

## Hospital admissions for asthma in east London: associations with characteristics of local general practices, prescribing, and population

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### Abstract

**Objective:** To determine the relative importance of appropriate prescribing for asthma in explaining high rates of hospital admission for asthma among east London general practices.

**Design:** Poisson regression analysis describing relation of each general practice's admission rates for asthma with prescribing for asthma and characteristics of general practitioners, practices, and practice populations.

**Setting:** East London, a deprived inner city area with high admission rates for asthma.

**Subjects:** All 163 general practices in East London and the City Health Authority (complete data available for 124 practices).

**Main outcome measures:** Admission rates for asthma, excluding readmissions, for ages 5-64 years; ratio of asthma prophylaxis to bronchodilator prescribing; selected characteristics of general practitioners, practices, and practice populations.

**Results:** Median admission rate for asthma was 0.9 (range 0-3.6) per 1000 patients per year. Higher admission rates were most strongly associated with small size of practice partnership: admission rates of singlehanded and two partner practices were higher than those of practices with three or more principals by 1.7 times (95% confidence interval 1.4 to 2.0,  $P < 0.001$ ) and 1.3 times (1.1 to 1.6,  $P = 0.001$ ) respectively. Practices with higher rates of night visits also had significantly higher admission rates: an increase in night visiting rate by 10 visits per 1000 patients over two years was associated with an increase in admission rates for asthma by 4% (1% to 7%). These associations were independent of asthma prescribing ratios, measures of practice resources, and characteristics of practice populations.

**Conclusions:** Higher asthma admission rates in east London practices were most strongly associated with smaller partnership size and higher rates of night visiting. Evaluating ways of helping smaller partnerships develop structured proactive care for asthma patients at high risk of admission is a priority.

### Introduction

Hospital admission rates for asthma in east London are among the highest in England and Wales.<sup>1-2</sup> Causes of increasing admission rates nationally and in other developed countries are unclear.<sup>3-5</sup> Admission rates for asthma are an important but poorly understood outcome measure of care and are a priority area for NHS research and development.<sup>6</sup>

Using a univariate analysis, we reported a significant association between admission rates for asthma by individual east London practices and the appropriateness of their prescribing (as the ratio of asthma prophylaxis to bronchodilator prescribing).<sup>7-8</sup> This relation was strongest for patients aged 5-64 years, for whom the diagnosis of asthma is most secure.<sup>9-10</sup> However, prescribing may be only one of many factors that relate to admission rates. Other candidates are a general practice's organisation and resources and patient factors. We report a multiple regression analysis of admission rates for asthma for patients aged 5-64 from east London practices with relevant characteristics of general practitioners, practices, prescribing behaviour, and practice populations.

### Methods

Our general practice database holds comprehensive information on all 163 practices in contract with East London and the City Health Authority, including practice characteristics, organisational details, staffing levels, and performance indicators.<sup>7-8-11</sup>

### Hospital admissions for asthma

Data on admissions of east London residents for asthma were available from the regional information system (primary diagnosis ICD code 493) for 134 of these practices for April 1992 to March 1994.<sup>7</sup> Of these admissions, 98% were acute and 97% were allocated to a general practitioner. For 1991-2, 94% of all admissions had a diagnostic code, as did 97% of admissions for 1993-4.

Our outcome measure was the admission rate for patients aged 5-64 years: we excluded data for young children and elderly people because cough and chronic obstructive pulmonary disease may be mistakenly coded as asthma. We calculated admission rates

per 1000 patients per practice from the average number of patients admitted each year, excluding readmissions within the same year. We excluded readmissions because they represent a special case. The factors associated with readmission are distinct and probably more complex than those associated with admission (such as patient preferences about site of care relating to services such as nebulisation<sup>12</sup> or perceptions of severity).

The numbers of east London residents aged 5-64 on practice lists were the denominators (523 117 and 520 026 in June of 1993 and 1994 respectively). During 1992-4, 945 patients aged 5-64 were admitted (473 in 1992-3, 472 in 1993-4). We pooled data for two years to give enough admissions per practice for our analyses.

### Candidate variables

Before the analysis, we selected candidate variables that could be associated with admission rates. These included doctor characteristics, practice resources, prescribing, and population factors.

We collected data on the resource variables from the files of the family health services authority in June of 1993 and 1994 (see table 1). We categorised the size of partnerships, in full time equivalents, as one principal, more than one but no more than two, and more than two principals (termed singlehanded, two partner, and multipartner) since these best reflected the organisation and resources of east London practices. Other variables were training status, average age of principals, and average period since registration with the General Medical Council (GMC). Possible proxies for workload included list size per doctor and claims for night visits (April 1992 to March 1994) expressed as total, high payments (principal), and low payments (deputised).

