

Non Invasive Ventilation (NIV) for Acute Hypercapnic Respiratory Failure - Full Clinical Guideline

Reference No: CG-T/2014/118

Purpose

The Trust recognises the significant risk of morbidity and mortality in patients admitted in acute hypercapnic respiratory failure (AHRF; also known as type II respiratory failure). 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. This guideline refers specifically to the use of Bi-level Positive Airways Pressure (BiPAP) in such patients, although many of the principles encompassed are applicable to other forms of NIV which may be available.

Aim and Scope

The aim of the guideline is:

- To ensure that the service is provided by a cohort of staff with appropriate competencies and skills under appropriate supervision.
- To determine appropriate indications and contraindications
- To standardise techniques and documentation
- To ensure the highest standards of infection control

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 and respiratory failure in patients with tracheostomies - in such cases early Respiratory Specialist advice should be sought.

Definitions Used

- 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 these skills.
- Appropriate indications and contraindications:** see section A below

Implementing the Guideline

1. It is the responsibility of Clinical Directors to ensure that medical staff are aware of this guideline. It is recognised that well-established operational policies exist in some areas of the Trust, which will reflect the principles of this Trust guideline.
2. Doctors are responsible for undertaking procedures for which they have received approved training and are deemed competent. If the procedure is to be undertaken by an inexperienced doctor this must be under the direct supervision of a competent doctor for the duration of the procedure and he/she will take responsibility for this. The doctor undertaking the procedure will be responsible for ensuring that there is an appropriate indication for the procedure and that no contraindications exist.
3. When assessing competency the assessor should ensure that the practitioner is able to satisfy the requirements set out in the Competency checklist in Appendix 1.
 - It is recommended that all staff should have initial training before a new service is introduced or extended to new clinical area.
 - The competencies achieved should be transferable and should be held by individuals in their training portfolios.
 - Staff involved in the delivery of NIV should keep skills current by completing either a locally organised annual refresher or equivalent training package.
4. NIV should be delivered in an area with adequate lighting, availability of spare materials and resuscitation equipment;
 - A system should be in place to enable traceability of equipment.
 - An electrical safety check of the NIV equipment should be performed by qualified personnel, once a year.
5. The procedure will take place ensuring the highest standards of infection control.
6. Complications of a potentially or actually life threatening nature must be reported to the responsible Consultant immediately. Adherence to this guideline will be monitored through audit (see NIV audit tool at www.brit-thoracic.org.uk/standards-of-care/audit), training programmes and the review of associated clinical incidents.

Abbreviations used

ABG	Arterial Blood Gas
AHRF	Acute Hypercapnic Respiratory Failure
A&E	Accident and Emergency
BiPAP	Bi-level Positive Airways Pressure
CBG	Capillary Blood Gas
CF	Cystic Fibrosis
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
EPAP	Expiratory Positive Airways Pressure
ICU	Intensive Care Unit
IPAP	Inspiratory Positive Airways Pressure
MAU	Medical Assessment Unit
NIV	Non-Invasive Ventilation
OHS	Obesity Hypoventilation Syndrome
OSA	Obstructive Sleep Apnoea
PEEP	Positive End Expiratory Pressure

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Section A: PATIENT SELECTION

A.1 When should NIV be considered?

Use the AHRF care bundle and referral script to aid with initial management and decision making (Appendix 4)

NIV should be considered in all patients with an acute exacerbation of COPD or known/suspected OHS in whom a respiratory acidosis (**pH<7.35*** and **PaCO₂ >6.0**) persists despite immediate maximum standard medical treatment on controlled oxygen therapy for **no more than 30 minutes**.

Standard medical therapy (for COPD) should include:

- Controlled oxygen to maintain SaO₂ 88–92%
- Nebulised salbutamol 2.5–5 mg
- Nebulised ipratropium 0.5 mg
- Prednisolone 30 mg or hydrocortisone 200mg IV
- Antibiotic (if clinically indicated)
- **All indicated therapies should be given within the first 30 minutes**

* 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.**

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.

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

- Decompensated obstructive sleep apnoea (OSA)
- Cystic fibrosis (CF)
- Non-CF bronchiectasis
- Chest wall deformity (eg. Kyphoscoliosis)
- Neuromuscular disorders (eg. Motor neurone disease)
- Cardiogenic pulmonary oedema refractory to CPAP treatment.

NIV can be used for such patients but in such specialist indications, only after discussion with the Respiratory Consultant on call.

NIV should **not** be used on the Respiratory wards for pneumonia, trauma, asthma or ARDS except in exceptional circumstances and only after approval from the Respiratory Consultant on call.

A.2 Where can NIV be given?

