Does discharging clinically well patients after one hour of treatment impact emergency department length of stay for asthma patients

Original article

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LEARNING POINTS

What is already known about this topic:

1. Studies suggest that assessment of asthma severity one hour after initial treatment is highly predictive of the need for admission
2. Asthma is major contributor to direct and indirect healthcare costs and resource use
3. Clear clinical pathways and admission criteria can be used to reduce the length of stay in ED and improve patient flow for children presenting with asthma

What this paper adds:

1. Discharging asthma patients who are clinically well one hour after completion of initial therapy may result in reduced emergency department length of stay and admission rate
2. Discharging patients who are clinically well one hour after completion of initial therapy is unlikely to result in an increase in ED representation

ABSTRACT

OBJECTIVE: Asthma is a major contributor to direct and indirect healthcare costs and resource use. In May 2015 the Royal Children's Hospital (RCH) amended its clinical practice guideline (CPG) for acute asthma management from discharging patients if the anticipated salbutamol requirement was 3 to 4-hourly to discharging patients who were clinically well at one hour after initial treatment. Our objective was to examine the impact of the new discharge recommendation on emergency department (ED) length of stay (LOS), rates of admission and representation.

METHODS: We retrospectively audited the case notes for children presenting with mild or moderate asthma to the RCH ED over the equivalent two-week periods in winter 2014 (pre implementation of the new guideline) and 2015 (post-implementation).

RESULTS: One hundred and five patients in 2014 and 92 patients in 2015 were included. In both years, all patients who initially presented with mild or moderate asthma either improved or stayed within the same severity classification at the one-hour assessment. For patients who became clinically well by the one-hour assessment, there was a significant reduction in admissions between 2014 and 2015 (40% vs. 10%, p = 0.001). There was also a reduction for these patients in the median LOS from 3 hours 13 minutes in 2014 to 2 hours 31 minutes in 2015 (p=0.03). In both years all patients who were moderate at one hour were admitted. There was no difference in the rate of representation or subsequent deterioration in those patients who were discharged at one hour between the two years.

CONCLUSION: Early discharge of patients who are clinically well one hour after initial therapy may be associated with a reduction in LOS and admission rate without an apparent compromise to patient safety. Further evaluation of this intervention is required to determine whether this is a true causal relationship.

Key words: healthcare utilization, guidelines, time, length of stay, emergency medicine

Word Count: 2500

INTRODUCTION

Asthma is a major contributor to healthcare costs and resource use as children with asthma frequently present to the emergency department (ED) with exacerbations of their symptoms.[1] There are also significant indirect costs to families when their child attends for an emergency visit. Approximately 10% of all Australians have asthma [2] and in Australia, asthma is a leading cause of childhood ED presentation.[3] Asthma management consumes considerable hospital resources [4] and hospital admission rates for asthma are as high as 53%.[5] It has been suggested that for children admitted to hospital with asthma, many admissions could be prevented by means of appropriate access to primary care as well as adherence to evidence based management.[6]

Optimising the ED care of patients presenting with acute asthma not only improves the quality of care for asthma patients but also reduces the impact of asthma presentations on hospital resource use. Acute asthma management often relies on repeated assessments to determine clinical progression and to estimate the likelihood of hospital admission being required. Early assessment of the severity of an exacerbation can facilitate decision making around the need for hospitalisation.[7] A recent study [5] that was aimed at improving ED flow used objective criteria to score asthma severity in children and determine the need for admission; this was based on the finding that almost 90% of patients with high scores after one hour of treatment were ultimately admitted to hospital.[5]

Similarly, another study showed that repeat assessment at one hour after initial treatment was highly predictive of the need for hospitalisation.[8]

The Royal Children's Hospital (RCH) is a major specialist children's hospital in Melbourne, Australia. The RCH ED manages approximately 75,000 children per year. The RCH Clinical Practice Guidelines (CPGs) have been developed by an experienced panel of general paediatricians and emergency physicians in conjunction with relevant subspecialists. Until 2015, the RCH asthma CPG for acute asthma management in the ED recommended that discharge be considered 'when the child's anticipated salbutamol requirement has been weaned to three to four hourly.' However, based on the above studies, the CPG was amended in May 2015 to recommend 'assessment of patients for clinical improvement one hour following initial therapy and discharge if clinically well'.

