Acute Asthma in Childhood

An investigation of hospital care and its effect on outcome

by
Philippa Madge

Thesis submitted for the degree of M.Sc. (Med.Sci.)

Departments of Child Health and Nursing Studies,
Faculty of Medicine, University of Glasgow

May 1995

ABSTRACT

Adult studies suggest that treatment and outcome of acute asthma is better for patients treated in specialist respiratory wards[1]. The situation for children is less clear as there are no similar large scale studies. We performed a prospective study of 727 asthma admissions (occurring in 572 children) in two health board areas in the West and Central Scotland between January 93 and January 94. The aims of the study were to assess treatment and outcome in terms of continuing morbidity and readmissions. The results showed that the acute treatment was excellent with over 93% of children receiving nebulised bronchodilators and oral steroids. Discharge planning was less good with only 10% receiving written information at time of discharge. Readmissions were common and accounted for 21.3% of the yearly admissions. A morbidity questionnaire completed by a random sample of 25% of parents within one month of discharge showed a number of children suffering ongoing asthma symptoms. Final analysis showed there was no difference in outcome of children cared for by a specialist respiratory team, or between health board areas.

In response to these specific deficiencies an enhanced discharge package was developed for use in Royal Hospital for Sick Children, Glasgow. A "Home management package", which included an asthma education booklet, a written asthma management plan, follow-up at a nurse run asthma clinic and an asthma help-line, was then evaluated in a controlled randomised study over a one year period. Children with acute asthma were randomised at time of admission to either an intervention or control group. Outcome was assessed by monitoring readmissions and a morbidity questionnaire completed by the parents. In all, 201 children were randomised, 96 into the intervention group and the 105 into the control group. Although, both groups received the same hospital care, there were both fewer readmissions and fewer reported symptoms in the intervention group. In conclusion, a structured "Home management package" achieved significant reductions in readmissions and improvements in asthma morbidity.

DECLARATION

I declare that this thesis embodies the results of my own work, that it has been written by myself, and that it has not been accepted in any previous application for a degree. All the data collection was done by myself with the exception of the data for the asthma audit in Forth Valley. This was collected by Ann Valance and Val Sneddon under my supervision.

Signature:

Date: 23/1/96

ACKNOWLEDGEMENTS

Thanks are due to a number of individuals for their help during this project:

to Dr J.O. Beattie, Stirling Infimary NHS Trust and Dr J.Y. Paton, Department of Child Health, Yorkhill NHS Trust for their help and support throughout the planning and execution of the audit

to Val and Anne for the data collection in Forth Valley.

to John McColl, Department of Statistics, University of Glasgow for ongoing statistical advice throughout both studies.

In specific relation to the asthma booklet I would like to thank Greta Barnes, (Asthma Training Centre), Andrew Rutherford, (National Asthma Campaign), Edwina Wooler, Cathy Meade, and Jane Hobbs, (Asthma Specialist Sisters at The Royal Alexandria Childrens Hospital, Brighton) for their valuable help in reviewing the booklet.

I am grateful to Professor Cockburn, Head of Department of Child Health, for allowing me to benefit from the facilities within the department, to all the Consultants in Yorkhill NHS Trust who allowed their patients to take part, and to the nursing staff on the medical wards for their cooperation throughout. Ms Di Carter, Lecturer, Department of Nursing Studies, University of Glasgow, provided ongoing supervision.

I am especially grateful to all the children and families who participated in the research. Finally, sincere thanks to Dr J.Y. Paton for believing in me in the first place, and providing the motivation and support that enabled me to complete this thesis.

INTRODUCTION

Throughout the world, hospital admission rates for asthma have risen steeply in the last thirty years[2,3,4,5]. In Britain, admissions have risen from around 20,000 per year in the 1960s to 100,000 per year in the 1990s[6].

The largest increase has occurred in children, particularly those in the youngest age group, 0-4 years[2,3,5,7]. For example, in England and Wales, rates among pre-school children have risen from 4 per 10,000 in 1962 to around 100 per 10,000 per year. In Scotland, the number of admissions started to rise later, but from 1980 has increased to around 90 per 10,000 per year[6] (Figure 1). In fact, in Scotland the number of hospital admissions for all obstructive diseases has been increasing[8] (Figure 2). This increase in hospital admissions for obstructive disease has occurred at a time when the morbidity for most other chronic diseases has been falling. Not surprisingly, these figures have caused much concern. Yet, it would be true to say that the fundamental reasons for this substantial rise in asthma are not known.

Why are paediatric hospital admissions for asthma rising?

