# Guidelines for the use of Non-Invasive Ventilation in Acute Hypercapnic Respiratory Failure at Queens Hospital, Burton

## 1. Introduction

Acute Hypercapnic Respiratory Failure (AHR) occurs due to reduced alveolar ventilation in an elevated $pCO_2$ which can lead to respiratory acidosis. AHRF is commonly due to exacerbation of chronic obstructive lung disease (COPD) but can also develop in patients with thoracic restriction due to neuromuscular weakness, chest wall deformity or obesity (obesity hypoventilation syndrome)

AHRF is defined as pH < 7.35 with a $pCO_2$ >6.5kPa on arterial blood gas (ABG), (BTS 2016).

20% of patients per year admitted to hospital with acute exacerbations of COPD will develop hypercapnia (BTS 2016). These at-risk patients when given uncontrolled oxygen therapy are more likely to develop respiratory acidosis and suffer increased mortality and morbidity. Patients with suspected exacerbation of COPD or at risk of AHRF should therefore receive controlled oxygen aiming to achieve a target SpO2 of 88-92% (BTS 2016) and optimal medical therapy. If this fails to improve pH and $pCO_2$ within 30 mins then Non-Invasive Ventilation (NIV) should be considered.

NIV may also be required in the long term for patients with chronic respiratory failure and is managed by the UHDB Home Ventilation Service. Patients presenting to any hospitals within UHDB would ordinarily need to continue their normal NIV whilst an in-patient. Occasionally, patients awaiting review by a Home Ventilation or NIV Service will continue to need NIV whilst remaining an in- patient.

## 2. Aim and Purpose

The Trust recognises the significant risk of morbidity and mortality in patients admitted with AHRF. The purpose of this guideline is to provide standards and practical advice to healthcare staff for the optimal delivery of a non-invasive ventilation (NIV) service for hospitalised patients with AHRF primarily due to COPD.

The aim of the guideline is:

- To ensure safe and effective provision of NIV to acutely unwell adults with AHRF in a safe and timely manner and with appropriate escalation plans for implementation in the case of lack of response to treatment.
- To determine appropriate indications and contraindications for NIV
- To ensure that appropriate supervision by a cohort of staff with appropriate competencies and skill mix is provided
- To standardise techniques and documentation
- To ensure the highest standards of infection control
- to provide standards and practical advice to healthcare staff for the optimal delivery of an NIV service

This guideline applies to the use of NIV in adult patients primarily with COPD and AHRF. While most of the principles outlined are applicable to other indications for NIV, this guideline should not be considered adequate in isolation to cover specialist indications such as the management

of acute neuromuscular respiratory failure or respiratory failure in patients with tracheostomies - in such cases early Respiratory Specialist advice should be sought.

This guideline refers specifically to the use of Bi-level Positive Airways Pressure (BiPAP) (which is usually and for the purposes of this document, referred to as NIV). Many of the principles encompassed are applicable to other forms of NIV which may be available. It also aims to provide guidance on the maintenance management of patients already established on long term NIV admitted to in-patient wards at UHDB.

Since the Covid pandemic and to date, NIV is considered an aerosol generating procedure (AGP) and so patients should be nursed in areas appropriate to the level of PPE required and full PPE including FFP3 masks must be worn if the patient is suspected or confirmed as having covid 19.

## 3. Definitions, Keywords

Adult: Over 16 years of age

Competent individual: Doctor or allied health professional who has received instruction in the use of NIV and has demonstrated competence in these skills.

AHRF; Acute Hypercapnic Respiratory failure

COPD; Chronic Obstructive Pulmonary Disease

NIV; Non-invasive ventilation . Term is used generically within this document and colloquially in practice referring more correctly to Bi-level Positive Airways Pressure or BiPAP

T2RF; Type two respiratory failure

QHB; Queens hospital, Burton

RDH; Royal Derby Hospital

HDU; High dependency or level 2 unit

RNS; respiratory nurse specialist

$SpO_2$; an estimation of the amount of haemoglobin saturated with oxygen in capillary blood measured via a non-invasive device

$pCO_2$; partial pressure of carbon dioxide in arterial or venous blood. This article refers to $pCO_2$ within Arterial blood

## 4. Indications and contraindications for NIV

**Note: Patients with AHRF but with severe life-threatening hypoxaemia may be more appropriately managed by early tracheal intubation and should also be discussed early with the ICU team.**

