

Acute Bi-level Non-Invasive Ventilation (NIV)

Operational Protocol Incorporating Clinical Guidelines

Respiratory High Dependency Unit (RHDU) and Acute Respiratory Care Unit (ARCU)

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| GLOSSARY | | | |
|-------------------------|--------------------------------------|------------------------|---|
| ABG | Arterial Blood Gas | pCO₂ | Arterial carbon dioxide tension |
| AVPU | Alert/Voice/Pain/Unresponsive | pH | Negative algorithm of hydrogen ion concentration |
| BE | Base Excess | pO₂ | Arterial oxygen tension |
| BiPAP | Bilevel Positive Airway Pressure | RR | Respiratory Rate |
| BP | Blood Pressure | Sats | Haemoglobin oxygen saturation |
| cmH₂O | Centimetres of water | tds | three times a day |
| CXR | Chest X-Ray | Senior Doctor | Registrar, Consultant or ICU registrar/Consultant |
| DNAR | Do Not Attempt Resuscitation | | |
| ECG | Electrocardiogram | | |
| EPAP | Expiratory Positive Airway Pressure | | |
| FiO₂ | Fraction of inspired Oxygen | | |
| HCO₃ | Bicarbonate | | |
| HDU | High Dependency Unit | | |
| HR | Heart Rate | | |
| IPAP | Inspiratory Positive Airway Pressure | | |
| NEWS | National early warning score | | |
| NIV | Non-Invasive Ventilation | | |
| O₂ | Oxygen | | |

Introduction

This operational protocol has used the recommendations of the British Thoracic Society, 2008 and the Intensive Care Society 'Levels of Critical Care for Adult Patients (revised 2009)' standards to identify levels of care and subsequent capacity. The protocol describes the optimal staffing for a Respiratory High Dependency Unit (RH DU) and Acute Respiratory Care Unit (ARCU); the location, training, escalation and patient selection for patients who have Non-Invasive Ventilation initiated in Bradford Teaching Hospitals NHS Foundation Trust. The clinical guidelines and information on patient selection are included in the document.

Core Principles

- Dedicated facility for Bi-level NIV Patients with monitoring for the first 24 hours of initiation of NIV treatment
- Patients will be nursed as level 2 for at least the first 24 hours of NIV
- The 4 bedded RH DU will be staffed on a 1 Registered Nurse (RN) : 2 x level 2 patients' ratio and is a mixed sex facility
- The 4 bedded ARCU will be staffed on a 1 RN: 4 patients' ratio. Patients will be cared for with single sex compliance in place
- The 20-bedded general ward will be staffed on a 1 RN: 8 patients' ratio. Patients will be cared for with single sex compliance in place
- Acute Cardiology patients requiring NIV will be managed on the Coronary Care Unit with in-reach from the respiratory consultants and appropriately trained physiotherapists
- Patients with no 'ceiling of care' will be managed with Critical Care input
- All patients on RH DU and ARCU will be under the care of the Respiratory Team (24/7)
- Competency trained nurses in the management of bi-level NIV
- A suitably experienced senior nurse will be in charge of the Respiratory Ward/RH DU/ARCU
- Respiratory Physiotherapy input including on-call 24/7
- All patients in Respiratory High Dependency Unit (RH DU) and Acute Respiratory Care Unit (ARCU) will receive a daily Consultant review of their plan of care, with a minimum standard of senior review within 12 hours of admission, 7 days per week
- Once deemed as clinically appropriate to step down from RH DU to ARCU, a transfer time limit of 4 hours will be adhered to in order to maintain single sex compliance
- The general ward will take step down NIV post 24-48 hours of ARCU care based on an assessment by a consultant
- A nominated bi-level NIV service lead clinician - Dr Dinesh Saralaya, Consultant Respiratory Physician
- The governance for the service will report through the Respiratory Specialty Governance meeting.

Patient selection

COPD Patients

The National Institute for Clinical Health Excellence (NICE) currently accepts the following criteria for NIV in exacerbations of COPD.

- Acute potentially reversible exacerbation
- Hypercapnic respiratory acidosis- pH less than 7.25 - 7.35 with raised pCO₂ persisting despite immediate maximum standard medical treatments for up to 1 hour
- Hypercapnic respiratory acidosis- pH less than <7.25 (BIPAP is less effective but may still be considered in these patients if it is established that BIPAP is the ceiling of care)
- Ability to co-operate with non-invasive ventilation.

The exclusion criteria are as follows:

- Conditions causing Type I Respiratory Failure only- e.g. Pulmonary
 - Oedema, Pneumonia without COPD, Acute Asthma
- Pneumothorax
- End stage malignancy
- Acute myocardial infarction
- Multi-organ failure
- Cranio-facial abnormalities
- Normo-capnic metabolic acidosis
- Impaired level of consciousness (GCS <8).