NIV for AHRF (outside of its use on ICU), should **only be administered on the Respiratory wards (402, 403 and 404), Medical HDU (407) or in the A&E department.**

- Patients requiring NIV acutely should be admitted to the Respiratory HDU on ward 403. Exceptionally, during busy periods, some patients on NIV may be managed in the general ward area on 402, 403 or 404 where appropriate skills are available.
- Depending on comorbidities (eg. renal failure) or the need for other specialist treatment (eg. inotropes) patients may need NIV on medical HDU (407).
- **Aim for patients to start on NIV within 1 hour of a decision made to offer NIV treatment or within 2 hours of patient arrival to hospital.**
- NIV should be considered in patients presenting to the A&E department in AHRF not improving after 30 minutes of appropriate medical treatment. Ensure the following;
 - The patient is discussed with and/or assessed by the Respiratory Consultant or Intensive Care team on call, preferably prior to commencing NIV.
 - A clear decision regarding ceiling of care and location for continuing NIV is made, documented in the notes and is discussed with the patient and relatives.
 - Patients whose pre-morbid status does not preclude invasive ventilation who meet these criteria (pH < 7.25 with a GCS of ≤8) need urgent transfer to a critical care area.
 - The patient does not present with AHRF due primarily to a neuromuscular problem. These patients need urgent transfer to a critical care area if escalation is appropriate.
 - The patient is not more appropriately managed with palliative intent (eg. high flow oxygen mask may be more appropriate in patients meeting the criteria for end of life care).

NIV should **not** be initiated or administered on MAU.

- Patients admitted through MAU requiring NIV should be initiated on medical therapy with controlled oxygen and discussed urgently with the respiratory consultant on call and transferred to the Respiratory ward as soon as possible.

A.3 Inclusion and Exclusion Criteria

Inclusion Criteria: the ideal patient for NIV should be:

- Sick but not moribund
- *Able to protect airway
- *Conscious and cooperative
- Have no excessive respiratory secretions
- Have potential for recovery to quality of life acceptable to the patient
- Patient's wishes considered (if possible)

* There is evidence to support the use of NIV in patients who are comatose secondary to COPD-induced hypercapnea in whom intubation and escalation to ICU is not deemed appropriate.

Please discuss these patients early with the Respiratory team.

Exclusion Criteria:

- Life-threatening hypoxaemia
- Severe co-morbidity
- Confusion/agitation/severe cognitive impairment
- Facial burns/trauma/recent facial or upper airway surgery
- Uncontrolled vomiting
- Fixed upper airway obstruction
- Undrained pneumothorax
- Recent upper gastrointestinal surgery
- Inability to protect the airway
- Copious respiratory secretions
- Bowel obstruction
- Patient declines treatment
- Patient considered end of life

NIV is not effective in AHRF due to fibrotic lung disease.

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.

Please discuss these patients early with the Respiratory team.

A.4 Risk Stratification at Initiation of Treatment

Patients should be stratified into **5 groups** based on their pre-morbid state, the severity of the physiological disturbance, the reversibility of the acute illness, the presence of relative contraindications and where possible the patient's wishes.

The stratification should be recorded in the medical notes as follows:

- 1) Requiring immediate intubation and ventilation
- 2) Suitable for NIV and suitable for escalation to intensive care treatment / intubation and ventilation if required
- 3) Suitable for NIV but not suitable for escalation to intensive care treatment/ intubation and ventilation
- 4) Not suitable for NIV but for full active medical management
- 5) Palliative care agreed as most appropriate management

In all patients commencing NIV a decision regarding escalation status and resuscitation status should be made, and discussed with patients / relatives. Decisions should be clearly documented with completion of a DNACPR or ReSPECT form if appropriate.

Section B: SET UP

The decision to commence NIV should be made by a doctor of ST3 (registrar) level or above and should be discussed as soon as possible with a senior decision maker (ED Consultant, Respiratory consultant, ICU consultant). The doctor commencing NIV should complete the NIV prescription form (Appendix 3). Patients initiating NIV have an uncertain outcome and an Amber Care bundle should also be completed at initiation

Please use the standard NIV Set-Up Guide as a checklist (Appendix 2)

The initiation of NIV should only be performed by a healthcare professional trained and competent in the set up of NIV.

- All patients established on NIV should be reviewed as soon as possible by the most senior doctor on site responsible for the patient. If this is a non-respiratory specialist, a respiratory specialist review should be arranged at the first available opportunity.
- The patient's consent should be sought wherever possible. This process should include an explanation of the treatment rationale, how it may help the patient, the consequences of not receiving this treatment and other therapeutic options available including palliation (see Patient Information Appendix 5).
- There should be a minimum staffing ratio of 1 nurse to 2 NIV patients for at least the first 24 hours of NIV when provided for AHRF.

B 1 How do I Set Up NIV (Practical Tips)?

Clarify the management plan if a trial of NIV fails, after discussion with senior medical staff, **and document in the notes before setting up NIV.**

- The patient should be in a sitting leaning forward or semi-recumbent position when started on NIV.
- A full-face mask is recommended in the first 24 hours. A range of design and mask sizes should be available
- Select a mask to fit the patient, and hold it in place to familiarise the patient.
- Instruct the patient how to remove the mask, and how to summon help.

Setting up the NIPPY 3 Ventilator

The NIPPY 3/3+ ventilators are the standard NIV machines used in the Trust. Occasionally patients may be admitted arrive with a ventilator they use at home. If you are unsure how to operate a ventilator, find someone who is appropriately trained to use it.