### 4.1 NIV in COPD

NIV should be considered in patients with COPD and acute hypercapnic respiratory failure pH<7.35* and PaCO2 >6.5kPa) which persists despite standard medical management for 30 minutes to include:

- Controlled oxygen to maintain SaO2 88–92%
- Nebulised salbutamol 2.5–5 mg (may be given “back to back”)
- Nebulised ipratroprium 500mcg 4 hourly
- Prednisolone 30 mg or hydrocortisone 200mg IV
- Antibiotic (if clinically indicated)

**All indicated therapies should be given within the first 30 minutes**
**Possibility of covid should be established ASAP by appropriate procedures**

**Escalation of care must be considered early** on in case of failure of NIV, ie for level 3 care or for palliation and clear plans made and documented accordingly

Patients must be reviewed as soon as possible by a Respiratory Consultant following presentation with AHRF

** NIV is most effective in COPD when the pH is <7.35 but ≥7.26; COPD patients with pH <7.26 have higher rates of treatment failure; they require more intensive monitoring with a lower threshold for intubation and should be treated within an HDU or ICU setting as appropriate. These patients should be discussed early with the Respiratory/ICU team.*

### 4.2 NIV in other conditions

There is also evidence to support the use of NIV in the following conditions:

- Obesity hypoventilation syndrome (OHS)Chest wall deformity (eg. Kyphoscoliosis)
- Neuromuscular disorders (eg. Motor neurone disease)
- Cardiogenic pulmonary oedema refractory to CPAP treatment.

NIV may be considered for other patients with more specialist indications, only after discussion with the Respiratory Consultant on call.

### 4.3 General inclusion/exclusion criteria for NIV

Suitable patients for NIV should be;

- Sick but not moribund
- Able to protect airway
- Conscious and cooperative (however sometimes NIV may be of benefit if cause is hypercarbia and escalation to ICU is not appropriate)
- Have no excessive respiratory secretions

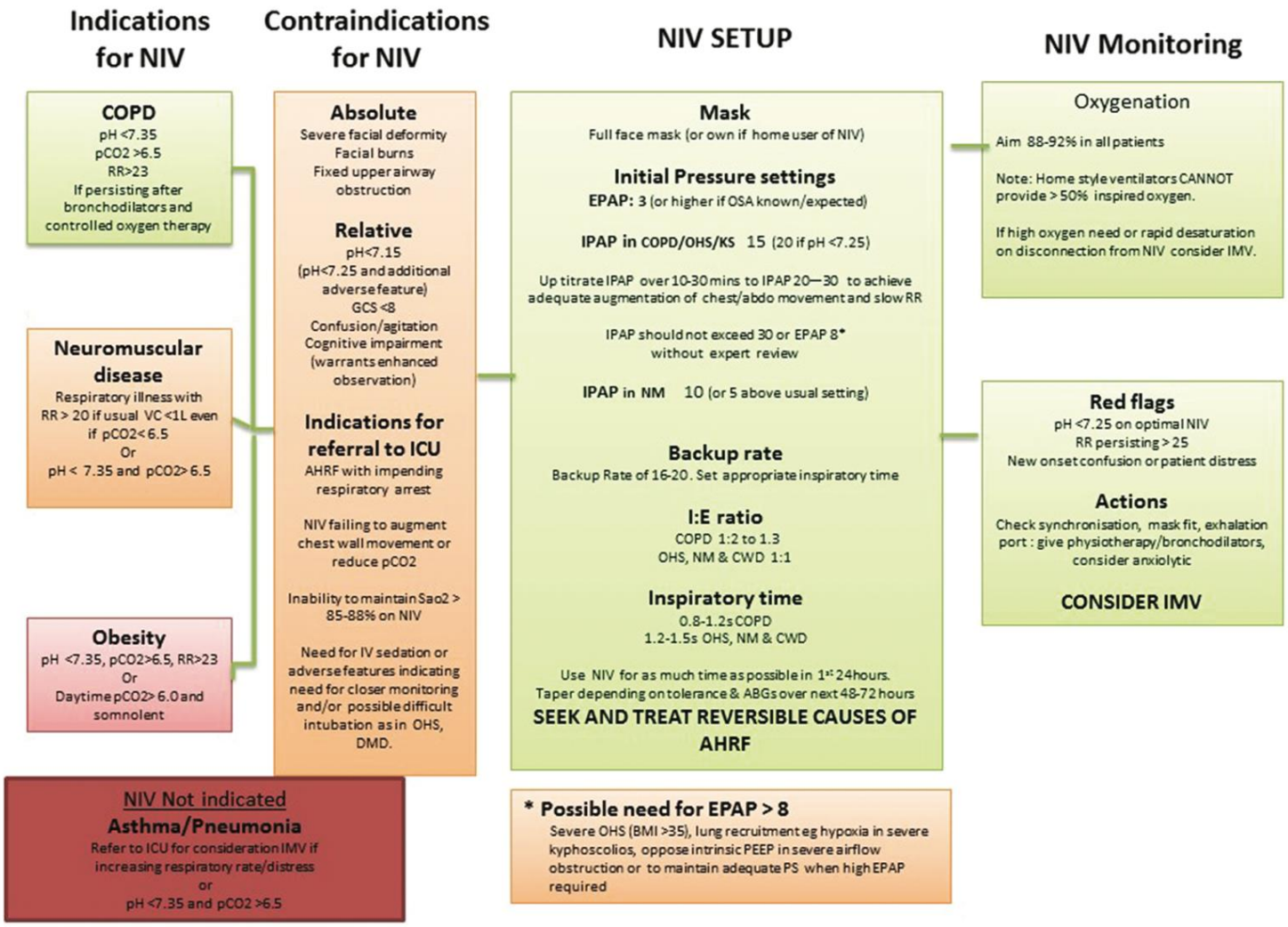
- Have potential for recovery to quality of life acceptable to the patient
- Patient's wishes considered (if possible)
- Escalation of care has been considered and clearly documented and should not delay intubation and ventilation if this is more appropriate
- Patient should not be in the dying process
- Plans for treatment failure and palliation or ICU review should be clearly documented