Standard medical therapy (**within first hour**) should include:

- Controlled oxygen to maintain oxygen saturations 88-92% (prescribed on patient's drug chart)
- Nebulised salbutamol 2.5.-5mg (on air)
- Nebulised ipratropium 500mcgs (on air)
- Prednisolone 30 - 40mg orally
- Antibiotic agent

All therapy should be administered within one hour and the response then assessed.

Non COPD admissions

Patients with some forms of restrictive lung disease and non COPD hypercapnic respiratory acidosis may also be considered for NIV. Evidence for the use of NIV in some patients is less well established and admission of such patients will require specific discussion and review by the on call Respiratory Consultant or Acute Medical Consultant on call. Possible patients include those with:

- Obesity Hypoventilation Syndrome
- Neuromuscular Disease or Diaphragmatic Dysfunction
- Pulmonary Fibrosis with a reversible acute illness
- Central Apnoea
- Bronchiectasis or Cystic Fibrosis

- Permissive ventilation

Contraindications to NIV

- Patient declines treatment
- Facial burns / trauma / recent facial or upper airway surgery
- Fixed upper airway obstruction
- Undrained pneumothorax
- Haemodynamically unstable requiring inotropes/pressors (unless in a critical care unit)
- Severe co-morbidity/ irreversible condition
- Inability to protect airway (relative contraindication)
- Copious respiratory secretions (relative contraindication)
- Upper gastrointestinal surgery (relative contraindication)
- Vomiting (relative contraindication as NG tube can be considered in these patients if intubation is not an option)
- Confusion / agitation (relative contra indication)
- Bowel obstruction (relative contra indication)

Ceiling of care

- Patients should all have a defined ceiling and resuscitation status recorded in their medical records by an appropriate senior doctor before bi-level NIV is initiated.
- If a patient is initially assessed as for 'full escalation' which includes intubation then they must be reviewed by an anaesthetist within an hour to determine ceiling of care.

Admission routes and transfer management

- AED to directly admit any patient on bi-level NIV to ward 23 HDU (level 2 care)
- If the patient is for escalation and intubation they could be managed on the RHDU with agreement from the respiratory physicians and nurse in charge of ward 23 , with critical care input and with a clear escalation plan of transfer to ICU in case of treatment failure.
- Patients requiring bi-level NIV on any hospital ward can have their bi-level NIV initiated on the ward by the respiratory physiotherapists but must be transferred to ward 23 HDU within 4 hours of treatment initiation (see page 7 for actions should RHDU be full)
- Whilst awaiting transfer, the patient must be reviewed by an appropriate senior doctor, critical care outreach and/or specialist physiotherapist. Once bi-level NIV is initiated patients must be nursed at a 1:2 nursing ratio with full monitoring (ECG, continuous oxygen saturations, and hourly NEWS)
- All patients must be transferred on a Trilogy 202 ventilator by a qualified nurse
- Bi-level NIV should, if possible, be commenced on the unit but it is understood that in some cases, due to clinical prioritisation, it may be initiated in any bed in the hospital with transfer within the specific timeline. (see page 7 for actions should RHDU be full)
- Patients will be nursed as level 2 for at least the first 24hours of NIV

- The expected total length of stay across RHDU and ARCU combined is 48 – 72 hours per patient

NB. Patients who receive domiciliary nocturnal bi-level NIV and who have not been admitted due to respiratory deterioration do not need admission to a level 2 facility. These patients will be nursed on any ward with advice if required from the on call respiratory physiotherapist or ward 23 RHDU.

Staffing

This guideline is for use by the multi-professional team (trained nursing staff, physiotherapists and medical staff) in the acute hospital setting.

The flow chart in Appendix D should be used for patients awaiting transfer to RHDU. The chart is intended to inform staff about the management of patients prior to and during the transfer period.

All ward 23 RHDU staff and respiratory physiotherapists will be competency-trained in the use of bi-level NIV devices. Ward managers will keep records of staff training and achievement of competence in the use of bi-level NIV.

NIV should only be administered by staff members trained in bi-level NIV delivery. This could be Doctors, nurses and physiotherapists who have received specialist training.

Lead Specialist Staff:

5 x Consultant Respiratory Physicians

2 x Registrars, Respiratory Medicine

Matron

2 x Sisters, Respiratory Unit

Lead Respiratory Physiotherapist

Critical care outreach nurse team

The RHDU and ARCU will be under the clinical leadership of a Respiratory Consultant. Consultant input and advice from the Acute Consultant on-call and on-call Physiotherapist will be available 24 hours a day, 7 days per week.

The 4 RHDU beds will be managed as per level 2 standards on a ratio of 1 nurse to 2 patients.

The 4 ARCU beds will be monitored step down beds and managed on a ratio of 1 nurse to 4 patients.

The remaining 20 beds on Ward 23 will be managed on a planned ratio of 1 nurse to 8 patients.

There will be physiotherapy input to the RHDU/ARCU/main ward as required supported by on-call physiotherapy arrangements.

Location

The ward 23 RHDU is comprised of a 4-bedded unit. This is a level 2 critical care facility therefore mixed sex. The acute respiratory care unit (ARCU) is comprised of 4 step-down beds. These units are located directly adjacent to each other which will allow some flexibility in grouping same sex patients.

