Paediatric asthma severity score and length of stay in patients presenting to a paediatric emergency department

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Objectives: **To determine whether asthma severity, as assessed by the paediatric asthma severity score (PASS), correlates with a patient's length of stay in a paediatric emergency department (ED).**

Methods: **A retrospective analysis of patients, presenting in a six month period to the ED of the Children's Hospital of Western Ontario, London, Canada, was performed. It looked at determinates for the length of stay of children presenting with acute exacerbations of asthma. From their medical records, their PASS was extracted, as well as other demographics and treatment modalities. Multiple regression was used to test the effects of several predictor variables on length of stay.**

Results: **411 patients were included in the study. The median length of stay in the ED was 151 minutes. 38.9% of patients were treated with steroids. The PASS ranged from 0 to 4. The majority of patients (79%) had a PASS of either 0 or 1. There were 138 patients with a PASS of 0, and 273 patients with a PASS of 1–4. 10.9% of patients with a PASS of 0 were in the ED $\geq$ 4 hours compared to 27.1% of patients with a PASS of 1–4 ($P<0.001$). Sensitivity was 83.2% and specificity was 38.2%. The positive predictive value was 0.271 and the negative predictive value was 0.891. A univariate analysis showed that the only variable predictive of length of stay was PASS, which was confirmed with the multiple regression model ($P<0.001$).**

Conclusions: **This study suggests that the PASS can be used as a predictor of length of stay in the ED for children presenting with an acute exacerbation of asthma. It also confirms previous studies that there is a poor association between actual clinical practice compared to the treatment recommended by formal guidelines.**

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Introduction

Asthma is the most common chronic illness in children in the developed world and the leading reason for hospitalisations among children in most developed nations[1]. It is estimated that 10–15% of all Canadian children live with asthma[2]. This creates a significant burden on the health care system with regard to financial cost as well as the number of days in hospital[1].

Acute exacerbations of asthma in children are also a frequent presentation to the emergency department (ED), where they present with a wide range of disease severity[3]. In Canada, as elsewhere, treatment guidelines based on their asthma severity have been developed. A combined position statement from the Canadian Association of Emergency Physicians and the Canadian Paediatric Society outlines the Canadian approach[4]. This severity is based on level of consciousness, degree of tachypnoea, oxygen saturation of the patient's blood on room air, response to standard dose of β2 agonists, and FEV1/FVC ratio at the time of presentation.

Many studies have been done looking at asthma severity. One commonly used method is to evaluate patients with a clinical score. There are more than 10 clinical scores used to determine asthma severity[5]. This is of special interest in studies involving children, as it is difficult to use spirometry or other pulmonary function tests in the ED as many patients are too young to be able to co-ordinate their breathing in the manner required for accurate spirometry. For this reason, tools such as the Paediatric Asthma Severity Score (PASS) and the Pulmonary Index clinical score, which do not involve pulmonary function tests in the acutely ill patient, have been developed[6-8].

The PASS is a relatively new clinical score to measure asthma severity[6]. It has three parameters: amount of wheeze, work of breathing as assessed by use of accessory muscles, and presence of prolonged expiration. It is a simple tool that was developed for use in asthma severity studies. It is a modified version of the Pulmonary Index, a previously validated clinical asthma severity score[7,8]. The PASS is less comprehensive but easier to use than the Pulmonary Index. The simplicity and ease of use of this instrument was what attracted us to the use of this scoring system.

Length of stay in the ED has been assessed as a marker of severity in the Clinical Asthma Score, but this has not been correlated with the PASS[6]. We wished to determine whether the PASS would also be a predictive factor of a patient's length of stay in the ED, with the caveat that other factors such as time of day, availability of in-patient beds and social situation may also be important determinants.

In the current climate of increased ED visits, ED overcrowding, and rationalisation of health resources, the use of a simple asthma score in a paediatric ED would be of benefit in helping to plan management of an acutely asthmatic child with respect to utilisation of ED resources. Studies are already underway to help develop scores that predict ED workload[8]. Therefore, we evaluated how the degree of severity as assessed by the PASS correlated with the length of stay for children with asthma presenting to a paediatric ED.

Methods

The Children's Hospital of Western Ontario is a regional children's hospital serving an area of 1.5 million people in central Canada. The paediatric ED sees, on average, 40,000 patients per year, and asthma is the commonest cause for hospital admission from the ED.

Data was collected retrospectively for a 6 month period (July–December 2003) from the paediatric emergency medicine database on all children presenting with asthma, cough, or wheeze above the age of 2 years. From these charts, we determined their PASS (Table 1). The PASS was determined at the time of triage, which was when the child first presented to the ED. We chose this time as this was a standard time for all patients, i.e. the time at which they arrived at the ED. This was also prior to the first dose of bronchodilator. We also extracted data relating to basic demographic details, length of stay in the ED, and whether the patient received steroids, which is recommended in the treatment of moderate to severe asthma. The protocol was approved by the Research Ethics Board for Health Sciences Research Involving Human Subjects at the University of Western Ontario.

