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Original Article

Compliance With Asthma Guidelines and Association With Outcomes in the Emergency Department of a Tertiary Care Teaching Hospital

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Background: Despite the existence of guidelines for treating acute asthma patients in the emergency department (ED), compliance is often poor. We aimed to examine the compliance to treatment guidelines for asthma at our tertiary care teaching hospital's ED and association with re-attendance rates.
Methods: We performed a retrospective analysis of electronic patient records of patients above 16 years old who presented to our ED with a primary diagnosis of asthma over a 6 month period in 2012. Patient demographics such as age, gender, history of previous intubations and hospitalisations were reviewed, as were the treatment administered during the ED visit and on discharge. Concordance of treatment was compared with the National Asthma Education and Prevention Program's Expert Panel Report 3 (NAEPP EPR3) guidelines. Re-attendance rates to our ED within one year were then analysed.
Results: A total of 552 patients were included in the study. We found that 151 (27.4%) of patients re-attended within the year, 35 (6.3%) returned more than twice. Low compliance to the EPR3 guidelines ($p = 0.005$), age of between 41 and 60 ($p = 0.049$), previous hospitalisations for asthma ($p < 0.001$) and non-use of recommended systemic corticosteroids ($p = 0.020$) in the ED predicted a higher re-attendance rate. Follow up care and medications on discharge were not significant factors.
Conclusion: Low compliance to recommended treatment by established guidelines is associated with higher re-attendance, as are middle age and previous hospitalisations. Besides managing pressures of time and resource limitations in the ED, an increased awareness of guidelines amongst doctors will improve asthma care.

Key words: *acute asthma, emergency care, re-attendance, NAEPP EPR3*

Introduction

Asthma is frequently encountered in the emergency department (ED) and accounts for 1.8 million ED visits in the U.S. and is one of the twenty leading diagnoses that bring patients to the ED.[1] Asthma also inflicts a high socio-economic cost. In Singapore, the disease contributed to 1.2% of the total disability-adjusted life years (DALYs) lost in 2004.[2] Therefore there is a need to closely examine clinical practice and institute changes to improve healthcare delivery.

It is hence important that the Emergency Phy-

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sician be cognisant of the best evidence in treating asthma. Due to the interplay between genetic, environmental and patient factors, it can be difficult to control. Not surprisingly, re-attendance is common—up to 15% of asthma patients will return to the ED within two weeks.[3] Severity of the exacerbations, types of triggers and patients' socio-economic backgrounds and occupations are some factors that may play a part in the re-attendance rates, but suboptimal management in the ED may also be a crucial factor.[4]

Various guidelines have been drawn out internationally to distil the latest evidence in asthma care into structured guidelines that physicians can follow, either in the ED or the respiratory physician's clinic. One such guideline is the National Asthma Education and Prevention Program (NAEPP) which was developed in 1989. The Expert Panel Report 3 (EPR3) is the latest version of the guidelines published in 2007 (see Table 1 for summary of guidelines for acute exacerbations), and organises asthma care into four components: assessment and monitoring, patient education, control of factors and pharmacologic treatment.[5] The benefits of following such guidelines are lower risk of hospitalisations both in the U.S.[6] and abroad.[7] However studies overseas have shown that compliance to such guidelines is poor.[8,9]

The objectives of our study were to examine physician compliance to the EPR3 and to determine the factors related to guideline compliance associated with re-attendance in patients presenting to our tertiary care teaching hospital's ED.

Methods

We conducted a retrospective electronic chart review of all patients aged 16 and above who presented to our ED from 30 June to 31 December 2012, and who had a primary diagnosis of asthma. Our tertiary hospital is located next to Singapore's Central Business District as well as a densely populated residential area, and our department sees an average of 135,000 patients per year. ED consultation notes and treatment details were entered into a locally-developed, web-based electronic patient records system called EMERGE, with each patient identified by their unique national identity registration number.

Patients were excluded if they had a secondary diagnosis of other chronic lung conditions, heart disease, or if they were transferred from another institution or presented solely for a refill. Also excluded were those who were pregnant or under police jurisdiction.

