PAKISTAN CHEST SOCIETY

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CHEST SOCIETY
STRIVING FOR PULMONARY CARE

Clinical Practice Guidelines

Non-Invasive Ventilation

PAKISTAN CHEST SOCIETY-2025

Guidelines On

Non-Invasive Ventilation

March 2026

PAKISTAN CHEST SOCIETY

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Preface

First of all, I thank Allah Almighty for His countless blessings that enabled me to accomplish the task of updating the PCS Guidelines on Non-Invasive Ventilation (NIV).

Non-invasive mechanical ventilation (NIV) is now widely used in acute care settings for the management of acute respiratory failure (ARF) arising from various causes. This document presents recommendations for the clinical application of NIV, based on the most up-to-date scientific evidence and best clinical practices.

I extend my heartfelt gratitude to my team members for their technical expertise and invaluable contributions in completing this work. The document comprehensively covers all major aspects of NIV, including its modes, indications, contraindications, complications, and troubleshooting. In addition, this guideline introduces **High Flow Nasal Cannula (HFNC)** therapy as an emerging and highly effective modality for respiratory support. The inclusion of HFNC reflects the evolving trends in non-invasive respiratory management and aims to familiarize clinicians with its principles, clinical applications, and evidence-based recommendations for safe and effective use.

This guideline reflects the current state of knowledge regarding the role of NIV in the management of respiratory failure and provides evidence-based recommendations to guide clinicians and healthcare professionals. I am deeply thankful to my mentors and teachers for their continuous encouragement and support, which strengthened my confidence to explore this important yet often neglected domain of pulmonary medicine.

Finally, I express my sincere appreciation to all my patients, from whom I have learned immensely. Their experiences have deepened my understanding of NIV and inspired me to refine its practical applications. I hope that this guideline will serve as a valuable resource for readers, helping them achieve improved patient outcomes in both ward and ICU settings.

Prof. Dr. Muhammad Irfan Malik
Chairman
NIV Guidelines, Working group

Message by the President

Pakistan Chest Society

Non-invasive ventilation has transformed the management of acute and chronic respiratory failure. These guidelines provide clear indications, practical initiation protocols, and monitoring strategies to optimize outcomes and reduce complications. PCS strongly encourages their adoption to promote safe and effective use of NIV across varied healthcare settings.

Prof. Shereen Khan
President
Pakistan Chest Society

Message by the Chairman

Guideline Committee, Pakistan Chest Society

It gives me great pleasure to present the Guidelines for the Use of Non-Invasive Ventilation (NIV) by the Pakistan Chest Society. These guidelines represent an important step toward improving and standardizing ventilatory support for patients with respiratory failure across Pakistan. NIV has become a key modality in managing breathing difficulty without endotracheal intubation, helping to reduce complications, length of hospital stay, and the need for invasive ventilation.

Non-Invasive Ventilation delivers assisted breathing through masks rather than an artificial airway. In Pakistan, its common applications include acute exacerbations of COPD, cardiogenic pulmonary edema, neuromuscular weakness, chest infections, post-tuberculosis lung disease, and obesity-related hypoventilation. Recognizing these local clinical patterns is essential for effective and timely use.

The NIV Working Group, led by Prof. Dr Muhammad Irfan malik, has adapted international recommendations to suit our healthcare environment. These guidelines emphasize correct patient selection, early initiation, close monitoring, appropriate interface choice, and clear criteria for escalation.

A thorough assessment of respiratory effort, blood gases, oxygen levels, and underlying disease is recommended before starting NIV. Careful titration of pressures, proper mask fitting, ensuring comfort, and monitoring for leaks are essential for successful therapy. Supportive measures such as bronchodilators, steroids when indicated, diuretics in heart failure, airway clearance, and avoidance of sedatives further improve outcomes.

These guidelines aim to ensure timely intervention, reduce the need for invasive ventilation, and improve survival and recovery in patients receiving NIV. We extend our appreciation to all committee members for their contribution and remain committed to advancing respiratory care and evidence-based practice throughout Pakistan.

Prof. Muhammad Ashraf Jamal
Chairman Guideline Committee
Pakistan Chest Society

Pakistan Chest Society

Guideline Committee

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Non-Invasive Ventilation (NIV)

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Guideline Development:

This guideline has been developed by the NIV working Group of PAKISTAN CHEST SOCIETY using the BTS SIGN grades of recommendations and level of evidence. The scope of the guidelines is defined by taking opinions from all stakeholders, and we have maximally tried to cover all aspects in terms of Narrative and PICO question formats.

Committee Composition:

The guideline committee included Consultant Pulmonologists working in different parts of Pakistan with expertise in NIV application and its trouble shooting.

Table 1
SIGN grades of recommendations

A.	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating overall consistency of results
B.	A body of evidence including studies rated as 2++, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C.	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++
D.	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+

Table 2
SIGN levels of evidence

1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews or RCTs with a high risk of bias
2++	High-quality systematic reviews of case control or cohort or studies High-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case-control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, eg, case reports, case series
4	Expert opinion

RCT, randomised controlled trial.

Introduction

Overview:

- The concept of applying ventilator support non-invasively had always been attractive because of relative simplicity and it spares intubation. Use of non-invasive ventilation is markedly increased over the past two decades and now has become integral tool in management of acute and chronic respiratory failure in both home setting and ICU.

Definition:

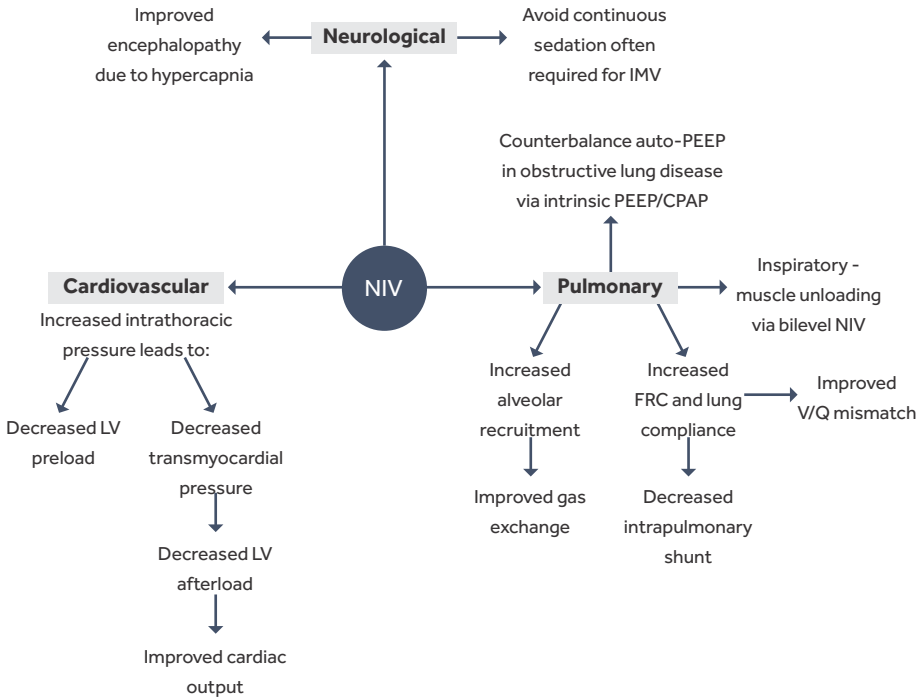
- Non-invasive ventilation (NIV) means administration of ventilatory support through non- invasive interface (nasal mask, facemask, or nasal plugs) rather than invasive interface (endotracheal tube, tracheostomy).
- It is the best short-term therapy to buy time for medical therapy and to treat rapidly reversible cause of respiratory failure.

Question 1:
How Does NIV Improve Respiratory Mechanics In Respiratory Failure?

Mechanism:

Non-invasive ventilation improves respiratory mechanics in patients with respiratory failure. In addition to pulmonary effects, NIV causes physiological and clinical improvements in the cardiovascular and neurological systems. The following mechanisms involve:

1. Improve Oxygenation
2. Improve Ventilation / Respiratory Acidosis
3. Decrease Work of Breathing



Question 2:

What Can Be the Advantages / Disadvantages Of NIV?

Advantages of NIV over Invasive Positive Pressure Ventilation (IPPV):

- Avoid trauma secondary to endotracheal tube
- Avoid need of sedation
- Allow for intermittent eating/drinking
- Reduce risk of ventilator associated pneumonia
- Oral patency (preserve speech, swallowing and cough)
- Reduce cost and length of stay

Disadvantages of NIV:

NIV is generally safe. Complications related to positive pressure ventilation (e.g. barotrauma, hemodynamic instability) tend to be less common during NIV than invasive positive pressure ventilation. Most complications due to NIV are local and related to the tightly fitting mask:

Systemic

- Slower correction of gas exchange abnormalities
- Gastric distention (occur in 2%)
- Lack of airway access and protection
- Unable to suction the bronchial tree
- Aspiration

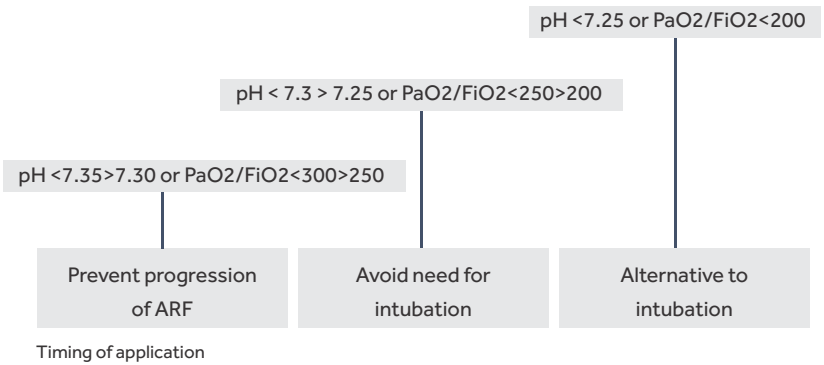
Mask

- Claustrophobia
- Facial pressure sores
- Eye irritation
- Considerable medical and nursing expertise required

Question 3:

Who are the Suitable Candidates for NIV Therapy?

Indications - a trial of NIV is worthwhile in most patients who do not require emergent intubation and have a disease known to respond to NIV, assuming that they lack contraindications.