A number of possible explanations for the increase in paediatric asthma admissions, have been put forward. In summary, the principle suggestions have been:

i) that changes in the diagnosis and coding of asthma have occurred which have led to substantially more admissions being classified as due to asthma;

ii) that there have been changes in the organisation and delivery of healthcare which have led to more cases being admitted to hospital for treatment;

iii) that the increased number of admissions reflects a real increase in the prevalence and severity of asthma and;

iv) that there has been no change in the number of patients admitted with asthma but these patients are being admitted more often i.e. there has been a rise in readmissions.

(i) Has there been a change in diagnosis and coding of asthma?

A number of studies have investigated whether a change in diagnostic coding underlies the increase in asthma admissions in children. In particular, they have looked at changes in the labelling of symptoms such as wheezing[9].

Labelling wheezing illnesses as asthma

Wheezing frequency has been shown to be a reliable indicator of the severity of wheezing illness[9], and has therefore been used as an indicator of asthma. Using frequency of wheezing to compare the rate of parent reported wheeze against doctor diagnosed asthma a number of studies have shown an increase over time in the numbers formally diagnosed as having asthma[10,11]. For example, Strachan reported findings from a study using an identical questionnaire sent to parents of children aged 7.5 - 8.5 years in 1878 and 1991. In answer to the question "Has he/she ever had attacks of wheezing in the chest", Strachan found that twice as many children in 1991 with wheezing illnesses had been given a formal diagnosis of asthma (31% in 1978 to 61% in 1991)[11]. While the number of children affected by wheeze in the past year had increased slightly (1.8%) over the 13 years, the frequency of attacks had barely changed (1978 - 2.5% vs 1991 - 2.6%). Although the main purpose of this study was to explore changes in prevalence in relation to increased

utilisation of health services, Strachan concluded that while there had been a significant increase in the labelling of wheeze as asthma there was little evidence of a true increase in the prevalence of asthma.

Comparing a slightly shorter time gap of 1985 to 1988, Hill et al[10] also found that the overall percentage of those who had wheezed ever was similar at 17.7% (1985) vs 16.4% (1988) while the number of children with reported asthma had risen significantly. Again, the conclusion was that there had been an increase in the use of asthma as a diagnostic label for wheezing without much evidence for an increase in asthma prevalence.

In contrast, in 1985 Conway et al investigated asthma admissions and found that 32% of children admitted with a past history of wheezing had not been labelled as asthma[4]. Similarly, Luyt et al[12] found that despite the strong association of an asthma label with bouts of recurrent wheeze, in 15.6% of children <5 yrs old suffering repeated wheezy episodes (1 in 10 reported >20 attacks of wheeze ever), only 8.6% had been formally diagnosed as having asthma. This was a large study, with a high response rate (86.2%). For the purpose of the study wheeze was defined as "high pitched musical or whistling sound coming from the chest during breathing, not from the throat", a question slightly more specific than Strachan's question ("Has he/she ever had attacks of wheezing in the chest"). These two studies, therefore, argue against the idea that there has been an increase in the use of the label asthma and provide substantial evidence for continuing underdiagnosis of childhood asthma.

It is possible that the accuracy of parental recall may decline with time and make retrospective studies which rely on parental recall of symptoms over long periods of time potentially less accurate. Luyt's study[12] specifically tried

to take account of this by picking a group of children under five. By concentrating on a more circumscribed and recent time period, Luyt hoped that parental recall would be better and the resulting symptom recall more accurate. Despite this point, the studies of Strachan and Hill clearly differ in their findings from those Conway and Luyt. The present consensus is probably to acknowledge that some change in labelling has occurred but that the huge increase in asthma admissions in children is not entirely attributable to increased use of asthma as a diagnostic label in children with wheezing.

(ii) Changes in the organisation and delivery of care

Shift from community to hospital

A second important possibility is that some of the increase in admissions may have arisen from changes in the delivery of medical care. Certainly, clear evidence exists of a change in the way parents seek medical advice for asthmatic children, with more children being self-referred to hospital [2].

Anderson reported a 167% rise in paediatric asthma admissions in South west Thames Region between 1970 - 78[3]. Although part of the increase appeared to be accounted for by an increase in readmissions, a five-fold increase in self-referrals was noted. The patients self-referring were found to have less severe asthma on admission, and a higher readmission rate than those referred by the GP's. There was no apparent reason for self-referral. Although some hospitals operate an open door facility for those with severe asthma, only a few patients were found by Anderson to have been admitted under an agreed emergency programme. Anderson, finally, attributed the increase in self-referral to a shift in the balance of care towards hospital, with hospitals accepting an increasing primary care role. However, he could find

no evidence that this rise reflected a deterioration in primary care, and the study remains unclear as to the cause of the increase.

