Thorax 2000;**55**:566–573

Factors associated with hospital admissions and repeat emergency department visits for adults with asthma

Robert J Adams, Brian J Smith, Richard E Ruffin

Abstract

***Background*—A small proportion of patients with asthma account for a disproportionate number of acute health service events. To identify whether factors other than severity and low socioeconomic status were associated with this disproportionate use, a prospective study was undertaken to examine management and psychosocial factors associated with increased risk for admission to hospital with asthma and repeat visits to the emergency department over a 12 month period.**

***Methods*—A total of 293 patients with moderate or severe asthma managed at least in part at two teaching hospitals completed surveys of clinical status, acute events, sociodemographic, and psychological variables.**

***Results*—Twenty three percent had a single admission to hospital and 16% had two or more hospital admissions. Twenty six percent had one emergency department visit and 32% had two or more visits to the emergency department. In a multiple logistic regression model, adjusted for age, sex, education and income, odds ratios (95% CI) for baseline factors associated with hospital admissions over the next 12 months were: moderate severity compared with severe asthma 0.6 (0.2 to 0.9); no hospital admissions in the past 12 months 0.1 (0.01 to 0.2); not possessing a written asthma action plan 4.0 (1.5 to 10.7); less use of an avoidance coping style 0.4 (0.3 to 0.7); lower preferences for autonomy in asthma management decisions 1.4 (0.96 to 2.0). Adjusted odds ratios (95% CI) for repeat emergency department visits were: moderate asthma severity 0.3 (0.1 to 0.8); current regular use of oral corticosteroids 10.0 (3.1 to 32.4); a hospital admission in the past 12 months 2.9 (1.8 to 4.8); not possessing a written asthma action plan 2.2 (1.1 to 5.6); less dislike of asthma medications 0.7 (0.5 to 0.9).**

***Conclusions*—In addition to factors relating to severity, not possessing a written asthma action plan, avoidance coping, and attitudes to self-management were related to acute use of health services in this at risk group. Interventions need to address or take these factors into account to reduce asthma morbidity.**

(*Thorax* 2000;**55**:566–573)

Keywords: asthma; hospital admissions; emergency room visits

Department of Medicine, The University of Adelaide, The Queen Elizabeth Hospital, Woodville, South Australia
R J Adams
B J Smith
R E Ruffin

Correspondence to: Dr R Adams, Channing Laboratory, Brigham & Women's Hospital, 181 Longwood Avenue, Boston, Massachusetts 02115–5584, USA
email: robert.adams@channing.harvard.edu

Received 23 July 1999
Returned to authors 6 October 1999
Revised version received 6 March 2000
Accepted for publication 22 March 2000

Asthma attacks remain a frequent cause of presentations to emergency departments and of admissions to hospital,[1] and the reduction in the acute use of health services for asthma remains a target of health policy.[2] Costs due to asthma are substantial,[3] and this relates both to treatment costs and the use of health services consequent on poor disease control.[4] A small proportion of patients with asthma who have poor disease control account for a disproportionate amount of these costs.[3 4]

Studies have indicated that excessive use of β agonist medication and inadequate anti-inflammatory treatment, coupled with therapeutic non-adherence, social disadvantage, and psychological factors, are important indicators for excess hospital admissions and asthma deaths.[5–9] The retrospective or cross sectional nature of much of this evidence has limited the ability to examine how these influences interact with baseline disease status. A role in poorer outcomes for how an individual copes with asthma was shown in a series of studies by Jones *et al*[10] but the cumbersome nature of the instruments used to measure coping has limited further research in this area.

The influence of physician behaviour is also unclear. Sociodemographic factors can influence who is offered peak flow meters and self-management programmes, even within systems of universal or managed health care, suggesting that physician attitudes play some part in these interactions beyond financial barriers.[11] Clinical trials have shown a benefit from the use of written asthma action plans,[12] but evidence from the less controlled clinical practice setting is lacking. Although disease severity and socioeconomic factors are well known contributors to asthma morbidity, the influence of personal psychosocial factors has received less attention. There is little work in the routine practice setting which prospectively examines the relationship of baseline clinical status, asthma management, and a range of psychosocial and demographic factors to the unusual but serious events of hospital admissions and repeated emergency department visits.

This study describes a sample of adults with moderate to severe asthma recruited from hospital contact; a high proportion came from lower socioeconomic backgrounds. These factors are known to place patients at a higher risk for greater asthma morbidity.[8 13 14] Our aim was to investigate what factors measured at baseline were associated with future hospital admissions and emergency department visits for asthma over a 12 month period. In particular, we

sought to examine whether better management, as judged by the use of written asthma action plans and a greater level of inhaled anti-inflammatory medication, would predict a lower need for admission to hospital or emergency department visits. The influence on this relationship of individual characteristics such as coping styles and attitudes and beliefs towards management was also studied.

