



# Childhood asthma: healthcare resource utilisation in those with and without a diagnosis of the condition

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## KEYWORDS

Asthma;  
Children;  
Healthcare utilisation

**Summary Aim:** To examine healthcare utilisation and the direct financial costs in providing medical care to a population of children aged 5–15 years with respiratory complaints. Secondly, to assess whether these costs depended upon having specific asthma diagnosis or not.

**Method:** A postal respiratory questionnaire was sent to the parents or guardians of all children registered with two general practices. A search of the general practice medical records over a 2-year reference period was made for a stratified random sample and results are presented for 488 children aged 5–15 years.

**Results:** The cost of primary care lower respiratory tract consultations in children with 4–5 symptoms/risk factors was £17.02 per patient per year for those with a previous diagnosis of asthma compared with £6.08 per patient per year for those with the same number of symptoms but no diagnosis ( $t = -4.446, P < 0.001$ ). The cost of primary care lower respiratory consultations in those with no GP diagnosis of asthma and no symptoms/risk factors was £2.25 per patient per year.

**Conclusions:** Studies, which fail to include the costs associated with treating children with respiratory symptoms but without a formal diagnosis, will seriously underestimate the costs of treating asthmatic children.

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## Introduction

Over the previous two decades there has been a rising prevalence of asthma in many countries, including the UK.<sup>1–4</sup> Although it has been said that this has placed an increasing burden on healthcare services,<sup>5–7</sup> the actual burden has been difficult to quantify. Firstly, there is no generally accepted

method of calculating healthcare utilisation and direct financial costs.<sup>8</sup> In addition, healthcare services used in different parts of the system, (e.g. primary and secondary care sectors) have rarely been included for one population in the same study;<sup>9</sup> nor have the costs associated with managing symptomatic individuals without a formal clinical diagnosis been considered. This may be particularly important for common conditions such as asthma, which are said to be underdiagnosed.<sup>10</sup> The present study examines these issues in two general practice (GP) populations in children aged

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5–15 years. These two populations are in Wythenshawe, a large housing estate in South Manchester. This estate is characterised by high levels of deprivation with the area being in the most deprived 10% of the country with high levels of ill health.<sup>11</sup>

## Aim

To examine healthcare utilisation and the direct financial costs in providing medical care to a population of children aged 5–15 years with respiratory complaints. Secondly, to assess whether these costs depended upon having specific asthma diagnosis or not.

## Subjects

1. Those with likely asthma (defined as three or more symptoms/risk factors reported from five key questions) but with no recorded diagnosis in the GP records of "asthma ever" or medication for asthma in the previous 12 months.
2. Those with likely asthma and with a recorded diagnosis in the GP records of "asthma ever" or medication for asthma in the previous 12 months.
3. Those with less than three symptoms/risk factors reported to the five key questions and no recorded diagnosis in the GP records of "asthma ever" or medication for asthma in the previous 12 months.

## Method

In May 1993, a postal respiratory questionnaire based on the International Study of Asthma and Allergy in Children study<sup>12</sup> was sent to the parents or guardians of all children aged 15 years or less registered with two GPs in Manchester. Reminders were sent to non-responders after 4 and 8 weeks.

To estimate the burden of care to the medical services, all responders were stratified into four categories according to the number of symptoms/risk factors (0, 1–2, 3, 4–5) reported from the following five key questions on the questionnaire.

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 random sample of 200 children from each category was identified and a researcher and a general practitioner searched the GP records.

## Healthcare utilisation

Details of all primary care consultations (including those occurring in the surgery and at the patients home, during both the day and the night), all prescriptions issued by the practice and all tests requested were collated retrospectively for the 2-year period following the initial questionnaire mailing. Information regarding secondary care use (outpatient contacts and inpatient care) was also collected from the GP medical records. As records of Accident and Emergency (A&E) attendances were not routinely notified to the practices, this information was obtained directly by search of local A&E records.