Storr et al[2] also reported a similar increase in the number of self-referrals to the Childrens Hospital in Brighton during 1971 - 1985. Asthma admissions increased eight fold in Brighton over the 15 year period. The increase was due to the number of individual children seen, as opposed to readmissions. Seventy tow percent self-referred. Part of the increase was attributable to the introduction of nebulised salbutamol as when questioned directly, the reason parents gave for preferring hospital treatment was the availability of nebulised treatment. Since then, the use of nebulisers by GPs has become much more widespread reducing the importance of access to nebulised therapy as a reason for coming directly to hospital[13,15].

In 1989 Anderson[5] re-examined the increase in admissions he had reported in an earlier study[3], looking for causes that would explain the continuing increase in admissions. In the earlier investigation the increase was mainly attributed to a shift in the balance of care towards hospital with no clear change in asthma severity. In the second study Anderson examined in more detail the circumstances surrounding the admissions, investigating two groups, 0-4 years and 5-14 years. Specific data extracted for patient records included the mode of referral, duration of episode, vital signs on admission, treatment in the 24 hours before and after admission and the investigations performed. The results showed that overall admissions for both age groups rose, but no increase in readmission was noted. In fact, for the 5-14 age group, the readmissions fell. From 1975-1985 the population aged 0-4 increased by 10%, whereas the population aged 5-14 decreased by 19%. The results showed that for the 0-4 group there was no change in length of stay, or numbers of readmissions and no significant changes in GP referrals,

although they were generally lower. For the 5-14 group, there were also no significant trends in referral although again there was a tendency toward increased self-referral. There was also no change in the time of admission and the readmission rate had fallen.

However, when the 1985 referrals were split into two age groups (0-4 vs 5-14 yrs) and investigated independently, some differences were apparent. Self - referred patients in the 0-4 group were older, had a longer hospital stay, higher readmission rate, and greater tendency to be admitted during midnight to 11 am than the GP referred patients. In the 5-14 group, self referred patients were older, had a higher readmission rate, and a longer duration of symptoms pre-admission than the GP referred patients. Somewhat surprisingly, although both groups had slightly lower pulse and respiratory rates in the later study, Strachan concluded that an increase in admissions was due to an increase in the frequency of severe asthma rather than a shift in the balance of care.

While these studies confirmed that there had been an increase in the incidence of self-referral and raised the possibility that this had occurred as a result of increased asthma severity, they do not, in the main, attribute the huge increases in hospital admissions to increased self-referral alone. Referral trends certainly appear to be susceptible to transient changes in availability of new therapies, as happened with the nebulisers. However, the rise in asthma admissions has continued long after the introduction of nebulised therapy.

(iii) Has there been change in the prevalence and severity of asthma

Difficulties with measuring asthma prevalence in children

Unfortunately, measuring asthma prevalence in childhood has not been straightforward, partly because of differences in factors such as case definition and methodology.

What is meant by prevalence?

Prevalence refers to the proportion of the population with evidence of asthma[16]. This can be described in 3 ways, (i) at the point of enquiry (**point prevalence**), (ii) over a defined prior period of time (**period prevalence**), or (iii) at any time in their life (**life time prevalence**). Point prevalence is the easiest to measure precisely, but as asthma tends to fluctuate this may underestimate the extent of the problem, as many children may be symptom free at point of enquiry. Life time prevalence will take takes account of this variability but is subject to the problem of recall bias. As a compromise most studies now tend to use period prevalence, usually referring to the previous 12 months.

The main published studies separate into those (i) describing changes in prevalence over time, usually comparing similar age groups after an interval of years[17,20] or those (ii) describing similar age groups, often simultaneously but in different geographical locations[21,25].

Different methodology

The studies also vary in how the information is sought. Most have been based on questionnaire data looking at parent reported symptoms. While questionnaire based studies are economical, there has been concern that

surveys of reported symptoms may be affected by recall bias[26,27]. Unfortunately, adding any objective measurements substantially increases both the cost and the time needed to complete the study. Further, for certain groups such as pre-school children, objective measures are often not available. Moreover, the relationship between objective measures such as bronchial reactivity and other features of asthma such as symptoms is not always simple. For example, evidence of bronchial reactivity is not always detectable in children identified as asthmatic[28]. Fortunately, a number of studies have established that a well-designed respiratory questionnaire provides valid information[28,29] on the presence of asthma.

Variations in prevalence over time

A number of studies using the same questionnaire and study design at different times periods are available and they have found that the prevalence of asthma and atopy has increased with time[17,20].

