Impact of an asthma education programme on patients' knowledge, inhaler technique and compliance to treatment

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ABSTRACT

Introduction: We conducted a study to assess the impact of an asthma education programme (AEP) on knowledge of asthma and medication, compliance to treatment and inhaler technique, emergency department visits and hospital re-admissions.

Methods: Patients hospitalised for asthma exacerbation were administered a questionnaire to test their baseline knowledge and beliefs on asthma, its medications and their compliance to treatment. Their inhaler technique was assessed. They then underwent an AEP consisting of two individualised education sessions. Re-testing was performed after three months. Per protocol approach and McNemar's test was used to analyse the statistical significance of the change in the pre- and post-AEP test scores. Hospital administrative data were used to determine the number of ED visits and hospital admissions pre- and post-AEP.

Results: Among the 67 patients who completed the two-phase AEP, there was significant improvement in some knowledge aspects (ability to identify rescue medication [p-value is 0.031], that different stimuli can trigger asthma symptoms [p-value is 0.016], that a peak flow meter is used for monitoring asthma [p-value is 0.004], that asthma symptoms are caused by airway swelling/ narrowing [p-value is less than 0.001], that steroid inhaler are to be used daily as preventive therapy [p-value is less than 0.001], in self-reported inhaler compliance (number of puffs per administration [p-value is less than 0.001] and per day [p-value is less than 0.001]), and in inhaler technique [p-value is 0.001]. There was also significant reduction in emergency department attendances (p-value is less than 0.001) and hospital admissions (p-value is less than 0.001) among all 97 subjects over a one-year period.

Conclusion: This study demonstrated the effectiveness of an AEP in patients hospitalised for asthma exacerbation.

Keywords: asthma, asthma education programme, emergency department, inhaler, patient knowledge

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INTRODUCTION

Patient education is becoming an essential area of service provision, with our increasing population of people with chronic diseases and conditions requiring long-term management in the community. Asthma is one of the chronic respiratory conditions that is very common in Singapore. It is estimated that 140,000 individuals in Singapore currently have asthma, with a prevalence as high as 20% among school children[1], and 5% among the adult population[2]. A large number of patients still experience a high level of morbidity[3]. Much of the morbidity from asthma is believed to be due to factors such as denial of having a chronic condition[4], poor knowledge of the disease process and medication use[5], poor understanding on the use of inhalers[6] and poor self-management[7, 8].

Numerous studies worldwide have evaluated the impact of patient education and indicated that each of the above components is amenable to asthma education[4]. Thus, patient education has become a key component of asthma management for asthma patients at all age groups[9,10]. However the effectiveness of patient education for asthma in a hospital-based setting in Singapore has not been previously evaluated. This study sought to test the hypothesis that an individualised patient education programme for asthmatics would increase patients' knowledge of asthma, which in turn will result in better compliance to the treatment regimen, improvement in inhaler technique and

ultimately, reduction in hospital emergency department (ED) visits and hospital admissions.

METHODS

Consecutive patients admitted for an exacerbation of asthma to the Department of Respiratory Medicine in a university-affiliated urban hospital in Singapore were screened for recruitment into this study. To be eligible for the study, subjects had to: (1) be between the ages of 13 and 50 years, (2) have a confirmed diagnosis of bronchial asthma in the medical record, (3) be on inhaled steroids prior to discharge, and (4) have had at least two physician follow-up visits for asthma. Patients who were excluded included those: (1) whose age was greater than 50 years, (2) who refused inhaled steroids, (3) who were discharged to primary care services, (4) who had undergone asthma counselling before, and (5) those with significant co-morbidity (e.g. heart disease, diabetes mellitus with complications, stroke, renal disease and chronic obstructive pulmonary disease).

