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Research Article

A Retrospective Study on Clinical Outcomes of the Asthma and COPD Clinical Pathway in the Management of Asthma Exacerbations in the Emergency and Trauma Department of Hospital Kuala Lumpur

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Abstract

Background: Implementation of asthma clinical pathways has been found to reduce the length of stay (LOS), improve outcomes, and minimize the burden on emergency departments (ED). The ED of Hospital Kuala Lumpur receives about 50 - 70 patients with asthma exacerbations daily. The Asthma and Chronic Obstructive Pulmonary Disease (COPD) Clinical Pathway (ACCP) was introduced in 2015 to optimize the management of asthma and COPD.

Objective: To assess the clinical outcomes of ACCP for management of asthma exacerbations.

Methodology: We retrospectively reviewed the case notes of patients with asthma exacerbations, aged 5 - 65 years, who received treatment before (July 2015-October 2015; pre-pathway) and after (October 2015-January 2016; post-pathway) the implementation of ACCP in the ED of Hospital Kuala Lumpur. The primary endpoints were rate of referral from ED to follow-up centers, and rate of return visits to ED within 72 hours, before and after implementation of ACCP. Secondary endpoints included LOS, hospitalization rate, and use of systemic corticosteroids/bronchodilator therapy, before and after implementation of ACCP.

Results: Of the 1083 asthma case notes screened, 800 were considered for the study (pre-pathway: 46.3%, post-pathway: 53.7%). A significantly higher percentage of patients were given proper referral upon discharge in the post vs. pre-pathway groups (24.7% vs. 11.9%; $p = 0.001$). There was no significant difference in the rate of return visits, hospitalization rate, LOS, or frequency of bronchodilator use between the two groups. Use of systemic corticosteroids was significantly higher in the post- vs. pre-pathway groups (37.2% vs. 17.8%; $p < 0.05$).

Conclusion: Implementation of ACCP in the ED of Hospital Kuala Lumpur for management of asthma exacerbations may enhance the rate of referral and rate of administration of corticosteroids in asthma cubicles. Use of educational interventions in future may help further improvise the impact of ACCP for the management of asthma exacerbations.

Keywords: *Asthma; Clinical Pathways; Emergency Department; Malaysia*

Introduction

Asthma is one of the most common chronic respiratory diseases, associated with high morbidity and mortality [1-3] and an alarmingly increasing worldwide prevalence rate [1]. The burden of asthma in Malaysia is comparable to global trends. According to the National

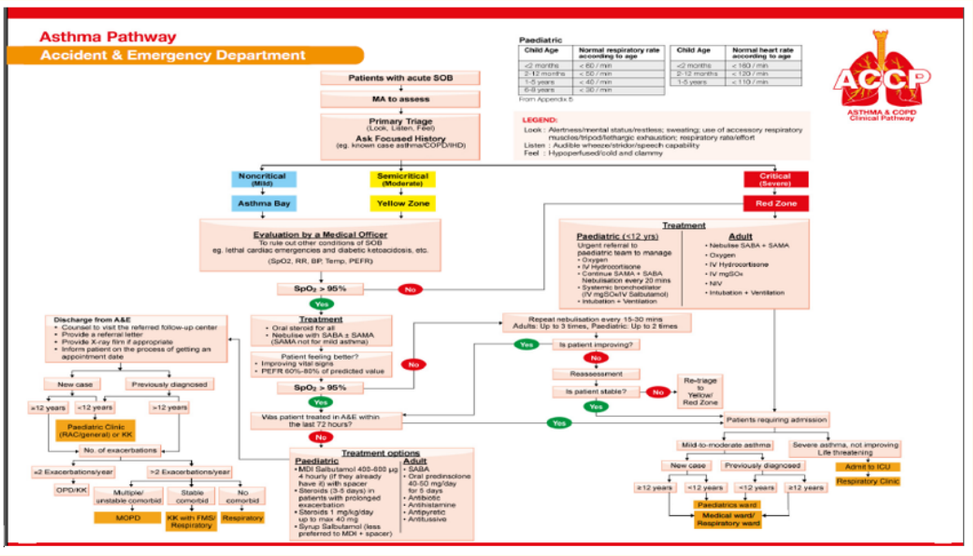
Health and Morbidity Survey (NHMS III) (updated till 2004), the overall prevalence of asthma in adults in Malaysia was noted to be 4.5%, with about 25.8% presenting with persistent asthma. In this survey, about 74.2% of patients with asthma exacerbations were noted to have attacks at least 1-3 times a year and 17.8% about 4-12 times a year. Close to 20% of asthmatics visited the emergency department (ED), of whom 22.8% visited the ED at least twice a year and more than 22% visited the ED more than thrice a year [4]. According to the NHMS IV in 2011, the overall prevalence of asthma had increased by 50% compared to NHMS II in 1996 [5]. Studies such as the Asthma Insight and Management (AIM) survey, conducted in 2013 in Asia-Pacific countries, including Malaysia, have also reported a high burden of asthma in Malaysia [6]. The results of the AIM survey in Malaysia revealed that - [1] about 22% and 24% of respondents reported daily daytime and night-time asthma symptoms, respectively; [2] 39% and 35% of asthmatics reported daytime and night-time asthma symptoms 1-2 times a week, respectively; and [3] 32% of asthmatics reported asthma exacerbations [6].

