ADVANCES

Changing the process of care and practice in acute asthma in the emergency department: experience with an asthma care map in a regional hospital

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ABSTRACT

Introduction: Despite the frequency of acute asthma in the emergency department (ED) and the availability of guidelines, significant practice variation exists. Asthma care maps (ACMs) may standardize treatment. This study examined the use of an ACM to determine its effects on patient management in a regional hospital.

Methods: Patients aged 2 to 65 years who presented to the ED with a primary diagnosis of acute asthma were enrolled in a prospective study that took place 5 months before (pre) and 5 months after (post) ACM implementation. Research assistants using a standardized questionnaire abstracted data through direct patient interviews and then followed up at 2 weeks with a standardized telephone interview.

Results: Overall, 71 pre patients and 70 post patients were enrolled. Characteristics in both groups were similar. The care map was used in 100% of the cases during the post period. The mean length of stay in the ED for the pre, compared with the post period, was similar (2 h 14 min v. 2 h 25 min; $p = 0.60$), as were admission rates (11% v. 9%; $p = 0.59$). Systemic corticosteroid use was similar (62% v. 57%; $p = 0.56$); however, the total number of β-agonists (2 v. 4 treatments; $p = 0.002$) and anticholinergics (1 v. 2 treatments; $p < 0.001$) administered in the ED was higher during the post period. Prescriptions for oral (73% v. 60%; $p = 0.15$) and inhaled (78% v. 78%; $p = 0.98$) corticosteroids at discharge remained the same. Relapse rates at follow-up were unchanged (29% v. 34%; $p = 0.52$).

Conclusion: This study provides evidence that implementation of an ACM increased acute bronchodilator use; however, prescribing preventive medications did not increase. Further research is required to evaluate other strategies to improve asthma care by emergency physicians.

Key words: asthma, corticosteroids, prevention, guidelines

RÉSUMÉ

Introduction : En dépit de la fréquence des cas d'asthme aigu qui se présentent à l'urgence et de la disponibilité de guides, les normes de pratique varient considérablement. Les plans de soins de l'asthme (PSA) peuvent normaliser le traitement. Cette étude a porté sur l'utilisation d'un PSA afin

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d'en déterminer les effets sur la prise en charge des patients dans un hôpital régional.
Méthodes : Les patients âgés de 2 à 65 ans qui se sont présentés à l'urgence et chez lesquels on a posé un diagnostic primaire d'asthme aigu ont été inscrits à une étude prospective qui s'est déroulée cinq mois avant et cinq mois après la mise en œuvre du PSA. Des adjoints de recherche utilisant un questionnaire normalisé ont résumé les données en interviewant directement les patients et ont ensuite effectué un suivi à deux semaines au moyen d'une entrevue téléphonique normalisée.
Résultats : Au total, on a inscrit 71 patients avant la mise en œuvre du PSA et 70 après celle-ci. Les caractéristiques des deux groupes étaient semblables. On a utilisé le plan de soins dans 100 % des cas au cours de la période qui a suivi la mise en œuvre. La durée moyenne du séjour à l'urgence pendant la période qui a précédé la mise en œuvre a ressemblé à celle de la période qui a suivi (2 h 14 min. c. 2 h 25 min.; $p = 0,60$), de même que les taux d'admission (11 % c. 9 %; $p = 0,59$). L'utilisation de corticostéroïdes systémiques se ressemblait (62 % c. 57 %; $p = 0,56$), mais le nombre total de traitements aux bêta-agonistes (2 traitements c. 4; $p = 0,002$) et aux anticholinergiques (1 traitement c. 2; $p < 0,001$) administrés à l'urgence a été plus élevé au cours de la période qui a suivi la mise en œuvre. Les ordonnances portant sur des corticostéroïdes oraux (73 % c. 60 %; $p = 0,15$) et inhalés (78 % c. 78 %; $p = 0,98$) au moment du congé n'ont pas changé. Les taux de rechute au suivi n'ont pas changé non plus (29 % c. 34 %; $p = 0,52$).
Conclusion : Cette étude produit des données indiquant que la mise en œuvre d'un PSA a augmenté l'utilisation de bronchodilatateurs aigus, mais on n'a pas prescrit davantage de médicaments préventifs. Une recherche plus poussée s'impose pour évaluer d'autres stratégies afin d'améliorer la prise en charge de l'asthme par les médecins d'urgence.

Introduction

Asthma is an important health problem that is characterized by intermittent exacerbations followed by variable periods of "stability." Presentation to the emergency department (ED) with acute asthma is common in Canada, as well as in the United States, where nearly 2 million ED visits occur annually for this condition.[1] Acute exacerbations of asthma are precipitated by many potential factors, with superimposed upper respiratory tract infection, environmental allergies and poor control of chronic asthma being the most common. The cost associated with treatment is significant.[2–4] In the United States, approximately $6 billion per year are spent on asthma,[2] of which 25% is for the hospital-based treatment of acute exacerbations.[4]

The classical presentation of an acute exacerbation includes worsening symptoms of dyspnea, wheeze and/or cough, and an increasing use of short acting β-agonists.[5] Attacks can be severe to the point of life threatening. Given the serious nature and high worldwide prevalence of asthma and its sequelae, it is not surprising that national and international clinical practice guidelines have been developed to direct patient management.[6–8]

Despite the availability of these guidelines there remains a "care gap" between what is known and what is practised.[9] There is often a failure to transfer new information to the clinical setting. For asthma, this may be in part due to the changing understanding of the pathophysiology and management strategies. This "care gap" may be even wider in less urban, non-teaching centres, where other priorities and time commitments may make evidence-based practice even more difficult.

