Worcestershire Acute Hospitals NHS Trust

GUIDELINES FOR THE USE OF NON-INVASIVE VENTILATION (WARD-BASED BiPAP)

This guidance does not override the individual responsibility of health professionals to make appropriate decisions according to the circumstances of the individual patient in consultation with the patient and/or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

These guidelines have been developed to assist health care professionals in the use of Ward Based Bi-Level Non-Invasive Ventilation (NIV) for the management of Acute Acidotic Hypercapnic (Type II) Respiratory Failure, including patients with Chronic Obstructive Pulmonary Disease (COPD) not responding to maximal medical treatment. It provides indications as to those patients for whom NIV may be appropriate, contraindications, potential complications and specific care for a patient undergoing NIV.

NIV is the delivery of mechanical pressure to support the patient's inspiratory effort via a full face mask, nasal mask, nasal pillows or hood. Application of IPAP and EPAP decrease the work of breathing thereby improving alveolar ventilation and facilitating oxygenation without raising $PaCO_2$. There is a range of evidence indicating that the use of NIV reduces $PaCO_2$, eases breathlessness, reduces the need for intubation, reduces hospital stay and reduces in-patient mortality, in COPD patients with decompensated respiratory acidosis despite maximal medical therapy [*Roberts et al,* 2008, *Bott et al*, 1993; *Brochard et al*, 1995].

These Trust guidelines are based on the current British Thoracic Society Guidelines on Non-Invasive Ventilation in Acute Respiratory Failure [*BTS Guideline,* 2016] and Non-Invasive Ventilation in Chronic Obstructive Pulmonary Disease: Management of Acute Type II Respiratory Failure [Roberts *et al,* 2008]. They incorporate the NICE Quality Standard, "*people admitted to hospital with an acute exacerbation of Chronic Obstructive Pulmonary Disease and with persistent acidotic ventilatory failure are promptly assessed for, and receive, non-invasive ventilation delivered by appropriate trained staff in a dedicated setting*."

This guideline is for the use by the following staff groups:

All Doctors, Registered nurses and physiotherapists who deal with patients requiring ward based NIV.

Lead Clinicians

Andrew Crawford	Consultant Respiratory Medicine WRH
Kate Spolton	Specialist Respiratory Physiotherapist WRH

Approved by Respiratory Directorate on:	28th September 2022
Approved by Medicines Safety Committee on:	14th December 2022
Review Date: This is the most current document and is to be used until a revised version is available	14th December 2025

Key amendments to this guideline

Date	Amendment	By:
16.6.14	Addition of BiPAP to title	Dr S Deacon
Dec 2016	Document extended for 12 months as per TMC paper approved 22nd July 2015	TMC
Nov 2017	Document extended whilst under review	TLG
Dec 2017	Sentence added in at the request of the Coroner	
01.05.18	Abbreviations list updated	Dr S Deacon
	Ward areas supporting NIV changed, in line with ward SOP	Dr S Deacon
	Reference made and cross reference to ward SOP WAHT-RES-020	Dr S Deacon / Sally McNally
	Separation of absolute and relative contraindications	Dr S Deacon
	Machine makes specified and delivery of % oxygen noted	Dr S Deacon
	Indication pCO2 changed to pCO2 > 6.5 as per BTS guidelines 2016	Dr S Deacon
	Increase in initiating and target IPAP pressures (page 7)	Dr S Deacon
	Maximal EPAP pressure added (page 7)	Dr S Deacon / Sally McNally
	Inclusion of oxygen wrist bands for safe oxygen prescribing	Dr S Deacon / Sally McNally
	Addition of back up rate as per BTS guidelines	Dr S Deacon / Sally McNally
	Updated “Nursing Care” and “Trouble Shooting” (Appendix 2)	Sally McNally
	Removal of “Weaning Stage 4” and “NIV Weaning Plan” flow chart (see Appendix 3)	Sally McNally
	Guidance for initiation, weaning and referral for patients with neuromuscular disease NMD and OHS (weaning page)	Sally McNally
	Initiation page renamed “proforma”, new Appendix 1	Sally McNally
June 2020	Document extended for 6 months during COVID-19 period	
Nov 2021	Document extended during current period whilst document is reviewed	Dr S Deacon
15.07.22	Kate Spolton added as key contributor to document Abbreviations list updated Circulation list updated	Dr S Deacon Kate Spolton
15.07.22	Respiratory ward base WRH changed from Laurel 2 to Acute Respiratory Unit (ARU)	Dr S Deacon
15.07.22	Clinical lead at the Alex changed to Dr Abhi Lal	Dr S Deacon

15.07.22 Page 6	Respiratory rate added to inclusion criteria as per BTS/ICS guidelines NEWS2 scale 2 for COPD patients added to maximal medical therapy	Dr S Deacon
15.07.22 Page 7	Update to absolute contra-indications: ward-based NIV in Covid positive patients only in “Red Covid Zone” Guideline for AGPs added Update to relative contra-indications: Covid positive patients who have failed CPAP	Dr S Deacon Kate Spolton
21.07.22 Page 8	Update of BiPAP machines available within Trust: Trilogy Updated DNAR form to ReSPECT Addition of Interim Covid-19 Pandemic Guideline and AGP guideline Addition of respiratory in-reach service at WRH and ANP bleep	Dr S Deacon Kate Spolton
21.07.22 Page 9	Inclusion of best practice respiratory ward morning board round NIV check criteria	Dr S deacon
21.07.22 Page 10	Addition of the use of 2 filters and non-vented mask post Covid-19 Percentage oxygen delivery used for compatibility with Trilogy machines Addition of Trust oxygen prescribing policy WHAT-RES-001 NIV PI sheet and reference added WHAT-PI 0060	Dr S Deacon Kate Spolton
21.07.22Page 12	Clarification of acceptable pO_2 level; cor pulmonale or heart failure; pO_2 > 8.0 on ABG Withdrawal guideline added; *Guideline for the Withdrawal of Non-Invasive Respiratory Support (NIV/CPAP) In Patients with Proven or Suspected COVID-19*	Dr S Deacon
21.07.22	Appendix 2 added: Task Specific Respiratory Adjuncts: WAHT Guideline for ward based use of AGP and adjuncts in Adults 2021 Appendix numbers changed with addition of new appendix References updated	Dr S Deacon Kate Spolton
27.07.22	Update Competencies Document Appendix 5	Kate Spolton
02.08.22	Medical High Care removed from high flow oxygen locations	Kate Spolton
02.08.22	Infection control change inlet filter on EVO prior to each new patient use, change at 3 months for trilogy 202	Kate Spolton

