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A randomized controlled evaluation of specialist nurse education following accident and emergency department attendance for acute asthma

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We investigated whether hospital-based specialist asthma nurses improved recognition and self-treatment of asthma episodes by patients followed up after attending accident and emergency departments (A&E) for asthma exacerbations.

We carried out a randomized prospective controlled trial of adult asthma self-management, following a hospital outpatient nurse consultation in two outer-London District General Hospitals (secondary care centres).

The study included 211 adults, over 18 years old (mean age 40 years) who attended for asthma in two accident and emergency departments over 13 months. One hundred and eight evaluable patients were randomized into the control group who continued with their usual medical treatment and were not offered any intervention during the study period.

One hundred and three evaluable patients were randomized into the intervention group. They were offered three 6-weekly outpatient appointments with one of two specialist asthma nurses for a structured asthma consultation, after attendance at the accident and emergency department. Following assessment of their asthma treatment and control, the nurses advised patients, through the use of self-management-plans, how to recognize and manage uncontrolled asthma and when to seek medical assistance. Medication and inhaler device type were altered if necessary

The primary outcome was patient reported self-management of asthma exacerbations for 6 months. Secondary outcomes were assessed at baseline, 3 months and 6 months. These included home peak flow and symptom diaries, structured telephone questionnaires and audit of general practitioner records to determine utilization of services (6 months before and after A&E). Data were analysed on an intention to treat basis by multiple and logistic regression.

The intervention group increased their use of inhaled topical steroids in 31/61 (51%) *vs.* 15/70 (21%) attacks in controls (OR 3·91 CI 1·8–8·4, $P<0·001$) and their use of rescue medication in 54/61 (89%) severe attacks *vs.* 53/70 (76%) controls (OR 2·88 CI 1·1–7·9, $P<0·05$). Intervention patients had significantly higher (mean 20·11min^{-1}; CI 0·4–39·7; $P<0·05$) and less variable PEF and significantly lower and less variable symptom scores 6 months after entry. Thirty-four percent of intervention patients *vs.* 42% controls had severe attacks (61 and 70 respectively, OR 0·96 CI 0·7–1·4) during the 6 months. Intervention patients had fewer days off work than controls in the first 3 months (NS) but similar days off during the 6-month period. Intervention patients had fewer episodes away from work in the first (0·34 *vs.* 0·54, $P=0·08$) and the second 3 months (0·25 *vs.* 0·30, NS) than the controls. Over 80% of the patients records were audited by their general practitioners; the active group had less routine consultations with the doctor ($P=0·03$) and practice nurse ($P=0·03$), less consultations for uncontrolled episodes ($P=0·06$) and less hospital visits (NS) than the controls.

Hospital-based specialist nurses reduced asthma morbidity by improving patient self-management behaviour in acute attacks leading to reduced symptoms, improved lung function, less time off work and fewer consultations with health professionals.

Key words: randomized controlled trial (RCT); asthma; specialist nurse; interface; peak expiratory flow; self-management.

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Introduction

Although many episodes of asthma are treated in general practice (1), 66–88% of those presenting to accident and emergency departments (A&E) refer themselves directly without consulting their own doctor (2–4). Attendance at A&E with acute asthma is usually due to acute symptoms and poor control, but over 10% attend because they have run out of medication (5), suggesting that A&E may provide a primary care role for some patients. Such patients may have more severe disease and lack education in self-management and disease monitoring.

In this study, we investigated whether patient education by hospital based specialist asthma nurses, using guided self-management plans based on nationally agreed guidelines, could improve patient recognition and self-treatment of asthma.

Method

RECRUITMENT, PATIENTS AND SETTING

Following Ethics Committee approval, we enrolled patients over 18 years of age through prospective, rolling recruitment. We obtained informed written consent from those attending A&E or admitted to hospital for uncontrolled asthma, over a 13-month period. Patients' consent was either obtained in A&E on presentation or through daily audit of the attendance register followed by written invitation. This recruitment method was used successfully in a previous study where we obtained consent to participate from 156/233 patients attending A&E in three local hospitals (5). Patients were randomized consecutively into intervention and control groups using equal blocks of four generated using the Clinstat program developed by Martin Bland (http://www.sghms.ac.uk/depts/phs/staff/jmb). This was done by the two nurses at their respective hospitals, by first producing two patient lists, by date order of receipt of their consent forms (i) completed when attending or (ii) returned by post. Patients who had a previously recorded diagnosis of chronic obstructive pulmonary disease were excluded. Patients in the two lists at each hospital were then randomized by allocation to the intervention or control group, from two lists of random numbers, in blocks of four. The nurses had no idea which group the patients would be randomized into, however, once randomized they became aware in order to proceed and invite intervention group patients to attend. The control group was not offered any treatment by the nurses; they simply continued with their usual medical treatment from their general practitioner.