We selected practice prescribing markers from prescribing analysis and cost (PACT) data for the same period as admissions (see table 1). These comprised the ratio of asthma prophylaxis to bronchodilator prescribing as items and net ingredient cost<sup>8</sup> and annual average number of asthma drug items per prescribing unit and their net ingredient cost.

We also selected practice population variables that were potentially related to admissions (see table 2). These were proportionally allocated for practices by weighting data at ward level from the 1991 census using postcode distributions of practice lists (details available from authors).<sup>13</sup>

### Statistical analysis

We carried out statistical analyses with SPSS-PC and STATA and used Poisson regression to investigate the association between admission rates and candidate variables.<sup>14 15</sup> Regression analyses were based on the 124 practices with complete data sets. We performed univariate analyses to identify variables significantly associated with admission rates. All variables with a P value of <0.2 in the univariate analyses were initially included in our multiple regression model, and we then used a backward elimination procedure to select the final model.<sup>16</sup> We investigated effects of interaction terms. Likelihood ratio tests were used to assess the significance of candidate variables.

Since a few patients admitted in the first year were readmitted in the second (less than 5%), we

constructed separate models for each year to substantiate our findings. To examine the potential effect of the exclusion of practices with missing data, we constructed a model with notional admission rates for practices lacking admissions data set at zero for singlehanded practices and at the median rate for two partner and multipartner practices.

## Results

The median admission rate for asthma was 0.9 (range 0-3.6) per 1000 patients aged 5-64 per year. Tables 1 and 2 show the distribution of candidate variables.

### Univariate regression analysis

Table 3 shows the regression coefficients and incidence rate ratios from the univariate analyses for the variables that showed significant association with admission rates ( $P < 0.05$ ). For continuous independent variables, the coefficients show the estimated change in the log of the incidence rate ratio for a unit increase in the variable.

Increased incidence rate ratios were mainly associated with practice characteristics rather than those of the practice populations. Small partnership size, absence of a general practitioner trainer, low asthma prescribing ratios, older age of principals, and high rates of night visiting were the most significant factors. Less significant factors included larger list sizes per principal and staffing levels. With regard to practice populations, increased incidence rate ratios were associated with high proportions of the population living in households lacking or sharing amenities and high proportions living in households not owner occupied. Conversely, an increased admission rate was also associated with higher social class.

**Table 1** Distribution of admission rates for asthma, general practitioners' characteristics, practice resources, and prescribing variables in 163 general practices in east London. (Values are median (minimum, maximum) (interquartile range) unless stated otherwise)

Variable	No of practices	Value
Admission rate for asthma for ages 5-64	134	0.9 (0, 3.6) (0.7-1.3)
List size per principal	160	2030 (806, 4973) (1721-2555)
No of night visits/1000 patients/year:	159	27 (0.9, 167) (20-35)
Low payment visits (deputised)	159	19 (0.1, 162) (10-27)
High payment visits (principal)	159	5.1 (0, 134) (1.7-16)
Ratio of asthma prophylaxis to bronchodilator prescribing:		
No of items	158	0.34 (0.09, 0.63) (0.28-0.4)
Net ingredient cost	158	1.1 (0.4, 2.4) (0.9-1.4)
Asthma drugs prescribed/1000 prescribing units:		
No of items	157	382 (136, 1055) (297-459)
Net ingredient cost	157	3624 (1193, 9977) (2780-4681)
Hours of work/week/1000 patients:		
Practice nursing	154	4.7 (0, 18.6) (0-8.2)
Administration	154	25 (0, 76) (17.5-34)
Mean No of years since principals' GMC registration	161	16.9 (3.3, 42) (12.8-23.5)
Mean age of principals (years)	159	49 (33, 69) (42-56)
No (%) of practices:		
With one principal*	163	74 (45)
With two principals*	163	40 (25)
With more than two principals*	163	49 (30)
With general practitioner trainer†	161	17 (11)
Employing practice nurse†	154	102 (66)
Employing practice manager†	154	74 (48)

\*Categorical variable: practices were divided into those with full time equivalents of 1 principal, 1-2 principals, and >2 principals.

†Logical variable: present=1, absent=0.