The data collected were used to calculate the costs detailed below. Primary care costs were divided into consultations, GP requested investigations and prescribed medications. Consultation costs were calculated by relating healthcare utilisation data to total practice income. Access to accounts for the generation of cost estimates was only available for one GP. The income this practice receives from the provision of general medical services is broadly comparable to the UK norm. The GP accounts included the costs of running the practice, e.g. salaries of practice staff, building, heating and lighting, etc. but excluded the costs associated with drugs and payment of secondary care for services. Using data for the 314 children from this practice; the mean number of consultations (surgery, day-time home visits and night-time home visits) in each of the four symptoms/risk factor response categories was calculated. This was then applied to all responders to the questionnaire in each group ( $n = 1069$ ), and an overall mean consultation rate for all responders calculated. In the absence of evidence to the contrary, the consultation rate in non-responders was assumed to be the same and this was then applied to all children on the practice list during the reference period ( $n = 1625$ ) to give the consultation rate of 5–15 year olds separated into surgery, day-time home visits and night-time home visits. Since practice income could not be

apportioned between adults and children, this process was replicated for adults and children aged under 5 years. The average consultation time at the time of this study was 7.5 min (1 unit) and it was estimated that a home visit during the day took 15 min (2 units). A night-time home visit was estimated to take 1 h (8 units), which included the doctor's travel to and from home. The practice income was divided by the number of units of 7.5-min GP time to give the cost per (unit) consultation. The time taken for day and night home visits was arrived at after discussions with general practitioners in this practice and are unlikely to have differed greatly between practices.

The average cost of a surgery consultation was determined from the total practice income for the 2-year period ( $p$ ) on the assumption that all practice activity is in some way related to the consultation. The average cost of a surgery consultation is represented by  $x$ ,  $c$  represents the total number of surgery consultations,  $h$  the total number of day home visits, and  $n$  the total number of night home visits. A day-time home visit is estimated to cost twice that of a day surgery consultation, and a night-time home visit eight times the cost due to the estimated time taken to perform the task

$$x = \frac{p}{c + 2h + 8n}$$

The cost of GP requested investigations were calculated by summing the charges made to the practice for each type of test and dividing this figure by the number of tests performed. The data were available from fund-holding costs operating at the time of the study.

Medication costs for each prescription written were calculated using a computer program obtained from the Prescription Pricing Authority<sup>13</sup> an organisation that collates all the information from prescriptions in the UK.

Secondary care costs in 1993/94 and 1994/95 were not available. To determine the cost of secondary care to correspond with the primary care data collection period, cost data from the local NHS Trust for 1998/99 were used and adjusted for inflation since 1993 using Bank of England data. Mean costs per day were calculated for each speciality using the number of children admitted within each speciality, the number of inpatient days and the total expenditure by each speciality. These data detailed the number of children admitted to each speciality with the number of days as an inpatient and the total expenditure by

each speciality. These results were then aggregated into costs relating to lower, upper and non-respiratory illness. Upper respiratory illness was defined as conditions relating to the ears, nose and throat. Lower respiratory illness was defined as conditions relating to the lungs. All other conditions were classified as non-respiratory. Similar data were available for outpatient consultations.

Costs for A&E consultations were also established using cost and utilisation data from the Trust. These data were not recorded by presenting complaint; therefore, a mean cost per A&E consultation for any condition was derived.

The unit costs established in the study are shown in Table 1.

A scoring system was proposed to identify children aged 5–15 years with "likely asthma". Three or more symptoms/risk factors from five on the postal respiratory questionnaire was the threshold for likely asthma. This scoring system was validated in children aged 5–15 years and gave a high positive predictive value of 84% (confidence interval 74–90) for identifying children who would benefit from a trial of inhaled asthma medication.<sup>14</sup>

For this paper, children with such scores were categorised as having "likely asthma".

A GP diagnosis of asthma included all children with a diagnosis of asthma ever recorded in their GP notes and also those children who had been issued with a prescription for an inhaled asthma medication in the proceeding 12 months.

