Respiratory illness and healthcare utilization in children: the primary and secondary care interface

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Respiratory illness and healthcare utilization in children: the primary and secondary care interface. J.A. Cropper, T.L. Frank, P.I. Frank, M.L. Laybourn, P.C. Hannaford. ©ERS Journals Ltd 2001.
ABSTRACT: The aim of the present study was to quantify the healthcare utilization of a child population according to level of respiratory illness.

A stratified random sample of 713 children was selected from respondents to a postal respiratory questionnaire, carried out in two general practice populations in 1993. Children were stratified into four groups according to the number of positive responses to five key questions. These groups were used as indicators of likelihood of asthma diagnosis. A search was made of these childrens′ practice records covering a 2-yr period, to include both primary and secondary healthcare.

There was a significant increase across positive response groups in the proportion of children having primary and secondary care based consultations, particularly for respiratory conditions (p = 0.001). There was also a significant increase in prescribing. Of those children considered to be "likely asthmatics" from their questionnaire responses, 8.1% (n = 31) did not receive any primary or secondary care for a respiratory problem over the 2-yr period.

As the likelihood of respiratory illness increased in this population, more demand was made upon resources for the treatment of respiratory illness. Quantification of this demand enables evidence based resource allocation decisions to be made. This method of quantification could be applied in other populations.
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Quantifying the burden placed by different morbidities on the National Health Service (NHS) is an essential part of planning healthcare provision, and for making evidence based resource allocation decisions. In the case of asthma in children, a large proportion of the care is provided by general practice [1]. PARTRIDGE [2] reported that in 1989, 97% of all asthma cases were treated in primary care. Despite this, a significant number of children also receive care for respiratory illness in the secondary sector [3] and the proportion of the total direct costs of asthma attributed to secondary care has been estimated to be ~20–25% [1].

Although some consideration has been given to the interaction between primary and secondary care [3–5], the two aspects of care have usually been considered separately [6]. However, in order to enable informed resource allocation decisions to be made, it is essential to have quantified data from a defined population over an extended time period, considering both primary and secondary care. Furthermore, healthcare utilization has often been quoted purely as an outcome measure in intervention studies [7, 8], rather than looking at the burden as it occurs ordinarily in general practice.

The present study addresses these problems and forms part of the Wythenshawe Community Asthma Project (WYCAP) [9–11], a long-term prospective study into the natural history of asthma in two neighbouring general practice populations in South Manchester, both of which refer almost all cases of respiratory illness to the same hospital.

Methods

In 1993, a questionnaire (Appendix 1) based on the International Study of Asthma and Allergy in Childhood (ISAAC) respiratory questionnaire [12], was sent, after South Manchester Ethics Committee approval, to the parents of all children (aged <16) registered with either of two general practices situated on a housing estate in Wythenshawe, South Manchester. The majority of the population was Caucasian and of lower socioeconomic status. After two reminders, 2,659 replies were received (a response rate of 75%). The questionnaire contained five key questions. The responses to the questionnaire were very similar between the two practices, therefore for the purposes of this study the two populations have been combined. The respondents were stratified into four categories according to the number of positive responses made to the five key questions; 0, 1–2, 3 and 4–5. Two hundred respondents (100 from each general practice population) were randomly selected from each category, a total sample of 800 children.

The key questions were: 1) Has your child had wheezing or whistling in the chest in the last 12 months? 2) In the last 12 months, has your child had a dry cough at night, apart from a cough associated with a cold or chest infection? 3) Has your child had more than three courses of antibiotics for respiratory infections (chest, ears or throat) in the last 12 months? 4) Has your child had hay fever or eczema? 5) Has anyone in your child's family (parents, grandparents, sisters or brothers) had asthma?

A scoring system was developed using these questions, designed as a screening method to identify children with likely asthma. Children who were likely asthmatics, if not known to the practice, would require clinical assessment to determine their asthma status. An evaluation of this scoring system [11] has shown that increasing numbers of positive responses to these key questions increase the likelihood of a child benefiting from a trial of asthma medication. Three or more positive responses had a positive predictive value (PPV) of 84% (95% confidence interval (CI) 74–90) to identify such children who were, therefore, classed as "likely asthmatics".