203 subjects admitted with a diagnosis of asthma were prospectively screened. Of these, 97 subjects met the inclusion criteria. They were invited to participate and gave verbal consent to be interviewed. The Before-and-After-Design[11] was used in the study with the subjects serving as their own control. Two questionnaires were specifically designed for this study by the investigators. The first section of the pre-test questionnaire measured factual information on the subject's demographics, number of years of current asthma symptoms, frequency of symptoms for the last six months, and number of admission or emergency visits in the past year.

The second section of the questionnaire assessed subjects' understanding and compliance to asthma medication, explored barriers to non-compliance, level of basic knowledge on disease process and inhaler technique, using closed-ended questions. Responses are made on a five-point Likert Scale ranging from 1, "strongly disagree," to 5, "strongly agree". A sample item is "Asthma cannot be cured but it can be controlled." The post-test questionnaire omitted the first section of the pre-test questionnaire but the subsequent layouts were similar. Alternate observer reliability testing was done to assess inhaler technique. The test-retest reliability testing for the questionnaire was not done due to the difficulties in getting the same subject back for the second test prior to discharge since the length of hospital stay for asthmatics were short.

The pre-test questionnaire was administered by investigator PL, a trained asthma nurse educator at the hospital before institution of the asthma education programme (AEP). The first individualised patient education programme was instituted according to the subject's educational needs which were assessed using the pre-test questionnaire. Key points where the subject lacked understanding of the disease, medication or barriers to treatment were highlighted and immediately addressed. The session was designed to be interactive and personalised.

The second patient education session was held at the next outpatient visit two weeks after discharge. It was on the same day as the subject's regular visit with the physician. It was in accordance with asthma management guidelines "Educate and review regularly"[3]. The patient education session consisted of assessing asthma control, compliance and inhaler technique, self-management in real-life asthma situations based on the presence of symptoms, use of relievers, breathing and relaxation techniques, and when to seek assistance, were taught. Subjects' concerns, fears and beliefs were also addressed. Subjects were then left to self-manage their asthma for three months. The next follow-up appointment with the physician was scheduled three months later.

At the third month follow-up, subjects were again assessed for knowledge of asthma, compliance and technique using the post-test questionnaire. Subjects were not told previously that they would be filling in another questionnaire. This questionnaire was administered by investigator CYM who was a trained asthma nurse educator. She was blinded to the subject's pre-test questionnaire assessment results. The post-test questionnaire items addressed were similar to the pre-test questionnaire. Hospital administrative data were used to determine the number of ED visits and hospital admissions pre- and post-intervention. The number of hospital ED visits and hospital admissions for asthma 12 months pre- and 12 months post-education were monitored using an SAP system that records hospital contacts.

Data were entered using MS Office Excel and all statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS) for Windows version 11.5 (Chicago, IL, USA). To assess the effects of the programme on the subjects' knowledge of disease process and medication, the "per protocol"[12] analytical approach was chosen because data for post-test are only available for those patients that completed both the inpatient (phase 1) and outpatient (phase 2) components of the AEP.

Table I. Characteristics of subjects.

Variables		Non-defaulters N=67	Defaulters N=30	p-value*	Remarks**
Sex				0.633	NS
	Female	37	15		
	Male	30	15		
Race				**0.047**	**S**
	Chinese	38	10		
	Malay	13	14		
	Indian	13	5		
	Others	3	1		
Age (in years)				**0.041**	**S**
	Mean	35.93	31.13		
	SD	10.77	10.06		
Highest educational level				0.405	NS
	Nil	2	0		
	Primary	17	10		
	Secondary	32	11		
	ITE	3	4		
	Diploma	4	2		
	Pre-university	4	0		
	Degree	5	3		
History of childhood asthma				0.541	NS
	Yes	38	29		
	No	19	11		
Frequency of symptoms				0.554	NS
	Daily	26	10		
	3 – 4 per month	8	2		
	≥ 5 per month	10	6		
	<2 per month	13	4		
	Infrequent	10	8		
Years of current symptoms					
	Mean	17.45	10.63	0.525	NS
	SD	15.97	10.02		

* Chi-square test was used for all categorical variables (sex, race, highest education level, history of childhood asthma, and frequency of symptoms. Paired t-test was used for age, and years of current symptoms.