**Table 1** Unit costs of health care.

<i>Primary care</i>		
Contact	Surgery consultation	£8.61
	Day home visit	£17.22
	Night home visit	£68.88
Tests	Chest X-ray	£7.50
	Other X-ray	£13.25
	Haematology	£9.41
	Biochemistry	£4.83
	Microbiology	£15.80
<i>Secondary care</i>		
Out-patient	Lower respiratory	£97.94
	Upper respiratory	£99.91
	Non-respiratory	£56.32
In-patient day	Lower respiratory	£210.71
	Upper respiratory	£273.58
	Non-respiratory	£422.09
Accident and emergency		£50.54

## Results

A total of 3653 questionnaires were sent out to parents or guardians. After two reminders to non-responders, 2659 replies were received, giving a response rate of 72.8%. The population was predominately Caucasian and of lower socio-economic status. Responses to the questionnaire were very similar between the two GPs; so replies from the two populations were combined.

Of the 800 children identified for additional data collection, 86 children were excluded because

their records were missing following data collection and one child had died. Of the remaining 713 for whom adequate information was available, 488 were aged 5–15 years and were included in the present analysis (Table 2).

The cost of GP consultations increased as the number of symptoms/risk factors reported on the questionnaire increased (Table 3), particularly for consultations for lower respiratory illness (from £2.37 in those with no symptoms/risk factors to £13.96 in those with 4–5 symptoms/risk factors). The costs for non-respiratory consultations showed

**Table 2** Number of individuals in each questionnaire response group by age, availability of data and presence of a GP diagnosis of asthma.

Symptoms/ risk factors	Responders with complete questions aged 5–15 years old	5–15 year olds available for analysis	Responders with complete questions (5–15 years old)		
			GP asthma diagnosis		
			Yes	No	Total
0	482	136	70	412	482
1–2	929	128	190	739	929
3	191	106	105	86	191
4–5	191	118	142	49	191
Total	1793	488	507	1286	1793

**Table 3** Mean cost per patient per year (£) of surgery/outpatient consultations, prescriptions and secondary care by number of symptoms/risk factors from five key questions (95% confidence interval).

	Number of symptoms/risk factors			
	0 <i>n</i> = 136	1–2 <i>n</i> = 128	3 <i>n</i> = 106	4–5 <i>n</i> = 118
<b>Primary care consultations</b>				
Lower respiratory	2.37 [1.43–3.31]	3.55 [2.38–4.72]	12.29 [8.66–15.92]	13.96 [10.75–17.17]
Upper respiratory	7.03 [5.13–8.94]	9.13 [7.17–11.10]	12.70 [9.38–16.02]	12.20 [9.23–15.17]
Non-respiratory	19.23 [15.84–22.63]	24.25 [19.52–28.98]	19.41 [15.84–22.98]	23.80 [19.78–27.82]
<b>Prescriptions</b>				
Respiratory	3.24 [1.18–5.30]	4.95 [2.92–6.97]	21.49 [13.36–29.62]	36.01 [24.06–47.96]
Non-respiratory	7.90 [1.09–14.71]	5.69 [3.50–7.89]	7.95 [5.59–10.32]	11.81 [6.81–16.82]
Prescriptions total	11.14 [3.98–18.31]	10.64 [7.34–13.94]	29.44 [20.66–38.24]	47.82 [34.49–61.15]
All Primary care	28.64 [24.10–33.18]	36.93 [31.36–42.51]	44.40 [37.15–51.66]	49.96 [43.24–56.68]
<b>Secondary care</b>				
Lower respiratory	2.09 [–1.70–5.89]	1.53 [–0.60–3.66]	3.78 [–0.10–7.66]	14.76 [4.00–25.52]
Upper respiratory	20.24 [5.47–35.03]	23.63 [7.25–40.01]	26.01 [7.62–44.41]	53.62 [28.30–78.94]
Non-respiratory	81.16 [34.00–128.31]	93.12 [53.12–133.12]	75.03 [20.93–129.14]	130.19 [45.91–214.48]
All secondary care	103.50 [54.51–152.49]	118.28 [75.58–160.98]	104.83 [46.98–162.69]	198.58 [111.59–285.57]
All care	143.28 [87.88–198.69]	165.85 [119.91–211.79]	178.67 [118.56–238.81]	296.36 [203.50–389.23]

**Table 4** Mean number of inpatient days/stays per patient per year by number of symptoms/risk factors from five key questions (95% confidence interval).

