Performance Improvement Plan for Pediatric Patients in Respiratory Distress: Clinical Experience

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History of Aerosol Therapy in our Pediatric Patients Leading to a Performance Improvement Plan
As respiratory therapist, a large portion of our time is spent delivering aerosolized medications to patients yet it is often given the least amount of thought. In addition we often have a false sense that the dosage of medication placed in a nebulizer is also delivered to patient’s lung effectively. This is not necessarily the case. Several factors affect delivery to the lung including: nebulizer type, driving gas flow, particle size, residual volumes, respiratory patterns, age, cognitive and physical ability to use device, crying during therapy and clinical application (interface).

The development of new aerosol delivery devices and associated research has increased our awareness surrounding aerosol delivery.

Historically, jet nebulizers also referred to as, small volume nebulizers (SVN) have been the aerosol devices utilized by clinicians to deliver aerosolized medications. "Radioisotopic studies demonstrate that around 10% of the dose placed in the chamber of a jet nebulizer may reach the lungs in adults, though this is greatly influenced by the nebulizer used and the way in which it is operated."1

Children pose additional obstacles. Their lack of cognitive and physical ability to follow instructions forces us to utilize alternative methods for aerosol delivery, preferably an aerosol mask. However, many of us have been confronted with a scared and crying child. In vivo studies indicate that lung deposition of aerosol is significantly reduced in the crying child, to as little as 0.6%.2 In this situation many clinicians resort to “blow by” application, which is an inefficient and ineffective aerosol delivery method. Everard, et al demonstrated a 50% and 80% reduction in medication delivery via a facemask when a nebulizer was moved 1 and 2 cm respectfully from the face."1 So you can imagine what waving a blow by inches away from a screaming child’s face will do. Now also imagine the impact of an efficient delivery method on a very sick child in respiratory distress who needs the medication delivered to the lung.

As many other departments, aerosol delivery via SVN was common practice in our department, up until about 8 years ago when we observed a demonstration of a new type of aerosol delivery device (Aerogen Solo). The Solo delivers up to 4 times the amount of medication as compared to an SVN. Dubus, et al, demonstrated this utilizing an animal model and radioscintigraphy. He measured 12.6% lung deposition with an Aerogen Pro versus 0.5% with a MistyNeb SVN, a twenty-five-fold increase in lung deposition.3

Figure 1. Examples of SVN with a pediatric aerosol mask.

Figure 2. To the left is an Aerogen Solo with a pediatric mask. To the right is an Aerogen Solo in-line with the Fisher & Paykel Optiflow System.

Our commitment to making the best technology available to our patients led us to our first opportunity to use the Aerogen Solo. Two days after initial demonstration of the device, a concerned staff respiratory therapist contacted me about a pediatric patient in respiratory distress. The patient was an 8-year-old asthmatic admitted from the ER to the pediatric inpatient unit in severe respiratory distress. The plan was to move him to the pediatric intensive care unit (PICU) for more intensive therapy. Our goal was to relieve the patient’s respiratory distress, keep him out of intensive care and get him home.

He had already received usual treatment in the Emergency Room, which consisted of 5 hours of continuous albuterol (7.5 mg/hour) via AirLife brand MistyNeb continuous SVN and was refractory to treatment. He was retracting, and tachypneic. Auscultation of his lungs revealed decreased aeration, inspiratory and expiratory wheezes and a prolonged expiratory phase.

We gave him one albuterol (7.5 mg) treatment with the Aerogen Solo via mouthpiece application, which took less than 8 minutes
to deliver as compared to 1 hour with the MistyNeb. Within minutes he demonstrated an increase in aeration, decrease in work of breathing, decreased wheezing and an improvement in expiratory phase. He had one more 7.5 mg albuterol treatment with the Solo, spent less than one hour in the PICU and was discharged the next morning.