A total of 552 consecutive patients were included. Details about their demographics, mode of arrival to ED, triage category, intervention during the visit and on discharge were extracted from the ED electronic patient records. Severity of the exacerbation was determined based on vital signs recorded as well as documentation of physical findings, according to the EPR3 guidelines. Re-attendance was defined as a repeat visit to our ED within 1 year. Asthma education referred to either oral advice or patient information leaflets that were given to patient on discharge.

There were eight components of ED care measured, as recommended by the EPR3 guidelines.

Table 1. Summary of Expert Panel Report 3 guidelines for acute exacerbations based on severity

Severity	Definitions	Recommended care
Mild	Moderate wheeze, ambulatory	Inhaled SABA by nebuliser or MDI Oral SCS if no immediate response or patient recently took oral SCS
Moderate	Speaking in phrases, loud wheeze	Inhaled SABA Oral SCS
Severe	Speaking in words, accessory muscle use, tachycardic	Inhaled SABA Oral SCS Anticholinergics Consider adjunct therapies
Life-threatening	Drowsy, confused, silent chest	Nebulised SABA and ipratropium Intravenous corticosteroids Consider adjunct therapies and mechanical ventilation

MDI: metered dose inhaler; SABA: short acting β agonists; SCS: systemic corticosteroids.

These were: at least one peak expiratory flow rate (PEFR) measured during the visit to our ED, recommended use of short acting β agonists (SABA), systemic corticosteroids (SCS) and anticholinergics (Ach), asthma education, follow up appointments as well as SABA and oral corticosteroids (OCS) on discharge. The first 4 were also analysed as part of a concordance score to determine the impact of EPR recommended interventions during the ED consultation on patient outcomes.

This cross-sectional study was approved by the SingHealth Centralised Institutional Review Board (CIRB). A waiver of consent was granted as there was no intervention involved and medical records were reviewed within the ED itself. All patient identifiers were removed before the charts were reviewed to preserve patient confidentiality. The first and fourth authors were involved in the data entry and chart review.

Statistical Methods

The demographics and clinical characteristics were compared between patients with ED re-attendances (≤ 2 ED visits, > 2 ED visits) and those who did not. Chi-squared test or Fisher exact test was used to compare categorical factors associated with frequent ED revisits where appropriate. Analysis of variance (ANOVA) was used to compare normally distributed continuous variables and Kruskal-Wallis test was used to assess the continuous variables which are not normally distributed.

We assessed the independent relationship between asthma and ED re-attendance outcomes after adjusting for the demographic and clinical characteristics documented in the previous literature. We selected the included variables in the multivariate analyses based on whether they were significant at $p < 0.1$ in the univariate analysis and used a backward step-wise procedure in the multivariate models. Data was analyzed using SPSS version 22.0. Statistical significance was set at $p < 0.05$.

Results

Of the 552 patients, 44.4% were aged 16–40 and 56.5% were female. Four hundred and eighty-six of them came to our ED by themselves rather than via public ambulances, and most presented during the day. Only a tenth of the patients were classified as a severe exacerbation; however about a fifth were triaged as the most urgent Category 1 (Table 2).

A total of 151 patients (27.4%) re-attended within the year for asthma of which only 40 returned within the month. Only a small number (n = 35) re-attended more than twice. About 15% of the study population required admissions within the year.

Not receiving the recommended therapy of SCS in ED was associated with increased re-attendance rates, as were lower compliance scores to the recommended management during the ED visit. Such patients received a median of 1 out of the 4 components of care and were more likely to have more than 2 ED visits compared with those who received at least 2 components of care (Table 3).

Factors found not to be significant were assessment of airflow limitation, providing recommended care of Ach ($p = 0.078$), asthma education ($p = 0.737$), follow up and discharge medications (Table 4). The overall level of compliance to all 4 class A evidenced treatments listed in the EPR guidelines of SABA, SCS, Ach and discharge OCS was low with only 12.5% of patients receiving all the recommended therapy.

Multivariate analysis showed that previous hospitalisations and an age of between 41–65 was significantly associated with re-attendance, after adjusting for age, gender, race and compliance score of over 4. Poor score for compliance out of 4 (i.e., first 4 levels of compliance as shown below) showed a trend towards higher rate of ED admission, though the association was not statistically significant (odds ratio [OR] =1.4; 95% confidence interval [CI] = 0.9–2.3; $p = 0.132$) (Table 5).