	Number of symptoms/risk factors			
	0 <i>n</i> = 136	1–2 <i>n</i> = 128	3 <i>n</i> = 106	4–5 <i>n</i> = 118
Inpatient days	0.19 [0.08–0.30]	0.18 [0.08–0.28]	0.18 [0.04–0.32]	0.39 [0.19–0.59]
Inpatient stays	0.07 [0.03–0.10]	0.08 [0.04–0.11]	0.06 [0.02–0.09]	0.13 [0.08–0.17]

no clear trend across positive response categories. The mean cost of primary care prescribed respiratory medications per patient per year was £3.24 for those with no symptoms/risk factors compared to £36.01 for those with 4–5 symptoms/risk factors.

The cost of secondary care also increased as the number of symptoms/risk factors rose (Table 3), particularly for lower respiratory illness (from £2.09 in those with none to £14.76 per patient per year for those with four or five symptoms/risk factors. The number of respiratory symptoms/risk factors was also related to the mean annual cost of consultations for upper respiratory conditions in both primary and secondary care.

The mean number of inpatient days per patient per year of in those with four or five symptoms risk factors (0.39, 95% confidence interval 0.19–0.59) were higher than those with fewer symptoms/risk factors (Table 4). Similar results were seen for inpatient stays.

When the data were stratified by whether there was evidence of a GP diagnosis of asthma; children with a diagnosis of asthma tended to have higher primary and secondary care costs than those without such a diagnosis, regardless of the number of symptoms reported (Table 5). For example, the cost of primary care lower respiratory tract consultations in children with 4–5 symptoms/risk factors was £17.02 per patient per year for those with a previous diagnosis of asthma compared with £6.08 per patient per year for those with the same number of symptoms but no diagnosis. The cost of primary care lower respiratory consultations in those with no GP diagnosis of asthma and no symptoms/risk factors was £2.25.

Those diagnosed asthmatics with three or more symptoms/risk factors accounted for the highest mean yearly NHS cost £260.25, compared with diagnosed asthmatics with fewer symptoms/risk factors costing £231.58. Children with no GP diagnosis of asthma had a mean annual cost of £201.26 if they had three or more symptoms /risk factors and £152.76 if they had fewer or no symptoms/risk factors.

When children whose parents reported three or more symptoms/risk factors (likely asthma) were compared with those who had fewer symptoms, significant differences were seen in the mean annual cost for several categories of healthcare (Table 6). The mean cost of primary care consultations in the less symptomatic group was £2.93 compared to £13.17 in those with the greater likelihood of respiratory disease ( $P < 0.001$ ). Similar differences were found for respiratory prescriptions (£4.05 and £29.14,  $P < 0.001$ ) and secondary care for lower respiratory conditions (£1.81 and £9.57,  $P = 0.017$ ). The overall mean costs of primary care and of all care irrespective of sector were also significantly higher for those in the group with more than three symptoms/risk factors.

The proportion of healthcare events, and associated NHS costs in primary and secondary care consultations for lower, upper and non-respiratory illnesses, extrapolated to the whole study population, are shown in Fig. 1. In each illness group, most consultations occurred in the primary care, although large proportions of costs were incurred in the secondary care sector.

## Discussion

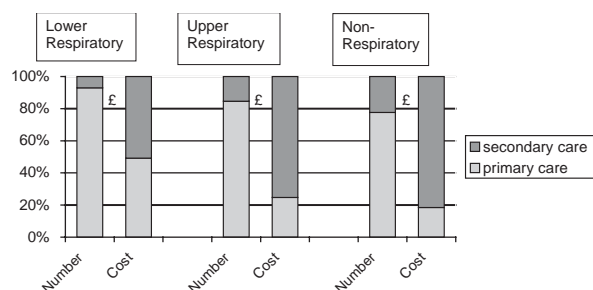
It is noteworthy that many of the healthcare costs for children in this study with three or more symptoms/risk factors (likely asthma) but without a GP diagnosis of asthma were higher than those without a diagnosis of asthma with fewer symptoms. This indicates that many children are requiring and receiving care even though they have no formal diagnosis. Studies, which fail to include the costs associated with treating symptomatic children without a formal diagnosis, will underestimate the costs of treating children with the condition. This is particularly important for conditions like asthma where there is still a high frequency of underdiagnosis. We have previously estimated that around 7.9% of all children in the study population have undiagnosed asthma.<sup>10</sup>

**Table 5** The mean cost (£) of surgery/outpatient consultations, prescriptions and secondary care (per patient per year) by GP diagnosis of asthma (95% confidence interval).

