

Impact of an Asthma Carepath on the Management of Acute Asthma Exacerbations

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Abstract

Introduction: Clinical pathways are being developed to standardise the management of acute asthma with the aim of improving asthma care. We evaluated the impact of an asthma carepath (CP), developed and instituted at a large community-based teaching hospital. **Materials and Methods:** Case records of consecutive asthma cases were reviewed after the implementation of a new asthma CP (November 1999 to March 2000). Data from July to October 1998 were used as historical control data [pre-carepath (pre-CP)]. Data collected included patient demographics, investigations performed, treatment prescribed, use of peak expiratory flow rate (PEFR) monitoring, length of stay (LOS) and asthma relapse rates. **Results:** One hundred and eighteen consecutive cases treated according to CP were compared with 67 pre-CP controls. There was no significant difference between the two groups with regard to LOS, use of PEFR monitoring, use of systemic steroids in hospital or asthma relapse after discharge ($P > 0.05$). A significant decrease in sputum tests (34.3% pre-CP versus 18.6% CP, $P = 0.017$) and use of antibiotics (62.7% pre-CP versus 30.4% CP, $P < 0.001$) was observed for patients on CP. The proportion of patients who had their salbutamol reviewed (49.3% pre-CP versus 73.7% CP, $P = 0.001$) and oxygen reviewed (25.8% pre-CP versus 73.8% CP, $P = 0.004$) was also significantly higher for cases on CP. **Conclusion:** Although the asthma CP did not significantly reduce LOS or early relapse, it was associated with a significant reduction of the use of sputum tests and antibiotics. Review of salbutamol and oxygen as treatment was also more likely.

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Key words: Asthma management, Clinical pathway

Introduction

Asthma is a chronic respiratory disorder with considerable medical and economic impact. There is rising morbidity, mortality and health care cost of managing this common condition worldwide.^{1,2} In Singapore, asthma is a very common problem. It is estimated that 140,000 individuals in Singapore have current asthma, with a prevalence as high as 20% among school children,³ and 5% among the adult population.⁴ The overall economic burden of asthma in Singapore was estimated at US\$33.9 million per annum in a recent study by the National University of Singapore (NUS). This was made up of US\$17.22 million in direct costs, and US\$16.71 million in indirect costs from the disease.⁵

Clinical pathways are being developed to standardise the

management of acute asthma with the aim of improving asthma care.^{6,7} There is also the potential for safely reducing health care costs with the institution of such guidelines and pathways. We evaluated the impact of an asthma carepath (CP), developed and instituted at a large community-based teaching hospital. The main objective of our study was to assess the effectiveness of the asthma CP, based on selected outcomes and indicators. The study also enabled us to compare asthma in-patient resource utilisation, across two periods of time, before and after the institution of a CP.

Materials and Methods

Clinical Pathway

The study was performed at Tan Tock Seng Hospital, Singapore, a 1200-bedded community-based teaching

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hospital. A clinical pathway was developed by a multidisciplinary work-group and implemented in August 1999 for the care of hospitalised patients with acute asthma exacerbations. The clinical pathway was designed to set out the sequence of care during the hospitalisation. It allowed flexibility and deviation as necessary on the part of the attending physician, depending on the patient's course and progress, in accordance with the CP management guidelines. A summary of the asthma clinical pathway is shown in Figure 1. The pathway was derived from the medical literature and from the National Asthma Education Programme Expert Panel 2 report of the National Heart, Lung, and Blood Institute published guidelines for appropriate asthma management.⁷

Study Design

Case-records of consecutive asthma cases were reviewed 3 months after the implementation of the new asthma CP (post-CP), from November 1999 to March 2000. Data from July to October 1998 were used as historical control data (pre-CP). The data were collected based on the ninth revision of the *International Classification of Disease* (ICD-9) codes for asthma without status asthmaticus (493.90) and asthma with status asthmaticus (493.91).

Data were collected retrospectively and included patient demographics (age, gender, race), investigations performed, treatment prescribed, use of peak flow rate monitoring, length of stay (LOS) in hospital and asthma relapse rates (re-attendance to emergency department within 2 and 4 weeks, and re-hospitalisation within 2 and 4 weeks after discharge). Length of stay was recorded in days according to the hospital midnight census. Data entry and coding was done in MS Excel spreadsheet, and subsequent statistical analysis was performed using SPSS software.