For example, Burr et al described an increase in asthma prevalence in children aged 12 years living in South Wales during the 15 year period of 1973-1988[17]. The questionnaire used in 1988 contained the same questions as the original used in 1973, and was distributed to the same schools, plus one other that had opened in the catchment area during the 15 year gap. The questionnaire was completed by the parents at home, and the children had PEF measured before and after exercise provocation tests. The response rate was good and the same investigator conducted both surveys. The results showed that there was an increase in wheezing attributed to contact with animals and food but the proportion who wheezed in response to colds decreased. There was also an increase in the number of children who reported eczema (three fold) and hayfever (50%). The author concluded that

no single factor was identified as the cause of the increase. The possibility of some environmental change in the way of life could not be excluded. Similar increases were reported for wheeze and atopic illness in Aberdeen by Ninan[19]. They obtained information on the prevalence of wheezing on children aged 8-13 years, compared in both 1964 and 1989[19]. The study reported a doubling of prevalence of wheezing from 10.4% (1964) to 19.8% (1989). The questions used to obtain the information in both studies were similar, with the exception of the question relating to wheeze, which was altered slightly. The original question asked *"Has your child had a wheezy chest? If yes is it with a cold, sometimes with a cold or not known when"*. This was changed to "*Has your child had a wheezy chest in the last three years? If yes are the episodes of wheeze less than once every three months or more often than every three months in the last year?*". This change allowed both the occurrence of wheeze and the frequency of wheezy episodes to be obtained. A number of possible reasons for the increase in wheeze were put forward. Firstly the oil industry in Aberdeen has brought affluence to the city along with increased improvements in the standard of living and housing. The study concluded that the increase in the number of wheezy children could not be solely attributed to a change in diagnostic pattern as the proportion of children wheezing not diagnosed as having asthma had only risen from 7.5% to 9.8%. There was no evidence of increasing severity of the asthma. In conclusion, the authors proposed that the increase in wheeze and asthma reflected a true increase in the prevalence of all forms of atopy in children.

The British National Study of Growth[20] which monitored school children in England and Scotland since 1972 has also reported an increase in the prevalence of asthma in children. The proportion of English children reported to wheeze by parents has increased steadily by 5% per year. The study also

found that the number of children with persistent wheezing had increased by 50%, suggesting an increase in the severity of asthma.

Similar changes in the prevalence of asthma over time have been reported from other countries. Robertson et al[18] studied 7 year olds in Melbourne, Australia, in 1964 and in 1990 using similar questionnaires. The prevalence of a history of asthma in 7 year olds was 46% in 1990 compared to 19.1% in 1964. Robertson concluded that the prevalence of asthma in Melbourne school children was high, and had increased substantially during the 26 years.

In summary, these studies show that there does seem to be a real increase in the prevalence of asthma in children, along with other atopic disorders. When combined with the evidence of an increase in atopy this suggests that there has been a real increase in asthma, although the reasons underlying are as yet unexplained. It seems likely that this change in prevalence is one of the most important reasons behind the increased admissions.

Geographical variations in prevalence between different places

Some studies have made direct comparisons in children of similar ages in different locations. The problem with such an approach is the possibility of local environmental effects substantially distorting the results. However despite these limitations a number of studies report similar findings.

Barry et al simultaneously investigated 12 year olds in New Zealand and South Wales in the late 80's[22]. These authors included an exercise test as an objective measure. However as mentioned previously this does not necessarily guarantee the findings[28]. The prevalence of a history of asthma was higher at any time in New Zealand (16.8% compared to 12% in Wales),

as was the chance of a hospital admission. Interestingly the frequency of owning a pet was higher in New Zealand although no obvious association between pet ownership and wheeze was recorded. Both hay fever and allergic rhinitis were significantly more common in New Zealand, while eczema was the same. The study concluded that the much higher prevalence of asthma in New Zealand might be attributable to increased allergen exposure or other provoking factors but not necessarily to an increase in atopic disease. The overall prevalence of 12% for a history of asthma at any time compares well with other British studies.

In contrast, Robertson et al investigated school children of similar ages 7, 12, and 15 years in Australia, Switzerland and Chile[23]. They used the same questionnaire, appropriately translated and asked about symptoms in the past twelve months. Response rates varied from 97.5% in Switzerland to 71% in Chile. The findings varied with quite striking differences noted in the percentages of reported wheeze in the different age groups and between countries. Overall reported wheeze was lowest in Switzerland for 7, 12, 15 years at 7.4%, 6% and 4.5% respectively. Chile and Australia were more similar being highest in the younger age group of 7 year olds at 26.5% and 23.1% respectively. The rates for the individual countries compared well with previous estimates. It is unclear why the rates for Switzerland were so much lower, although the country has a long history of providing a healthy respiratory environment. It was concluded even allowing the different cultural and environmental factors that there was a difference in prevalence.
With the low rates noted in Switzerland in mind, it is of interest to note that Austin et al[21] investigating the prevalence of wheeze and asthma in the Highlands of Scotland, an area of relatively low background pollution, found the level of reported asthma was 14%. The study used a questionnaire in children aged 12-13 years old attending schools in the Highland region,

backed up by exercise provocation tests, along with ozone levels during the same period. The main aim of the study was to determine the history of wheeze, and parental awareness of a diagnosis of asthma. However it concluded that the prevalence of asthma is not lower in rural areas and therefore does not support the theory that asthma is more common in areas of higher pollution.