1. Take a pre-assembled circuit (consisting of filter, oxygen inlet port, length of 22mm tubing and exhalation vent) and attach a suitable full-face mask.
2. Turn on the power switch
3. In “Pressure support mode” adjust the IPAP and EPAP as follows:
 - Start with an initial IPAP of 12cms H₂O and an EPAP of 4-5 cms H₂O
 - These settings are well tolerated by a most patients and allow them acclimatise to the ventilator (but may not significantly improve gas exchange)
 - Gradually increase the IPAP by 2-5 cm H₂O increments each 5-10 minutes until target pressures have been achieved or patient tolerability has been reached.
 - **The target IPAP for most patients is 20 cms H₂O.**
 - **A target EPAP of 4-5 cm H₂O reduces CO₂ re-breathing and assists triggering of the ventilator.**
 - Although intrinsic PEEP (PEEPi) may be 10–15 cms H₂O in patients with severe acute COPD, levels of EPAP of >5 cm H₂O are rarely tolerated).
 - Obese patients may need higher target pressures; IPAP up to 30 cms H₂O and EPAP up to 12 cms H₂O.

If there is uncertainty over target pressures discuss this with the Respiratory Consultant on call

4. If the patient reaches and is tolerating target pressures and has oxygen saturations of 88-92%, leave them on these settings and check an ABG/CBG in 1 hour.

5. Other issues;

▪ **Oxygen:**

- Oxygen should be entrained into the circuit at the same rate (litres/minute) as that given prior to starting NIV, adjusted thereafter to maintain the target saturation, usually 88 - 92%.
- **The maximum effective rate to entrain oxygen via an NIV ventilator is around 6 litres/min. Higher rates do not achieve a higher breathed oxygen concentration.**
- Oxygen should be prescribed on the electronic prescription system and the appropriate NEWS template selected on the electronic observation system (Patientrack). The patient should wear the appropriate colour coded wristband.

- **Bronchodilators:** should preferably be administered **off** NIV but may be administered on NIV and when so should be entrained between the expiration port and the facemask. Delivery of both oxygen and nebulised solutions is affected by NIV pressure settings.

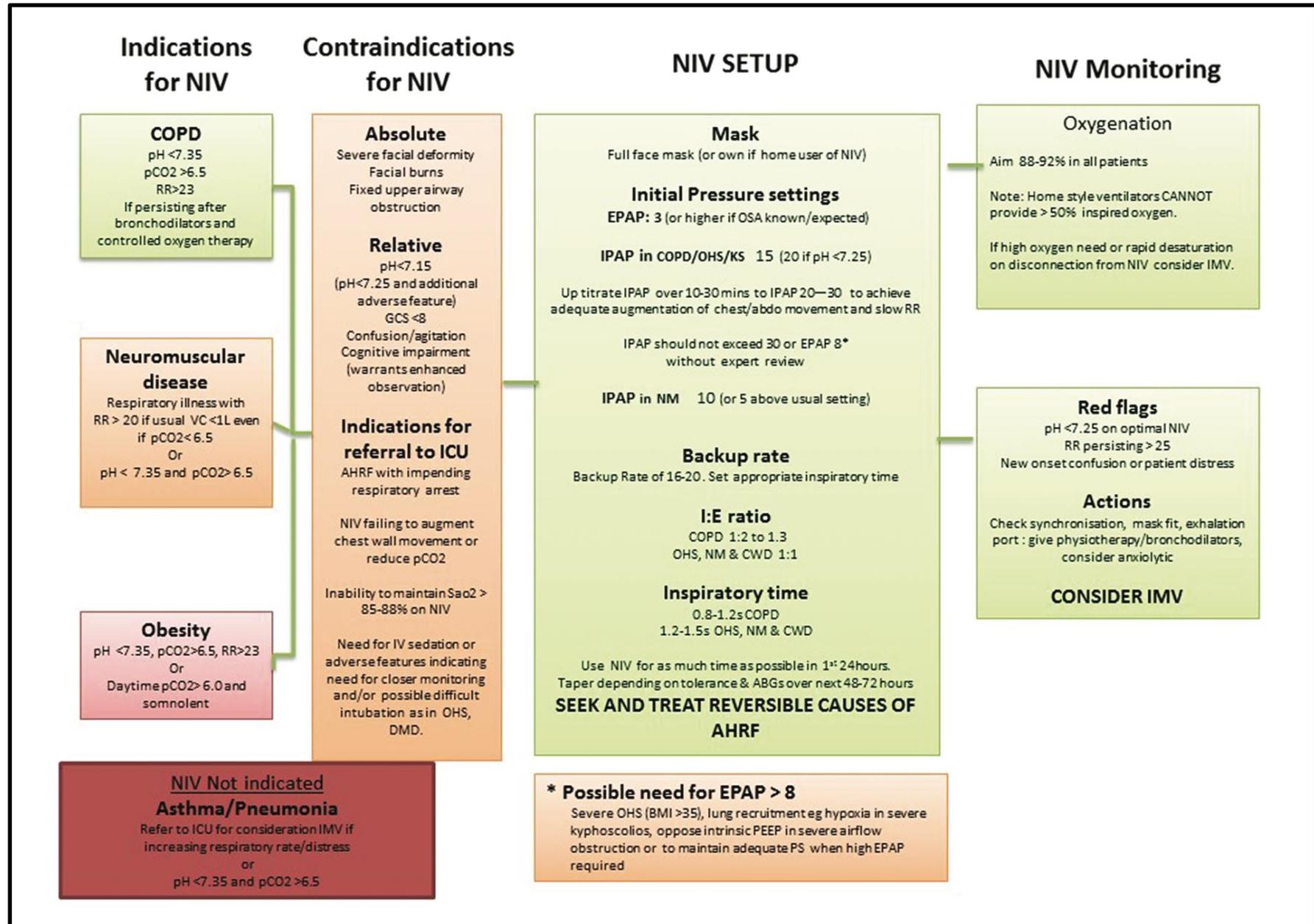
- **NG-tube:** Non-invasive ventilation can be used with a naso-gastric tube in place, in which case this should be a fine bore tube to minimise mask leakage. It is **not** necessary to place a naso-gastric tube simply because a patient is to receive NIV.