	Symptoms/risk factors							
	0		1-2		3		4-5	
	<i>n</i> = 9 Diagnosis	<i>n</i> = 127 No diagnosis	<i>n</i> = 27 Diagnosis	<i>n</i> = 101 No diagnosis	<i>n</i> = 60 Diagnosis	<i>n</i> = 46 No diagnosis	<i>n</i> = 85 Diagnosis	<i>n</i> = 33 No diagnosis
<b>Primary care</b>								
Lower respiratory	4.07 [1.66–6.47]	2.25 [1.25–3.25]	8.98 [5.22–12.73]	2.09 [1.15–3.04]	16.98 [11.14–22.82]	6.17 [3.32–9.02]	17.02 [12.83–21.22]	6.08 [3.49–8.67]
Upper respiratory	10.76 [2.57–18.95]	6.77 [4.79–8.75]	8.29 [4.04–12.54]	9.36 [7.16–11.61]	13.22 [8.79–17.65]	12.02 [6.82–17.23]	12.38 [8.97–15.79]	11.74 [5.48–18.01]
Non-respiratory	20.12 [6.58–33.67]	19.17 [15.62–22.72]	21.45 [13.25–29.66]	25.00 [19.36–30.64]	19.55 [14.96–24.14]	19.23 [13.38–25.08]	24.91 [20.40–29.42]	20.94 [12.14–29.73]
<b>Prescriptions</b>								
Respiratory	17.88 [–14.89–50.65]	2.20 [1.30–3.11]	12.53 [4.94–20.11]	2.92 [1.46–4.38]	31.06 [18.76–43.37]	9.01 [0.09–17.93]	48.02 [32.11–63.94]	5.06 [2.56–7.57]
Non-respiratory	56.29 [–58.48–171.06]	4.47 [2.43–6.51]	9.90 [1.15–18.67]	4.56 [2.96–6.17]	9.03 [5.55–12.51]	6.55 [3.42–9.69]	14.17 [7.44–20.91]	5.73 [1.50–9.97]
Prescriptions total	74.17 [–40.65–188.99]	6.67 [4.25–9.11]	22.43 [10.55–34.32]	7.48 [4.91–10.06]	40.09 [26.83–53.35]	15.56 [5.91–25.21]	62.19 [44.65–79.74]	10.79 [5.55–16.04]
All primary care	34.95 [20.17–49.74]	28.19 [23.41–32.97]	38.72 [27.08–50.37]	36.45 [30.02–42.89]	49.75 [39.14–60.36]	37.43 [27.97–46.89]	54.31 [45.93–62.69]	38.75 [28.55–48.96]
<b>Secondary care</b>								
Lower respiratory	28.85 [–37.68–95.39]	0.20 [–0.19–0.59]	7.25 [–3.09–17.59]	0 [0–0]	4.50 [–0.90–9.90]	2.83 [2.88–8.56]	16.48 [3.73–29.23]	10.34 [10.73–31.41]
Upper respiratory	59.28 [–70.30–188.88]	17.48 [3.64–31.33]	35.84 [–18.50–90.18]	20.36 [4.84–35.88]	21.67 [–1.37–44.72]	31.68 [0.83–62.53]	41.08 [15.53–66.64]	85.92 [22.30–149.53]
Non-respiratory	259.20 [–323.19–841.60]	68.54 [31.72–105.36]	44.48 [3.36–85.62]	106.12 [56.65–155.60]	44.78 [20.98–68.59]	114.50 [–8.02–237.02]	159.72 [43.79–275.66]	54.13 [11.03–97.24]
All secondary care	347.34 [–226.81–921.50]	86.22 [47.18–125.27]	87.58 [19.87–155.29]	126.49 [75.10–177.87]	70.96 [0.17–111.74]	149.02 [25.01–273.02]	217.28 [99.23–335.34]	150.40 [77.12–223.68]
All care	456.46 [–227.95–1140.88]	121.08 [79.34–162.85]	148.73 [68.06–229.42]	170.42 [115.75–225.10]	160.80 [112.88–208.72]	202.01 [75.55–328.48]	333.78 [208.25–459.34]	199.94 [123.90–275.99]

**Table 6** The mean cost (£) of surgery/outpatient consultations, GP tests and prescriptions (per patient per year) by presence of three or more symptoms/risk factors from five key questions.