STAFFING

(i) Two respiratory nurses trained in asthma care (NARTC Diploma), were based at Edgware and Barnet General hospitals, for 2 years. They were responsible for recruitment, randomization, consultation and facilitation of patient self-management in the intervention group.

(ii) An interviewer (MR), blinded to the patients randomization status, conducted four structured telephone interviews using the St George's Respiratory Questionnaire (SGRQ) (6) and an assessment questionnaire, described below. The first, third and fourth interviews included the SGRQ and the complete assessment questionnaire and the second only included the self-management sections of the assessment questionnaire. Interviews took place at about 2 weeks after randomization (baseline), 6 weeks, 3 and 6 months after randomization.

PATIENT EDUCATION (THE INTERVENTION)

The intervention group was invited to attend a 1 h consultation with one of the nurses beginning 2 weeks after entry to the study, followed by two more lasting half an hour, at 6-weekly intervals. The second and third could be substituted by a telephone call. Patients were phoned, by the nurse before each appointment in order to improve attendance rates. Patient's asthma control and management were assessed (7) followed by education on recognition and self-treatment of episodes of asthma (see Fig. 1 for a summary of the assessment procedure).

Thus patients were taught to step-up medication when they recognized uncontrolled asthma using PEF or symptoms. The advice was in accordance with national guidelines (12). Prescriptions were obtained from one of the doctors in the clinic or by providing the patient with a letter to their general practitioner. Patients presenting with severe asthma (severe symptoms or PEF below 60% of their best/normal) were referred immediately to the consultant.

OUTCOME MEASURES, OVER 6 MONTHS

(i) The primary outcome measure was the patients' reported, appropriate, adherence to self-management

The nurses:

(i) established the patients' understanding of asthma, their current treatment, their trigger factors and symptoms as well as guided self-management using PEF measurements;
(ii) assessed PEF, reversibility and inhaler technique (8);
(iii) expanded the patients knowledge to include a basic understanding of asthma and the medication used for prevention and relief; and
(iv) provided a validated, guided self-management 'credit card plan' (9,10) modified with lines drawn on the peak flow charts at 80%, 60% and 40% of best or predicted peak expiratory flow (PEF) (11).

FIG. 1. Summary of the assessment procedure during the nurse consultations (7).

(i) Have you had any episodes of wheezing or coughing or shortness of breath during the last two/six weeks? Bad enough to prevent daily activity (work/leisure)?;
(ii) What treatment did you take and what did you do when you had these symptoms?; (if medications were increased, which: Bronchodilator or Inhaled Steroids?);
(iii) Did you measure your Peak Flow Rate?;
(iv) Did you start a short course of oral cortisone?
(v) Did you go to your GP?;
(vi) Did you go to hospital?

FIG. 2. Self-management questions (14,15)

Episodes of asthma:-

(i) which the patient regarded as severe, i.e. asthma has caused person to wake at night, or severe difficulty in breathing or where relief medication (β_2-agonist bronchodilators) is not working as it usually does; or
(ii) which resulted in attendance at A & E; or
(iii) which resulted in attendance at the GP/nurse (not for routine follow up); or
(iv) which resulted in, a home visit for asthma; or
(v) which resulted in hospital admission.

FIG. 3. Definition of severe attacks

plans. The assessment questionnaire contained two parts: (a) extracts from a previously validated questionnaire (13) (with permission), on demography and morbidity and (b) previously piloted questions (see Fig. 2) to assess patient reported self-management (14,15) of mild attacks within the previous 2 weeks or severe attacks (Fig. 3 for definition) in the previous 6 weeks.

(ii) A second outcome measure was a self-completed, 1 week, diary card (modified from a 2 week chart, with permission from Professor Bonnie Sibbald). These cards were posted to all patients on three occasions: baseline, i.e. before intervention in the active group, and after 3 and 6 months. The first mailing included a Mini-Wright peak flow meter, with the American Thoracic Society scale and with clear written instructions on how to perform the readings. Patients recorded the best of three PEF readings in the morning and evening, and symptom scores daily for 7 days (see Fig. 4).