Patients likely to get benefit:

- Acute exacerbation of COPD with hypercapnic respiratory acidosis
- Acute cardiogenic pulmonary edema
- Obesity hypoventilation syndrome
- Neuromuscular and chest wall disorder
- Post-Extubation respiratory failure
- Post-operative respiratory failure
- Chest trauma induced respiratory failure
- Intubation refusal or palliation

Patients less likely to get benefit:

Hypoxemic non-hypercapnic respiratory failure not due to ACPE

- Acute non-hypercapnic respiratory failure due to AECOPD
- Pneumonia
- Immunocompromised patients
- Acute respiratory distress syndrome
- Asthma exacerbation

I. Should NIV be used in established acute hypercapnic respiratory failure due to a COPD exacerbation?

Recommendations

- For most patients with AECOPD, the initial management should be optimal medical therapy and targeting an oxygen saturation of 88–92% (Grade A).
- NIV should be started when pH6.5 kPa persist or develop despite optimal medical therapy (Grade A).
- Severe acidosis alone does not preclude a trial of NIV in an appropriate area with ready access to staff who can perform safe endotracheal intubation (Grade B).
- The use of NIV should not delay escalation to IMV when this is more appropriate (Grade C).
- The practice of NIV should be audited regularly to maintain standards (Grade C).

Good practice points:

- ABG measurement is needed prior to and following starting NIV.
- Chest radiography is recommended but should not delay initiation of NIV in severe acidosis.
- Reversible causes of respiratory failure should be sought and treated appropriately.
- At the start of treatment, an individualised patient plan (involving the patient whenever possible) should document agreed measures to be taken in the event of NIV failure.

II. Should NIV be used in ARF due to acute asthma?

Recommendation

- NIV should not be used in patients with acute asthma exacerbations and AHRF (Grade C).
- Acute (or acute on chronic) episodes of hypercapnia may complicate chronic asthma. This condition closely resembles COPD and should be managed as such (Grade D).

Evidence statement:

Pooled analysis demonstrated that NIV has an unclear effect on mortality, intubation (RR 4.48, 95% CI 0.23–89.23; very low certainty) or ICU length of stay (mean difference 0.3 higher, 95% CI 0.63 lower to 1.23 higher) in this population. However, given the possibility of overlap between asthma and COPD, bilevel NIV may be considered in a subgroup of patients diagnosed with asthma who are behaving more like patients with COPD (i.e. fixed airway obstruction).

III. Should NIV be used in high-risk patients, post extubation as RESCUE THERAPY?

Recommendation:

- Prophylactic use of NIV should be considered to provide post-extubation support in patients with identified risk factors for extubation failure (Grade B).
- NIV should not be used routinely for unexpected post-extubation respiratory failure (Grade B).
- In COPD, a trial of NIV may be justified for unexpected post-extubation respiratory failure where local expertise exists (Grade D).

Evidence statement:

- NIV may be effective in reducing respiratory failure, re-intubation and mortality in COPD (Level 1 +) and patients with increased BMI (Level 2+).
- Planned post-extubation NIV reduces mortality, ICU and hospital length of stay and the incidence of ventilator-associated pneumonia (Level 1−).
- The use of NIV as rescue therapy for unexpected postextubation respiratory failure does not improve outcome and may be detrimental (Level 1+)

IV. Should NIV be used in ARF in the post-operative setting?

Recommendation

- We suggest NIV for patients with post-operative ARF.

Evidence statement:

- Pooled analysis demonstrated that NIV use led to a decrease in mortality (RR 0.28, 95% CI 0.09–0.84; moderate certainty), the need for intubation (RR 0.27, 95% CI 0.12–0.61; low certainty) and the incidence of nosocomial pneumonia (RR 0.20, 95% CI 0.04–0.88; very low certainty) in this post-operative population.
- Both CPAP and bilevel NIV counter the pathophysiological mechanisms predisposing to post-operative respiratory failure. The evidence suggests that both are effective to improve clinical outcomes in patients with post-operative ARF, particularly those with abdominal and thoracic surgery, but also after cardiac surgery.
- NIV reduces intubation rates, nosocomial infections, lengths of stay, morbidity and mortality. Before initiating NIV in post-operative patients with ARF, surgical complications such as anastomotic leak or intra-abdominal sepsis should be addressed first.
- Then, if the patient is cooperative and able to protect the airway, NIV can be initiated safely.

V. Should NIV be used in patients with ARF receiving palliative care and End of LIFE CARE?

Recommendation

- Clinicians delivering NIV or IMV should have ready access to palliative medicine (Grade D).
- Multidisciplinary advance care planning should be an integral part of the routine outpatient management of progressive or advanced disease and care plans should be reviewed on presentation during an episode of AHRF (Grade D).
- The use of NIV may allow time to establish patient preference with regard to escalation to IMV. (Grade D)

Good practice points

- Although removal of the NIV mask may be agreed as preferable, a dignified and comfortable death is possible with it in place.
- Clinicians delivering NIV or IMV should have training in end-of-life care and the support of palliative care teams.

VI. Should NIV be used in ARF due to chest trauma?

Recommendation

- We suggest NIV for chest trauma patients with ARF.

Evidence statement:

- Pooled analysis demonstrated that NIV use led to a decrease in mortality (RR 0.55, 95% CI 0.22–1.41; moderate certainty), the need for intubation (OR 0.21, 95% CI 0.06–0.74; moderate certainty) and the incidence of nosocomial pneumonia (OR 0.29, 95% CI 0.13–0.64; low certainty) in this population.
- There was also a decrease in ICU length of stay (mean difference 2.47 lower, 95% CI 1.5–3.45 lower). However, given the positive overall results, we suggest a cautious NIV trial in these patients when pain is controlled and hypoxemia not severe.

VII. Should NIV be used to facilitate weaning patients from invasive mechanical ventilation?

Recommendation

- NIV is recommended to aid weaning from IMV in patients with AHRF secondary to COPD (Grade B).
- In other causes of AHRF, NIV may have a role in shortening the duration of IMV when local expertise in its use exists (and of cough assist when indicated) and there are features present that indicate extubation is likely to be successful (Grade D).

Evidence statement:

- NIV has been shown to accelerate weaning from IMV in the patient with COPD failing an SBT (Level 1+)

VIII. Should NIV be used in chronic respiratory failure from neuromuscular disorder and chest wall diseases?

Recommendation

- Controlled oxygen therapy should be used in patients with NMD or CWD and AHRF (Grade D).
- NIV should almost always be trialled in the acutely unwell patient with NMD or CWD with hypercapnia. Do not wait for acidosis to develop (Grade D).
- In patients with NMD or CWD, NIV should be considered in acute illness when VC is known to be 20, even if normocapnic (Grade D).
- In patients with NMD or CWD, consider controlled ventilation as triggering may be ineffective (Grade D).
- In NMD and CWD, unless escalation to IMV is not desired by the patient or is deemed to be inappropriate, intubation should not be delayed if NIV is failing (Grade D).

Good practice points

- Individuals with NMD and CWD who present with AHRF should not be denied acute NIV.
- NIV is the ventilation mode of choice because patients with NMD or CWD tolerate it well and because extubation from IMV may be difficult.
- In patients with NMD or CWD, deterioration may be rapid or sudden, making HDU/ICU placement for therapy more appropriate
- In patients with NMD or CWD, senior/experienced input is needed in care planning and is essential if differences in opinion exist or develop between medical staff and patient representatives.
- In patients with NMD, it should be anticipated that bulbar dysfunction and communication difficulties, if present, will make NIV delivery difficult and may make it impossible.
- Discussion about NIV and IMV, and patients' wishes with respect to cardiopulmonary resuscitation, should occur as part of routine care in patients with NMD or CWD.
- In patients with NMD or CWD, nocturnal NIV should usually be continued following an episode of AHRF pending discussion with a home ventilation service.

IX. Question: Should NIV be used in Obesity Hypoventilation Syndrome?

Recommendation

- Controlled oxygen therapy should be used in patients with OHS and AHRF (Grade D).
- In patients with OHS, NIV should be started in AHRF, using the same criteria as in AECOPD (Grade B).

- NIV is indicated in some hospitalised obese hypercapnic patients with daytime somnolence, sleep disordered breathing and/or right heart failure in the absence of acidosis (Grade D)

Good practice points:

- NIV is indicated in obesity hypoventilation syndrome (OHS) with the goal of
  - Normalization of PCO_2 during wakefulness and sleep i.e. < 45 mmHg,
  - Elimination of oxyhemoglobin desaturation during wakefulness and sleep,
  - Relief of daytime symptoms and
  - Improvement of sleep architecture and quality

- OHS is diagnosed in patients with obesity BMI>30 when awake alveolar hypoventilation cannot be attributed to other causes like neuromuscular disorder. For these patients, we recommend NIV therapy during sleep rather than lifestyle modifications alone in order to improve symptoms and parameters of awake ventilation. Mode selection is in the form of CPAP, BPAP and Hybrid modes, depending upon coexisting obstructive sleep apnea and sleep related hypoventilation.
- High IPAP and EPAP settings are commonly required in patients with OHS (e.g., IPAP >30, EPAP >8).
- Volume control (or volume assured) modes of providing NIV may be more effective when high inflation pressures are required.

X. Should NIV be used in non-CF bronchiectasis?

Recommendation

- In patients with non-CF bronchiectasis and AHRF, controlled oxygen therapy should be used (Grade D).
- In patients with non-CF bronchiectasis, NIV should be started in AHRF using the same criteria as in AECOPD (Grade B).
- In patients with non-CF bronchiectasis, NIV should usually be tried before resorting to IMV in those with less severe physiological disturbance (Grade C).
- In non-CF bronchiectasis, the patient's clinical condition prior to the episode of AHRF, and the reason for the acute deterioration, should be evaluated and used to inform the decision about providing IMV (Grade C).

Good practice points:

- In patients with non-CF bronchiectasis, the precipitating cause is important in determining short-term prognosis.
- Health status prior to the episode of AHRF is an important predictor of outcome.

XI. Should NIV be used in cf. Cystic fibrosis bronchiectasis?

Recommendation:

- In patients with CF, controlled oxygen therapy should be used in AHRF (Grade D).
- In patients with CF, NIV is the treatment of choice when ventilatory support is needed (Grade C).
- In patients with CF, specialised physiotherapy is needed to aid sputum clearance (Grade D).
- In patients with CF, a mini tracheostomy combined with NIV may offer greater chance of survival than resorting to IMV (Grade D).

Good practice points:

- When ventilatory support is needed, outcome following IMV is worse than with NIV, especially when infection is the precipitant.
- Secretion clearance is a major issue and may render NIV ineffective or poorly tolerated.

XII: Should NIV be used in restrictive disorder like NMD and CWD?

Recommendation:

- Controlled oxygen therapy should be used in patients with NMD or CWD and AHRF (Grade D).
- NIV should almost always be trialled in the acutely unwell patient with NMD or CWD with hypercapnia. Do not wait for acidosis to develop (Grade D).
- In patients with NMD or CWD, NIV should be considered in acute illness when VC is known to be 20, even if normocapnic (Grade D).
- In patients with NMD or CWD, consider controlled ventilation as triggering may be ineffective (Grade D).
- In NMD and CWD, unless escalation to IMV is not desired by the patient or is deemed to be inappropriate, intubation should not be delayed if NIV is failing (Grade D).

Good practice points:

- NIV is the ventilation mode of choice because patients with NMD or CWD tolerate it well and because extubation from IMV may be difficult.
- In patients with NMD or CWD, deterioration may be rapid or sudden, making HDU/ICU placement for therapy more appropriate.
- In patients with NMD or CWD, senior/experienced input is needed in care planning and is essential if differences in opinion exist or develop between medical staff and patient representatives.
- In patients with NMD, it should be anticipated that bulbar dysfunction and communication difficulties, if present, will make NIV delivery difficult and may make it impossible.
- Discussion about NIV and IMV, and patients' wishes with respect to cardiopulmonary resuscitation, should occur as part of routine care in patients with NMD or CWD.
- In patients with NMD or CWD, nocturnal NIV should usually be continued following an episode of AHRF pending discussion with a home ventilation service.

Question 4:

What are the contra-indications of NIV?

Contraindications of NIV:

Absolute contraindication

a. The need for emergent intubation e.g. cardiac or respiratory arrest, severe respiratory distress, unstable cardiac arrythmias

Relative Contraindication

b. Non respiratory organ failure that is acutely life threatening:
   i. Severe encephalopathy GCS < 10
   ii. Severe upper GI bleeding
   iii. Hemodynamic instability
c. Facial or neurological surgery , trauma or deformity
d. Significant airway obstruction e.g. laryngeal mass or tracheal tumor
e. Inability to cooperate or protect airways
f. Anticipated prolonged duration of mechanical ventilation e.g. ≥ 4 to 7 days
   i. Recent esophageal or gastric anastomosis
   ii. Multiple contraindications
   iii. Insufficient staff support

Question 5:

What types of interfaces are used in NIV to improve patients' compliance?

Recommendation

- **We recommend appropriate training of staff involved in delivering NIV as a range of masks and sizes are available and to choose the mask for the patients best fit in.**

Patient ventilator interfaces play a very important role in improving compliance of patients. 10- 15% patients fail to tolerate NPPV due to mask interface. Poor mask fit may lead to asynchrony between patient and NIV as inspiratory effort may fail to be detected. Over tightening of head gear may lead to ulceration and poor compliance

Most commonly used mask is nasal and Oro-nasal interfaces. To summarize:

Nasal versus oronasal masks: Advantages and Disadvantages

Variables	Nasal	Oronasal	Full face
Comfort	+++	+	+
Claustrophobia	-	+	+
Rebreathing	+	-	-
Lowers CO2	++	+	+
Permits expectoration*	++	+	+
Permits speech	+	++	++
Permits eating	+	++	++
Function if nose obstructed	+	++	+++
Air leak	+++	++	+

+: possible; ++: most likely; +++: very likely; -: not possible.

* Expectoration is possible but requires the assistance of a respiratory therapist with oronasal mask.

- Speech is possible but may vary depending on the degree of respiratory failure.
- Eating necessitates oronasal mask removal and may be contraindicated in patients with severe respiratory failure.

Different Interface for Non-Invasive Ventilation

Nasal Mask

Patient's nose is covered only, leaving the mouth exposed

Advantages:

- **Comfort:** Less intrusive than full-face masks, often preferred for long-term use (e.g., in sleep apnea).
- **Communication:** Allows speaking, eating, and drinking without removal.
- **Lower Risk of Aspiration:** Since the mouth isn't covered, there's less chance of vomit being trapped.
- **Minimal Claustrophobia:** Open design feels less confining.

Disadvantages:

- **Mouth Leaks:** Ineffective if the patient breathes through their mouth, reducing delivered pressure unless a chin strap is used.
- **Limited in Acute Settings:** Less suitable for severe respiratory failure where higher pressures or tighter seals are needed
- **Nasal Irritation:** Prolonged use can cause dryness or soreness in the nasal passages.

Oronasal / Full Face masks

This interface covers both the nose and mouth.

Advantages:

- **Effective Seal:** Prevents mouth leaks, making it ideal for patients who breathe through their mouth or need higher pressures (e.g., acute respiratory failure, COPD exacerbations).
- **Effective for Mouth Breathers:** Ensures ventilation remains effective even if the patient breathes through their mouth, which is a common issue with nasal-only interfaces
- **Versatility:** Suitable for a wide range of conditions, from chronic to acute settings.
- **Better Pressure Delivery:** Ensures consistent ventilation even with nasal congestion or obstruction.
- **Improved Compliance in Acute Settings:** In emergencies, full-face masks can be quickly applied and are often better tolerated encouraging patient adherence

Disadvantages:

- **Claustrophobia:** More restrictive, which can reduce patient tolerance.
- **Skin Irritation and Pressure Sores:** Prolonged use may cause redness, ulcers, or breakdown of skin, particularly over the nasal bridge, cheeks, or chin where the mask seals tightly.
- **Gastric Distension Risk:** Higher pressures delivered through a full-face mask can force air into the stomach, leading to bloating or nausea. It also increases the risk of aspiration.
- **Communication Difficulty:** Muffles speech and prevents eating/drinking without removal.
- **Increased Dead Space:** The mask's larger volume can lead to rebreathing of exhaled CO_2, potentially reducing ventilation efficiency unless properly vented.

Nasal Pillows

Small inserts that seal at the nostrils, leaving the rest of the face free.

Advantages:

- **Minimalist Design:** Lightweight and less obtrusive, reducing claustrophobia and improving comfort.
- **Good for Low Pressures:** Works well for mild to moderate sleep apnea or early-stage respiratory support.
- **Fewer Skin Issues:** Less contact with the face reduces the risk of sores or irritation.
- **Clear Field of Vision:** Doesn't obstruct the eyes, enhancing patient satisfaction.

Disadvantages:

- **High Pressure Limitations:** May not seal well at higher pressures, leading to leaks or discomfort.
- **Nasal Discomfort:** Can irritate the nostrils or cause dryness, especially with prolonged use.
- **Mouth Breathing Issues:** Like nasal masks, ineffective if the patient opens their mouth unless paired with a chin strap.

Helmet Interfaces

A transparent hood or a mask that covers the entire head, sealing around the neck or shoulders.

Advantages:

- **No Facial Pressure:** Avoids skin breakdown or sores since it doesn't press on the face.
- **Tolerability:** Less claustrophobic for some patients despite its appearance; allows free head movement.
- **Effective for Prolonged Use:** Useful in critical care settings (e.g., ARDS or post-extubation support).
- **Accommodates Irregular Features**: Fits a variety of head shapes without needing precise sizing.

Disadvantages:

- **Noise:** Airflow within the helmet can be loud, disturbing sleep or comfort.
- **CO2 Rebreathing:** Risk of carbon dioxide buildup if ventilation isn't optimized.
- **Limited Accessibility:** Harder to adjust or remove quickly in emergencies.
- **Bulkiness:** Less portable and more cumbersome than masks

Comparative Summary

Interface	Used Best For	Key Advantage	Key Disadvantage
Nasal Mask	Chronic use (e.g., sleep apnea)	Comfort, communication	Mouth leaks
Full-Face Mask	Acute respiratory failure	Effective seal, no leaks	Claustrophobia, skin issues
Nasal Pillows	Mild conditions, comfort	Minimalist, fewer sores	oor at high pressures
Helmet	Critical care, long-term use	No facial pressure	Noise, CO2 rebreathing risk

Practical Considerations:

- **Patient Preference:** Comfort and tolerance heavily influence compliance, so trial and error may be needed to find the best fit.
- **Condition Severity:** Acute conditions (e.g., pulmonary edema) often favor full-face masks or helmets, while chronic conditions (e.g., OSA) lean toward nasal options.
- **Fitting and Maintenance:** Proper sizing, regular cleaning, and adjustments are critical to avoid leaks or complications across all types.

Question 6:

When do we use supplemental oxygen along with NIV?

Recommendations

- Oxygen saturation should be adjusted to achieve SaO_2 88–92% in all causes of AHRF being treated by NIV (Grade A).
- Oxygen should be entrained as close to the patient as possible (Grade C).

Good practice points:

- As gas exchange will improve with increased alveolar ventilation, NIV settings should be optimised before increasing the FiO_2.
- The flow rate of supplemental oxygen may need to be increased when ventilatory pressure is increased to maintain the same SaO_2 target.
- Mask leak and delayed triggering may be caused by oxygen flow rates >4 L/min, which risks promoting or exacerbating patient–ventilator asynchrony. The requirement for high flow rates should prompt a careful check for patient–ventilator asynchrony.
- A ventilator with an integral oxygen blender is recommended if oxygen at 4 L/min fails to maintain SpO_2 >88%.

Question 7:

When can humidification be considered along with NIV?

Recommendation

- Humidification is not routinely required (Grade D).

Good practice point:

- Heated humidification may reduce upper airway resistance and increase comfort when leak is high.
- In short-term studies, heated humidification reduces upper airway dryness, which might improve tolerance.
- Heated humidification should be considered if the patient reports mucosal dryness or if respiratory secretions are thick and tenacious.

Question 8:

How often should bronchodilator therapy be given along with NIV?

Recommendations

- Nebulized drugs should normally be administered during breaks from NIV. For patients requiring continuous BiPAP, nebulizer should be inserted into the ventilator tubing.

Good practice points:

- Brief discontinuation of NIV for the administration of bronchodilators appears to be safe.
- Bronchodilator therapy is probably better given during breaks in NIV. This may also facilitate coughing and the clearing of respiratory secretions.
- If discontinuing NIV results in patient distress, it should be continued and a nebuliser sited proximally in the circuit.

Question 9:

How often is sedation given along with NIV?

Recommendation

- Sedation should only be used with close monitoring (Grade D).
- Infused sedative/anxiolytic drugs should only be used in an HDU or ICU setting (Grade D).

If intubation is not intended should NIV fail, then sedation/anxiolysis is indicated for symptom control in the distressed or agitated patient (Grade D).

Good practice point:

- In the agitated/distressed and/or tachypnoeic individual on NIV, intravenous morphine 2.5–5 mg (± benzodiazepine) may provide symptom relief and may improve tolerance of NIV
- On one hand, such therapy may enhance tolerance of NIV when anxiety or pain is limiting NIV use. On the other hand, sedatives may precipitate worsening of respiratory failure or arrest and prompt intubation. DEXMEDETOMIDINE is an appealing agent, given its lack of significant impact on respiratory drive. A meta-analysis of 12 studies that included a mix of medical and surgical patients found that the use of DEXMEDETOMIDINE reduced the risk of intubation, delirium and ICU length of stay. These benefits came at the price of increased incidence of bradycardia and hypotension. Notably, in the studies included in this meta-analysis, control groups received variable treatments the included midazolam, haloperidol and propofol infusions while some received placebo.

Question 10:

What can be done for sputum retention?

Recommendations

- In patients with neuromuscular disease (NMD), mechanical insufflation and exsufflation should be used, in addition to standard physiotherapy techniques, when cough is ineffective and there is sputum retention (Grade B).
- Mini tracheostomy may have a role in aiding secretion clearance in cases of weak cough (NMD/chest wall disease (CWD)) or excessive amounts (COPD, cystic fibrosis (CF)) (Grade D).

Good practice points:

- Manual-assisted cough and MI-E (Mechanical insufflation – exsufflation) are safe methods for aiding secretion clearance.

- MI-E is more effective than manual-assisted cough in patients with stable NMD.

- Mini tracheostomy is a useful bedside procedure that can markedly improve secretion clearance but requires patient cooperation and a skilled operator to be performed safely.

Question 11:

What can be the specific duration of NIV in acute respiratory failure?

Recommendation

- NIV can be discontinued when there has been normalization of pH and pCO2 and a general improvement in the patient's condition (Grade B).

Good practice point:

- Time on NIV should be maximized in the first 24 hours depending on patient tolerance and/or complications.
- NIV use during the day can be tapered in the following 2– 3 days, depending on pCO2 self-ventilating, before being discontinued overnight.

Question 12:

How many modes are there in NIV, and how do you use them?

Modes of ventilation:

MODE is most important setting In NIV which is related to the outcome of patient suffering from respiratory failure. Wrong MODE may lead to poor compliance and aggravating respiratory failure. Following are the MODES used:

Bilevel noninvasive ventilation

MODE:

A. Spontaneous (S)
B. Spontaneous/Time Mode (S/T)
C. Time Mode (T)
D. Pressure control Mode (PC)
E. HYBRID - Volume Assured Pressure Support (VAPS)

Continuous positive airway pressure

Spontaneous Mode (S)

Therapy mode in which all breaths are spontaneous

Spontaneous/Timed Mode(S/T)

Therapy mode that is similar to S mode, but can also deliver mandatory breaths

Timed Mode (T)

Times pressure support therapy mode with all mandatory delivered breaths

Pressure Control Mode (PC)

Delivers assisted and mandatory breaths at a user-defined pressure.

Volume Assured Pressure Support (VAPS)

- VAPS automatically increases Pressure Support (PS) to maintain the target Tidal Volume (Vt).
- The IPAP level will not rise above IPAP Max, even if the target Vt is not reached.
- Conversely, as the patient effort increases, AVAPS will reduce PS, IPAP will not fall below IPAP Min, even if the target Vt is exceeded.
- AVAPS automatically adapts pressure support to patient needs to guarantee an average tidal volume.

Summary of Bi-level Modes & Breath Types

Mode	Breath Type	Ventilator Triggered Breath	Patient Triggered breath	Breath Target
CPAP	None	None	None	None
S	Spontaneous	None	Patient Triggered	Pressure (Bi-level)
S/T	Either Patient or Machine	Machine Triggered	Patient Triggered	Pressure (Bi-level)
T	Time	Controlled	None	Pressure (Bi-level)
PC	Either Patient or Machine	Controlled	Assisted	Pressure (Bi-level)

Question 13:

What can be the delivery of care planning in NIV patients?

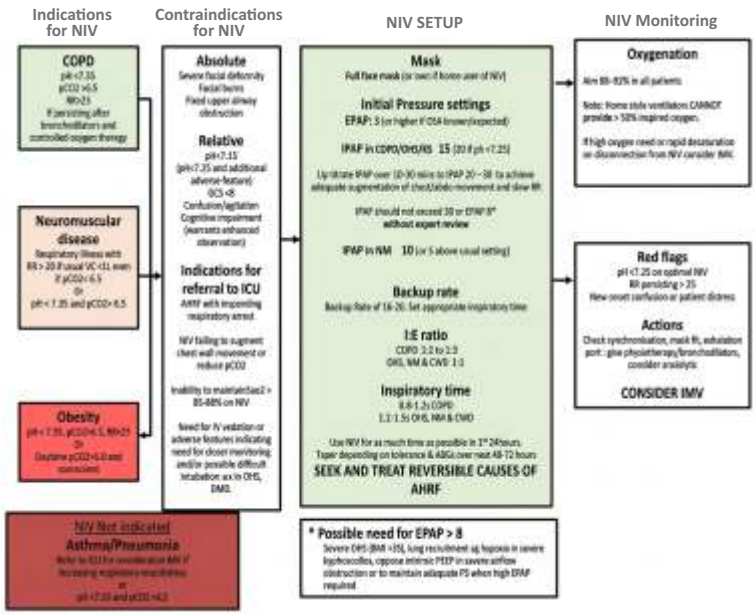
Recommendations

- NIV services should be operated under a single clinical lead having working links with ICU
- NIV should be arranged in a clinical environment with enhanced nursing and monitoring facilities that are beyond those of a general medical ward
- Ideally a 2-4 bedded designated HDU / NIV unit, located within a respiratory ward with enhanced staffing levels, should be arranged
- Areas providing NIV should have a process for audit and interdisciplinary communication.

Typical initial setting

Recommendation

- If BiPAP is indicated, the patient should be referred to critical care physician by the A&E or medical unit
- The critical care physician should decide, with other teams involved, if a patient is a suitable candidate for BiPAP in the ward according to the criteria above.
- The critical care consultant must be involved if there is any doubt whether ward BiPAP is appropriate for any particular patient.
- Initial documentation should include prescription for BiPAP and a management plan in the event of treatment failure (intubation or palliative management).



Ref. BTS guidelines

Question 14:

How do we monitor patients during NIV therapy?

Recommendation

- Monitoring should include continuous pulse oximetry and hourly respiratory rate, non-invasive blood pressure and assessment of consciousness level.
- We recommend continuous monitoring of oxygen saturation and intermittent monitoring of PH and PCO2.
- We recommend ECG monitoring if the patient has a pulse rate > 120 bpm.

Monitoring after applying NIV is very important and should be primarily on clinical assessment. In patients suffering from AHRF with sever acidosis (PH less than 7.20) may need clinical assessment after every 15 min.

- **Clinical evaluation**
  - Assessment of patient comfort
  - Conscious level
  - Chest wall motion
  - Accessory muscle recruitment
  - Coordination
  - Respiratory and heart rate

- **Laboratory evaluation**

ABGs: Arterial blood gases should be checked routinely at 1, 4 and 12 hours after the initiation of BIPAP or more often if clinically indicated.

ECG: Important to see ongoing or old ischemic change

Electrolytes: Drowsiness and failure can be due to hyponatremia and hypokalemia. So, it is important to send electrolytes like Sodium, Potassium, Magnesium, Calcium.

TARGET:
We have to reduce our target in patients with AHRF. As with time and improvement in primary disease the target itself starts improving. The initial target should be:

- PaO260 mmHg
- Saturation 85%-90%
- PH normal

Question 15:

What can be the complications of NIV therapy and how do we handle its Trouble-shooting?

Recommendation

- We recommend that the patients should be frequently assessed to identify potential complications of NIV.

Minor complications are common but serious complications can occur. Some of the complications are:

- Local skin damage due to pressure effects of the mask and straps
- Eye irritation, sinus pain, congestion or epistaxis due to mucosal dryness
- Mild gastric distension
- Pulmonary barotrauma
- Hemodynamic instability
- Aspiration
- Anxiety, fear, claustrophobia
- Delirium

Troubleshooting of NIV:

Recommendation:

- We recommend that always check common technical issues have been addressed and ventilator settings are optimal, before considering NIV to have failed.
- The BiPAP should be applied and started by trained ward nursing staff. If help is needed on commencing or during the therapy, critical care nurse in charge will be asked to provide technical problem solving.
- During the first 12 hours of BiPAP in the ward, every two patients receiving BiPAP should be looked after by 1 nurse.

Non-invasive ventilation (NIV) has become an important part of support in patients with acute and chronic respiratory failure. Although NIV is well tolerated by most patients, it is not entirely free from serious adverse side-effects and complications. The most common side effects and troubleshooting problems with Non-invasive positive pressure ventilation are discussed as follows:

1. Mask intolerance:

Mask discomfort is the most commonly encountered problem for patients adapting to NIV amounting to up to as many as 30–50% of patients and is responsible for 12– 33% of NIV failure.

Remedies:

It should be ensured that mask fit is optimal and that minimal strap tension is used to control air leaking.

Different types of interfaces can be applied to encourage tolerability like nasal masks, oronasal masks, total face masks, nasal pillows, mouthpiece and helmets.

Patients who require long term NIV use should be encouraged for gradual adaptation for

weeks or months before giving up, which can include wearing the mask for brief, but progressively longer periods while watching TV or participating in another distracting activity.

2. Claustrophobia

Claustrophobia may present as minor discomfort to a frightening sense of inability to breathe and suffocation. Claustrophobia not only causes difficulty to initiate, but also to continue NIV with a variable incidence that ranges from 5% to 20%.

Remedies:

Nasal masks are less likely to cause claustrophobia than face masks.

Using manual mask application (i.e. placing the interface gently over face, holding it in place and starting ventilation; and then tighten straps) also helps.

Patients should be reassured; mild sedation can also be used for better compliance.

3. Nasal congestion or dryness:

During NIV, nasal or oral dryness affects 10–20% of patients and nasal congestion 20–50% of patients, particularly when a nasal mask or nasal CPAP is used.

Remedies:

In-line heated humidification and heated tubing have become standard and have reduced the nasal dryness problem. The main types of humidification devices used, heated humidifiers and HMEs, are used for both short-term and long-term humidification during NIV.

Dryness may also respond to nasal saline and water based nasal gels.

Nasal congestion may be ameliorated by use of inhaled nasal glucocorticoids or antihistamine decongestant combinations.

Decreasing ventilator pressures slightly also helps in reducing nasal dryness and congestion.

4. Secretion clearance:

Patients with neuromuscular or chest wall disease, or ventilatory pump failure for any reason, can develop severe hypercapnia, difficulty clearing airway secretions with ventilation-perfusion mismatching, and ultimately acute on chronic respiratory failure.

Remedies:

There are both manual and mechanical methods to increase cough flows. The most effective method for generating effective cough flows for clearing airway debris is the use of mechanical insufflation-exsufflation (MIE). This can be used in combination with the manual thrusts of manually assisted coughing. The goal is to fully inflate then fully empty the lungs in four to six seconds to clear airway debris while avoiding both hypo- and hyperventilation.

5. Nasal bridge redness or ulceration

Nasal skin lesions (i.e. erythema, ulcers) at the site of mask contact increase with longer NIV durations and can be a major factor that can limit the tolerance and duration of mask NIV.

Remedies:

Decrease strap tension, using foam rubber "spacers," silicone inserts or applying artificial skin (e.g., Duoderm, Restore), or switching to alternative masks such as the foam inner seal, "bubble" mask or nasal "pillows."

Switch to oral nasal masks that fit under the nose and do not rest on the bridge of the nose.

Low potency corticosteroid creams, oral doxycycline or clindamycin lotion may be helpful to

treat acneiform lesions.
Soft cloth liners that fit between the mask and the skin are also helpful.

6. Gastric insufflation

Aerophagia occurs in most NIV patients and gastric insufflation in 5% to 30–40% of patients. When gastric insufflation occurs during NIV, gastric distension compresses the lungs, thereby decreasing lung compliance and demanding higher airway ventilation pressure.

Remedies:

Inspiratory airway pressures higher than 20–25 cm H_2O should be avoided.
High pressure NIV should also be carried out in an almost sitting position approximately half an hour after a meal and with routine gastric decompression care.

7. Air leak

Air leakage through the mouth is uNIVersal among users of nasal noninvasive positive pressure ventilation (NPPV) and patients can be successfully ventilated despite small air leaks. Large air leaks decrease the FIO_2 and arterial oxygen saturation, and increase ventilator autotriggering, patient ventilator dyssynchrony, and rebreathing of exhaled gas, all of which increase chances of NIV failure.

Remedies:

Air leaks are negligible when a proper device for NIV is chosen and fitted.
Choosing an oral-nasal mask that seals under the chin may improve mask stability and reduce leakage.
A tighter fitting of the interface may alone improve leaks and ventilation but should be done cautiously due to skin discomfort.
Pressure-controlled ventilation causes less air leaks than volume-controlled ventilation. A reduction in inspiratory pressure or tidal volume may also reduce air leaks.
Chin straps may also be applied.

8. Failure to improve gas exchange and carbon dioxide rebreathing

Failure to improve gas exchange after initiating NIV can be due to insufficient hours of use, unintentional air leak during inspiration, residual obstructive respiratory events, asynchrony, and insufficient support of minute ventilation.

Remedies:

Improvement may be accomplished by upward adjustments in inspiratory pressure or tidal volume, ventilator rate, duration of ventilator use, or a combination of these changes may be helpful.
Adjustment of the trigger sensitivity or upward adjustment of backup rate may be helpful if there is evidence of inability to trigger the ventilator.
Carbon dioxide (CO_2) rebreathing may impair CO_2 elimination and load the ventilatory muscles further. Lowering respiratory rate, increasing expiratory time, use of expiratory positive airway pressure (EPAP) greater than 4 cm H_2O, switching to a nonrebreather valve, or use of masks with in-mask exhalation ports may help.
Follow-up nocturnal monitoring in the sleep lab or at home is the optimal way in which to evaluate problems with NPPV.

Question 16:

What can be the factors related to NIV success or failure?

Recommendation:

- **We recommend changing the management strategy if there is worsening of physiological parameters, particularly PH and respiratory rate. This may include clinical review, change of interface, adjustment of ventilator settings and considering proceeding to endotracheal intubation.**

The medical physician should inform critical care physicians to consider patient transfer to critical care if patient shows signs of deterioration.

- **Trial Success – indicators:**
  - Younger age
  - Lower acuity of illness APACHE score
  - Able to cooperate, better neurologic score
  - Less air leaking, intact dentition
  - Moderate hypercarbia, PCO2 >45 mm HG, <92 mmHG
  - Moderate acidemia PH < 7.35, >7.10
  - Improvements in gas exchange as well as heart and respiratory rates within first 2 hours

- **Trial Failure – indicators:**
  - Severe Pneumonia
  - Copious secretion
  - Low BMI
  - Confusion or impaired consciousness
  - High severity score at commencement of NIV (SAPS II >30, APACHE II >20)
  - Minimal or no reduction in PH after 1- 2 hours
  - **HACOR & NIVO SCORE:** Two scores HACOR and NIVO predict NIV failure, with HACOR being a more established score for predicting failure in the short-term within hours, while the NIVO score predicts both in-hospital and 1-year mortality and NIV failure, particularly in acute exacerbation of COPD. A HACOR score >5 often indicates an increased risk of failure and a NIVO score>7 is associated with a higher risk of NIV failure and long-term mortality. So HACOR score is chosen for short term prediction and NIVO score is chosen for predicting long-term outcomes.

NIVO score	Points
Chest radiograph consolidation	1
Glasgow Coma Scale <14	1
Atrial fibrillation	1
pH <7.25	1
Time to acidaemia > 12 h	2
eMRCD 5a	2
eMRCD 5b	3
Total	9

TABLE 4 In-hospital and 90-day mortality by Noninvasive Ventilation Outcomes (NIVO) score increment and risk category			
	Patients n	In-hospital mortality	90-day mortality
NIVO score			
0	67	0	10.4
1	79	8.9	20.3
2	133	5.3	15.8
3	152	15.1	26.3
4	116	19.0	40.5
5	97	35.1	46.4
6	54	53.7	59.3
7	26	65.4	76.9
8	8	87.5	87.5
9	1	100	100
Total	733	20.1	32.2
Risk category			
Low (0-2)	279	5.0	15.8
Medium (3-4)	268	16.8	32.5
High (5-6)	151	41.2	50.1
Very high (7-9)	35	71.4	80.0

Data are presented as %, unless otherwise stated.

HACOR SCORE:

Variable	Value	Score
HR	≤ 120	0
	> 121	1
pH	≥ 7.35	0
	7.30-7.34	2
	7.25-7.29	3
	<7.25	4
Glasgow	15	0
	13-14	2
	11-12	5
	10	10
PaO2/FiO2	>201	0
	176-200	2
	151-175	3
	126-150	4
	101-125	5
	< 100	6
RR	≤30	0
	31-35	1
	36-40	2
	41-45	3
	≥ 46	4

Interpreting the score

- **HACOR score > 5:**

This is considered a high-risk score for NIV failure. Patients with this score have an approximately 80% chance of failure, according to some studies.

- **Action for high score:**

Clinicians should consider early intubation for patients with a HACOR score greater than 5, especially after one hour of NIV.

- **HACOR score ≤ 5:**

This indicates a lower risk for NIV failure, and continued monitoring and supportive measures may be appropriate.

- **When to shift to ICU:**
  - Worsening ABGs after one hour of initiation of BiPAP therapy
  - No improvement of ABGs after 4-12 hours of initiation of BiPAP
  - Worsening of ABGs or clinical deterioration of patient at any time while on BiPAP
  - Respiratory rate > 35/min
  - Uncontrolled arrhythmias
  - Signs of heart failure
  - Patient requiring sedation and nursing management becomes difficult

Question 17:

When do we plan for domiciliary NIV therapy?

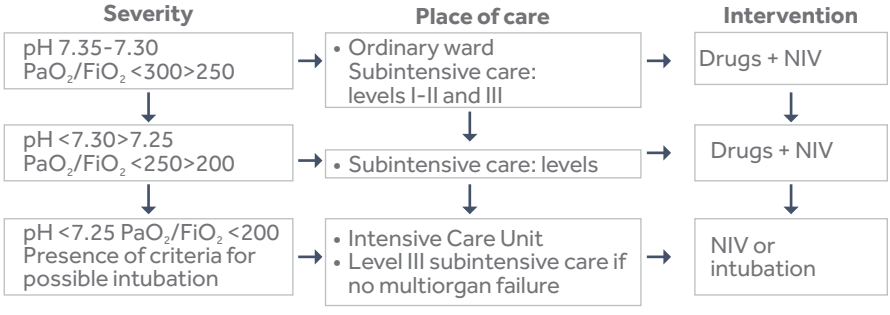
Indications for domiciliary NIV:

- Failure to wean from ventilator
- Acute hypercapnic respiratory failure secondary to
  - Spinal cord lesion
  - Chest wall deformity (scoliosis, thoracoplasty)
  - Morbid obesity

COPD with

- Recurrent AHRF (>3 episodes) requiring NIV
- Intolerant to supplementary oxygen

Guidance for using ward based NIV & patient documentation



Flow-chart of the use of NIV in hospital

Protocol for initiation of noninvasive positive pressure ventilation:

1. Appropriately monitored location, oximetry, respiratory impedance, vital signs as clinically indicated
2. Patient in bed or chair at >30-degree angle
3. Select and fit interface
4. Select ventilator mode
5. Apply headgear; avoid excessive strap tension (one or two fingers under strap)
6. Connect interface to ventilator tubing and turn on ventilator
7. Start with low pressure in spontaneously triggered mode: 12 to 15 cm H_2O inspiratory pressure; 4 to 5 cm H_2O expiratory pressure
8. Gradually increase inspiratory pressure (10 to 30 cm H_2O) as tolerated to achieve alleviation of dyspnea, decreased respiratory rate, increased tidal volume (if being monitored), and good patient–ventilator synchrony
9. Provide O_2 supplementation as needed to keep O_2 saturation >90 percent
10. Check for air leaks, readjust straps as needed
11. Add humidifier as indicated
12. Can consider mild sedation only in ICU set up.
13. Encouragement, reassurance, and frequent checks and adjustments as needed
14. Monitor occasional blood gases (within 1 to 2 hours) and then as needed

Question 18:

What is the weaning strategy in NIV therapy?

Recommendation

NIV can be discontinued when there has been normalization of PH and PCO_2 and a general improvement in the patient's condition.

Weaning criteria

- pH is preferably > 7.35 for more than 24 hours and the patient should ideally be afebrile, awake and alert or easily arousable
- SpO_2 88 - 92%
- Respiratory Rate ≥ 12 and ≤22 breaths per minute
- Patient hemodynamically stable for more than 6 hours
- Patient tolerating short periods of NIV for eating / drinking etc.

Protocols

- Reduce oxygen gradually until <4 litres / min is reached
- Reduce EPAP gradually by 1 cm of H_2O
- Reduce IPAP gradually by 1 cm of H_2O
- Gradually increase NIV off interval time during day while maintaining 4-6 hours NIV overnight

Monitoring

- Vital monitoring
- ABGs sampling as required
- Saline Nebulizers while on NIV

Discontinue NIV

- When the weaning criteria is maintained

Question 19:

How are the cleaning and disinfection of NIV devices done between patients?

Check list for Cleaning and Disinfection of BiPAP/CPAP Devices Between Patients

- Before starting any hygiene tasks, please ensure that:
- All electrical medical equipment is disconnected from power supply, and all activities are performed at designated disinfection room
- After each patient uses, the BiPAP/CPAP must be cleaned, disinfected, and stored appropriately in a clean environment before use on another patient

Ser	Tasks	Description
1.	Perform risk assessment prior	Consider the patient care tasks that will need to be performed or additional risks during disconnection of the device.
2.	Perform hand hygiene	
3.	Don appropriate personal protective equipment (PPE)	PPE worn during disinfectant preparation should include surgical mask/respirator, goggles or face shield, long-sleeved fluid resistant gown or gown + apron, rubber gloves, and boots or closed work shoes.
4.	Disconnect the device.	Turn off the device and disconnect from the patient, oxygen source and the power.
5.	Dispose of single use tubing, interface and filters in designated waste containers	If patient is being permanently disconnected from BiPAP/CPAP device, dispose of single use tubing, interface, and exhalation valve filters in designated infectious material/biohazardous waste container.
6.	Move the device to a well-ventilated area for cleaning	Move the BiPAP/CPAP device away from patients and other equipment to a designated well-ventilated space where cleaning and disinfection of the device can be performed.
7.	Change gloves	Discard gloves in appropriate waste containers, perform hand hygiene, and don new gloves.
8.	Wash humidifier	Wash the humidifier in warm water using a mild detergent. Rinse the humidifier thoroughly and allow to air to dry completely.
9.	Wipe with detergent and clean water from top-to-bottom (Cleaning)	Wipe the exterior of the device from top to bottom weekly and between patients with a damp cloth or disposable wipe soaked in detergent and clean water and then wipe off any remaining detergent residue with a dry lint-free cloth.

Ser	Tasks	Description
		Use mechanical action (scrubbing) and brushing, if necessary, along the edges and joints to remove visible dirt deposits and calcifications.
10.	Prepare disinfectant solutions	Should always be performed before use, in well-ventilated areas away from patients.
11.	Wipe with disinfectant	•Prepare a fresh cloth or disposable wipe soaked in a compatible disinfectant. Wipe the device from top to bottom, ensuring surfaces of sensors/cables are wiped while avoiding contact with electrical connectors. •0.1% sodium hypochlorite (1000 ppm) should only be used according to the manufacturer's instructions if device is known to withstand use of chlorine-based agents and no ammonia-based cleaning agents or acidic body fluids (e.g. urine) are present on the device. •Do not use different disinfectant formulations during the same disinfection step, this may produce toxic fumes.
12.	Remove PPE- wash hands	Doff and discard PPE and perform hand hygiene.
13.	Store clean BiPAP /CPAP and disinfect before new use	Ensure cleaned BiPAP/CPAP device is stored in an area where there is low risk of contamination between uses, and that at least 1 minute of contact time has elapsed after the application of the chosen disinfectant (or as specified by the manufacturer) before ventilator device is used on a patient.

Check list for Cleaning and Disinfection of BiPAP/CPAP Devices
Same Patient

- Before starting any hygiene tasks, please ensure that:
- All electrical medical equipment is disconnected from power supply and all activities are performed at designated disinfection room

Ser	Tasks	Description
1.	Humidifier must be washed, rinsed, and disinfected daily	• Oxygen bubble humidifier (non-heated bottle) must be washed, rinsed, and disinfected regularly when used for the same patient and after use between patients. • Empty the water from the humidifier. • Rinse the humidifier flask under running water.

Ser	Tasks	Description
		• Fill in proper distilled water or cold boiled water within the scale between the top scale line and the lowest one. • Do not use tap water (not boiled), even if it is safe drinkable water. • Do not use bottled water, even distilled, which has been stored in warm conditions. (These conditions allow bacterial growth in the water and increase the risk of patient infection).
2.	Check the air filter weekly and replace every 4 weeks	Replace more often if there are any holes or blockages by dirt, dust, or other organic matter

1 **Daily Mask Cleaning**

2 **Cleaning the Humidifier Chamber**

3 **Daily Cleaning the Tubing**

Disinfecting **Non-Invasive Ventilation (NIV)** equipment, such as full-face masks, nasal masks, tubing, and headgear, is critical to prevent infections and ensure patient safety. Consumables associated with oxygen delivery are generally intended as single use devices, should be treated as infectious material and disposed of accordingly.

1. Preparation

- **Turn Off and Disconnect:** Power down the NIV machine and unplug it from the electrical outlet. Disconnect the mask, tubing, and humidifier (if applicable) from the device.
- **Wash Hands:** Thoroughly wash your hands with soap and water or use an alcohol-based sanitizer to avoid contaminating the equipment.
- **Disassemble:** Separate all removable parts (e.g., mask cushion, headgear straps, tubing, humidifier chamber) as per the manufacturer's instructions.

2. Cleaning (Remove Debris)

Soap and Water: Use mild dish soap (unscented, non-antibacterial preferred) and warm water to clean each component:

- **Mask:** Soak and gently scrub the mask (cushion and frame) with a soft cloth or brush to remove sweat, oils, or mucus.
- **Tubing:** Run soapy water through the tubing, rinse thoroughly, and shake out excess water.
- **Headgear:** Hand-wash straps if detachable; avoid soaking if they're non-removable elastic.
- **Humidifier Chamber:** Empty any residual water and wash with soap, ensuring no residue remains.

Rinse: Rinse all parts thoroughly with clean water to remove soap.

Avoid the Machine: Do not submerge the NIV machine itself (the blower unit), wipe it down separately

3. Disinfection

Choose a disinfection method based on availability and manufacturer recommendations:

Vinegar Solution:

- Mix 1 part white vinegar with 3 parts water (e.g., 1 cup vinegar to 3 cups water).
- Soak the mask, tubing, and humidifier chamber for 20–30 minutes.
- Rinse thoroughly with clean water to remove vinegar odour.

Isopropyl Alcohol (70%):

- Wipe down hard surfaces (e.g., mask frame) with alcohol wipes or a soaked cloth. Avoid soaking soft parts like cushions or headgear, as alcohol can degrade them.
- Let air dry; do not rinse after alcohol unless specified.

Heat (if applicable): Some components (e.g., humidifier chambers) may be dishwasher-safe or compatible with boiling water—check the manual.

Hospital-Grade Disinfectants: In clinical settings, solutions like quaternary ammonium compounds or bleach dilutions (e.g., 1:10) may be used, followed by thorough rinsing.

4. Drying

Air Dry: Place all components on a clean towel or hang tubing vertically to dry naturally. Avoid direct sunlight or heat sources, which can damage materials.

Ensure Complete Dryness: Moisture left in tubing or masks can breed bacteria or mold.

5. Machine Maintenance

Wipe Down: Use a damp cloth with mild soap or an alcohol wipe to clean the exterior of the NIV machine. Avoid getting water inside vents or ports.

Filter Cleaning: Check the machine's air filter (foam or disposable). Wash reusable filters with water and let them dry, or replace disposable ones as recommended (e.g., every 1–2 months).

6. Reassembly and Storage

- Once dry, reassemble the equipment and store it in a clean, dry place away from dust or contaminants.

Frequency

Daily: Clean the mask and tubing with soap and water to remove daily buildup.

Weekly: Perform a full disinfection (e.g., vinegar or disinfectant soak) of mask, tubing, and humidifier.

As Needed: Replace worn-out parts (e.g., masks every 3–6 months, tubing every 6–12 months) or if contamination is suspected.

Additional Tips

Avoid Harsh Chemicals: Bleach, strong detergents, or scented products can damage equipment or irritate airways.

Check Manufacturer Guidelines: Some brands (e.g., ResMed, Philips Respironics) specify compatible disinfectants or warn against certain methods.

Infection Control in Healthcare Settings: Use autoclaving or chemical sterilants for shared equipment, following facility protocols (e.g., CDC or WHO standards).

Humidifier Care: Empty and dry the water chamber daily to prevent bacterial growth like Pseudomonas.

Patient's Pathway

Pathway point	Aim	Recommendations
In A&E or medical ward: First seen by A&E or medical team Review by Medical and Critical Care team	To confirm diagnosis of exacerbation of COPD and recognition of patients suitable for ward NIV Appropriateness for escalation of treatment has been discussed (such as CPR, inotropes or intubation) or BiPAP as a ceiling of active treatment. Initial medical management for at least one hour Assess response to medical treatment and patient's tolerance to NIV	Baseline blood gases. Start medical treatment for one hour then repeat blood gases. Apply NIV if indicated and assess patient's tolerance to the mask. Prescribing NIV in patient's notes Prescription of patient's regular medications and medications for treatment of COPD as appropriate.
In AMU: Under care of AMU or respiratory ward medical and nursing staff Respiratory team may be involved in selected cases in AMU	24 hours of NIV at maximal pressure (20/5) with minimal interruption. Wean NIV over subsequent 48 hours Patient may need referral to respiratory physician if not already in AMU (e.g. patients difficult to wean off NIV)	ABG at 1, 4 and 12 hours of NIV. Repeat ABG at any time if significant clinical changes such as increasing narcosis

Pathway point	Aim	Recommendations
Critical Care input to patents on ward NIV: Regular medical input to patients on NIV in the ward in the first 4 hours Nursing support from critical care nursing staff for problem solving and technical issues with the equipment. Receive requests for review of patients on NIV throughout their stay in the ward	To provide support to AMU nursing and medical staff To assess patients regarding the need for transfer to critical care (patients who are not responding to NIV, needing sedation, or developing other organ failure, etc.)	Critical care team (outreach if available) to review ABG at 1 and 4 hours from initiation of BIPAP. Medical team to discuss difficult patients or patients who are not responding to NIV with a critical care registrar if the patient is candidate for escalation of treatment (for transfer to critical care intubation, etc.)

NIV Prescription Chart & Checklist **Must be completed by medical staff from parent team prior to commencement of NIV therapy**	Patient details / label: Name: Age: Department:

Does the patient have capacity to provide consent for this procedure / treatment? (Refer to Mental capacity Act 2005 and Codes of Practice)		
• If YES, the patient should provide consent. • If NO, the patient should be treated according to 'best interests'.	YES YES	NO NO
• If the patient has capacity to consent, has consent been provided? • If NO, treatment with NIV should not be provided.	YES YES	NO NO
IMPORTANT: To ensure optimum and appropriate treatment with NIV, all of the responses to the questions below should be YES.		
Is there a respiratory acidosis (i.e. pH <7.35 & PC02 >45mmHg) secondary to acute exacerbation of COPD, despite best medical therapy.	YES	NO
Has the patient been discussed with the on-call SpR / Respiratory Consultant If YES, with whom? ……..... Which parent team is responsible for this patient?.....	YES	NO

Has the patient been referred to Critical Care SpR / Consultant?	YES	NO
If YES, with whom?.....		
Has the decision been made and documented regarding escalation of treatment should the NIV fail?	YES	NO
If the patient is a candidate for intubation and escalation of treatment in Critical Care, has this been discussed with the Critical Care SpR or Consultant?	YES	NO

NIV Observation Chart

- Record observations **hourly for the first 6 hours** on NIV and then **2hrly** after that
- Record ABG's as required by the patient
- Mark **changes to therapy** with an Asterisk*

Patient details / label:

Name:

Age:

Date:

Time															
IPAP cmH20															
EPAP cmH20															
Resp rate															
02 litres															
Est Vt - Tidal volume / mls															
Est MV- Min volume / ltrs															
Sa02 (on monitor)															
ABG's (Time)															
pH															
pC02															
p02															
Hc03															
BE															
Sa02 (on ABG)															

Segment 2

High Flow Nasal Cannula (HFNC)
Overview
Traditionally the oxygen therapy systems have been classified as low and high flow.

The low flow oxygen system most widely used is the nasal prongs. Unlike low flow systems, high flow systems are able to provide the entire atmosphere breathed by the patient and do ensure a stable FiO2 and it is possible to control the temperature and moisture of the inspired gas.

HFNC
High Flow Nasal Cannula (HFNC) is a non-invasive respiratory support modality that delivers heated and humidified oxygen at high flow rates through nasal prongs.

Physiological Basis for Its Usage
During quiet breathing, gas flows around 15 litres per minute warmed and humidified in the upper airway, primarily through the nasal mucosa, with nasal turbinates increasing surface area. The inhaled air reaches a temperature of 36°C and achieves 80-90% humidity. In contrast, breathing through the mouth reduces maximum humidity to 70%. During exercise or respiratory distress, flow rates can rise to 120 liters per minute, leading to increased fluid loss and a higher metabolic oxygen demand for warming gases. Such high flow rates can only be sustained briefly due to fatigue. Introducing cold, dry gases in patients with increased oxygen needs can exacerbate heat loss, causing discomfort and decreased compliance.

Physiological Benefits OF HFNC
- ☐ Reduced airway surface dehydration
- ☐ Improved secretion clearance
- ☐ Decreased atelectasis
- ☐ CO2 washout, reduction in anatomical dead space
- ☐ Provides an oxygen reservoir
- ☐ Allows FIO2 close to 1.0 to be delivered PEEP
- ☐ Increased end-expiratory lung volume
- ☐ Alveolar recruit

Mechanism of Action:

1. High Flow Delivery:
- Delivers up to 60 L/min of oxygen/air blend, allowing for precise control of FiO_2 (21–100%).
- The rate of flow in HFNC generally exceeds that of the patient, carrying very little room air and resulting in an FiO2 that is more reliably delivered

2. Humidification & Heating:
Gas is conditioned to 37°C and 100% relative humidity, improving mucociliary clearance and comfort.

3. Dead Space Washout:
Flushes nasopharyngeal dead space, improving CO_2 clearance.

Improved washout with HFNC, compared to other oxygen delivery systems, permits a higher fraction of minute ventilation to participate in alveolar gas exchange.

4. Positive Airway Pressure:
Provides low levels of PEEP (~2–5 cmH_2O), supporting alveolar recruitment. This "PEEP effect" can potentially unload auto-PEEP (if present), decrease work of breathing, and enhance oxygenation in patients with alveolar filling diseases such as congestive heart failure or the acute respiratory distress syndrome.

5. Reduced Work of Breathing:
Matches inspiratory flow demands, decreases inspiratory resistance and decreases inspiratory effort. Carbon dioxide clearance is achieved at lower flow rates.

Uses:
Both in neonates (pediatrics) and Adults

Neonates: The initial rationale for the use of HFNOT in neonates was to provide a distending pressure to counteract a lack of surfactant. Its use in neonates is now widespread and is backed by large evidence
base

Adults: HFNOT is gaining popularity in

1. the treatment of acute respiratory failure (ARF)
2. the management of difficult airways
3. to improve gas exchange post-abdominal and cardiac surgery
4. post - extubation and immediate pre-intubation period in intensive care
5. to facilitate bronchoscopy

Pediatric Care:
HFNC is also utilized in pediatric populations, particularly in cases like bronchiolitis or respiratory syncytial virus (RSV) infections.

Types:

1. Adult HFNC Systems:
Designed for use in adults, providing flow rates up to 60 litres per minute.

2. Pediatric HFNC Systems:
Tailored for infants and children with lower flow capacities.

3. Portable HFNC Systems:
Lightweight, portable systems for use in ambulatory care or home settings.

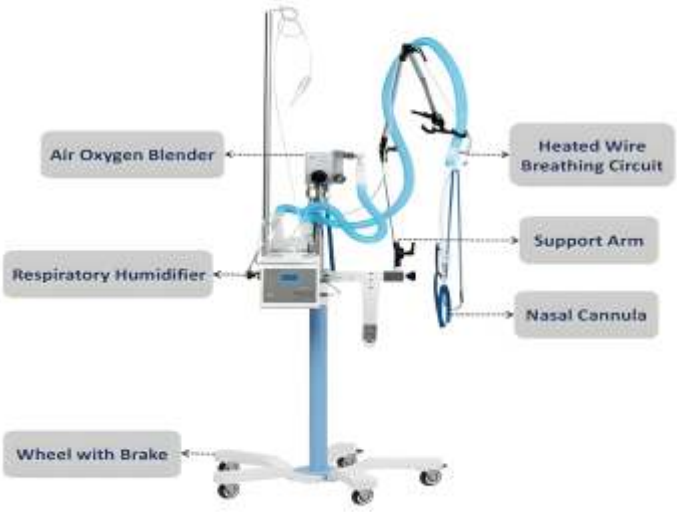
Equipment Used:

Air-Oxygen Blender:
Ensures accurate mixing of air and oxygen.
Flow Meter:
Regulates and measures the flow rate of oxygen delivered.
Heated Humidifier:
Maintains the temperature and humidity of the delivered gas.
Nasal Cannula Prongs:
Specially designed prongs that fit comfortably in the nostrils.

Contraindications:

Caution in Certain Conditions:
Patients with facial trauma, nasal or sinus blockage, or those at risk for aspiration may require careful evaluation.
Severe Airway Obstruction:
HFNC is not indicated for patients with significant upper airway obstruction.
High-Pressure Need:
Patients requiring high positive pressure ventilation may not be suitable candidates.
Impaired Consciousness:
Unconscious patients or those unable to protect their airway may not be appropriate for HFNC.

How to operate High Flow Nasal cannula



Operating a high-flow nasal cannula(HFNC) involves several steps to ensure effective delivery of oxygen therapy.

1. Gather Supplies:
- High-flow nasal cannula device
- Oxygen source (e.g., wall oxygen or portable tank)
- Humidification system (typically included with HFNC)
- Connecting tubing

2. Set Up the device:
- Connect the humidification chamber to the high-flow nasal cannula unit as per the manufacturer's instructions.
- Attach the connecting tubing to the oxygen supply and the humidification chamber.

3. Turn on the Oxygen Supply:
- Set the flow rate according to the physician's order. HFNC typically operates between 20 to 60 liters per minute. Higher flows may be used based on patient needs.

4. Adjust Humidification:
- Set the temperature of the humidified air, usually between 31°C to 37°C, to ensure the patient receives warm and moist air.

5. Fit the Nasal Cannula:
- Position the nasal cannula comfortably in the patient's nose. Ensure a proper fit to prevent air leaks while allowing comfort.

6. Monitor Patient:
- Observe the patient's respiratory status, oxygen saturation, and comfort level. Adjust flow rates and humidification as required.

7. Regular Maintenance:

- Check the water levels in the humidification chamber regularly and refill as needed.
- Clean or replace the cannula and tubing as per hospital protocols to prevent infection.

8. Document:

- Record the flow rates, settings, patient response, and any adjustments made in the patient's medical record.

9. Educate the Patient:

- Explain the device to the patient, ensuring they understand its purpose and to call for help if they experience discomfort or difficulty breathing.

Outcome: To assess outcome of HFNC, we use ROX INDEX

What is it?

- SpO2 (oxygen saturation)
- FiO2 (fraction of inspired oxygen)
- Respiratory Rate (RR)

Why it matters:

Early prediction of HFNC failure can prevent delays in intubation, improving patient outcomes

Formula:

$$ROX = \frac{SpO_2/FiO_2}{RR}$$

Clinical Thresholds:

≥ ≥ 4.88 after 12 hours: HFNC success likely
< 3.85 aft fter 12 hours: High risk of failure, consider intubation
3.85-4.88: Gray zone - close monitoring

Clinical Indications

The initial rationale for the use of HFNOT in neonates was to provide a distending pressure to counteract a lack of surfactant. Its use in neonates is now widespread and is backed by a large evidence base[5]. In adults, HFNOT is gaining popularity in the treatment of acute respiratory failure (ARF), in the management of difficult airways, to improve gas exchange post-abdominal and cardiac surgery, in the post-extubation and immediate pre-intubation period in intensive care, and to facilitate bronchoscopy.

1. Acute Hypoxemic Respiratory Failure

- HFNOT is useful for the treatment of ARF due to its ability to provide an FIO2FIO2 of close to 1.0, PEEP of ~5 cm H 2 O, and humidified gases through a comfortable interface.

- The FLORALI trial has shown that HFNOT can reduce intubation requirements in patients with non-cardiogenic ARF with a PaO2/FIO2PaO2/FIO2ratio of <200 mm Hg. No difference in intubation rate is seen in patients with a higher PaO2/FIO2PaO2/FIO2 ratio. This trial also noted a significantly reduced mortality rate in patients receiving HFNOT, both during intensive care unit (ICU) admission and within 90 days[6].

- HFNOT can be particularly useful in ARF patients with increased work of breathing who do not tolerate facemask therapy or those who have a high secretion load. Much of the work done in this area has a focus on patient comfort and tolerability. A comparison of Venturi face mask oxygen therapy, HFNOT, and non-invasive facemask ventilation (NIV) in patients with ARF due to infection revealed the most improvement in subjective dyspnea with HFNOT. The greatest increase in arterial oxygen tension was seen with NIV, but this had the lowest patient acceptance score. Other studies corroborate these findings.

2. Hypercapnic Respiratory Failure

- Hypercapnic respiratory failure is a frequently encountered problem. Patients with this condition are unsuitable for mechanical ventilation, and NIV has been the primary modality for their respiratory support. Because of poor mask tolerance, however, for some patients it is inappropriate. More easily tolerated, HFNC can often be applied to successfully manage hypercapnic respiratory failure in patients unable to tolerate conventional NIV.[7].

- Although HFNC does not provide active inspiratory support, compared with unaided breathing, in COPD subjects, HFNC increased V T. Investigating the effects of HFNC on COPD subjects with chronic hypercapnic respiratory failure, Nilius et al found that individual responses to HFNC varied: For some, breathing frequency decreased, and for others, P aCO2 decreased. HFNC also increases exercise capacity for stable COPD subjects, providing better oxygenation than spontaneous breathing. HFNC is a highly promising therapy for some types of hypercapnic respiratory failure.

3. Post Extubation

- Re-intubation is associated with longer stays, both in the ICU and in hospital, and with greater mortality. HFNC seems to improve oxygenation and reduce the need for escalation of respiratory support and re-intubation. Comparing HFNC and high-flow face mask delivery for extubated subjects, Tiruvoipati et al found no differences in respiratory and hemodynamic parameters between the modes, but tolerance of HFNC was better [8].

- Corley et al investigated whether HFNC after extubation could reduce postoperative atelectasis in subjects with a body mass index ≥30 kg/m 2. They found no improvement of postoperative respiratory function with HFNC. HFNC did not necessarily improve postextubation respiratory failure in all subjects. We still await the findings of the OPERA trial, which is evaluating the effects of HFNC on postextubation hypoxemia following abdominal surgery.

4. Airway Management

- There is a place for HFNOT in emergency and elective airway management. Preoxygenation, to denitrogenate the lungs, provides an oxygen reservoir for use during apnea. This is a core principle in airway management, not just in the anticipated difficult airway. Increasing the viable apneic window is highly desirable in the management of the difficult airway, and in those patients with a reduced functional residual capacity, or increased metabolic demand for oxygen. These patients will have a limited oxygen reservoir, and reduced time to desaturation. Obstetric, bariatric, and septic patients represent potential groups where preoxygenation with HFNOT may be beneficial. It has been used successfully in awake fiberoptic intubation, where a major advantage appears to be its ability to provide an FIO2.FIO2 of nearing 1.0 via soft nasal cannula that allow the passage of a fiberoptic scope[9].

- Insufflation of oxygen into the lungs during apnea can maintain oxygenation through diffusion. This effect is well described and is likely one of a number of mechanisms by which jet ventilation oxygenates the lungs. Recent attention has focused on the use of HFNOT in the difficult airway and its ability to increase the time to desaturation and decrease the severity of the destruction in anaesthetized patients, allowing for unhurried attempts at intubation. [13]This effect extends to the critical care population requiring intubation, where fewer and less severe episodes of arterial desaturation are seen when preoxygenated with HFNOT, rather than high-flow oxygen using conventional facemask. [14] This effect is not seen in all populations, notably those with severe respiratory failure.[15]

- Carbon dioxide (CO 2) is cleared to some extent in apneic application of HFNOT possibly due to diffusion after washout of CO 2 from the anatomical dead space. However, it is important to remember that periods of apnea in excess of 15 min can be achieved with HFNOT, but arterial CO 2 levels may increase to dangerous levels, resulting in severe acidosis.

5.Acute Heart Failure

- Various oxygenation methods are used for treating respiratory failure occurring with acute heart failure. HFNC is a good alternative means of supplementing oxygenation. Examining the effect of HFNC on subjects with dyspnea and hypoxemia following NIV, Carratalá Perales et al found that all of their 5 subjects showed clinical improvement and were successfully treated with HFNC. Roca et al examined inferior vena cava collapses during inspiratory phase by echocardiography in subjects with New York Heart Association class III heart failure. HFNC decreased inspiratory collapse of the inferior vena cava, and it suggested that HFNC was supportive for subjects with severe heart failure. Moriyama et al have also reported successful maintenance of oxygenation in a patient with life-threatening reperfusion pulmonary edema.

6.Sleep Apnea

- OSA is attributed to upper airway collapse associated with intermittent hypoxemia, neurocognitive dysfunction, and cardiovascular morbidity. Although CPAP is held to be the most effective treatment, adherence is suboptimal. McGinley et al found that HFNC for OSA alleviated upper airway obstruction in children and that, both in children and adults, HFNC reduced arousals and apnea-hypopnea index ratings. Disordered breathing during sleep is also common among acute stroke patients and is associated with neurologic worsening and poor outcome.

HFNC (18 L/min) was well-tolerated and decreased ratings both for apnea-hypopnea and oxygen desaturation: The percentage of slow-wave sleep significantly increased, and quality of sleep was better[10].

Other Conditions Like Bronchoscopy

- Hypoxemia is common during invasive procedures, and supplemental oxygen may be delivered by various interfaces. Testing HFNC during bronchoscopy in adults, Lucangelo et al compared the effects of 40 L/min delivered via air-entrainment mask with HFNC of 40 and 60 L/min. At the end of the procedure, HFNC at 60 L/min resulted in better oxygenation than 40 L/min delivered either by air-entrainment mask or by HFNC. Oxygenation was also better at 10 min after the completion of the procedure. Miyagi et al also applied HFNC during bronchoalveolar lavage in ARF. In a case reported by Diab and Fraser, HFNC effectively prevented hypoxemia in an orthotropic lung transplant recipient who required diagnostic bronchoscopy.

- Patients with do-not-intubate status and respiratory failure are generally treated with NIV, which has been found effective in relieving sensations of dyspnea. HFNC may also be an effective alternative to NIV. Peters et al assessed the efficacy of HFNC in do-not-intubate subjects with hypoxemic respiratory distress. Mean age was 73 y, and underlying diseases were pulmonary fibrosis, pneumonia, COPD, cancer, hematologic malignancy, and congestive heart failure. Only 9 of 50 subjects were escalated to NIV; 82% were maintained on HFNC. The median duration of HFNC was 30 h. HFNC can provide adequate oxygenation for patients with hypoxemic respiratory failure and may be a more easily tolerated alternative to NIV for do-not-intubate patients.

- Many clinical reports of HFNC use have been published. For example, Díaz-Lobato et al used HFNC to treat ARF of neuromuscular origin in a patient who could not tolerate NIV, and Boyer et al used it to treat pulmonary fibrosis for >30 d. Generally, over the long term, it is not possible to continuously support respiration with NIV. Byerly et al reported successfully using HFNC to treat a pediatric patient with inhalation injury, postextubation stridor, and a high risk of extubation failure. Calvano et al applied HFNC to a 92-y-old woman with delirium and dementia who was in the ICU for multi-lobar pneumonia with severe hypoxemia. After she had rejected various facial and nasal masks, it was found that she could tolerate HFNC. It reduced her agitation, ameliorated her dyspnea, improved oxygenation, and increased her comfort at the end of life.

Contra-indications

- Contraindications to the use of HFNOT are much the same as for NIV delivered via a facemask or hood. HFNOT should not delay mechanical ventilation in those with severe respiratory failure, particularly in type II respiratory failure. Any contraindication to the application of PEEP should prompt alternative methods of respiratory support to be sought. Additionally, it should not be used on those with reduced levels of consciousness, or uncooperative patients. In addition, epistaxis, facial injury, or airway obstruction should preclude its use.

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