Patients may be stepped down to the ARCU 4 bedded unit (single sex), and stepped down to the 20 bedded general ward on ward 23 to facilitate the admission of other patients. The ARCU facility will split over 2 double side rooms based on ward 23.

There are close links with the:
Accident and Emergency Department (AED)
Acute Medical Units (AMU)
Intensive Care Unit (ICU)

Where necessary, patients should move rapidly and seamlessly between the units. The only areas in the trust commissioned to manage NIV for longer than 4 hours are critical care (ICU, HDU), ward 22 CCU and ward 23 RHDU/ARCU.

In addition, patients on post-anaesthetic CPAP may be managed on the satellite HDU on ward 21.

Escalation

Where demand exceeds capacity, an assessment by the Respiratory Consultant or Acute Medicine Consultant on-call will be undertaken to determine if any patients are able to be stepped down from NIV. If this is not the case then 3 options will be explored in the following order:

- Additional skilled staff are available to convert 2 of the monitored beds to level 2
- Patients will be transferred to general HDU (an assessment of skills will be undertaken prior to transfer to ensure appropriate skills within HDU). The most appropriate patient will be transferred i.e. it may be more appropriate to transfer a patient who has been on NIV for 12 hours to the general HDU leaving the newly initialized patient on the Respiratory HDU
- Transferred to an alternative provider

Where there are insufficient staff to deliver the staffing ratio of 1:2 for the RHDU (for the number of patients on the unit) appropriately trained staff will be moved from an alternative location

Where alternative staff cannot be located, the Acute Medicine Consultant on-call will be contacted to review with options to:

- Identify patients suitable for step-down
- Patients will be transferred to general HDU (an assessment of skills will be undertaken prior to transfer to ensure appropriate skills within HDU). The most appropriate patient will be transferred i.e. it may be more appropriate to transfer a patient who has been on NIV for 12 hours to the general HDU leaving the newly initialized patient on the Respiratory HDU
- Transferred to an alternative provider

Non respiratory patients should be transferred to the appropriate specialty ward once the need for NIV and other respiratory input has ceased. This should happen within 4 hours of the decision and will be determined by the Respiratory Consultant of Acute Medicine Consultant on-call. The nurse in charge of the ward is responsible for actioning the decision and has the authority to deliver this in conjunction with the Clinical Site Management Team

Equipment

Each bed in the RHDU and ARCU has advanced monitoring with continuous ECG, non-invasive blood pressure, pulse oximetry and respiratory rate.

There is an arterial blood gas analyser available to the unit.

BiPAP machines are in the following locations:

- Focus x6 in the Physio dept
- Trilogy 202 x4 on ward 23 RHDU
- Trilogy 202 x1, Focus x3 on ARCU
- Focus x2, Trilogy 202 x1 in A&E

Training and Induction

The nominated bi-level NIV service Lead Clinician, through the Ward manager, will be responsible for ensuring staff receive appropriate training and induction.

All staff within the RHDU and ARCU will be formally assessed, following completion of a clinical skills course, in line with British Thoracic Society October 2008 guidance.

The Ward 23 Sister or Charge Nurse is responsible for ensuring that all nursing staff within the Respiratory unit are competent and up to date with training and induction.

The Ward 23 Respiratory Unit education, training and induction plan forms part of the unit's clinical governance structure and will be monitored through the Respiratory Specialty Governance meeting.

Governance

The unit governance will be through the Respiratory Specialty Governance meeting including a mortality and morbidity review.

An external review of the unit will be undertaken within 3 months of implementation.

An annual audit of the clinical provision will be included in the 2015/16 Trust's High Priority audit programme.

Continuous audit of practice will be monitored through Divisional Performance Management structures and will include:

- Appropriately identified patients who meet the criteria
- A process for initiation of NIV is followed and documented in the clinical notes
- Ensuring that the duration of NIV is clearly aligned to clinical need and in line with guidance
- A review of the process of weaning and clinical plan to step down is followed and documented
- The nursing audit timetable
- Ensuring that the 'Friends and Family Test' will apply to this unit and intelligence gleaned from this process will continuously inform improvement

The Trust will conduct an annual audit using the criteria as defined in the British Thoracic Society NIV Audit and will participate in the next British Thoracic Society NIV Audit in 2016.

Communications

Following ratification through the Trust Governance Framework, this document will be posted on the Trust intranet site alongside other clinical operational documentation to ensure this is readily available at all times.

This will be formally received at all specialty governance meetings and all Trust Consultants participating in the on-call rota will receive a copy of the document.

In addition, the following will receive and be required to have signed to state that they have read and understand this SOP;

- All new staff who are rostered to this area
- Heads of Nursing
- Clinical Site Team
- All Physiotherapy staff who deliver care to patients on NIV

In addition, the following are responsible for cascade:

- Clinical Leads taking responsibility for cascade within their Directorate
- Deputy Divisional Clinical Directors for inclusion on Divisional Governance agenda

Both the Complaints Team and the Patients Advice and Liaison Service (PALS) will support monitoring of this document through identification of trends and themes relating to this Unit and therefore will receive a copy of this SOP.