The purpose of this study was to examine the impact of the amended discharge recommendation on hospital resources and patient flow. We hypothesised that the new guideline would result in a reduced length of stay (LOS) for the relevant patients without an adverse impact on representation rates or other clinical outcomes.

METHODS

We retrospectively audited patients aged one to 18 years with acute asthma who presented to the RCH ED over a two-week period (1 June to 15 June) during the winter seasons of 2014 and 2015. Comparison was made between the two years, as the change to the RCH CPG was implemented with staff education sessions in May 2015.

Eligible patients were identified using International Classification of Diseases (ICD) codes from the ED database; these included allergic asthma, wheezing, acute upper respiratory tract infection unspecified, cough and dyspnoea. Patients were excluded if they were less than 12 months of age, if an alternative diagnosis was found or if the episode was a first presentation of asthma or viral-induced wheeze as these children often require admission for parental education. Children with co-morbidities potentially necessitating hospital admission (developmental delay, other chronic cardiac or respiratory disease, and immunosuppression) were also excluded.

The medical records for all patients who met the inclusion criteria were reviewed and data regarding patient demographics, asthma history, pre-hospital and in-hospital asthma management, timing of admission, bed request order, discharge, and representation to hospital within seven days were collected. All records were reviewed for deteriorations following initial improvement. Deteriorations were classified as either an increase in salbutamol requirement, need for oxygen or need for intravenous (IV) therapy.

Data were collected for those whose asthma exacerbation was mild or moderate; patients were classified as 'clinically well', 'mild' or 'moderate' on initial assessment (as defined in Table 1) and again one-hour post completion of initial management. All patients who were clinically well on initial assessment received bronchodilator therapy either en route or at home prior to presentation. Initial therapy included 6 or 12 puffs (depending on age) of salbutamol with or without 4 or 8 puffs of ipratropium bromide administered at 20-minute intervals over a one-hour period. This treatment protocol was the same in both years studied. For both mild and moderate asthma, initial therapy

also included administration of oral steroid. The timing of steroid administration did not change during the two study periods. However, due to a change in practise between the two years, in 2015 the recommended oral steroid dose was increased to 2 mg/kg instead of 1 mg/kg. Patients who were assessed to have a severe exacerbation at their initial assessment were excluded, as the modification in the RCH guideline was unlikely to affect them.

Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at our institution.[9] This study received ethics approval by the hospital's human research ethics committee (HREC 34200 A).

STATISTICAL METHODS

Fisher Exact Test was used to compare the proportion of patients in each year who were admitted, who deteriorated and who represented. The difference in the median LOS in ED and time to inpatient bed request was compared using the Wilcoxon signed-rank test. Stata v13.1 was used for all statistical analyses.

RESULTS

In 2014, the total number of patients presenting to RCH with asthma identified using the ICD codes was 275. Of these, there were 110 patients with mild or moderate asthma who fulfilled the inclusion criteria. Initial severity assessment and one-hour post treatment assessment data were available for 94 patients. There were an additional 11 patients who were discharged home prior to the one-hour post-treatment assessment that were included and determined to be clinically well. In 2015, 269 patients were identified with the ICD codes, of whom 97 were eligible. Initial and one-hour post treatment severity assessment data were available for 81 patients. Eleven patients who were discharged prior to the one-hour assessment were determined to be clinically well and therefore, also included.