Evidence of increased asthma severity

There is some difficulty in interpreting the findings regarding changes in asthma severity. Few studies have focused directly on relation between severity and admission. Accordingly, most of the information has to be disentangled from the studies. Further, there are difficulties making judgements about asthma severity from retrospective studies, and there has been debate about the validity of the severity indicators used. The only consistently available measures are pulse and respiratory rate, and duration of wheeze before the attack. Although in adults pulse rate has been found to correlate well with functional disability and blood gas disturbance this is not so in children[30]. Tachycardia is a recognised side effect of bronchodilator therapy and may therefore may be misleading when used to judge severity.

Despite these problems, some studies suggest an increase in severity. Strachan et al reported in 1994 on the prevalence and severity of wheezing illness and asthma in a wider range of school children aged 5-17 years old in a National survey of the United Kingdom[31]. This study tried to estimate both prevalence and severity. The questions were administered to the public during March and April 1992. In the past twelve months 15% of children had wheezed, compared to 23% who had a history of wheezing at any age. Overall 13% of the sampled had been diagnosed as having asthma. The

annual period prevalence of wheezing varied little with the degree of urbanisation, but the severity and frequency of wheezing was lower in rural areas. Overall the prevalence appeared lower in Scotland, in contrast to Austin's findings[32], with a marked trend towards more severe, more frequent episodes in the lower socio-economic groups.

Conclusions

The general conclusion of many reports, therefore, points to an increase in the number of children who have asthma over time, both in the United Kingdom and elsewhere. There is also evidence of substantial geographical variations. The answer to whether there has been a concomitant change in severity is less clear.

(iv) Evidence of an increase in readmissions

The final possible explanation for the increase in asthma admissions, is that there has been no true increase in the number of admissions, but rather that the number of admissions per child has increased. A number of studies have reported such increases, although this has often not been the main aim of the reports. However as with all of these studies interpretation of the results is made difficult by the different definitions used, the different time periods, and the population studied. Finally, some studies have included a mixed population of both adults and children. Since there is some evidence that the readmission rates may be slightly higher in children if followed over a longer period, combing data on adults and children may give the wrong overall impression.

However despite these limitations, there are a number of studies, mainly from New Zealand and Australia, which report rises in the number of children

being readmitted[33]. The readmission levels reported appear slightly higher than levels than in the United Kingdom, and higher than those reported in adult studies[1, 7].

Defining re-admission

Differences in readmission rates can be misleading if the definition of readmission varies. From the main studies reviewed in this section there are two ways of defining readmission:

i). Readmission may be defined as a second or subsequent asthma admission during a period of time in the same patient[1, 33]. The readmission rate (%) is then usually obtained by determining the % of the original sample who had at least one subsequent admission e.g. if 30 out of a sample of 120 had one further admission during the study period, the readmission rate would be 25% (i.e. 30/120*100=readmission%).

ii) Other studies have described a readmission ratio, defined as the number of patients having a single admission to the number of patients having two or more admissions during a calendar year[34]. For the example above, this ratio would be 3:1 (120-30=90/30).

Readmissions in children

During any given year up to 33% of the total admissions in children may be re-admissions[2, 4, 33, 34]. It appears that readmissions in children have increased both in Britain [2] and New Zealand[34, 35]. The studies investigating childhood admissions have reported clearly that a larger percentages of childhood admissions are re-admissions[3, 4, 33]. The overall percentages of readmissions vary according to the length of time they are followed for. For

example, Mitchell in New Zealand in 1994 reported that paediatric readmissions increased to 50% when followed up to 2 years[33].

Mitchell in 1987, reported on common characteristics of children admitted with a history of multiple admissions compared to children with a single admission[35]. The study investigated asthma discharges from the paediatric wards of the hospital in Auckland, New Zealand. Information was collected from two studies taking place at around the same time. The 200 children in the first study consisted of 61% multiple admissions and 39% single admissions. The children in the multiple admission group had their first asthma attack significantly earlier than the "singles" group, and reported a higher incidence of allergies to food, dust and pollen, although there was no difference in the groups for eczema or family history of atopy. There was no difference in the socio-economic status of the two groups. The "multiple" group were receiving more medication, implying that they had more severe asthma. The study concluded that it was difficult to identify the child at risk from further attacks, but confirmed that 24% were readmitted within six months, and that a large proportion of children (61%) had history of previous attacks at the start of the study.