Asthma exacerbations not only impact the morbidity of the patient, but they also account for a considerable burden on healthcare services and healthcare expenditure [7,8]. Patients with asthma exacerbations seek treatment mostly in the ED [9,10]. In the Asia-Pacific AIM survey, about 40% of respondents from Malaysia visited the ED or made an unscheduled ED visit during an acute exacerbation of asthma symptoms [11].

Care plans such as personal asthma action plans (PAAPs) have been formulated to facilitate asthma patients to self-manage their symptoms after receiving treatment at a healthcare facility, thereby minimizing the number of ED visits and reducing the burden on the ED. Although PAAPs have proven efficacy in reducing asthma-related symptoms, exacerbations, and morbidity [12,13], one of the biggest roadblocks is the low level of patient' adherence (50%) to the instructions given in the action plan. This may be attributed to a lack of education of patients, difficulty in interpretation of the information in the action plan and limited interaction with treating physicians and clinical staff [12,14,15]. Another limitation in the use of care plans may be the lack of adherence to these plans by the clinicians due to: [1] lack of a clear dissemination plan of the protocol; [2] lack of an implementation strategy; [3] recommendations unsuitable to the characteristics of some patients; [4] lack of awareness about and familiarity with recommendations in the protocol; and [5] disagreement with certain recommendations [16].

Clinical pathways have been introduced to help bridge the gaps between action plans and clinical practice. Clinical pathways can be defined as systematic approaches that provide detailed, essential steps to healthcare professionals for managing specific problems [17,18]. Implementation of asthma care clinical pathway in the ED has been found to be associated with decreased variation/uncertainty in patient care; increased clinicians' knowledge of best practices; improved clinicians' adherence to asthma guidelines; reduced wheezing; reduced administration of relievers; fewer hospital admissions; decreased length of hospital stay; reduced return ED visits; and increase in the use of oral steroids, pulse oximetry and peak expiratory flow rate [19-30]. Thus, the use of asthma clinical pathways in the ED can lead to better patient outcomes and minimize the burden on ED healthcare professionals.

The ED of Hospital Kuala Lumpur receives about 50 - 70 patients with mild-to-moderate exacerbations of asthma daily, contributing to a significant burden and overcrowding of the ED. The Asthma and Chronic Obstructive Pulmonary Disease (COPD) Clinical Pathway (ACCP) was introduced in 2015 to optimize the utilization of resources for treating patients with asthma and COPD, to ensure better clinical outcomes (Appendix A). We conducted this retrospective study in the ED of Hospital Kuala Lumpur to assess the clinical outcomes of ACCP for the management of exacerbations of asthma. We also compared the clinical outcomes before and after the implementation of ACCP. We hypothesized a plausible improvement in clinical outcomes after the implementation of this pathway.



Appendix A: *The asthma and chronic obstructive pulmonary disease clinical pathway at the emergency and trauma department of Hospital Kuala Lumpur.*

Methods

Study design/settings

This was a single-centre, retrospective study that involved the review of case notes of patients with acute exacerbations of asthma who received treatment before and after the implementation of ACCP in the Emergency and Trauma Department of Hospital Kuala Lumpur. This study was registered with the National Medical Research Register and received approval from the Ministry of Health Medical Research Ethics Committee.

The retrospective review of case notes was limited to six months (3 July 2015 to 2 January 2016). The historical control group included data retrieved from the case notes dated from 3 July 2015 until 2 October 2015, prior to the implementation of ACCP (pre-pathway group). The ACCP was officially launched at the hospital level in Hospital Kuala Lumpur on 3 October 2015. The post-implementation cohort consisted of data retrieved from case notes dated from 4 October 2015 until 2 January 2016 (post-pathway group).