Descriptive initial data

Table 2 shows the proportion of patients in each severity classification at the initial assessment and at their one-hour assessment. In 2014 and 2015 all patients who were initially clinically well remained clinically well at the one-hour assessment. In both years, patients who presented with a mild or moderate exacerbation all either improved or stayed within the same severity classification (i.e. none deteriorated by the one-hour assessment). However, deteriorations following the one-hour assessment occurred in 21 (20%) patients in 2014 and 13 (14%) in 2015. In 2014, all of these patients had increased salbutamol requirements and four required IV therapy. Of the four patients who required IV therapy in 2014, none were clinically well at the one-hour assessment. Of these four patients, three were initially classified as having a moderate exacerbation and one as mild. Three of these patients had improved at their one-hour assessment but received IV therapy more than 12 hours later following admission to the hospital ward. The fourth patient had not improved one hour after initial therapy and was treated with IV therapy in ED. Of the patients who needed IV

therapy, two had frequent episodic asthma with multiple previous admissions, one had frequent asthma but was from overseas so had no documented admissions, and one had infrequent episodic asthma with one previous admission. None were taking preventative (steroid) inhalers.

In 2015, of the 13 patients who deteriorated after the one-hour assessment, all had increased salbutamol requirements and none required IV therapy. Of these 13 patients, four had infrequent episodic asthma, five had frequent episodic asthma and one had persistent asthma (the asthma history was unknown for three children). Of these 13 patients, 10 had previous admissions or presentations to hospital and one patient had previously been admitted to the intensive care unit (ICU) requiring IV therapy.

Table 3 shows the baseline characteristics of the ED encounters based on their severity classification at one-hour post initial management.

Assessment of the intervention

Comparison of admission rates in patients who were clinically well at the one-hour assessment between 2014 and the post-intervention period in 2015 showed a significant reduction in admissions (40% vs. 10%, p = 0.001) (see Table 4). To assess whether this reduction in admissions was due to the change in the CPG, we examined compliance with the new CPG. In 2015, of the 40 patients who were clinically well at the one-hour assessment, 23/40 (57.5%) were discharged within three hours of initial assessment and were thus determined to have been managed as per the new CPG. The median age of these 23 patients was 2 years old (range 1- 4).

For the 23 patients who were managed as per the new CPG, the median ED LOS (from time of presentation to ED) was 2 hours 31 minutes (range: 27 minutes to 3 hours 39 minutes). In 2014, the median ED LOS for discharged patients who were clinically well at one hour was 3 hours and 13 minutes (range: 45 minutes to 13 hours 47 minutes). There was an overall reduction in median ED LOS by 42 minutes for those patients who were managed according to the new CPG in 2015 (p=0.03). Similarly, there was a significant reduction in the distribution in ED LOS (p=0.001, 95% confidence interval 0.67 to 2.61).

The rate of representation within seven days of discharge in 2014 for patients who were clinically well at the one-hour assessment was 6/57 (10.5%). Of these, three required readmission for asthma management. Of these three, two had infrequent episodic and one had frequent episodic asthma. None had previous ICU admissions. Of the 23 patients who were managed according to the new CPG in 2015, 2/23 (8.7%) represented within seven days and none required ICU admission (p=1.00). Both patients represented for reasons other than asthma and neither was subsequently admitted.

For those whose symptoms were assessed to be mild or moderate at the one-hour assessment, there was no significant difference in the admission rate in the pre and post-intervention period (table 4). For those with mild asthma at the one-hour assessment, 28/42 (65%) were admitted in 2014 and 30/41 (73%) in 2015 (p=0.48). For those with moderate asthma one hour after initial therapy, all patients were admitted to hospital in both years (5/5 in 2014 and 11/11 in 2015). There was no difference in the time taken to submit an inpatient bed request for those patients who were admitted.

DISCUSSION

The burden of asthma on hospital resources is high.[4] In Australia, asthma contributes up to 3.5% of all ED presentations in children.[3] Hospital admissions for asthma are common, with hospitalisation rates in children as high as 41% (Australian Institute of Health and Welfare, AIHW) [10], with considerable associated costs throughout the world and particularly in low and middle-income countries.[11 12 13 14] Preventing hospitalisation has been shown to significantly reduce asthma-associated costs.[15] Our study has demonstrated that a simple change to the discharge criteria for asthma can result in a 22% (42 minute) reduction in the LOS in ED for relevant patients without apparently compromising patient safety.

