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Comparison of the Efficacy of Two Nebulizers
in Treating Acute Exacerbation of COPD in the
Emergency Department

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Comparison of the Efficacy of Two Nebulizers in Treating Acute Exacerbation of COPD in the Emergency Department

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Introduction

Over 1.5 million adults are treated annually in the Emergency Department (ED) for acute exacerbation of COPD (AECOPD). A series of aerosolized bronchodilator treatments is the standard of care in treating AECOPD. The type of nebulizer used affects the dose and deposition of the aerosolized drug. Substantial evidence demonstrates that the breath-enhanced and breath-actuated nebulizers are more efficient in medication delivery than the traditional T-piece small volume nebulizer. There are few published clinical trials comparing the outcomes of two high performance nebulizers.

Objective

This study compared the efficacy of two high performance small volume nebulizers used in the initial medication regimen for AECOPD patients admitted to the ED. The outcomes of interest were length of stay (LOS) in the ED, treatment time, and number of treatments.

Methods

A comparison of the performance of two nebulizers was conducted in the ED on patients with acute exacerbation. A total of 36 patients with similar demographics were included in the product evaluation. In the first group, eighteen patients were treated with the breath-actuated nebulizer. The second group of eighteen patients was treated with the breath-enhanced high density nebulizer (HDN) small volume nebulizer. The same flow rate of 8 LPM and the same mouthpiece were used with both nebulizers. The hospital's AECOPD Respiratory Protocol was followed. For the first treatment, patients received either 1.25 mg Xopenex with 500 mcg Ipratropium or 2.5 mg Albuterol/500 mcg Ipratropium depending on their home medication and heart rate. The ED LOS, total number of treatments given per patient and nebulization times were recorded.

Results

Following completion of the evaluation, the median number of treatments was 3.0 and 3.5 for the breath-enhanced HDN group and breath-actuated group, respectively ($p = .0006$). Treatment times (4.0 ± 0.0 vs. 8.0 ± 1.7 min, $p < .0001$) and length of ED stay (2.5 vs. 3.1 hrs, $p < .0001$) significantly favored the breath-enhanced HDN device.

Summary

Our results showed significantly less number of treatments, shorter treatment duration, and shorter ED LOS with breath-enhanced HDN nebulizer. A cost savings from the shorter ED LOS, fewer treatments and less therapist time should be recognized. Further evaluations to assess the efficacy of the breath-enhanced HDN nebulizer in different hospital settings and patient groups may be beneficial.

Table 1. Evaluation data

Data	Breath-Enhanced HDN N=18	Breath-Actuated N=18	p-value
Albuterol w/Ipratropium	14	13	-
Xopenex w/Ipratropium	4	5	-
Median # Treatments	3.0	3.5	0.0006 ¹
Nebulization time/min	4.0 ± 0.0	8.0 ± 0.3	< .0001 ¹
Length of ED stay/min.	150.6 ± 17.0	187.7 ± 25.7	< .0001 ¹

¹ = Statistically significant difference

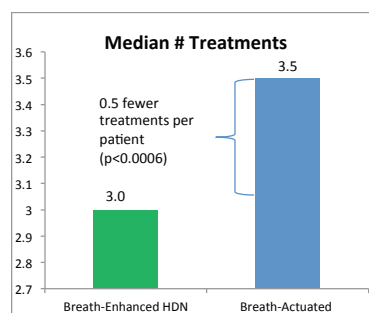


Figure 1: Median number of treatments per patient for each nebulizer.

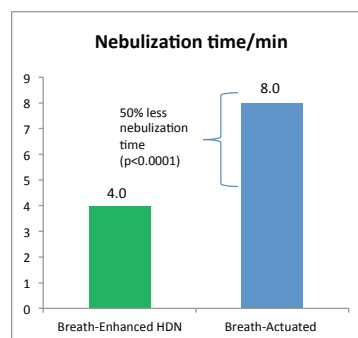


Figure 2: Average medication nebulization time for each nebulizer.

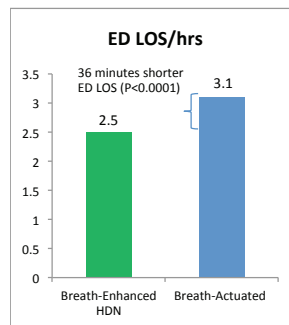


Figure 3: Average length of stay in the Emergency Department for each nebulizer.

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Case Study: Respiratory Collaborative Group Savings Initiative

Kathy Ehlers, BA, RRT; James Rish, MD

Introduction

Respiratory Care managers have always explored ways to reduce operational costs without compromising patient safety or quality of the respiratory services provided. The Patient Protection and Affordable Care Act of 2010 (ACA) added additional challenges for department managers to become more creative and find solutions for managing our respiratory patients, especially those with COPD, asthma and pneumonia. To maintain a high quality of patient care, while managing the budget and keeping staff positively engaged can be a juggling act. Managers are on the lookout for anything that improves the patient experience, decreases Emergency Department (ED) length-of-stay, and reduces total costs for the entire system.

Two years ago, the North Mississippi Medical Health Systems, consisting of 6 facilities, implemented a Respiratory Advance Program (RAP). The RAP provides a mechanism for respiratory therapists to receive recognition for their performance and contributions, participate in community programs and identify areas for improvement. One RAP participant requested to conduct an evaluation comparing two high performance small volume nebulizers, a breath-actuated versus breath-enhanced high density nebulizer (HDN), in COPD patients admitted to the ED for acute exacerbation. Breath actuated nebulizers are designed to generate aerosol only during the inhalation phase of the breath; maximizing the drug delivery and preventing loss of medication during exhalation. The breath-enhanced HDN nebulizers utilize one-way valves. During exhalation the aerosolized medication is captured in a reservoir tower, therefore reducing waste on exhalation. When the patient inhales, a high density bolus of medication is delivered during the first part of the breath.