Abbreviations Used within this document:

ABG	Arterial Blood Gas
AECOPD	Acute exacerbation of COPD
AGP	Aerosol Generating Procedure
AHRF	Acute Hypercapnic Respiratory Failure
ARU	Acute Respiratory Unit, WRH
BiPAP	Bi-level Positive Airway Pressure (use of 2 levels of pressure support)
BTS	British Thoracic Society
bpm	beats per minute (heart rate)
CBG	Capillary blood gas
CCU	Coronary Critical Care
CF	Cystic Fibrosis
COPD	Chronic Obstructive Pulmonary Disease
Covid	Coronavirus (COVID-19)
CPAP	Continuous Positive Airways Pressure
DNAR	Do Not Attempt Resuscitation
ECG	Electrocardiogram
EPAP	Expiratory Positive Airway Pressure
FiO_2	Fractional inspired concentration of oxygen
IPAP	Inspiratory Positive Airway Pressure
IMV	invasive Mechanical Ventilation
ICU	Intensive Care Unit
IE ratio	Inspiratory/expiratory time ratio
NIV	Non-Invasive (positive pressure) Ventilation
NMD	Neuromuscular Disease
mg	milligrams
OHS	Obesity hypoventilation syndrome
OOHNP	Out of Hours Nurse Practitioner
$PaCO_2$	Partial pressure carbon dioxide in blood (Kpa – Kilopascal)
PaO_2	Partial pressure oxygen in blood (Kpa – Kilopascal)
pH	“Potential of Hydrogen”, measure of hydrogen ion concentration; acidity or alkalinity
RHC	Respiratory High Care
RR	Respiratory Rate
SOP	Standard Operational Policy
SpO_2	Oxygen Saturation
ST/SpR	Specialist Trainee Doctor
VC	Vital Capacity

Competencies Required

Non-Invasive (positive pressure) Ventilation (NIV) is a medical intervention and can only be requested by medical staff.

NIV set up, or alteration in settings, must be by a health care professional (Doctor, Qualified Nurse or Registered Physiotherapist), who has received in-house training and achieved appropriate skill based competencies in the procedure (*Appendix 5*). NIV training will be offered to all acute medical ST2 and above doctors.

Patients Covered

These guidelines cover all adult in-patients who require ward-based NIV. The resources available to deliver NIV are limited.

In order to aid best practice, ward-based NIV should only be used on A&E; designated respiratory high care (RHC) beds: Acute Respiratory Unit (ARU) WRH or Ward 5 Alexandra Hospital (Marlow Unit) and Intensive Care Unit, where appropriate monitoring and nursing ratios are available, as per guidelines.

Patients commenced on NIV should be discussed with the ward sister on ARU or ward 5 and transferred within the hour to RHC, as per the respiratory ward SOP WAHT-RES-020.

Where, in the patient's clinical interest, NIV is commenced in an inappropriate area, the bed manager must be notified prior to commencing NIV so that the patient can be transferred to one of the designated areas immediately.

Receiving wards must be given advance warning that a patient needing NIV is being transferred, to allow for review of the ward staffing levels. **The recommended staffing ratio is 1 nurse to 2 NIV patients, for at least the first 24 hours of NIV** [Oct 2008].

In exceptional clinical circumstances, such as the event of the patient being infective, or designated beds are occupied, appropriate nursing staff may need to be seconded to another ward.

Transfer to Respiratory High Care should not occur until appropriate discussion and handover with a senior nurse on the appropriate ward, ARU or ward 5.

In the event that a machine is not available, a NIV machine can be requested from another hospital site.

Clinical leads

WRH Dr Andrew Crawford

Alex Dr Abhi Lal

Guideline

1. Inclusion Criteria

Acute Hypercapnic (Type II) Respiratory Failure (AHRF), after an hour of optimal medical therapy*, defined as persistent:

- Acidosis, pH < 7.35,
- Upward CO_2 trend, *$PaCO_2$ ≥ 6.5 kPa (consider in patients with $PaCO_2$ 6.0-6.5 kPa),*
- Respiratory rate >23 breaths/mins
- able to protect airway
- conscious and cooperative
- potential for recovery to acceptable quality of life

Patient groups who should be offered NIV include:

- Acute exacerbation of COPD (AECOPD) with persistent hypercapnic respiratory acidosis (*pH 7.25 - 7.35, $PaCO_2$ ≥ 6.5*), after immediate maximal standard medical therapy*.
- Acute Hypercapnic Respiratory Failure due to:
  - chest wall deformity,
  - neuromuscular disease, *refer to respiratory ward SOP*
    consider if acutely unwell, VC < 1L and RR > 20, even if normocapnic, intubation should not be delayed if IMV appropriate
  - obstructive sleep apnoea or obesity hypoventilation syndrome (OHS)
  - non-CF bronchiectasis,
  - cardiogenic pulmonary oedema, unresponsive to CPAP and medical therapy.
- Respiratory "exhaustion"
- Patient with pH < 7.25, and $PaCO_2$ > 6.5, **who are not for escalation** beyond ward based care

***Optimal standard medical therapy for patients with AHRF due to AECOPD, for no more than 1 hour. Aim to commence NIV within 1 hour of abnormal blood gas result:**

- Controlled oxygen therapy, to achieve SpO_2 88-92%, preferably using Venturi mask
  - **All known COPD patients should be on NEWS2 scale 2; SpO2 88-92%**
- Nebulised salbutamol, 2.5 - 5 mg, every 10 - 20 mins for 1st hr, as clinically indicated
- Nebulised ipratropium, 500 micrograms
- Corticosteroid, oral prednisolone 30-40 mg
  or intravenous hydrocortisone 100-200 mg
- CXR to exclude pneumothorax and review of CXR documented on NIV proforma.
  CXR should not delay NIV in severe acidosis
- Antibiotics, if indicated.