(iii) Quality of life was assessed by the SGRQ (6), which enabled the calculation of four scores for each interview (symptoms, activity, impacts and a total) ranging from 0 (excellent quality of life) to 100 (poor).

(iv) Patients' use of medical services (A&E audits, GP audits 6 months before and after the study, asthma-nurse consultations in the active group only) was assessed.

(i) Did you wheeze or cough last night? (0 = none; 1 = woke once; 2 = woke twice and 3 = woke over two times).
(ii) Did you wheeze or cough during today? (0 = none; 1 = a little; 2 = a moderate amount and 3 = a lot). and
(iii) Did your asthma interfere with your daily activities? (0 = none; 1 = a little; 2 = a moderate

FIG. 4. Self-completed diary card symptom questions. Three symptom questions were assessed. They were scored from 0 to 3; these scores were added together giving a possible range of 0 to 9 for total symptom score.

(v) The process of care delivered by the nurses was documented and audited. Symptom scores at consultation ranged from 0–5 (one point for each symptom; cough, wheeze, shortness of breath, pain, difficulty in breathing) and inhaler technique scores ranged from 1–4 (8).

STATISTICAL ANALYSIS

A power calculation (Clinstat) determined that 127 patients were required in each group in order to demonstrate an improvement, in the primary outcome measure, from 40 to 60% in the proportion of appropriate self-treated episodes of asthma with 95% confidence at the 5% level.

An intention to treat analysis was performed using logistic regression for binary, patient reported self-management data and by the Wilcoxon-signed-ranks test for paired data in the active group between the first and second, and the first and third asthma-nurse consultations. It was not possible to transform the general practice audit data so the Mann–Whitney *U*-Wilcoxon rank sum test was used. These analyses were performed by Mark Levy using SPSS/PC version 5·0 for DOS.

The diary card analysis was performed by Martin Bland using the Stata package (16). The data were summarized as follows: mean PEF over 7 days, standard deviation of PEF over 7 days, as a measure of variability, and the mean and SD of symptom score over 7 days. Cases were regarded as missing if the PEF SD was zero. The PEF SDs and the mean symptom score were transformed using log for PEF SD and log $(x + 1)$ for the purpose of analysis of the mean and SD of the symptom scores. These transformations produced a good fit to the Normal distribution for PEF SD, and a reasonable fit for the score mean and SD (checked by histograms). Analysis: multiple regression was used to compare the second or third sets of peak flow and symptom data for the two groups with the first (baseline) visit values of these variables. Thus our analysis compared the individual patients' baseline values of PEF and symptom score to those obtained 3 and 6 months after entry into the study.

Standard deviations of all available observations during the week were used as the measure of variability for PEF

and symptom diaries. This approach is efficient because it uses all the data and so gives the maximum information. The only analyses of diary data carried out were of mean and standard deviation, so these were not chosen because they gave significant differences.

Results

Patients were recruited from 940 A&E asthma consultations by approximately 600 patients, during the 13 month period. Twenty-six patients, outside the protocol (not asthma, COPD, wrong age group) were inadvertently recruited (14 were assigned to the intervention group, seven to the control group and five were unassigned); this left 211 evaluable patients (103 intervention and 108 controls) participating in the study. The two groups were similar with respect to age, sex, severity of asthma and response to treatment (see Table 1). The baseline data for those recruited were similar to data obtained from the patients who declined entry to the study indicating that our sample was representative of the asthma population utilizing these departments (Table 1). After the initial A&E consultation, the intervention and control groups re-attended the two A&E departments for a further 36 and 39 consultations respectively (NS) during the study period.

Seventy-nine (77%), 61 (59%) and 39 (38%) of the intervention group patients attended one, two and three nurse outpatient appointments respectively. A further four and 20 intervention patients had telephone consultations with the nurse instead of attending the second and third outpatient appointments respectively; increasing the numbers given advice at the second consultation to 65 (63%), and third to 59 (57%). Thirty-two patients (20 intervention) withdrew during the course of the study. Although only 77% of the 103 intervention patients attended at least one nurse consultation, the intention-to-treat analysis included data for all. At least 79% of the intervention and 87% of the control group were interviewed, all four times by the interviewer (Monica Robb) during the 6 month study period (see Table 2); some patients who had withdrawn from the study completed the fourth interview, because the interviewer was not aware of their withdrawal.