Crane et al described markers of risk for death or readmission following a hospital admission in 1992[36]. Although this study reports on patients within an age range of 5-45 years the findings are of interest. The authors identified three markers of chronic asthma severity which were associated with an increased risk of death and readmission. These were, a hospital admission in the previous twelve months, the occurrence of multiple admissions in the previous twelve months and three or more categories of prescribed asthma drugs.

Mitchell investigated readmissions again in 1994[33] and reported further on risk factors, in a large sample of 1,034 children, aged 0-14, followed for a maximum of 33 months. A survival analysis was then performed to try to identify possible risk indicators for readmission. Mitchell concluded that risk factors for readmission of children with asthma were the sex and age of the child, the severity of the asthma categorised by the use of intravenous therapy, and the number of previous admissions. Medical treatment and management did not influence readmissions. Mitchell suggested that strategies to reduce the high readmission rates in children should be developed.

Conclusion

While all the above factors, may have contributed to the rise in hospital admissions for asthma in children, the main driving force has been thought to be an unexplained increase in the prevalence of asthma.

It also seems that readmissions in children are an important problem and may be contributing to substantially to the numbers of admissions. They are certainly an area which merits further investigation[36].

What is the significance of readmission?

It is possible that re-admissions in children with asthma are more a marker of poor outcome than in adults. Alternatively it may just be that in childhood asthma is more active and difficult to control. Few studies, with the exception of Mitchell[34], have investigated paediatric readmissions in detail. While Mitchell's study involved children in New Zealand it raises general questions about the quality of care in paediatrics. This concern about the impact of care on outcome echoes earlier adult data. Bucknall[1] found that care in a specialist respiratory ward led to an improved outcome. In particular, readmissions were considerably lower (2% vs 20%) in the specialist group. This difference in outcome was associated with patients in the specialist unit receiving more commonly treatments that were thought important in the treatment of acute asthma. Whether the impact of specialist hospital care and its impact on outcome differs between adults and children requires further study.

Using audit to investigate the standard of asthma care

Bucknall's pioneering papers highlighted that quality of care can affect outcome and have been an important stimulus to the wider appraisal of quality of care and its effect on outcome through the introduction of clinical audit.

Definition

Audit is defined as "the systematic and critical analysis of the quality of medical care"[37]. Audit aims to measure performance against agreed standards[38]. Deficiencies can identified and appropriate changes to improve can be introduced. In asthma practice, the development of national

guidelines has provided widely adopted standards of good practice[39] to use as a benchmark.

Outcome

Defining outcomes

In medical audit, attention has often been focused on three measurable features of care: structure, process and outcome. There has been growing appreciation that outcome is the most important of these three. Unfortunately defining good and relevant outcome indicators has been very difficult. Within any given population outcome may be affected by a variety of external factors, such as environment, so the overall effect of hospital care may be small.

Outcomes for hospital care in paediatric asthma

A number of hospital outcome indicators for child health have been suggested by the British Paediatric Association Health Services Working Group in 1990. For asthma, three were proposed:

i). numbers of children with asthma admitted to hospital for longer than 72 hours

ii). numbers of children re-admitted with asthma within 14 days of discharge from a previous attack

iii). children admitted within 24 hours of being seen in accident and emergency because of asthma

It was hoped that variations in paediatric practice and outcomes between hospitals might provide a starting point for improving outcome. Unfortunately, numerous problems were encountered when an attempt was made to measure these outcomes in practice[40]. Six paediatric centres all with an

interest in asthma (Aberdeen, Brighton, Leicester, Manchester, Oxford and Romford) agreed to audit the casenotes of children who fitted any of the three outcome categories. One auditor in each centre examined the casenotes suitable for inclusion into the audit. The auditors then subjected the case notes to the BPA clinical practice audit for inpatients which had been modified by the British Paediatric Respiratory Group with specific reference to asthma. This audit asked 53 questions on seven categories; admission, documentation of illness, investigations, treatment, patient education and welfare, discharge, and finally availability of resources. Data was collected from 264 case notes.

There was wide variation noted in the ability of the six hospitals to collect the information. Of the 53 questions posed, 17 were deemed unanswerable. because the information was lacking in the casenotes, or because the proposed audit question was ambiguous. Only 21 questions were answered in a similar way by the majority of centres. There was a wide variation noted in the responses. For example, for the question "Pulse oximetry recorded?" the percentage of notes that the information was recorded in varied from 3% to 92%. There was no indicator of whether the saturation was simply not performed because there was no machine available or omitted due to poor practice. When assessing indicators that were not resource dependant there was still wide variation. For example "Documented that child could use inhaler at discharge?" elicited responses ranging from 10% to 70%.