Local clinical practice guidelines in the form of care maps have been shown to improve care for acute respiratory conditions such as community acquired pneumonia[10] and acute asthma.[11] The prospective study presented here was designed to evaluate the influence of an abbreviated asthma care map (ACM) on the treatment of acute asthma in a single ED site. Specifically, the study compared asthma care delivery during 2 different time periods: prior to the implementation of an ACM and immediately post implementation during active promotion. The goal of this evaluation was to determine the influence of the ACM on the process and clinical care provided in the ED.

Methods

Study setting

Patients presenting to the Lethbridge Regional Hospital Emergency Department (LRH-ED) with acute asthma were eligible for enrollment. LRH is located in Lethbridge, Alberta, a community of approximately 50 000 people, surrounded by smaller or sparsely populated, largely rural communities in the southern aspect of the province. The LRH-ED is staffed 24 hours each day by full-time emer-

gency or family physicians with an interest in emergency medicine.

Asthma care map

The ACM was developed by an interdisciplinary group of emergency physicians, emergency nurses, respiratory therapists, pulmonary specialists and pharmacists at the University of Alberta Hospital, using high-quality respiratory evidence.[12] The final care map was a 4-page form for documenting history, medications, treatment, discharge instructions, nomograms for peak expiratory flows (PEF) and nursing notes. The implementation of this ACM in a tertiary care ED was recently documented.[11] This document was then edited to a shorter version based on feedback from a multidisciplinary group at the LRH working to develop a local solution to ED asthma care. Appendix 1 is a sample copy of the ACM. While there was involvement of one ED physician in the development of the ACM, no other ED physicians or nurses were aware of the ACM until the educational interventions and disseminations during the run-in to the post period.

The interventions were approved by the LRH emergency physician group and were designed to apply to both pediatric and adult cases. The introduction of the ACM was accompanied by extensive continuing medical education sessions and feedback was returned to ED staff. Respiratory therapists were provided with training and given approval to initiate care prior to physician assessment.

Inclusion/exclusion criteria

All patients between the ages of 2 and 65 years who presented to the ED with a primary diagnosis of acute asthma (ICD-9-CM codes 493.x) were eligible. Since asthma and chronic obstructive pulmonary disease (COPD) often coexist beyond the age of 65 years,[13] we elected to restrict enrollment to a group where COPD was not a concommitment diagnostic possibility. Other exclusion criteria included patient charts where treatment was not provided in the ED (e.g., prescription renewals, very mild disease, etc.), where diagnosis was miscoded (e.g., community acquired pneumonia, COPD, etc.), where patients were transferred from other institutions and where patients were directly transferred to pulmonary/general medicine.

Data sources

A consecutive sample of patients who met inclusion criteria during the 2 time periods was enrolled. On-call nurses provided coverage between 0700 and 2400 daily and were called for each asthma patient by staff nurses and/or the treating physician. A refused, missed and other (RMO) registry was maintained. A 5-month period (November 2001–March 2002) before introducing the ACM (pre) was compared with a 5-month period (April 2002–August 2002) after the ACM implementation (post).

Data collection

Research assistants performed initial patient interviews as well as 2-week follow-up telephone interviews using a standardized questionnaire. Data were also abstracted from the patient charts by one of our trained research assistants using a standardized audit form; however, reliability was not assessed. A priori criteria were established to determine the degree of complete documentation and success of adhering to the ACM treatment guidelines. Physicians were aware of the study at the time of patient presentation in both the pre- and post-periods.

Data were collected for demographics (e.g., age and sex), severity (e.g., history of asthma, vital signs or PEF), medical history (e.g., comorbidity, duration of illness, smoking, etc.), presenting asthma description (e.g., duration, signs and symptoms), in-ED treatment (e.g., medications, route and dose), outcome (e.g., admission, time in ED, etc.) and discharge treatment (e.g., type, route and dose of medication prescribed).

Outcomes

The primary outcomes of interest for this study were the timing and appropriateness of bronchodilators, the proportion of patients to whom systemic corticosteroids were administered while in the ED, the number of prescribed systemic corticosteroids and inhaled corticosteroids at discharge, and the eventual outcomes during both of these time periods.

Sample size

Our goal was to collect 70 patients from each time period in order to be able to identify large changes in the use of evidence-based asthma management. The sample size was determined from previous research conducted here and elsewhere.[14]

Statistical analysis

Data were analyzed using the SAS, Version 8.2 statistical software program (SAS Institute Inc., Cary, NC). Categorical values are reported as counts and percentages, and continuous variables are reported as means and standard deviations (SDs) or medians and interquartile ranges (IQRs). Comparisons between periods were made using *t* tests or the Wilcoxon sign rank test, as appropriate, for continuous variables, or chi-squared or Fisher's exact tests, as appropriate, for categorical variables.

Post-hoc, an analysis was undertaken to find predictors of treatment in the ED. First univariate linear regression models were fit. Any predictor that was significant at the 0.05 level was entered into a stepwise linear regression model (p enter = 0.05, p stay = 0.10).

Ethics

This study was approved by the University of Alberta Health Research Ethics Board and the LRH Institutional Ethics Board. Informed consent was obtained from each patient for this study as per the ethics committee approval. Patient names and identifying characteristics were not kept; records remained stored in a secure area and only aggregate data are reported.

Results

Recruitment

In total, 141 patients were prospectively enrolled (71 pre and 70 post). During the pre period, 7 patients were excluded; during the post period, 6 patients were excluded (Fig. 1).

Care map use

Following official implementation, all 70 (100%) post-period charts had evidence of ACM use. Documentation greatly improved in many areas of ED charting; however, improvement in others is still required. The asthma history, medication lists and treatments were well documented and measuring the PEF over the 2 periods increased from 68% to 86% (p = 0.016).