Discussion

In this study, we found that non-compliance to recommended treatment was associated with increased ED re-attendances, along with middle age and previous hospitalisations for asthma. Interestingly, ED treatment with SABA and Ach, asthma education as well as follow up appointments and discharge medications did not impact one year re-attendance rates.

The limitations of this study mainly lie in its retrospective nature. Patients were recruited based on their primary diagnosis listed on their electronic patient records, and hence patients presenting with upper respiratory tract infections together with an asthma exacerbation may have been missed. We were also not able to rule out patients with asthma mimics. Classification of the severity of attacks was based on

Table 2. Patient demographics

Characteristic	All patient visits[a] n = 552 (%)	No subsequent ED visit n = 401 (%)	≤ 2 ED visits n = 116 (%)	> 2 ED visits n = 35 (%)	*p*
Age groups					
16–40	245 (44.4)	183 (45.6)	51 (44.0)	11 (31.4)	0.022
41–65	199 (36.1)	131 (32.7)	52 (44.8)	16 (45.7)	
> 65	108 (19.6)	87 (21.7)	13 (11.2)	8 (22.9)	
Female	312 (56.5)	220 (54.9)	75 (64.7)	17 (48.6)	0.107
Race					
Chinese	234 (42.4)	179 (44.6)	43 (37.1)	12 (34.3)	0.645
Malay	149 (27.0)	107 (26.7)	31 (26.7)	11 (31.4)	
Indian	122 (22.1)	84 (20.9)	29 (25.0)	9 (25.7)	
Others	47 (8.5)	31 (7.7)	13 (11.2)	3 (8.6)	
Smoker status (n = 266)					
Current	105 (39.5)	69 (40.4)	26 (38.8)	10 (35.7)	0.168
Former	36 (13.5)	21 (12.3)	7 (10.4)	8 (28.6)	
Never	125 (47.0)	81 (47.4)	34 (50.7)	10 (35.7)	
Risk factors					
Previous intubation for asthma (n = 205)	24 (11.7)	10 (7.7)	10 (18.2)	4 (20.0)	0.061
Previous hospitalization for asthma	87 (15.8)	46 (11.5)	24 (20.7)	17 (48.6)	< 0.001
Time of registration					
0800–1559	221 (40.0)	162 (40.4)	42 (36.2)	17 (48.6)	0.518
1600–2359	220 (39.9)	163 (40.6)	45 (38.8)	12 (34.4)	
0000–0759	111 (20.1)	76 (19.0)	29 (25.0)	6 (17.1)	
Triage class[b]					
P1	119 (21.6)	82 (20.4)	28 (24.1)	9 (25.7)	0.770
P2	306 (55.4)	228 (56.9)	59 (50.9)	19 (54.3)	
P3	127 (23.0)	91 (22.7)	29 (25.0)	7 (20.0)	
Severity of exacerbation[c]					
Mild	271 (49.1)	199 (49.6)	54 (46.6)	18 (51.4)	0.827
Moderate	219 (39.7)	157 (39.2)	47 (40.5)	15 (42.9)	
Severe	59 (10.7)	42 (10.5)	15 (12.9)	2 (5.7)	
Life-threatening	3 (0.5)	3 (0.7)	0	0	

ED: emergency department.
[a]Unless otherwise indicated.
[b]Singapore Ministry of Health Patient Acuity Category (PAC) scale as follows: (1) P1: life-threatening; (2) P2: ill and severe distress, not life-threatening but in need of very early attention; (3) P3: ambulant, mild to moderate symptoms.
[c]Severity of asthma exacerbations: (1) Mild: moderate wheeze, ambulatory. (2) Moderate: speaking in phrases, loud wheeze. (3) Severe: speaking in words, tachycardiac. (4) Life-threatening: drowsy, confused, silent chest.

