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Paediatric inpatient utilisation in a district general hospital

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Abstract

Paediatric inpatient utilisation in a district general hospital was studied for 20 general practices covering a population of 26 433 children. The factors influencing the rate and route of admission (general practitioner (GP) or accident and emergency department) were analysed for 894 emergency non-traumatic admissions over a 12 month period.

The overall rate of acute, non-traumatic admission was 33·8 /1000; 35% of these admissions were via the accident and emergency department. Asthma was the most common reason for admission (16·1%); 56·9% of the admissions resulted from respiratory tract illness and 44% were for an infective illness.

There was a significant variation in the route and rate of admission across practices. Admission rates ranged from 10 to 70/1000 children under 15 and the proportion via the accident and emergency department from 19% to 85%. The proportion of admissions via the accident and emergency department for each practice was highly negatively correlated with the number of GPs in the practice, the number of children under 15 registered, and positively correlated with the unemployment rate attributed to the list. Using multiple logistic regression analysis, the risk of being admitted via the accident and emergency department relative to GP admission was shown to be higher for older children (odds ratio for each year of age 1·05) and less for children registered with large practices with more GPs (odds ratio for each extra GP 0·36) or practices with more children under 15 (odds ratio per extra child 0·9991). Access to hospital as measured by isochrone bars and social characteristics of the ward of residence of each child admitted were not associated with the route of admission.

The admission rate for each practice was positively, but not statistically significantly, associated with the unemployment rate attributed to the list, the unemployment rate of the ward where the practice was located, and the percentage of admissions via accident and emergency, and negatively associated with the percentage of the list under 15 years.

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Hospital admissions in childhood have increased over the past 10–15 years.[1–5] Various explanations have been advanced: the increased availability of beds because of the decreasing lengths of stay; changing technology; increased patient expectation[6]; improved paediatric training for general practitioners (GPs)[3]; and changing patterns of admission for childhood asthma.[7 8]

Admission rates for disorders which have contributed most to the increase in paediatric admissions (asthma, upper respiratory tract infections, and gastrointestinal diseases)[1] show large geographical variations.[9] The variations may partly result from the referral and admission process – that is, via the GP or self referral to the accident and emergency department limiting the control over hospital use by the GP. Between 4%[10] and 7%[11] of children attending a children's accident and emergency department were referred for outpatient opinion and between 11%[10] and 14%[11] were admitted.

There is little information on the referral patterns of paediatric admissions and on the variation in use of acute paediatric inpatient services by GPs. This paper reports the results of a population based study aimed at identifying factors influencing the route of admission and the rate of admission by GPs.

Methods

Data were taken from an extract of the Wakefield district information services. All children, aged 0–15 years, admitted as medical emergencies via GPs and accident and emergency departments between 1 January 1990 and 31 December 1990 were identified. For each child the diagnosis, route of admission, postcode of residence, and GP were identified. Diagnostic coding analysis showed the range of disorders for which children were admitted by each route. Those with an E code diagnosis – that is, an external cause (such as head injury and accidental ingestion) – were excluded as presentation to the accident and emergency department for this reason was clearly appropriate.

Data on children resident in Wakefield but admitted to neighbouring hospitals were

Table 1 Summary of study population

Population	*Total No*	*Aged 0–15 years*
Wakefield DHA*	145 820	28 520
Wakefield DHA practices†	141 048	26 433
Catchment population*		
All acute specialties	209 000	–
Paediatrics	–	46 460

DHA=District Health Authority.
*Source: Health Services Indicators.
†Source: Family Health Services Authority:

obtained from the regional information services but details of the GP were not available for most of these children and they were not included in the final analysis. Analysis of Wakefield District Health Authority area general practices was carried out. The population data showed that these practices have registered with them 93% of the Wakefield District Health Authority population aged 0–15 years (table 1). The Wakefield District Health Authority practice population was used because it allowed a population based analysis.