It is recognised that there may be other patients who may benefit clinically from NIV, but do not meet the usual criteria for ward-based treatment. Where this is the case, NIV should still be considered but must be provided in a high dependency area, under the direction of a Consultant in Respiratory Medicine or Intensive Care.

Escalation of care:

In patients with **pH < 7.25, and *Pa*CO_2 > 6.5**, escalation of care should be discussed with critical care at the time of or soon after commencement of NIV (NIV should not be delayed).

NIV may be considered as a ceiling of care for these patients, advice can be sought from the Respiratory Physicians (week day working hours 9am – 5pm) or from ICU.

Use of NIV should not delay escalation to intubation and mechanical ventilation (IMV) when this is more appropriate.

2. Contra-indications

Ward-based NIV is **contraindicated** in the following circumstances:

Absolute contra-indications

- Ward-based NIV for Covid positive patients should only be commenced within designated "Red Covid Zones" *(Trust Covid-19 Respiratory Key Documents for AGP guidelines; Appendix 2)*
- Unable to maintain / protect airway, e.g. coma or bulbar diseases [*Simonds*, 1997]
    - *Use of a Guedel airway can be considered*
- Unstable airway e.g. recent facial or upper airway surgery or burns
- Life threatening hypoxia; especially in association with acute asthma (see below)
- Pneumothorax, unless an intercostal drain in place.
- Fixed upper airway obstruction

Relative contra-indications

- Covid positive patients who have failed a trial of CPAP, developed type 2 respiratory failure and are not for escalation to ITU
- Multi-system failure or haemodynamic instability, (where monitoring in critical care/ICU is required)
- Patient unable to co-operate with NIV, e.g. due to confusion or dementia
    - *although NIV can support confusion/coma secondary to COPD-induced hypercapnia [Simonds, 1997],*
- Severe co-morbidity; including end-stage cardiac failure or pulmonary fibrosis, respiratory failure as the end stage of prolonged hospital admission due to unresolvable medical or surgical issues, or moribund patients
- Patients with neuromuscular disease (NMD) and bulbar dysfunction, as NIV delivery may be difficult and is more likely to fail. Senior staff should be involved in decision making

NIV should be **used with caution**:

- Copious secretions,
- Vomiting,
- Bowel obstruction,
- Naso-gastric feeding,
- Gross bullous lung disease,
- Life-threatening hypoxia, *Pa*O_2 < 8 kPa on the maximum dose of oxygen.

Machines available

WAHT has 2 models of acute BiPAP machines available, *Philips Trilogy 202 and EVO.*

While the Trilogy can provide up to 100% inspired oxygen, **NIV is not the treatment of choice in type 1 respiratory failure**. Its use may lead to an undesirable delay in intubation (IMV).

Use of NIV should not delay escalation to IMV when this is more appropriate.

Continuous Positive Airways Pressure (CPAP) is a more appropriate option for type 1 respiratory failure. There is a separate policy for CPAP, which is held on ICU.

High flow oxygen is available within Respiratory on both sites, as well as ICU and surgical high care (HHNC Treatment Pathway WAHT TP 011)***.***

3. Setting-up and Monitoring NIV

A decision to commence NIV must be made by a doctor (ST3 or above).

An **NIV Initiation Proforma MUST** be completed and signed by an appropriate doctor (*Appendix 1*), documenting the indication and time when the decision to initiate NIV is made.

> ***A decision regarding the patient's further management and escalation of care, should NIV fail, must be agreed before commencing NIV and must be documented in the patient's notes. Appropriate "DNAR" ReSPECT form should be discussed and signed.***

Covid-19 Specific Guidance

All patients require a Rapid Covid PCR swab which must be taken at the earliest indication that NIV may be required.

PCR results should be awaited and reviewed prior to initiating NIV for clinically stable patients. All patients should receive 60 minutes of medical management whilst awaiting result.

If positive Covid PCR and need for NIV is established, patients should be moved to an appropriate clinical area prior to initiation (*Table 1)* (also *see Trust Covid-19 Respiratory Key Documents for AGP guidelines; Appendix 2*).

Table 1: Clinical area for Covid positive patient NIV Initiation

Worcester Royal Hospital	
Negative	**Positive**
ARU High Care	ARU Red AGP area
Alexandra Hospital	
Negative	**Positive**
Marlow Unit	Red AGP area on Ward 5

If Covid PCR results are unavailable and the patient need is clinically urgent and deemed to be unsuitable to wait, COVID-19 risk should be considered by senior medical team and NIV commenced in clinical areas outlined in table 2.

Table 2: Clinical area for URGENT patient NIV Initiation before Covid PCR available

Worcester Royal Hospital	
Low Clinical Suspicion	**High Clinical Suspicion**
Can be started in ED high care pods with senior medical approval whilst awaiting PCR	Move to ARU Red Side room to start NIV whilst awaiting PCR
Alexandra Hospital	
Low Clinical Suspicion	**High Clinical Suspicion**
Ward 5 Side Room/ED Side Room dependent on availability	Ward 5 Side Room/ED Side Room dependent on availability

Once result is known patient should be moved to appropriate clinical area as above.

NIV must be initiated by a qualified health care professional who has received in-house training and achieved appropriate competencies *(Appendix 5*). NIV at WRH will be set up and initiated by the respiratory physiotherapists (Bleep 303) and at the Alex, by the Respiratory Nurse Specialists or nurses based on Ward 5 Respiratory Support Unit (Marlow Unit ext 47975). Critical Outreach and OOHNP may have appropriate competencies.

