

# Pediatric Emergency Noninvasive Ventilation



Chad D. Viscusi, MD<sup>a,b,\*</sup>, Garrett S. Pacheco, MD<sup>a,b</sup>

## KEYWORDS

• Noninvasive ventilation • Acute respiratory failure • Infants • Children

## KEY POINTS

- Noninvasive ventilation (NIV) is a powerful tool often initiated early in the management of pediatric acute respiratory failure (ARF).
- NIV includes the following 2 positive pressure modalities: continuous positive airway pressure and bilevel positive airway pressure, which treat hypoxemic and hypercapnic respiratory failure, respectively.
- Humidified high-flow nasal cannula, although not classically considered a mode of NIV, provides another mean of treating hypoxemic ARF in infants and children.
- Commonly encountered pediatric respiratory diseases, such as bronchiolitis and asthma, may benefit from the early utilization of NIV.

## INTRODUCTION (BACKGROUND AND DEFINITIONS)

Respiratory illness is one of the most common reasons parents seek emergency medical care for their children. Although many of these children will have a benign and self-limited process, some will present with respiratory distress or frank respiratory failure. The ability to promptly recognize respiratory failure and appropriately, quickly, and safely initiate ventilatory support are vital skills for any professional providing care to sick or injured children. This article reviews the use of noninvasive ventilation (NIV) in the emergency care of infants and children with acute respiratory failure (ARF). The authors discuss the physiology, highlight the evidence, and provide a practical approach to the use of this powerful technique.

Historically, pediatric ARF has been managed with endotracheal intubation (ETI) and invasive mechanical ventilation (IMV). However, ETI and IMV are associated with a variety of significant complications in children<sup>1,2</sup> (**Box 1**).

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<sup>a</sup> Department of Emergency Medicine, University of Arizona College of Medicine, 1501 N. Campbell Avenue, Tucson, AZ 85724, USA; <sup>b</sup> Department of Pediatrics, University of Arizona College of Medicine, 1501 N. Campbell Avenue, Tucson, AZ 85724, USA

\* Corresponding author. Department of Emergency Medicine, University of Arizona College of Medicine, 1501 N. Campbell Avenue, Tucson, AZ 85724, USA.

E-mail address: [cviscusi@aemrc.arizona.edu](mailto:cviscusi@aemrc.arizona.edu)

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**Box 1****Risks and complications associated with conventional invasive acute respiratory failure management***ETI*

Oropharyngeal injury

Laryngeal injury

Tracheal injury

Hypoxia, bradycardia

Subglottic stenosis

*IMV*

Ventilator-associated pneumonia

VILI: barotrauma

VILI: volutrauma

Need for heavy sedation, paralysis

Inability to speak, eat

*Abbreviation:* VILI, ventilator-induced lung injury.

NIV is the application of mechanical respiratory support without the use of an invasive endotracheal tube. The use of NIV in children has increased significantly in recent years in hopes of improving respiratory physiology while avoiding the risks of ETI and IMV and is now used widely in the management of acute and chronic respiratory failure in patients of all ages.<sup>3-5</sup> Much of the historical evidence supporting the safety and efficacy of NIV in children comes from the study of neonatal apnea and respiratory distress syndrome and the management of obstructive sleep apnea and chronic respiratory failure of neuromuscular disorders.<sup>6,7</sup> Evidence suggests that early NIV decreases the work of breathing, improves oxygenation and ventilation while avoiding complications associated with ETI (see **Box 1**). Additional advantages of NIV include preservation of spontaneous respiration and airway protective reflexes (swallowing, coughing), maintenance of the ability to speak, and the provision of enteral feeding in select circumstances. NIV has become, at many institutions, the first-line intervention in the emergency management of ARF in children.<sup>3,5</sup>

**GENERAL PHYSIOLOGY**

The primary objective of NIV used in the emergency management of pediatric acute respiratory distress and ARF is to improve oxygenation and ventilation while decreasing the work of breathing and the associated metabolic demands. There are 2 basic types of noninvasive positive pressure ventilation currently in use: continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BiPAP); although not historically considered a form of NIV, high-flow nasal cannula (HFNC) oxygen therapy has emerged as another powerful tool in the emergency armamentarium for noninvasive management of pediatric ARF.

***Continuous Positive Airway Pressure***

CPAP provides a constant positive distending airway pressure throughout the entire respiratory cycle of spontaneously breathing patients. CPAP is most appropriate for

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