For each practice the total number of admissions was analysed by route of admission and proportion of total admissions which occurred via the accident and emergency department. Data on practice characteristics were obtained from the Family Health Services Authority (FHSA).

Social characteristics for each ward were derived from the 1991 census and were linked via the postcode to each child admitted. The unemployment rate and the Jarman underprivileged area score for the electoral ward in which each practice was located were also recorded. An attributed unemployment rate for the list of each general practice was obtained from the FHSA. This was calculated as a weighted average of the unemployment rate of each enumeration district weighted by the number of people registered with each practice in each enumeration district. Attributed rates of other social characteristics from the census were not available. The social characteristics of the ward in which the practice was based were used as proxies for the socioeconomic profile of the practice population. An average of 52% of all admissions were resident in the same electoral ward as the practice (range 30% to 100%), the central town practices having the lower figures.

Accessibility to the hospital by private transport from the different electoral wards was assessed by the method described by the University of York Health Economics Consortium.[12] Areas showing common travel times (isochrone bars) were determined. By superimposing the isochrone map onto an electoral ward map of the Wakefield District Health Authority and using Office of Population Censuses and Surveys census data on populations, the proportions of the population in approximate travel time bands was established. The weighted travel time for each electoral ward was then calculated. These ranged from five minutes to over 23 minutes.

Table 2 Acute medical paediatric (0–15 years) admissions to Pinderfields Hospital (1990). Total paediatric admissions 2069, of which 1645 (79·5%) were emergencies

Route of admission	*No of admissions*	*Admissions with E code*	*Non-traumatic admissions*	
			Total	*Wakefield DHA*
Accident and emergency department	845	367	478	318
GP	800	16	784	576
Total	1645	383	1262	894

DHA=District Health Authority.

ANALYSIS

Confidence intervals (95%) for the admission rates and the proportion admitted via accident and emergency departments were calculated assuming Poisson and binomial distributions respectively, using the software package 'Confidence with statistics'.[13]

The proportion of admissions via accident and emergency departments for each general practice was explored by multiple linear regression on a range of practice characteristics and social variables for the practice. Variables which were not significant at the 5% level were removed in a stepwise manner. For children admitted to hospital, the risk of being admitted via the accident and emergency department compared with GP admission was modelled using multiple logistic regression. Modelling used a backward manual stepwise approach which included all the available individual social data based on the ward of residence and practice characteristics. Variables which were not significant at the 5% level were removed in a stepwise manner. Children admitted by the two routes in one year were omitted in this part of the analysis and multiple admissions via one route were treated as a single admission as they do not contain independent information.

The variation in practice rates of admission was analysed by simple correlation and linear regression using the package SPSS. The GP practice, socioeconomic, and access characteristics were used as explanatory variables. The practice characteristics included the number of GPs, the population and the percentage of the population under 15 years of age registered, the total list size and the attributed unemployment rate, and the unemployment rate and Jarman underprivileged score of the ward in which the practice was located.

Results

A total of 2069 paediatric medical admissions occurred over the 12 month period. A total of 1645 (79·5%) of these were admitted as emergencies via the GP or the accident and emergency department. Three hundred and eighty three (23·3%) of all the emergency admissions resulted from trauma (head injury or accidental ingestion) and were excluded from the analysis. Three of the remaining 1262 children with an acute non-traumatic medical illness could not be allocated to a practice, one was not registered with a GP, and the medical records were unobtainable for two. Of the remainder, 894 (71·2%) came from the Wakefield District Health Authority practices. Table 2 summarises these data.