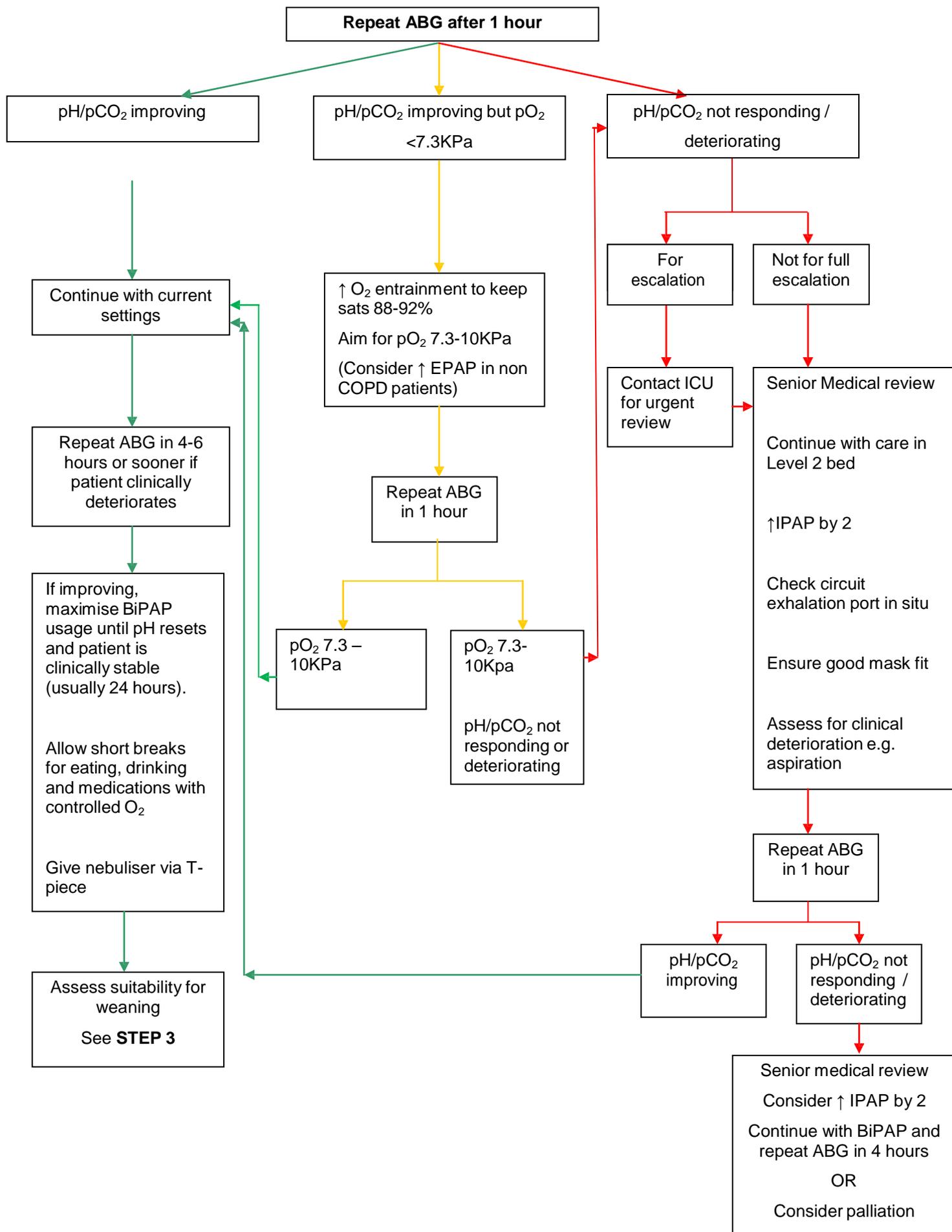
TRANSFERS MUST BE ON A TRILOGY 202 VENTILATOR WITH A QUALIFIED NURSE ESCORT

Patients should be transferred to the facility most appropriate to their clinical need. Surgical patients should be cared for within adult Critical care. Medical patients should be managed on ward 23 RH DU beds.