Reductions in ED LOS for patients and improved patient flow have multiple benefits. Whilst there is a perception that ED crowding is caused by patient arrivals to ED, it has been shown that the LOS in ED may have more of an effect. It is well established that delivery of care to patients is negatively affected by ED crowding and may even lead to delay in treatment to high acuity patients.[16] Furthermore, crowding in the ED results in prolonged ED LOS, even for patients who can ultimately be discharged. For patients with asthma, this has been shown to be due to delays in initiating asthma treatment.[17] The patient experience and satisfaction with ED care is improved with a reduced LOS.[18]

Our new RCH asthma CPG is similar to that of the National Institute of Health which bases the decision to discharge from ED on the patient's initial response to bronchodilator treatment. Inhaled salbutamol acts topically on bronchial smooth muscle and the bronchodilator effect of each administration lasts for at least four hours.[19] If the initial response is inadequate, this can be used as an indicator of poor clinical response to asthma therapy. Hence, initial response to treatment is an important predictor of admission. The change in our guideline was prompted by the study published by Kelly *et al* that demonstrated that the response to initial asthma treatment is more important than the initial assessment in predicting hospitalisation. The authors showed that for patients with moderate asthma, the initial assessment was a poor predictor of hospitalisation compared to the one-hour assessment, which identified 84% of patients requiring admission.[8] Our results support the findings of Kelly *et al*, as all patients who were assessed as having moderate symptoms at the one-hour assessment were admitted. Similarly, another prospective study by Analgi *et al* reported that asthma severity assessments at two and three hours after commencement of initial therapy (i.e. one and two hours post completion when aligned to our study) were equally good at predicting admission and significantly better predictors compared to triage assessment.[20]

Clear clinical pathways and admission criteria have been shown to reduce the LOS in ED of children with asthma.[21 22] A retrospective study of 3,688 children presenting with an exacerbation of asthma analysed ED LOS and other factors pre- and post-implementation of a modified asthma pathway.[5] It reported a reduction of 30 minutes in both ED LOS and time to inpatient bed request with implementation of a standard asthma pathway with clear admission criteria.[5]. An observational study of 854 patients, showed a significant reduction in the hospital LOS for patients managed via

an asthma pathway compared to those who were not, independent of the quality of inpatient asthma care.[23]

Our intervention not only resulted in a reduction in ED LOS but also lead to a reduction in the admission rate of those children who were clinically well at the one-hour assessment. This may be partially explained by the results of a previous study that found that the duration of observation in ED is directly related to the likelihood of hospital admission.[24] However, the lower admission rate in 2015 may also be the result of the patients in the 2015 group having milder presentations and hence a shorter LOS. The National Emergency Access Target is a directive for all Australians EDs that encourages admission, discharge or transfer of patients within four hours of presentation to ED[25] and was implemented by the National Partnership Agreement in 2012. When ED observation periods are longer, there may be a tendency to admit patients to comply with the four-hour target. With the new protocol, for patients who have a good response to initial treatment, their assessment, management, and discharge can all be achieved within the four-hour time frame, thus reducing the impetus for admission.

The limitations of our study include the retrospective method of data collection and as a result, missing data, particularly relating to asthma history. We were unable to exclude that some patients may have re-presented to a different hospital, although the chances of this are low. During the study period, the ED changed its documentation of vital signs from the 'asthma encounter' to the Victorian Children's Tool for Observation and Response ('ViCTOR') chart which did not include information about wheeze, work of breathing and mental state. This may have resulted in some variation in assessment of severity. Furthermore, the dose of prednisolone recommended in the

CPG changed from one milligram per kilogram (mg/kg) to two mg/kg, but given that our study focused on LOS and admission of patients who were clinically well at one-hour post initial therapy, it is unlikely that this change in steroid dose would have impacted these results. Another limitation is the low number of patients who were assessed as having moderate asthma. Finally, adherence to the updated CPG may not have been universal, as it had only been introduced a few weeks before the audit.