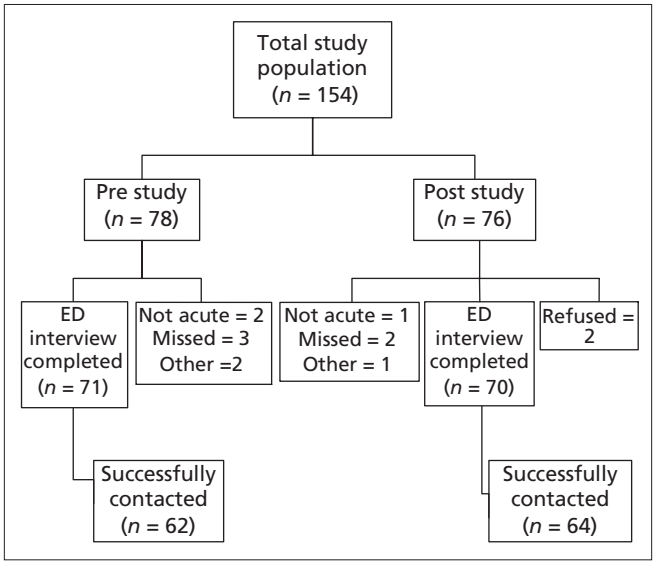

Fig. 1. Patient flow diagram for acute asthma care map study. ED = emergency department.

Patient demographics

The mean age of patients was similar between the pre- and post-study groups (20 v. 21 yr, respectively), as was female sex (59% v. 47%, respectively; p = 0.15); however, better general health was observed in the post (81% good–excellent health), compared with the pre (63% good–excellent health) period (p = 0.02). The patients in both periods were otherwise similar, with most having a seasonal asthma component (77%), more than one-quarter admitting to cigarette smoking (25%) and few reporting using asthma aides (diary 4%; peak flow monitoring 22%; action plan 22%). The majority (92%) identified a primary care physician (Table 1).

Pre-ED treatment

The use of theophylline (3% v. 1%; p = 0.99) and oral corticosteroids (13% v. 16%; p = 0.61) was rare; the use of inhaled corticosteroids was more common (79% v. 73%; p = 0.4), and β-agonist use was very common (90% v. 93%; p = 0.56) among the populations in the pre- and post-study groups, respectively. The use of these agents did not vary among the groups (Table 1). Moreover, the use of newer agents, such as long-acting β-agonists (28% v. 23%; p = 0.47) and leukotriene modifiers (15% v. 9%; p = 0.21) was not statistically different between the 2 study periods. Finally, the use of ipratropium bromide as a chronic treatment for asthma was low during both periods (Table 1). Patients presented at the same time of day (Table 2).

Asthma severity

Patients enrolled all suffered from moderate-to-severe asthma using traditional measures of severity (Table 2). The post-period patients had lower median PEF (309 L/min v. 239 L/min; p = 0.002); however, the mean pulse rate (26 beats/min v. 24 beats/min; p = 0.13) and O_2 saturation (95% v. 94.7%; p = 0.68) were similar. Most patients had self-administered 5–6 puffs of β-agonists prior to ED arrival over variable time periods.

In-ED treatments

The number of treatments with β-agonists and anticholinergics was higher in the post group, both in the first 60 minutes in the ED, as well as for the entire stay (Table 3). For example, the number of treatments in the first hour increased for β-agonists (2 v. 3; p = 0.001) and for anticholinergics (1 v. 2; p = 0.0001). Furthermore, the total number of β-agonists (2 v. 4; p = 0.003) and anticholinergics (1 v. 2; p = 0.0001) was also increased. In the post period, systemic corticosteroids were administered at the

same frequency (62% v. 57%; $p = 0.57$); however, it occurred somewhat later (< 60 min 53% v. 36%; $p = 0.11$).

Time period, demographics (age, sex) and markers of disease severity (initial PEF, number of admissions in the past 2 years, history of intubation and good health status) were considered possible predictors of the number of β-agonist and anticholinergic treatments in the ED. Older age and lower initial PEF were predictive of the number of β-agonist treatments (i.e., there was no difference between time periods after these 2 variables were accounted for). However, only time period was predictive of the number of anticholinergic treatments.

Table 1. Demographic, prevention and chronic asthma characteristics of patients and emergency department treatment, according to pre- and post-period status

	% of patients*		
Demographic factors	Pre ($n = 71$)	Post ($n = 70$)	p value
Mean age, yr (SD)	20.3 (13.4)	21.4 (12.6)	0.62
Female sex	59	47	0.15
Married	39	36	0.74
High school graduate†	86	81	0.49
Smoking status			
Current	27	24	0.46
Former	9	16	NA
Never	64	60	NA
Good–excellent general health	63	81	0.02
Primary care provider status	93	91	0.74
Asthma prevention			
Allergies	71	74	0.70
Seasonal component to asthma	78	76	0.84
Use of spacer device for β–agonist delivery	69	59	0.20
Use of asthma diary to monitor symptoms	2	6	0.37
Use of peak flow device to monitor symptoms	23	21	0.84
Asthma action plan during exacerbations	25	19	0.33
Chronic asthma factors			
Mean no. of years with asthma (SD)	10.6 (9.9)	11.5 (10.1)	0.57
Median no. of months since last admission (IQR)‡	13 (4–36)	30 (12–81)	0.04
Ever hospitalized for asthma	50	55	0.60
Ever intubated for asthma	6	14	0.10
Theophylline	3	1	0.99
Oral corticosteroids	13	16	0.61
Inhaled β-agonist during past 4 weeks	90	93	0.56
Inhaled corticosteroid during past 4 weeks	79	73	0.40
Inhaled long acting β-agonist	28	23	0.47
Inhaled ipratropium bromide	4	3	0.99
Leukotriene modifier	15	9	0.21
Other asthma medications	1	9	0.06
Median no. of months since last MD visit (IQR)	4 (1–10)	2 (1–7)	0.86
Median no. of ED visits in past 2 yr, (IQR)§	3 (0–6)	2 (0–4)	0.11
Admitted for asthma in past 2 yr	27	23	0.63
ED usual site for problem asthma care	49	53	0.67
ED usual source of asthma prescriptions	11	6	0.24

NA = not applicable; SD = standard deviation; IQR = interquartile range; ED = emergency department.
*Unless otherwise indicated.
†Patients e ducation level for patients aged 18–54 years; parent/guardian's education level for patients aged 2–17 years.
‡For patients with a previous hospitalization.
§$p \leq 0.05$.

Disposition and discharge treatments

The total time asthma patients spent in the ED did not change between the study periods (134 v. 145 minutes; $p = 0.57$). Similarly, there were no differences between the study periods in the proportion of patients admitted (11% v. 9%; $p = 0.59$), discharged with a systemic corticosteroid prescription (72% v. 60%; odds ratio [OR] 0.62 95% confidence interval [CI] 0.3–1.2; $p = 0.15$), discharged with an inhaled corticosteroids prescription (78% v. 78%; $p = 0.98$), or discharged without inhaled or systemic corticosteroids (8% v. 14%; $p = 0.28$).

Table 2. Acute asthma presentation of patients according to pre- and post-period status

Presentation	Pre ($n = 71$)	Post ($n = 70$)	p value
ED triage time, %			
0000–0759	21	21	0.70
0800–1559	30	36	NA
1600–2359	49	43	NA
Median no. of days of symptoms (IQR)	3 (1–7)	2 (1–4)	0.03
< 24 h, %	27	44	NA
> 24 h, %	73	56	NA
Median no. of inhaled β-agonist puffs within 24 h of ED (IQR)	6 (3–15)	5 (2–10)	0.08
Mean initial respiratory rate (SD)	25.7 (9.1)	23.6 (7.2)	0.13
Mean initial oxygen saturation (SD)	95.0 (3.9)	94.7 (6.1)	0.68
Mean initial PEFR (earliest peak flow) (SD)	309 (120)	239 (104)	0.002

ED = emergency department; NA = not applicable; IQR = interquartile range; SD = standard deviation; PEFR = peak expiratory flow rate.

Outcomes

Successful contact with patients by research assistants following discharge was lower than expected in both groups; however, the differences were not significant (84% v. 75%; $p = 0.5$). Compliance with treatment was similarly high between the 2 periods. Total relapse was not different between the groups (29% v. 34%; $p = 0.52$); however, there was a trend toward earlier relapses (within 48 hours) in the pre group ($p = 0.23$).

Discussion

Asthma presentations to North American EDs are common. Previous research has demonstrated that many patients receive inadequate care, often leading to unsatisfac-

Table 3. Acute asthma emergency department and post-emergency department treatment of patients, according to pre- and post-period status

Variable	Median no. of treatments (IQR)* Pre ($n = 71$)	Post ($n = 70$)	p value
ED treatment	15 (4–32)	NA	0.25
Time (min) from presentation to first PFT	NA	10 (4–21)	NA
No. inhaled β-agonists in first hour†	2 (1–2)	3 (2–4)	0.001
No. inhaled β-agonists over ED stay	2 (2–4)	4 (2–6)	0.003
Total dose of inhaled β-agonists over ED stay, mg	5 (5–10)	10 (5–15)	0.09
No. inhaled anticholinergics in first hour	1 (0–1)	2 (1–3)	0.0001
No. inhaled anticholinergics over ED stay	1 (0–1)	2 (2–4)	0.0001
Total dose inhaled anticholinergics over ED stay, mg	0.5 (0.0–0.5)	0.8 (0.5–1.0)	0.0001
Given corticosteroid treatment in ED, %	62	57	0.56
Final PEFR (absolute), mean (SD)	413 (125)	356 (133)	0.03
Change in PEFR (absolute), mean (SD)	114 (90)	113 (91)	0.94
Sent home on systemic corticosteroids, %‡	72	60	0.15
Sent home on any ICS, %‡	78	78	0.98
Sent home on prednisone + ICS, %‡	59	52	0.39
Sent home on neither prednisone nor ICS, %‡	8	14	0.28
Total ED time, mean (SD)‡	2 h 14 min (1h 17 min)	2 h 25 min (1 h 56 min)	0.60
Admitted, %	11	9	0.59

ED = emergency department; PFT = pulmonary function test; NA = not applicable; IQR = interquartile range; PEFR = peak expiratory flow rate; SD = standard deviation; ICS = inhaled corticosteroids.
*Unless otherwise indicated.
†Each nebulizer treatment was counted as equivalent to 6 "puffs" from a metered-dose inhaler.
‡Restricted to patients sent home from ED (Pre = 88.7%; Post = 91.4%).

tory outcomes.[15] Despite the development and dissemination of numerous guidelines on recommended treatment for acute asthma, care gaps remain. A major concern is the sub-optimal use of anti-inflammatory agents in the emergency setting.[15–17] This prospective before–after cohort study was initiated to examine the effect of introducing and widely advertising an ACM in a regional referral ED to improve acute asthma care. It represents one of the most comprehensive Canadian evaluations ever published.

Overall, acceptance of the ACM was high and, unlike other clinical practice guidelines, its use and adherence has been sustained since its introduction. In fact, today the ACM has largely replaced nursing notes and is used almost exclusively to document the progress of asthma patients through their ED treatment. This multidisciplinary care plan has received suggestions for feedback and updates have been accomplished; the iterative nature of the ACM must be recognized. Despite this acceptance, however, use of the discharge planning section by physicians is inconsistent and infrequent. There is room for considerable improvement in documenting discharge plans on the ACM.

In addition, the ACM resulted in an important effect on the treatment of patients in the ED in that there was an increased use of appropriate bronchodilators in a timely fashion. Systematic reviews have recommended that systemic corticosteroids should be administered early and in more patients in the ED to reduce admission to hospital.[18] We recognize that the ACM failed in one area, that is, it did not influence systemic corticosteroid use in the ED during the study period. Additional interventions appear to be required to increase physician prescription of systemic corticosteroids since only 60% of patients received such medication. Given that study patients were all moderate or severe asthmatics, almost all should have received systemic corticosteroids.

Table 4. Follow-up events, according to pre- and post-period status of patients discharged from emergency department

	% of patients		
	Pre (*n* = 62)	Post (*n* = 64)	*p* value
Contacted and agreed to follow-up	83.9	75.0	0.22
Compliance with prednisone	85.3	93.6	0.43
Relapse*			NA
Total relapse	29	34	0.52
Relapse within 48 h†	8	3	0.23

NA = not applicable.
*Urgent care visit, routine asthma visit or other visit that led to a hospital admission.
†Relapse event based on patient reporting a "worsening of asthma symptoms" that led to an urgent care visit during 48 hours or 14 days following emergency department discharge.

High-quality evidence also supports the use of systemic corticosteroids following discharge.[19] However, a trend was observed whereby more patients in the post period were discharged without receiving such treatment. Given that these agents are inexpensive, prescription filling is common and patient adherence is high, this trend is alarming. Current evidence also suggests that most patients deserve a trial of inhaled corticosteroids as well as short-course systemic corticosteroids.[20,21] Others have pointed out the lack of effectiveness of the strategy of replacing systemic with inhaled corticosteroids.[22,23] Consequently, despite the high use of inhaled corticosteroids in this physician group (78% of discharged patients in both time periods), the trend toward replacing systemic with inhaled corticosteroids is worrisome.[22] Moreover, the increased proportion of patients with treatment failure resulting in return visits was clinically important.

Despite many efforts to disseminate high-quality evidence for the care of asthmatic patients presenting to the ED, the lag in uptake of this evidence can still be demonstrated. Delays in information transfer have best been shown in cardiovascular research.[24] It is a common problem in respiratory diseases in the acute setting as well. Reasons for the lack of uptake of evidence in general, and specifically in clinical practice guidelines, are now well documented.[9,25] Evidence-based guidelines have met with considerable obstacles with almost no methods yet demonstrated to overcome these obstacles. A MEDLINE search for articles describing the impact of care map or guideline use in adults and children was generally unproductive. While some publications documented guideline use in pediatric asthma,[26] their impact has only been modestly successful. Two other studies should be mentioned. The first, a before–after study in a single, US adult ED indicated that a clinical practice guideline improved processes of care and improved care in acute asthma.[27] Our study differs in the focus of the intervention (all aspects), the setting (urban v. rural), and the influence of ED overcrowding on the results. The second was a before–after study in a single, Canadian adult ED, which indicated that a similar, albeit longer and more comprehensive, clinical practice guideline improved the processes of care and improved care in acute asthma.[11] Despite the differences between these studies and our own, both suggest that an ACM can improve process and care in the ED setting.

The seemingly modest success of the current ACM, especially in the area of anti-inflammatory agents, is surprising and does not reflect current Canadian practice profiling.[28] Despite a multifaceted approach in the development and dissemination, which conforms with current knowl-

edge about effective methods of changing practice,[29] the ACM improved process more than it improved care. Moreover, the improvements in care were observed in the areas of supportive and symptomatic care (bronchodilation, in-ED care) rather than preventive care (anti-inflammatory, discharge care). This may have been the result of increased education prior to the release of the ACM; however, efforts were made to avoid this. In this research, while we did not specifically engage physicians or nurses in a discussion regarding why some practices did not change, we did use opinion leaders and reminders as methods to change practice. Overall, we were disappointed with the failure to improve practice with anti-inflammatory agents. One observation that is germane to this discussion is that the use of inhaled corticosteroids was already higher than reported elsewhere in Canada[14,29] and interventions to improve practice are most effective where treatment adherence is low.[30]

ACM development did incorporate evidence-based approaches and resulted in input from a multi-disciplinary, "bottom-up" team including generalist and specialist clinicians. The group exercised ready acceptance of quality suggestions and sought feedback from all staff — suggestions that were reflected in the updates of the ACM form prior to its final printing. The tool is easily available throughout the ED and assists decisions and care at the bedside, and since use was high, some other component must have been missing to explain these results. Its introduction was accompanied by frequent education sessions until all ED staff were aware of its existence. Although there is still work to be done, the ongoing popularity of the ACM suggests that further improvements are possible.

Limitations

There are several possible limitations to this study. First, this study was a time series design rather than a randomized controlled trial (RCT). Therefore, we cannot rule out the possibility that clinical advances may have influenced the results over time. An RCT would be difficult and expensive to perform from one centre, and multicentred work will only be possible when ACMs are shown to uniformly change care. Second, it is also possible that data collection could be biased toward favourable results. Only one research staff member completed the ED chart review. However, this was the primary airway researcher in this centre with extensive nursing/research experience. Moreover, the main form of data collection in this study was through patient self-report. Third, while patient follow-up did occur, the duration was short (2 weeks). There is a possible longer-term benefit to better treatment in the ED, however, extending the study would have dramatically increased the cost and complexity of the study. Our goal, however, was to enhance the use of evidence-based therapies in the ED and following discharge, not to re-prove the effectiveness of this mode of treatment. Fourth, the sample size is relatively small, and the study was powered to identify large treatment effects. Finally, the study was also limited to a single centre (LRH) and the generalizability of these results in other centres awaits confirmation.

Conclusion

The development and implementation of an evidence-based, multi-disciplinary care map for acute asthma has demonstrated widespread acceptance in this community ED. An evaluation of the impact of such interventions is important in the ongoing efforts to provide optimal, timely care in busy, often overcrowded EDs. In this setting, the ACM has produced modest improvements in both documentation and in administering recommended bronchodilator treatment. As witnessed in the trends to less combination anti-inflammatory therapy after discharge, additional efforts are required to improve clinical practice guideline dissemination of preventive practices in this setting.

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See Appendix on next page

Appendix 1. Sample asthma care map from Chinook Health.

Chinook Health

Acute Asthma Treatment Protocol

ELIGIBILITY: *Age 2-55 years AND previous diagnosis of asthma*

PRESENTATION and HISTORY

Site	Time In	Date (dd/mm/yy)

HISTORY OF ACUTE EPISODE:

Onset of respiratory symptoms	Stated Severity	Cause or Trigger (specify):
_____ ❑ Hours ❑ Days ❑ Weeks	❑ Mild ❑ Moderate ❑ Severe	

Medications	Dose/Freq.	# last 24h
Ventolin (Salbutamol)		
Bricanyl (terbutaline)		
Atrovent (ipratropium)		
Combivent (salb. + ipratropium)		
Flovent (fluticasone)		
Pulmicort (budesonide)		
Qvar (beclomethasone)		
Oxeze (formoterol fumerate)		
Serevent (salmeterol)		
Advair (fluticasone + salmeterol)		

Medication Allergies

Medical History

ASTHMA MANAGEMENT AT HOME: (check all that apply)

- ❑ Does NOT use a written action plan
- ❑ Does NOT use a Peak Flow meter
- ❑ > 2 ED visits for acute asthma in the past year
- ❑ Has nocturnal cough when otherwise well
- ❑ Has asthma triggers in the home
- ❑ Smokes or is exposed to 2nd hand smoke
- ❑ Uses MDI without a spacer
- ❑ Uses Ventolin > 3x/week and does NOT use inhaled steroid

PHYSICAL EXAM

BP	Temp (route)	HR
Resp	**Height** cm / in	**Weight** kg / lb

O_2 Sat _____ ❑ RA ❑ O_2 @ ____ L/min

PEF Effort: ❑ Good ❑ Poor

PEF Result: _____ L/min

Usual best PEF: _____ L/min OR

Predicted PEF: _____ L/min see chart on page 3

Calculated % of normal PEF _____ % see calculation on page 3

Indrawing & accessory muscle use _____ ❑ none ❑ + ❑ ++

Additional findings:

ASTHMA SEVERITY DETERMINATION

circle choices

	Mild	Mod.	Severe
Respiratory Rate			
2-5 yrs	<40	40-50	>50
6-12 yrs	<30	30-40	>40
Over 12 yrs	<25	25-35	>35
Speech	normal	abbreviated	difficulty
Mental Status	normal		altered
O2 Sat. (RA)	>94%	91-94%	<91%
PEF _____% from physical exam	>85%	60-85%	<60%
	Mild	Moderate	Severe

2 or more circles in worst category determines severity.

circle choice

INITIAL TREATMENT PLAN

Time: _____

■ Oxygen if O2 sats < 94% _____ L/min via _____

■ Salbutamol neb: dose given _____ time: _____
2-12 yrs = 2.5 mg >12 yrs = 5.0 mg

■ Ipratropium: dose given _____ time: _____
2-12 yrs = 0.25 mg >12 yrs = 0.5 mg

■ Oxygen for nebs @ 5-8 L/min

■ **Contact RRT for education.** ←

❑ Contacted. Time: _____
❑ Referred to community RT

■ If severity is "mild" or "moderate", confirm asthma diagnosis with physician and continue with care plan / protocol as per MD order. RN to re-assess 20 mins after start of initial treatment.

▶■ If severity is "severe" **Notify physician IMMEDIATELY.**

FC-980-06/06

Signature _____

continued on next page

SECOND ASSESSMENT - 20 minutes after start of neb #1

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			❑ RA @ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 90% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 90% or O2 sat < 95%:

■ Salbutamol #2 (same dose) _____ mg and Ipratropium #2 (same dose) _____ mg Time given_____

❑ if O2 Sat < 94% ■ O2 _____ L/min via _____

➡ ■ **If moderate severity (from Asthma Severity Determination - page 1) give:**

❑ Prednisone or ❑ Prednisolone PO _____ mg (>12 yrs = 50 mg, under 12 yrs = 1 mg/kg) Time given_____

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

THIRD ASSESSMENT - 20 minutes after start of neb #2

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			@ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 90% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 90% or O2 sat < 95%:

■ Salbutamol #3 (same dose) _____ mg and Ipratropium #3 (same dose) _____ mg Time given _____

❑ O2 _____ L/min via _____ ❑ RA

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

FOURTH ASSESSMENT -20 minutes after start of neb #3

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			@ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 70% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 70% or O2 sat < 95%: **Continue Tx q1h and notify MD. Time contacted:** _____

■ Salbutamol #4 (same dose) _____ mg and Ipratropium #4 (same dose) _____ mg Time given _____

❑ O2 _____ L/min via _____ ❑ RA

❑ If Prednisone/Prednisolone not given earlier:

❑ Prednisone or ❑ Prednisolone PO _____ mg (>12 yrs = 50 mg, under 12 yrs = 1 mg/kg) Time given_____

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

FIFTH ASSESSMENT - one hour after start of neb #4

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			@ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 70% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 70% or O2 sat < 95%:

■ Salbutamol #5 (same dose) _____ mg and Ipratropium #5 (same dose) _____ mg Time given _____

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

SIXTH ASSESSMENT - one hour after start of neb #5

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			@ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 70% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 70% or O2 sat < 95%:

■ Salbutamol #6 (same dose) _____ mg and Ipratropium #6 (same dose) _____ mg Time given _____

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

SEVENTH ASSESSMENT - one hour after start of neb #6

Time	Peak Flow	Resp	HR	O2 Sat	Stated dyspnea	Additional Findings
	_____l/min ____ %			@ _____l/min	❑ Mild ❑ Moderate ❑ Severe	

❑ If peak flow > 70% and O2 sat > 95% AND patient shows clinical improvement -> **Contact physician re: discharge evaluation**

❑ If peak flow < 70% or O2 sat < 95%:

■ Salbutamol #7 (same dose) _____ mg and Ipratropium #7 (same dose) _____ mg Time given _____

❑ Other:

Alert physician if: HR > 140 (180 in peds), dysrhythmias, worsening O2 sats or decreasing LOC Signature:_____

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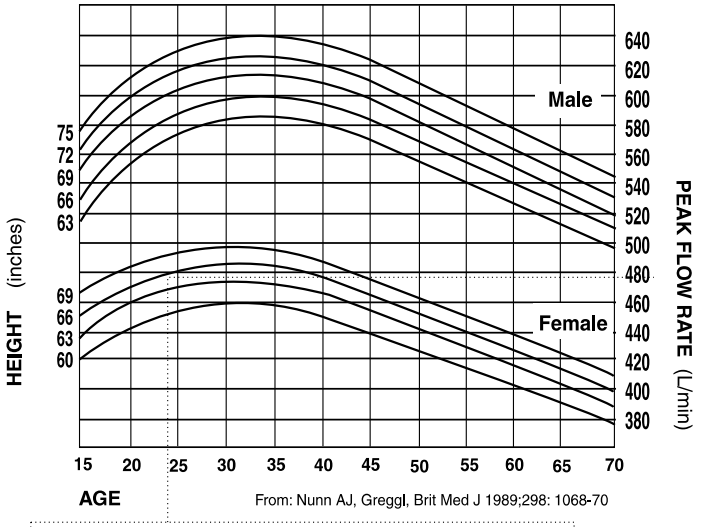
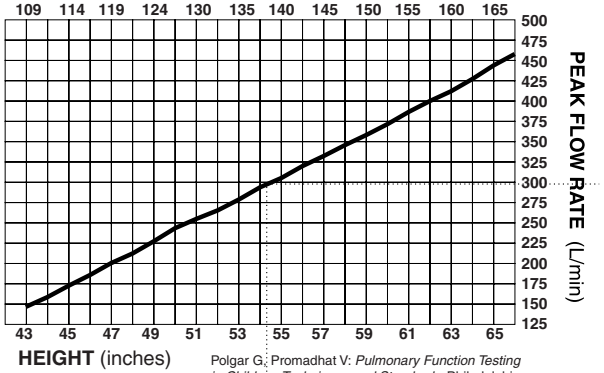
ADULTS: Normal Reference Values for PEF (ages 15-70)



From: Nunn AJ, Greggl, Brit Med J 1989;298: 1068-70

eg. a 5'5" tall female age 24 has a predicted PEF of 475 l/min

CHILDREN: Normal Reference Values for PEF (⩾ 6 yrs. old)



Polgar G, Promadhat V: *Pulmonary Function Testing in Children: Techniques and Standards.* Philadelphia, W.B. Saunders Co., 1971.

eg. a 138 cm tall child has a predicted PEF of ~300 l/min

To calculate % of normal peak flow:

either:

$$\frac{\text{Current PEF}}{\text{Usual best PEF}} = \_\_\_\_ \times 100 = \_\_\_\_ \%$$

or:

$$\frac{\text{Current PEF}}{\text{Predicted PEF (from tables)}} = \_\_\_\_ \times 100 = \_\_\_\_ \%$$

Normal breathing/pulse rates

Age	Breathing	Pulse
0 - 2 mos.	< 60 / min	< 160 / min
2 - 12 mos	< 50 / min	< 120 / min
12 - 24 mos	< 40 / min	< 110 / min
2 - 5 years	< 40 / min	< 110 / min
6 - 8 years	< 30 / min	< 110 / min
9+	< 20 / min	< 100 / min

Preparation for intubation

If MD requests setup for intubation:

1. Call RRT (if available on site)
2. Draw Ketamine 1.5 mg/kg = _____ mg
3. Draw Succinlycholine 1.5 mg/kg = _____ mg
4. Peds < 5 yr: Atropine 0.2-0.5 mg = _____ mg

in asthmatic arrests consider...

- Setup for bilat. decompression / chest tubes
- Stat portable CXR
- IV Epinepherine 0.5 mg (peds 0.02 mg/kg)

MD options for severe / near death presentations

Tests: CXR/ABG

Medication	Adult	Pediatric
Salbutamol and Ipratropium	Continuous neb x 1 hour	Continuous neb x 1 hour
Solumedrol	125mg IV	2 mg/kg IV
Heliox for nebs		
MgSO4 IV (over 20 mins)	2.0 g IV (PF < 30%)	25 mg/kg IV (PF < 50%) = _____ mg
Salbutamol IV Bolus 250 µg	250 µg: 0.25 ml of 1 mg/ml IV solution diluted to 1 ml given over 2 minutes	**Over 12 years:** 4 µg/kg = _____ µg
Drips	5 µg/min. Increase by 5 µg/min q 15 min prn	**Over 12 years:** 5 µg/min. Increase by 5 µg/min q 15 min prn **Less than 12 years:** 1 µg/kg/min = _____ µg/min.

continued on next page

Chinook Health

Acute Asthma Treatment Protocol

Time	B/P	T	P	R	Sats	Init.