Methods

PROTOCOL

The data for this study come from patients participating in the Western Region Asthma Pilot Project (WRAPP), a longitudinal observational study of factors related to adult asthma patient outcomes over a 12 month follow up period. Data were collected between June 1995 and December 1997 from subjects attending The Queen Elizabeth Hospital, Woodville or the Lyell McEwin Health Service, Elizabeth, South Australia, for management of asthma. Consecutive adult subjects were recruited following attendances at outpatient clinics and emergency departments, or hospital admissions for asthma at both sites.

Subjects were eligible if they were able to give informed consent and there was a physician's diagnosis of asthma and evidence of an increase of 15% or more in forced expiratory volume in one second (FEV_1) after bronchodilator medication (or >200 ml if the baseline FEV_1 was 1.3 litres or less) when performed either at the clinic by a specialist respiratory physician or at an accredited laboratory[15]; or an increase in peak expiratory flow (PEF) of more than 20% after bronchodilator medication (provided baseline PEF was greater than 300 l/min); or a variation in PEF of 20% or more within a day on more than one occasion; or evidence of bronchial hyperresponsiveness with a provocative dose of histamine required to cause a 20% fall in FEV_1 ($PD_{20}FEV_1$) of less than 4 μmol.[16] All eligible persons were contacted in person by a non-physician research assistant to seek their enrollment. Following enrollment, surveys were administered at baseline and subsequently at three monthly intervals. The questionnaires were sent via post to all subjects, with further contact at two weeks if no reply had been received, repeated again after two weeks as necessary.

DEMOGRAPHICS AND SOCIOECONOMIC STATUS

The surveys included items concerning demographic information and socioeconomic status, including household income, level of formal education, employment status, the main source of income, and housing situation. Two items were included to identify personal perceptions of current economic circumstances related to their asthma—whether individuals had experienced any financial difficulties over the past year, and whether costs had prevented or delayed seeking any asthma care that was needed. For the study, age was entered as a continuous variable. Education was dichotomised into those with ≤10 years of formal education and those with >10 years of schooling. Annual household income was divided into two groups at AUD$20 000. This value corresponds to the upper limit of the second lowest quintile (40th percentile) of household income in Australia.[17]

ASTHMA STATUS

The clinical status was categorised into three levels of mild, moderate, and severe asthma according to the criteria listed for severity in the National Asthma Education and Prevention Program (NAEPP).[18] These criteria use daily and nocturnal symptoms, asthma exacerbations, physical activity limitation, frequency of reliever use, and lung function to assign categories. An individual is assigned to the highest grade in which any feature occurs. To adjust for the effect of treatment on current disease status, controller medication use was included in all analyses. Controller medication use was categorised based on reported daily dose of inhaled corticosteroids into groups using 0, 1–1000 μg/day, >1000–2000 μg/day, and >2000 μg/day, with a further category for regular oral corticosteroids. Where fluticasone was being used, it was weighted at double its actual dose for the purposes of categorisation—for example, 100 μg was scored as 200 μg. Other variables reflecting asthma status were burst prednisolone courses for asthma during the study period and over the past 12 months, admissions to the intensive care unit over the past five years, days absent from work or school due to asthma, and days of limited activity due to asthma. At each three month follow up respondents were also asked: "How many times in the last three months have you had an attack of asthma that was so bad that you had to go to a hospital emergency or casualty department?"[19] and "How many times in the last three months have you had an attack of asthma that was so bad that you had to be admitted to a hospital ward and stayed there for at least one night?". For those lost to follow up by the questionnaire, subsequent hospital admissions and emergency department visits were determined by examining hospital records at both hospitals. Recent evidence from South Australia indicates that self-reporting is an accurate method of identifying asthma hospital admissions.[20]

PSYCHOSOCIAL

A number of validated scales were used to measure different psychosocial characteristics of importance in asthma. Personal coping styles thought to be of importance in asthma were measured. Avoidance coping measures assessed strategies of both a predominantly behavioural nature (for example, "I made myself feel better by eating, drinking or smoking") and of a predominantly cognitive nature ("I have hoped for a miracle to make me better").[21] Similarly, active coping strategies measured included predominantly behavioural (for example, "I have become more informed about my asthma") and cognitive strategies (for example, "I thought about what I needed to do for my asthma").[21] A third coping style—denial—has been described as a "tendency to

deny life's stresses and to attribute all problems to the effects of illness".[22] A number of attitudes and behaviour regarding asthma medication were measured including self-reported general treatment adherence,[21] specific asthma medication dislikes such as the need for daily use of medications or the use of inhaled or oral corticosteroids,[23] and attitudes and knowledge of medication.[24] Preferences for decision making autonomy in asthma self-management were assessed using the Asthma Autonomy Preference Index.[25] This scale was designed to measure preferences for autonomy in management decision making in a general sense, as well as the extent to which individuals prefer doctors or themselves to make decisions in three clearly defined asthma clinical vignettes. These vignettes include an attack of moderate severity requiring decisions about increasing medications and making an unscheduled physician visit ("moderate" attack) that corresponds to the clinical situation addressed by the self-treatment guidelines in written asthma action plans.[25] The level of confidence or self-efficacy in managing asthma was measured,[26] as well as indicators of perceived emotional social support and social participation.[27] Self-report measures of attitudes and behaviour have been criticised because some people may bias their responses to be more socially acceptable and present themselves in the most favourable light.[28 29] The five item Socially Desirable Response Set measure was used to control for this tendency.[28]

