



Literature List Non-Invasive Ventilation

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<p>Bülow HH. et al.</p>	<p>Experiences from introducing non-invasive ventilation in the intensive care unit: a 2-year prospective consecutive cohort study.</p>	<p>Acta Anaesthesiol Scand. 2007 Feb;51(2):165-70.</p>
<p>Objective: To describe 2 years of experience and staff learning curves after the introduction of non-invasive ventilation (NIV).</p> <p>Methods: A prospective, consecutive, strictly observational, 2-year cohort study of all patients treated with NIV in a county general hospital intensive care unit (ICU), with no interventions, was performed.</p> <p>Results: One hundred and fifty-seven patients with 15 different diagnoses were treated with NIV. An increasing number of patients were treated in the second year and, probably as a result of increased staff experience, the NIV treatment time and overall time spent in the ICU were less in the second year of the study period (30 h vs. 19 h and 55 h vs. 34 h, respectively; $P < 0.05$). Patients were also intubated earlier if NIV failed during the second year. Of the 157 patients, 119 had a full treatment option (i.e. including the possibility of invasive mechanical ventilation) and 26% died; their Acute Physiology and Chronic Health Evaluation II (APACHE II)- and Simplified Acute Physiology II (SAPS II)-predicted death rates were 31% and 32% respectively (not significant, NS). The overall mortality rate in all NIV patients was 38%, compared with predicted death rates of 36% and 33%, respectively (NS). 'Do-not-intubate' orders were issued for 38 of the 157 patients, and 11 of these (29%) left the hospital alive. Patients treated successfully with NIV had significantly lower APACHE II scores than those in whom it failed (18.8 vs. 22, $P = 0.01$).</p>		
<p>Conclusions: With increasing staff experience, more patients may be treated with NIV and the treatment period decreases significantly. Weaning from NIV has almost exclusively been taken over by nurses. Unselected cohorts of patients with chronic obstructive pulmonary disease can be treated successfully with NIV, and NIV offers a treatment option even for some patients with a 'do-not-intubate' order.</p>		
<p>Carlucci A. et al.</p>	<p>Noninvasive versus conventional mechanical ventilation. An epidemiologic survey.</p>	<p>Am J Respir Crit Care Med. 2001 Mar;163(4):874-80.</p>
<p>Abstract: A prospective survey was performed over a period of 3 wk among 42 intensive care units to assess the incidence of use and effectiveness of noninvasive mechanical ventilation (NIV) in clinical practice. All patients requiring ventilatory support for acute respiratory failure (ARF), either with endotracheal intubation (ETI) or NIV, were included. Ventilatory support was required in 689 patients, 581 with ETI and 108 (16%) with NIV (35% of patients not intubated on admission). Reasons for mechanical ventilation were coma (30%), cardiogenic pulmonary edema (7%), and hypoxemic (48%) and hypercapnic ARF (15%). NIV was never used for patients in coma (who were excluded from further analysis), but was used in 14% of patients with hypoxemic ARF, in 27% of those with pulmonary edema, and in 50% of those with hypercapnic ARF. NIV was followed by ETI in 40% of cases. The incidence of both nosocomial pneumonia (10% versus 19%, $p = 0.03$), and mortality (22% versus 41%, $p < 0.001$) was lower in NIV patients than in those with ETI. After adjusting for differences at baseline, Simplified Acute Physiology Score (SAPS) II (odds ratio [OR] = 1.05 per point; confidence interval [CI]: 1.04 to 1.06), McCabe/Jackson score (OR = 2.18; CI: 1.57 to 3.03), and hypoxemic ARF (OR = 2.30; CI: 1.33 to 4.01) were identified as risk factors explaining mortality; success of NIV was associated with a lower risk of pneumonia (OR = 0.06; CI: 0.01 to 0.45) and of death (OR = 0.16; CI: 0.05 to 0.54). In NIV patients, SAPS II and a poor clinical tolerance predicted secondary ETI. Failure of NIV was associated with a longer length of stay.</p>		
<p>Conclusions: NIV can be successful in selected patients, and is associated with a lower risk of pneumonia and death than is ETI.</p>		