Inclusion and Exclusion Criteria

Only patients 18 years of age or older and admitted to hospital with the primary diagnosis of bronchial asthma were considered for study inclusion. Other inclusion criteria included: 1) a previous history of bronchial asthma or reversible bronchospasm (defined as 200 mL and 12% increase in FEV₁), and 2) an acute asthma exacerbation, defined as an episode of progressively worsening shortness of breath or wheezing within 24 hours with cough or chest tightness or some combination of these symptoms. The episode is characterised by a decrease in expiratory airflow that can be documented and quantified by peak expiratory flow rate (PEFR) measurement. Patients who fulfilled the inclusion criteria were enrolled onto the asthma clinical pathway at the request of their attending physician. Exclusion criteria were as follows: 1) patients with significant or unstable co-morbidities; 2) all current or ex-smokers; 3) history of chronic obstructive pulmonary

disease (COPD) as defined by sputum production 3 months out of a year for 2 consecutive years, or a history of emphysema; and 4) sepsis.

Statistical Analysis

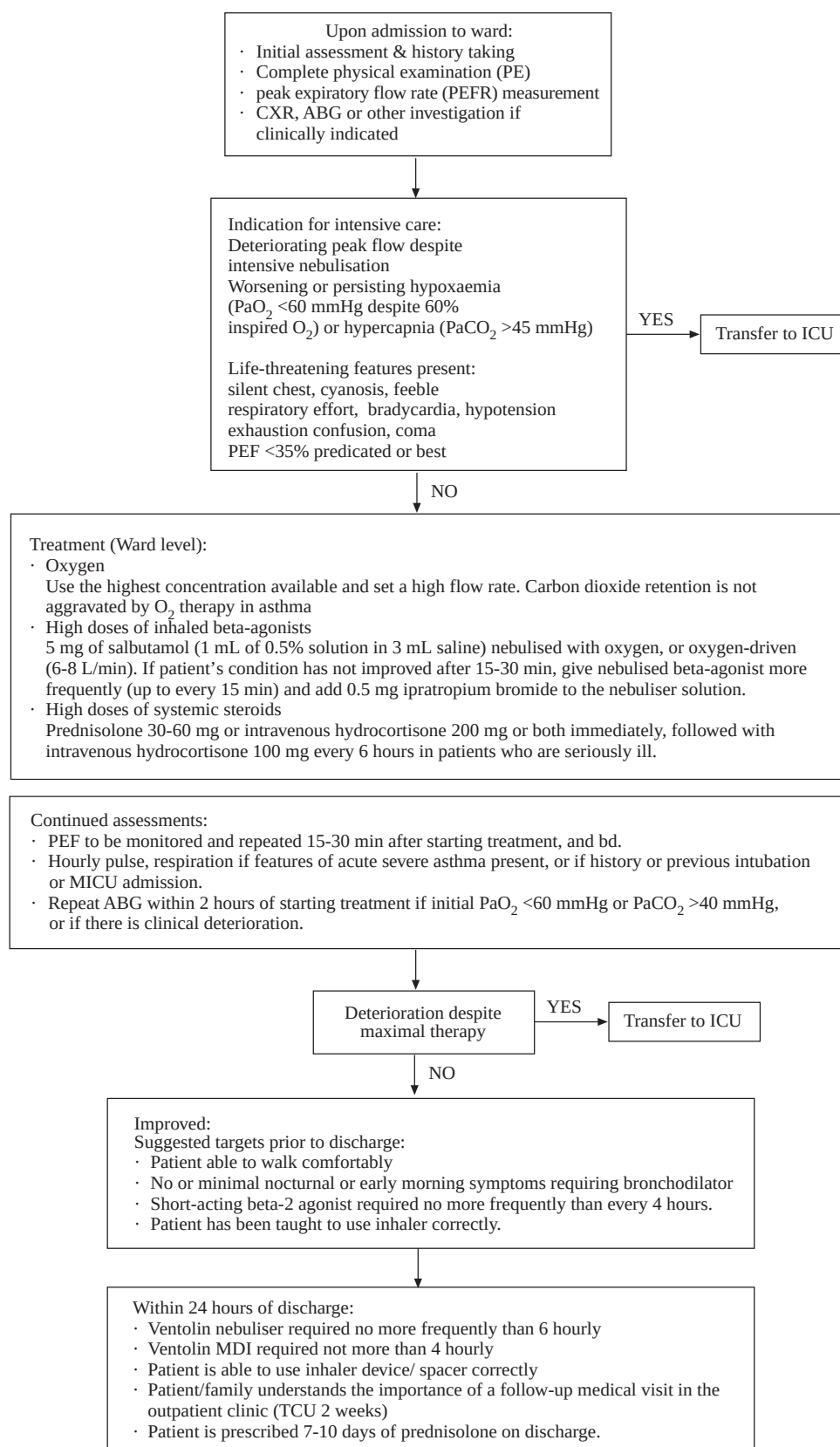
Chi-square and Fisher's exact tests were used, wherever appropriate, to test for association between categorical data. Independent *t*-test and Mann-U test were performed to test for significant differences in quantitative data. Potential confounding factors were controlled for, using logistic regression. The resulting *P* values were tested against alpha = 0.05. A *P* value <0.05 was considered statistically significant.