NIV is not generally the treatment of choice for patients in heart failure with AHRF or who have significant radiological consolidation, but is sometimes used if escalation to ventilation and intubation is deemed inappropriate.

**When NIV is not appropriate**

| **Contra-indications to NIV** | **Relative contra-indications to NIV:** |
|---|---|
| Life-threatening hypoxaemia<br>• Severe co-morbidity<br>• Confusion/agitation/severe cognitive impairment<br>• Facial burns/trauma/recent facial or upper airway surgery<br>• Uncontrolled vomiting<br>• Fixed upper airway obstruction<br>• Metabolic acidosis<br>• Undrained pneumothorax<br>• Recent upper gastrointestinal surgery<br>• Inability to protect the airway<br>• Copious respiratory secretions<br>• Bowel obstruction<br>• Patient declines treatment<br>• Patient considered end of life<br>NIV is not effective in AHRF due to fibrotic lung disease. | • pneumonia and AHRF; should be referred to ICU as appropriate. If not for escalation to ICU, NIV may be considered as the ceiling of care<br>• pH < 7.26 due to severe hypercarbia (Consider ICU referral)<br>• Hypovolameia ; restore BP prior to commencing NIV as increased intra-thoracic pressure may decrease BP<br>• Cognitive impairment, confusion or agitation (may need low dose anti-anxielitics) |

**4.4 Decision making flow chart** (Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults. Davidson et al. Thorax, 2016;71:ii1-ii35.)



## 5. Procedure for NIV at QHB

The patient is identified as having AHRF with potential cause identified with:

- pH <7.35 and PCO2 >6.0 kPa on 2 consecutive ABGs 30-60minutes apart
- Treatment is optimised and oxygen target SpO2 88-92% achieved
- Indications and contra-indications for NIV are considered as above.
- CXR has been performed and reviewed to exclude pneumothorax
- senior review has occurred (Respiratory SpR or Consultant, out of hours, Medical Registar or Consultant or ED consultant and medical registrar covering new admissions)
- Escalation plans have been documented
- Patient consent should be sought whenever possible or commenced in patients best interest
- Relatives should be involved in treatment plans and ceiling of care decisions.
- Palliation should be considered in cases of treatment failure and where patient is not a candidate for ICU.

### 5.1 Location

If patient is stable and conscious;

- transfer to respiratory ward to commence NIV.

If the patient is unstable or in respiratory distress

- NIV may be commenced by appropriately trained staff prior to transfer to the respiratory ward.

Staff from the respiratory ward may be required to initiate NIV on the outlying ward or department. Patient is then transferred when safe to do so with monitoring whilst wearing the NIV mask and using battery powered NIPPY3+ until machine can be plugged in again.