At first I was hesitant about the nebulizer evaluation. In 2008, our respiratory department had a very successful transition to the breath-actuated nebulizer using concentrated medication. To optimize performance, the manufacturer sited the use of a concentrated medication with the breath-actuated nebulizer. I was not expecting to see a significant difference in patient outcomes or ED length of stay between the two nebulizers.

Product Evaluation

Isaac Timmons, RAP participant, conducted a product evaluation on COPD patients admitted to the Emergency Department (ED)

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with acute exacerbations. Eighteen patients received treatments using the breath-actuated nebulizer and eighteen patients received treatments using breath-enhanced HDN nebulizer. Objective data collected included length of ED stay from the time seen by a respiratory therapist to the time of discharge from ED, the number of nebulizer treatments given and percent change in FEV1 measured by spirometry. Due to the improved efficiency in medication delivery, patients treated with the breath-enhanced HDN required fewer nebulizer treatments, recognized a reduction in total treatment time, and had a shorter ED length of stay (Table 1).

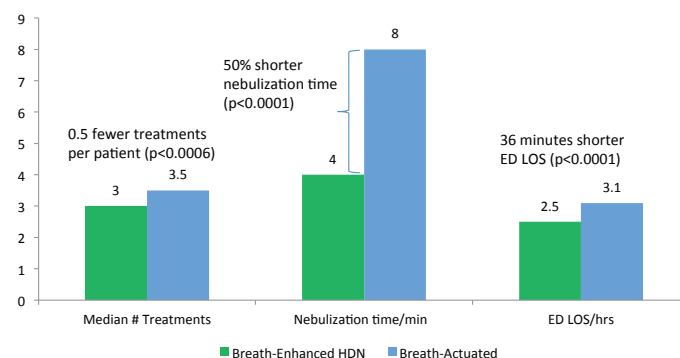


Table 1. Outcomes from nebulizer evaluation.

Cost Improvement

The biggest source of savings is on medication. In order to speed up treatment time with the breath-actuated nebulizer, our pharmacy unit orders a special concentrated form of the respiratory drugs. Per our AECOPD protocol, the first nebulizer treatment is given with the patient's home medication and Ipratropium. The concentrated unit dose for 2.5 mg albuterol with 0.5 mg Ipratropium is \$2.59. With the breath-enhanced HDN nebulizer; a generic albuterol solution can be used without impacting treatment times. The medication cost is reduced to \$0.24 per unit dose. A representative from Pharmacy and the Supply Chain Director met with the Respiratory Collaborative group and discussed the potential cost savings associated with standardizing supplies. Based on the previous year's usage of 136,000 nebulizer treatments, the main unit pharmacy would yield a savings of \$168,875/year. In addition, the respiratory department would realize a cost savings of \$20,000/year in nebulizer disposables. This does not include the potential savings the other 5 facilities will recognize.

Table 2. Cost of nebulizer treatments including therapist's time.

	First Treatment (includes nebulizer)		Subsequent Treatments	
	Breath-Actuated	High Density, Breath-Enhanced	Breath-Actuated	High Density, Breath-Enhanced
Medication used	2.5mg albuterol 0.5mg ipratropium	2.5mg albuterol 0.5 mg ipratropium	2.5mg albuterol	2.5mg albuterol
Treatment Time	15 min	11 min	15 min	11 min
Therapist Wage	\$11.10	\$7.06	\$6.47	\$4.41
Medication Cost	\$2.59	\$0.24	\$1.10	\$0.32
Total Cost	\$13.69	\$7.30	\$7.57	\$4.63
High-Density, Breath-Enhanced Savings per treatment	\$6.39		\$2.94	

In our hospital group, the average Respiratory Therapist's salary is \$25.91/hour. Using the breath-enhanced HDN nebulizer; we shaved 4 minutes from each nebulizer treatment. Based on the number of procedures performed last year that equates to 9,000 hours/year or in theory, \$200,000 of labor costs. To actually capture the labor savings is unlikely; however, a portion of the time may shift to other revenue-generating therapies. The recognized cost improvement from the ED evaluation, including therapist's time, nebulizer and medication cost, was \$273.78.

Hospital-Wide Adoption

Based on the combination of shorter treatment times and ED LOS, equivalent-to-better clinical outcomes, and substantial cost savings, we made the decision to implement the high density, breath-enhanced nebulizer throughout our hospital. Working closely with the Pharmacy Department, and the supply chain director we proposed a new regimen for our nebulizer protocol. The other facilities in our health system conducted an evaluation and plan to adopt the new nebulizer protocol. The Ambulance Services department is reviewing the protocol for use of the breath-enhanced HDN nebulizer in the pre-hospital setting for asthma and COPD patients.

Conclusion

To adapt to the new ACA guidelines, utilizing a multidisciplinary team approach is essential. Any contribution made that reduces the cost of inpatient care and prevents re-admissions of respiratory patients is a valuable asset. Often there is a tradeoff between efficiency and clinical outcomes. However, in our evaluation we found that the breath-enhanced HDN nebulizer improved both speed and clinical outcomes compared to a breath-actuated nebulizer. It shows that there are real performance differences between various high-performance nebulizers. The leadership and participation from the pharmacy, supply chain and our medical director was vital for the successful implementation of the new respiratory protocol. Additional evaluations are needed to capture North Mississippi Medical Health System's true cost savings over the next 6 to 12 months.