** S=significant; NS=not significant.

The subjects' ability to identify their bronchodilators and their compliance to treatment regimen were assessed using "yes" and "no" categories and McNemar's test was used to assess the statistical significance of the before and after measurements. The subjects' responses to questions assessing knowledge of disease process and medication were elicited using a five-point Likert scale (strongly disagree, disagree, neutral, agree and strongly agree) in order that the questions do not appear to subjects as an examination testing their intelligence. The questions were phrased in a way that correct responses to assessment of knowledge will be "agree" and "disagree".

In the data analysis, the five-point scale was collapsed into two categories: (1) not knowledgeable (strongly disagree, disagree and neutral responses) and (2) knowledgeable (agree and strongly agree). Thereafter, the McNemar test[13,14] was used to test the difference in proportion of correct responses before and after the intervention. p-values <0.05 were considered statistically significant. Similarly, to assess the impact of the programme on the subjects Metred Dose Inhaler (MDI) technique, their achievement was categorised into two categories: (1) proper and (2) improper. McNemar test[13,14] was also used to test the differences in proportion of proper MDI technique before and after the intervention. p-values <0.05 were considered statistically significant. Responses to questions on knowledge, and demonstration of skills, were grouped into "pass" and "fail" categories as the compliance of patients in their care is influenced by whether they are knowledgeable of their disease condition, and medication, and skilled in their self care management.

Given a before-and-after study design, paired t-test[15] was used to analyse the statistical significance of the reduction in ED visits and the reduction in hospital admission post intervention. Since all patients received the inpatient phase of asthma education, the "intention to treat"[12] approach was used to analyse the hospital admissions and emergency attendances for all 97 subjects (The defaulters only missed the phase 2 education scheduled to be given two weeks at the outpatient clinic after the inpatient discharge). The intention to treat approach was made possible by the availability of data for all 97 subjects on their hospital ED visits and hospital admissions before and after the intervention. p-values <0.05 were considered statistically significant.

Table II. Reason for defaulting outpatient one-to-one education session.

		Defaulters (N=30)	
SN	Reasons	Number	%
1	No time	15	50%
2	Telephone number given not in use	12	40%
3	Financial	2	6.7%
4	Seeing family doctor	1	3.3%

RESULTS

Of the 97 subjects who met the inclusion criteria and agreed to be followed-up and participated in the education programme, 67 (69%) completed the full programme. To achieve modest participation rate, every attempt was made to encourage patients to attend the education sessions. 30 (31%) defaulted despite telephone calls and sending three reminder letters of scheduled appointments with the physician. Table I shows the demographical profile of the 97 subjects in the study, and Table II lists the reasons for defaulting. The non-defaulters and defaulters did not differ in gender, highest education level, history of childhood asthma, frequency of symptoms in the last six months prior to the inpatient admission, and years of current asthma symptoms. The groups did differ, however in race (p=0.047) and age (p=0.041) (Table I).

Table III. Knowledge of disease process and medications.

		McNemar Test			
S/N	Area of knowledge	Proportion passing (before)	Proportion passing (after)	p-value	Remarks*
1	You must carry your reliever inhaler wherever you go.	79%	90%	0.065	NS
2	Asthma is an illness that lasts many years.	89.70%	95.60%	0.07	NS
3	Many different things (stimuli or triggers) can bring about an asthma episode.	88.20%	100%	**0.016**	**S**
4	Asthma cannot be cured but it can be controlled.	79.40%	82.30%	0.424	NS
5	Asthmatics can use a device called peak flow meter to measure how well air moves out of the lungs.	64.70%	85.30%	**0.004**	**S**
6	Symptoms of asthma (e.g. difficulty in breathing, wheezing, cough, or chest tightness) are caused by swelling and narrowing of airway.	72.05%	97%	**<0.001**	**S**
7	The steroid inhaler (i.e. Becotide, Beclomet, Pulmicort, or Flixotide) is to be used every day to prevent asthma attacks from occurring.	58.82%	91.18%	**<0.001**	**S**

* S=significant, NS=not significant.