CONCLUSION

Asthma is a disease where exacerbations can be numerous and frequent. Our study has shown that the implementation of an asthma guideline recommending the earlier discharge of patients who are clinically well one hour after completion of initial therapy may be associated with a reduction in ED LOS and admission rate without an apparent increase in the ED representation rate. The change in our treatment guideline will be further audited to determine whether there is a true causal relationship and assess for potential adverse effects (readmission, severity of representation) in a larger cohort of patients.

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Table 1: taken from RCH Asthma Encounter Form (Clinical Path Part A)

MR920/A

	Clinically Well	**Mild**	**Moderate**	**Severe**
Work of breathing/accessory muscle use	None	Mild	Moderate	Severe
Mental state	Normal	Normal	Agitated/confused	Severe confusion/drowsy
Limitation of activity	None	Mild	Moderate	Severe
Ability to talk	Normal	Mild limitation	Moderate	Unable to talk
Wheeze	None	Expiratory only	Inspiratory and expiratory	Audible wheeze without stethoscope or silent chest

Table 2: Severity assessment distribution on initial assessment and one hour after initial treatment

Asthma severity	No. (%) patients at time of assessment			
	Presentation (2014)	1 hour (2014)	Presentation (2015)	1 hour (2015)
Clinically well	13 (12%)	57 (54%)	9 (10%)	40 (43%)
Mild	53 (51%)	43 (41%)	45 (49%)	41 (45%)
Moderate	39 (37%)	5 (5%)	38 (41%)	11 (12%)
Total	105	105	92	92

Table 3: Comparison between groups for each severity classification at one hour

	1 hour severity classification 2014 Vs 2015					
	Clinically well		**Mild**		**Moderate**	
	2014 (n=57)	**2015 (n=40)**	**2014 (n=43)**	**2015 (n=41)**	**2014 (n=5)**	**2015 (n=11)**
Age median (range)	5y 4 m (1-14y)	4y 5 m (1-13y)	4y 6 m (1- 14y)	3y 11 m (1-15y)	3yr 2 m (1-6y)	2yr 1m (1-4y)
Sex (% male)	40M (70%)	27M (67.5%)	31M (72%)	30M (73%)	3M (60%)	7M (64%)
Triage category: 2 3 4	 5/57 (9%) 35/57 (61%) 17/57 (30%)	 5/40 (12.5%) 20/40 (50%) 15/40 (37.5%)	 8/43 (19%) 29/43 (67%) 6/43 (14%)	 14/41 (34%) 25/41 (61%) 2/41 (5%)	 1/5 (20%) 4/5 (80%) 0/5	 7/11 (64%) 4/11 (36%) 0/11
Asthma history: Infrequent episodic Frequent episodic Persistent Unknown	 36/57 (63%) 10/57 (17.5) 1/57 (2%) 10/57 (18%)	 23/40 (57.5%) 7/40 (17.5) 1/40 (2.5%) 9/40 (23%)	 29/43 (67%) 12/43 (28%) 0/43 2/43 (5%)	 20/41 (49%) 7/41 (17%) 1/41 (2%) 13/41 (32%)	 4/5 (80%) 1/5 (20%) 0/5 0/5	 6/11 (55%) 3/11 (27%) 0/11 2/11 (18%)
Child on a preventer	27/57 (47%)	19/40 (47.5)	13/43 (30%)	8/41 (19.5%)	1/5 (20%)	1/11 (9%)
Past hospital admission or presentation: Any previous: 1 in last 12 months: >1 in last 12 months	 44/57 (77%) 18/57 (32%) 14/57 (25%)	 33/40 (82.5%) 14/40 (35%) 12/40 (30%)	 38/43 (88%) 12/43 (28%) 18/43 (42%)	 33/41 (80%) 9/41 (22%) 15/41 (37%)	 4/5 (80%) 2/5 (40%) 2/5 (40%)	 8/11 (73%) 2/11 (18%) 4/11 (36%)
Previous IV therapy	9/57 (16%)	4/40 (10%)	10/43 (23%)	6/41 (15%)	2/5 (40%)	0/11
Previous ICU admission	3/57 (5%)	3/40 (7.5%)	4/43 (9%)	3/41 (7%)	0/5	0/11
Salbutamol prior to	55/57 (96%)	38/40 (95%)	40/43 (93%)	37/41 (90%)	5/5 (100%)	11/11