STATISTICAL ANALYSIS

Separate analyses were conducted for the dependent variables of (1) at least one hospital admission, (2) two or more hospital admissions, and (3) two or more visits to the emergency department for asthma over the 12 month follow up period. For those subjects identified from a hospital admission or visit to the emergency department, this event was recorded as a past event for purposes of analysis. Thus, only hospital admissions and visits to the emergency department after enrollment were counted as events in the analysis.

To represent the form of relationships with patient characteristics which were not linear, dummy variables were used to obtain meaningful estimates. For the purpose of analysis, control groups for the respective comparisons were patients who indicated they had not been admitted to hospital (for (1) and (2)) and who had had one or no visits to the emergency department (for (3)). Thus, an individual could have repeat emergency department visits but still be a control for the admissions analysis. Estimated odds ratios for variables adjusted for age, sex, educational level, and household income were calculated by multiple logistic regression using LogXact for Windows (Cytel Software, Cambridge, Massachusetts, USA). Results from separate equations for each risk factor of interest are given in the "univariate analysis" tables. Because of the large number of variables available, only those with significance at or below $p = 0.05$ were considered as candidate variables for multivariate logistic regression analysis. All variables found to be significant at the univariate stage were entered into each logistic regression. Insignificant variables were progressively omitted until satisfactory models were found that explained hospitalisation, rehospitalisation, and repeat emergency department visits. The final model adjusted for age, sex, income, employment status, and education level was then assessed for multicollinearity. Each omitted variable was added one at a time to assess if any effect was seen on the model variable coefficients. As controller use may influence clinical asthma status, we also specifically assessed whether this had any effect on the coefficients and fit of the final model. Adequacy of the fit was assessed by estimation of the deviance and the Hosmer-Lemeshow statistic. Approval of the study protocol was obtained from institutional ethics committees.

Results

POPULATION CHARACTERISTICS

Of 343 individuals identified as eligible for enrollment in the study, completed survey responses were received from 293 at baseline, from 268 at six months (91%), with 212 (72%) completing 12 month surveys. Most of those lost to follow up (n = 61) declined to participate further in the study. At least 56 of these individuals could be identified from hospital records and from correspondence as continuing to receive care at the study hospitals. A

Table 1 Demographic and clinical features of the population

Variable	*%*
Mean (SD) age (years)	42 (18)
Sex (% female)	67
Marital status (%)	
Married/partner	61
Divorced/widowed/separated	16
Never married	23
Country of birth (%)	
Australia (non-Aboriginal)	66
Australia (Aboriginal)	2
Other	32
Income level per annum (%)	
<A$8000	32
A$8000–20 000	29
A$20 001–50 000	31
>A$50 000	8
Principal income source (%)	
Wages/salary	46
Government allowances	54
Education level (%)	
≤10 years school	46
>10 years school	26
Some post school	28
Asthma clinical status	
Moderate	42
Severe	58
FEV_1 (%predicted)	
<60%	30
60–80%	40
>80%	30
Inhaled corticosteroids (μg/day)	
0	20
1–1000	29
1001–2000	32
>2000	19
Regular oral corticosteroids (% yes)	14
Bronchodilator use	
<weekly	24
>weekly–<daily	22
1–4 times/day	29
>4 times/day	25
Long acting β agonists (% yes)	18
"Other" asthma medications (% yes)	44
Has written asthma action plan (% yes)	55

Table 2 Proportions (%) with different frequencies of hospital admissions and visits to the emergency department among those in various demographic categories

	Admissions to hospital			*Emergency department visits*		
	0	*1*	*≥2*	*0*	*1*	*≥2*
Whole sample (n=293)	61	23	16	42	26	32
Men	60	18	22	51	20	29
Women	59	25	16	39	29	32
Unemployed	43	24	33	43	24	33
Employed	59	20	21	43	28	29
Education						
≤10 years schooling	40	40	20	26	33	42
>10 years schooling	53	34	13	44	27	29

Table 3 Odds ratios for variables associated with any (≥1) admissions to hospital