Results

One hundred and eighteen consecutive cases treated according to CP were compared with 67 pre-carepath (pre-CP) controls. The proportion of male patients admitted for acute asthma was significantly higher during the CP period (57% males) compared with the pre-CP period (33% males), *P* = 0.003. There was, however, no significant difference in age group (*P* = 0.18) or race distribution (*P* = 0.76) between the two groups studied.

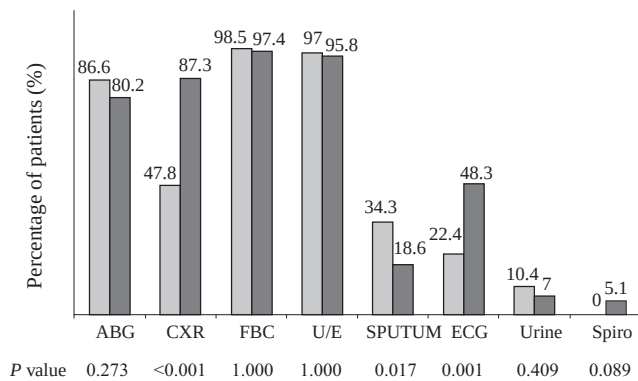
There was no significant difference in the proportion of the following tests performed between the two periods: arterial blood gas (ABG) analysis, full blood count (FBC), blood urea, electrolytes and creatinine (U/E), urine microscopy (urine) and spirometry (spiro). Although the proportion of patients with chest X-ray (CXR) and electrocardiogram (ECG) performed was significantly higher during the CP period (*P* <0.05), 81% of the CXR and 46% of the ECGs were performed at the A&E Department for this period, and were not ordered by the ward doctors. A significant decrease in sputum tests (gram stain and sputum culture) was observed during the CP period (34.3% pre-CP versus 18.6% CP, *P* = 0.017). A summary comparison of the investigations performed is shown in Figure 2.

In comparing the medications and treatment regimen prescribed between the two periods, there was a significant reduction in the use of antibiotics during the CP period (62.7% pre-CP versus 30.4% CP, *P* <0.001). The proportion of patients on oxygen (46.3% pre-CP versus 67.8% CP, *P* = 0.004), and the proportion who had oxygen therapy reviewed during hospitalisation was significantly higher on CP (25.8% pre-CP versus 73.8% CP, *P* <0.001) (Fig. 3). The proportion of patients who had salbutamol nebulisation was similar (98.5% pre-CP versus 100% CP, *P* = 0.36), but the proportion who had salbutamol nebulisation therapy reviewed during hospitalisation was also significantly higher for cases on CP (49.3% pre-CP versus 73.7% CP, *P* = 0.001) (Fig. 4). The use of intravenous hydrocortisone (94% pre-CP versus 94.1% CP, *P* = 1.0) and the in-patient



ABG: arterial blood gas; CXR: chest X-ray; ICU: intensive care unit;
MDI: metered dose inhaler; MICU: medical intensive care unit; TCU: to come up

Fig. 1. Asthma clinical pathway.