arrival						(100%)
Prednisolone before arrival	24/57 (42%)	15/40 (37.5%)	17/43 (39.5%)	11/41 (27%)	2/5 (40%)	3/11 (27%)
Given 1mg/kg prednisolone as part of initial therapy	32/57 (56%)	6/40 (15%)	30/43 (70%)	9/41 (22%)	3/5 (60%)	1/11 (9%)
Given 2mg/kg prednisolone as part of initial therapy	1/57 (2%)	17/40 (42.5%)	1/43 (2%)	17/41 (41%)	0/5	7/11 (64%)
Given 3 x salbutamol 20 minutely as part of initial therapy	38/57 (67%)	19/40 (47.5%)	34/43 (79%)	39/41 (95%)	4/5 (80%)	10/11 (91%)
Given 3 x ipratropium 20 minutely as part of initial therapy	22/57 (39%)	8/40 (20%)	21/43 (49%)	23/41 (56%)	3/5 (60%)	5/11 (45%)

Table 4: Comparison of outcomes for patients in each severity classification at one hour

	n(%) 2014 vs n(%) 2015						
	Clinically Well			**Mild**		**Moderate**	
	2014 (n=57)	**2015 (n=40)**	**P**	**2014 (n=43)**	**2015 (n=41)**	**2014 (n=5)**	**2015 (n=11)**
Proportion admitted	23/57 (40.4%)	4/40 (10.0%)	0.001	28/43 (65.1%)	30/41 (73.1%)	5/5 (100%)	11/11 (100%)
Representation within 7 days	6/57 (10.5%)	5/40 (12.5%)	0.757	5/43 (11.6%)	4/41 (7.3%)	0/5 (0%)	0/11 (0%)
Representation resulting in admission	3/57 (5.3%)	3/40 (10.0%)	0.688	3/43 (6.9%)	1/41 (0%)	0/5 (0%)	0/11 (0%)
Deterioration after initial treatment	3/57 (5.3%)	1/40 (2.5%)	0.641	15/43 (34.8%)	6/41 (14.6%)	3/5 (60.0%)	6/11 (54.5%)
Deterioration requiring IV therapy	0/57 (0%)	0/40 (0%)	1.0	3/43 (6.9%)	0/41 (0%)	1/5 (20.0%)	0/11 (0%)
Median LOS in ED for patients ultimately discharged from ED (range)	3h 13m (0:44-13:47)	2h 55m (0:27-11:45)	0.098	6h 57m (3:14-21:17)	4h 46m (2:18-16:01)	All patients admitted	All patients admitted
Median LOS in	3h 12m	2h 47m	0.946	4h 27m	5h 5m	7h 10m	9h 50m

ED for admitted patients (range)	(1:15 – 13:12)	(2:16-4:04)		(1:53-17:16)	(0:37-15:33)	(3:28-9:03)	(2:53-16:04)
Median time from initial assessment to bed request for admitted patients (range)	1h 19m (-0:48-5:16)	1h 19m (0:43-2:07)	0.943	1h 45m (0:02-3:02)	1h 40m (-0:29-3:02)	1h 24m (0:30-2:44)	1h 37m (0:06-3:12)

h – hours m – minutes

Does discharging clinically well patients after one hour of treatment impact emergency department length of stay for asthma patients

Original article

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