Statistical analysis

Raw data were entered and analysed in SPSS 14.0. Continuous variables were reported as mean ± SD, and categorical variables were reported as proportions. Univariate analyses were conducted to establish potential relationships between length

Table 1 Paediatric asthma severity score (PASS)

	0	1	2
Wheezing	None	Moderate	Severe or absent
Work of breathing (use of accessory muscles)	None	Moderate	Severe
Prolonged expiration	None	Moderate	Severe

Table 2 PASS and number of children assigned to each score

	0	1	2	3	4	Total
Number of children	138	187	74	11	1	411
Children receiving steroids	59	73	23	4	0	159
Children represented to ED	17	22	15	2	1	57
Minutes in ED, median (range)	125 (25–805)	165 (35–870)	195 (35–532)	420 (90–670)	455 (455–455)	151 (25–870)

of stay and each independent variable. Bivariate correlations were completed to establish the form of relationships between continuous variables. A standard multiple regression was then performed to determine which variables were associated with length of stay in the paediatric ED. A *P*-value ≤ 0.05 was considered statistically significant.

Results

A total of 411 children were included in the study. The mean age of children was 6.4 years (SD = 4.5) and 63.5% were males. The median length of stay in the paediatric ED was 151 minutes (range 25–870 minutes). Only 38.9% of children received steroids for their asthma. Inhaled salbutamol was used in 95.3% of patients, and inhaled ipratropium bromide was used in 4.7%. It should be noted that 13.9% of all patients were patients who returned to the ED following a visit for treatment of asthma within the previous seven days.

The PASS was used to assess the level of asthma severity. Scores ranged from 0 to 4, with higher scores indicating greater severity (Table 2). The vast majority of patients had very low severity, with 79.1% having scores of either 0 or 1. Only one patient had a PASS of 4.

The univariate analyses did not show any significant associations between the independent variables and length of stay, with the exception of PASS. The same findings were verified from the standard multiple regression model. Age, sex, steroid use, ipratropium use, representation, and PASS were included in the univariate and multivariate regression analyses. The regression was significantly different from zero, F (6, 372) = 8.95, *P*<0.001. PASS was the only significant predictor of length of stay in the paediatric ED (*P*<0.001), with higher PASS indicating longer lengths of stay. The findings from the regression results can be found in Table 3.

There were 138 patients with a PASS of 0, and 273 patients with a PASS of 1 or higher. We also dichotomised time in the ED as < 4 hours vs ≥ 4 hours. The results showed that 10.9% of patients with a PASS=0 were in the ED ≥ 4 hours compared to 27.1% of patients with a PASS of 1 or higher (*P*<0.001). Sensitivity was 83.2% and specificity was 38.2%. The positive predictive value was 0.271 and the negative predictive value was 0.891.

Discussion

This study was done in an ED where children presenting with acute exacerbations of asthma could be assessed and observed to determine both the success of initial treatment and whether the child could be discharged or if the severity of their asthma warranted admission to a general ward or a paediatric intensive care unit. As the majority of patients seen were from the local region and were readily able to be discharged home if stable, the principal determinant of admission was asthma severity rather than issues related to travel to and from a regional centre. Hence, length of stay in our patients could be observed and recorded, and a correlation of length of stay with a clinical severity score – in this case the PASS – was possible.

We have demonstrated that a patient's severity of asthma exacerbation was the only factor that produced a significant correlation with increased length of stay in the ED. Use of steroids or ipratropium bromide was not associated with differences in a patient's length of stay. It is interesting that of the patients studied, only 39% of patients received steroids. This is in keeping with studies that show that despite the release of the Canadian asthma guidelines in 1999, there is still poor compliance with these guidelines by physicians[9,10]. This is also true for other studies around the world examining compliance to national guidelines[11-13]. We can only speculate the reasons for this. It may be that asthma is under diagnosed, and that patients who fit the criteria of asthma are treated as viral chest infections, without presumed need for steroids. This may also relate to physician culture and to perceptions of the value of published guidelines. As well, the degree to which hospital policy requires adherence to formal guidelines may be variable.

Table 3 Standard multiple regression for predicting length of stay in the paediatric ED

Independent variables	Standardised beta value	*P* value
Age, yrs	–0.021	0.67
Sex	–0.057	0.25
Steroids	0.048	0.32
Atrovent	0.039	0.44
Represented to ED	–0.014	0.78
Asthma severity score	0.35	<0.001

It is possible that use of this score could predict which patients are likely to require a prolonged rather than a shorter stay in the ED. This potentially has impact on use of ED resources, notably in the assignment of patients to areas with more rather than less nursing and respiratory therapy resources. Also, this data may help determine the need to develop an official ED observation ward for longer stays, with the potential of improving the efficiency of hospital resource usage in times when bed shortages are becoming more of an issue accompanied by ED overcrowding.

An important limitation to this study is the retrospective nature of sample collection and the fact that the study only covered two seasons. We do not believe that there is likely to be a significant seasonal variation related to length of stay, but a full year study would address this. Additionally, this study was conducted at a single regional centre in a largely middle-class university community. Results in other communities may be different. This study included children with established asthma, as well as children with more recently diagnosed asthma, and it would be instructive to investigate whether there are differences between these two groups of children in terms of PASS and response to therapy. Finally, retrospective reviews may not be as accurate in data retrieval as a prospective study.

In summary, this study found the PASS was a significant determinant of length of stay in an ED of a child who presents with severe asthma. It also shows that there were a low proportion of patients receiving steroids for asthma during this time period, which needs to be addressed as the guidelines clearly state that patients who present with acute asthma of moderate or higher severity should be treated with steroids. This suggests that future research in the utility of using the PASS as a triage tool would be useful in enhancing the efficiency of emergency care for children. There is also a need to understand how physician behaviour determines adherence to formal guidelines and to the actual utility of these guidelines.

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