B. 2 Equipment

Equipment should be cleaned according to manufacturer and local Infection control guidelines:

- A bacterial filter must be attached to the ventilator outlet port. This should be changed between patients and at regular intervals according to the manufacturers' recommendations.
- The filters in the machine's air entrainment mechanism should be changed when visibly dirty and between patients.
- Single patient use items should not be reused and should be disposed of appropriately.
- A system should be in place to enable traceability of equipment e.g. in the event of product failure to enable recall of equipment.

Summary for providing acute non-invasive ventilation



Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults.
Davidson *et al.* Thorax, 2016;71:ii1-ii35.

Suitable for printing to guide individual patient management but not for storage Review Due: April 2020

Section C: PATIENT MONITORING

Outcome measures associated with success or failure of NIV are:

- CBG results - specifically pH and PaCO₂
- Respiratory rate at 1 hour
- Heart rate (HR) at 1 hour.
- Clinical assessment of level of consciousness (GCS), chest wall movement and use of accessory muscles.
- Patient agitation and poor tolerance for NIV predict a poorer outcome.

It is recommended that during the first 12 hours patients should have continuous pulse oximetry and cardiac monitoring.

Frequent clinical monitoring of acutely ill patients is recommended:

- every 15 minutes in the first hour;
- every 30 minutes in the 1-4 hour period
- hourly in the 4-12 hour period.

Patient comfort and therefore enhanced compliance are key factors in determining outcome. Synchrony of ventilation should be checked frequently.

A clinical assessment of mask fit to include skin condition and degree of leak (particularly onto the corneas) should be performed.

If there are difficulties in patient compliance then a number of common problems should be sought (see the Trouble Shooting Guide Appendix 5)

A CBG/ABG should be measured after 1 hour of NIV therapy.

- Frequency of further CBG monitoring after the 1 hour sample should be determined by pH, PaCO₂ and the patient's clinical status. 'Routine' CBGs are not necessary.

Section D: ESCALATION OF TREATMENT

A documented plan which addresses how potential failure of NIV will be dealt with should be recorded in writing at the outset (see section A4).

There is evidence that a decision to proceed to intubation and ventilation ought to be made ideally within the first 4 hours of treatment:

Intubation should also be considered in patients suffering 'late failure' (defined as failure after 48 hours of non-invasive ventilation). Intubation is associated with lower mortality than continued non-invasive ventilation in this patient group.

Alternatives to non-invasive ventilation, including palliative care, should be **proactively implemented** for patients where a decision has been made not to escalate to intubation. Such a decision should, where possible, be discussed with the patient or their representative and their views taken into account in the decision making process.

In all patients commencing NIV a decision regarding escalation status and resuscitation status should be made, and discussed with patients / relatives. Decisions should be clearly documented with completion of a DNACPR or ReSPECT form if appropriate.

Section E: WEANING FROM NIV

E. 1 Treatment Duration

Patients who appear to benefit from NIV during the first few hours of treatment should receive NIV **for as long as possible (minimum of 6 hours)** with appropriate breaks for oral intake, nebulisers etc, during the first 24 hours.

In patients in whom NIV is successful (pH \geq 7.35 achieved, resolution of underlying cause and symptoms, respiratory rate normalised) following an appropriate duration of treatment, it is appropriate to start a weaning plan. Gradual reduction of the duration of NIV should be determined by clinical improvement.

E. 2 Weaning

Initially weaning should be during the day with extended periods off the ventilator for meals, physiotherapy, nebulised therapy etc.

After successfully weaning during the day, most patients will require an additional night on NIV.

- **A guide to a typical weaning plan after the first 24 hours is:**
 - Day 2: continue NIV for 16 hours (including 6-8 hours overnight)
 - Day 3 continue NIV for 12 hours (including 6-8 hours overnight).
 - Day 4 NIV may be discontinued, unless continuation is clinically indicated

Patients who have a rapid resolution of acidosis within 4 hours of starting NIV treatment (often those presenting with AHRF due to oxygen toxicity) may be appropriate for rapid weaning from NIV (generally weaning within 24 hours). Any plans for rapid weaning from NIV should be discussed first with the Respiratory Consultant responsible for the patient's care.