	Number of symptoms/risk factors		<i>t</i>	<i>P</i>
	Less than three <i>n</i> = 265	Three or more <i>n</i> = 224		
<b>Primary care consultations</b>				
Lower respiratory	2.93	13.17	-8.05	<0.001
Upper respiratory	8.02	12.44	-3.36	0.001
Non-respiratory	21.60	21.72	-0.06	0.952
<b>Prescriptions</b>				
Respiratory	4.05	29.14	-6.57	<0.001
Non-respiratory	6.82	9.99	-1.35	0.178
Prescriptions total	10.88	31.13	-6.11	<0.001
All Primary care	32.55	47.33	-4.79	<0.001
<b>Secondary care</b>				
Lower respiratory	1.81	9.57	-2.41	0.017
Upper respiratory	21.81	40.56	-1.92	0.056
Non-respiratory	86.63	104.09	-0.58	0.564
All secondary care	110.25	154.22	-1.39	0.166
All care	153.68	240.68	-2.55	0.011

**Figure 1** Illness categories—total number and cost of consultations over the 2-year period (*n* = 488).

Children who do not have formal diagnoses can be included in cost analyses based on responses to a questionnaire. Alternatively, records of presenting symptoms can be used in addition to recorded diagnoses. The widespread use of computerised GP records makes this more practical than in solely paper-based settings.

Previous work has shown that primary and secondary healthcare utilisation increases as the number of symptoms/risk factors to key questions on a respiratory questionnaire rises.<sup>15</sup> This paper now quantifies the healthcare costs associated with these increases. As found by other studies, most care took place in the primary sector whereas most cost was associated with secondary care usage.<sup>16-18</sup>

Other studies have also found that children with asthma utilise a greater proportion of services than those without the diagnosis, whether for respiratory or non-respiratory illness.<sup>5-7</sup>

The relationship between respiratory symptoms/risk factors and mean annual cost of consultations was evident for both lower and upper respiratory conditions, which provides further evidence that the airways need to be considered as a whole—conditions of the lung can impact on the ears, nose and throat and vice versa.

Earlier studies have established costs for a GP consultation using different methods, usually based on estimates. One study in 1997 estimated the cost of a GP consultation to be £9.00 and a nurse consultation £6.00.<sup>19,20</sup> Another derived a cost of £6.90 ( $\pm$  £2.73) in 1995/96 for a GP consultation.<sup>9</sup> The cost of a primary care consultation obtained in the present study from actual practice data was £8.61, similar to those found by others.

This study did not differentiate between consultations occurring with a GP or a practice nurse. It was decided that the longer appointment times assigned for a nurse consultation would balance the difference in remuneration between GPs and practice nurses. A study in Sheffield examined the costs of consultations in GP and estimated that a day-time GP contact cost £7.32 with a home visit costing £14.75 and a day-time nurse consultation

costing £6.89.<sup>21</sup> These figures compare favourably with our assumptions of a nurse consultation costing the same as a GP consultation and a day-time home visit costing twice as much, reflecting the time taken by the health professional to perform the task and so are comparable to our calculations.

The prescribing costs of respiratory and non-respiratory medication rose with the number of symptoms/risk factors reported, both in those children with a GP diagnosis of asthma and those with no diagnosis. It is possible that antibiotics for respiratory conditions, hay fever and eczema medications drove these patterns of expenditure. It has previously been shown that patients receive several courses of antibiotics before being diagnosed as being asthmatic.<sup>22</sup>

Earlier work examined possible response bias to the postal questionnaire in this population; no important differences were found.<sup>23</sup>

The stratified sample was designed to "enrich" the sample in favour of those likely to have asthma compared to the distribution in the general population. Due to available resources, only a finite number of GP records could be examined. Thus it was considered important to select equal numbers of subjects for record examination in each of the symptom/risk factor groups. The selected group also included children aged less than 5 years, whose results are not presented here, owing to differences in the likely aetiology of symptoms.

