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Treatment Variability of Asthma Exacerbations in a Pediatric Emergency Department Using a Severity-Based Management Protocol

Michael Glenn O'Connor, MD¹, Benjamin R. Saville, PhD¹, Tina V. Hartert, MD, MPH¹, and Donald H. Arnold, MD, MPH¹

¹Vanderbilt University, Nashville, TN, USA

Introduction

Acute asthma exacerbations are one of the most frequent reasons for emergency department visits and the most frequent reason for hospitalization of children in North America. Appropriate management and disposition decisions are dependent on accurate assessment of exacerbation severity, and severity scores are frequently used for this purpose. To our knowledge the variability of exacerbation management when a severity score is used to guide treatment has not been reported.

There are a variety of published acute asthma severity scores. In 2000, Chalut *et al* published the Preschool Respiratory Assessment Measure (PRAM)¹. The PRAM consists of five variables: wheezing, air entry, contraction of scalenes, suprasternal retraction, and oxygen saturation. It was standardized against respiratory resistance as measured by forced oscillation. In 2012, Arnold published the Acute Asthma Intensity Research Score (AAIRS)². The AAIRS is similar to the PRAM, but substitutes scalene muscle retractions with visual observation of intercostal and subcostal retractions as well as auscultation for expiratory phase prolongation.

Our tertiary children's hospital uses the 15-point pediatric asthma score (PAS)³. The PAS is used by clinicians and respiratory therapists for scoring pediatric asthma exacerbation severity in our emergency department (PED). The PED utilizes an acute asthma exacerbation management pathway derived from National Asthma Education and Prevention Program (NAEPP) guidelines, with four recommended treatment tiers corresponding to ranges of the PAS⁴.

Our objective was to evaluate adherence to the recommended management pathway in our pediatric ED.

Methods

We performed a secondary data analysis of a prospective cohort of children ages 5 – 17 years who presented with acute asthma exacerbations to our urban, tertiary, academic children's hospital. Inclusion criteria included physician-diagnosed asthma, signs or symptoms of an asthma exacerbation (cough, dyspnea, wheezing, and/or chest pain), and need for treatment with systemic corticosteroids and inhaled bronchodilator as determined by the attending physician. Children with chronic lung disease other than asthma, foreign body aspiration, or other reason for pertinent signs and symptoms were excluded. Patients were recruited from 07:00 to 22:00 on each weekday and on approximately every third weekend day.⁵ The study was approved by the Vanderbilt IRB and informed consent and assent were obtained from parents and participants.

The exacerbation management pathway used in the PED recommends that each patient be assigned to one of four escalating treatment tiers based on the pre-treatment PAS.³ As displayed in Table 1, the PAS is divided into four severity groups and each has a corresponding treatment tier: PAS 0–4 (minimal symptoms, treatment tier 1), PAS 5–7 (mild, treatment tier 2), PAS 8–11 (moderate, treatment tier 3), PAS 12–15 (severe, treatment tier 4). The treatments are based on NAEPP guidelines for the treatment of acute asthma exacerbations.

A research assistant dedicated to this project was trained to perform PAS scoring. The PAS was calculated at time of presentation and before treatment with systemic corticosteroid and bronchodilator. Treatments provided in the first hour were recorded. We assigned the treatment tier that each participant received based on the highest single treatment rendered. For example, if a participant who received continuous albuterol nebulization, supplemental oxygen, and systemic corticosteroids, the treatment was scored as tier 3. The number of incomplete treatment tiers provided was also recorded.

The primary outcome was the following treatment tier statistics for each severity group: mean, SD, and 95% CI of the SD (as a measure of treatment variability). Secondary outcomes included the proportion of patients who received at least one recommended treatment from the recommended tier for each severity group.

Results

Amongst 914 children studied between April, 2008 and October, 2012, median [IQR] age was 8.8 [6.95, 11.17], 558 (61%) were male; 368 (40%) white, 539 (59%) African American, and 574 (63%) had TennCare Medicaid insurance. Within each severity group there was marked variability from recommended treatment, measured using the SD of treatment tier within each severity group (Figure 1). An asterisk in each grouping designates the treatment tier recommended by the management pathway. Mean treatment tier value and variability measures (SD and 95% CI of the SD) according to severity level are also provided in Figure 1. The moderate severity group (PAS 8–11) displayed the least treatment variability (SD 0.47, 0.44–0.66), and the minimal symptom group (PAS 0–4) displayed the greatest treatment variability (SD 0.67, 0.63–0.79).

In addition, of 555 children with mild, moderate, or severe exacerbations, 181 children (33%) received the complete treatment tier that was called for in the recommendations. Of 515 children with a mild or moderate exacerbation, 173 (34%) received a treatment tier above the recommendation. There were 359 children with a PAS of 0–4 and of these 313 or 87% received some asthma treatment which is above the recommendation.

Discussion

Our results demonstrate less than expected adherence to the treatment recommendations established in our PED when a severity-score based protocol is used to guide management. There was also notable treatment variability within severity groups. We expected that children with less severe clinical symptoms would have greater variability in treatment in comparison to those with more severe presentations as the latter would likely have all available resources applied to them. However, we did not expect the amount of treatment variability at each level of severity presentation. There were 555 children who presented with a mild, moderate, or severe acute asthma exacerbation. Of these children only 33% received the complete treatment tier recommended by the PED management pathway. This reflects another source of variability in our treatment recommendations. A study limitation is that the management pathway recommends no treatment for children with PAS of 0–4, yet 87% of participants in this group received some asthma treatment. Our results indicate a need to establish greater clarity of treatment recommendations for children presenting to the ED with minimal symptoms of an asthma exacerbation.

Another limitation of our study is that it was conducted in a single, academic PED. Although the greatest value of this data is likely in our own continuing quality improvement, most facilities nonetheless approach management of children with acute exacerbations with similar severity-based treatment pathways. Our efforts further illustrate the need for acute care facilities to apply quality improvement efforts to evaluate treatment recommendations within their institution and to examine sources of variability to better provide consistent, optimal care.

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Figure 1. Treatment Variability

Treatment tiers are displayed by PAS severity grouping. Asterisk designates the recommended treatment tier for severity group. Mean tier value, Tier SD, and 95% CI of the SD are displayed for each PAS severity group.

Table 1
Exacerbation Guidelines Management

Pre-treatment Pediatric Asthma Score (PAS) defines four severity groups each with a corresponding treatment tier of recommended interventions.

Treatment	Minimal Symptoms PAS 0-4	Mild Exacerbation PAS 5-7	Moderate Exacerbation PAS 8-11	Severe Exacerbation PAS 12
Supplemental oxygen		X	X	X
Inhaled SABA x1 or x3 in one hour		X		
SCS		X	X	X
Continuous SABA + ipatropium			X	X
IV fluids			X	X
IV Magnesium			X	X
Systemic SABA				X
Consider NIPPV				X