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

Long-term nocturnal ventilatory support may be indicated in selected patients following assessment by the respiratory team

Patients who initially appear to be responding to NIV but deteriorate again after 48 hours of NIV rarely do well if they continue to be managed with NIV and should be considered for invasive ventilation or palliative care as deemed appropriate.

Section F: PALLIATIVE CARE

Palliation of symptoms is appropriate in patients in whom standard medical treatment and NIV fails or where patients have chosen not to receive this treatment and where a decision has been made and documented not to escalate to intubation and mechanical ventilation.

Exceptionally continued NIV may be appropriate for palliation of breathlessness where this is agreed with the patient but in the majority it should be withdrawn. Opioids and benzodiazepines can be used to treat breathlessness in this situation.

The planned withdrawal of NIV care requires a multidisciplinary approach involving the medical team and ward nursing staff in conjunction with the patient and their relatives. Additional support may be needed from the palliative care specialist team.

NIV Competency Checklist**Appendix 1**

The practitioner must be able to:

1. Identify appropriate patients for NIV and explain the basic physiology behind their decision.
2. Identify the contraindications for the above.
3. Correctly assemble and prepare the equipment
4. Provide an explanation to the patient.
5. Demonstrate the ability to commence the treatment (on a patient) and explain their rationale for doing do.
6. Explain and implement the safety measures required
7. Accurately record the treatment of the patient, the changes in the patients' condition and maintain appropriate documentation throughout the patients' treatment.
8. Demonstrate the ability to assess for and understand the signs of success or not of the treatment and explain their subsequent actions e.g. settings, changes and rationale for doing do.
9. List the potential complications and limitations of NIV therapy.

Date	Demonstrated	Not yet demonstrated	Assessors comments	Assessors signature

NIV Set Up Guide

Appendix 2

Action	Rationale
Ensure ward emergency equipment available	Provide safe environment
Patient discussed with nursing staff, medical staff (at all times) and physiotherapists (in hours)	To ensure NIV is the appropriate intervention and support is available
Ensure the NIV chart has been fully completed with an appropriate prescription	To ensure appropriate settings are maintained
Check with medical staff that patient has a recent CXR which is clear of pneumothorax/pneumonia	Pneumothorax must be discounted prior to starting NIV as positive pressure can cause lung barotrauma. If a patient already has a pneumothorax the size can be increased by NIV. NIV is unlikely to succeed if pneumonia is present
Explain procedure to patient positively and calmly. Take consent from patient or relative/carer. The patient will require reassurance throughout the procedure. Sit the patient up in bed	To gain consent and co-operation. This is potentially a frightening and claustrophobic experience
Set up the equipment as shown in the diagram. Ensure filter is connected to the port on the NIV machine before attaching the tubing	To prevent contamination of the machine
Carry out as much preparation as possible away from patient's bedside	To prevent distressing patient
Check size of mask which must fit firmly and not encroach on upper lip and into corners of the eye. Assess mask size using gauge on mask pack.	To ensure seal and prevent air leaks which may reduce effectiveness or cause complications e.g. conjunctivitis
Check for any poor facial skin condition - consider applying hydrocolloid semi-permeable dressing to bridge of patient's nose.	This is a very high risk pressure area. Existing poor facial skin condition may also be exacerbated
Connect patient's current supplemental oxygen to second O2 supply	Maintain O2 supply whilst preparing equipment
Set mode to spontaneous/timed mode, set IPAP, EPAP and back up BPM settings as instructed by NIV chart	To ensure machine is functioning correctly and that a back-up rate is provided in the spontaneous/ timed mode
Turn the machine on and connect entrained O2 to connector	To commence treatment and provide oxygen supply
Ask patient to breathe through nose and maintain tight mouth seal. Hold mask to patient's nose for a few minutes	To reassure patient and acclimatize
Attach head cap straps to mask and obtain seal. The mask should be firm but not tight and small leaks may be acceptable.	To ensure no leaks
Ensure that exhalation port (if using a fixed leak circuit) on connector between mask and tubing is not blocked and facing away from patient	To prevent build up of CO2
Document a set of observations	Provide baseline for assessing progress
Watch chest wall movement and titrate settings to achieve therapeutic effect – increase in chest wall movement and improved clinical signs	Improving the tidal volume is the aim as inadequate Vt is the cause of the patient's ventilatory failure

NIV Prescription Chart

Appendix 3

Add patient sticker or complete patient details

Surname

Forename

DOB

Hospital number

For completion by medical staff in any patient commenced on NIV

See page 3 for indications and instructions on commencing NIV

This form should be completed in conjunction with the acute hypercapnic respiratory failure checklist

Consider any COPD patients with severe respiratory acidosis (pH<7.25) or severe hypoxia (PO₂<8Kpa) for immediate invasive ventilation. NIV may be less successful in this patient group but could be appropriate if the patient is not a suitable candidate for escalation to ICU.