### 5.2 Set up/application of NIV

**NB NIV is an Aerosol Generating Procedure (AGP), wear full FFP3 PPE as appropriate**

1. Set up should only be performed by staff trained and competent in the setup of NIV.
2. Apply tubing to device with non-vented mask/vented tubing system with additional exhalation valve
3. Set device to **Pressure Support** mode
4. Test device as per manufacturer's instruction
5. Select appropriate sized mask using manufacturers sizing guides
6. Set IPAP to 10 cms and EPAP to 4, back-up ventilation rate to 12bpm
7. Explain procedure to patient
8. With 2 HCPs, if possible, apply mask and head straps whilst continuing oxygen via oxygen entrainment port to maintain target SpO2 88-92%. Attach remaining tubing to machine
9. Inform patient and commence machine at pre-set as above settings
10. Allow patient to settle onto the device, reassure, check BP and record observations
11. If BP drops, remove NIV and treat low BP
12. If patient remains stable increase IPAP by 2cms then increase every 5 minutes to 18-25cmsH20 depending on patient tolerance to achieve therapeutic effect.

13. EPAP may be increased to help optimise SpO2 to a maximum of 8cmH2O. NB. IPAP will need adjusting accordingly
14. In order for treatment to be effective, there must be at least at 8cmsH2O pressure difference between IPAP and EPAP
15. Encourage patient to wear the NIV as much as possible during the first 24hrs.
16. Bronchodilators should preferably be administered off NIV but may be administered on NIV during the first few hours via a "T-piece" nebuliser circuit between the expiration port and face mask.
17. If a naso-gastric tube is in place, a fine bore tube is preferred to minimize mask leakage

### 5.3 Monitoring

Patients should receive NIV during the first 24 hours as much as tolerated with breaks for meals, drinks and medications.

Monitoring is via

- Continuous pulse oximetry with oxygen entrained to the patient to achieve SpO2 88-92%
- ECG monitoring if tachycardic or has arrhythmia such as AF
- Hourly EWS for first 24 hours or until stabilised
- Observations of machine settings and patients respiratory rate should be recorded hourly when NIV is in use on the relevant chart (appx 3)
- ABGs or CBGs at minimum 1, 4 and 12 hours after the initiation of NIV to assess response to NIV. Thereafter each morning as early as possible whilst on NIV to assess onging response and weaning potential
- Attention to pressure area care especially the bridge of the nose which should be documented in the SKINS Care bundle
- Compliance with NIV, patient-ventilator synchrony and mask comfort should be documented in the nursing notes.
- As the patient's condition improves and weaning commences observations may be reduced to 4 hourly EWS to allow rest and sleep

Patients requiring long term or domicilary NIV should have observations monitored as pertinent to their acute condition or at minimum 4 hourly

### 5.4 Treatment Duration and weaning

- Patients should receive NIV during the first 24 hours as much as tolerated with breaks for meals, drinks and medications.
- Treatment should last until the acute cause has resolved, commonly 2-3 days
- Weaning begins when pH ≥7.35, resolution of underlying cause and symptoms and respiratory rate normalized.
- During weaning periods, oxygen should be administered to maintain SpO2 88-92%
- In cases of agitation where this is preventing the patient from receiving adequate NIV, very small doses of sedation or anti-anxiolytics may be used to improve tolerance to NIV treatment, this must be weighed up as a risk versus benefit for the patient.
- Weaning should commence during the day with extended periods off the ventilator for meals, physiotherapy, nebulised therapy etc.
- During weaning, observations should be carried out as the patients' condition dictates, at minimum 4 hourly on EWS

- Ideally if patient will tolerate, a 4 day weaning period should occur following resolution as above, please see appendix 3 for weaning plan
- NIV may be discontinued on day 4 unless continuation is clinically indicated, e.g., 2 hours in the morning, 2hours in the afternoon and 6 hours or more overnight.
- Some patients make a rapid recovery and shorter weaning periods of 2-3 days are commonly indicated clinically.
- Other patients may self-determine at an earlier stage that they no longer require NIV.

- The weaning strategy should be documented in the nursing and medical records.