A search of the general practice paper and computer medical records of each child was made for a 2-yr period (May 1, 1993 to April 30, 1995). Details of all care were collected including: surgery consultations, home visits and prescribed medications, hospital outpatient consultations (new and follow-up) and inpatient admissions (normal ward and intensive care). Details of accident and emergency (A&E) consultations were collected from records kept in the local A&E department, where the majority of attendance would have occurred. The search was conducted by a general practitioner (GP) and a research assistant, during a 6 month period between 1995 and 1996. Although both were aware of the responses to the questionnaire, data were recorded in a standardized format, in order to reduce opportunity for information bias. All coding difficulties were dealt with by the GP.

All consultations and prescribed medications were categorized into one of three groups: lower respiratory, upper respiratory (including all ear, nose and throat conditions) and nonrespiratory. If the child was seen for more than one condition during one consultation (for example, for a lower respiratory and nonrespiratory condition) a proportion of the consultation was allocated to each category. All prescriptions (including repeats) issued during the observation period were recorded according to British National Formulary (BNF) [13] groupings. The dosage, amount and strength of medication prescribed

were recorded. For analysis, prescription data were subdivided into respiratory-related (BNF section 3: respiratory system; 5.1: antibacterial drugs; and 6.3: corticosteroids) and nonrespiratory-related medications (all other BNF sections). Antibacterial drugs and corticosteroids were included in the respiratory category as these medications are mostly prescribed to children for respiratory conditions.

Analysis was carried out using the Statistical Package for the Social Sciences (SPSS) for Windows (SPSS, Chicago, IL, USA) [14]. The data were very highly positively skewed i.e. there were many children who had none or very few consultations or prescriptions, therefore having implications for the analysis of the data. Mean values of utilization for the 2-yr period were calculated along with the 5–95 percentile range. However, as the data were skewed, nonparametric analyses examined the proportion of children in the positive response categories who had one or more surgery based consultation, home visit, hospital consultation, admission, and prescription. To analyse the statistical significance of any relationship between healthcare utilization and the number of positive responses made to the questionnaire, the Chi-squared test for linear trend was used. Discrete positive response values (0, 1, 2, 3, 4, 5) were used in the Chi-squared analysis.

Results

Of the 800 children selected, adequate information for the present analysis was available for 713 children. There were approximately equal numbers of children in each of the positive response groups (table 1). Most of the 87 excluded children had moved away from the practice during the study period.

The 713 children had 5,056 practice-based consultations during the 2-yr period. The proportion of children having a surgery consultation for all conditions increased across the number of positive responses made (table 2) i.e. a greater proportion of children in the 4–5 positive response group had a surgery consultation, than in the zero positive response group. Furthermore, the mean number of consultations over the 2 yrs also increased across the groups. There was a highly significant increasing trend in the proportion of children having consultations for lower and upper respiratory tract illnesses across positive responses (p<0.001) and again, an increase in the mean values is apparent. This trend was not evident in consultations for nonrespiratory morbidities.

A total of 810 home visits were made to the children

Table 1. – Numbers of responders to the respiratory questionnaire, and the number eventually included in the analysis

Number of positive responses	All complete 1993 responders	Selected	Available for analysis	Mean age of children available for analysis
0	636	200	165	8.8
1–2	1301	200	167	8.2
3	316	200	192	6.3
4–5	310	200	189	6.5
Totals	2563	800	713	7.4

Table 2. – Percentage of children having ⩾1 consultation or prescription in primary care by positive responses with mean number of consultations or prescriptions (5–95 percentile range) per child over the 2 yr period