RESULTS OF THE OUTCOME MEASURES

(i) *Patient reported self-management:* after entry (interviews 2–4), 14 (14%) of the intervention and 19 (18%) control patients had had mild episodes of asthma in the study period during the 2 weeks before interview (19 and 22 attacks respectively, NS). The intervention group reported that they had increased their use of inhaled steroids in 9/19 (47%) *vs.* 5/22 (23%) mild attacks in controls (OR 3·06 95% CI 0·79–11·73), and their rescue medication in 17/19 (89%) *vs.* 18/22 (82%) of mild attacks respectively (OR 1·89, 95% CI 0·31–11·68). Thirty-five (34%) of the intervention *vs.* 45 (42%) control patients had had severe attacks in the 6 weeks before the interviews (61 and 70 severe attacks respectively, NS) during the study period. The intervention group reported that

TABLE 1. Entry demography for patients recruited (Some data for those who declined entry to the study are also shown)

	Intervention ($n = 103$ patients)	Control ($n = 108$ patients)	Those who declined ($n = 654$ A&E attendances)
Age (SE)	43 (2)	40 (2)	37·33 (0·69)
Sex (m/f)	34/69	46/62	311/343
	33%/67%	43%/57%	48%/52%
Patients refferred by GP	27 (26%)	28 (26%)	107 (16%)
Patients nebulized in A&E	81 (79%)	85 (79%)	494 (76%)
Patients prescribed oral steroids	63 (61%)	71 (66%)	321 (49%)
Patients admitted	30 (29%)	38 (35%)	178 (27%)
Peak Expiratory Flow data:			
Before Rx in A & E:			
Median PEF (IQR)	230 (160, 320)	225 (150, 321)	240 (160, 330)
	($n = 84$)	($n = 94$)	($n = 487$)
%Predicted PEF*	49·08%	44·77%	–
	($n = 81$)	($n = 84$)	
After Rx in A&E:			
Median PEF	340 (250, 420)	340 (200, 410)	340 (240, 400)
	($n = 65$)	($n = 71$)	($n = 382$)
% Predicted PEF*	62·77%	59·54%	–
	($n = 62$)	($n = 63$)	

* % Predicted peak flow (calculated retrospectively from age & height obtained by interview, formula courtesy of Dr Martin Miller)

TABLE 2. Numbers (%) of patients interviewed

Interview number	Intervention group ($n=103$) n (%)	Control group ($n=108$) n (%)
1: Baseline	99 (96)	103 (91)
2: 6 weeks (only self-management)	87 (84)	94 (87)
3: 3 months	81 (81)	96 (89)
4: 6 months	86 (79)	95 (88)

TABLE 3. Numbers (%) of patients returning diary charts

	Baseline	3 Months	6 Months
Intervention	77 (75)	58 (56)	47 (46)
Control	70 (65)	53 (49)	46 (43)
Total	147 (70)	111 (53)	93 (44)

they had increased their use of inhaled topical steroids in 31/61 (51%) severe attacks *vs.* 15/70 (21%) in controls (OR 3·91 CI 1·8–8·4, $P<0·001$) and their use of rescue medication in 54/61 (89%) severe attacks *vs.* 53/70 (76%) controls (OR 2·88 CI 1·1–7·9, $P<0·04$).

Intervention patients had fewer days off work than controls in the first 3 months (NS) and had similar numbers of days off work (median 0 days in both; ranges 0 to 21 and 0 to 86 days respectively) during the 6 month study period. The intervention group had fewer episodes away from work in the first (0·34 *vs.* 0·54, $P=0·08$) and the second 3 months (0·25 *vs.* 0·30, NS) than the controls.

(ii) *Diary records*: There was some loss of subjects returning diary cards during the study, but the loss was similar in the two groups (Table 3). Initial values for all variables are shown in Table 4.

In the 3 month diaries (Table 5), mean PEF was $15 l min^{-1}$ less in the control group though this was not significant. The SD of the PEF was greater in the control group ($P<0·02$), as was mean symptom score (NS) and standard deviation of the symptom score (NS). Six months after entry to the study (Table 6) these trends continued being statistically significant. Intervention patients had significantly higher (mean $20·11 l m^{-1}$, CI 0·4; 39·7, $P<0·05$) and less variable PEF ($P<0·001$) and significantly lower ($P=0·01$) and less variable ($P=0·01$) symptom scores 6 months after entry into the study.