Baseline variables	*OR**	*95% CI*	*p value*
Clinical asthma status			
Moderate asthma severity	0.4	0.2 to 0.8	0.007
Severe asthma	1.0	—	—
Hospital admission past year	14.4	4.5 to 45.8	<0.0001
No admission past year	1.0	—	—
Taking oral corticosteroids regularly	2.7	1.1 to 7.1	0.04
Not on oral corticosteroids regularly	1.0	—	—
Taking "other" asthma medications	2.0	1.0 to 4.2	0.049
Not taking "other" asthma medication	1.0	—	—
Feels asthma generally getting better	0.2	0.1 to 0.5	0.01
Feels asthma generally staying the same	0.4	0.2 to 1.1	
Feels asthma generally getting worse	1.0		
Processes of care			
GP visits for asthma in past year: 0–3	0.3	0.1 to 0.7	0.004
GP visits for asthma in past year: 4–6	0.5	0.2 to 1.4	
GP visits for asthma in past year: >6	1.0		
No written asthma action plan	3.4	1.5 to 7.7	0.003
Has written asthma action plan	1.0		1.0
Patient characteristics and attitudes			
Less dislikes of asthma medication	0.8	0.6 to 0.9	0.02
Less use of avoidance coping	0.4	0.3 to 0.6	<0.0001
Lower autonomy preferences in moderate attacks	1.6	1.0 to 2.1	0.05

*Odds ratios were adjusted for age, sex, education, household income, and employment status.

further 18 people had changed address and could not subsequently be contacted; three had died. There were no statistically significant differences between the groups with and without 12 month follow up when compared for age, sex, education, household income, and baseline asthma status, medication use, or lung function. There were no significant differences between the eligible group who did not return baseline surveys and study subjects when compared by age, sex, or lung function.

The demographic and clinical characteristics of the population are shown in table 1. Forty one percent were aged 15–34 years, 14% were aged 35–44 years, 15% were 45–54 years old, 17% were aged 55–64 years, and 13% were 65 years or older. Including current students, nearly half (46%) had only 10 years of formal education, 26% had >10 years at school, and 28% had some post-school education compared with national population proportions of 35%, 17%, and 48%, respectively.[17] Over half (51%) reported having financial difficulties during the past year and 41% indicated that concerns about costs had caused them to delay or avoid seeking care needed for their asthma in the previous 12 months. Over half (54%) received some form of income assistance from government allowances or social security compared with a national figure of 30%.[17] Current smokers comprised 18% of the population. All of the study subjects had asthma control such that their current asthma status could be classified as either moderate (42%) or severe (58%) according to the NAEPP criteria.

Table 2 shows the proportions of patients who were admitted to hospital and had emergency department visits in various demographic categories. There were no significant differences in hospital admissions between men and women but men were significantly less likely to have an emergency department visit ($p = 0.048$). Hospital admissions ($p = 0.03$) and emergency department visits ($p = 0.0007$) were significantly more frequent in those with 10 years or less of formal education. Of those subjects who reported not taking any inhaled or oral corticosteroids at baseline, 40% were admitted to hospital and 45% had recurrent presentations to emergency facilities.

FACTORS ASSOCIATED WITH HOSPITAL ADMISSION AND REPEAT ADMISSIONS

A large number of baseline variables were significantly associated with at least one admission to hospital over 12 months in univariate analysis (table 3). These have been grouped into those that are principally markers of clinical asthma control, those reflecting processes of care, and patient characteristics and attitudes. Of the other markers of clinical asthma analysed, baseline lung function, inhaled corticosteroid dose being taken, and frequency of bronchodilator use were not significantly related to admissions. Those reporting not being in possession of a written action plan with self-treatment guidelines were significantly more likely to be admitted to hospital than those with such a plan. The degree to which an individual wanted to be in charge of initiating treatment changes in an asthma attack (autonomy preferences) was also associated with future hospital admissions. Each unit decrease in the level of autonomy preferences on the asthma API scale (range 1–5) was associated with an odds ratio of 1.6 (95% CI 1.0 to 2.1) for a hospital admission. Less use of avoidance coping was strongly associated with a protective effect for admission to hospital.

A separate analysis was done for recurrent hospital admissions (≥2) compared with those not admitted to hospital. All of the variables found to be associated with any hospital admission showed even stronger associations with repeat admissions. In addition, the dose of

Table 4 Multivariate analysis of factors associated with hospital admissions and repeat admissions

	*OR**	*95% CI*	*p value*
Hospital admissions			
No hospital admission in past year	0.1	0.01 to 0.2	<0.0001
Admission past year	1.0	—	—
Moderate asthma severity	0.6	0.2 to 0.9	0.042
Severe asthma	1.0	—	—
No written asthma action plan	4.0	1.5 to 10.7	0.005
Has written asthma action plan	1.0	—	—
Less use of avoidance coping	0.4	0.3 to 0.7	0.0001
Lower autonomy preferences in moderate attacks	1.4	0.96 to 2.0	0.07
Repeat hospital admissions			
No hospital admission in past year	0.1	0.03 to 0.2	<0.0001
Admission in past year	1.0	—	—
Moderate asthma severity	0.2	0.04 to 0.9	0.04
Severe asthma	1.0	—	—
No written asthma action plan	5.9	1.2 to 28.1	0.02
Has written asthma action plan	1.0	—	—
Less use of avoidance coping	0.2	0.1 to 0.5	0.0005
Lower autonomy preferences in moderate attacks	2.1	1.1 to 3.9	0.02

*Odds ratios adjusted for age, sex, education, household income, and employment status.