**Table 2** Distribution of characteristics of practice populations of 163 general practices in east London. (Values are median (minimum, maximum) (interquartile range) unless stated otherwise)

Variable	No of practices	Value
% Of those aged ≥16 unemployed	161	21 (10.4, 28) (19-23)
% Educationally qualified to age ≥18	161	11.5 (4.7, 29) (9.3-15)
% Living in households with head an unskilled worker	159	4.2 (2.3, 8.4) (3.4-4.7)
% Living in households with economically active head in social class IV or V	159	25.5 (15.6, 34) (23-28)
Standardised mortality ratio for those aged <75	159	119 (99, 147) (109-130)
% Of those aged ≥16 permanently sick	159	5.1 (2.5, 6.8) (4.7-5.4)
No of long term sick aged <75 (age standardised):		
Males	159	131 (77, 153) (126-136)
Females	159	137 (88, 167) (131-144)
% Reporting minority ethnicity:		
Black	159	14.1 (3.2, 28) (10-20)
Asian	159	15.5 (4.5, 50) (8-29)
Chinese or other	159	2.8 (1.7, 5.3) (2.2-3.6)
% Living in households where head was born in Pakistan or New Commonwealth	159	28 (7, 57) (22-38)
% Living with a different address one year before 1991 census	159	10.7 (7.9, 15.4) (9.9-11.3)
Practice average population density	161	96 (20, 127) (83-105)
% Of children living in overcrowded circumstances	161	34 (19, 70) (30-38)
% Living in households with more than one person per room	159	16.6 (6.1, 44) (14.6-21)
% Living in households lacking or sharing amenities	159	2.4 (0.3, 4.2) (1.3-3.2)
% Living in lone parent households	159	8.3 (3.8, 14.7) (6.7-9.6)
% Of pensioners living alone	159	40 (32, 45) (37-41)
% Living in households not owner occupied	159	67 (31, 84) (56-77)
% Living in households with no car	159	51 (33, 65) (46-56)

**Multiple regression analysis**

The multiple Poisson regression model showed that partnership size had the strongest association with admission rates for asthma (table 4). Compared with multipartner practices, admission rates in singlehanded practices were 1.67 (95% confidence interval 1.42 to 2.0) times higher and those in two partner practices were 1.33 (1.12 to 1.57) times higher. The only variable that remained significant in the regression model after the inclusion of partnership size was the night visiting rate. No interaction terms were significant. The incidence rate ratio for night visit-

ing was 1.004 (1.001 to 1.007), implying that if the night visiting rate increased by 10 visits per 1000 patients over two years then the admission rate would increase by 4% (1% to 7%).

**Analysis of separate years and excluded practices**

Most variables remained constant over the two years. We observed similar results when admission rates in the two years were analysed separately, although the association with night visiting rate was weakened in the multiple regression analysis. Of the 39 practices without complete data, 29 lacked admission data and 10 had other explanatory variables missing. Compared with the 124 included practices, the 39 excluded practices were less likely to employ a nurse, had a lower mean ratio of asthma prophylaxis to bronchodilator prescribing, and comprised a higher proportion of singlehanded practices (60% v 40%).

The 22 singlehanded practices that were excluded were similar to singlehanded practices that were included for all explanatory variables but two: they were less likely to employ a nurse and had a smaller mean list size per doctor. Associations with partnership size and night visiting rate were retained when we modelled the data using notional admission rates for practices lacking data on admissions (details available from authors). Thus the absence of these practices from our main analysis would be highly unlikely to alter our conclusions.

**Partnership size and practice resources**

Table 5 summarises aspects of practice resources by partnership size. In east London 45% of practices were singlehanded, compared with 12% in England and Wales.<sup>17</sup> Less than half of the singlehanded practices had a practice nurse, less than a third had a manager, and only one had a general practitioner trainer. Smaller partnerships had on average greater list sizes per principal, lower ratios of asthma prophylaxis to bronchodilator prescribing, and higher admission rates for asthma.

**Table 3** Results from univariate analyses for the variables that showed significant association (P<0.05) with admission rates for asthma in patients aged 5-64 years from 124 general practices in east London