During normal working hours (9-5), the respiratory SpR or consultant should be made aware of any patient commencing NIV. There is not a dedicated respiratory on-call service within the trust but any concerns should be discussed with the ward team.

Out of hours, the patient should be discussed with the on-call medical registrar.

As soon as the need for NIV has been identified, the respiratory wards should be informed that a high care bed is required. At WRH contact the Respiratory ANP (Bleep 170) in hours (08:30-16:00) as well as contacting ARU. Out of hours contact ARU directly. At the Alex contact Marlow Unit directly (ext 47975).

Patient Transfer

All patients on NIV should be transferred immediately to an appropriate bed and ward space (*WAHT-RES-020).*

It is recommended that patients on NIV at the Alex are transferred to ward 5 within the hour. Transfer to WRH Respiratory High Care should not occur until after appropriate discussion and handover with a senior nurse on ARU. (WAHT-RES-020)

If a patient on NIV is not on RHC, the respiratory team should be informed as soon as possible the next working day**.** A member of the respiratory team should be spoken to directly, or patients should be high-lighted to the morning "Respiratory In-reach" service at WRH (*Bleep 170)*.

Respiratory Morning Board Round should include the following best practice assessment questions;

- the identification of any patients on NIV outside of RHC
- number of NIV machines in use and escalation plan to ensure adequate machines
- staffing levels within RHC to support acute NIV (1:2 band 6 nurses per acute NIV)
- escalation plan for next NIV bed / step-down plan
- current status of blood gas machine (errors, calibration)

Initiating NIV with Trilogy Machine::
For use in Covid-positive or suspected case see Trust Covid-19 Respiratory Key Documents for AGP guidelines; *Appendix 2**

- **Baseline arterial (ABG) or capillary (CBG) should be documented, if available**
- Position patient comfortably – as upright as possible
- ***Use 2 viral/bacterial filters***: One in between mask and exhalation port on tubing and one at the other end between tubing and machine. **Ensure exhalation port in circuit tubing is not obstructed.**
- Use a ***non-vented*** full or total face mask for first 24 hours if possible, fitted correctly with air leak < 40. A range of masks and sizes are available.
- Start with IPAP 15 cmH_2O and EPAP 4 cmH_2O
- Increase IPAP by **increments of 2-5 cmH_2O every 10 - 20 minutes**, aiming for a pressure target of 20-24 cmH_2O (can go up to 30 cmH_2O), until clinical improvement achieved or patient tolerance has been reached. In patients with OHS high pressure are often required (IPAP > 30, EPAP > 8)
- EPAP can be increased to a maximum of 8 (see trouble shooting guide, *Appendix 3*)
- Backup rate should be set at 10 breathes per minute (adjust inspiratory time to 2 seconds or appropriate to patient)
- Percentage oxygen delivery should be adjusted to achieve target oxygen saturations, SpO_2 88-92% in all cases of AHRF. NIV setting should be optimised before increasing FiO_2
    - *Target SpO_2 should be prescribed on the drug chart, SpO_2 88-92%, as per Trust Oxygen Policy (WHAT-RES-001 Guideline for the Prescribing, Monitoring and Administration of Oxygen in Adults).*
- Aim for continuous use for the first 24 hours, with breaks only for food, drink, skin and mouth-care
- Nebulised bronchodilators can be administered without interruption of NIV, via a T-piece in the circuit or during breaks from NIV during weaning
- If a nasogastric tube is required, a fine bore is preferable to minimise air leak
- Provide “NIV: Patient Information Sheet” to patient and family (WHAT-PI 0060)

Monitoring NIV

- A member of the medical team **must review the patient within 1 hour of initiating NIV**, including a repeat blood gas, ABG or CBG).
- ABG/CBG should be repeated:
    - **1 hour after any change of settings** (following initial set up)
    - **4-6 hours following commencement** of treatment, or earlier in patients who are not clinically improving
    - *All ABG/CBG result slips must be mounted on appropriate mount sheets for scanning, stating oxygen flow and NIV settings as appropriate*
- Further invasive monitoring should only occur if clinically indicated
- Pressure settings should be altered in accordance with blood gas results and recorded initially on the NIV Initiation Proforma and then on the high care/ICU chart (available in RHC or Marlow Unit)

- Continuous oxygen saturation monitoring
- ECG monitoring for at least the first 12 hours and continued if pulse rate >120 beats per minute (bpm) or any dysrhythmia or possible cardiomyopathy
- Additional monitoring must be completed hourly, as per 24 hour high care/ICU/ NEWS chart. Observations should include:
    - NIV-ON
    - IPA/EPAP
    - O_2 (FiO_2)%
    - Mask Fit/Leak,
    - Respiratory Rate,
    - Heart Rate,
    - Conscious level.
- Any health care professional adjusting settings must have completed in-house NIV competencies (*Appendix 5*)
- All patients using NIV must be reviewed **at least once a day** by a consultant week days and by an ST3 doctor or above, during the weekend

Optimising NIV:

Patients who are improving with NIV in the first 4-6 hrs should receive continuous NIV as much as possible during the first 24 hrs. NIV should not be stopped in first 24 hrs even if pH normalises.

- **If ABGs improve (reduced *p*CO_2)**
  Continue NIV at current settings as tolerated with minimal interruption for 24 hours.

- **If no change, failing to respond adequately or deteriorating**
  Follow the troubleshooting guide (A*ppendix 3*), aiming to optimise NIV treatment.

  If the patient continues to deteriorate, an urgent medical review should be sought with consideration of escalation and ICU involvement if appropriate.

- **Safe sedation**
  Sedation or anxiolytics may be required, and is safe under close monitoring, to ensure adequate ventilation in distressed or agitated patients, see trouble shooting guide (A*ppendix 3*).

4. Weaning

Care should be taken in patients with or suspected neuromuscular disease. Advice from the respiratory team should be sort and the patient should be transferred to RHC before weaning is commenced. Nocturnal NIV may be required after an episode of AHRF and referral to a tertiary centre for consideration of home ventilation may be required.