This was the first of what seemed to be a pattern of successful treatment with the Aerogen Solo for patients who were refractory to albuterol therapy via traditional SVN. So much so that use of the Aerogen Solo with pediatric patients in respiratory distress became more favorable than the SVN. The next wave of use for the Aerogen Solo was associated with the high flow cannula application.

Our experience utilizing Fisher & Paykel High Flow Nasal Cannula (HFNC) in the pediatric patient has produced positive clinical outcomes. McKiernan, et al, described a 68% reduction in intubations with the use of HFNC in our pediatric patients with respiratory distress associated with bronchiolitis. They theorized, “that reduction in intubation was associated with decreased respiratory rates and work of breathing due to the use of a noninvasive form of ventilatory support that is comfortable and well tolerated.”

Many of our patients requiring HFNC also require aerosol drug delivery. Bench studies have demonstrated efficient and effective aerosol delivery utilizing the Aerogen Aeroneb Solo via the Fisher & Paykel HFNC application. In addition to being an effective method for delivering aerosol to children, aerosol delivery via HFNC also does not require cooperation from the patient. The aerosol can be delivered without disturbing the child and requires less time to deliver than the traditional SVN reducing therapist time at the bedside. For these reasons aerosol delivery via the HFNC application utilizing the Solo has become our standard of practice for any patient requiring HFNC.

**Performance Improvement Plan for the Pediatric Patient in Respiratory Distress**

According to the Pioneer Valley Asthma Coalition, “The Pioneer Valley has one of the highest rates of asthma in the nation. Pediatric asthma rates are extremely high in both Holyoke (19%) and Springfield (17%).” Both close to double the statewide prevalence of 9.5%.” Baystate Medical Center, in Springfield, Massachusetts is a major medical center serving western Massachusetts with the region’s only Pediatric ER. Pediatric asthma patients frequent the emergency room at Baystate. In an effort to improve the care of these patients we developed a Pediatric Performance Improvement Plan (PIP) for patients in respiratory distress. The ultimate goal of the PIP was to provide the best possible clinical outcomes utilizing the least invasive methods available in a timely and efficient manner. Our hope was to improve patient comfort, reduce work of breathing, improve clinical outcomes, decrease length of stay and reduce hospital admissions.

In September 2013, we assembled a team to develop a PIP that included: respiratory therapists, ER nurses, ER pediatric physicians, PICU intensivists, health care quality, pulmonologists and infants/children’s physicians. Based on our experience within our own institution a plan was developed which included: frequent assessments by the respiratory therapist, a therapist driven model, a clinical asthma score (CAS), Fisher & Paykel High Optiflow Nasal Cannula (HFNC) and Aerogen Aeroneb Solo.

In order to facilitate patient care, our Pediatric ER is equipped with a mounted HFNC system and Aerogen controller at each patient bedside providing quick easy access to equipment. Respiratory Therapists initially score patients utilizing a modified CAS, scoring mild, moderate or severe. The respiratory therapist repeats CAS every 30 to 60 minutes, as needed, until the patient is either discharged or admitted. Patients who score mild receive aerosol therapy via traditional SVN, patients who score moderate receive aerosol therapy via Solo and patients who score severe are placed on a HFNC with aerosol therapy delivered via Solo. All patients receive the same albuterol dosing of 7.5 mg albuterol for weights <10 kg or 15 mg albuterol for weights >10 kg. (Figure 3)

During the first month of the performance improvement plan (fall 2013) we treated approximately 96 patients with respiratory distress associated with asthma exacerbations with an average length of stay around 2.2 hours. This was not designed as a clinical study. It was simply a plan to try to improve the care of our pediatric asthma patients in the ER. Clinical observations and respiratory therapist commentaries indicated that our plan produced more favorable clinical outcomes than our previous methods of treatment.

The team was reassembled this summer (2014) to plan for the anticipated influx of seasonal pediatric respiratory distress patients for the fall. Feedback around clinical response to the PIP was so positive that the team felt that it would be beneficial for all pediatric patients in respiratory distress to receive aerosol therapy via the Solo instead of SVN, independent of CAS. The team also decided to reduce the albuterol dose to 7.5 mg and leave the 15 mg dose as an option.