Table 5 Odds ratio for variables associated with repeat (⩾2) emergency department visits

Baseline variables	*OR**	*95% CI*	*p value*
Clinical asthma status			
Moderate asthma severity	0.3	0.1 to 0.6	0.001
Severe asthma	1.0	—	—
No hospital admission in past year	1.0	—	—
Admission in past year	2.9	1.1 to 7.8	0.03
Taking oral corticosteroids regularly	12.1	3.7 to 34.1	<0.0001
Not taking oral corticosteroids regularly	1.0	—	—
Taking "other" asthma medication	5.5	2.3 to 13.7	0.0001
Not taking "other" asthma medication	1.0	—	—
Self-rating of asthma over past 3 months			
Severe	7.3	1.3 to 41.6	0.001
Moderate	3.7	0.7 to 19.2	
Mild/no problem	1.0		
Feels asthma generally getting worse	2.8	1.5 to 5.1	0.0008
Feels asthma generally getting better/staying same	1.0		1.0
Processes of care			
GP visits for asthma past 12 months 0–3	0.2	0.1 to 0.6	0.002
GP visits for asthma past 12 months 4–6	0.4	0.1 to 1.1	
GP visits for asthma past 12 months >6	1.0		
No written asthma action plan	3.1	1.5 to 7.1	0.0039
Has written asthma action plan	1.0		1.0
Patient characteristics and attitudes			
Less dislikes of asthma medication	0.7	0.6 to 0.9	0.0034
Less use of avoidance coping	0.6	0.4 to 0.8	0.001
More use of active coping	0.7	0.5 to 1.0	0.05
Less perceived social support	1.6	1.2 to 2.3	0.001
Cost concerns delay seeking care for asthma	3.7	1.3 to 10.5	0.01

*Odds ratios were adjusted for age, sex, education, household income and employment status.

inhaled corticosteroid being taken was associated with repeat hospital admissions. Compared with those who reported taking >2000 μg inhaled corticosteroid per day, those on >1000–2000 μg/day were significantly less likely to have recurrent admissions to hospital; those on 1–1000 μg/day also had a reduced risk, although this just failed to reach significance (p = 0.052).

In the final model for the multivariate logistic regression analysis (table 4), adjusting for age, sex, education, household income, and employment status, those admitted to hospital were significantly more likely to have been previously in hospital for asthma in the past year and to report not being in possession of a written asthma action plan. Those with asthma of moderate severity and those using less avoidance coping strategies to cope with their asthma were significantly less likely to be admitted. Lower preferences for decision making autonomy in the moderate asthma attack scenario were also associated with hospital admissions, but this did not reach significance. In the multivariate model for re-admissions to hospital, stronger associations were seen with each of the independent variables compared with the "any hospital admission" model (table 4).

Table 6 Multivariate analysis of factors associated with repeat emergency department visits

	*OR**	*95% CI*	*p value*
Hospital admission past year	2.9	1.8 to 4.8	0.0001
No admissions past year	1.0	—	—
Moderate asthma severity	0.3	0.1 to 0.8	0.013
Severe asthma	1.0	—	—
Taking oral corticosteroids regularly	10.0	3.1 to 32.4	<0.0001
Not taking oral corticosteroids regularly	1.0	—	—
No written asthma action plan	2.2	1.1 to 5.6	0.04
Has written asthma action plan	1.0	—	—
Less dislikes of asthma medication	0.7	0.5 to 0.9	0.007

*Odds ratios adjusted for age, sex, education level, household income and employment status.

FACTORS ASSOCIATED WITH REPEAT EMERGENCY DEPARTMENT VISITS

A number of clinical and psychosocial variables were associated with repeat attendances at the emergency department (table 5). Clinical variables were similar to those associated with hospital admissions. Those not in possession of a written asthma action plan were more likely to present frequently at the emergency department than those with plans. Coping, active and avoidance, was associated with repeat emergency department visits. Those with concerns about the costs of treatment causing them to delay seeking care needed for asthma attended emergency department more often than those with greater economic resources.

In multivariate logistic regression analysis, adjusting for age, sex, household income, education and employment status, repeat attenders were more likely to have been admitted to hospital in the previous year, to be taking oral corticosteroids regularly, and to report not having a written asthma action plan (table 6). Those with moderate asthma severity and less dislike of asthma medication use were significantly less likely to have repeat attendances at the emergency department.