LOCAL SITUATION

Around 1990 at the Royal Hospital for Sick Children, Glasgow, a number of concerns about the management of acute childhood asthma were emerging. Firstly, it was recognised that the number of children admitted with wheezing/asthma (ICD code 493.0-493.9) was rising substantially (Figure 3).

Secondly, the results of a small pilot study undertaken primarily to investigate the relationship between asthmatic children admitted to hospital and damp, mouldy housing in Glasgow provided more direct cause for anxiety[41]. The study sample was obtained by information provided from Greater Glasgow Health Board (GGHB) Statistics Department, who generated a printed list of all the children aged between 2 and 14 years who lived in the GGHB area with an SMR1 discharge diagnosis of asthma or wheezing (ICD code 493.0 and 493.9). The print out gave details for 604 episodes which occurred during 1990. These 604 episodes occurred in 462 children once readmissions had been accounted for. Parents of 457 children with available addresses were sent a questionnaire and seventy eight percent (355/456) were eventually returned .

More than half the year's admissions occurred in the months of September through to November. A substantial number of children were admitted on more than one occasion during the study year. Indeed, approximately one quarter of parents claimed their child had in total had had 5 or more admissions (Table 1).

In the conclusion, it was suggested that a more detailed study be undertaken to validate this high reported rate of re-admission. Since high readmission rates might reflect poor disease management, it was additionally suggested that, if confirmed, this high rate should be investigated further.

This local evidence of a rise in the number of admissions combined with reports of frequent readmission led to the idea of undertaking a detailed prospective study to investigate asthma care in children hospital in Glasgow and its impact on outcome, particularly readmissions. It was hoped that knowledge of areas of poor care would allow these to be directly targeted with the aim of improving outcome.

HYPOTHESES

i) The outcome for children hospitalised with acute asthma in the West of Scotland was poor as reflected in high re-admission rates and continuing morbidity.

ii) That appropriate clinical interventions could reduce the number of readmissions.

AIMS OF THE STUDY

1. To identify all children over two presenting with acute asthma and admitted into three paediatric centres in two health boards.

2. To validate the high rate of readmissions reported by parents.

3. To examine the recorded medical treatment of children admitted with acute asthma with a view to identifying any deficiencies of care.

4. To evaluate outcome following hospital care for an acute asthma admission and investigate the impact of different levels of care on outcome. In particular, to examine outcome in relation to specialist versus non-specialist care and teaching hospital versus district general hospital.

5. To develop a plan for improving outcome by targeting areas where poor practice was occurring.

STUDY 1

In order to achieve the first four aims, a prospective audit similar to that of Bucknall et al was undertaken.

METHODS

Study plan

The audit was designed in two parts. In the first part it was planned to collect information on the process of asthma care at the Royal Hospital for Sick Children, Glasgow. This was to be achieved through a prospective audit of the hospital management of all asthma admissions during a one year period. The second part of the audit was to focus on morbidity and outcome following hospital care of an acute asthma exacerbation. In this part, it was planned that a random sample of the admissions would be contacted within a month of discharge. All children admitted with acute asthma were also monitored throughout the study in order to obtain information on subsequent readmissions.

Timing

The study took place over two years from August 1991 - August 1993. The first six months (August 1991 - January 1992) were used for the development and piloting of forms and questionnaires for data collection. Data collection then ran prospectively for one year beginning in January 1992-93. The final period from February 93 - August 93 was used for data analysis. All asthma admissions occurring during the year were included.

It was decided to study a whole year for a number of reasons. Firstly, it was considered a study over a one year period would take account of any

seasonal effect on asthma admissions, and asthma care. Secondly, the previous pilot study[41] suggested that a number of children had more than one admission during a twelve month period. Using a fairly long time scale would then allow the occurrence of readmissions to be monitored.

Subjects

All children admitted with acute asthma aged 2 years and over were included in the study. It was decided to exclude children under two for a number of reasons. Firstly, there is less agreement about both the nature and diagnosis of asthma in children under two years of age. Further, bronchiolitis, an acute wheezing illness occurring mainly in children under two years and due to viral infection may be difficult to distinguish from asthma.

Setting

While the study was being planned, the opportunity arose to include all children with acute asthma admitted to the wards of the neighbouring Forth Valley Health Board (FVHB) in addition to those admitted to Royal Hospital for Sick Children, Glasgow. The estimated childhood population in the age group 0-14 years in the two health board areas combined is 223,000. Together these two health board areas provide medical care for nearly a quarter (23%) of Scottish children, aged 0-15 years[42]. The inclusion of children from the Stirling and Forth Valley area was of great interest because of the differences in the two areas. The Stirling and Forth Valley area compromises a mixture of rural and semi-urban environments.