The 894 admissions analysed occurred in 755 children. Six hundred and forty nine were admitted once only; the remaining 106 children accounted for 245 admissions with 21 children (2·8% of the children admitted) having three or more admissions (accounting for 8·2% of all admissions). For children under the age of 2 years such multiple admissions occurred in 17%, accounting for 32% of the admissions in this age group. This pattern has been observed in another study.[14] Forty one

Table 3 Diagnostic codes and route of admission

Diagnosis (ICD codes)	No (%)* (n=894)	Route of admission (%)	
		Via accident and emergency department	Via GP
Febrile convulsion (780.3)	41 (4·6)	73·2	26·8
Otitis media (382)	13 (1·5)	53·8	46·2
Constipation (564)	12 (1·3)	50·0	50·0
URTI (460–465)	91 (10·2)	38·5	61·5
Viral infection (078–079)	78 (8·7)	37·2	62·8
Asthma (493)	144 (16·1)	36·1	63·9
Gastroenteritis (003–009, 558)	44 (4·9)	31·8	68·2
Breathing difficulties (786)	30 (3·3)	30·0	70·0
Bronchiolitis (466)	48 (5·4)	29·2	70·8
Vomiting (787)	30 (3·4)	20·0	80·0
Meningitis (320, 322, 047)	21 (2·3)	14·3	85·7
Pneumonia (480–486)	39 (4·4)	15·4	84·6
Failure to thrive/feeding problem (783)	26 (2·9)	11·5	88·5
Pyloric stenosis (750·5)	11 (1·2)	9·0	91·0
UTI (599)	17 (1·9)	0	100·0
Others	249 (28·1)	41·4	58·6

URTI=upper respiratory tract infection; UTI=urinary tract infection.
*Percentage of all admissions.

children were admitted via both the GP and accident and emergency routes.

Some Wakefield resident children (103) were admitted to a hospital outside the district. Of these, 98 (95%) went to a hospital for infectious diseases. Although these were all referred by a GP, the details of the referring GP were not available on the data from the regional information services.

Table 3 gives the common diagnoses classified by International Classification of Diseases groups and frequency expressed as a percentage of the total number of admissions. Asthma (144 children (16·1%)) was the most common diagnosis and 56·9% of the admissions resulted from respiratory tract illness. Forty four per cent of the admissions were for infective illness.

Febrile convulsion was the only condition where the admission rate via accident and emergency was greater than via the GP route and reflects the perception of urgency for treatment. The range of conditions is otherwise similar for the two routes of admission.

The overall rate of admission of children from the Wakefield District Health Authority

Table 4 Variation between practices in admission rates per 1000 child population and proportion of admissions via the accident and emergency department

Practice No	Admission rate/1000 (95% CI)*	% Via accident and emergency department (95% CI)†
1	39·3 (24 to 60)	40·0 (19 to 64)
2	18·6 (13 to 25)	20·0 (9 to 36)
3	40·3 (30 to 52)	39·7 (27 to 53)
4	43·8 (35 to 54)	25·8 (17 to 36)
5	44·7 (34 to 57)	40·9 (29 to 54)
6	35·6 (28 to 44)	24·4 (16 to 35)
7	39·3 (30 to 51)	46·7 (34 to 60)
8	33·5 (26 to 47)	30·4 (18 to 46)
9	25·7 (20 to 33)	19·4 (10 to 31)
10	60·6 (45 to 80)	67·4 (52 to 80)
11	43·7 (35 to 54)	24·7 (16 to 35)
12	19·4 (14 to 27)	27·0 (14 to 44)
13	36 ·0 (26 to 49)	48·7 (32 to 61)
14	31·0 (24 to 40)	35·6 (24 to 49)
15	33·6 (17 to 59)	41·7 (15 to 72)
16	16·0 (9 to 25)	33·3 (13 to 59)
17	30·5 (19 to 46)	65·2 (43 to 84)
18	16·3 (6 to 33)	85·7 (42 to 99)
19	35·1 (21 to 54)	70·0 (46 to 88)
20	70·0 (38 to 117)	21·3 (5 to 51)

*Calculated assuming Poisson distribution.
†Calculated assuming binomial distribution.
CI=confidence interval.