OTHERWISE, ENSURE;

- Patient has *respiratory* acidosis (pH<7.35 and pCO₂>6 Kpa)
- Patient is on appropriate *controlled* oxygen therapy (with target SpO₂ 88-92% - ensure prescribed on ICM)
- Maximal medical therapy has been instigated (see below)

NIV can be used acutely on any of the respiratory wards (402, 403 or 404) or medical HDU (ward 407) though the Respiratory High Dependency Unit on ward 403 may be more appropriate if the patient is haemodynamically unstable. Please contact the either the Respiratory registrar on call (07879 115510) or the Respiratory consultant on call (07879 115941) and thereafter the ward nursing staff (ward 403: x88403 / Ward 403 coordinator: 07879115868) if the patient is considered suitable for NIV.

1. Medical therapy (prescribed or discontinued as appropriate, mainly in those with COPD)

Tick if applicable

• Controlled oxygen therapy instigated (target SpO ₂ 88-92%)	<input type="checkbox"/>
• Oral/IV corticosteroids prescribed	<input type="checkbox"/>
• Nebulisers (B ₂ agonist and anti-muscarinic)	<input type="checkbox"/>
• Antibiotic therapy	<input type="checkbox"/>
• Drugs discontinued if appropriate (e.g. Opiates, benzodiazepines)	<input type="checkbox"/>

* 1 in 5 COPD patients with acidotic type 2 respiratory failure will improve with medical therapy alone, avoiding NIV

2. Indications for NIV

Tick if applicable

• Acute exacerbation of COPD with acidotic T2RF	<input type="checkbox"/>
• Obese patient with T2RF (suspected obesity hypoventilation syndrome)	<input type="checkbox"/>
• Neuromuscular condition* with hypercapnia	<input type="checkbox"/>
• Kyphoscoliosis / chest wall deformity with T2RF	<input type="checkbox"/>
• Other (please specify)	
Chest x-ray reviewed for evidence of pneumothorax or pneumonia?	<input type="checkbox"/>

*Motor neurone disease, Duchenne muscular dystrophy, T2RF=Type 2 respiratory failure.

3. NIV settings and oxygenation

Starting pressures	12/5	<input type="checkbox"/>	Other (specify)	IPAP.....	EPAP.....
Target pressures*	20/5	<input type="checkbox"/>	Other (specify)	IPAP.....	EPAP.....
Target saturations	88-92%	<input type="checkbox"/>	94-98%	<input type="checkbox"/>	

If COPD, aim for SpO₂ of 88-92%. 1-2L/min is usually sufficient. A flow rate of 4L/min of oxygen via NIV is equivalent to an FiO₂ of around 40% - greater flow rates do not lead to an increase in FiO₂ beyond this.

*Maximum IPAP should be titrated against tolerability – patients with neuromuscular weakness or smaller, frail patients may require a lower IPAP.

4. Location NIV started

Tick if applicable

402 403 (Resp HDU) 404 407 (Medical HDU) A+E Other (specify)

5. Monitoring

- What time is the next ABG/CBG required? (aim for 1 hour after starting NIV)
- Request for repeat ABG/CBG has been handed over to medical/nursing staff?

6. Escalation of care

- Patient should be considered for intubation if NIV fails
- NIV is the ceiling of treatment
- Withdrawal of NIV (palliative care) is appropriate if NIV fails
- DNACPR form completed (if appropriate)

7. Handover

- Patient has been discussed with on call Respiratory consultant / registrar
- Patient has been discussed with the nurse-in-charge on respiratory ward
- Patient has been discussed with the ICU registrar/consultant on call (if appropriate)

8. Discussion with patient

Yes No

- Has the patient agreed to start NIV?
- If not, does the patient have capacity to consent for NIV as a treatment?
- If not, why?
- Has the ceiling of treatment been discussed with patient?
- Has resuscitation status been discussed with patient or appropriate relative?

9. ABG / CBG results

	Date	Time	FiO ₂	pH	PO ₂	PCO ₂	HCO ₃	Signature
Pre-NIV								
1-2 hrs post-NIV								
4-6 hrs post-NIV								
Pre-discharge from hospital								

Indications for NIV

- Exacerbations of COPD with T2RF
- Obese patients with T2RF with likely OHS
- Neuromuscular conditions (such as MND) when patients develop hypercapnia.
- Kyphoscoliosis / chest wall problems when patients develop T2RF
- Consider in COPD patients with reduced consciousness due to hypercapnia if not suitable for ICU

T2RF=Type 2 respiratory failure, OHS=Obesity hypoventilation syndrome, MND=Motor neurone disease

Conditions where NIV is not typically used

- Asthma
- Pneumonia
- Acute pulmonary oedema
- Guillan-Barre syndrome*
- Botulism*
- If intubation and invasive ventilation is readily available and more appropriate, including significant patient distress.

*unless on ICU where invasive ventilation is immediately available.

