

How to initiate noninvasive ventilation program in your hospital

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Abstract

Noninvasive ventilation (NIV) is increasingly being employed in the management of acute respiratory failure associated with a number of disease states. However, while there is strong evidence from randomized trials supporting its routine use in the intensive care units (ICU), the task of integrating NIV into standard practice remains a challenging one. In this article, we discuss different considerations surrounding NIV incorporation into hospitals' standard programs for managing acute

respiratory distress. We also outline the important factors crucial for setting up an NIV program and diffusing its operation and the derivable benefits into a clinic's respiratory care management system. It is important that the NIV diffusion process is anchored on the experience of a clinical champion, an early adopter and opinion leader who is effective in communicating the benefits of noninvasive mechanical ventilation methods to other clinicians.

Key words: Noninvasive ventilation, intensive care unit, ICU, intermediate care, multidisciplinary, outcome measurement, mechanical ventilation, endotracheal intubation.

Introduction

Noninvasive ventilation (NIV) represents the most recent development in the management of acute respiratory failure. In NIV, the invasive interface of the endotracheal intubation is replaced with noninvasive masks (**Figures 1-6**). The development of NIV attempts to address important drawbacks in invasive methods, such as the development of complications (e.g., nosocomial infections), and a lack of flexibility. Its advent also reflects an improvement in our understanding of the operation of artificial respiratory

support system. (1,2) While NIV has not completely supplanted intubation, it is increasingly applied in critical and noncritical-care situations (**Table 1**), these situations were evaluated according to level of evidence described on **Table 2**, especially in acute hypercapnic respiratory distress associated with chronic obstructive pulmonary disease (COPD), cardiogenic pulmonary edema, postoperative respiratory distress syndrome, asthma, Pneumocystis carinii, cystic fibrosis, in post-extubation care, in immunocompromised patients and in do-not-intubate status. (3,4)

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In COPD exacerbations, the use of NIV has been associated with overall reduction in mortality rate and complication emergence, and in the total length of ICU admission. (3,5) Respiratory support with NIV reduced in-hospital deaths, intubation rates, and the length of hospital admission respectively by 5-15% (6-18% in severe exacerbations), 15-40% and 2.3-6.4 days, (3,5) with significant improvements in response obtained within one hour. (6) This led to the recommendation of NIV as the preferred management option in hypercapnic respiratory failure in COPD. (3,4)

However, NIV is grossly under-utilized in many clinical settings, partly resulting from lack of awareness among caregivers. Long-term experience of many caregivers with invasive ventilation methods has also generated certain inertia, which makes it hard for them to agree with the evidence-based efficacy of NIV's superiority. As a result, many physicians are not likely to routinely use NIV unless they can personally reproduce its benefits. In some cases, however, it is the unrealistic expectations of NIV's efficacy that is responsible for its under-utilization.

Transferring evidence into practice

In 1995, Rogers outlined a theoretical approach to facilitate the diffusion of evidence into practice. (7) His principle can be adopted in the case of NIV, especially because it directly addresses the barriers limiting the incorporation of noninvasive ventilation methods into practice. Roger's model (7) (**Table 3**) ensures that the caregiver is presented with and acquires the knowledge of the evidence of the superiority of NIV to intubation in selected cases of acute respiratory failure. This approach to evidence diffusion into practice contains five elements, including relative advantage, compatibility, complexity, trialability and observability. These five are crucial for the successful adoption of new innovation into standard practice. These are especially relevant in the case of NIV, where its adoption is strongly affected by an entrenched bias for intubation. (8)

Relative advantage

Clinicians with years of experience caring for intubated patients generally find it difficult to appreciate and admit the superiority of noninvasive methods. It is helpful to understand the perception of clinicians towards NIV, and preferably also the reason they hold such perceptions. This will help the champions properly devise a strategy of approach that efficiently addresses clinicians' objections.