**5.5 Dealing with potential treatment failure**

It should be recognised that many patients requiring NIV may have co-morbidities that limit the ceiling of care to NIV.
Treatment options should be discussed with the patient and relatives wherever possible and a written plan addressing plan for potential failure of NIV must be documented in patients' medical notes with a Respect form completed at the earliest opportunity as appropriate if not already done so. The appropriateness for escalation to invasive mechanical ventilation should already have been assessed and recorded at the initiation of NIV. If a patient is to be considered for level 3 care, if NIV fails then an early Consultant to ICU Consultant discussion should occur.

If NIV fails, all other appropriate treatment should continue as necessary eg. controlled oxygen therapy etc.

Palliative care should be considered in cases of failure of NIV with ongoing deterioration.

**6.0 References**

BTS (2016) Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults Thorax Volume 71 Supplement 2

Ghosh, D, Elliott, M (2019); Acute non-invasive ventilation- getting it right on the medical take Clinical Medicine Vol 19 no 3 pp237-242
https://www.rcpjournals.org/content/clinmedicine/19/3/237.full.pdf accessed 13/10/21

**6. Documentation Controls** (these go at the end of the document but before any appendices)

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|---|---|---|---|---|
| **Reference Number**<br><br>CG-RESP/2905/21 | **Version: 3** | | **Status**<br><br>Final | |
| Version / Amendment History | Version | Date | Author | Reason |
| | 3 | Dec21 | CNS Joanna Wright<br>Dr James Donaldson | Following merger to align policies |
| | | | | |
| **Intended Recipients:**<br>All acute medical and ED qualified staff involved in caring ofr respiratory patients | | | | |
| **Training and Dissemination:** Formal training and study days, ad hoc training on ward/clinical areas | | | | |
| **Development of Guideline:** Respiratory CNS and Consultant Respiratory Physician | | | | |
| **Consultation with:** respiratory and ED consultants and senior nursing staff | | | | |
| **Linked Documents:** oxygen policy | | | | |
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Appendix 1 **Checklist for commencing NIV**

| Name |
|---|
| B |
| DOB |

**Consider NIV in patients presenting with pH < 7.35 with CO2 6.5 AND**

- exacerbation of COPD or severe bronchiectasis
- Obesity related hypoventilation syndrome
- Chest wall disease eg kyphoscoliosis
- Neuromuscular disease
- Severe heart failure

- Give appropriate treatment and **controlled oxygen therapy to maintain SpO2 88-92% ASAP**
- Repeat ABG after 30minutes
- If pH still < 7.35 with PCO2 >6.5 despite above, complete checklist; if appropriate, commence NIV

| **Contra-indications to NIV** | **Relative contra-indications to NIV:** |
|---|---|
| Life-threatening hypoxaemia<br>Asthma<br>Severe co-morbidity<br>Confusion/agitation/severe cognitive impairment<br>Facial burns/trauma/recent facial or upper airway surgery<br>Uncontrolled vomiting, upper airway obstruction, Inability to protect the airway, Copious respiratory secretions<br>Metabolic acidosis<br>Un-drained pneumothorax<br>Recent upper gastrointestinal surgery or Bowel obstruction<br>Patient declines treatment<br>Patient considered end of life | pH < 7.26 due to severe hypercarbia (Consider ICU referral)<br><br>Pneumonia and AHRF should be referred to ICU as appropriate. If not for escalation to ICU, NIV may be considered as the ceiling of care<br><br>Hypovolaemia ; restore BP prior to commencing NIV as increased intra-thoracic pressure may decrease BP<br>Cognitive impairment, confusion or agitation (may need low dose anti-anxiolytics)<br>NIV is not effective in AHRF due to fibrotic lung disease. |

| **Action** | **Y** | **N** | **Comment** |
|---|---|---|---|
| Is pH <7.35 and PCO2 >6.5 kPa on 2 consecutive ABGs 30-60minutes apart? | | | |
| Is treatment optimised and oxygen target SpO2 88-92% achieved? | | | |
| Are indications and contra-indications for NIV considered as below? | | | |
| Has CXR has been performed and pneumothorax excluded? | | | |
| Has senior medical review occurred (Respiratory SpR or Consultant, or OOH, Medical Registar/ Consultant or ED consultant)?<br>Refer to Respiratory Specialist Nurses also via V6 or bleep 617<br><br>Ensure NIV bed is requested on a respiratory ward | | | |
| Are escalation plans documented /respect form completed as appropriate? | | | |
| Has patient consent been sought, or<br>Is NIV to be commenced in patients best interest? | | | |
| Relatives aware of treatment plans and ceiling of care decisions. | | | |