes on the level
5. Too breathless to leave the house, or breathless when dressing or undressing (1)

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Accountabilities

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|----------------------------|--|
| Author | Dr.B.Kathiresan |
| Reviewed by (Group) | Dr.P.D.Hughes, Dr.R.Parry, Dr.S.Waddy, Dr.Waine, Dr.Ward Matron N.Howes |
| Approved by (Lead) | Dr Waine |

Links to other documents

[Standard Operating Policy For Respiratory High Care Bay \(HCB\).](#)

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