Compatibility

There are different levels at which the issue of compatibility needs to be addressed for NIV. In the most fundamental level,

the degree to which the clinicians believe it is compatible with existing therapy needs to be assessed. The perception that the use of NIV would conflict with or compromise certain aspects of respiratory care will be counterproductive to the effort to introduce it into the concerned clinical setting. A practical way of handling this involves identifying specific issues associated with the existing mechanical ventilation method, and how these are addressed by the use of NIV. This also becomes applicable in cases where the clinicians find it difficult to agree with the fact that certain problems with the use of intubation can be addressed by NIV. In this case, presenting evidence from published reports is not likely to sufficiently convince the clinicians, but interacting with other clinicians who have experience using NIV will. At other levels, compatibility assessment will also consider how well the use of NIV integrates into the hospital's long-term goals, the effect its acquisition will have on the financial statement, and how its integration into everyday use will impact staffing and the service culture. With this information, the clinical champion will be able to design an effective strategy that accurately addresses compatibility concerns peculiar to the concerned clinic. (9)

Complexity

At the initial stages of introduction, it is not uncommon for an innovation to be perceived as more complex than it really is. In the case of NIV, such perception will discourage the readiness to utilize. This is partly because the details of NIV application are significantly different from those of intubation, which the physicians have already spent time learning how to operate. For instance, the specific details of the choice and fitting of masks, the selection of appropriate ventilator settings, and how to reconcile these with different medical indications are likely to make the clinicians, respiratory therapists (RTs) and nurses view NIV as extremely complex to operate. Studies have shown that at the early period of introducing NIV, some amount of time may likely be required to get the clinical staff acquainted with the operation of NIV, (10) and in certain cases, up to an 8 hour-learning curve is associated with this initial stage which, however, rapidly tapers off. (1,4,10-20) Considering the benefits associated with the use of NIV, this initial learning period may be seen as a worthwhile time investment.

Trialability

Can NIV be tried and modified to accommodate different application scenarios? How flexibly can its operation be adapted to changing treatment objectives? Answers to these two questions give an indication of how trialable NIV is. The high functional trialability characterizing NIV largely results from the availability of different interfaces, ventilation modes and ventilator settings that allow its operation to be adapted to handle different situations. NIV features different types of patient interfaces, of which the orofacial and nasal masks are the most popular. (3) The orofacial masks are suitable for use in patients with very severe respiratory distress, and constitutes an efficient way of providing respiratory support for the less responsive patients with mouth-breathing. (3) The nasal masks on the other hand are better suited for the more cooperative patients, making them suitable for home use. Apart from these, helmet masks worn over the patient's entire head, facemasks, nasal pillows, as well as mouthpieces exist to allow for greater flexibility. (3)

Observability

Observability indicates the extent to which the derivable benefits and superior attributes of an innovation are visible. For instance, NIV's observability can take as an index of measurement the need for endotracheal intubation, the associated risk of complications relative to intubation, and the length of hospital/ICU stay.

However, while a positive outcome of observability assessment for NIV will likely culminate in the decision to adopt it, failure during the initial trials may be extremely counterproductive. Careful attention paid to patient selection for NIV trials, as well as the choice of ventilation settings, should help prevent such negative outcome of observability.

Initiating a noninvasive ventilation program: practical considerations

From the points discussed above, it is clear that the process of initiating a noninvasive ventilation program is not a trivial one. The principles discussed in this section can be adopted in an acute care setting to initiate an NIV program. (18)

The need for a clinical champion

Different from an NIV product representative, a clinical champion is a physician, an RT, or a nurse who is an early adopter of NIV. Because they use NIV in their practice, the clinical champion possesses sufficient knowledge and experience to direct the entire initiation procedure. His familiarity with the quality of respiratory support obtainable from different NIV ventilation modes, and the ventilation settings needed to obtain desired benefit for differing medical conditions, are invaluable to addressing practice-based questions from the prospective users of NIV. In particular also, he assists the hospital administration in addressing specific objections, as well as helping to draft a realistic road map for the NIV program. For this, the clinical champion should be flexible and able to adapt the objective of initiating NIV to various institutional considerations.

The place of knowledge and training

Public seminars, conferences, scientific articles, and the internet are reportedly of minimal effect in advancing the utilization of NIV. While these should not be completely ignored, particular attention should be accorded to dissemination methods, such as hands-on sessions involving in-hospital sessions where the clinicians interact directly with the clinical champion. The education of patients will necessarily occur at the bedside. (19) In general, effective transfer will ensure an adequate NIV utilization. (21)

Availability of relevant resources and cost-effectiveness

Initiating an effective NIV utilization program will require the acquisition of a number of additional resources, which will require buy-in by the management. The clinical champion works with the procurement committee to design a cost-effective acquisition plan. It is important that all necessary resources are procured, since inadequate resources represent a major hindrance to NIV use. Prospective suppliers should be contacted to determine minimum requirements for the ventilation unit to function properly. Compared with intubation, NIV is highly cost-effective with a \$3000 cost cut realized in some Canadian clinics. (3) Costs associated with the management of intubation-associated complications is additionally reduced.