Conti G. et al.	Noninvasive vs. conventional mechanical ventilation in patients with chronic obstructive pulmonary disease after failure of medical treatment in the ward: a randomized trial	Intensive Care Med. 2002 Dec;28(12):1701-7. Epub 2002 Aug 30.
<p>Objectives: We conducted a randomized prospective study comparing noninvasive positive pressure ventilation (NPPV) with conventional mechanical ventilation via endotracheal intubation (ETI) in a group of patients with chronic obstructive pulmonary disease who failed standard medical treatment in the emergency ward after initial improvement and met predetermined criteria for ventilatory support.</p> <p>Design and setting: Prospective randomized study in a university hospital 13-bed general ICU.</p> <p>Patients: Forty-nine patients were randomly assigned to receive NPPV (n=23) or conventional ventilation (n=26).</p> <p>Results: Both NPPV and conventional ventilation significantly improved gas exchanges. The two groups had similar length of ICU stay, number of days on mechanical ventilation, overall complications, ICU mortality, and hospital mortality. In the NPPV group 11 (48%) patients avoided intubation, survived, and had a shorter duration of ICU stay than intubated patients. One year following hospital discharge the NPPV group had fewer patients readmitted to the hospital (65% vs. 100%) or requiring de novo permanent oxygen supplementation (0% vs. 36%).</p>		
<p>Conclusions: The use of NPPV in patients with chronic obstructive pulmonary disease and acute respiratory failure requiring ventilatory support after failure of medical treatment avoided ETI in 48% of the patients, had the same ICU mortality as conventional treatment and, at 1-year follow-up was associated with fewer patients readmitted to the hospital or requiring for long-term oxygen supplementation. An editorial regarding this article can be found in the same issue.</p>		

Elliott MW. et al.	Non-invasive ventilation for acute respiratory disease.	Br Med Bull. 2005 Mar 31;72:83-97. Print 2004
<p>Abstract: Non-invasive ventilation (NIV) has been shown to be effective in acute respiratory failure of various aetiologies in different health care systems and ward settings. It should be seen as complementary to invasive ventilation and primarily a means of preventing some patients from deteriorating to the point at which intubation is needed. Generally it is best initiated early before assisted ventilation is mandatory, although it has been shown to be effective even in very sick patients. Important benefits include the avoidance of endotracheal-tube-associated infections, which carry an important morbidity and mortality, and a reduction in health care costs. The most important ingredient for an acute NIV service is a well-trained enthusiastic ward team.</p>		
<p>Conclusions: NIV can be used with success in respiratory failure of various aetiologies, particularly acute exacerbations of COPD. It should be seen primarily as a means of avoiding the need for endotracheal intubation. There are few contraindications and usually little to be lost by a trial of NIV provided that there is a clear strategy of how to monitor progress and when to switch to invasive ventilation if the patient is not progressing satisfactorily. It is effective and cost effective and can be used in a wide variety of settings. When starting an NIV service, it should be kept as simple as possible and should begin with less severely ill patients. As expertise and confidence grow, more sophisticated equipment can be introduced and sicker patients treated. Training and education of the whole team—doctors, nurses and therapists—is key.</p>		

<p>Ferrer M. et al.</p>	<p>Noninvasive ventilation during persistent weaning failure: a randomized controlled trial.</p>	<p>Am J Respir Crit Care Med. 2003 Jul 1;168(1):70-6. Epub 2003 Apr 10.</p>
<p>Abstract: To assess the efficacy of noninvasive ventilation (NIV) in patients with persistent weaning failure, we conducted a prospective, randomized, controlled trial in 43 mechanically ventilated patients who had failed a weaning trial for 3 consecutive days. This trial was stopped after a planned interim analysis. Patients were randomly extubated, receiving NIV (n = 21), or remained intubated following a conventional-weaning approach consisting of daily weaning attempts (n = 22). Compared with the conventional-weaning group, the noninvasive-ventilation group had shorter periods of invasive ventilation (through tracheal intubation) (9.5 +/- 8.3 vs. 20.1 +/- 13.1 days, p = 0.003) and intensive care unit (ICU) (14.1 +/- 9.2 vs. 25.0 +/- 12.5 days, p = 0.002) and hospital stays (27.8 +/- 14.6 vs. 40.8 +/- 21.4 days, p = 0.026), less need for tracheotomy to withdraw ventilation (1, 5% vs. 13, 59%, p < 0.001), lower incidence of nosocomial pneumonia (5, 24% vs. 13, 59%, p = 0.042) and septic shock (2, 10% vs. 9, 41%, p = 0.045), and increased ICU (19, 90% vs. 13, 59%, p = 0.045) and 90-day survival (p = 0.044). The conventional-weaning approach was an independent risk factor of decreased ICU (odds ratio: 6.6; p = 0.035) and 90-day survival (odds ratio: 3.5; p = 0.018). Earlier extubation with NIV results in shorter mechanical ventilation and length of stay, less need for tracheotomy, lower incidence of complications, and improved survival in these patients.</p>		
<p>Conclusions: NIV is effective to shorten the period of invasive ventilation in patients with persistent weaning failure, and, in consequence, to decrease the incidence of nosocomially acquired infections, mortality, and other outcome parameters such as length of ICU and hospital stays.</p>		