This study has some important limitations. The medication data were obtained from records of prescriptions issued, not actually medication dispensed. A previous study has found that up to 20% of patients do not submit their prescription for dispensing,<sup>24</sup> and thus the costs presented may be overestimates. The costs will also have been inflated by an unknown amount because of the treatment of children with mild, self-limiting symptoms, or because of an incorrect diagnosis of asthma.

The source of data was GP records and under recording of hospital utilisation may have occurred. If this occurred randomly it would tend to underestimate our costs; however, if one speciality was more likely to send clinic letters and discharge summaries to the GP, bias could have been introduced. While it is possible that the dissemination of a respiratory questionnaire may have increased awareness and thus affected patient and GP behaviours, it is difficult to quantify any possible effect. It is also likely that any effect would have been short term, and thus minimised by the collection of utilisation data over 2 whole years. Data had to be collected retrospectively at

the end of the 2-year period, due to logistical and practical limitations of the study. Neither patients nor GPs were informed of the results of the categorisation during the period of data collection. It is possible that some of the children who did not have an asthma diagnosis in 1993 would have subsequently been diagnosed by 1995. This information was not collected and may have had some impact on our results. Although the derivation of the cost of a consultation was based on the accounts of one GP, utilisation data were collected from two GPs. Although no formal evaluation of wider applicability was made, the results include consultations with nine partners; four trainees and five practice nurses and thus reflect the practice behaviours of a number of healthcare professionals.

The methods used to collect the data and the data collected have not been validated. This could be done by repeating the study in a number of settings on a number of occasions but is limited by time and cost constraints. While there is no single widely accepted method for obtaining the costs of a consultation validation against a gold standard is not possible. Comparison with the results of other similar studies provides evidence for the validity of the methods used here.

The population studied had a consultation rate of 3.5 per person per year compared with 2.5 per person per year seen in the 2001 UK national census.<sup>25</sup> This higher consultation rate could be explained by the practices being in a deprived area with known high levels of ill health. The secondary care cost data did not specifically relate to the randomly sampled patients involved in the study, as this type of information was not available. However, data were obtained from the local NHS Trust where most patients from the practices receive their care. For those that received secondary care elsewhere, it was assumed that the costs of treatment would be similar. The cost data presented here relate to the period 1993–1995. It must therefore be acknowledged that circumstances and care may have changed since then. Due to inflation, the costs presented here will be lower than the equivalent present-day values. However, there is little evidence for substantial change, either in diagnosis (e.g. there is still no gold standard for asthma diagnosis) or in the system of healthcare delivery.

There were only eight children who had a consultation in A&E for a respiratory problem possibly indicating inaccurate recording of consultations by A&E. However, 32.5% ( $n = 232$ ) of the total sample attended A&E during the study period for a non-respiratory problem, which suggests A&E attendances were being picked up successfully by



the study team. The low figure for respiratory related attendances in both A&E and secondary care (37 children) suggests that most children in the study population were receiving treatment for their respiratory illness in primary care.

The mean number of inpatient stays per patient per year varies between 0.07 and 0.13 (Table 4) depending on the number of symptoms risk factors. This is comparable with a figure of 0.06 found in the UK General Household Survey.<sup>25</sup>

Weiss et al.<sup>26</sup> state that financial resources need to be directed towards asthma in a more effective way and that "overall costs are not as important as their relative distribution", across patients and types of healthcare. With the introduction of Primary Care Trusts in the UK, practitioners will have increasing amounts of responsibility for the purchasing of services. In order to do this efficiently and equitably; the costs of services need to be known. A fundamental part of any priority setting programme is the availability of relevant and comprehensive costs; data that this study provides. In essence, clinicians and managers must both contribute to decisions on resource allocation in order to optimise outcomes in asthma care and in care for other illnesses.<sup>18</sup> Failure to consider the costs associated with treating symptomatic children without a clinical diagnosis of asthma will underestimate the resources needed to manage such children, both for their respiratory and non-respiratory problems.

## Conclusion

Despite the absence of a formal diagnosis, children with respiratory symptoms are important users of healthcare services. The importance of including such children in studies of cost is considerable if underestimation of the costs of treating children with asthma is to be avoided.