Discussion

Acute use of health services was common among this group of hospital patients. This in part reflects the recruitment of patients from acute events such as emergency department visits and from specialist outpatient clinics. Although these events were not counted in the study (which reported events over the succeeding 12 months), it could be expected that these individuals would be at risk for future morbidity. Several factors emerged as risk indicators for future admissions and repeat emergency department visits. Predictably, one group of variables related to markers of asthma severity—previous admissions, less well controlled asthma as measured by symptoms and lung function, and the need for regular oral corticosteroids. The lack of a written asthma action plan with self-treatment guidelines was a major association for both types of acute events. Lower desires to be responsible for initiating changes in medication during a moderately severe attack were also associated with admissions to hospital. Less personal resources, expressed as avoidance coping, were significantly associated with future admissions to hospital for asthma. Less dislike of asthma medications and their usage—for example, the need for daily use—was associated with a significantly lower risk for repeat emergency department visits.

Efforts to increase the use of written action plans may reduce asthma morbidity, as indicated by the significant effect on both hospital admissions and emergency department visits of providing a written asthma action plan to patients. Our data support the findings of a recent meta-analysis by Gibson and colleagues which indicated that optimal self-management including a written action plan for the use and adjustment of medications led to a reduced number of hospital admissions.[30] However, van

der Palen *et al* have contended that, because of a lack of adequate control groups in studies, it is unclear whether improved outcomes are due to self-treatment guidelines via written action plans or to such things as more education or more medical attention.[31] We did not find evidence to support such a contention as there were no associations between knowledge of asthma and its management, or with asthma management self-efficacy, and acute events. Furthermore, a "dose response" relationship was seen with written plans, with higher odds ratios associated with greater morbidity—that is, repeat hospital admissions—suggesting the results were robust. However, a controlled trial with a written action plan as the sole intervention would be needed to answer this question conclusively.

Increased use of action plans should be accompanied by efforts by clinicians to elicit the attitudes of patients towards using them. Action plans need to be individualised. Specifically, clinicians need to ascertain whether people want to be individually responsible for making the decisions to initiate changes to treatment during attacks or wish to defer such decisions to their doctors, as these preferences have a significant effect on the risk of admission to hospital. Future work is needed to examine whether interventions can successfully be implemented to increase patient preferences for decision making autonomy in asthma.

The dose of inhaled corticosteroid was not a significant factor associated with acute health service events. This may be due to a number of factors including confounding by severity (or indication), as well as the many influences on both the self-reporting of medication use and the amount of this medication actually used by patients.[9 32] Without some form of objective measurement of inhaler use it will be difficult to gauge the consequences of this usage or non-usage. The amount of reported morbidity suggests that asthma control for many patients remained suboptimal. Those reporting not taking any anti-inflammatory medication at baseline had high rates of health service use. Our data suggest that some reductions in recurrent health service use may be possible by the use of more intensive treatment regimens in the small group with frequent symptoms and inadequate levels of anti-inflammatory treatment. However, the complex nature of adherence,[32] together with the identification of avoidance coping and medication dislikes as significant predictors of events, suggests reducing acute events will be more complicated than the relatively simple expedient of increasing the prescription of inhaled corticosteroids.

Avoidance coping may operate negatively at several levels to affect asthma patients. Individuals may avoid the regular use of preventive medications leading to poorer control of asthma. In an acute exacerbation this response style may cause the patient to delay initiating appropriate changes to treatment or in seeking medical help. Avoidance coping is associated with withdrawal from social contact, and this may reduce the buffering effect of social support which can further increase the risks of poorer outcomes.[33] A resentment of regular medications and denial of the chronic nature of asthma has also been reported as a significant factor in non-adherence to treatment regimens.[34] The combination of avoidance coping and a dislike of the regular use of asthma medications has been described as a form of "magical thinking", leading people to hope that "if they stop taking the medicine the illness will disappear".[35] Negative perceived consequences of inhaled therapy has been associated with an increased risk of readmission in children with asthma.[36] Identifying this "at risk" group with higher use of avoidance coping mechanisms and a greater dislike of using asthma medications may allow a specific focus on cognitive-behavioural interventions to assist patients' reappraisal of situations rather than a general focus on "asthma education" in order to reduce morbidity. Further work is needed to identify specific self-management errors that may occur during asthma exacerbations, and the relationship of these errors to avoidance coping and medication dislikes.