Patients with OHS may also require long-term domiciliary support (NIV or CPAP) and referral to the respiratory team for home ventilation is recommended.

The following weaning plan is for patients with COPD. NIV treatment should continue until the underlying acute cause has resolved (commonly 3-4 days).

Weaning (*Appendix 4*) should be considered after 24 hours of NIV if ABG/CBG show:

- normalisation of pH (pH ≥ 7.35)

  and

- improvement of $PaCO_2$ (pCO_2 < 6.5)

  or acceptable for patient based on baseline blood gas, if known

- with acceptable PaO_2

  COPD alone: pO_2 > 7.3 on ABG;

  with evidence of cor pulmonale or heart failure; pO_2 > 8.0 on ABG

Weaning should begin during the day and NIV should not be stopped abruptly. If this is over a weekend, a clear "weekend plan" should be documented in notes and on the RHC chart.

When weaning the patient off NIV a daily plan, based on clinical findings and ABG/CBG, should be agreed by the clinical team and documented on the RHC chart and in the medical notes. If need be contact the respiratory team via the referral system for advice.

Treatment Failure: Escalation/Palliation

Once treatment has been optimised, ***failure to reverse acidosis and reduce $PaCO_2$ levels after the first 4-6 hrs is a poor prognostic sign,*** and the continuation of NIV should be reviewed by the medical team or a referral made to the respiratory team for review.

A decision should be made regarding escalation to invasive ventilation or withdrawal of NIV and palliation of symptoms, as discussed and documented at initiation of NIV.

Difficult weaning may be an indication for domiciliary / nocturnal NIV for some patients and this requires a respiratory team referral and consultant review.

NIV may be continued for palliation of symptoms, with support from the respiratory and palliative care teams. Patients must not be discharged on NIV without a consultant respiratory review.

NIV/CPAP withdrawal guidelines, in the context of Covid, may be helpful in the situation where withdrawal and palliation is more appropriate; *Worcestershire Acute Hospitals NHS Trust Guideline for the Withdrawal of Non-Invasive Respiratory Support (NIV/CPAP) In Patients with Proven or Suspected COVID-19*

5. Discharge planning

On discharge, COPD patients treated with acute NIV should be issued with an "Oxygen Alert Card" stating NEWS2 scale should be used in future admissions, aiming for SpO2 88-92%.

Follow up should be requested for COPD patients presenting with AHRF, via the respiratory secretaries or respiratory nurse specialist, to be seen in ventilation clinic in 4-6 weeks' time, with ABG/CBG and spirometry on arrival, where future use of NIV will be discussed.

6. Nursing Care

Pressure sores

Pressure sores across the nose bridge are a significant risk, especially if the mask is tight fitting. A degree of mask leak is acceptable and the mask should be fitted to obtain the best balance between leaks and mask comfort. If the patient can tolerate it, the mask should be removed for 10 - 15 minutes every 2 hours to relieve pressure (*Keilty and Moxham*, 1995). This will also provide opportunity for basic care needs. Should signs of pressure damage occur, check mask fit, consider loosening head straps and accepting a larger degree of air leak or try an alternative mask. A granuflex dressing can be used over the nose bridge as extra protection.

Abdominal Distension

Should patients suffer with abdominal distension when on NIV, insertion of a nasogastric tube should be considered. When weaning, avoid re-starting NIV for 2 hours following a meal, where possible (*Knebel et al*, 1997).

Air Leakage

Air leakage into the eyes can cause dryness and irritation and must be addressed by altering fit or style of mask

Fluid Intake

Patients on NIV easily become dehydrated (*Knebel et al*, 1997) and should therefore have their fluid balance monitored. IV fluids should be considered for any patient on NIV, especially those with a full-face mask in situ. The majority of patients should be able to tolerate short breaks from NIV for drinks and light meals (*Keilty and Moxham*, 1995). Patients using NIV may experience problems with clearance of secretions. Where this is a problem, consider nebulising sodium chloride 0.9% through the circuit, using a T-piece.

Nebulisers

Nebulised sodium chloride 0.9% can be given via a t-piece if secretions become thick and difficult to clear

Humidification

Humidification is not routinely required but should be considered if the patient reports mucosal dryness or if respiratory secretions are thick and tenacious.

Positioning

Patients should be nursed in a position which best assists breathing, e.g. high side lying, forward lean sitting or upright.

Poor cooperation

Patient may be unable to co-operate with NIV, due to confusion or dementia. NIV however can support confusion/coma secondary to COPD-induced hypercapnoea and should therefore be considered as treatment [Simonds, 1997]. Low dose sedation or anxiolytics may be used if needed – see trouble shooting guide *(Appendix 3)*

7. Infection Control

NIV tubing, masks, exhalation ports and headgear are for single patient use only.

The inlet filter must be checked prior to the machine being used. The inlet filter on Philips EVO must be changed prior to being used on a new patient. The inlet filter on Philips Trilogy 202 should be changed every 3 months or sooner if discoloured/dirty.

Two viral/bacterial filters must be used - One in between mask and exhalation port on tubing and one at the other end between tubing and machine. Nursing staff must change these filters daily.

Following use, the electrical equipment should be un-plugged and wiped clean with a disinfectant wipe before being returned to the store cupboard.

The electrical equipment must be serviced and checked for electrical safety yearly.

8. Monitoring Tool

The use of ward based NIV will be monitoring annually by the respiratory team, using the BTS Adult NIV audit tool and using these standards.

STANDARD	%	Clinical Exceptions
Patients using NIV meet the inclusion criteria.	100	None
Blood gases will have been done prior to commencing NIV and repeated within 2 hours of starting NIV.	100	None
NIV Initiation Page has been completed.	100	None
High Dependency / ICU observation charts have been completed	100	None

9. References

BTS/ICS Guidelines for the Ventilatory Management of Acute Hypercapnic Respiratory Failure in Adults. British Thoracic Society/Intensive Care Society Acute Hypercapnic Respiratory Failure Guideline Development Group. Thorax (April 2016) Volume 71 Supplement 2.