Table 5 Logistic regression model of risk of admission via accident and emergency department relative to number of GPs in the practice

Variable	Coefficient (β)	Standard error	Statistical significance of coefficient	Odds ratio
Age on admission	0·0456	0·020	0·025	1·047
Number of GPs	−1·0342	0·509	0·04	0·3555
Practice code			0·0311	
Constant	3·58	2·11	0·09	

practices to Pinderfields Hospital for acute non-traumatic illness was 33·8/1000. Thirty five per cent of these admissions were via the accident and emergency department. Table 4 shows that there was significant variation in the rates and route of admission among the 20 practices. Data on the size and number of admissions for each practice are not included to maintain the anonymity of the practices. The practice child population (0–15 years) ranged from 200 to 2419, with a mean of 1322 and a median of 1369. One of the practices was very small, had unusual characteristics with a high proportion of children under 15 years, and was excluded from further analysis.

The proportion of admissions which occurred via the accident and emergency department for each practice was highly negatively correlated with the number of GPs in the practice ($r=-0·72$; $p<0·001$) and the population under 15 years ($r=-0·7$; $p<0·001$), and was positively correlated with the attributed unemployment rate of the list ($r=0·64$; $p<0·01$). Multiple regression analysis resulted in the best model being:

$$\%\ \text{Admitted via accident and emergency} = -0·16 + 0·064\ \text{Unemployment} - 1·5\times10^{-4}\ \text{Population<15 years}\ (R^2=0·59)$$
(p=0·06) (p=0·02)

Using multiple logistic regression, the risk of being admitted via the accident and emergency department relative to GP admission was shown to be higher for older children (odds ratio for each year of age 1·05; p=0·003) and less for children registered with a practice having more GPs (odds ratio for each extra GP 0·36; p=0·042) (table 5). Independent of these two variables, a further factor for general practice was also statistically significant in explaining the variation in route of admission. This means that one or more unidentified characteristics that distinguish practices are associated with the likelihood of admission via accident and emergency. Access to hospital, as measured by the weighted travel time, was not associated with the route of admission. This model shows a high sensitivity of the odds of admission via accident and emergency to the number of GPs. Thus in going from a practice of three to one of six GPs decreases the odds by a factor of 22. Repeating the analysis, an equally good model replaces 'the number of GPs' with 'the number of children under 15 years of age' with an odds ratio of 0·9991 ($p<0·0001$), indicating that for every 100 extra children in a practice the odds of admission via accident and emergency decreases by 0·09 (table 6).

Table 6 Logistic regression model of risk of admission via accident and emergency department relative to number of children aged <15 years in practice

Variable	*Coefficient (β)*	*Standard error*	*Statistical significance of coefficient*	*Odds ratio*
Age on admission	0·048	0·021	0·02	1·049
Population under 15 years in practice	−0·001	0·0002	0·000	0·999
Constant	0·928	0·26	0·000	

The rate of admission of children by practice was positively associated with the attributed unemployment rate of patients registered with the practice ($r=0·24$), the unemployment rate of the ward where the practice was located ($r=0·39$), and the percentage of admissions via accident and emergency ($r=0·15$) and negatively associated with the percentage of the list under 15 years of age ($r=-0·3$). The latter association is in contrast with the review outpatient attendance rate per practice reported in a previous study.[15] None of these was statistically significant at the 5% level, however. This is most probably due to the lack of power because of the small number of practices (19) in the analysis. The relation with the Jarman 8 underprivileged area score for the ward where the practice was based ($r=0·27$) was less strong than for unemployment rate. Multiple linear regression of the rate of admission against all the social and practice characteristic variables produced no significant result.

Discussion

This study provides information on the use of paediatric inpatient services in a well defined population which is distributed over a fairly dense urban and surrounding semirural area. The hospital has 19 paediatric medical beds and 20 paediatric surgical beds. Referrals for admission from GPs and the accident and emergency department are received by the senior house officer on call and are accepted if there is an available bed, the threshold for admission being determined by the source of referral. It is departmental policy to admit any child under the age of 5 years who presents to the accident and emergency department after 9 pm.