Table IV. Inhaler technique.

		McNemar Test			
S/N	Area of knowledge	Proportion passing (before)	Proportion passing (after)	p-value	Remarks*
1	Identified the right inhaler	90.50%	100%	0.031	S
2	Inhaler technique	38.23%	95.58%	<0.001	S

* S=significant.

Table III provides the results on the knowledge of the subjects of their disease process and medication. The subjects showed significant improvement in their knowledge that many different stimuli can bring about an asthma episode (p=0.016). The subjects also showed an improved level of knowledge about symptoms of asthma being caused by swelling/narrowing of airways (p<0.001) and that a peak flow meter is used for monitoring asthma (p=0.004). The subjects also showed improvement in their knowledge that steroid inhaler is to be used daily as preventive therapy (p<0.001). However, subjects did not show significant improvements in knowledge that they must carry with them their rescuer inhaler wherever they go (p=0.065), that asthma lasts many years (p=0.070), and asthma cannot be cured but can be controlled (p=0.424).

The frequency rating that indicates subjects' reasons for not taking inhaled steroids as prescribed is illustrated in Fig. 1. Following our education and counselling interventions, subjects showed improvement in self-reported compliance to the number of puffs per administration (p<0.001) and the number of administrations per day (p<0.001) (Fig. 2). At enrollment, only 90.5% of subjects could identify the correct inhalers and only 38.23% were able to demonstrate correct MDI technique according to the checklist. After instruction and performance feedback, 100% were able to identify the correct inhalers and 95.58 % were able to demonstrate the technique correctly (p<0.001) (Table IV).

The mean number of hospital emergency visits before (12 months prior) and after the intervention (12 months after the asthma education) were 2.85 (SD=3.28) and 1.33 (SD=2.61), respectively. The reduction in hospital emergency was statistically significant (p<0.001). The mean number of hospital admissions 12 month prior to intervention was 1.52 (SD=1.05) and at 12 months after asthma education was 0.56 (SD=1.22). The reduction in hospital admissions was statistically significant (p<0.001) (Fig. 3).

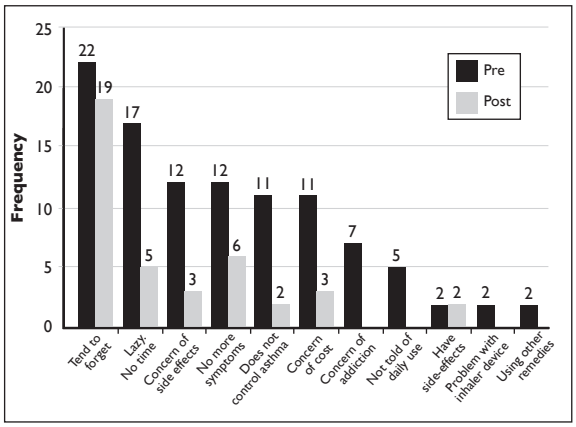

Fig. 1 Reason for not using steroid inhalers.

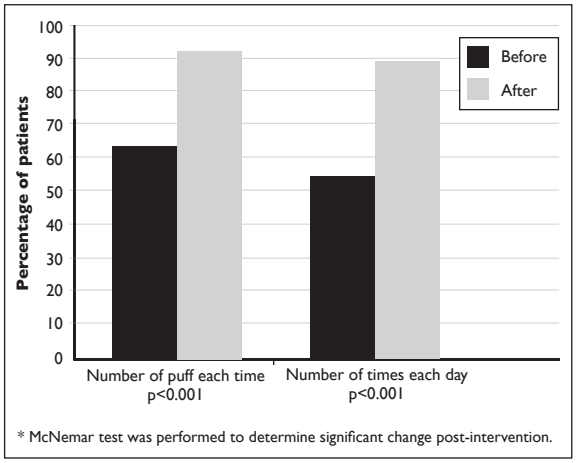

Fig. 2 Compliance to inhaled steroids.

