



Title	Guidelines for Acute Non-Invasive Ventilation (NIV)
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1. DEFINITION

'Non-invasive ventilation (NIV) refers to the provision of ventilatory support through the patient's upper airway using a mask or similar device.'

BTS 2002.

In this document, NIV refers to non-invasive bi-level positive pressure ventilation.

This document DOES NOT cover management of CPAP (Continuous Positive Airway Pressure).

There are many acronyms used in ventilation that may confuse. Bi-level NIV is also marketed by Dräger as BiPAP (a trade name), and may also (but more usually and accurately in an Intensive Care setting through an invasive tracheal tube) be called ASB (Assisted Spontaneous Breathing) or PSV (Pressure Support Ventilation).

In addition, ventilation settings may also be known by various names. For explanation and clarification, these are explained below:

EPAP (Expiratory Positive Airways Pressure) = PEEP (Positive End-Expiratory Pressure, usually via an endotracheal tube) = CPAP

IPAP (Inspiratory Positive Airways Pressure) = degree of Pressure Support (calculated by IPAP-EPAP) measured in cm of H₂O

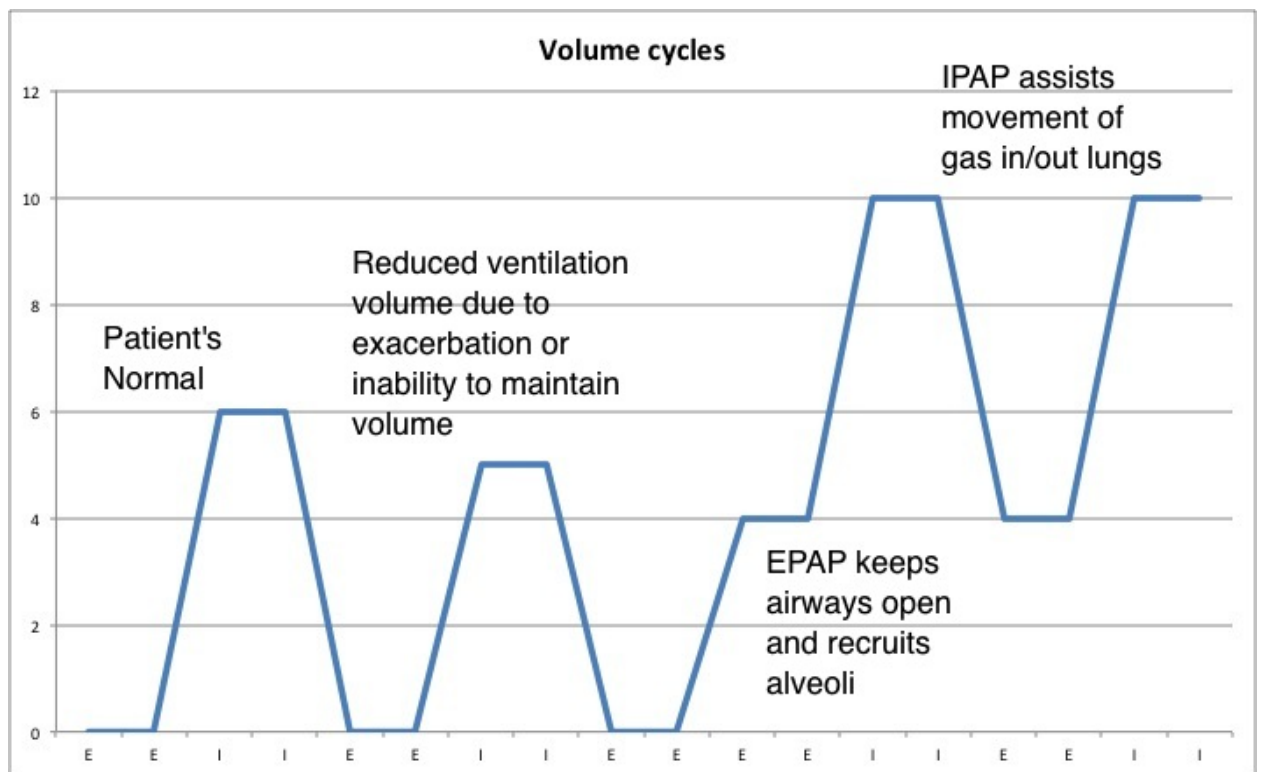
2. BACKGROUND INFORMATION ABOUT NIV

Bi-level NIV is a non-invasive method of augmenting spontaneous respiratory efforts. When a patient who is receiving bi-level NIV initiates a breath, the ventilator delivers air at a preset pressure (the IPAP). The ventilator will maintain this pressure until the patient breathes out. The patient then breathes out to a lower pressure (the EPAP). The assistance with inhalation improves gas exchange as it increases the volume of gas passing in and out of the patient's lungs with each breath. In turn this will increase minute ventilation (amount of gas inhaled and exhaled in a minute) and therefore help to expire alveolar carbon dioxide.

Bi-level NIV also provides EPAP - the background pressure during expiration. Providing some pressure during expiration helps recruit alveoli that weren't being used, and also reduces alveolar and airway collapse in the expiratory phase of respiration (emphysematous lungs in COPD trap gas as their elastin molecules that keep airways open (allowing air to escape) have to a lesser or greater degree been destroyed). Therefore more air is helped to pass in and out of the lungs during the breathing cycle. This often helps with oxygenation.

The active force applied pushing air into the lungs additionally gives some rest to the respiratory muscles.

It is important to note that the pressures of both IPAP and EPAP can be varied to optimise ventilation and oxygenation. In addition, as ventilation is being assisted, higher oxygen concentrations can be delivered without the same risk of hypercapnia.



The main advantage of NIV is that ventilatory support can be provided without the need for tracheal intubation. This has many benefits including:

- Ease of application