Patient population

The case notes of patients were selected based on the following inclusion criteria: [1] age 5-65 years; [2] established bronchial asthma; and [3] exacerbation of asthma with mild-to-moderate severity with or without return visit to the ED of Hospital Kuala Lumpur within 72 from the date of visit. The severity of asthma exacerbation was categorised as mild, moderate or severe based on clinical parameters such as respiratory rate, pulse rate, and pulse oximetry, as per the GINA executive summary 2007.

Pregnant women and patients with severe asthma exacerbations; acute bronchiolitis; respiratory distress requiring ventilation support; or underlying congenital heart disease, pulmonary hypertension, tuberculosis, heart failure, or chronic kidney disease were excluded from the analysis.

Outcomes

The primary outcomes of the analysis were: [1] the rate of referral from the ED after acute asthma care to follow-up centers (healthcare clinics, outpatient departments, and physician clinics); and [2] the rate of return visits to the ED within 72 hours, before and after the implementation of ACCP. The secondary outcomes were to compare the following before vs. after the implementation of ACCP: [1] LOS; [2] hospitalization rate; [3] use of systemic corticosteroids; and [4] frequency of administration of bronchodilator therapy during the management of asthma exacerbations.

Statistical analysis

A comparison of the clinical outcomes before and after the implementation of ACCP was done. Continuous measures were calculated using mean/standard deviations or median/interquartile ranges (when distribution was not normal). For the primary and secondary outcomes, univariate logistic regression models were used to examine whether the odds of outcomes differed in the groups using generalized estimating equations. For all analyses, p-value < 0.05 was considered statistically significant.

The sample size was calculated using the following formula

$$n = p(1-p)\left(\frac{z_{1-\alpha/2} + z_{1-\beta}}{p - p_0}\right)^2$$

Where, n is sample size; p0 is the comparison value = 0.45; α is Type I error = 5%; β is Type II error; 1- β is power = 80%.

The calculated sample was 776 and rounded to 800.

Results

Baseline characteristics

A total of 1083 asthma case notes were separated from the general medical case notes in the Emergency and Trauma Department of Hospital Kuala Lumpur. About 800 case notes, fulfilling the set eligibility criteria were considered for the study. The asthma case notes were divided into the pre-pathway group, dated from 3 July 2015 to 2 October 2015 (46.3%) and the post-pathway group, dated from 3 October 2015 until 2 January 2016 (53.7%).

The baseline characteristics of the study population are presented in table 1. Overall, the baseline characteristics between the pre-pathway and post-pathway groups were comparable and no significant differences were noted in terms of age, gender, race, and comorbidities between the groups ($p > 0.05$). The mean age of the patients in the pre- and post-pathway groups was 33.1 ± 16.79 and 32.6 ± 17.3 years, respectively.

Characteristics	Pre-pathway; n (%)	Post-pathway; n (%)
Gender		
Male	193 (52.2)	196 (45.6)
Female	177 (47.8)	234 (54.4)
Race		
Chinese	10 (2.7)	7 (1.6)
Indian	71 (19.2)	79 (18.4)
Malay	279 (75.4)	333 (77.4)
Others	10 (2.7)	11 (2.6)
Hypertension	28 (7.6)	21 (4.9)
Diabetes mellitus	23 (6.2)	15 (3.5)
Cardiac disease	1 (0.3)	0 (0.0)
Renal disease	1 (0.3)	1 (0.2)
Dyslipidemia	22 (5.9)	17 (4.0)
Obesity	1 (0.3)	0 (0.0)
Atopy	1 (0.3)	0 (0.0)

Table 1: *Baseline characteristics of study population.*

Clinical Characteristics

Most patients (99.9%) with acute asthma exacerbation had a stable general condition that enabled them to walk on their own to the asthma bay. Wheezing was observed in 27 (7.3%) patients in the pre-pathway group and 38 (8.8%) patients in the post-pathway group, with no significant between-group differences ($p > 0.05$).

For the clinical assessment, the respiratory rate was categorized into mild, moderate, or severe. Two hundred and ninety-five (79.7%) and 347 (80.7%) patients from the pre-pathway and post-pathway groups, respectively, had a normal respiratory rate (mild). There were 68 (18.4%) and 79 (18.4%) patients in the pre- and post-pathway groups, respectively, with moderately increased respiratory rate (less than 25 breaths/min). About seven (1.9%) patients from the pre-pathway group and four (0.9%) patients from the post-pathway group, had a severe respiratory rate (> 25 breaths/min). Most of the patients (769 [96.1%]) had a measured pulse oximetry value (SPO2) > 95%. We found that there were more patients with an SPO2 value < 95% in the post-pathway group (20 [4.7%] vs. 7 [1.9%] in the pre-pathway group), with no significant between-group differences. Only three (0.4%) patients (one in pre- and two in post-pathway group) had their peak expiratory flow rate (PEFR) measured in the ED. Overall, there were 624 (78%) patients with mild asthma exacerbations and 146 (18.2%) patients with moderate asthma exacerbations (Table 2).