Table 3. Asthma management in the emergency department

ED management	All patient visits n = 552 (%)	No subsequent ED visit n = 401 (%)	≤ 2 ED visits n = 116 (%)	> 2 ED visits n = 35 (%)	*p*
Investigations					
At least one PEFR done	21 (3.8)	17 (4.2)	4 (3.4)	0 (0.0)	0.442
Treatment					
SABA	484 (87.7)	345 (86.0)	106 (91.4)	33 (94.3)	0.143
SCS	354 (64.1)	248 (61.8)	79 (68.1)	27 (77.1)	0.118
Ach	358 (64.9)	248 (61.8)	81 (69.8)	29 (82.9)	0.020
$MgSO_4$	27 (4.9)	13 (3.2)	11 (9.5)	3 (8.6)	0.013
Antibiotics	62 (11.2)	45 (11.2)	15 (12.9)	2 (5.7)	0.495
Intubation	3 (0.5)	2 (0.5)	1 (0.9)	0 (0.0)	0.809
Recommended care for SCS was received[a]	327 (59.2)	241 (60.1)	73 (62.9)	13 (37.1)	0.020
Recommended care for Ach was received[a]	220 (39.9)	168 (41.9)	44 (37.9)	8 (22.9)	0.078
Concordance score out of 4[b], median (IQR)	2 (1, 2)	2 (1, 2.5)	2 (1, 2)	1 (1, 2)	0.005

Ach: anticholinergics; ED: emergency department; IQR: interquartile range; $MgSO_4$: magnesium sulphate; PEFR: peak expiratory flow rate; SABA: short acting β agonist; SCS: systemic corticosteroids.
[a]Concordance score made up of ED interventions of: at least one PEFR done and recommended use of SABA, SCS and Ach.
[b]Recommended use is defined as drug administered according to Expert Panel Report (EPR) guidelines (Table 1).

Table 4. Asthma management at emergency department discharge

ED discharge	Patients discharged from ED n = 336 (%)	No ED visit n = 246 (%)	≤ 2 ED visits n = 75 (%)	> 2 ED visits n = 15 (%)	*p*
Asthma education given	179 (53.3)	134 (54.5)	38 (50.7)	7 (46.7)	0.737
Follow-up					
No follow-up	153 (45.5)	114 (46.3)	35 (46.7)	4 (26.7)	0.188
Referred GP/private specialist	72 (21.4)	51 (20.7)	19 (25.3)	2 (13.3)	
Refer hospital specialist (SOC RCCM)	111 (33.0)	81 (32.9)	21 (28.0)	9 (60.0)	
Medications					
SABA	225 (67.0)	170 (69.1)	46 (61.3)	9 (60.0)	0.384
OCS	259 (77.1)	186 (75.6)	60 (80.0)	13 (86.7)	0.486
ICS	6 (1.8)	4 (1.6)	1 (1.3)	1 (6.7)	0.339
No of times recommended care for OCS was received	163 (48.5)	123 (50.0)	35 (46.7)	5 (33.3)	0.427
All 4 level of evidence class A recommendations followed[a]	42 (12.5)	30 (12.2)	11 (14.7)	1 (6.7)	0.396

ED: emergency department; GP: general practitioner; ICS: inhaled corticosteroids; OCS: oral corticosteroids; SABA: short acting β agonists; SOC RCCM: Respiratory Outpatient Clinic.
[a]The 4 class A recommendations as listed by National Asthma Education and Prevention Program Expert Panel Report 3 (NAEPP EPR 3) are: treatment in ED with SABA, systemic corticosteroids (SCS) and anticholinergics (Ach), as well as prescribed OCS on discharge.

Table 5. Multivariate analysis of factors associated with emergency department reattendance within 1 year for asthma

Factor	OR (95% CI)	*p*
Previous hospitalization	3.0 (1.8–4.8)	< 0.001
Age group	—	0.020
16–40 years	reference	reference
41–65 years	1.5 (1–2.4)	0.048
> 65 years	0.7 (0.4–1.3)	0.277
Male gender	0.7 (0.5–1.1)	0.092
Race	—	0.480
Chinese	reference	reference
Malay	1.3 (0.8–2.1)	0.339
Indian	1.4 (0.8–2.3)	0.210
Others	1.6 (0.8–3.1)	0.217
Concordance score out of 4[a]	—	—
Poor (score ≤ 2)	1.4 (0.9–2.3)	0.132
Good (score ≥ 3)	reference	reference