- Increased patient mobility
- Better tolerated and allows time off for communication with staff and family, meals, drinks and physiotherapy
- Patient is conscious (no sedation required) and able to participate in treatment
- Fewer problems weaning ventilation
- Reduced tracheal and barotrauma
- Reduced ventilator-associated pneumonias
- Shorter hospital stay
- Lower mortality
- Less labour intensive
- Can be used in patients not suitable for intubation

The majority of evidence for NIV applies to patients in Type 2 Respiratory Failure (T2RF) in Acute Exacerbations of COPD (AECOPD).

Data from good-quality randomised controlled trials shows the benefit of NIV as an adjunct therapy to optimal medical care in all suitable patients in the management of T2RF secondary to AECOPD. Optimal medical therapy in the form of controlled oxygen,

nebulisers and steroids (+/- antibiotics as appropriate) will normalise pH in approximately **20%** of patients. NIV should be considered early in the course of respiratory failure after 1 hour of medical therapy has failed and before severe respiratory acidosis (pH <7.20) has occurred, aiming to reduce the likelihood of intubation, treatment failure and mortality.

Clinicians should be aware that since the 2002 guidelines were produced, national audits have shown NIV is being used in more acidotic patients (pH <7.25). This implies the greater use of NIV but also the use of NIV in patients who have a greater risk of NIV treatment failure (either delaying intubation or who then require palliation). Careful consideration of the appropriate treatment and risk of failure is required.

Outwith COPD, acute NIV may be required for those with obesity hypoventilation syndrome, bronchiectasis, neuromuscular disease or chest wall deformities, but with different thresholds for starting NIV and at different pressure settings. See below for further information on these conditions and follow the appropriate line of the flowchart!

Patients in whom traditional ventilation is more appropriate (e.g. asthma, pneumonia) should **not** have NIV unless within a critical care area where immediate intubation and ventilation is available. There is evidence that pursuing NIV in these settings outwith critical care (where it is appropriate) increases mortality.

3. INDICATIONS AND REQUIREMENTS FOR ACUTE NIV

- A full history, examination and investigations are required. Specifically ABG and CXR (to exclude pneumothorax) are needed. Patient directives, and pre-morbid state (including severity of underlying disease process) with reference to recent clinic letters (if available) may help guide the appropriateness of NIV and Intensive Care. Discussion should be had with the patient and relatives regarding NIV before commencing. There may be situations where this may not be possible.
- All patients with a respiratory acidosis, i.e. with $\text{paCO}_2 > 6.5\text{KPa}$ and $\text{pH} < 7.35$ ($\text{H}^+ > 44$) should be considered for NIV.