<p>Ram FS. et al.</p>	<p>Non-invasive positive pressure ventilation for treatment of respiratory failure due to exacerbations of chronic obstructive pulmonary disease.</p>	<p>Cochrane Database Syst Rev. 2004;(3):CD004104.</p>
<p>Background: Non-invasive positive pressure ventilation (NPPV) is being used increasingly in the management of patients admitted to hospital with acute respiratory failure secondary to an exacerbation of chronic obstructive pulmonary disease (COPD).</p> <p>Objectives: To determine the efficacy of NPPV in the management of patients with respiratory failure due to an acute exacerbation of COPD</p> <p>Search Strategy: An initial search was performed using the Cochrane Airways Group trials register and other relevant electronic databases. An updated search was conducted in September 2003 and another in April 2004.</p> <p>Selection Criteria: Randomised controlled trials comparing NPPV plus usual medical care (UMC) versus UMC alone were selected. Trials needed to recruit adult patients admitted to hospital with respiratory failure due to an exacerbation of COPD and with PaCO₂ > 6 kPa (45 mmHg).</p> <p>Data Collection and Analysis: Two reviewers independently selected articles for inclusion, evaluated methodological quality of the studies and abstracted the data.</p> <p>Main Results: Fourteen studies were included in the review. NPPV resulted in decreased mortality (Relative Risk 0.52; 95%CI 0.35 to 0.76), decreased need for intubation (RR 0.41; 95%CI 0.33 to 0.53), reduction in treatment failure (RR 0.48; 95%CI 0.37 to 0.63), rapid improvement within the first hour in pH (Weight Mean Difference 0.03; 95%CI 0.02 to 0.04), PaCO₂ (WMD -0.40 kPa; 95%CI -0.78 to -0.03) and respiratory rate (WMD -3.08 bpm; 95%CI -4.26 to -1.89). In addition, complications associated with treatment (RR 0.38; 95%CI 0.24 to 0.60) and length of hospital stay (WMD -3.24 days; 95%CI -4.42 to -2.06) was also reduced in the NPPV group.</p>		
<p>Reviewers' Conclusions: Data from good quality randomised controlled trials show benefit of NPPV as first line intervention as an adjunct therapy to usual medical care in all suitable patients for the management of respiratory failure secondary to an acute exacerbation of COPD. NPPV should be considered early in the course of respiratory failure and before severe acidosis ensues, as a means of reducing the likelihood of endotracheal intubation, treatment failure and mortality</p>		

<p>Schönhofer B. et al.</p>	<p>Clinical practice guideline: non-invasive mechanical ventilation as treatment of acute respiratory failure.</p>	<p>Dtsch Arztebl Int. 2008 Jun;105(24):424-33. doi: 10.3238/arztebl.2008.0424. Epub 2008 Jun 13</p>
<p>Introduction: Non-invasive mechanical ventilation (NIV) has been used to treat acute respiratory failure (ARF) for approximately 20 years. This guideline addresses the indications for, and limitations of, NIV as treatment for ARF according to evidence-based criteria.</p> <p>Methods: A panel of experts from 12 scientific medical societies reviewed circa 2900 publications. The panel judged the clinical relevance of these studies and assessed the evidence presented in each, then held two interdisciplinary consensus conferences to formulate guideline recommendations and algorithms.</p> <p>Results: Whenever possible, NIV should be preferred to invasive mechanical ventilation, in order to avoid the risk of ventilator and tube-associated complications such as nosocomial pneumonia (grade of recommendation A). Particularly in patients with hypercapnic ARF, NIV reduces the rate of hospital-acquired pneumonia, the length of hospital stay and mortality in the intensive care unit and in the hospital (grade of recommendation A). NIV (or continuous positive airway pressure) is also recommended in cardiogenic pulmonary edema (grade of recommendation A), as treatment for ARF in immunocompromised patients (grade of recommendation A), to prevent postextubation failure, to facilitate weaning in patients with hypercapnic ARF (grade of recommendation A), and to improve dyspnea in palliative care (grade of recommendation C). NIV is not generally recommended in patients with hypoxic ARF because of its high failure rate of 30% to over 50% in such patients.</p> <p>Discussion: Although evidence indicates that NIV can be used as the treatment of first choice for several indications, it is still underutilized in the acute setting. These guidelines provide evidence-based information about the indications for, and limitations of, NIV in the treatment of ARF.</p>		
<p>Conclusion:</p> <ul style="list-style-type: none"> • Non-invasive ventilation (NIV) is preferable to invasive ventilation whenever possible. • The advantages of NIV are greatest in the treatment of hypercapnic respiratory failure. • The most important parameters of clinical course are PaCO₂ (the arterial partial pressure of carbon dioxide), pH, respiratory rate, dyspnea, and alertness; these must show a trend toward improvement in the first 2 hours of NIV. • NIV failure may occur early or after a few days. NIV failure must be recognized in timely fashion so that the patient can be intubated without delay. • Hypoxemic ARF should generally not be treated with NIV except in selected patients and under meticulously controlled conditions. 		