Severity of exacerbations	Number of patients (%)		p-value
	Pre-pathway	Post-pathway	
Mild	300 (81.1)	324 (75.3)	0.034
Moderate	60 (16.2)	86 (20.0)	
Not available	10 (2.7)	20 (4.7)	

Table 2: *Categorization of patients based on the severity of asthma exacerbations.*

Prior medication use

There was no significant difference between both groups in terms of previous use of inhaled, short-acting β2-agonist (SABA) (314 [84.9%] vs. 361 [78.5%], p = 0.21). However, the pre-pathway group had significantly more patients on prior inhaled corticosteroids compared to the post-pathway group (MDI Budesonide - 82[22.2%] and 91 [21.2%], respectively; MDI Flixotide - 17 [4.6%] and 7 [1.6], respectively; p = 0.047). Further, there was no significant difference between the two groups in terms of previous use of combination inhalers (Appendix B).

Type of medication/combination	Number of patients (%)		Total Number (%)	P value
	Pre-pathway	Post-pathway		
Short acting **β**-2 Agonist (SABA)	361(84.0%)	314(84.9%)	675(84.4%)	0.77
Inhaled Corticosteroid (ICS) + SABA	100(23.3%)	98(26.5%)	198(24.8%)	0.32
ICS + Long acting **β**-2 Agonist (LABA)	0(0.0%)	2(0.5%)	2(0.3%)	0.21
Short acting Muscarinic Antagonist (SAMA) + SABA	9(2.1%)	7(1.9%)	16(2.0%)	0.99
Not on any medication	68(15.8%)	55(14.9%)	123(15.4%)	0.77

Appendix B: *Types of combination of inhalers.*

Primary outcomes

Rate of referrals

Overall, only 150 (18.8%) patients were discharged with proper referral letters to a primary care physician or specialist. Significantly more patients were given a proper referral letter upon discharge in the post- vs. pre-pathway group (106 [24.7%] vs. 44 [11.9%], respectively; p = 0.001) (Table 3). Furthermore, significantly more patients were referred to the outpatient department in the post- vs. pre-pathway group (53 [12.3%] vs. 17 [4.6%]; p < 0.05) (Figure 1).

Type of disposition	Number of patients (%)		p-value
Discharge with referral	44 (11.9)	106 (24.7)	0.001
Discharge without referral	314 (84.9)	308 (71.6)	
Discharge against advice	1 (0.3)	2 (0.5)	

Table 3: *Types of disposition.*

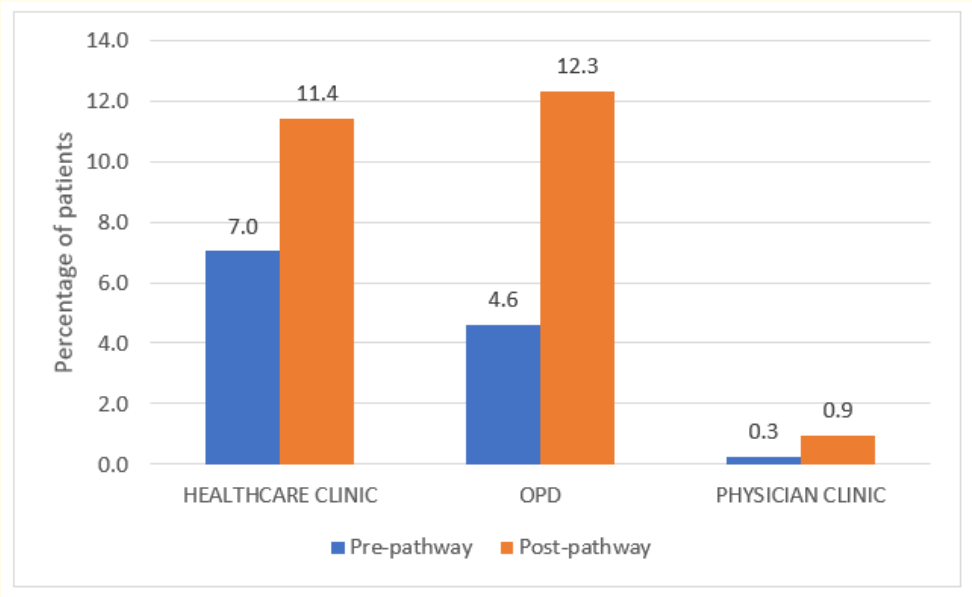


Figure 1: *Destination of referrals.*

Rate of return visits to the ED

We found that there was no significant difference in the rate of return visits between the pre- and post-pathway groups (n = 14 [3.7] vs. 12 [2.79] in the pre- vs. post-pathway groups respectively; p = 0.43).