The need for practice guidelines

The guidelines should ideally be designed in-house and by clinicians who are part of the NIV delivery system. A survey by Sinuff et al observed that easy-to-use formats employing electronic devices and preprinted orders are the preferred types. (20) Clinical guidelines are crucial for promoting uniformity of care. They are useful for future retrospective studies, and they help minimize errors while maximizing the benefits.

Self-efficacy and progressive improvement

In the initial phase of establishing NIV, it is important that the clinicians maintain a realistic expectation. It is usual to expect an initial NIV success rate of about 70, plus/minus 10%. In other words, the introduction of NIV is not likely to completely eliminate the need for intubation. The success rate is expected to increase as NIV operation is continually modified based on self-using efficacy and the experience garnered within the department.

Regulating care via certification

There may also be a need for the hospital to set up a certification scheme to ensure a minimum level of training of the ICU staff involved with the NIV program. For clinicians and RTs, amongst others, such a certification scheme should focus on recognizing eligible patients for NIV treatment. Other areas that should be covered include ventilator settings, patient interfaces and mask fitting, and monitoring patients' response to NIV treatment. The certification of nurses should, in addition, include handling complications of NIV treatment, including facial and nasal skin sores and pressure necrosis, aspiration of gastric contents, as well as gastric distention. (3)

The interdisciplinary dimension of NIV care delivery

The institution of NIV calls for extensive communication and a high level of multidisciplinary cooperation between different departments. It is important that the role of each person is well defined to avoid effort duplication. Using adopted eligibility criteria, the physician identifies the target patients, following which a recommendation of the equipment setting is made by the RTs. The ICU nurses help in mask fitting and coaching the cooperative patients.

Conclusion

In summary, efforts to introduce NIV to routine practices should be directed at ensuring that clinicians and decision-makers in the hospital administration view noninvasive ventilation as superior to the conventional intubation method. While there exists rich data of evidence supporting this, physicians with long-term experience in intubating patients are often reluctant to adopt NIV based on such reports. In order to effectively diffuse NIV into clinical practice therefore, a clinical champion and an early adopter is required, who will help in clearing their colleagues' objections. Via practice-based settings, NIV should be demonstrated as not difficult to use, as superior to existing methods, as trialable and as cost-effective. For these, interactive hands-on training is necessary. Furthermore, a successful implementation of an NIV program crucially depends on personnel and the availability of necessary resources and practice guidelines. Special attention should be accorded to patient selection, as this strongly affects treatment outcome, and importantly, the experience gained in the initial utilization of NIV in the hospital should be used in continually optimization treatment guideline.

Table 1. Acute respiratory failure conditions for which NIV administration is recommended

Indications	Evidence level
Hypercapnic respiratory failure COPD Facilitation of extubation in COPD	A
Hypoxemic respiratory failure Cardiogenic pulmonary edema Immunocompromised patients	A A
Postoperative respiratory failure	B
Facilitation of bronchoscopy	B
Preintubation oxygenation	B
Hypercapnic respiratory failure Asthma	C
Hypoxemic respiratory failure Pneumonia	C
Do-not-intubate status	C
Extubation failure	C

Legend: Adapted from Lippincott, Williams, and Wilkins. Crit Care Med 2007.

Table 2. Evidence level description

Evidence level	Description
A	Recommendation derived from several randomized trials and meta-analyses
B	Recommendation derived from randomized trials (>1) and cohort studies
C	Recommendation derived from case series and data with low confidence

Table 3. Applying Roger’s model (7) for facilitating NIV diffusion of evidence into practice

Transferring NIV into Practice	Important questions
Relative advantage	How is NIV superiority perceived by the clinician?
Compatibility	Does the clinician view NIV as compatible with treatment objectives?
Complexity	Does the clinician think NIV operation is too complex?
Trialability	Can NIV be modified to accommodate different application scenarios?
Observability	Can the advantages of NIV be demonstrated and observed?