ABG: arterial blood gas; CXR: chest X-ray; FBC: full blood count; U/E: urea, electrolytes and creatinine; SPUTUM: sputum gram stain and culture; ECG: electrocardiogram; Urine: urine microscopic examination; Spiro: spirometry

Fig. 2. Asthma carepath—investigations performed.

use of oral prednisolone was similar (98.5% pre-CP versus 99.2% CP, $P = 1.0$) for the two periods (Fig. 3). A significantly higher percentage of patients were prescribed a short course (7 to 10 days) of oral steroids for continued out-patient use during the CP period (84.8% pre-CP versus 96.6% CP, $P = 0.004$). The proportion of patients on twice-daily PEFr monitoring was similar (76.1% pre-CP versus 81.6% CP, $P = 0.38$) (Fig. 4).

Median (range) LOS was not significantly different between the two groups [3 (1-7) days pre-CP versus 2 (1-7) days CP, $P = 0.074$]. Although this was slightly lower for the CP period, the marginal drop in LOS was attributed to the imbalance in gender profile across the two periods. Looking at the strata of males and females (Table I), there was no significant difference in the LOS for the two groups ($P = 0.22$ among males, $P = 0.51$ among females).

Asthma re-attendance rates at A&E within 2 weeks [3% (2/67) pre-CP versus 10.2% (12/118) CP, $P = 0.076$] and 4 weeks [4.5% (3/67) pre-CP versus 12.7% (15/118) CP, $P = 0.069$] were slightly but not significantly higher for the CP group. After further adjustment by logistic regression for sex and age, they were not found to be significantly different. The odds ratios (95% CI) for A&E re-attendance within 2 and 4 weeks between the two groups (CP compared with pre-CP) were 2.45 (0.51 - 11.86) and 2.52 (0.67 - 9.40), respectively. This was not found to be significantly different from 1 (95% CI). Similarly, asthma readmission rates within 2 weeks [1.5% (1/67) pre-CP versus 5.1% (6/118) CP, $P = 0.43$] and within 4 weeks [3% (2/67) pre-CP versus 7.7% (9/118) CP, $P = 0.33$] were not significantly different for the two groups.

Discussion

Guidelines and clinical pathways have been developed to standardise the management of acute asthma with the

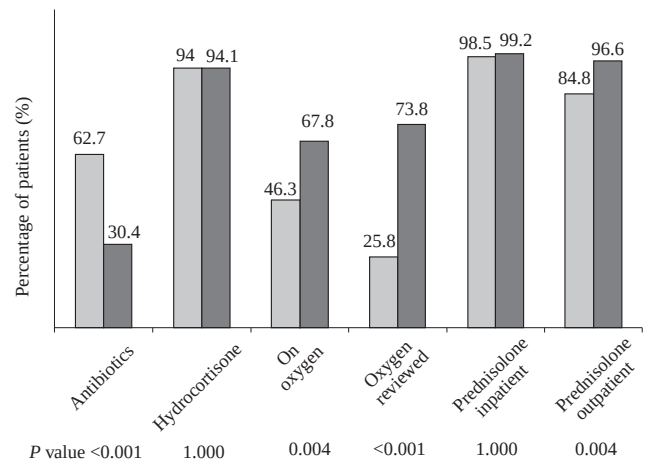


Fig. 3. Asthma carepath—medications/treatment prescribed.

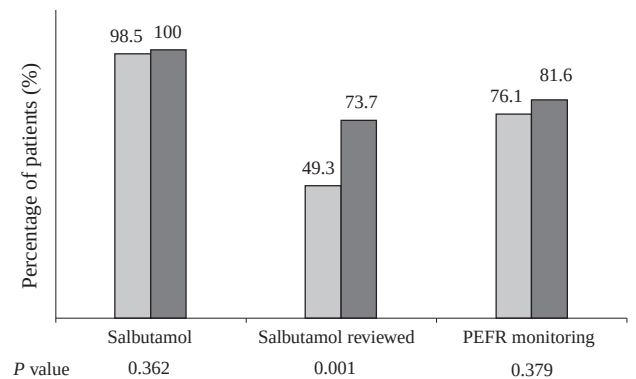


Fig. 4. Asthma carepath—medication review/PEFR monitoring.