Overall, response to the PIP has been overwhelmingly positive from clinicians, patients and parents. Short treatment times, frequent clinical assessments by respiratory therapists, readily available access to critical respiratory equipment, high-quality aerosol delivery and minimal residual medication volumes associated with the Aerogen Solo, most likely contributed to clinical outcomes. We believe that use of noninvasive methods of ventilatory support and efficient advanced aerosol techniques.

**Table 1. Shows asthma rates in Western Massachusetts as compared statewide prevalence.**

<table>
<thead>
<tr>
<th>Towns</th>
<th>Asthma Rates (%)</th>
<th>Statewide Prevalence 9.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holyoke</td>
<td>19%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Springfield</td>
<td>17%</td>
<td>9.5%</td>
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High Optiflow Nasal Cannula (HFNC) and Aerogen Aeroneb Solo.
had a positive impact on clinical outcomes, as well as staff and patient satisfaction.

Our respiratory therapy department believes that patients deserve the best care possible and we are committed to providing quality patient care beyond the status quo. In addition, our proactive approach to the care prepared us well in advance for the high volume of pediatric respiratory distress patients associated with the outbreak of the Enterovirus D68, allowing Baystate staff to respond quickly and efficiently to the crisis. In September there were reports that pediatric patients in respiratory distress were being admitted to our ER at a rate of 50 per day. The majority of these patients were discharged from the ER after 6-9 treatments. Those admitted were discharged on the next day and none required intubation. ER care for Enterovirus D68 requires 5 hours of care; in August 2014 we reported we spent 2.5 hours.

Anecdotal feedback from clinicians, in addition to improvement in CAS led us to hypothesize that patients demonstrate a positive clinical response to aerosol delivery utilizing the Aerogen Solo via Fisher & Paykel HFNC application. In addition our overall consensus is that patients demonstrate a better clinical response from aerosol delivery utilizing Aerogen solo methods of ventilatory support and efficient advanced aerosol techniques had a positive impact on clinical outcomes, as well as staff and patient satisfaction. In addition, our proactive approach to the care prepared us well in advance for the high volume of pediatric respiratory distress patients associated with the outbreak of the Enterovirus D68, allowing Baystate staff to respond quickly and efficiently to the crisis. In September there were reports that pediatric patients in respiratory distress were being admitted to our ER at a rate of 50 per day. The majority of these patients were discharged from the ER after 6-9 treatments. Those admitted were discharged on the next day and none required intubation. ER care for Enterovirus D68 requires 5 hours of care; in August 2014 we reported we spent 2.5 hours.

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References

Disclosure: Patricia Dailey is a Registered Respiratory Therapist. She was employed at Baystate Medical Center as the Clinical Educator in the Respiratory Therapy Department from 1994-2011, and the Manager of Respiratory Therapy and Pulmonary Patient Services from 2011-2014. Currently, she is employed by Aerogen as a Medical Science Liaison. During the course of her career, she has led the way with aerosol delivery and use of high flow nasal application by taking an innovative approach to patient care. She is an author, educator, lecturer, researcher and respiratory clinician. She has had numerous faculty appointments and has experience in all facets of respiratory therapy in all age groups. She received numerous Presidents’ Quality Awards while employed at BMC, including a 2014 winner of the award for collaboration on the Proven Care Initiative for patients with lung cancer. Her positive clinical experience with aerosol delivery utilizing Aerogen delivery devices and interest in clinical research with aerosol and HFNC led her to pursue a career with Aerogen. Her goals are to expand clinical research in the area of aerosol delivery in order to optimize care to patients with respiratory disease. She also plans to take an active role in educating clinicians on the importance of quality aerosol delivery. Positive clinical outcomes, innovation, patient satisfaction, respiratory therapy engagement and reduction in healthcare costs are her top priorities.