Figure 1. Orofacial mask

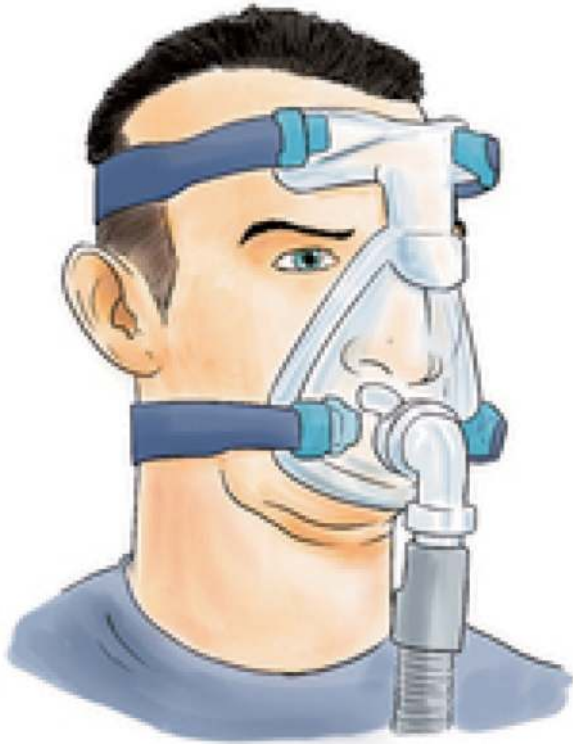


Figure 2. Nasal mask



Figure 3. Hockey mask or full-face mask



Figure 4. Helmet mask

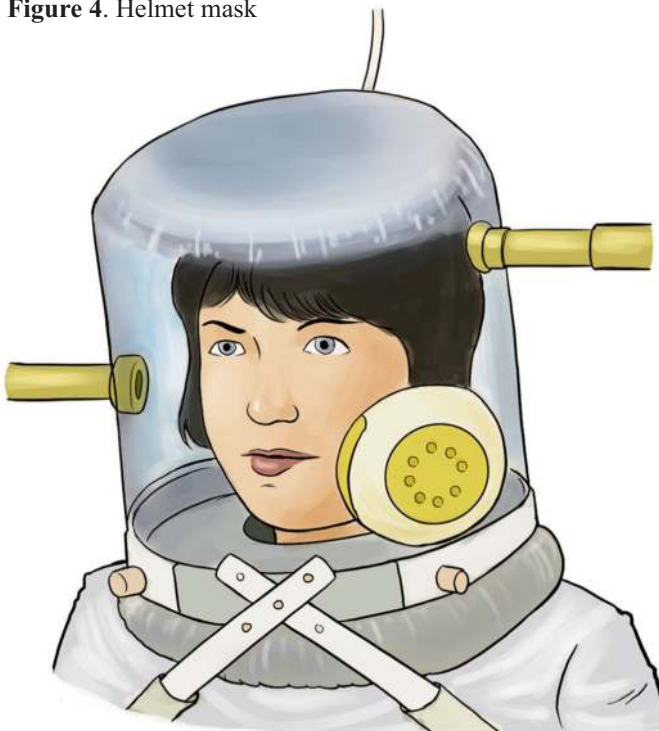
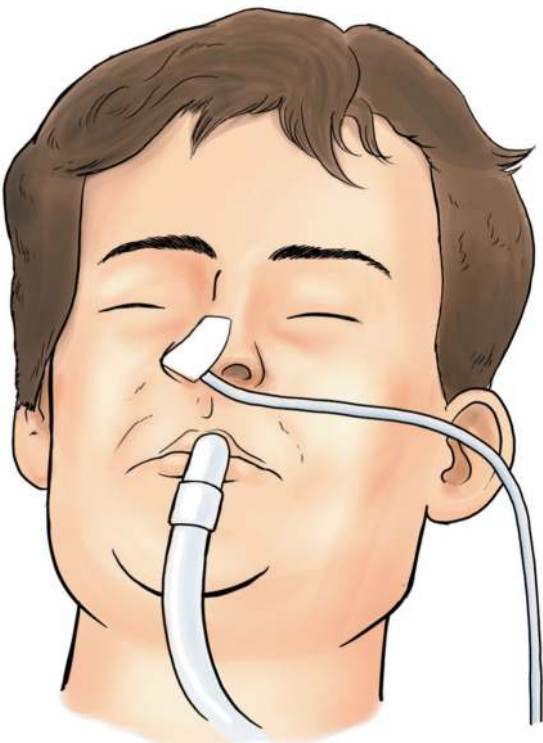


Figure 5. Nasal pillows mask



Figure 6. Mouthpiece mask



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