WAHT-RES-020: Operational and Admission Policy for the Respiratory Wards, including Admission into Respiratory High Care Areas (Respiratory High Care and Marlow Unit)

WHAT TP 011 HHNC Treatment Pathway

High Flow Guideline: http://nww.worcsacute.nhs.uk/departments-a-to-z/clinical-policies/respiratory-key-documents/

Bott J, Carroll MP, Conway JH, Keilty SE, Ward EM, Brown AM, Paul EA, Elliott MW, Godfrey RC, Wedizicha JA and Moxham J. (1993) Randomised controlled trial of nasal ventilation in acute ventilatory failure due to chronic obstructive airways disease. *Lancet* Vol. 341 p1555 - 1557

British Thoracic Society Standards of Care Committee (2002). British Thoracic Society Guidelines on Non-Invasive Ventilation in Acute Respiratory Failure. *Thorax* Vol 57 p192-211

Brochard L, Mancebo J, Wysocki M, Lofaso F, Conti G, Rauss A, Simonneau G, Benito S, Gasparetto A, Lemaire F, Isabey D and Harf A. (1995) Noninvasive ventilation for acute exacerbations of chronic obstructive pulmonary disease. *The New England Journal of Medicine* Vol. 333 p817-822.

Keilty SEJ, and Moxham J. (1995) Noninvasive ventilation in acute-on-chronic airways disease. Update in medicine. *Hospital Update* April 1995 p165-171.

Knebel A, Allen M, McNemar A, Peterson A and Feigenbaum K (1997) A guide to noninvasive intermittent ventilatory support. *Heart and Lung* Vol. 26 p307-316.

Meyer TJ and Hill NS (1994) Non-invasive Positive Pressure Ventilation To Treat Respiratory Failure. *Ann Intern Med.* Vol. 120 p760-770.

Pennock BE, Crawshaw L and Kaplan PD (1994) Non-invasive Nasal Mask Ventilation for Acute Respiratory Failure. *Chest* Vol. 105 p441-444.

Roberts M. *Royal College of Physicians, British Thoracic Society, Intensive Care Society* document. Chronic obstructive pulmonary disease: non-invasive ventilation with bi-phasic positive airways pressure in the management of patients with acute type II respiratory failure. (With particular reference to Bi-level positive pressure ventilation). Concise Guidance to Good Practice series, No 11. London RCP, 2008.

http://www.rcplondon.ac.uk/pubs/brochure.aspx?e=258

Simonds A. (1997) NIPPV in acute ventilatory failure. *Respiratory Disease in Practice* Autumn 1997 p14-16.

Clinical guide for the use of acute non-invasive ventilation in adult patients hospitalised with suspected or confirmed coronavirus during the coronavirus pandemic. Publications approval reference: 001559. 19 March 2020 Version 1

For further information see BTS website:

https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/non-invasive-ventilation-(niv)/

CONTRIBUTION LIST

Key individuals involved in developing the document

Name	Designation
Dr. Sarah Deacon	Consultant Respiratory Physician
Kate Spolton	Clinical Specialist Physiotherapist

Circulated to the following individuals for comments

Name	Designation
Dr. C Hooper	Consultant Respiratory Physician
Dr K Cusworth	Consultant Respiratory Physician
Dr B Barker	Consultant Respiratory Physician
Dr J Johnstone	Consultant Respiratory Physician
Dr A James	Consultant Respiratory Physician
Dr A Crawford	Consultant Respiratory Physician
Dr A Lal	Consultant Respiratory Physician
Dr SL Tan	Consultant Respiratory Physician
Dr R Hodson	Consultant A&E Medicine
Donna Bagnall	Critical Care Outreach Lead
Mini Isac	Ward manager ARU
Binju Jacob	Charge Nurse Marlow Unit
Lisa Walker	Ward Manager Ward 5 Alex
Clare Alexander	Matron Respiratory WRH
Marion Freeman	Matron Respiratory Alex
Donna Jeynes	Matron Urgent Care WRH
Marc Tarrant	Matron Urgent Care Alex
Emma Hurst	Respiratory Nurse Specialist – WRH
Jane Newport	Respiratory Nurse Lead

Circulated to the following CD's/Heads of dept for comments from their directorates / departments

Name	Directorate / Department
Dr S Bhardwarj	Clinical Director ICU
Dr J Walton	DCMO / Consultant A&E Medicine
Dr W Foster	Clinical Director Respiratory Directorate
Dr J Trevelyan	Medical Director

Appendix 1: NIV Initiation Proforma

Non-Invasive Ventilation – Initiation Checklist

Must be completed in FULL prior to NIV being commenced

Worcestershire Acute Hospitals NHS Trust

Location	**AGH**	
Location	**WRH**	

Please attach patient sticker here or record

Name: . . . . . .

Hosp No: | | | | | | | | | | |

NHS No: | | | | | | | | | | |

D.O.B: . . . / . . . . / . . . . . Male ☐ Female ☐

SAFETY CHECKLIST All below MUST be ticked 'Yes'

	Yes	No
Type II Respiratory Failure		
Optimal Medical Therapy (see Box 1)		
Oxygen requirement <60%		
No Contra-indications (see box 2)		
CXR – Reviewed		
CXR – No Pneumothorax (see box 2)		

SUITABILITY for NIV discussed with:

Consultant [ ] Middle Grade [ ] N/A [ ]

ED [ ] Resp [ ] Med [ ] ICU [ ]

INDICATION – Type II Respiratory Failure due to:

COPD	
Obesity / Hypoventilation	
Decompensated OSA	
Chest Wall / Neuromuscular Disease	
Cardiogenic Pulm Oedema - consider CPAP	
Other – state	