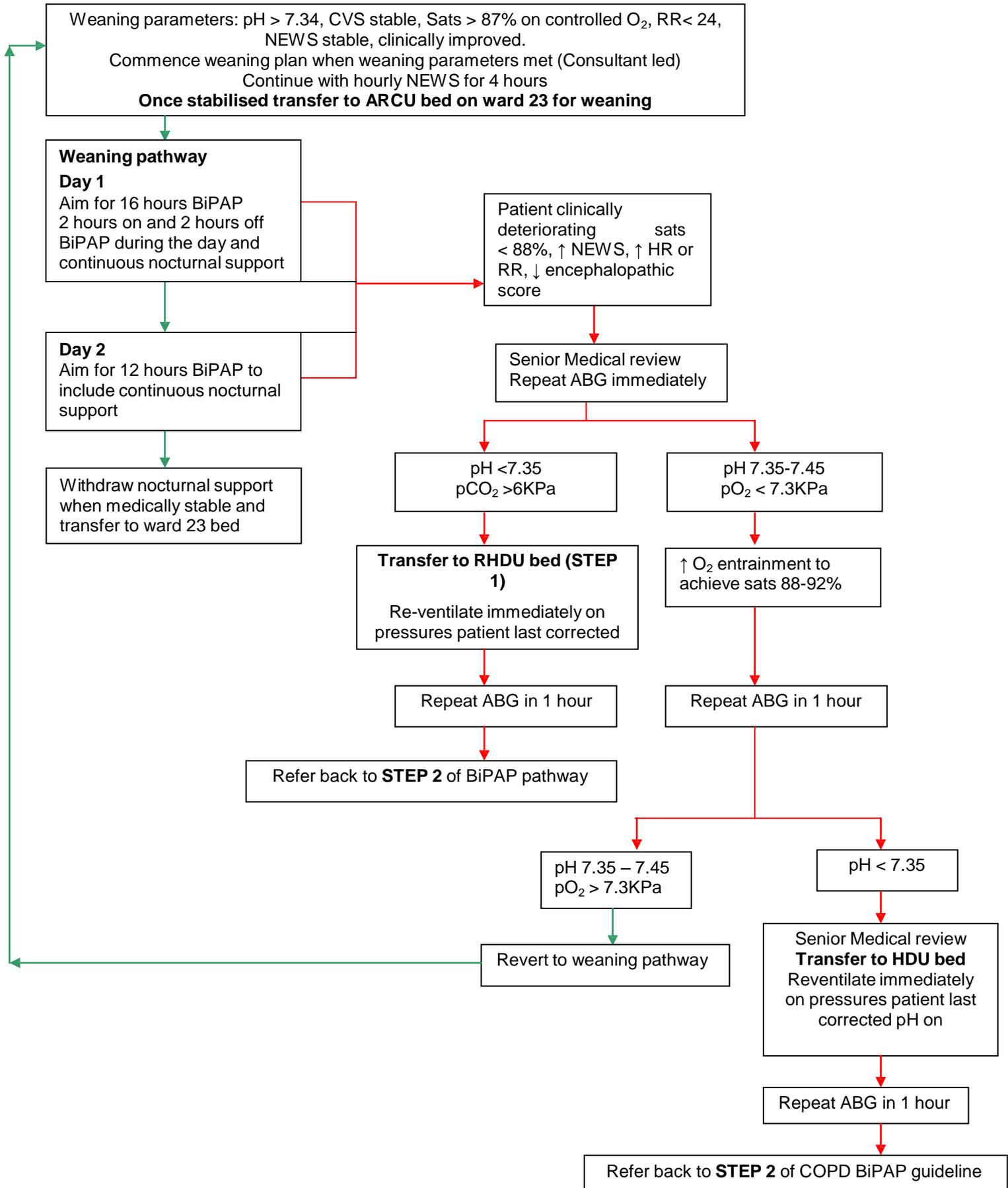
Setting up Bi-level NIV

- Physiotherapist or competency trained nursing staff to initiate BiPAP.
- IPAP 10 EPAP 4 initially for patient compliance (Rise time 1, back up rate 10, I-time 2seconds)
- **Increase IPAP until an IPAP of 20cmH₂O is achieved, or as the patient can tolerate, within the first 20 minutes**
- Supplemental O₂ to keep saturations between 88 -92%
- Repeat ABG in 1 hour (**See STEP 2**)
- Hourly NEWS

STEP 2 – Assessing progress & optimising Bi-level NIV



STEP 3 – weaning pathway



Appendix B

Clinical CPAP Guideline

Inclusion Criteria (all must apply):

pO₂ <8KPa; pCO₂ < 6KPa, RR>24; able to protect airway; patient wishes considered.

Exclusion Criteria:

Undrained pneumothorax; haemodynamic instability; vomiting; fixed upper airway obstruction; life threatening hypoxaemia; recent upper GI surgery; bowel obstruction; unable to protect airway; trachea-oesophageal or broncho-pulmonary fistula; facial surgery or burns; severe co-morbidity

Patient must have a CXR to rule out pneumothorax

DO ANY EXCLUSION CRITERIA APPLY? Yes - If for escalation, contact ICU

No - See STEP 1

Escalation to ICU? Yes - Contact Anaesthetists to review patient

No – See STEP 1

For resuscitation? Yes - See STEP 1. Refer to Clinical Care Outreach (CCOR).