We considered that selective dropout of patients during the study may explain the significant results at 6 months, however Table 7 shows data at 3 months for those subjects having data at 6 months only. The differences are very similar to those for the whole group at 3 months, and not like those at 6 months. Thus we cannot ascribe the differences between treatment and control subjects at 6 months to selective dropout.

(iii) *St George's Respiratory Questionnaire:* The results of the baseline, 3 months and 6 months questionnaires are shown in Table 8 (Interviews performed in 95% and 91% of the intervention control groups of patients respectively). The quality of life scores improved significantly in both groups, apparently more so for symptoms in the control group. There was no statistically significant difference in the scores between the groups.

(iv) *GP Audit data (Table 9):* Eighty-seven (84%) intervention and (80%) control patients' general practitioners returned extracts from their records for the 6 months before and 67 (65%) and 69 (64%) after

TABLE 4. Baseline values

	Intervention		Control	
	Mean	SD	Mean	SD
Mean PEF	314·29	122·85	328·3	121·03
SD of PEF	33·33	17·44	27·06	21·47
SD of PEF [log(x)]	3·36	0·56	3·44	0·60
Mean score	2·46	1·96	3·02	2·49
Mean score [log(x + 1)]	1·10	0·54	1·17	0·71
SD of score	1·05	0·78	1·24	0·84
SD of score [log(x + 1)]	0·65	0·36	0·74	0·39

TABLE 5. Three months after entry

	Mean Intervention-control	SE	*t*	*P*	95% CI
PEF mean	15·16	8·35	1·82	0·07	−1·4, 31·71
PEF SD (log)	−0·23	0·09	−2·46	<0·02	−0·42, −0·05
Score mean (log x + 1)	−0·12	0·10	−1·28	0·20	−0·3, 0·07
Score SD (log x + 1)	−0·10	0·07	−1·51	0·14	−0·2, 0·03

TABLE 6. Six months after entry

	Mean Intervention-control	SE	*t*	*P*	95% CI
PEF mean	20·05	9·89	2·03	<0·05	0·40, 39·70
PEF SD (log)	−0·43	0·11	−3·99	<0·001	−0·65, −0·22
Score mean (log x + 1)	−0·33	0·13	−2·50	0·01	−0·59, −0·07
Score SD (log x + 1)	−0·22	0·08	−2·89	0·005	−0·37, −0·07

TABLE 7. Three months: patients with a six month diary only

	Mean Intervention-control	SE	*t*	*P*	95% CI
PEF mean	17·81	9·94	1·79	0·08	−1·97, 37·59
PEF SD (log)	−0·18	0·11	−1·62	0·11	−0·40, 0·04
Score mean (log x + 1)	−0·18	0·11	−1·62	0·11	−0·40, 0·04
Score SD (log x + 1)	−0·13	0·08	−1·72	0·09	−0·29, 0·02

TABLE 8. St George's respiratory questionnaire scores

	Baseline			3 months			6 months		
	Interv. Mean (SD) *n* = 99	Control mean (SD) *n* = 98	95% CI differences between means	Interv. Mean (SD) *n* = 99	Control mean (SD) *n* = 98	95% CI differences between means	Interv. Mean (SD) *n* = 99	Control mean (SD) *n* = 98	95% CI differences between means
Symptoms	55·42 (17·43)	56·01 (19·05)	−5·72, 4·54	41·67 (19·17)	44·19 (20·76)	−8·13 to 3·09	45·67 (22·86)	38·12 (21·98)	1·25, 13·9*
Activity	35·55 (25·58)	37·70 (25·27)	−9·30, 5·00	33·86 (22·80)	35·73 (26·74)	−8·85 to 5·11	32·29 (25·18)	32·07 (26·76)	−7·08, 7·52
Impacts	29·70 (17·16)	32·25 (17·83)	−7·47, 2·37	24·83 (18·29)	27·14 (20·18)	−7·72 to 3·10	24·27 (20·59)	23·88 (17·89)	−5·03, 5·81
Total scores	35·74 (17·51)	37·85 (17·91)	−7·09, 2·87	30·36 (17·87)	32·58 (20·48)	−7·62 to 3·18	30·25 (17·51)	28·73 (17·91)	−4·05, 7·09

entry to the study. After entry to the study, the intervention group had significantly less routine consultations with the doctor ($P<0·05$) and the practice nurse ($P<0·03$), less consultations for uncontrolled episodes (NS) and less hospital visits (NS) than the controls.