PATIENT FACTORS

CONSENT	By patient		Patient Unable to consent		Discussed with Relatives	
ESCALATION IF NIV FAILS			ICU / Intubation		Palliative / Supportive Care	
RESUSCITATION STATUS			For Resuscitation		Not for Resuscitation	

DNAR FORM Completed **[ ] No [ ] Yes** – date of form:

In hours, please try to discuss case prior to commencing NIV with a Respiratory Consultant or Registrar.
To commence NIV in hours; at WRH bleep 303 for the Respiratory Physiotherapist, out of hours contact switchboard.
At the Alexandra Hospital contact the Marlow unit on Ext.47975

TIMINGS (24hr clock)

NIV Decision	Resp Physio contacted	Initiation NIV	NIV Bed Request

To be completed by:

	Arterial Blood Gases	Date	Time	IPAP	EPAP	FiO_2	SpO_2	pH	PaO_2	$PaCO_2$	BE	HCO_3^-	
Physio	Pre NIV												
	Time for next gas			**Handed over to doctor** (name):									
Doctor	1-2 hrs on NIV												
	Actions post ABG												

Signed: **Print name:** **Designation:** **Date:**

Box 1: OPTIMAL MEDICAL THERAPY

- Controlled O_2 therapy (Venturi)
- Salbutamol Nebs
- Ipratropium Neb
- Corticosteroids
- Antibiotics

For COPD patients, print off COPD Bundle from Patient First Additional Documents section

Box 2: CONTRA-INDICATIONS TO NIV

Absolute

- Airway – not maintained eg. coma, bulbar disease
- Airway – potential to deteriorate eg. facial burns / surgery
- Airway – fixed obstruction
- Pneumothorax, unless chest drain in-situ

Relative

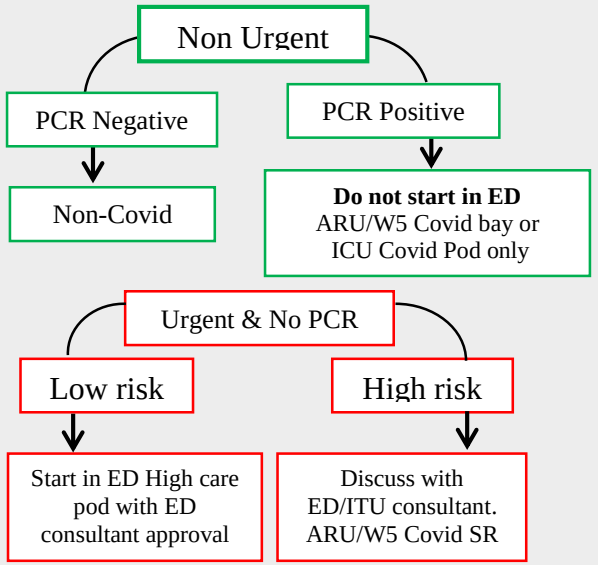
- Haemodynamic instability – consider ICU
- Multi-organ Failure – consider ICU
- Severe co-morbidity or moribund incl. end-stage pulmonary fibrosis/cardiac failure
- Type I Respiratory Failure – consider CPAP or High Flow Nasal Oxygen
- Life threatening HYPOXIA incl. acute asthma

Box 3: CAUTIONS TO NIV

- Patient unco-operative eg. Dementia/confusion
- Copious secretions
- Vomiting/ NG Feeding
- Bowel Obstruction
- Gross Bullous Lung Disease

Worcestershire Acute Hospitals NHS Trust

Appendix 2: Task Specific Respiratory Adjuncts: WAHT Guideline for ward based use of AGP and adjuncts in Adults 2021 (Version 8.0)

AGP	**Non – Covid pathway** Must have recent negative PCR No clinical suspicion of Covid	**Covid pathway** (includes Covid positive, Covid contact, clinically suspected COVID with false negative swab, patients awaiting PCR test)	
		Non AGP Area (eg Avon 3)	***AGP area (eg ARU/ Ward 5)*** ***AGP PPE: gown, apron, gloves, visor / eye protection, FFP3 mask***
Acute NIV / BiPAP See WHAT-RES-004 NIV guideline	***Rapid Covid PCR must be sent as soon as need for NIV is identified*** **Negative PCR test required** Should be started on ARU high care wherever possible Gloves, apron, FRSM and eye protection *If clinically urgent, after 60 mins medical management and unable to move to ARU, can be started in A&E high care pods following ED consultant approval with use of 2nd filter until able to be transferred.*	Should not be used	***Rapid Covid PCR must be sent as soon as need for NIV is identified*** **If possible, await result before starting NIV to allow transfer to appropriate setting.** 
Acute CPAP See WAHT Covid CPAP guideline V3 Jan 2021	**Negative PCR test required** Should only be used routinely on CCU and ICU. Not routinely offered on ARU for type 1 respiratory failure.	Should not be used	Must **not** be started in A&E Must only be delivered in ICU Covid pod or ARU Covid bay.

Appendix 3: Trouble-Shooting Guide for Ward-Based NIV

Persistently elevated or rising $PaCO_2$	• Is there excessive mask leak? Check fit. Consider alternative mask • Is the circuit set up correctly? Check connections and identify leaks. • Is the patient taking enough breaths? Consider increasing back up rate, and adjust i-time accordingly, aiming for a 1:2 I:E ratio • Is there re-breathing? Is the expiratory port patent? • Is the patient being over-oxygenated? Consider target SpO_2 / PaO_2 • Is the patient spending sufficient time on the NIV? • Consider increase in IPAP (up to 30 cmH_2O) • Consider decrease in EPAP if very high level set (i.e. >8)
Persistent hypoxaemia or falling PaO2	• Check O_2 entrainment / connection into circuit • Consider increasing FiO_2 • Consider increasing EPAP (remember to increase IPAP as well to maintain pressure support.) Indications for high EPAP may include OHS, severe kyphoscoliosis or severe airflow obstruction with high intrinsic PEEP • *Deteriorating clinical condition and persistent hypoxaemia requires an urgent medical review and consideration of escalation to invasive ventilation / ICU*
Mask leaks	• Leak <40 ml is acceptable. Larger leaks may cause inefficient ventilation, eye irritation, noise, dry mouth and nasal symptoms. • Refit mask or Try alternative mask types
Asynchrony between patient and ventilator	• Ensure correct tubing is used in the circuit. It must be smooth on the inside to allow flow to be detected by the machine. • Poor respiratory effort may not be sufficient to trigger breaths. An increase in EPAP may help. The *Trilogy* device has an 'autotrak sensitive' setting which may help where inspiratory effort is poor. • If the patient is very tachypnoeic, ensure rise time is as quick as possible (setting 1)
Previous ventilator-associated pneumothorax	• Consider admission to ICU for ventilation and use NIV at lower than normal inspiratory pressures