Difficult decisions should be discussed with a Consultant.Potential contraindications to NIV

ABSOLUTE	RELATIVE
Patient refusal	Reduced conscious level
Facial trauma/burns/recent surgery	Life-threatening hypoxaemia
Fixed airway obstruction	Severe co-morbidity
Vomiting	Confusion / agitation / cognitive impairment
Undrained pneumothorax	Upper gastrointestinal surgery
	Bowel obstruction
	Excessive respiratory secretions
	Haemodynamically unstable, requiring inotropes

Suggested protocol for commencing NIV

- NIV should preferably be started only on the Respiratory wards or A+E resus.
- To ensure better compliance and effectiveness patients should have the treatment explained to them and the mask should be held against the patient's face to allow them to acclimatise to NIV before tightening the head straps.
- Patients may need support and encouragement to help relax breathing and enable synchronising with the NIV machine.
- Starting pressures should be (IPAP/EPAP) at 10/4 or 12/5 for most patients.
- Once instigated, aim to increase the IPAP in 2cm increments every 5 minutes up to 20 (or the pre-specified target). The acidosis resolves more rapidly at higher pressures.
- Repeat the ABG/CBG at one hour post-instigation of NIV.
- A further ABG/CBG at 4 hours should be done if an acceptable improvement.
- If the raised pCO₂ and acidosis fails to improve, consider increasing the IPAP further.
- Increasing EPAP will potentially improve oxygenation only (no higher than 8 cmH₂O).
- If no improvement after 4 hours consider escalation to invasive ventilation (if appropriate).

Care Bundle: Immediate Management of Acute Hypercapnic (Type 2) Respiratory Failure

Patient ID

Ward / Clinical Area _____

Cons _____

Date _____ Time _____

- 1) Confirm diagnosis by checking the following:

CHECK THAT:	TRUE
Arterial Blood Gas sample taken	
pH<7.35 pCO ₂ >6.5	
Symptoms are NOT asthma *	

*Acute severe asthma, that results in hypercapnic respiratory failure needs **IMMEDIATE** review by critical care – see asthma guidelines

- 2) Immediate actions:

ACTION:	DONE
Note the date & time here	
Titrate oxygen SpO ₂ 88-92%	
Prescribe oxygen target SpO ₂ 88-92%	
Select Patientrack template 88-92%	
Ensure patient is wearing grey wristband	
Give bronchodilator nebulisers	

- 3) 30 minutes after time noted in Step 2):

ACTION:	DONE
Repeat ABG	

Next Action depends on results of ABG

IF pH_≥7.35:

pH>7.35:	DONE
Note time again	
Continue current treatment	
Get senior review within 60 minutes of time noted here	

IF pH<7.35 and pCO₂>6.5:

pH<7.35 and pCO ₂ >6.5:	DONE
Recognise patient MAY require Ventilatory Support	
IMMEDIATE senior review (Medical/ED SpR or Consultant)	
Discuss with Respiratory Consultant or ICU if appropriate for escalation (see referral script overleaf)	

IF: Any other results shown then this may indicate metabolic acidosis - ref to SpR or Consultant

Referral Script for Acute Hypercapnic Respiratory failure patient to Respiratory Consultant on call or ICU for consideration of Ventilatory Support

Ensure you have the following information at hand:

- Arterial or capillary blood gas result taken within the last 30 minutes
- GCS
- Recent CXR (taken during current admission)
- Recent inflammatory markers (taken during current admission)
- Assessment of Pre-morbid functional status:

walk distance on flat	
cognitive ability	
previous respiratory tests or diagnosis (check cardiobase and old letters) FEV1=	
Comorbidities	

Start the call with the following statements:

“XYZ Patient on ABC Ward under CBA Consultant is presenting with acute hypercapnic respiratory failure.

“Please can you advise on a management and escalation plan and if NIV is appropriate.”

Patient Information**Appendix 5****PATIENT INFORMATION****DERBY HOSPITALS NHS TRUST****Respiratory Medicine**

Non Invasive Ventilation (NIV): The Treatment Explained

A document planned for our patients as a result of patient consultation, support and action.

What is NIV?

Non Invasive Ventilation (NIV) is a way of helping you breathe using a machine (see picture below) attached to a tight fitting mask that you wear over your face. It is not the same as a nebuliser which you might have used before and delivers a medication to the lungs. It is used usually when you are having a severe flare-up of your breathing problem.



At this time your breathing gets hard work and your muscles can become tired. This sometimes leads to a build-up of waste gas (carbon dioxide) and not enough oxygen getting into your blood. NIV supports your breathing to give your muscles a rest and allow them time to recover. It doesn't breathe for you, but gently assists each breath that you take. This can help to get your oxygen and carbon dioxide levels back to normal.

In the past a machine to help breathing needed to be connected to a tube placed inside the windpipe of the patient and had to be done in the intensive care unit. Instead using this new type of ventilator you will need to wear a facemask, which fits firmly but not too tightly. As you take a breath in you will feel a flow of air from the machine, then as you breathe out there will be a little resistance to help keep your lungs open. It can feel a bit strange to start with, however most people find that they get used to it fairly easily.

How is NIV given?

The nurse (or physiotherapist) will set the machine up and make sure that it is as comfortable for you as possible. The nursing staff will check on you frequently so if you do find it uncomfortable they can help.

You will have your buzzer near by to call for help at any time.



To start with, you need to wear the mask (see picture on the left) as much as possible for the first 24 hours. It can be removed for short periods to enable you to eat and drink as normal and for your medicines and nebulisers.

After the first 24 hours you will usually be asked wear it for 2 hours in the morning and afternoon as well as overnight and then we will cut it down to overnight only.

Your doctor will discuss your treatment with you. The length of time you need it will depend on how quickly the oxygen and carbon dioxide levels in your blood improve.

If you have any questions

If you have any further questions please do not hesitate to ask any of the following people involved in your care who will be happy to help:

Nurse in charge Respiratory Ward (403 or 402)
Consultant Respiratory Physician

Trouble-Shooting Guide**Appendix 6**

Persistently elevated PaCO₂	<p>Is there excessive mask leak? Check mask fit.</p> <p>Is the circuit set up correctly? Check connections and identify leaks.</p> <p>Is there re-breathing? Is the expiratory port patent?</p> <p>Is the patient being over-oxygenated? Especially consider the desired level of O₂ therapy during period off NIV. Consider the acceptable level of PaO₂ aimed for.</p> <p>Consider increase in IPAP</p> <p>Is the patient spending sufficient time on the ventilator? Encourage more sustained period of use, particularly during sleep. Address compliance issues.</p> <p>If the patient is very obese or has other causes of chest-wall restriction, a volume-controlled ventilator may be more effective.</p> <p>Consider decrease EPAP if very high level set (>8)</p>
Masks leaks	<p>Small leaks are normal and acceptable, but larger leaks may cause insufficient ventilation, eye irritation, noise, dry mouth and nasal symptoms</p> <p>Be prepared to try different mask types and headgear</p> <p>Consider customised foam, or granuflex for comfort</p>
Asynchrony between patient and ventilator	<p>Check that the correct tubing is used in the circuit. The tubing should be smooth inside to allow flow to be detected accurately by the machine.</p> <p>If the patient has a feeble inspiratory effort, the machine may not sense inspiration. An increase in EPAP may help.</p> <p>If the patient is very tachypnoeic, increasing the IPAP may help. Ensure that the IPAP rise time is as quick as possible</p>
Hypocpnaia/alkalosis	<p>Minute ventilation is too high. Reduce IPAP</p> <p>Is ventilation still required?</p>
Difficulty inflating the chest	<p>Poor expansion of the chest and desaturation may be due to bronchospasm, mucus plugging, pneumothorax, atelectasis/collapse, consolidation, pulmonary oedema or rarely circuit tube obstruction/kinking. Clinical examination is necessary. Chest X-ray may be needed.</p>
Nasal problems	<p>Nasal redness/soreness/nasal bridge sores? Appropriate padding or a change of mask may be necessary.</p> <p>Rhinitis/nasal crusting/bleeding? Ask about nasal symptoms. Consider short-term use of 0.5% ephedrine nose drops for stuffiness. Alternately, nasal steroid preparations can be employed (nosebleeds are a relative contraindication to nasal steroids). Anticholinergic drops (ipratriptium bromide) or aqueous spray may be helpful for nasal streaming. For longer-term use, consider humidification.</p>
Dry mouth	<p>Regular mouth care is essential</p>
Gastric distension	<p>Check for abdominal pain or distension occurring during NIV</p> <p>Try to reduce IPAP if possible</p> <p>Consider a nasogastric tube with a nasogastric tube guard, accepting a small leak will ensue. Small leaks should not cause a problem.</p>
Persistent hypoxaemia	<p>Check correct O₂ entrainment into the circuit near machine. If there is definite OSA or atelectasis, hen increasing EPA may help (remember to increase IPAP as well to maintain the same amount of pressure support)</p> <p>Deteriorating clinical condition in the presence of hypoxaemia should lead to an urgent re-evaluation of the cause and considertaion of intubation and mechcal ventilation. CONTACT ITU IF PATIENT DEEMED FOR</p>

	INTUBATION
Patient position	The patient should be positioned sitting upright with their head up. Consider additional support (soft collar, rolled-up towel) if necessary.
Non cooperation/aggressive behaviour	Assess for patient agitation, confusion and not maintaining mask ventilation This may be due to hypoxaemia or hypercapnoea. Ensure constant supervision, as it may be necessary to hold the mask in place until ABGs correct themselves, before the confused/agitated state settles. This may be life saving. Relatives can be helpful. SEDATION MUST BE AVOIDED WITHOUT SENIOR MEDICAL OR ANAESTHETIC INPUT. Haloperidol may be useful to decrease agitation and facilitate tolerance of NIV therapy. Avoid benzodiazepines.

Documentation Controls

Development of Guideline:	Dr James Donaldson, Consultant Respiratory Physician
Consultation with:	
Approved By:	17/4/18 - Dr Deepak Subramanian (Head of service for Respiratory Medicine) 21/06/2018 - Medical Division
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