No - complete DNAR form. See STEP 1

Consultant/Senior physician on call/Anaesthetist led decision to initiate BiPAP

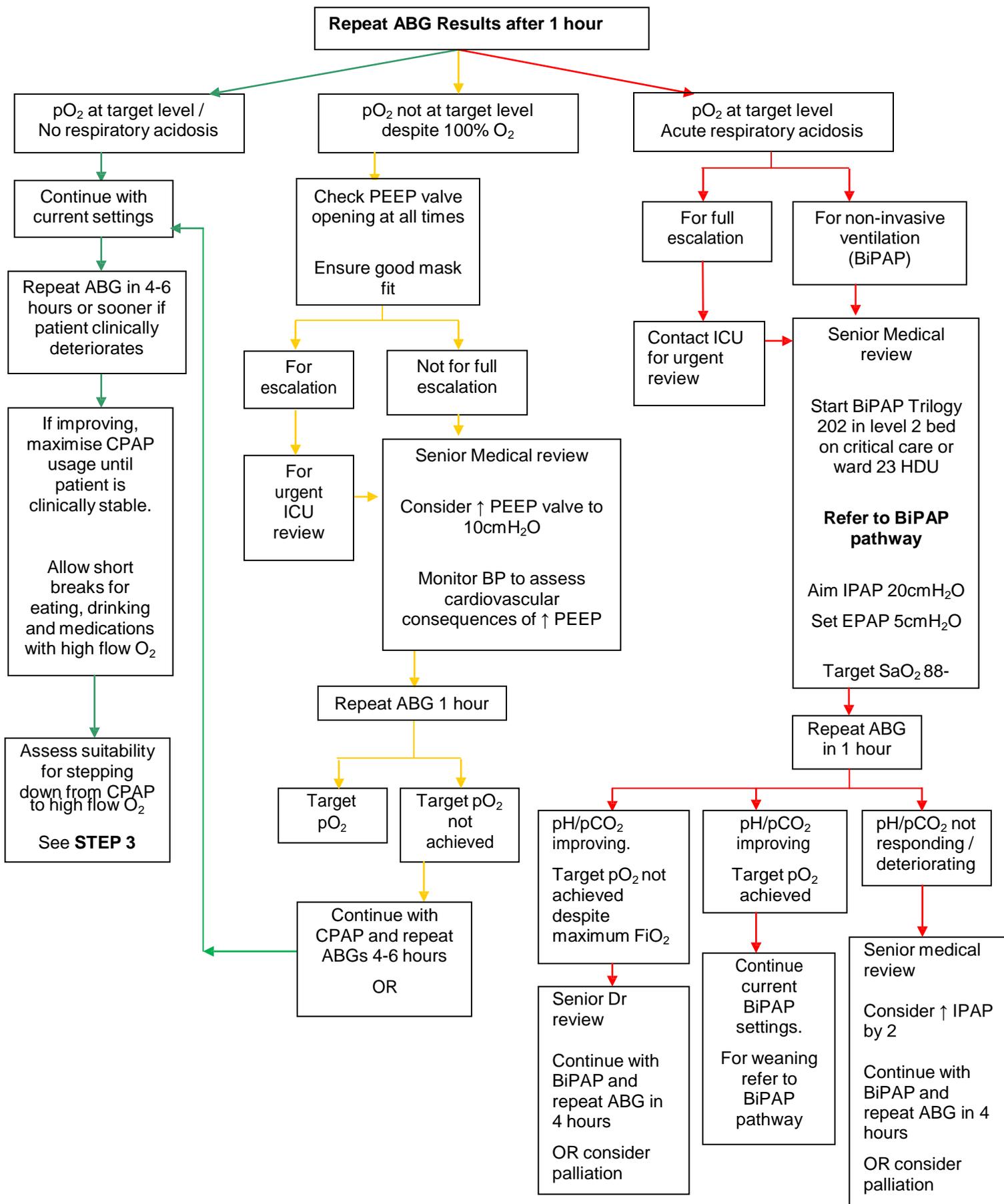
STEP 1 – Initiate CPAP

- Transfer surgical patients to critical care (ICU or satellite ICU) or medical patients to ward 23 RHU bed with qualified nurse escort.
- Physiotherapist or competency trained nursing staff to initiate CPAP.
 - Refer to Critical Care Outreach