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## References

- Rona RJ, Chinn S, Burney PG. Trends in the prevalence of asthma in Scottish and English primary school children 1982–92. *Thorax* 1995;**50**(9):992–3.
- Strachan DP. The epidemiology of childhood asthma. *Allergy* 1999;**54**(Suppl 49):7–11.
- Woolcock AJ, Peat JK. Evidence for the increase in asthma worldwide. *Ciba Found Symp* 1997;**206**:122–34.
- Burney PG, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973–86. *BMJ* 1990;**300**(6735):1306–10.
- Lozano P, Sullivan SD, Smith DH, Weiss KB. The economic burden of asthma in US children: estimates from the national medical expenditure survey. *J Allergy Clin Immunol* 1999;**104**(5):957–63.
- Szucs TD, Anderhub H, Rutishauser M. The economic burden of asthma: direct and indirect costs in Switzerland. *Eur Respir J* 1999;**13**(2):281–6.
- Smith DH, Malone DC, Lawson KA, Okamoto LJ, Battista C, Saunders WB. A national estimate of the economic costs of asthma. *Am J Respir Crit Care Med* 1997;**156**(3 Pt 1):787–93.
- Hughes D. Costing consultations in general practice: towards a standardized method. *Family Pract* 1991;**8**(4):388–93.
- Graham B, McGregor K. What does a GP consultation cost? *Br J Gen Pract* 1997;**47**(416):170–2.
- Frank PI, Frank TL, Cropper J, Hirsch S, Niven RM, Hannaford P, et al. The use of a screening questionnaire to identify children with likely asthma. *Br J Gen Pract* 2001;**51**(463):117–20.
- Wythenshawe Strategic Regeneration Framework Stage 1 Brief. Manchester: Manchester City Council; <http://www.cn4m.info/files/Strategic%20Regeneration%20Frameworkbrief13503rev5.doc>, 2003.
- Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, et al. International study of asthma and allergies in childhood (ISAAC): rationale and methods. *Eur Respir J* 1995;**8**(3):483–91.
- Prescription Prescribing Authority: primary care drug information database, 1993.
- Frank TL, Frank PI, McNamee R, Wright T, Hannaford P, Morrison J, et al. Assessment of a simple scoring system applied to a screening questionnaire of asthma in children aged 5–15 yrs. *Eur Respir J* 1999;**14**(5):1190–7.
- Cropper JA, Frank TL, Frank PI, Laybourn ML, Hannaford PC. Respiratory illness and healthcare utilisation in children: the primary and secondary care interface. *Eur Respir J* 2001;**17**(5):892–8.
- Partridge MR. Should chest physicians run asthma clinics? *Respir Dis Pract* 1989;**6**:5–7.
- Price DB, Wolfe S. Delivery of asthma care: patient's use of and views on healthcare services, as determined from a nationwide interview study. *Asthma J* 2000;**5**(3):12–4.
- Barnes PJ, Jonsson B, Klim JB. The costs of asthma. *Eur Respir J* 1996;**9**(4):636–42.
- Netten A, Dennett J. Unit costs of health and social care. Canterbury: PSSRU; 1997.
- Netten A, Dennett J, Knight J. Unit costs of health and social care. Canterbury: PSSRU; 1998.
- Consultations in General Practice—What do they cost? Sheffield: Centre for Innovation in Primary Care; <http://www.innovate.org.uk/library/CostRep/costreport.pdf>, 1999.
- Levy ML, Bell LC. General Practice audit of asthma in childhood. *Br Med J* 1984;**289**:1115–6.

23. Cropper JA, Frank TL, Frank PI, Hannaford PC. Primary care workload and prescribing costs in children: the impact of respiratory symptoms. *Asthma Gen Pract* 2000;**9**(1):8–11.
24. Rashid A. Do patients cash prescriptions? *Br Med J Clin Res Ed* 1982;**284**(6308):24–6.
25. Rowlands O, Singleton N, Maher J, Higgins V. Living in Britain. London: The Stationery Office; 1997.
26. Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. *N Engl J Med* 1992;**326**(13):862–6 [see comments].