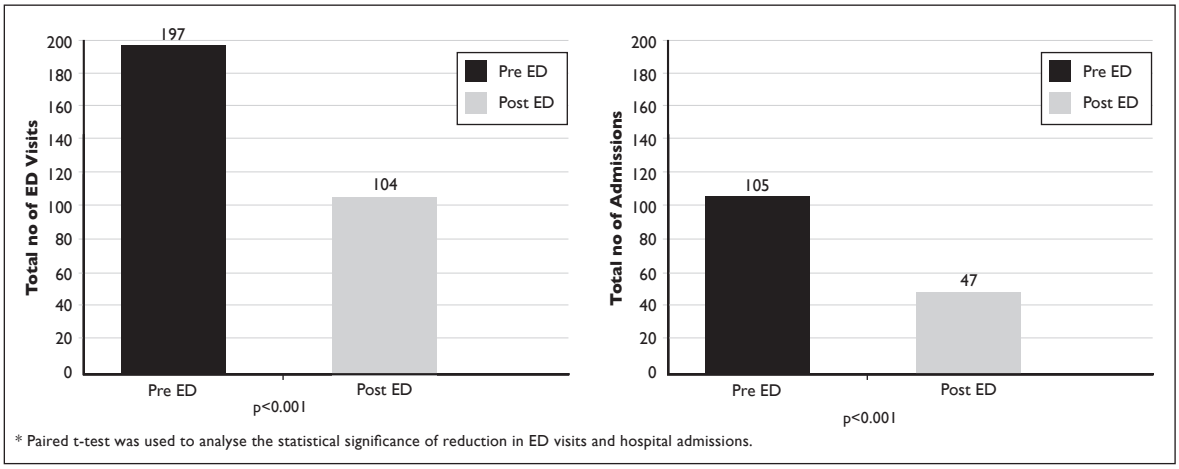

Fig. 3 Hospital emergency visits and admissions.

DISCUSSION

The effectiveness of patient education for asthmatics in a hospital-based setting in Singapore has not been previously evaluated. Thus, this study was designed to assess the effect of a patient education programme aimed at improving patients' knowledge of asthma, inhaler technique and compliance. The individualised patient education program was tailored to patient needs. It was successful in improving knowledge of the disease process of asthma. The findings showed a significant increase in knowledge of asthma scores at three months follow-up in most of the responses.

However, patients did not show significant improvement in the knowledge that asthma is a chronic illness that lasts many years (p=0.070) and that asthma cannot be cured but it can be controlled (p=0.424). They found this fact difficult to accept possibly due to pre-existing health beliefs, which may be related to the ethnic and cultural beliefs and practices of our multicultural society in Singapore[16]. For example, a common Chinese belief is that asthma is caused by the body's imbalance of the yin (cool) and yang (heat) and if it is restored, asthma can be cured and therefore not a chronic illness needing long-term medication. It is difficult to close the gap between what patients choose to believe and what healthcare professionals think they ought to believe.

Healthcare professionals should ensure that each patient is treated as an individual by focusing on his or her health beliefs and needs, and work towards a set of achievable goals[17]. If this fails, it is important that healthcare professionals establish how the patient wishes to behave and ensure they have come to their decision by informed choice. This study has a positive impact on patient's knowledge of asthma, but did not bring about changes in attitude and beliefs about asthma. Similar findings have been reported in other controlled trials[9,10].

Although the findings demonstrated that individualised education and counselling can improve patient's knowledge, it can be argued that it might have been due to the higher proportions of patients with moderate to severe persistent asthma in the study. Patients with acute exacerbation of chronic conditions may be more motivated to know about their disease and are more likely to benefit from the education than patients with mild conditions[7,9]. On the other hand, retention of information might be greater in persons whose onset of asthma was more recent and whose starting level of knowledge was low[18].