Non-cooperation/ aggressive behaviour **Safe sedation**	• Agitation or confusion can reduce compliance with ventilation and close supervision may be needed to maintain mask fit. • NIV can support confusion/coma secondary to COPD-induced hypercapnoea and should therefore be considered as treatment. • Intravenous morphine (2.5-5mg) or low dose oral lorazepam (0.5mg) may be useful to decrease agitation and facilitate tolerance of NIV. • Avoid long acting benzodiazepines or infused sedative/ anxiolytic drugs • SEDATION MUST BE AVOIDED WITHOUT SENIOR MEDICAL INPUT, recommend referral to respiratory team or ICU.

Appendix 4: NIV Weaning Stages

NIV Weaning Stages

- Once weaning has started, ABGs should be taken daily, **ideally after a period off NIV,** to assess weaning tolerance.
- Whilst off NIV, patient should receive controlled oxygen therapy with target saturations of SpO_2 88-92%

Stage 1: On all the time (24 hours), short breaks for eating, drinking, pressure relief etc

Stage 2: Aim for 16 hours of NIV, allowing 2-3 hour breaks at mealtimes. NIV on overnight.

Stage 3: Aim for 12 hours of NIV, at least 6-8 of these overnight.

Performance Criteria for Assessment of Competencies for the use of Acute Non Invasive Ventilation

Appendix 5:

Make (s) and Model (s)

1) _____ 2) _____ 3) _____

PERFORMANCE CRITERIA:	Date Attained	Name and Signature of Facilitator
Discuss appropriate practice with reference to Infection Control and Health and Safety • Pre-operational safety checks • Hand washing/alcohol gel • Checking of inlet filter • Transportation of NIV Machine • Positioning of patient and clinician		
Discuss and / or demonstrate safe practice of setting up of the NIV machine. This should include the function of all switches, dials, indicators and display		
Discuss and / or demonstrate how the machine should be applied to the patient and how a treatment should be carried out. This should include • Accurate assessment of required mask size • Choice of correct tubing/filters • Correct fitting to patients face • Clear explanations to patient re treatment		
Discuss the clinical indications for use, including choice of initial settings and explain setting changes in a variety of clinical situations		
Discuss and know the contraindications and precautions for NIV		
Discuss the procedure to be followed should NIV machine be working incorrectly		
Discuss appropriate note writing with reference to the use of NIV • Recording of settings, oxygen flow and interface used • Recording of individual machine used		

Name…….. Worcestershire Acute Hospitals NHS Trust **RISK CATEGORY – MEDIUM**

Appendix 5: Performance Criteria for Assessment of Competencies for the use of Acute Non Invasive Ventilation

ASSESSMENT SPECIFICATION: **The candidate should be able to demonstrate competence using the specified NIV machines using the Following knowledge evidence and performance criteria**

KNOWLEDGE EVIDENCE: **The candidate should be able to:**

Demonstrate knowledge of local guidelines for NIV therapy
Demonstrate an awareness of the Medical Devices Training Policy – in particular the criteria for authorised users of Medical Devices.
Discuss potential problems/contra indications that may be encountered and how to prevent/resolve them
Discuss their role, responsibility and accountability with reference to the most up to date clinical guidelines and rules of professional conduct as set out by the Chartered Society of Physiotherapy and the Health and Care Professions Council, Nursing and Midwifery Council (regulatory bodies).
Discuss safety aspects of the procedure and disposal and storage of equipment

Competencies may be assessed by designated individuals within each area. Individuals would have attended a trust recognised training programme for this device. This may be training provided by Worcestershire Acute Hospitals NHS trust or external training.

Any problems, please contact Professional Development on 01905 760600 or Ext 33742

I declare that I have delivered training which covers all aspects of the competency.

Key Trainer (please print) **----------**

Signature---------- **date----------**

I declare that I have expanded my knowledge and skills undertaken to practice with Accountability for my decisions and actions in Accordance with WAHT trusts policies for the above medical device.

Candidate (please print**) ----------**

Role/Band ----------

Signature---------- **date----------**

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

		Yes/No	Comments
1.	**Does the policy/guidance affect one group less or more favourably than another on the basis of:**	N	
	Race	N	
	Ethnic origins (including gypsies and travellers)	N	
	Nationality	N	
	Gender	N	
	Culture	N	
	Religion or belief	N	
	Sexual orientation including lesbian, gay and bisexual people	N	
	Age	N	
2.	**Is there any evidence that some groups are affected differently?**	N	
3.	**If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?**	N	
4.	**Is the impact of the policy/guidance likely to be negative?**	N	
5.	**If so can the impact be avoided?**	N/A	
6.	**What alternatives are there to achieving the policy/guidance without the impact?**	N/A	
7.	**Can we reduce the impact by taking different action?**	N/A	

If you have identified a potential discriminatory impact of this key document, please refer it to Human Resources, together with any suggestions as to the action required to avoid/reduce this impact.

For advice in respect of answering the above questions, please contact Human Resources.

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	N
2.	Does the implementation of this document require additional revenue	N
3.	Does the implementation of this document require additional manpower	N
4.	Does the implementation of this document release any manpower costs through a change in practice	N
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	N
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval