



Non-Invasive Ventilation Frequently Asked Questions

THE FOLLOWING FAQ IS FOR INFORMATIONAL PURPOSES ONLY AND DOES NOT PROVIDE MEDICAL ADVICE. ANY AND ALL DECISIONS ABOUT MEDICAL CARE MUST BE MADE BY LICENSED PROFESSIONALS EXERCISING THEIR INDEPENDENT JUDGMENT.

1. When can non-invasive ventilation be indicated?

There is strong clinical evidence that non-invasive ventilation can be used for the initial management of acute respiratory failure in patients with exacerbated COPD, acute pulmonary edema, disorders with concomitant immunosuppression as well as to facilitate extubation in patients with COPD who have failed weaning attempts[1].

In postoperative patients, non-invasive ventilation should be considered both as a prophylactic and as a therapeutic tool for improving gas exchange[2].

Administration of non-invasive ventilation is also recommended in palliative care for hypercapnic and pulmonary edema patients[3].

In properly selected and monitored patients, non-invasive ventilation should be considered for the treatment of asthma, do-not-intubate (DNI) patients, hypoxemic respiratory failure and weaning failure[1]. For patients who do not demonstrate a favorable initial response to non-invasive ventilation, intubation without delay should be strongly considered[1].

2. When is non-invasive ventilation contraindicated?

Exclusion criteria for non-invasive ventilation include

- respiratory arrest or bradypnea
- unconsciousness
- inability to clear secretions
- facial surgery
- hypotensive shock
- nosocomial pneumonia
- gastrointestinal bleeding[4]

Some studies differentiate between relative and absolute contraindications. According to these studies, non-invasive ventilation is absolutely contraindicated (and can even lead to death) when the patient is not spontaneously breathing or is gasping, anatomical or functional airway obstruction is present or gastrointestinal bleeding occurs.



Relative contraindication criteria include massive retention of secretions despite bronchoscopy, severe hypoxemia or acidosis ($\text{pH} < 7.1$), hemodynamic instability (cardiogenic shock, myocardial infarction), anatomical and/or subjective difficulty in gaining access to the airway and recent upper gastrointestinal surgery[5].

In these cases, non-invasive ventilation can be attempted provided the patient is carefully monitored and that caregivers are aware of the increased risk of failure[1].

3. Which ventilator is the best choice for non-invasive ventilation?

Clinicians should have a clear understanding of both the possibilities and the limits of mechanical ventilation in order to be able to choose the correct ventilator and the appropriate ventilation mode from the wide range of available options[6]. Technical features of the ventilator, such as efficiency of the triggering system, speed of pressurization, air-leak compensation, CO₂ rebreathing, reliability of FIO₂, and monitoring accuracy should be known and considered.

Non-invasive ventilation failure is significantly correlated with poor tolerance and excessive air leaks. Therefore, the choice of ventilator is vital for the success of non-invasive ventilation in the acute care setting. Furthermore, patient-ventilator asynchrony and discomfort can become a problem if caregivers do not select and maintain adequate non-invasive ventilation parameters in response to the patient's ventilatory demand[7].

It is crucial to consider that pressure-controlled modes are generally better suited to compensate for leaks at the patient/mask interface than are volume-controlled modes. Spontaneous-breathing modes such as pressure support and proportional-assist type ventilation may provide optimal patient comfort[6].

Furthermore, the results of a bench model non-invasive ventilation study confirm that leaks interfere with several key ICU ventilator functions and suggest that a partial or even total correction of these interferences can be achieved by choosing the appropriate non-invasive ventilation mode. However, such corrections show wide variations between machines in terms of efficiency, and caregivers are therefore advised to be aware of these differences when using non-invasive ventilation with an ICU ventilator[9].

Some recent clinical studies show that dedicated non-invasive ventilation ventilators achieve better patient-ventilator synchrony compared to ICU and transport ventilators, even when their respective non-invasive ventilation algorithms are used[8].

4. How should clinical teams be trained to provide successful non-invasive ventilation?

A careful patient and appropriate location selection by a trained and experienced team can optimize patient outcomes[10].

Clinical teams should be trained and empowered accordingly to evaluate the following questions in order to increase non-invasive ventilation success:

- Which interface should be used?
- Which non-invasive ventilation mode should be selected?
- Which individual patient characteristics may be relevant?[2]

Selecting a properly fitting mask can be challenging for both the patient and the caregiver. A recent study has led to the belief that interdisciplinary education and training in mask selection and fitting would reduce or even eliminate facial pressure ulcers. The study concluded that a combination of increased awareness, proper adjustment of the mask to allow for tolerable leakage and the selection of a mask type that eliminates the need for constant strap adjustment is necessary to reduce the incidence of pressure ulcers[11].

The following table gives a good overview of effectiveness and appropriate location for non-invasive positive pressure ventilation in acute respiratory failure (ARF) of various origins[12]:

Cause of ARF	Level of evidence	Location
AECOPD (acute exacerbation of chronic obstructive pulmonary disease)	A	Ward, RICU, ICU Depending on severity
Weaning (AECOPD)	A	ICU, RICU
CPO (cardiogenic pulmonary oedema)	A	ICU, RICU
Immunocompromised patient	A	ICU, RICU
Post-operative respiratory failure	B	ICU
Pre-intubation oxygenation	B	ICU
Endoscopy	B	Depending on severity

Evidence A: multiple randomized controlled trials and meta-analyses; evidence B: more than one randomized controlled trial, case-control series or cohort studies evidence; AECOPD: acute exacerbation of chronic obstructive pulmonary disease; RICU: respiratory intermediate intensive care unit; ICU: intensive care unit; CPO: cardiogenic pulmonary edema;

[12]

5. What are the current non-invasive ventilation weaning strategies?

With regards to weaning strategies in COPD patients, clinicians can be advised to start reducing treatment during daytime ventilation periods. A patient may require additional support with non-invasive ventilation during the night following successful weaning [13]. Studies found that non-invasive ventilation may result in more rapid weaning from mechanical ventilation in COPD patients with severe ARF in comparison to conventional invasive ventilation through an endotracheal tube[14]. Patients who were non-invasively ventilated following extubation and weaned according to a standard protocol using pressure support ventilation showed a range of positive outcomes such as increased weaning rates, decreased duration of mechanical ventilation and ICU stay[15]. By and large, experts agree that non-invasive ventilation can facilitate weaning[16].

6. What are the differences between mask and helmet interfaces?

Face masks are the preferred interface in the initial phase of non-invasive ventilation therapy. In contrast, the helmet is primarily used with patients with hypoxemic respiratory failure[17, 18].



Both face mask and helmet help improve gas exchange in patients with acute hypoxemic respiratory failure and cardiogenic pulmonary edema. A helmet is more comfortable and permits longer periods of continuous application.

However, it has a larger inner volume compared to the face mask (i.e., a dead space volume of 8 to 12 L). In earlier studies, experts feared that carbon dioxide rebreathing could occur with helmet use and thus limit the efficacy of non-invasive ventilation[19]. This, however, could not be clinically proven.

A recent computer based simulation found that no carbon dioxide rebreathing occurs during helmet use. According to these findings, the effective dead space is not directly related to the inner volume. Effective dead space is limited to half the tidal volume for interfaces with large volumes and approaches the interface gas volume only for interfaces with smaller inner volumes. As a result of this computer based simulation, it can be suggested that caregivers may choose an interface suitable for the individual patient with regard to comfort and ventilator/patient synchrony rather than taking dead space into consideration[19].

Two further studies in healthy study participants during pressure support ventilation found that patients using the helmet required greater inspiratory muscle effort and required more time to reach the selected level of airway pressure[20].

7. Non-invasive ventilation – is there a trend?

In recent studies experts found that the use of non-invasive ventilation in the intensive care setting will increase in the coming years. In the past, only 4.2% of admissions in the ICU were non-invasively ventilated. Also, during the first 3 days, 12% of all ventilated patients were ventilated non-invasively, although only 17,4% of all COPD patients received non-invasive ventilation.

Patients with non-invasive ventilation showed a significantly reduced risk of mortality[21]. Studies comparing use of non-invasive ventilation with invasive ventilation in the ICU found an increase of non-invasive ventilation from 4,4% (1998) to 11,1% (2004) of total mechanical ventilation. On ICUs in France, even 23% non-invasive ventilation use was confirmed[22, 23].

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