Costs of Ventilation Options Derived from *nThrive*® Database – Retrospective Database Analysis

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Statement of the Problem:

Noninvasive ventilation (NIV) is a recommended treatment for acute and chronic respiratory failure, especially in patients with chronic obstructive pulmonary disease (COPD) [1-4]. In comparison with invasive ventilation, NIV has the advantages of reducing the rate of intermittent mechanical ventilation (IMV), associated procedural complications (such as ventilator associated pneumonia), mortality and charges for ventilatory support [1, 5]. Identifying the predictors of NIV failure is important because of the strong link between failure and poor outcomes and because it may impact the cost of care. However, very little attention has been paid to the timing of the failure [4, 6-8]. Therefore, incorrect patient selection at admission, under-recognition of timing of NIV failure, or patient interface issues is subsequently associated with increased procedural complications and mortality as well as increased charges [5, 9].
The objective of this study was to estimate the frequency of use and compare NIV and IMV costs.

Methodology and Theoretical Orientation:

Hospitalized patients with COPD and respiratory distress treated with NIV or IMV were analyzed from the *nThrive*® US-database [10].
We included patients older than 18 years of age admitted with a primary diagnosis of COPD or a primary diagnosis of respiratory failure with a secondary diagnosis of COPD. Patients were grouped by their use of NIV and IMV: NIV only, IMV only, NIV prior to IMV and IMV prior to NIV. The following NIV ICD10 procedure codes were used: 5A09357, 5A09457, 5A09557. For IMV, ICD10 procedure codes were: 0BH17EZ and 0BH18EZ. We examined all patients in 2018 in the US. Total hospital costs were reported as means and standard deviation. All costs are in 2018 US dollars.

Findings:

A total of 12,284 admissions occurred in 2018 in the *nThrive*® database with the five ICD10 codes listed above (majority on NIV). The results showed that IMV is twice as expensive as NIV (Table 1). The increase was the steepest and the costs were the greatest for patients who were transitioned from NIV to IMV. This is because NIV was unsuccessful and IMV was subsequently initiated (NIV prior to IMV). The difference in mean total hospital costs was statistically significant for all groups compared to NIV only group ($p<0.0001$). The cost of IMV prior to NIV may be slightly higher than IMV alone and likely due to delays in initiating weaning to NIV. Additional analysis is needed.

Table 1. Total hospital costs

	N	Mean	Median	Standard deviation	p value
NIV only	6,775	$21,268	$13,575	$25,534	N/A
IMV only	5,315	$45,427	$29,535	$66,269	p<0,0001
NIV prior to IMV	194	$54,692	$38,746	$61,669	p<0,0001
IMV prior to NIV	477	$47,062	$36,274	$39,730	p<0,0001

IMV: Intermittent Mechanical Ventilation; N/A: Not applicable; NIV: Noninvasive Ventilation.

Conclusion and Significance:

NIV is more frequently applied to patients hospitalized for acute exacerbations of COPD than IMV. The results showed that NIV prior to IMV is 2.6 times more expensive than NIV alone. NIV failure is associated with frequent uncomfortable or even life-threatening adverse effects, the later due to delayed intubation. Therefore, the application of NIV should be performed with careful attention to signs of failure to reduce potential complications [1]. Furthermore, if NIV is not successful (i.e. the patient is not tolerating the mask; the device is not well synchronized with patients breathing or is not appropriately titrated) NIV should be stopped and care should be escalated to IMV as soon as possible as delay will also add to the cost. Close monitoring is indicated to detect early and late signs of deterioration, thereby preventing unavoidable delays in intubation [4, 6]. NIV should be applied by a trained and experienced team, with careful patient selection according to available guidelines and good clinical judgement, taking constantly into account the risk factors for NIV failure as this will likely increase cost [1, 3].
To summarize, successful NIV has a cost advantage.

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