Variable	Regression coefficient (SE)*	Incidence rate ratio (95% confidence interval)	P value
Practices with one principal	0.54 (0.08)	1.71 (1.46 to 2.00)	<0.001
Practices with general practitioner trainer	-0.37 (0.10)	0.69 (0.57 to 0.83)	<0.001
Ratio of asthma prophylaxis to bronchodilator prescribing (net cost)	-0.38 (0.10)	0.68 (0.56 to 0.84)	<0.001
Mean age of principals	0.018 (0.004)	1.018 (1.009 to 1.027)	<0.001
No of night visits/1000 patients/year (total)	0.005 (0.001)	1.005 (1.002 to 1.008)	<0.001
Practices employing practice manager	-0.23 (0.07)	0.80 (0.69 to 0.91)	0.001
Practices with two principals	0.27 (0.09)	1.31 (1.10 to 1.55)	0.002
Ratio of asthma prophylaxis to bronchodilator prescribing (No of items)	-1.09 (0.35)	0.34 (0.17 to 0.67)	0.002
No of night visits/1000 patients/year (high payment)	0.005 (0.002)	1.005 (1.002 to 1.008)	0.002
Mean No of years since principals' GMC registration	0.015 (0.005)	1.015 (1.004 to 1.026)	0.005
Hours of practice nursing/week/1000 patients	-0.02 (0.01)	0.98 (0.96 to 0.99)	0.007
% Of practice population in households lacking or sharing amenities	0.10 (0.04)	1.10 (1.03 to 1.19)	0.007
List size per principal	0.0001 (0.00004)	1.0001 (1.00003 to 1.0002)	0.007
% Of practice population in households with head an unskilled worker	-0.11 (0.04)	0.90 (0.83 to 0.97)	0.008
Hours of administration/week/1000 patients	-0.008 (0.003)	0.99 (0.99 to 1.00)	0.008
Practices employing practice nurse	-0.18 (0.08)	0.84 (0.71 to 0.99)	0.034
% Of practice population in households not owner occupied	-0.005 (0.002)	0.995 (0.990 to 0.999)	0.042
% Of practice population in households with head in social class IV or V	-0.020 (0.010)	0.980 (0.962 to 0.999)	0.044

\*Coefficient=logarithm of incidence rate ratio.

## Discussion

We have shown that higher admission rates for asthma in the age range 5-64 years for east London general practices are most strongly associated with smaller partnership size and higher night visiting rates. Although quality of prescribing for asthma, practice's resources, and some characteristics of practice populations were associated with admission rates in univariate analyses, these were outweighed in the multiple regression analysis, particularly by partnership size.

Admissions for asthma are distressing to patients and their families and increase the workload of primary and secondary care. During 1992-3 there were 1570 hospital stays (including readmissions) for east Londoners of all ages for asthma, with an average length of stay of 3.99 days. Assuming general medical ward day costs of £158 a day,<sup>18</sup> direct costs for hospitals alone amounted to £989 759.

### Limits of study

Multiple regression analyses of general practice and sociodemographic data can help to explain variations and unravel complex associations. However, three points should be remembered. Firstly, the potential of analyses must be balanced against possible bias; secondly, a causal relation cannot be inferred from a statistical association; and, thirdly, care must be taken when interpreting the meaning of explanatory variables. The variables analysed may be markers of other factors with which they are associated but which have not been measured. For example, we found high admission rates to be associated with high rates of night visiting. The latter might reflect higher workload or patient demand<sup>19</sup> but could reflect poorer daytime accessibility to the practice or better organisation in claiming for night visits, since we based these on claims submitted. The events that trigger an exacerbation of asthma are poorly understood.<sup>20-23</sup> Our analysis can contribute only in a crude way to an understanding of variations in admission rates.

### Asthma and sociodemography

High admission rates for asthma have been linked to poverty and non-white ethnicity in univariate analyses.<sup>24-26</sup> In our multiple regression analysis we found no significant associations between admission rates and sociodemography. There are several possible explanations. Firstly, imputing a practice population's sociodemographic profile from census data at ward level is an approximation that might weaken any association.<sup>27</sup> A similar study comparing affluent and deprived areas might find significant relations. Secondly, east London is a fairly uniformly deprived area with variation in distribution of ethnic groups, and our data might lack sufficient contrast between practice populations to show differences. Thirdly, excluding readmissions from our analysis might mean that practice admission rates were weighted more towards practice variables rather than patient factors. Finally, there may be no association between admission rates and sociodemography.

### Asthma and quality of prescribing

We previously reported a significant association between admission rates and prescribing quality for east London

**Table 4** Results from multiple Poisson regression model for the variables that showed significant association ( $P < 0.05$ ) with admission rates for asthma in patients aged 5-64 years from 124 general practices in east London

Variable	Regression coefficient (SE)*	Incidence rate ratio (95% confidence interval)	P value
Practices with one principal	0.511 (0.082)	1.667 (1.417 to 1.959)	<0.001
Practices with two principals	0.282 (0.087)	1.325 (1.117 to 1.571)	0.001
No of night visits/1000 patients/year	0.004 (0.001)	1.004 (1.001 to 1.007)	0.007

\*Coefficient=logarithm of incidence rate ratio.