Secondary outcomes

Hospitalization rate

Eleven (3.0) and 14 (3.3%) patients in the pre- and post-pathway group, respectively, were hospitalized and the difference was not significant (p = 0.001). The indications for hospitalization are listed in table 4.

Indications	Number of patients (%)	
	Pre pathway	Post pathway
Discharged from ward within 24 hours	0 (0.0)	2 (0.4)
Return visit within 24 hours	1 (0.3)	1 (0.2)
Moderate-to–severe asthma exacerbation	10 (2.7)	9 (2.1)
Respiratory distress	0 (0.0)	2 (0.5)

Table 4: *Indications for hospitalization.*

LOS

The mean LOS in the ED in the pre-pathway group was 36 minutes, while it was 54 minutes in the post-pathway group, with no significant between-group differences (p = 0.43).

Use of systemic corticosteroid/bronchodilator therapy

Administration of systemic corticosteroids was significantly increased in the post-pathway group (160 [37.2%] vs. 66 [17.8%] in the pre-pathway group; p < 0.05). The preferred route of administration of systemic corticosteroid was by intravenous (IV) injection. Only one patient (0.23%) from the post-pathway group was given oral corticosteroid in the ED (Figure 2).

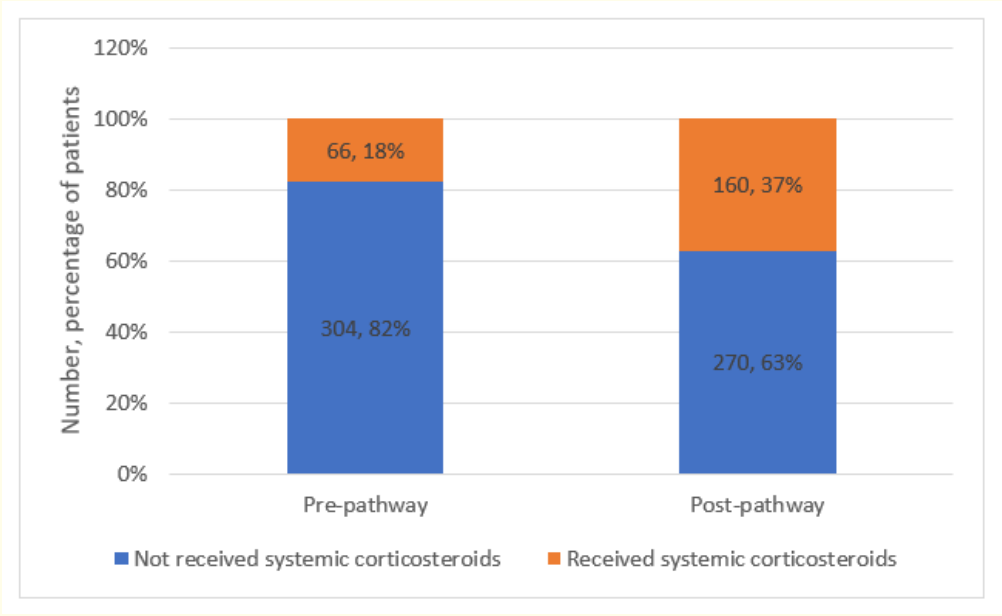


Figure 2: *Systemic corticosteroid administration.*

All patients were given bronchodilator therapy in the form of oxygen-driven hand-held nebulizer in the asthma cubicles. No significant difference was observed in the frequency of nebulization given to both groups (p = 0.085).

Medications at discharge

Prednisolone tablets were prescribed to 357 (96.5%) patients in the pre-pathway group and 405 (94.2%) in the post-pathway group; with no significant difference between the groups (p > 0.05). Salbutamol tablets were prescribed to 327 (88.4%) and 368 (85.6%) patients in the pre-pathway and post-pathway groups respectively, with no significant between-group differences (p > 0.05).

Discussion

Exacerbation of symptoms is a leading cause of hospitalization in asthma patients. In this retrospective study, we aimed at evaluating the clinical outcomes of patients presenting with asthma exacerbations to the ED, before and after the implementation of ACCP pathway.

