Effective Health Care Program

Breathing Conditions
Respiratory Failure

Noninvasive Positive-Pressure Ventilation for Acute Respiratory Failure: Comparative Effectiveness

Focus of Research for Clinicians

In response to a public request regarding the benefits and harms of noninvasive positive-pressure ventilation (NPPV) in patients with acute respiratory failure, a systematic review of 69 unique studies evaluated NPPV modalities. For the purposes of this review, acute respiratory failure was defined as a significant change in a patient's baseline gas-exchange status that occurs relatively suddenly (usually hours to days) and is potentially life threatening but does not require emergent intubation. Etiologies of respiratory failure assessed in this report included chronic obstructive pulmonary disease (COPD), acute cardiogenic pulmonary edema (ACPE), pneumonia, acute respiratory distress syndrome, asthma, obesity hypoventilation syndrome, interstitial lung disease, and acute respiratory failure in the postoperative and post-transplantation settings. Outcomes including rates of hospital mortality, reintubation, hospital-acquired pneumonia, incident myocardial infarction, adverse effects, and medical utilization outcomes were assessed. The full report, listing all studies, is available at www.effectivehealthcare.ahrq.gov/nppv.cfm. This summary, based on the full report of research evidence, is provided to assist in decisionmaking along with consideration of a patient's values and preferences. However, reviews of evidence should not be construed to represent clinical recommendations or guidelines.

Background Information

An increasingly recognized option for managing selected cases of acute respiratory failure is NPPV. NPPV uses positive pressure to deliver a mixture of air and oxygen. Patient-ventilator interfaces for NPPV include a face mask, a nasal mask, or plugs. Continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BPAP) are the two most commonly used modes of NPPV. CPAP is applied throughout the respiratory cycle of a spontaneously breathing patient. BPAP delivers two pressure levels according to the respiratory cycle—an inspiratory positive airway pressure and a continuous expiratory positive airway pressure.

The use of NPPV for support during the treatment of respiratory failure is attractive because it does not require either endotracheal intubation or sedation and can be easily initiated or discontinued as needed. It is also associated with few of the nosocomial complications recognized with endotracheal intubation. However, NPPV is a resource-intensive modality, requiring substantial training and experience for its successful implementation. Additionally, NPPV is not appropriate for some patients, such as those with cardiopulmonary arrest, shock, facial trauma, severely impaired consciousness, or high aspiration risk and those who are unable to cooperate, protect the airway, or clear secretions.

NPPV has been evaluated in a large number of trials, often with clinically important benefits. However, the use of NPPV remains highly variable across and within countries. Challenges related to the use of NPPV include a lack of physician knowledge, low rates of perceived efficacy, and limited information about the efficacy of NPPV in patients with acute respiratory failure caused by conditions other than COPD or ACPE. This systematic review aimed to address these knowledge gaps.

Conclusions

For patients with acute respiratory failure due to severe exacerbations of COPD or congestive heart failure, NPPV improves rates of mortality, endotracheal intubation, and hospital-acquired pneumonia when compared with supportive medical therapy alone. In a limited number of patients, the reduction in the rate of hospital-acquired pneumonia was seen with NPPV when compared with invasive ventilation. Limited evidence suggests the possibility of less benefit from NPPV in studies conducted in routine clinical practice settings when compared with controlled clinical trials; however, the evidence was insufficient to assess the impact of clinician experience, system resources, and patient characteristics on the effects of NPPV.

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Clinical Bottom Line

	Mortality	Endotracheal Intubation Rate	Hospital–Acquired Pneumonia	Incident Myocardial Infarction Rates
NPPV + Supportive Medical Therapy Versus Supportive Medical Therapy Only	Decreased with NPPV. Evidence was strongest in patients with COPD or ACPE. (OR = 0.56; 95% CI, 0.44 to 0.72) ●●●	Decreased with NPPV. Evidence was strongest in patients with COPD or ACPE. (OR = 0.31; 95% CI, 0.24 to 0.41) ●●●	Decreased with NPPV. Evidence was strongest in patients with COPD. (OR = 0.27; 95% CI, 0.15 to 0.49) ●●○	No difference between groups. Evidence was strongest in patients with COPD or ACPE. (OR = 1.11; 95% CI, 0.85 to 1.44) ●●○
NPPV With BPAP Versus NPPV With CPAP in Patients With ACPE	No difference between groups. (OR = 0.89; 95% CI, 0.58 to 1.35) ●●○	No difference between groups. (OR = 0.84; 95% CI, 0.51 to 1.38) ●●○	NR	No difference between groups. (OR = 0.69; 95% CI, 0.34 to 1.40) ●○○

Other Findings

- Evidence in a limited number of patients (n = 405) suggested that NPPV, when compared with invasive ventilation, decreased rates of hospital-acquired pneumonia (●●●), whereas rates of mortality did not differ between the two groups (●○○). Evidence was strongest in patients with COPD.
- Limited evidence suggests potential benefits of NPPV in preventing recurrent respiratory failure postextubation in high-risk patients. ●○○
- Effects of NPPV on mortality and intubation rates were stronger in controlled clinical trials when compared with studies conducted in routine clinical practice settings. ●○○

Abbreviations: 95% CI = 95-percent confidence interval; ACPE = acute cardiogenic pulmonary edema; BPAP = bilevel positive airway pressure; COPD = chronic obstructive pulmonary disease; CPAP = continuous positive airway pressure; NPPV = noninvasive positive-pressure ventilation; NR = not reported; OR = odds ratio

Strength of Evidence Scale

High:	●●●	High confidence that the evidence reflects the true effect. Further research is very unlikely to change our confidence in the estimate of effect.
Moderate:	●●○	Moderate confidence that the evidence reflects the true effect. Further research may change our confidence in the estimate of effect and may change the estimate.
Low:	●○○	Low confidence that the evidence reflects the true effect. Further research is likely to change the confidence in the estimate of effect and is likely to change the estimate.
Insufficient:	○○○	Evidence either is unavailable or does not permit a conclusion.

Gaps in Knowledge and Future Research Needs

- Evidence on the effects of NPPV versus supportive care in patients with asthma, interstitial lung disease, pneumonia, acute lung injury/acute respiratory distress syndrome, or obesity hypoventilation syndrome and those who have postoperative or post-transplantation respiratory failure is limited.
- The benefits of NPPV to assist weaning or to prevent recurrent acute respiratory failure postextubation remain uncertain.
- It is unclear if the effects of NPPV vary by patient characteristics such as body mass index, mental status, or overall disease burden.
- The impact of NPPV versus supportive care on outcomes such as patient psychological status, quality of life, and functional status and on resource utilization require more extensive characterization.
- There is uncertainty about the effects of training, staffing composition/ratios, and the use of algorithms on NPPV effectiveness.

Source

The information in this summary is based on *Noninvasive Positive-Pressure Ventilation (NPPV) for Acute Respiratory Failure: Comparative Effectiveness*, Comparative Effectiveness Review No. 68, prepared by the Duke Evidence-based Practice Center under Contract No. HHSA 290-2007-10066-I for the Agency for Healthcare Research and Quality, July 2012. Available at www.effectivehealthcare.ahrq.gov/nppv.cfm. This summary was prepared by the John M. Eisenberg Center for Clinical Decisions and Communications Science at Baylor College of Medicine, Houston, TX.

Ordering Information

For electronic copies of this clinician research summary and the full systematic review, visit www. effectivehealthcare.ahrq.gov/nppv.cfm. To order free print copies, call the AHRQ Publications Clearinghouse at 800-358-9295.

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