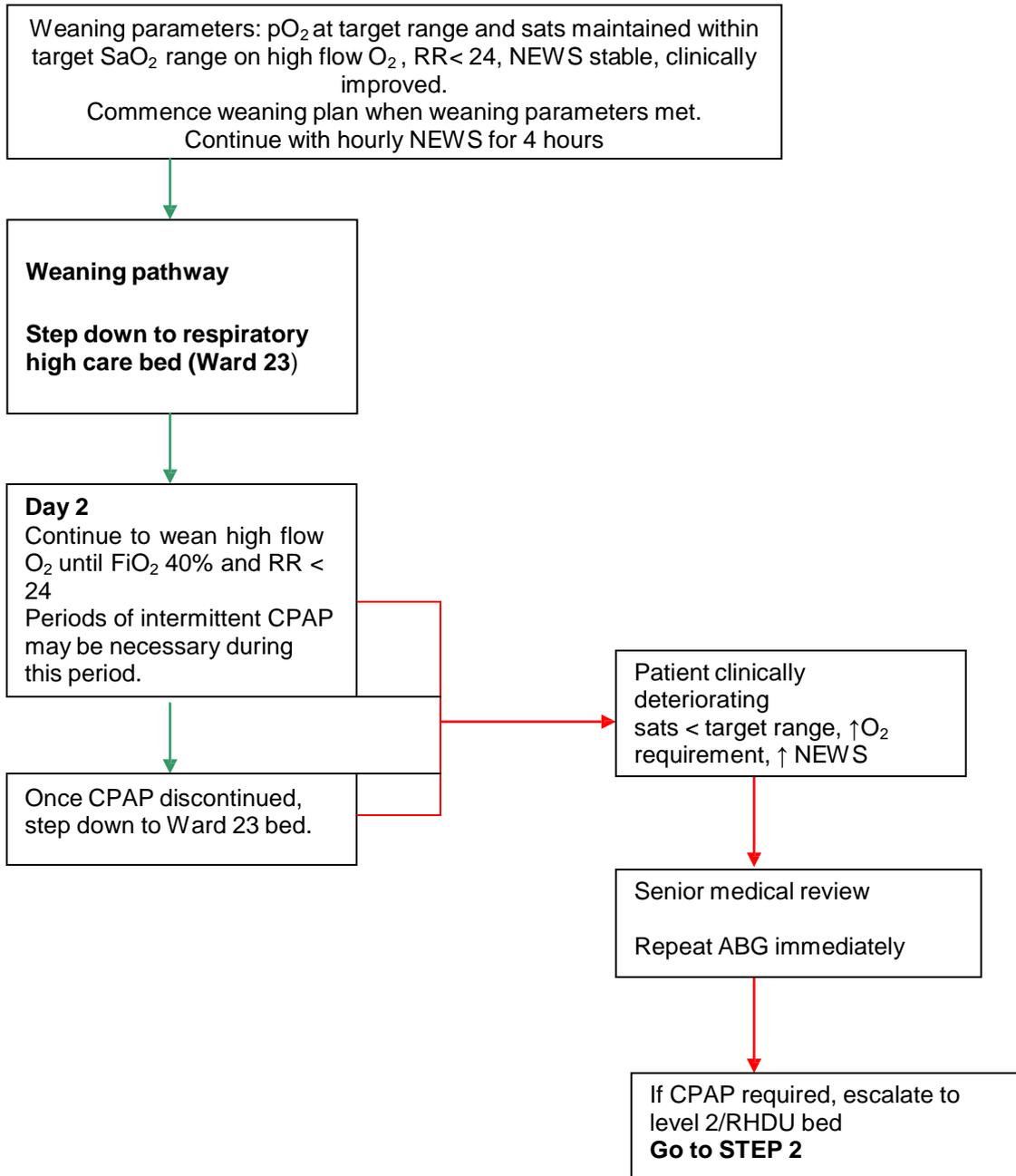
CPAP CAN BE INITIATED ON ANY WARD IF THE PATIENT IS AT CLINICAL RISK OF DETERIORATION WITHOUT IT. THEY MUST BE TRANSFERRED TO AN HDU BED WITHIN 4 HOURS.

- Set PEEP at 7.5cmH₂O, flow rate at maximum.
- Set O₂ to maintain target saturations
- Repeat ABGs in 1 hour (**See STEP 2**)
- Hourly NEWS, continuous saturation monitoring.

STEP 2 – Assessing progress & optimising CPAP



STEP 3 – weaning pathway



Appendix C

Trouble Shooting

Trouble shooting guide to address the common side effects of bi-level NIV and failure to improve gas exchange:

Mask issues

- **Incorrect sizing:** a mask that is too large will cause leak and one that is too small will increase the risk of nasal bridge ulceration
- **incorrect mask:** most COPD patients are mouth breathers so a full face mask is used, occasional patients struggle with this or have facial abnormalities and these require specialist masks (available through physiotherapy team)
- **Mask leak** A mask leak can increase the time required for the ventilator to achieve its pressure target thus prolonging inspiration and causing discomfort. It can cause asynchrony as the patient fails to trigger inspiration and expiration.
- **Mask too tight :** the skirt should lift on each inspiration lessening the pressure that particularly affects the nasal bridge . Nasal bridge redness or ulceration is caused by excessive tension from the mask straps. This usually results from efforts to reduce air leakage from around the mask, which may irritate the eyes. Minimising strap tension usually alleviates this problem. Dressing such as *grauflex* or *kerra Pro* may also be used to help patient comfort. Switching to an alternative mask may be necessary for long term NIV users.

Mask discomfort is a commonly encountered problem for patients adapting to NIV. The practitioner should ensure the mask fit is optimal and that minimal mask strap tension is used to control air leaking.

Nasal congestion or dryness:

This should be treated symptomatically. It is possible to add heated humidification to the NIV circuit.

Secretion clearance:

Patients may require regular chest physiotherapy and nebulised bronchodilators and saline.