The mean age of the pre- and post-pathway groups in our study was 33.1 ± 16.79 and 32.6 ± 17.3 years, respectively. This is justified as bronchial asthma affects patients at a younger age as compared with COPD [31,32]. About 78% (n = 624) of the patients in our study had mild exacerbations: A majority of these were in the pre-pathway group (81.1%, n = 300; p = 0.034). We believe that this variation could be attributed to the difference in seasons of the year of data collection.

Guidelines for the management of asthma recommend pulse oximetry and PEFR as fundamental elements of evaluation of acute asthma exacerbations in the ED. [32-34] However, we observed that only three (0.4%) patients in our study had their PEFR measured. This clearly reflects a lack of awareness among healthcare professionals in the ED. Also, as PEFR measurement requires more time by the clinician, this may illustrate, in part, the complexity in the implementation of PEFR measurement. However, educating and training on the importance of PEFR could encourage healthcare staff to measure this parameter in all patients with asthma exacerbation symptoms. Studies have shown that educating healthcare staff on PEFR meter use may result in a significant increase in the rate of its utility [19,20,35,36].

There was a significant increase in the primary outcome of rates of referral in the post-pathway group in our study. In a multicentric, non-randomized, pre-post intervention study by Lougheed., et al. implementation of a standardized ED asthma care pathway was associated with a significant increase in referrals [27]. In our study, despite the increase in the referrals after implementation of ACCP, the total number of patients being referred was low (18.8%; n = 150). This can be attributed to inadequate awareness of referral among healthcare personnel, and lack of adequate staff in the ED-resulting in non-awareness among newcomers. Additionally, it reflects the need of adequate time for the staff to get familiarised with the new asthma care pathway. We suggest that establishing an ED asthma team comprising of an education committee and a treatment-monitoring committee will help in establishing the importance of care pathways amongst clinicians, periodically evaluating treatment adherence, enforcing an asthma action plan, and ensuring the compulsory release of referral letters at discharge. Involvement of a primary care representative as well as establishing a dedicated medical/primary care clinic for asthma can also be beneficial in this regard.

Implementation of the ACCP pathway in our study did not have an impact on the rate of return visits to the ED. Views in the literature are mixed regarding this clinical outcome. While some studies have reported a significant reduction in the rate of return visits to the ED after the implementation of asthma care pathway [22,37,38], no change was reported in the rate of return visits to the ED before versus after implementation of asthma care pathway in some other studies [24,27,39].

In this study, no significant difference was found in the rate of hospitalization between the two groups. Our findings are in line with most other studies reported in the literature, [19,39] though few studies have reported fewer hospital admissions after the implementation of asthma care pathway in the ED [25,28].

Studies have shown that asthma care pathways significantly reduce the LOS. Emond., et al. and Johnson., et al. in their studies assessed the impact of asthma care pathways on patient outcomes in the ED and revealed that the LOS decreased by 58 min and 13 hours, respectively following the implementation of a pathway vs. before pathway implementation [20,40]. In a study by Wazeka., et al. the LOS drastically reduced to 2.7 days from 4.2 days after the enforcement of clinical pathways for asthma management [41]. In another recent study, the average LOS was 26 hours lower in patients admitted for severe asthma exacerbations after versus before the implementation of the asthma care pathway [29]. We were unable to perform a statistical test on the LOS in our ED due to a lack of data-mainly because of failure to capture the time of discharge from the ED.

This study confirmed our hypothesis that the implementation of the ACCP pathway for the management of acute asthma exacerbations increases the rate of corticosteroid administration. A significant increase in the rate of IV corticosteroid administration was seen in the post-pathway group (37.2% vs. 17.8% in pre-pathway group). Similar findings have been reported in other studies [25,27]. In a Cochrane database systematic review of 12 randomized controlled trials involving 863 patients, it was reported that administration of systemic corticosteroids to patients with asthma within an hour of presentation to the ED leads to a significant reduction in readmission rates

[42]. Similarly, in an evidence-based evaluation of studies that administered corticosteroid therapy for acute asthma patients in the ED, a 34% reduction in admission rate was reported in patients receiving IV corticosteroids [43]. In another study conducted among 97 acutely ill asthma patients who were administered corticosteroids at presentation to the ED, it was observed that the hospitalization rate was significantly lower (19%) in the corticosteroid group compared to the control group not receiving corticosteroid therapy (47%) [44]. In a study that examined the benefits of nurse-initiated administration of corticosteroids in the ED, it was found that the hospital admissions rate was significantly reduced among children receiving steroids at triage [45]. However, in our study, we could not establish any significant association between increase in corticosteroid use and reduction in hospitalization rates or return visits to the ED. But, considering the findings from the literature, we propose that the administration of systemic corticosteroids can be listed as an important task to be carried out by healthcare providers for the management of acute exacerbations of asthma in the ED.