Criticism can be made of the nature of the study sample and hence of the generalisability of the results. Recruitment from hospital contact necessarily excluded those community persons with possibly milder asthma, as well as non-metropolitan patients. The study subjects had high numbers of economically disadvantaged persons and those in receipt of government benefits and with less education than average. This study sought to examine those factors leading to high usage of acute health services within a population at higher risk. It is possible these do not represent the risks present across the whole asthma population. Asthma is more prevalent and severe in lower socioeconomic groups,[8 13 14] and it is likely that the socially disadvantaged will be over-represented in a sample with moderate and severe asthma. Although the sample had a higher proportion than the general population of people with lower income and education, it was still diverse in terms of all the sociodemographic variables assessed. A recent representative population survey in the USA found that 43% of all adults with a physician's diagnosis of asthma had symptoms consistent with moderate or severe asthma.[37] Substantial numbers of people with asthma therefore have similar levels of symptoms to those in this study. Subjects were recruited from different sources within the hospital, which may have influenced their future morbidity. These groups were analysed together as the potential for misclassification was great if they had been analysed separately. For instance, subjects were recruited at an outpatient visit immediately following an admission for an acute life threatening asthma attack or referred to outpatients from the emergency department. Hence, sociodemographic variables, baseline symptoms, lung function, medication use, and recent past events (including an event used for recruitment) were used to group patients for analysis and significant associations were found.

An additional limitation of the study was the lack of any measure of the severity of an exacerbation leading to an admission, so it is difficult to know to what extent any increased frequency of acute visits represents a lower threshold for presentation in those patients or their carers. The association of a number of markers of asthma severity with increased hospital use suggests that this is not a major factor. Using admissions to hospital as an outcome as well as emergency visits also reduces the significance of this, as a clinical assessment has to be made to allow admission. Further, the association of higher risk with increasing frequency of GP visits suggests that these people were not substituting emergency care for regular primary care, but rather seeking help in as many ways as possible. As some subjects did not complete 12 month surveys, it is possible that the primary outcomes were incompletely measured. However, most subjects who declined further participation could be identified as continuing to receive care at one of the study hospitals, and a number of events were identified in this way. The sample population was broadly similar in sociodemographic make up to the population of the north-western suburbs of Adelaide, which is the catchment area of the two hospitals. However, this area of Adelaide is relatively economically disadvantaged and the risk of the results being influenced by hospital-specific factors exists, especially those related to how decisions to admit are made in each institution and the effect of socioeconomic status on these decisions. Although standard measures of socioeconomic status such as income, employment, income source, and education were included, there was not a unitary measure of socioeconomic status. Kolbe *et al* have reported that people tend to under-report their level of economic disadvantage.[8] All measures used were based on self-reporting and may be subject to a tendency for some respondents to give socially desirable responses. However, using the socially desirable response set as a control variable resulted in no change to the results.

In summary, the acute use of health services for asthma is predictably related to markers of asthma severity. Increasing the implementation of the non-medication aspects of the asthma guidelines, specifically the provision of written asthma action plans, may reduce the use of acute health care services. Identifying patients' attitudes to decision making within self-treatment guidelines will be important. Within the broad group of "at risk" hospital patients, there is the potential to identify individuals who may be at even greater risk by assessing their coping styles and attitudes to using asthma medication. Consideration of the impact of education level and economic resources could further stratify targeted interventions aimed at this group. An assessment of intervention strategies designed with these factors in mind is required.

We would like to express thanks to Ms D Bates and Ms E Carle for assistance with the conduct of this study.

Funding: This study was funded by the University of Adelaide, The Queen Elizabeth Hospital Research Foundation. Dr Adams is a recipient of the Thoracic Society of Australia and New Zealand/Allen & Hanbury's Respiratory Research Fellowship.