Time	Ongoing assessment / treatment / response

Asthma Education Provided

Time: _____

- ❑ Asthma management at home reviewed (see page 1)
- ❑ Use of Action Plan
- ❑ Device use
- ❑ Role of medications
- ❑ Winning With Asthma booklet
- ❑ Smoking cessation
- ❑ Asthma clinic brochure

Information provided by:

_____

Comments

.....

.....

.....

REFERRALS

- ❑ Specialist: _____
- ❑ Family Physician: _____
- ❑ Online - Building Healthy Lifestyles program (asthma clinic)
  or
- ❑ Fax: (403) 317-0435
  - *Top page Outpatient / ER Treatment Record*
  - *First and last pages (ADDRESSOGRAPHED) Acute Asthma Treatment Protocol*

Referred by: _____

DISPOSITION

DISCHARGE Condition on discharge: _____ Initials

_____ Patient handout: _____

VALUABLES:

Home by _____ Safekeeping by _____

APPLIANCES / DENTURES / GLASSES / CLOTHING:

Home by _____ Safekeeping by _____

SIGNATURES

Signature	Initial

Signature	Initial

CAEP | Canadian Association of Emergency Physicians
ACMU | Association canadienne des médecins d'urgence

AWARDS 2007

President's Award

The CAEP President's Award recognizes a CAEP member who has made a significant contribution to CAEP and its members. Our second annual **President's Award** was presented to **Dr. Terry Sosnowski** from the University of Alberta. Dr. Sosnowski is Clinical Professor and Director of the Emergency Medicine Residency Program at the University of Alberta and Staff Emergency Physician and Director of Medical Education at the Royal Alexandra Hospital. He has been contributing to the advancement of emergency medicine and CAEP for thirty years, is considered one of the pioneers in the field of emergency medicine, and is one of the founding fathers of the discipline, as it currently exists in Canada. Dr. Sosnowski is very passionate about pre-hospital care and was key in the establishment of pre-hospital care standards in legislation in Alberta and standards for the accreditation of ambulance training programs at the national level.

He is a former President of CAEP (1984-85), long-standing member of the EMS Committee, now the EMS Section, Co-Chair of CAEP 2005, and reviewer for the *Canadian Journal of Emergency Medicine* (CJEM). Dr. Sosnowski was also an Editorial Board Member for the *Canadian Association of Emergency Physicians Review* from 1980 through 1986. Outside of CAEP, he has been actively involved with the Alberta Medical Association, the Canadian Medical Association, and many provincial government and local advisory committees working to improve the quality of care available to Canadians who need out of hospital and in hospital emergency care.

Resident Awards

The CAEP EM Teacher of the Year and EM Resident Leadership awards were created to recognize excellence in both resident education and resident contributions to EM residencies in Canada. Nominations, received from CAEP Resident Members and Program Directors, are evaluated and recipients selected by the CAEP Resident Section. Awards are presented at CAEP's annual conference. We are honoured to be presenting these awards to current and future leaders in emergency medicine.

The **CAEP EM Teacher of the Year Award** was presented to **Dr. Paul Parks** of the University of Alberta. Dr. Parks has established himself as an exceptional clinician as well as a leader and mentor for residents in the emergency training program at the University of Alberta. He ensures that learning and excellence in learning is a priority; both for himself and for the residents he trains. He has also made many efforts to improve resident well being, assisting in the development of the University of Alberta Emergency Medicine Resident Well Being Program: an initiative created with the goal of providing guidance and support to residents.

The **CAEP CCFP EM Resident Leadership Award** was presented to **Dr. Elizabeth Haney**, a resident in the CCFP (EM) program and chief resident at the University of Calgary. Dr. Haney completed her family medicine residency at Dalhousie University in Halifax, Nova Scotia where she was also chief resident. She was the editor of the CFPC Journal Resident page for three years. In addition to her roles in administration and editorship, Dr. Haney has maintained an involvement in community volunteer organizations, most recently with the Himalayan Health Advisory Board.

The **CAEP FRCP EM Resident Leadership Award** was presented to **Dr. Aaron Sibley**, a fourth year resident in the FRCP Emergency Medicine program and co-chief resident at the University of Alberta. Dr. Sibley is already an accomplished researcher and writer and was the recipient of a 2005 scholarship to fund an elective at NASA in Houston, Texas. He is a flight physician for STARS, medical director for an EMS system just outside of Edmonton, medical director for ACLS and ITLS courses, and teacher of ATLS. He also teaches communication and clinical skill to University of Alberta medical students. Dr. Sibley maintains community involvement by volunteering with the homeless.

NEW AWARD - Grant Innes Research Paper and Presentation

We are delighted to announce a new award this year, created in honour of Dr. Grant Innes, Founding Editor-in-Chief of the *Canadian Journal of Emergency Medicine* (CJEM). Dr. Innes retired from this role in June 2007. Since CJEM's inception in 1999, Dr. Innes had poured his heart and soul into its development and growth. He completed his tenure with CJEM after successfully having it indexed with the National Library of Medicine.

The *Grant Innes Research Paper and Presentation* will be awarded to the top ranked abstract submitted to the annual CAEP research abstract competition. The recipient of this award will have their abstract published in CJEM as the *Grant Innes Research Paper* and they will present the abstract at the research plenary at the CAEP annual conference. A plaque and a cash prize of $500 will awarded to the recipient at the plenary presentation.