We found that the implementation of ACCP did not have any impact on the frequency of bronchodilator therapy or the use of combination bronchodilator therapy. However, in the literature, it has been reported that the implementation of a clinical pathway in an in-patient setting result in the reduction of β-agonist medication administration [33]. To date, there is no available literature that reveals a reduction in the frequency of bronchodilator therapy after the introduction of an asthma care pathway in the ED.

Due to the retrospective nature, a major limitation of our study was the lack of availability of complete data in relation to certain key components. Although the rate of referrals was better post-ACCP, we are unsure whether the patients who received these referral letters missed or turned up for a follow-up. As this was a single-centre study conducted in a tertiary healthcare center, the findings cannot be extrapolated to other clinical settings. Information about ACCP may not have been well circulated to all healthcare providers; this resulted in a lack of awareness and low acceptance of ACCP-leading to its underutilization. Reinforcement and educating personnel about the benefits of ACCP could have improved adherence to the care plan.

Conclusion

In conclusion, the implementation of ACCP in the ED of Hospital Kuala Lumpur for the management of acute asthma exacerbation was found to enhance the rate of referral to other healthcare centers and the rate of administration of corticosteroids in the asthma cubicles. If educational interventions are widely conducted, a better impact of ACCP can be observed.

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Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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Bibliography

1. GBD Chronic Respiratory Disease Collaborators. "Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015". *The Lancet Respiratory Medicine* 5 (2017): 691-706.

2. GBD 2017 DALYs and HALE collaborators. "Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Study 2017". *Lancet* 392.10159 (2018): 1859-1922.

3. GBD 2017 causes of death collaborators. "Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: A systematic analysis for the Global Burden of Disease Study 2017". *Lancet* 392 (2018): 1736-1788.

4. The Third National Health and Morbidity Survey (NHMS III) 2006, Asthma. Institute for Public Health (PIH) (2008).

5. National Health and Morbidity Survey (2011).

6. Thompson PJ., *et al.* "Insights, attitudes and perceptions about asthma and its treatment: Findings from a multinational survey of patients from 8 Asia-Pacific countries and Hong Kong". *Respirology* 18 (2013): 957-967.

7. Chastek B., *et al.* "Economic burden of illness among patients with severe asthma in a managed care setting". *Journal of Managed Care and Specialty Pharmacy* 22.7 (2016): 848-846.

8. Bahadori K., *et al.* "Economic burden of asthma: A systematic review". *BMC Pulmonary Medicine* 9 (2009): 24.

9. Johnson LH., *et al.* "Asthma-related emergency department use: current perspectives". *Open Access Emergency Medicine* 8 (2016): 47-55.

10. Rui P and Kang K. "National Hospital Ambulatory Medical Care Survey (NHAMCS): 2015 Emergency Department Summary Tables (2015).

11. Thompson PJ., *et al.* "Insights, attitudes, and perceptions about asthma and its treatment: findings from a multinational survey of patients from 8 Asia-Pacific countries and Hong Kong". Supplement 2-additional results. *Respirology* 18 (2013): 957-967.

12. Ring N., *et al.* "The 'vicious cycle' of personalised asthma action plan implementation in primary care: a qualitative study of patients and health professionals' views". *BMC Family Practice* 16 (2015): 145.

13. Djandji F., *et al.* "Enablers and determinants of the provision of written action plans to patients with asthma: a stratified survey of Canadian physicians". *npj Primary Care Respiratory Medicine* 27 (2017): 21.

14. Kaferle JE and Wimsatt LA. "A team-based approach to providing asthma action plans". *Journal of the American Board of Family Medicine* 25 (2012): 247-249.

15. Yin HS., *et al.* "A low-literacy asthma action plan to improve provider asthma counseling: A randomized study". *Pediatrics* 137.1 (2016): e2015046.

16. Wahabi HA and Alzeidan RA. "Reasons behind non-adherence of healthcare practitioners to pediatric asthma guidelines in an emergency department in Saudi Arabia". *BMC Health Services Research* 12 (2012): 226.

17. Campbell H., *et al.* "Integrated care pathways". *BMJ* 316 (1998): 133-137.

18. Talib HJ., *et al.* "The impact of a clinical asthma pathway on resident education". *BioMed Research International* 2018 (2018): 5472876.

19. Dalcin PTR., *et al.* "Effect of clinical pathways on the management of acute asthma in the emergency department: Five years of evaluation". *Journal of Asthma* 44 (2007): 273-279.