<p>Warren DK. et al.</p>	<p>An educational intervention to prevent catheter-associated bloodstream infections in a nonteaching, community medical center</p>	<p>Crit Care Med. 2003 Jul;31(7):1959-63.</p>
<p>Objective: To evaluate the effectiveness of an evidence-based intervention to prevent catheter-associated bloodstream infections among intensive care unit patients at a nonteaching, community hospital.</p> <p>Design: Nonrandomized pre/post observational trial.</p> <p>Setting: Two intensive care units at Missouri Baptist Medical Center, Saint Louis, MO</p> <p>Participations: Nurses and critical care physicians.</p> <p>Interview: A ten-page, self-study module on the prevention of catheter-associated bloodstream infections, lectures, and posters given between July and September 1999.</p> <p>Measurements: The incidence of nosocomial catheter-associated bloodstream infection and patient demographics were measured for patients admitted between March 1998 and July 2000.</p> <p>Main Results: Thirty cases of catheter-associated bloodstream infections during 6110 catheter-days were noted in the preintervention period (4.9 cases/1000 catheter-days) vs. 11 cases during the 5210 catheter-days in the postintervention period (2.1 cases/1000 catheter-days). The relative risk for catheter-associated infection in the postintervention period was 0.43 (95% confidence interval, 0.22-0.84). Among catheterized patients, Acute Physiology and Chronic Health Evaluation II score (25.2 preintervention vs. 25.1 postintervention; $p = .86$), hemodialysis (91 of 647 [14%] patients vs. 69 of 541 [13%]; $p = .70$), and the mean number of catheter days per patient (9.1 vs. 9.6 days; $p = .46$) did not differ between the pre- and postintervention periods.</p>		
<p>Conclusions: A focused, educational intervention among nurses and physicians in a nonteaching community hospital resulted in a significant, sustained reduction in the incidence of catheter-associated bloodstream infection.</p>		

<p>Warren DK. et al.</p>	<p>Outcome and attributable cost of ventilator-associated pneumonia among intensive care unit patients in a suburban medical center.</p>	<p>Crit Care Med. 2003 May;31(5):1312-7.</p>
<p>Objective: To determine the attributable cost of ventilator-associated pneumonia from a hospital-based cost perspective, after adjusting for potential confounders.</p> <p>Design: Patients admitted between January 19, 1998, and December 31, 1999, were followed prospectively for the occurrence of ventilator-associated pneumonia. Hospital costs were defined by using the hospital cost accounting database.</p> <p>Setting: The medical and surgical intensive care units at a suburban, tertiary care hospital.</p> <p>Patients: Patients requiring >24 hrs of mechanical ventilation.</p> <p>Interviews: None.</p> <p>Measurements and Main Results: We measured occurrence of ventilator-associated pneumonia, in-hospital mortality rate, total intensive care unit (ICU) and hospital lengths of stay (LOS), and total hospital cost per patient. Ventilator-associated pneumonia occurred in 127 of 819 patients (15.5%). Compared with uninfected, ventilated patients, patients with ventilator-associated pneumonia had a higher Acute Physiology and Chronic Health Evaluation II score on admission ($p < .001$) and were more likely to require multiple intubations ($p < .001$), hemodialysis ($p < .001$), tracheostomy ($p < .001$), central venous catheters ($p < .001$), and corticosteroids ($p < .001$). Patients with ventilator-associated pneumonia were more likely to be bacteremic during their ICU stay (36 [28%] vs. 22 [3%]; $p < .001$). Patients with ventilator-associated pneumonia had significantly higher unadjusted ICU LOS (26 vs. 4 days; $p < .001$), hospital LOS (38 vs. 13 days; $p < .001$), mortality rate (64 [50%] vs. 237 [34%]; $p < .001$), and hospital costs (70,568 dollars vs. 21,620 dollars, $p < .001$). Multiple linear regression, controlling for other factors that may affect costs, estimated the attributable cost of ventilator-associated pneumonia to be 11,897 dollars (95% confidence interval = 5,265 dollars-26,214 dollars; $p < .001$).</p>		
<p>Conclusions: Patients with ventilator-associated pneumonia had significantly longer ICU and hospital LOS, with higher crude hospital cost and mortality rate compared with uninfected patients. After we adjusted for underlying severity of illness, the attributable cost of ventilator-associated pneumonia was approximately 11,897 dollars.</p>		