(v) *Intervention group data from nurse consultations (Table 10):* Only 10/79 (13%) of the intervention

Table 9. GP audit data

	Before		After		Mann-Whitney *U*-wilcoxon rank sum W test comparing intervention and controls z scores-2-tailed *P*-values	
	Intervention ($n = 87$)	Controls ($n = 86$)	Intervention ($n = 67$)	Controls ($n = 69$)	Before	After
Routine GP consultations						
Median	1	1	1	1		
Range	0 to 15	0 to 32	1 to 6	1 to 23	−1·1302 $P > 0·2$	−1·9643 $P < 0·05$
Routine Practice Nurse consultations						
Median	0	0	0	0		
Range	0 to 9	0 to 5	1 to 5	1 to 8	−0·5536 $P > 0·5$	−2·1808 $P < 0·03$
Emergency GP consultations						
Median	0	0	0	0		
Range	0 to 9	0 to 9	1 to 7	1 to 7	−0·5630 $P > 0·5$	−1·5375 $P = 0·14$
Hospital consultations						
Median	0	0	0	0		
Range	0 to 3	0 to 6	1 to 3	1 to 6	−2·4654 $P > 0·2$	−1·3372 $P = 0·17$

Table 10. Intervention group consultations

	First consultation	Second consultation	Third consultation
Numbers attending	79	61	39
Numbers phoned		4	20
Total	79	65	59
Patients attending who required daily relief medication	60/79 (76%)	46/61 (75%)	34/59 (57%)
Symptom scores		3 (2, 4)	2 (1, 3)
Medians	4 (2, 5)	$P < 0.005$*	$P < 0.005$*
(Interquartile range)		(65 pairs data)	(59 pairs data)
Inhaler technique:		4 (3,4)	4 (4, 4)
Medians	3 (2, 4)	$P < 0.0001$*	$P < 0.0001$**
(Interquartile range)		(61 pairs data)	(39 pairs data)
Percentage of consultations	15 (increased Rx)	13 (increased Rx)	3 (increased Rx)
where nurses altered	15 (decreased Rx)	12 (decreased Rx)	12 (decreased Rx)

Wilcoxon matched-pairs signed-ranks test:
*Comparisons between 1st and 2nd consultations;
*comparisons between 1st and 3rd consultations.

group patients who consulted the nurses had previously been given a written self-management plan. Although 37% were using a PEF diary at the first consultation, this increased to 71% by the third. Symptom scores reduced significantly from the first to the third consultation: median scores (IQR) = 4 (2,5), 3 (2,4) and 2 (1,3); first to second ($P < 0·005$) and first to third ($P < 0·0001$); inhaler technique scores increased significantly: medians (IQR) = 3 (2,4), 4 (3,4) and 4 (4,4); first to second and first to third ($P < 0·0001$); the percentage of patients who reported requirement for daily relief medication decreased (76%, 71% and 58%) and the nurses advised patients to step their medication up in 15%, 13% and 3% and down in 15%, 12% and 12% during the three consultations, respectively.

Discussion

Our study addresses an important interface between primary and secondary care and has direct applicability

to patients who present with acute asthma in the Accident and Emergency Unit. Unlike previous studies on A&E asthma care, we have followed these patients for a long period and assessed the subsequent effect of self-management on both hospital and primary care usage. The intervention delivered by trained asthma nurses, following attendance for acute asthma, produced a reduction in morbidity and usage of health services. The nurses were trained and supervised together and covered for each other during leave of absence, so it was difficult to assess whether there was any practitioner effect. A key feature of the intervention included a detailed assessment of the patients understanding and control of their asthma (7) (see Fig. 1). This study has demonstrated changes in patient reported self-management, during attacks, following education; a factor which may partially explain the outcomes in this population. The diary card data corroborated by the GP record audits provided objective evidence of patients' improved clinical condition. Our nurses followed strict protocols and used data collection sheets which served as a record for the hospital notes as well as a means of communication with the patients' general practitioner. This idea was based on previous work by Town *et al.* (17) who demonstrated that management, record keeping and follow up improved through the use of an assessment sheet in A&E.