Positive Response Category	0	1–2	3	4–5	Chi-squared test for trend*	p value*
Total in each group	165	167	192	189		
All surgery consults	92.7%	98.8%	96.4%	98.4%	4.89	0.027**
	4.96(0–13.0)	6.29(1.0–18.0)	7.60(1.0–18.5)	9.14(2.0–21.0)		
Lower respiratory consults	29.1%	37.7%	64.0%	77.3%	106.02	<0.001
	0.50(0–3.0)	0.78(0–4.5)	2.05(0–9.0)	2.86(0–8.5)		
Upper respiratory consults	51.5%	59.8%	72.4%	74.1%	25.22	<0.001
	1.15(0–4.0)	1.40(0–5.0)	1.93(0–6.0)	2.16(0–8.0)		
Nonrespiratory consults	89.1%	93.4%	90.1%	93.7%	1.27	0.260**
	3.31(0–9.0)	4.11(0–10.8)	3.63(0–10.0)	4.12(0–11.3)		
Total home visits	34.5%	48.5%	53.1%	55.0%	13.80	<0.001
	0.66(0–3.0)	0.90(0–3.0)	1.38(0–5.0)	1.52(0–5.0)		
Lower respiratory home visits	3.0%	5.4%	18.2%	23.3%	42.96	<0.001
	0.04(0–0)	0.08(0–1.0)	0.30(0–2.0)	0.42(0–2.0)		
Upper respiratory home visits	18.8%	26.9%	34.4%	31.7%	9.49	0.002
	0.28(0–2.0)	0.34(0–2.0)	0.53(0–2.0)	0.58(0–2.0)		
Nonrespiratory home visits	18.2%	25.7%	24.0%	27.5%	1.92	0.166
	0.28(0–2.0)	0.38(0–2.0)	0.38(0–2.0)	0.38(0–2.0)		
Unknown cause home visits	4.8%	6.6%	11.5%	10.1%	3.98	0.046**
	0.07(0–0)	0.10(0–1.0)	0.17(0–1.0)	0.13(0–1.0)		
Total number of scripts	81.2%	91.6%	92.7%	97.4%	25.80	<0.001**
	5.32(0–19.0)	6.71(0–22.0)	12.21(0–36.0)	16.52(1–50.0)		
Nonrespiratory scripts	70.3%	83.2%	82.3%	86.2%	11.41	0.001
	3.32(0–13.0)	4.02(0–15.0)	5.32(0–20.0)	6.54(0–22.0)		
Respiratory scripts	67.3%	72.4%	86.4%	93.6%	50.10	<0.001
	2.00(0–8.0)	2.69(0–10.0)	6.89(0–28.0)	9.97(0–34.0)		

*: Trend test and p-values calculated using discrete positive response values; **: Some cells had less than the expected frequency (5) required for a Chi-squared test, therefore the Chi-squared statistic and p-value should be interpreted with caution.

during the observation period. There was a significant trend across positive responses for all home visits made (p<0.001). This trend was highly significant when restricting analyses to upper and lower respiratory conditions only (p=0.002 and p<0.001, respectively). The mean 2-yearly values reflect this increase. Again there was no increasing trend in the proportion of children having a consultation for a nonrespiratory condition (table 2).

The 713 children had a total of 7,466 prescriptions issued to them over the 2-yr period. An increasing trend across positive responses was observed for all categories of prescription. This trend was highly significant for both respiratory (p<0.001) and non-respiratory prescriptions (p=0.001; table 2).

Regarding secondary care, 397 children had ⩾1 secondary care consultation for any condition over the 2-yr period, of which 57.2% had ⩾3 positive responses. Only 37 children had ⩾1 secondary care contact for a respiratory problem, of which 83.8% had ⩾3 positive responses.

Total outpatient consultations increased significantly across the number of positive responses made (p=<0.001). This increasing trend also occurred in the proportion of children having consultations for upper and lower respiratory illness, and is reflected in an increase in the mean number of consultations per child over the 2-yrs. The increase that occurred in consultations for nonrespiratory illness was not statistically significant (table 3). Similar trends to those found for outpatient consultations were found for inpatient admissions.

Two-hundred and forty children attended A&E and had 368 consultations. The majority of these consultations were for nonrespiratory morbidity and there was no relationship with the number of positive responses (table 3)

Of the 381 children with ⩾3 positive responses (the "likely asthmatics"), 8.1% (n=31) had no record of any respiratory contact with either primary or secondary care during the 2-yr period, and in 17.6% (n=67), the only contact had been for repeat prescriptions of respiratory medication.

Discussion

Combining primary and secondary care data from one cohort of patients, both with and without respiratory symptoms, has provided an opportunity to examine the relationship between respiratory illness and total healthcare utilization.

As part of the WYCAP, a simple scoring system was developed from the questionnaire used in this study, in order to identify children with likely asthma. The details of the validation of this system have been described elsewhere [11]. Consensus expert opinion was used to determine those likely to benefit from a trial of asthma treatment ("likely asthmatics"), based on a full clinical examination of a random sample of children, stratified according to the number of positive responses to a later questionnaire survey. This showed a positive association between the number of positive responses to the five key questions and the likelihood

Table 3. – Percentage of children having $\geqslant 1$ secondary care consultation by positive responses with mean number of consultations or prescriptions (with the 5 – 95 percentile range) per child over the 2 yr period

Positive Response Category	0	1 – 2	3	4 – 5	Chi-squared test for trend*	p-value*
Total in each group	165	167	192	189		
Total out-patient (o/p)	24.8%	35.9%	37%	47.6%	19.01	<0.001
	0.62(0 – 4.0)	0.99(0 – 5.0)	0.92(0 – 5.0)	1.47(0 – 6.0)		
Lower resp o/p	0.6%	1.8%	2.6%	9.5%	21.55	<0.001**
	0.01(0 – 0)	0.03(0 – 0)	0.04(0 – 0)	0.33(0 – 3.0)		
Upper resp o/p	8.5%	12%	15.1%	18.5%	10.37	0.001
	0.20(0 – 1.0)	0.27(0 – 2.0)	0.29(0 – 2.0)	0.41(0 – 3.0)		
Non-resp o/p	20%	26.3%	25.5%	29.1%	2.41	0.120
	0.41(0 – 2.0)	0.69(0 – 5.0)	0.58(0 – 3.0)	0.73(0 – 4.0)		
Total in-patient (i/p)	12.7%	16.1%	13.5%	23.8%	5.07	0.024
	0.15(0 – 1.0)	0.18(0 – 1.0)	0.15(0 – 1.0)	0.31(0 – 1.0)		
Lower resp i/p	0.6%	0.6%	1%	5.3%	10.60	0.001**
	0.01(0 – 0)	0.01(0 – 0)	0.01(0 – 0)	0.06(0 – 1.0)		
Upper resp i/p	3.6%	3.6%	5.2%	12.7%	12.12	<0.001**
	0.04(0 – 0)	0.04(0 – 0)	0.05(0 – 1.0)	0.16(0 – 1.0)		
Non-resp i/p	8.5%	12%	7.8%	7.4%	0.99	0.319**
	0.10(0 – 1.0)	0.14(0 – 1.0)	0.08(0 – 1.0)	0.09(0 – 1.0)		
Total A&E	30.3%	40.1%	29.2%	35.4%	0.12	0.731
	0.41(0 – 2.0)	0.65(0 – 3.0)	0.47(0 – 2.0)	0.54(0 – 2.0)		
Lower resp A&E	0.6%	0.6%	1%	2.1%	2.41	0.120**
	0.01(0 – 0)	0.01(0 – 0)	0.01(0 – 0)	0.02(0 – 0)		
Upper resp A&E	1.2%	1.8%	0%	2.1%	0.16	0.691**
	0.01(0 – 0)	0.02(0 – 0)	0.00(0 – 0)	0.02(0 – 0)		
Non-resp A&E	29.1%	39.5%	28.1%	33.9%	0.04	0.847
	0.38(0 – 2.0)	0.62(0 – 3.0)	0.46(0 – 2.0)	0.50(0 – 2.0)		
A&E unknown	0.6%	0%	0%	0.5%	0.04	0.844**
	0.01(0 – 0)	0.00(0 – 0)	0.00(0 – 0)	0.01(0 – 0)		

*: Trend test and p-values calculated using discrete positive response values; **: Some cells had less than the expected frequency (5) required for a Chi-squared test, therefore the Chi-squared statistic and p-value should be interpreted with caution.

of asthma and more specifically, that $\geqslant 3$ or more positive responses had a PPV of 84% (95% CI 74 – 90) to identify such "likely asthmatics".