TABLE I: ASTHMA CAREPATH—LENGTH OF STAY

	Pre-Carepath (66)	Post-Carepath (114)	P value
Length of stay Median (Range)	3 (1 - 7)	2 (1 - 7)	0.074
Among males Length of stay Median (Range)	2 (1 - 6)	2 (1 - 7)	0.223
Among females Length of stay Median (Range)	3 (1 - 7)	3 (1 - 7)	0.505

*Mann-U Whitney test

aim of improving care and safely reducing health care costs. Such practice guidelines have been established to define optimum care,^{7,8} although they have not always received enthusiastic support.⁹ Our aim was to assess the effectiveness of an asthma clinical pathway, based on standard asthma morbidity outcomes and indicators. We

were also able to compare asthma in-patient resource utilisation, across two periods of time, before and after the local implementation of a CP.

There were 3 major findings from this study. First, the LOS did not significantly differ between the two groups. Although it appeared to be slightly lower for the CP group, the marginal drop in LOS was attributed to the significant imbalance in gender profile between the two groups. The LOS was generally the same for both patients on clinical pathway and those not on asthma clinical pathway. This is not surprising, given the fact that the CP was designed to comply with international clinical practice guidelines and not to specifically reduce LOS. Also, the data may reflect the knowledge and adherence of doctors to such guidelines for asthma management, as the key elements of care outlined were employed by the doctors, regardless of whether patients were formally placed on CP.

Second, the use of the CP was associated with a significant reduction in the inappropriate use of sputum tests and antibiotics. Although it is well recognised that infection can trigger asthma exacerbations, most asthma exacerbations are not caused by bacterial infections,^{7,10} but predominantly due to viral infections.¹¹ Bacterial, chlamydia and mycoplasma respiratory tract infections are thought to contribute only infrequently to exacerbations of asthma. Hence, the use of antibiotics is generally reserved for those patients with fever and purulent sputum, and for patients with evidence of pneumonia.^{7,12} Sputum tests such as gram stain and sputum culture are generally not required for acute asthma exacerbations, and the routine ordering of such tests would be inappropriate and contribute to an over utilisation of resources. Antibiotics are also generally not recommended for asthma exacerbations or treatment, but they may be required for co-morbid conditions (e.g. bacterial sinusitis). Patients with significant co-morbidity were excluded from the study. Hence, there was a high utilisation of antibiotics in the pre-CP group with 62.7% of asthma patients being prescribed antibiotics, but this proportion significantly decreased by more than 50% after the implementation of the CP.

Third, a significant change in care did occur in asthma patients treated on the CP. Review of salbutamol nebulisation and oxygen as treatment was more likely. Rather than continuing such treatments indefinitely until the time for hospital discharge, the CP reminded ward doctors to routinely review the need for such therapy, and to stop treatment if and when indicated. Also, significantly more asthmatics were prescribed a short course of oral steroids on discharge, which is the standard international clinical practice recommendation.^{7,12}

Early asthma relapse rates were generally low and were no different whether asthmatics were on or not on the CP.

This may reflect the result of adequate in-hospital treatment, and the high rate of utilisation of systemic steroids in the patients admitted for asthma in both groups. Corticosteroids play a critical role in blunting the inflammatory cascade in asthma and are standard recommended therapy for asthma exacerbations.^{7,12} They are also effective in preventing early asthma relapse.

Some limitations of this study include the small number of patients recruited, the gender imbalance of the two groups and the fact that the study was not randomised. Due to the small number of patients recruited, the lack of difference between the two groups in early asthma relapse may have been due to small sample size and inadequate power to detect a real difference.

Conclusion

Although the asthma CP did not significantly reduce LOS or early asthma relapse, it was associated with a significant reduction of the use of sputum tests and antibiotics. Review of salbutamol and oxygen as treatment was also more likely.

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