**Table 5** Practice resources, training status, asthma prescribing patterns, and asthma admission rates by partnership size in 163 general practices in east London

Variable	No of principals in practice		
	One (n=74)	Two (n=40)	More than two (n=49)
No (%) of practices:			
Employing practice nurse	32 (43)	26 (65)	44 (90)
Employing practice manager	21 (28)	16 (40)	37 (76)
With practice computer	46 (62)	32 (80)	45 (92)
With general practitioner trainer	1 (1)	1 (3)	15 (31)
Mean hours of administration/week/1000 patients	23	24	32
Mean list size per principal	2543	2011	1917
Mean ratio of asthma prophylaxis to bronchodilator prescribing:			
Net ingredient cost	1.02	1.20	1.32
No of items	0.31	0.34	0.39
Mean admission rate for asthma for ages 5-64	1.38*	1.00†	0.78‡

\*Based on 54 practices. †Based on 36 practices. ‡Based on 44 practices.

practices.<sup>7</sup> In our present study this relation was outweighed by more powerful associations with partnership size and night visiting rates. Our measure of the quality of prescribing for asthma, the ratio of asthma prophylaxis to bronchodilator prescribing, although validated against a range of practice characteristics,<sup>8</sup> is a crude reflection of how practices prescribe. Prescribing ratios based on PACT data have drawbacks,<sup>28</sup> and prescribing is only one element of managing asthma. More refined markers of prescribing quality could have stronger associations with admission rates.

### Asthma and practice size

It seems unlikely that patients with more severe asthma would choose to register with general practices with smaller partnerships, or that patients from these practices are more likely to request admission. Absence of support from partners and practice nurses, or less flexibility in working patterns, may make doctors from singlehanded and two partner practices more cautious in managing exacerbations of asthma with lower thresholds for referral. Indeed, singlehanded doctors themselves cite professional isolation and difficulties in providing 24 hour cover as the major disincentives to singlehanded practice.<sup>29</sup> Qualitative work such as a critical incident study of patients admitted to hospital with asthma and their general practitioners might clarify the association of higher admission rates with singlehanded practice.

While singlehanded practices can develop excellent systems for identifying, reviewing, and educating asthma patients,<sup>30</sup> management of chronic disease in smaller partnerships in east London is often underdeveloped.<sup>31</sup> A reluctance to provide structured clinics within singlehanded practice may result "as much from a different approach to primary care as from the practical constraints of factors such as inadequate premises and lack

**Key messages**

- Rates of hospital admission for asthma in east London are unusually high
- We conducted a multiple regression analysis of the relation of east London general practices' admission rates for asthma with prescribing for asthma and the characteristics of general practitioners, practices, and practice populations
- Smaller partnership size and high night visiting rates were the factors most strongly associated with practices that had high admission rates
- These factors outweighed the previously reported relation between admission rates and practices' quality of prescribing for asthma
- Evaluating ways of helping smaller partnerships develop structured proactive care for asthma patients at high risk of admission is a priority

of supporting staff.<sup>29</sup> Some smaller partnerships may choose not to run appointment systems<sup>32</sup> or disease management clinics,<sup>31</sup> making proactive care more difficult and reactive care more likely. Singlehanded doctors provide a unique service.<sup>29</sup> This style of practice will continue in east London despite changes to the general practitioner contract which disadvantage this method of delivering care. Local initiatives are currently developing continuing medical education,<sup>33</sup> preventive care,<sup>34</sup> and chronic disease management.<sup>31</sup>

Our descriptive study cannot elucidate cause and effect in the associations we found. However, we suggest that evaluating ways of helping smaller general practice partnerships to develop structured proactive care for asthma patients at high risk of hospital admission is a priority.

We dedicate this work to Angus Faid (son of PS), who died in a climbing accident in 1996.

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**ONE HUNDRED YEARS AGO**

**A flannel shirt club**

To a poor man leaving hospital few gifts can be more appropriate than a flannel shirt. The warmth and, perhaps more even than the warmth, the equability of the temperature in which he has lived for some weeks, in many cases make his "going out" a perilous adventure, and nothing is so likely to prevent relapse in such cases as the provision of the warm underclothing which the poor find it so difficult to obtain. We therefore wish every success to the Flannel Shirt Club which has been inaugurated by the Countess of Strafford.

The objects of the club and the duty of its members are very simple. Each member undertakes to provide one or more men's flannel shirts a year, or the flannel for the same, in addition to a small subscription. It does not seem much to do; yet it may save many lives, and the making of these articles would seem to be peculiarly appropriate work for the thousands of well-to-do convalescents who so often find the hours pass wearily while waiting for returning strength. (*BMJ* 1897;:162.)