In this study, the proportion of children receiving primary and secondary care significantly increased with a positive linear trend as the number of positive responses to the key questions increased. The mean number of consultations occurring per child for the 2-yr period also increased. This relationship between healthcare utilization and responses was more apparent and statistically more significant when care for respiratory illness was considered separately. Further, likely asthmatics (those with $\geqslant 3$ positive responses) had a greater utilization of both primary and secondary care resources than those with fewer positive replies.

Although mean values for the number of consultations had by each child over the 2-yr period have been quoted, it must be remembered that the sample is a stratified random sample, and there are, therefore, more symptomatic children in a "normal" general practice population. Furthermore, it is important to bear in mind that the mean value is calculated over 2 yrs and is not an annual rate.

In addition to considering primary and secondary care in one population, this study had several strengths. The questionnaire provided a standardized measure of respiratory symptoms, the 2-yr reference period and the measurement of respiratory and non-respiratory consultations and prescriptions allowed

any overall patterns to be observed, and the study population had a wide age range (0 – 15-yrs-old). Further, previous studies of healthcare utilization [1, 5, 15] have considered only those patients whose symptoms were known to their doctor. In the present study, it was possible to include children with no symptoms and those with symptoms unknown to their doctor. This may be a reason for the lower consultation and prescribing rates than found in this study.

Consideration was also given to some potential problems. The study was carried out in one population only, and therefore, is not representative of the entire UK population. It is therefore planned to repeat the survey in other locations.

The validation of the scoring system has only been carried out in children aged 5 – 15 yrs, due to difficulties in diagnosing asthma in those under 5 yrs of age. However, the increasing trend across positive responses was similar when the children under 5 yrs of age were analysed separately, although the p-values obtained indicated significance at a lower level.

A possible limitation of the study was that the data collected from general practice records were from two practices with differing methods of data recording. However, there were no differences in the main outcome variables between practices. In addition, all medication recorded in the practice notes are a record of prescriptions given, not necessarily prescriptions dispensed. There were 21 children aged <1, which affects their parents' ability to respond to the key

questions relating to symptom reporting over the previous 12 months.

To determine whether any bias may have occurred, a random sample of 100 responders to the 1993 questionnaire and 100 nonresponders were compared on several measures. In addition, those children excluded from the total selected sample of 800 were compared with the 713 children from the final analyses and no significant differences were found between either group on any of the parameters examined.

Finally, as the two researchers involved in data collection were not blind to the responses to the questionnaire, there was the opportunity for bias in the recording of data. However as data were recorded in a uniform manner, any effect would be minimal.

Only 37 (5.2%) children from the entire sample of 713 had a secondary care consultation (outpatient, inpatient or A&E) for respiratory illness in the 2-yr period, and the majority were classified as "likely asthmatics" according to their questionnaire responses. Although no significant relationship was found between the number of positive responses and A&E consultations, this is probably due to the small number of children (n = 8) receiving care in A&E for respiratory problems. The record search of the A&E department identified that 32.5% (n = 232) of the total sample had attended the department during the same time period for nonrespiratory problems and had 349 consultations, a mean of 0.5 nonrespiratory A&E consultations per child for the 2-yr period. The low figure for respiratory related attendances in A&E and in secondary care in general, indicates that these children were principally using their primary healthcare team for any exacerbations of their respiratory illness.

Furthermore, as part of the UK NHS almost the entire population is registered with a GP. In order to utilize secondary healthcare services, all patients must gain access through their GP, who is kept informed by letter of contact with the secondary care services. GP records are, therefore, an accurate record of primary and secondary healthcare.

In 8.1% (n = 31) of the children with "likely asthma" (≥3 positive responses), there was no contact with either the primary or secondary sector for a respiratory problem during the subsequent 2-yr reference period. The validation of the questionnaire would indicate that if these children had a clinical assessment, >80% would benefit from a trial of medication. A further 17.6% of likely asthmatics had no respiratory consultations in primary or secondary care, although they received a prescription for respiratory medication during the 2-yr period. There is probably a need for these children to have regular reviews to assess the suitability of their medication.

The trend for an increase in positive responses to the key questions to be associated with an increase in healthcare utilization is important for the planning and resourcing of services. The healthcare utilization data, stratified according to the number of positive responses could be used to quantify the amount of likely demand for healthcare in the entire population. For example, from the children selected for analysis, the 381 with ≥3 positive responses had 934.2 general practice consultations for a respiratory problem (partial consultations are possible if consultation is related to >1 problem) over the 2-yr period, a mean of 1.23 per child per year. Applying this mean to the 1993 study population as a whole would indicate that children diagnosed as being a "likely asthmatic" (those with ≥3 positive responses, n = 626) would have a total of 770.0 consultations in primary care for a respiratory problem, per year. As previously discussed, due to the skewed nature of the data, mean values are not statistically appropriate. However, such values give an illustration of how these findings could be applied in general practice.

This study provides quantification of the proportion of healthcare utilized by particular groups in this population, and provides a method for use in other general practice populations. Further, this quantification of demand for healthcare will allow recognition of the economic consequences of identifying previously undiagnosed asthmatics.

Using the method developed here, and including financial cost data in the future, will make it possible to obtain a comprehensive interpretation of the impact of respiratory illness in childhood on the health service. The quantification of likely future utilization based on differing patterns of questionnaire response, would be a valuable tool for making informed resource allocation decisions within primary care groups.

Appendix 1

Children's questionnaire:

To be completed by the Parent or Guardian – Please tick the appropriate box
What is your child's date of birth? ▭
Is your child   FEMALE ☐   MALE ☐

1. Has your child had wheezing or whistling in the chest **in the last 12 months?**   NO ☐   YES ☐
   IF 'NO' PLEASE GO ON TO QUESTION 7

2. How many attacks of wheezing has your child had **in the last 12 months?**
   None ☐   1 to 3 ☐   4 to 12 ☐   More than 12 ☐

3. **In the last 12 months,** how often, on average, has your child's sleep been disturbed due to wheezing?
   Never woken with wheezing   ☐
   Less than one night per week   ☐
   One or two nights per week   ☐
   More than 2 nights per week   ☐

4. **In the last 12 months,** has wheezing ever been severe enough to limit your child's speech to only one or two words at a time between breaths?
                                      NO ☐   YES ☐

5. Has your child been woken by an attack of wheezing in the last 12 months?   NO ☐   YES ☐

6. In the last 12 months, has your child's chest sounded wheezy during or after exercise? NO ☐ YES ☐

7. In the last 12 months, has your child had a dry cough at night, apart from a cough associated with a cold or chest infection? NO ☐ YES ☐

8. Has your child had more than 3 courses of antibiotics for respiratory infections (chest, ears or throat) **in the last 12 months?** NO ☐ YES ☐

9. Is your child currently taking any medicine for asthma? (including inhalers, aerosols or tablets) NO ☐ YES ☐

10. Has your child had an attack of asthma **in the last 12 months?** NO ☐ YES ☐

11. Has your child had hay fever or eczema? NO ☐ YES ☐

12. Has anyone in your child's family (parents, grandparents, sisters or brothers) had asthma? NO ☐ YES ☐

THANK YOU FOR YOUR HELP
PLEASE RETURN THIS FORM TO US IN THE REPLY-PAID ENVELOPE

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