3.1 COPD, Bronchiectasis or Obesity Hypoventilation Syndrome with a decompensated respiratory acidosis after 1 hour of optimal medical therapy

- Criteria for Ward 5 based NIV:

pH 7.25-7.35
 $\text{PaCO}_2 > 6.5 \text{ kPa}$
Single Organ Failure

- Any patient starting NIV should have a plan made whether they would be a candidate for ICU escalation if they were to deteriorate - if so, the ITU team / Outreach should be made aware of the patient.
- Indications for ICU/HDU referral +/- intervention (at any stage) also include:
 - Impending Respiratory Arrest
 - Inability to maintain O₂ saturations 85-88%
 - Persisting RR >25 despite optimal NIV
 - Worsening confusion / reduced GCS
 - Need for IV sedation
 - Haemodynamic instability
- Patients with a more severe respiratory acidosis ($\text{pH} < 7.20$) +/- multi-organ failure being considered for treatment with NIV should be discussed with the consultant on call and if appropriate then the ITU consultant for their opinion on possible management within Critical Care.
- If ITU care is felt to be inappropriate, NIV may be provided on the ward as the **ceiling of care** (on discussion with senior medical staff). In these patients it is important to carefully consider whether NIV is appropriate as well as reviewing the need for palliative care/end of life care pathways.

- There is evidence clinicians may underestimate survival in patients with COPD, leading to reduced critical care admission. Chung *et al* (2010) indicated that patients with COPD with any of BMI <22, on Long Term Oxygen Therapy and age >75 are the main predictors of poor prognosis after their first presentation requiring NIV. They have a five year survival of 26% (median 2 year survival). This information may help guide patients who are or are not candidates for critical care referral and/or intervention.
- Patients with Obesity Hypoventilation Syndrome may require high pressure settings due to both the extra-thoracic load and/or upper airway collapse. Additionally, in the setting of somnolence, a $\text{paCO}_2 >6$ but normal acid/base may flag the need to consider NIV.

3.2 Hypercapnic respiratory failure secondary to chest wall deformity (scoliosis, thoracoplasty) or neuromuscular diseases

- Acute Respiratory Acidosis – managed as above but with lower pressure settings – follow the pathway.
- NIV should also be considered for these patients if they present with a respiratory rate of >20 in the setting of a known Vital Capacity of <1 litre, even if their $\text{paCO}_2 <6.5$, aiming to treat before an acidosis develops.
- Patients with bulbar / swallowing dysfunction due to their underlying illness may struggle to tolerate NIV, or it may even make NIV delivery impossible.

3.3 The Patients Quality of Life Supports the Use of NIV

- PRIOR to commencement of NIV a decision regarding treatment escalation/ceiling of treatment should be clearly documented in the notes AND communicated to staff in the event of treatment failure.

Escalation decisions should be clearly recorded in the notes prior to commencing bi-level NIV, using the following stratification (RCP 2008)

1. Requires immediate intubation + ventilation
2. Suitable for NIV and escalation to ITU/intubation
3. Suitable for NIV, but not ITU/intubation
4. Not suitable for NIV, but for full active medical treatment
5. Palliative care

Stratification 1 & 2 should be decided with the ITU Consultant

3.4 The patient consents to treatment

- The treatment should be explained to the patient, and they must consent verbally or in writing before treatment is commenced. However in circumstances when

the patient is not able to take part in the discussion- speaking to family members is important.

3.5 Within the Emergency Department

- Patients presenting directly to the ED or being seen within the ED should be assessed in the same way as in the medical unit. They should have a trial of optimal medical therapy. If this fails, and the equipment is available, NIV should be started in the ED as per the pathway and the patient transferred as soon as possible to Ward 5 on the NIV equipment. At present, only some NIV machines can provide treatment during transfer – discuss with Ward 5 staff.

4 ABSOLUTE CONTRA-INDICATIONS FOR NIV

Type 1 Respiratory Failure / Life threatening hypoxaemia

pH > 7.35 (non-acidotic)

PaO₂ < 8.0 kPa

PaCO₂ < 6.5 kPa

- **Acute Severe Asthma – if in respiratory failure - urgent senior discussion and ITU referral**
- **Acute Respiratory Distress Syndrome- urgent senior discussion and ITU referral**
- **Undrained Pneumothorax – this will need intervention (drain insertion) if NIV is required**

All patients being considered for NIV and those who deteriorate on NIV must have a chest x-ray organised and reviewed to exclude pneumothorax, as NIV will make it worse. However, waiting for a CXR should not prevent starting NIV where it is appropriate, **BUT IT SHOULD BE CHASED ASAP.**

- **Facial Trauma/Burns**
- **Fixed Upper Airway Obstruction**
- **If the Patient is Vomiting Profusely and unable to wear a full face mask**
- **Patient/Legal Guardian Declines Treatment (after informed discussion)**

- **Recent Facial/Upper Airway/Thoracic or GI Surgery – better managed on ITU in case NIV worsens the above and requires invasive ventilation**
- **Bowel Obstruction**
- **Haemodynamic instability**

Some of these contraindications are relative if the patient is managed in ITU

5 RELATIVE CONTRA-INDICATIONS FOR NIV

In the following situations, formal invasive ventilation is likely to be more effective treatment and should not be delayed by attempting NIV (unless NIV is being used in Critical Care). NIV may be used despite the presence of these contraindications if it is to be the 'ceiling' of treatment, and is appropriate treatment in relation to the patient's quality of life.

- **Life Threatening Hypoxia due to pneumonia relative to the patient's normal respiratory function but potential for respiratory acidosis to occur (e.g. severe underlying COPD)**
- **Impaired Consciousness (GCS < 8)**

A significantly reduced level of consciousness impairs the ability of the patient to protect the upper airway. Management on HDU/ITU may be more appropriate in this situation +/- invasive ventilation.

- **Copious Respiratory Secretions**

Chest physiotherapy may help mobilise these secretions. Within a critical care setting, minitracheostomy can be considered to aid secretion removal.

- **Confused or Agitated Patient.** If present before NIV commenced, review the underlying cause for presentation. If agitated DUE to NIV, check the patient for complications of treatment (including NIV with Pneumothorax), recheck NIV equipment, and if excluded, consider a small dose of opiate (e.g. 2.5 – 5mg oral morphine / 2.5mg IV). Higher or repeated doses mandate a discussion with senior medical staff +/- Critical Care.

6. HOW TO SET UP NIV

6.1 Equipment Required

- **Appropriate nursing area (i.e. only A&E, ITU or Ward 5)**
- **Patients should be referred to the oncall Anaesthetic/ITU team or via Critical Care Outreach if during daylight hours PRIOR to starting NIV if Intensive Care / Ventilation may be appropriate**
 - **ITU Middle Grade bleep 3933, Consultant 3945, Outreach 6321**
- NIV machine
- Oxygen supply/suction facilities
- SaO₂ and ECG monitoring equipment.
- Tubing, facemask (appropriately sized) – NIV mask pack.
- IPAP/EPAP settings and changes, time on NIV and blood gases must be documented on the NIV Monitoring Chart (Appendix 1).
- A trained member of staff in NIV set-up

6.2 Appropriate Initial Settings are (See Flow Chart – Page 16):

In a patient with underlying COPD, appropriate initial settings would be;

- Mode Spontaneous/Timed (S/T)
- IPAP 15cm H₂O
- EPAP 4cm H₂O
- FiO₂ Aim for saturations of 88-92%
- BPM Backup Breaths per minute of 12
- I:E ratio 1:1.5 - For COPD 1:2 (may need 1:3 for longer expiration)

6.3 Procedure for setting up NIV

- See Table 1.

7. HOW TO MONITOR NIV

7.1 Monitoring

- Monitoring should include a mixture of physiological measures and clinical parameters. These parameters should be used in decisions regarding on-going treatment.
- The following should be recorded⁶
 1. Observations:
 - Respiratory Rate, Heart Rate
 - Level of Consciousness, Patient Comfort
 - Chest Wall Movement, Accessory Muscle use, Ventilator Synchrony (chest wall movement in time with support from ventilator), Mask Fit
 2. Frequency of Observations:
 - Every 15 minutes for the first hour
 - Every 30 minutes for 1-4 hours
 - Hourly in 4-12 hour period

The frequency of observations in the first few hours is vital in order to deliver treatment safely. This may necessitate extra staff during this period to comply with recommended guidance.

3. Continuous Pulse Oximetry whilst on NIV and ECG recording in first 12 hours if HR >120, dysrhythmia or cardiomyopathy

4. Arterial Blood Gases (ABG)

- After 1 hour of NIV, and 1 hour after every change in ventilator settings.

7.2 Signs that NIV is Effective

- pH normalising/ PaCO_2 decreasing
- PaO_2 improving (aim for SaO_2 88-92%)
- Reduced respiratory rate in the setting of a clinically improving patient.
- Good synchronisation (patient and ventilator breaths delivered in time (not 'fighting the ventilator')

Improvement in AECOPD, improvement in ABGs in the first few hours has been shown to predict the likelihood of success in preventing intubation or death.

If there is no improvement after one hour, optimise ventilator settings. Be mindful of patient's normal ABGs – if known, aim for the patient's normal physiology.

7.4 Optimising NIV (Refer to Flow Chart – Page 16)

- Reduce paCO_2 and acidosis by increasing the IPAP further (in 2-4 $\text{cm}/\text{H}_2\text{O}$ increments). The **IPAP should be increased at 2-5 cmH_2O every 10 minutes**

until the target pressure is reached or until maximum patient tolerability is reached. Lower pressures are better tolerated. Also check the equipment to ensure it is working and there is no significant leak.

- Oxygenation may be improved by increasing the EPAP (to maximum 10 cm/H₂O) and/or inspired O₂. Remember to increase IPAP by a similar amount, maintaining an IPAP-EPAP gap of at least 6cm H₂O.
- ABGs need to be repeated 1 hour after any changes in NIV settings or oxygen flow rate to determine treatment effectiveness.
- If paCO₂ is acceptable on NIV and SaO₂ controlled, then serial ABGs may not be necessary.
- Perform ongoing observations as in Table 2.

7.5 Continuing Medical Care

- **In areas/cases of uncertainty, discuss early with seniors / Respiratory**
 - The patient must be discussed with the Respiratory Team the next working day.
 - If there is no response after 6 hours of optimal ventilatory support, the likelihood of subsequent success is small and other management should be considered.
 - If the patient is improving, maximise usage during the first 24 hours – especially during the first night and wean slowly the next day. Further nocturnal support may be required. NIV can be discontinued in AECOPD after normalisation of pH and paCO₂ and a general improvement in the patient's condition.
 - Allow 15-20 minute breaks to encourage diet, drinks, oral hygiene, nebulisers and oral medication (ensure adequate supplemented oxygen to maintain oxygen saturations of 88-92%).
 - Prior to discharge the patient must be reviewed by a Respiratory Consultant, have ABGs on air and have appropriate follow-up arrangements as deemed necessary by Respiratory.
 - Respiratory Team may refer for sleep investigations (overnight oximetry/TOSCA), or domiciliary NIV. Further specialist review by RIE Sleep Department or WGH Home Ventilation Team should be requested to consider this further.
 - Where possible, given the high risk of future possible episodes of type 2 respiratory failure needing NIV, discuss with patients and relatives their wishes for future presentations and resuscitation status.

8. Staff Training

- All staff involved in the provision of NIV must ensure they receive appropriate training.
- Staff must have demonstrated appropriate level of competence.
- An ongoing training programme will be available in all acute hospitals providing NIV.
- Training will be required for :
 1. All registrars responsible for the acute medical intake.
 2. Staff nurses and sisters on the Respiratory Wards

Junior Doctors on Ward 5 managing NIV are more than welcome to attend training sessions and complete online learning

Audit

- Regular Audit against the guidelines will be undertaken by the Respiratory Team on a yearly basis, taking action on results as required
- BTS Audit tools will be used for audit.
- Audit should focus on organisational issues such as training.

9. ACKNOWLEDGEMENTS

Thanks to Dr K Lewis, Swansea and Joe Annandale (Respiratory Nurse Specialist) for loaning their guidelines which have provided a basis for these.

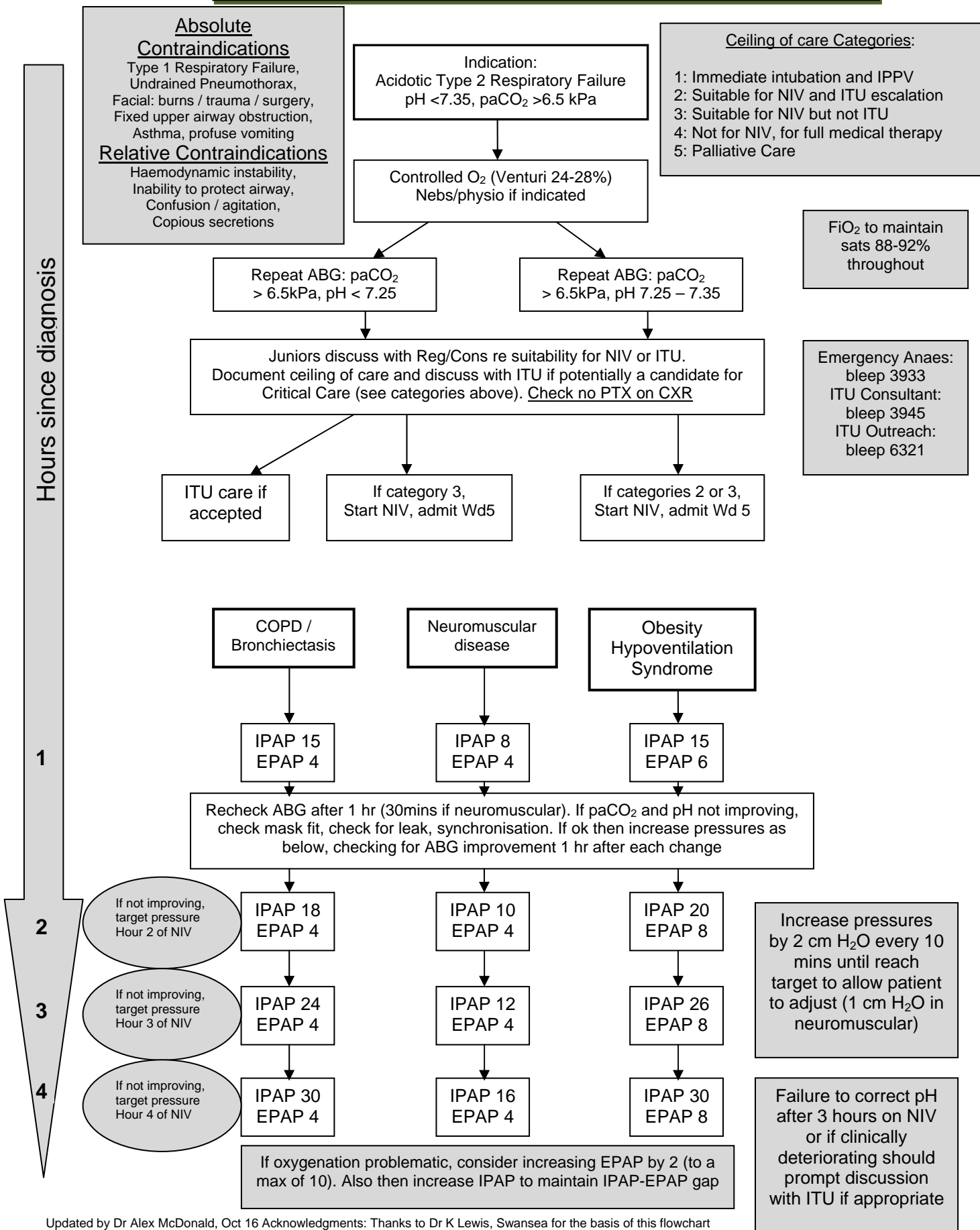
10. TABLE 1

ACTION	RATIONALE
Ensure ward emergency equipment is available	To provide a safe environment
Patient discussed with nursing staff and medical staff at all times	To ensure NIV is the appropriate intervention and support is available.
Ensure the NIV Prescription Chart has been fully completed with an appropriate prescription (see initial recommended settings).	To ensure appropriate settings are maintained
Explain procedure to patient positively and calmly. 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 with recommended initial settings.	To prevent contamination of the machine.
Check the size of the mask which must fit firmly and not encroach into corners of the eye.	To ensure a good seal and prevent leaks.
Ensure oxygen is connected and turn the machine on and prescribed.	To commence treatment and provide oxygen supply.
Ask the patient to breathe in and out whilst holding the mask to patient's face.	To re-assure patient and allow acclimatisation.
Attach head straps – the mask should be firmly in place but not tight and small leaks may be acceptable.	Minimise leaks
Ensure the exhalation port is not blocked.	To prevent build up of CO ₂ .
Document a set of observations	Provide a baseline for assessing progress.

11. TABLE 2

ACTION	RATIONALE
Patient should be closely observed	To provide reassurance and aid compliance
<p>The following observations should be documented at least each hour or if changes have been made to settings:</p> <ul style="list-style-type: none"> ▪ Oxygen flow (check as prescribed on NIV prescription chart) ▪ Oxygen saturation ▪ Heart rate ▪ Respiratory rate ▪ Exhalation port is not blocked ▪ NIV settings as instructed on NIV prescription chart 	<p>To check the patient is receiving the appropriate oxygen therapy. Should meet target saturations of 88-92%</p> <p>Monitor for signs of improving ventilation. If SaO₂ are dropping ensure no evidence of excessive leaks.</p> <p>Monitoring for signs of changing condition.</p> <p>Monitoring for signs of changing condition</p> <p>To monitor synchrony, work of breathing and changing clinical condition</p> <p>Check no undocumented changes have been made.</p>
<p>The following assessments should be made at regular intervals:</p> <ul style="list-style-type: none"> ▪ Enquire about patient's concerns 	<p>Anxiety, discomfort, intolerance – some patients find the mask and the rush of air claustrophobic</p>
<ul style="list-style-type: none"> ▪ Check nasal bridge 	<p>Nasal bridge sores – if the mask is too tight this can lead to pressure sores on the bridge of the nose. Loosen mask, consider dressing.</p>
<ul style="list-style-type: none"> ▪ Enquire about nasal dryness 	<p>Nasal dryness, congestion and streaming – these can occur in some patients. Consider nasal sprays/humidification to improve tolerance and compliance.</p>
<ul style="list-style-type: none"> ▪ Enquire about eye irritation 	<p>Eye irritation – due to leaks from the mask, re-fitting of the mask may be indicated.</p>
<ul style="list-style-type: none"> ▪ Assess nutrition 	<p>Reduced ability to eat/drink – patients must not eat or drink whilst the mask is on and connected to NIV due to the risk of aspiration.</p>
<ul style="list-style-type: none"> ▪ Enquire about abdominal bloating 	<p>Stomach inflation with air/trapped wind – some patients swallow air.</p>

BGH Acute NIV Guidelines 2016



Updated by Dr Alex McDonald, Oct 16 Acknowledgments: Thanks to Dr K Lewis, Swansea for the basis of this flowchart

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14. APPENDIX 1

NIV Monitoring Chart

Date:

Day on NIV:

Diagnosis:

Addressograph

	Pre-setup	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
NIV																									
Mode																									
IPAP																									
EPAP																									
FiO ₂ / Litres																									
BPM																									
Ti																									
TPR																									
RR																									
SaO ₂																									
HR																									
BP																									
ABG [A]																									
pH																									
PaO ₂																									
PaCO ₂																									
HCO ₃																									
SaO ₂																									

* Pre-set up observations/ABG must be documented

* The patient must be reviewed by medical staff after 30-60 minutes following set up and ABG repeated at 60 minutes

* Aim for SaO 88-92%