1 Adams R, Ruffin R, Wakefield M, *et al*. Asthma prevalence, morbidity and management practices in South Australia, 1992–1995. *Aust NZ J Med* 1997;**27**:672–9.
2 National Asthma Strategy Steering Group. *National asthma strategy: goals and targets.* Melbourne, Australia: National Asthma Campaign, 1994.
3 Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. *N Engl J Med* 1992;**326**:863–6.
4 Weiss KB, Sullivan SD. The economic costs of asthma: a review and conceptual model. *PharmacoEconomics* 1993;**4**: 14–30.
5 Dales RE, Schweitzer I, Kerr P, *et al*. Risk factors for recurrent emergency department visits for asthma. *Thorax* 1995; **50**:520–4.
6 Marder D, Targonski P, Orris P, *et al*. Effect of racial and socioeconomic factors on asthma mortality in Chicago. *Chest* 1992;**101**:426–9S.
7 Campbell DA, Yellowlees PM, McLennan G. Psychiatric and medical features of near fatal asthma. *Thorax* 1995;**50**: 254–9.
8 Kolbe J, Vamos M, Fergusson W. Socio-economic disadvantage, quality of medical care and admission for acute severe asthma. *Aust NZ J Med* 1997;**27**:294–300.
9 Dirks JF, Kinsman RA. Clinical prediction of medical rehospitalization: psychological assessment with the Battery of Asthma Illness Behaviour (BAIB). *J Pers Assess* 1981;**45**:608–13.
10 Jones NF, Kinsman RA, Dirks JF, *et al*. Psychological contributions to chronicity in asthma: patient response styles influencing medical treatment and its outcome. *Med Care* 1979;**17**:1103–18.
11 Garrett JE, Mercer Fenwick J, Taylor G, *et al*. Peak flow expiratory flow meters: who uses them and how does education affect the pattern of utilisation? *Aust NZ J Med* 1994;**24**:521–9.
12 Lahdensuo A, Haahtela T, Herrala J, *et al*. Randomised comparison of cost effectiveness of guided self management and traditional treatment of asthma in Finland. *BMJ* 1998;**316**:1138–9.
13 Lin S, Fitzgerald E, Hwang SA, *et al*. Asthma hospitalization rates and socioeconomic status in New York State (1987–1993). *J Asthma* 1999;**36**:239–51.
14 Lang D, Polansky M. Patterns of asthma mortality in Philadelphia from 1969 to 1991. *N Eng J Med* 1994;**331**:1542–6.
15 American Thoracic Society. Standardization of spirometry 1987 update. *Am Rev Respir Dis* 1987;**136**:1285–98.
16 Sterk PJ, Fabbri LM, Quanjer PH, *et al*. Airway responsiveness. Standardized challenge testing with pharmacological, physical and sensitizing stimuli in adults. Report Working Party Standardization of Lung Function Tests, European Community for Steel and Coal. Official Statement of the European Respiratory Society. *Eur Respir J Suppl* 1993;**16**: 53–83.
17 Australian Bureau of Statistics. *Australian now: a statistical profile*. Canberra: Commonwealth of Australia, 1999.
18 National Asthma Education and Prevention Program. *Expert panel report 2: guidelines for the diagnosis and management of asthma*. Publication No. 97-4051. 1997. Bethesda, Maryland: NIH/National Heart, Lung, and Blood Institute, 1997.
19 Wakefield M, Staugas R, Ruffin RE, *et al*. Risk factors for repeat attendance at hospital emergency departments among adults and children with asthma. *Aust NZ J Med* 1997;**27**:277–84.
20 Ruffin R, McCaul K, Wakefield M. A comparison of observed hospital admission rates for asthma with self-reported admission rates derived from the South Australian Health Omnibus Surveys. *Proceedings of Thoracic Society of Australia & New Zealand Annual Scientific Meeting*. Adelaide, South Australia: 1998, 139.
21 Sherbourne CD, Hays RD, Ordway L, *et al*. Antecedents of adherence to medical recommendations: results from the Medical Outcomes Study. *J Behav Med* 1992;**15**:447–68.
22 Pilowsky I, Spence ND. *Manual for the illness behaviour questionnaire (IBQ)*. 2nd edition. Adelaide, Australia: University of Adelaide, 1983.
23 Osman LM, Russell IT, Legge JS, *et al*. Predicting patient attitudes to asthma medication. *Thorax* 1993;**48**:827–30.
24 Dekker FW, Dieleman FE, Kaptein AA, *et al*. Compliance with pulmonary medication in general practice. *Eur Respir J* 1993;**6**:886–90.
25 Gibson PG, Talbot PI, Toneguzzi RC. Self-management, autonomy, and quality of life in asthma. *Chest* 1995;**107**: 1003–8.
26 Schlosser M, Havermans G. A self efficacy scale for children and adolescents with asthma; construction and validation. *J Asthma* 1992;**29**:99–108.
27 Kaplan GA, Camacho T. Perceived health and mortality: a nine-year follow-up of the Human Population Laboratory cohort. *Am J Epidemiol* 1983;**117**:292–304.
28 Hays RD, Hayashi T, Stewart AL. A five-item measure of socially desirable response set. *Educational and Psychological Measurement* 1989;**49**:629–36.

29 Brooks WB, Jordan JS, Divine GW, *et al*. The impact of psychological factors on measurement of functional status. *Med Care* 1990;**28**:793–804.
30 Gibson PG, Coughlan J, Wilson AJ, *et al*. *Self-management education and regular practitioner review for adults with asthma (Cochrane Review)*. Issue 4. Oxford: The Cochrane Library, 1999.
31 van der Palen J, Klein JJ, Zeilhuis GA, *et al*. The role of self-treatment guidelines in self-management education for adult asthmatics. *Respir Med* 1998;**92**:668–75.
32 Rand CS, Wise RA. Measuring adherence to asthma medication regimens. *Am J Respir Crit Care Med* 1994;**149**:S69–76.
33 Henderson AS. Social support: the concept and the evidence. *Epidemiol Psichiatria Sociale* 1992;**1**:161–3.
34 Adams S, Pill R, Jones A. Medication, chronic illness and identity:the perspective of people with asthma. *Soc Sci Med* 1997;**45**:189–201.
35 Donaldson JM. A patient's view of asthma. *J R Soc Med* 1995;**88**:590–3P.
36 Raymond D, Henry RL, Higginbotham N, *et al*. Predicting readmission to hospital with asthma. *J Paediatr Child Health* 1998;**34**:534–8.
37 Asthma in America™ Survey Project. *Executive summary*. Research Triangle Park, North Carolina: Glaxo Wellcome, 1999.