Gastric insufflation:

Many patients experience abdominal distension and flatulence in association with NIV use. Usually these symptoms are tolerable but if they are not a reduction in inflation pressure or use of medication may help or a fine bore nasogastric tube.

Failure to improve or worsening gas exchange:

With failure to improve gas exchange then upward adjustments in inspiratory pressure, tidal volume, ventilator rate, duration of ventilator use or a combination of these changes may be helpful.

Worsening gas exchange after initial stabilisation is often encountered among patients with slowly progressive diseases (i.e. neuromuscular diseases). Gradual increases in respiratory pressure, tidal volume, ventilator rate and amount of daytime use are often indicated to compensate for deteriorating pulmonary function.

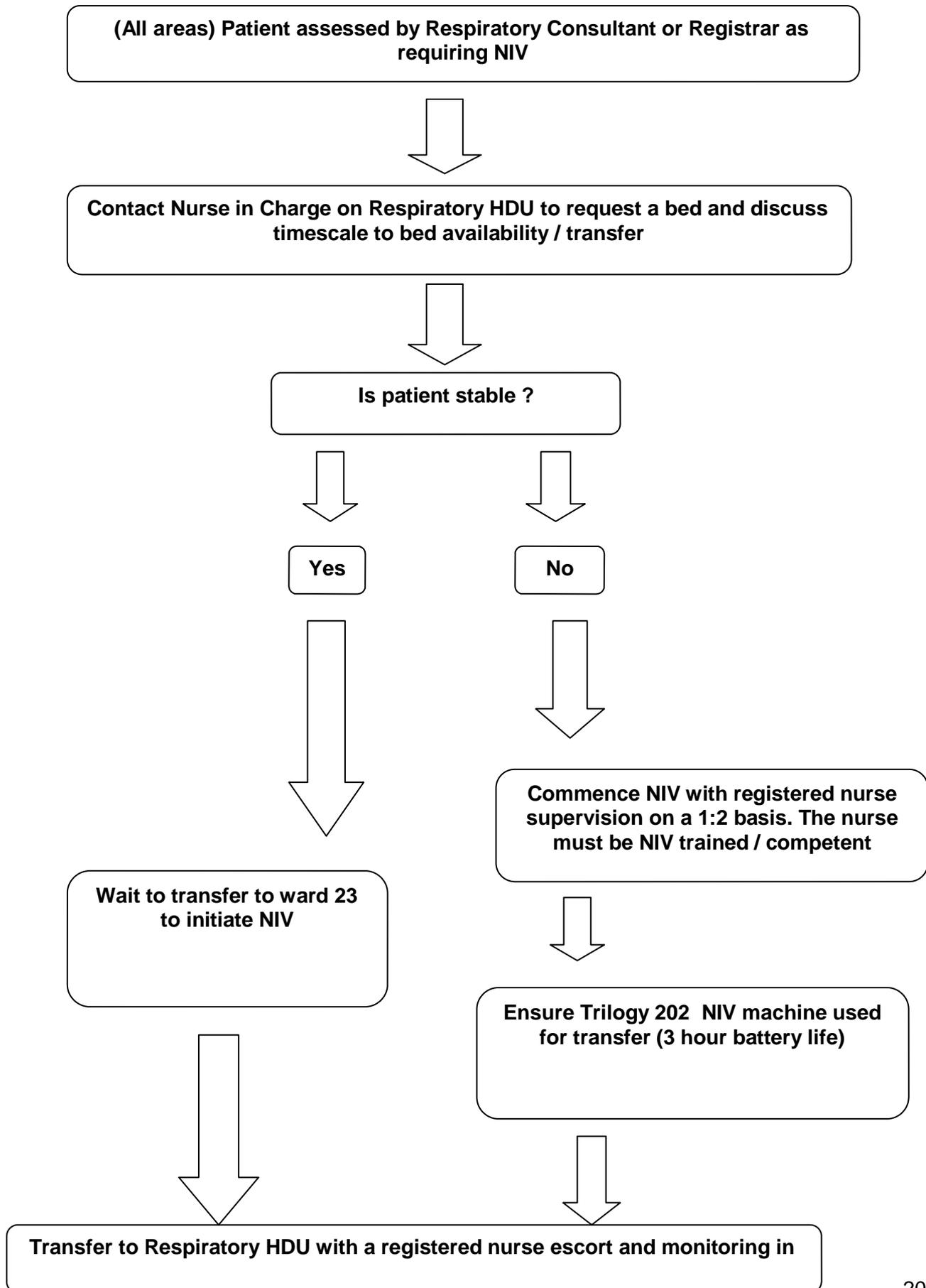
It is also important to consider if there are other possible causes for deteriorating gases, ie: metabolic or mixed acidosis. Are other treatments required in addition to NIV?

Patient compliance:

Patients requiring NIV can often be anxious and frightened. It is not unreasonable to prescribe small doses of morphine or diazepam to help patient to settle on to treatment providing it is not clinically contra-indicated for the patient.

Appendix D

Management of Patients awaiting transfer to RHDU



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