OR: odds ratio; 95% CI: 95% confidence interval.
[a]Concordance out of all 4 class A evidenced treatments listed in the National Asthma Education and Prevention Program Expert Panel Report 3 (NAEPP EPR 3) guidelines: short acting β agonists (SABA), systemic corticosteroids (SCS), anticholinergics (Ach) and discharge oral corticosteroids (OCS).

the limited information that was documented in the electronic ED records. A majority of our patients return to our hospital for care even in the acute setting but our study would have left out those who re-attended to other hospitals. Moreover, the duration of the review period itself was a limitation. While the intention was to explore the longer term effects of steroids and smoking education, confounders such as suboptimal primary care and specialist follow up could not be excluded.

There are not many studies that examine the age group highest for re-attendance in asthma, but a study in two states of Australia showed that re-attendance rates to EDs for asthma are highest in the 35–64 age group[10] which is similar to our results. A possible reason for this could be that this group of patients have a higher frequency of co-morbidities, as well as family responsibilities, which have a bearing on their self-care.

Early SCS administration within an hour has been shown in many studies, including a Cochrane review, to benefit patients by reducing the need for admissions.[11,12] Poor compliance to appropriate ED use of SCS in our study patients resulted in an increase in their re-attendance, in keeping with international data. OCS on discharge, while shown in studies to be useful in reducing relapses, were not significant in our study population.

Apart from these, it was noted during the chart review process that documentation about patients' history of presenting complaints and physical examination was less than satisfactory. Smoking history was only obtained in 266 of the 552 patients while a history of previous intubations of asthma, listed as a marker for increased risk of death in all the major guidelines, was only asked in 37.1% of the time. Important signs of respiratory effort such as use of accessory muscles were documented in about a third of the patients.

Poor compliance to treatment recommendations is not a new problem. Even in large facilities and tertiary care teaching hospitals, compliance to recommended SCS use was found to be 64%[6] and overall compliance to guidelines, less than 70%.[7] A detailed survey of 231 physicians across the U.S. conducted by the New England Healthcare Institute showed that limited relevance to local practice and the tendency of physicians to make decisions based on personal experience rather than evidence based guidelines in an environment that provides limited feedback were factors affecting physician compliance to clinical practice guidelines.[13] A smaller study looking at primary care doctors and paediatricians in Saudi Arabia listed lack of awareness as the top barrier to complying with the national asthma protocol.[14]

Some of the solutions that have been suggested include utilising information technology (IT) to improve access to guidelines, making guidelines succinct and user-friendly and training physicians to re-orientate their practice towards guidelines. Evidence-based, department-specific protocols can be used to help streamline the care in the ED. These protocols can be printed on reminder cards and placed in prominent areas of the department. However, online versions of reminder cards integrated with electronic decision support systems have resulted in improvements in documentation and better discharge management.[15] Such standardised protocols may also help identify areas of care that are lacking as part of quality improvement.[16]

Unsurprisingly, passive approaches to disseminating information and protocols are usually not effective. The use of evidence-based implementation strategies to implement guidelines has been shown to increase compliance with specific intervention, often by addressing specific barriers to change. An example is a five stage framework which includes having a clear proposal, identifying obstacles to change and monitoring progress with implementation.[17]

Based on the preliminary results of this study, our department introduced a standardised protocol for all patients presenting with asthma that helps physicians categorise patients by the severity of their exacerbation and thus initiate the appropriate treatment early.

Conclusion

A lack of physician compliance to evidence-based guidelines, age 41–65 and previous admissions are associated with increased re-attendances to ED in asthma patients. Besides patient factors, physician behavior plays a part in improving the care to patients and ensuring that they receive evidence-based treatment in the ED.

Conflicts of Interest Statement

The authors declare that there was no conflict of interest during the conduct of this study.

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Author Contribution

Marcus Eng Hock Ong and Mariko Siyue Koh were responsible for the design and concept. Andy Jun Wei Wong and Sherman Wei Qiang Lian performed the data entry and chart review analysis, together with Stephanie Fook-Chung. Jing Jing Chan wrote the final manuscript.

Ethics and Consent

Approval for this study was given by the SingHealth Centralised Institutional Review Board (CIRB), and a waiver of consent was obtained.

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