20. Emond SD., *et al.* "Effect of an emergency department asthma program on acute asthma care". *Annals of Emergency Medicine* 34.3 (1999): 321-325.

21. Sucov A and Veenema TG. "Implementation of a disease-specific care plan changes clinician behaviors". *American Journal of Emergency Medicine* 18 (2000): 367-371.

22. Kwok C., *et al.* "Effects of a standardized emergency department asthma care pathway on health services utilization". *European Respiratory Journal* 52 (2018): OA5155.

23. Olajos-Clow J., *et al.* "Emergency department adult asthma care pathway: Healthcare providers' perceived utility and barriers to implementation". *Advanced Emergency Nursing Journal* 31.1 (2009): 44-53.

24. Chen KH., *et al.* "Effectiveness of paediatric asthma clinical pathways: A narrative systematic review". *Journal of Asthma* 51.5 (2014): 480-492.

25. Bekmezian A., *et al.* "Clinical pathway improves pediatrics asthma management in the emergency department and reduces admissions". *Journal of Asthma* 52.8 (2015): 806-814.

26. Kim H., *et al.* "Clinical usefulness of asthma clinical pathway for management of acute asthmatic children in pediatric emergency department". *The Journal of Allergy and Clinical Immunology* 129.2 (2012): AB77.

27. Lougheed MD., *et al.* "Multicentre evaluation of an emergency department asthma care pathway for adults". *CJEM* 11.3 (2009): 215-229.

28. McCoy EM., *et al.* "Implementing a standardized clinical pathway leads to reduced asthma admissions and health care costs". *Pediatric Quality and Safety* 3.4 (2018): e091.

29. Shakirah MS., *et al.* "Paediatric asthma clinical pathway: Impact on cost and quality of care". *Medical Journal of Malaysia* 2019;74 (2): 138-144.

30. Norton SP., *et al.* "Effect of a clinical pathway on the hospitalisation rates of children with asthma: A prospective study". *Archives of Disease in Childhood* 92.1 (2007): 60-66.

31. Buist AS., *et al.* "International variation in the prevalence of COPD (The BOLD Study): a population-based prevalence study". *Lancet* 370 (2007): 741-750.

32. COPD and Asthma- Differential diagnosis. American Academy of Family Physicians (AAFP), (2016).

33. Camargo CA., *et al.* "Managing asthma exacerbations in the emergency department: Summary of the national asthma education and prevention program expert panel report 3 guidelines for the management of asthma exacerbations". *The Journal of Emergency Medicine* 37.2S (2009): S6-S17.

34. Reddel HK., *et al.* "A summary of the new GINA strategy: A roadmap to asthma control". *European Respiratory Journal* 46.3 (2015): 622-639.

35. Mishra N., *et al.* "Asthma education for better compliance in disease management". *The Indian Journal of Allergy Immunology* 19.1 (2005): 25-28.

36. Ly CD and Dennehy CE. "Emergency department management of pediatric asthma at a university teaching hospital". *Annals of Pharmacotherapy* 41 (2007): 1625-1631.

37. Guttman A., *et al.* "Effectiveness of emergency department asthma management strategies on return visits in children: A population-based study". *Pediatrics* 120.6 (2007): e1402-1410.

38. Browne GJ., *et al.* "The benefits of using clinical pathways for managing acute paediatric illness in an emergency department". *Journal of Quality in Clinical Practice* 21 (2001): 50-55.

39. Rutman L., *et al.* "Standardized asthma admission criteria reduce length of stay in a pediatric emergency department". *Academic Emergency Medicine* 23.3 (2016): 289-296.

40. Johnson KB., *et al.* "Effectiveness of a clinical pathway for inpatient asthma management". *Pediatrics* 106.5 (2000): 1006-1012.

41. Wazeka A., *et al.* "Impact of a pediatric asthma clinical pathway on hospital cost and length of stay". *Pediatric Pulmonology* 32 (2001): 211-216.

42. Rowe BH., *et al.* "Early emergency department treatment of acute asthma with systemic corticosteroids". *Cochrane Database of Systematic Reviews* 1 (2001): CD002178.

43. Rodrigo G and Rodrigo C. "Corticosteroids in the emergency department therapy of acute adult asthma: An evidence-based evaluation". *CHEST* 116 (1999): 285-295.

44. Littenberg B and Gluck EH. "A controlled trial of methylprednisolone in the emergency treatment of acute asthma". *The New England Journal of Medicine* 314 (1986): 150-152.

45. Zemek R., *et al.* "Triage nurse initiation of corticosteroids in pediatric asthma is associated with improved emergency department efficiency". *Pediatrics* 129 (2021): 671-680.

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