The proportion of admissions for each practice via the accident and emergency department ranged from 19% to 85%. This route is appropriate for children with traumatic injuries or serious illnesses needing urgent medical attention. The former were excluded from the analysis and the latter are uncommon. For most children this route of admission was inappropriate and in some cases could have resulted in an unnecessary admission by virtue of presenting after 9 pm.

This study shows that the variation in the proportion of children admitted via accident and emergency is significantly inversely associated with the size of the practice (number of GPs and children under 15 years). This may reflect the actual or perceived availability of the GP, which have been identified as important reasons for self referral to the accident and emergency department.[10 11 16 17] Larger practices may offer greater accessibility through longer surgery hours, more flexibility in providing urgent appointments and visits, out of hours (emergency) services, and increased promotion/patient education through practice information leaflets.

Of interest is the finding that the social characteristics of the ward of residence of children admitted was not associated with the route of admission, though the attributed unemployment rate for each practice list is positively associated with the proportion of children admitted via accident and emergency in the practice. In other words the individual and the practice based analysis of the factors influencing the route of admission, although agreeing on the importance of the size of the practice, differed with respect to the importance of social factors. The social characteristics of wards are likely to be poor proxies for the characteristics of individual children from that ward who are admitted to hospital. This is because wards are large and usually heterogenous, thus children admitted to hospital are unlikely to be representative of the ward (the ecologic problem). The attributed ward unemployment rate, being based on the smaller and less heterogenous enumeration districts, is likely to be a more accurate reflection of the average characteristics of the people registered with a GP, but not necessarily of families with children registered or children admitted.

Proximity and easy access to the hospital have been identified as being important factors contributing to the inappropriate use of the accident and emergency department[18–20]; this was not confirmed in this study after adjusting for other factors.

The overall acute, non-traumatic admission rate per 1000 child practice population was 33·8. Reported rates from previous studies include 30·9/1000 and 21·9/1000. Direct comparison with the previously reported studies[1–5] is limited because of the variable inclusion of accidental ingestion and head injuries. Significant variation was observed between general practice admission rates per 1000 child population ranging from 10 to 70. The analysis did not successfully explain much of this variation but suggests that, in addition to chance, the variation may be affected by practice characteristics (number of children under 15) and socioeconomic factors (such as unemployment rates). Because of the small number of practices, however, there was little statistical power to explore these potential relations.

Higher rates of admission to hospital in poorer areas may be due to the increased prevalence of certain disorders combined with a lowered threshold for admission. The relation between poverty and sickness has been well described,[21 22] but the actual factors contributing to it need to be understood. The fact that the unemployment rate of the ward in which the practice was based was more strongly associated with the rate of admission than the attributed rate for the list may have no significance, but is of interest. Whether this reflects some ecologic problems or something

more interesting about the influence of practice location is not possible to explore further in this study, but may be worth further investigation.

The extent to which differences in GP referral behaviour might account for the variation in admission rate for each practice is unclear. Studies of paediatric outpatient referral patterns suggest that this may vary according to the experience/interest of the GP.[15] The paediatric experience and training of GPs may heighten their awareness of the risks of serious illnesses contributing to a lowered threshold for admission.[2 3] The emphasis of both the Court report[23] and a follow up report,[24] however, has been on the provision of child health services outside the hospital, with particular emphasis on improvement of the primary care of the children. In a study from the USA 13% of patient days in general paediatrics were judged to be inappropriate.[25] A study on the appropriateness of self referrals and referrals for admission from GPs has been undertaken in Wakefield and will be reported elsewhere.

Reduction in some of the variations in admission rate may be possible with an experienced paediatric specialist screening some admissions, by GPs working in an accident and emergency department,[26] and by encouraging parents into the appropriate use of primary care services. It is likely, however, that further reduction in variations may need to be accompanied by reductions in the inequalities in socioeconomic factors and their consequent effect on the health of children. More research is needed to explore the complex and interactive effects of social conditions and practice characteristics and behaviour on the rate and route of admissions.

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