Caution is needed in the interpretation of the data because of lack of control and the relatively short-term follow-up period. Moldefsky et al[18] reported that the knowledge test score of the experimental group decreased to the level of the control group when retention of knowledge was assessed after a mean interval of 16 months of a videotape programme. Further, the pilot study took little account on long-term retention of information or beneficial effects on symptoms. In this respect it may not have been sufficiently comprehensive.

It is well known that compliance with therapeutic regimens for chronic conditions is generally low[19-21] and this is certainly the case for a chronic condition like asthma. Studies have shown non-compliance rates of around 50% with the taking of regular preventive therapies[22]. A range of different methods have been used to assess compliance, each having various advantages and disadvantages[23]. Non-compliance in this study is defined as the failure to take treatment as agreed upon by the patient and the healthcare professional[3]. At enrollment, the number of puffs per administration was 63.5% and number of administration per day was 54% in accordance with the treatment order. This is considered to be inadequate to control symptoms of asthma. A realistic control of symptoms cannot be achieved unless the patient maintains an appropriate regimen with regard to medication order[6].

Many subjects in this study had health practices and beliefs, in addition to fears and concerns regarding their treatment (Fig. 1), which may have led to poor compliance to using the preventive inhaler and limited its benefit. Wilson et al[6] stated that the rationale for patient education is to improve patients understanding of their condition and its treatment. If patients understand the risks of non-compliance and the benefits of compliance, and believe the treatment is safe, it will increase their motivation and confidence to improve their self management practices[21]. Thus, it should lead to better adherence to the treatment regimen. Following individualised counselling that addressed individual barriers for not using their preventive inhaler, subjects had a significant improvement in self-reported compliance to the number of puffs per administration ($p<0.001$) and the number of administrations per day ($p<0.001$). This finding was similar to several other studies that have shown patient education improves patients compliance and functional status[24-26].

Asthma medication, delivered by MDI, was part of the pharmacological regimen for virtually

all of the patients in this study. MDI requires patients to coordinate inhalation with action of actuation of the device, which can be difficult. Proper use of the inhaler (especially anti-inflammatory agents) as well as use of an appropriate dose schedule, is important to achieving the benefits of these medications[6]. Subjects in this study had to demonstrate correct MDI technique by taking two puffs. Correct MDI technique was assessed using a checklist of eight steps. The eight steps were based on international asthma clinical guidelines[3]. At enrollment, 61.76% of subjects exhibited improper use, a finding which was consistent with other studies[27,28]. Significant improvement in MDI technique was observed ($p<0.001$) after performance feedback and reinforcement during follow-up appointments. We found a significant reduction in hospital emergency visits ($p<0.001$) and hospital admissions ($p<0.001$); similar findings have been reported in another control trial[9]. As patients in this study were on regular follow-up with their respiratory physicians, this may also have contributed to improvement in compliance to preventive inhaler, leading to the reduction in emergency visits and hospitalisation[4].

In conclusion, the study showed that with post-intervention, there were significant improvements in the knowledge of asthma and medications, self-reported compliance to treatment regimen, and improvement in inhaler technique among those patients that completed the two-phased education sessions. The study also showed that there was a significant reduction in hospital ED visits and hospital admissions among all the 97 patients, including the 30 that defaulted the outpatient education session. As a whole, there were no significant differences among the defaulters and non-defaulters in the known characteristics.

The findings of this study may suggest that a well-structured inpatient AEP, coupled with reinforcement by doctors and asthma nurse clinicians during routine outpatient visits, is sufficient in achieving the outcome of effective self-care management. This in turn reduces ED visits and hospital admissions. It points to the importance of seizing the opportunity to teach and equip asthma patients with self-care management before they are discharged. The primary focus should be to identify negative behaviours and work toward positive behavioural changes to achieve good self-management of asthma.

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