A systematic review of 23 randomized controlled trials which compared self-management education with usual care (18), concluded that optimal asthma self-management education involving self-monitoring, by either PEF or symptoms, was more effective than treatment which did not include a written plan. Although self-management education reduced hospitalizations, emergency room visits, and unscheduled visits to the doctor, there was significant heterogeneity in the results related to the latter two variables. Reduction in days off work varied according to the way this was reported in the studies; as days off or number of patients off work. With optimal education (defined in the review as: regular medical review, self-monitoring and individualized written action plan), there was a significant reduction in days off work without heterogeneity. Improvements in PEF were marginal (18). While we have demonstrated improvements in symptom scores on diary charts and during nurse consultations (intervention group only), the quality of life in our control group patients improved as well as intervention group. Furthermore, compared with the controls, the intervention patients attended their GP and nurse significantly less frequently for routine consultations, and as frequently for uncontrolled asthma, despite having had a similar number of mild and severe asthma attacks. In slight contrast to the studies in the systematic review, our peak flow data demonstrated significant improvement in the intervention group 6 months after entry. Three possible explanations for these results are: the long telephone, questionnaire interviews may have inadvertently improved the well being of the control group patients (Hawthorne effect); alternatively, the fact that these patients were recovering from an acute exacerbation of asthma may have led to a relative sense of well being and thus improved quality of life; i.e. as a result of regression towards the mean; the third and most likely explanation is that the intervention group acquired a heightened awareness of their symptoms with a knock on effect of increasing reporting, and perhaps improved confidence in self-management demonstrated by their reduced utilization of routine primary care consultations. While, the mean increase in PEF reported in the systematic review was 'marginal' ($8{\cdot}41\,\mathrm{min}^{-1}$), our intervention patients who returned diary cards demonstrated a greater mean increase in peak flow from baseline to 3 and 6 months after entry to the study.

While it is clear that optimal education with written self-management plans are beneficial, the review studies (18) and our own study have demonstrated heterogeneity in the outcomes, which raises questions regarding the selection of outcomes in this type of research. Education raises awareness of asthma symptoms and the need to seek medical assistance at times, therefore possibly affecting outcome. For example, when patients' asthma is out of control, increased symptom reporting, emergency attendances and the use of short courses of oral steroids may be entirely appropriate. In fact, in one of the studies reported in the systematic review (18), control patients were instructed to visit the doctor or emergency room as part of their management (19). There is therefore a clear need for an agreed minimum data set for routine and research use in the management of people with asthma.

We could be criticized that our sample is not representative of the population at large. Table 1 provides a demographic comparison between the population recruited and those who declined, represented by the attendances of the latter group at our study hospitals; number of attendances is used rather than the actual number of patients as the latter value is unknown. Table 1 provides strong evidence that the patients recruited were comparable with those who were not. Recruitment of patients from A&E for research is difficult; so is the estimation of numbers of patients as opposed to consultations in the A&E department. We know the total number of A&E attendances for asthma during the study period ($n = 940$). Our 211 recruited patients consulted 286 times including the initial A&E consultation; an attendance rate of 1·33 during the study period. We therefore estimate that the remaining 654 consultations were made by 492 patients who declined entry to the study and our estimated recruitment rate is therefore 43% (211 out of 492) which we believe is fairly good for this type of study.

In this paper, we have also presented a useful, practical research methodology using mean and standard deviation for analysing PEF and symptom diary cards. By using the baseline data as a co-variate in multiple regression analysis, the need for baseline normal data is conveniently eliminated. Higgins *et al.* (20) previously suggested the use of either amplitude % mean or standard deviation % mean of PEF to assess variability in epidemiological studies. In our study, we did record the patient height (telephone interview), which enabled us to determine the predicted PEF values for both groups.

That the nurses needed to increase (step-up) medication in 15% of active patients attending for their first consultation and that active and control patients re-attended on 63 and 84 occasions respectively, during the 6 month follow-up period, indicates a need for improved A&E strategies for management. We did not formally assess the economic effects of our intervention and therefore we find it difficult to make firm recommendations for employing nurses in A&E departments. In view of the relatively low number of asthma consultations by adults in each A&E department (about one per day), it would seem unjustified to employ a nurse (day and night) with sole responsibility for asthma in these departments. However, departments with a higher throughput of patients with asthma may conclude it sensible to ensure there is always a nurse on duty (in A&E or institution wide) with additional training in this field.

Hospital-based specialist nurses reduced asthma morbidity by improving patient self-management behaviour in acute attacks leading to reduced symptoms, improved lung function, and resulted in less time off work and fewer consultations with health professionals.

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