The study was finally performed in three paediatric units in the West and Central Scotland (Royal Hospital for Sick Children, Stirling Royal Infirmary and Falkirk Infirmary).

GGHB

The Royal Hospital for Sick Children in Glasgow is a large teaching paediatric hospital of around 300 beds which provides secondary paediatric care for the whole of the Glasgow area. Ninety six beds are used for medical admissions divided into four medical wards of 24 beds. Each ward admits paediatric medical emergencies on a 1 in 4 rotation basis. Of the 4 medical wards (Table 2), one (ward C) has a respiratory specialist attached and provides specialist respiratory care. The ward is also the regional referral unit for children with Cystic Fibrosis. In the remaining three medical wards, the medical and nursing staff have no special interest or training in respiratory disease.

Forth Valley

Within the Stirling and Forth Valley Health Board area, there are two District General Hospitals - Stirling Royal Infirmary and Falkirk Infirmary each with a paediatric ward (Table 2). There are three Consultant Paediatricians whose time is shared equally between the two hospitals. One paediatrician is largely responsible for respiratory illnesses in children in both Stirling Royal and Falkirk Infirmary.

Identifying the subjects - the development of the asthma attendance database

Glasgow

Prior to the study there was no easily accessible record of patients with asthma attending the Royal Hospital for Sick Children, Glasgow, and no method of identifying asthma admissions. Basic information about all children treated in the Accident and Emergency Department is recorded in an

attendance book kept within the department. The information recorded includes the time, the child's name and age and a brief description of the medical problem. These details are entered in the book in the order of attendance, by the receptionist, usually a medical records officer. If the child is admitted, more detailed information is collected. Surprisingly, this attendance register is the only place where details of all children attending as emergencies are kept. It therefore, provided the most reliable method of identifying all children admitted with asthma eligible for the study.

All wards also keep an admission book into which every admission should be entered. While most children come through the A & E department, children are occasionally admitted directly to the ward from clinics in outpatients. Unfortunately, the admission book is not as complete as the A & E attendance register as it depends on nursing staff entering children's details and omissions do occur. For the purposes of the present study, a second important concern with the ward register was that that children are not necessarily entered in strict order of admission. In order for a true random sample to be selected, it was important that an accurate record of attendance was available.

Using Dbase IV (Borland), the author developed a database for the collection of basic demographic information. Every working day, the author updated the database, identifying all children over two years with asthma who had either been admitted (coded as 1) or discharged (coded as 0). The database was particularly useful in identifying children who either attended at A&E or were admitted frequently.

Forth Valley

The patient identification was slightly different in Forth Valley. The two paediatric wards are situated within adult hospitals, Stirling Royal Infirmary and Falkirk General, approximately 11 miles apart. To identify children admitted with asthma in Forth Valley the research nurses visited the wards daily and used the ward admission book to identify possible asthma patients. With only one paediatric ward in each hospital documentation was more accurate. In these two hospitals, the ward admission registers were the only place where a complete record of paediatric admissions was kept.

Data collection

In GGHB the author was responsible for the data collection. The study in FVHB was co-ordinated at local level by two part-time research nurses who were responsible for data collection working under the guidance of the author. The common forms and a short coding dictionary were developed and co-ordinated in Glasgow by the author.

Data collection forms

Case-note form

A case-note form was developed to collect details of each in-patient admission. One was completed for every asthma episode which occurred during the study period, including children who were admitted on more than one occasion.

The case note document was a comprehensive recording form (Appendix 1) developed by the author. Its purpose was to collect information about each

admission and care each individual child received. The document was developed after discussion and extensive review of published work. A particularly helpful model was the study of Bucknall et al of adults[1] admitted to a hospital with acute asthma. In developing the form for this study, we made close reference to this previous work to ensure that we covered the important areas highlighted by this study. Careful account was also taken of the standards of care recommended in the BTS guidelines for the management of asthma[39].

In order to document an admission fully, the form was conceived in 6 parts, each covering a different section area of a typical admission, beginning with the community treatment prior to admission and ending with the discharge.

Part 1. Community response

The first section investigated the response by the family or the GP in the days leading up to the admission. We were particularly interested to know whether and how bronchodilators had been used and whether oral corticosteroids had been started. We were also interested to know who had actually made the referral to hospital. At the time, the number of children referred by GPs compared to those coming directly to hospital was not known.

Part 2. Assessment of attack severity

Assessment of the severity of acute asthma was an area of some interest. The frequent lack of objective measurements of attack severity in adults is well recognised, and has been linked to an increase in mortality[43]. The difficulties of previous studies in assessing changes in severity has also been discussed. In this second section, we therefore, investigated the clinical assessment of asthma severity.

Part 3. Emergency Treatment

The first line treatment of acute asthma is now well-defined for both adults and children and consists of oxygen, high dose bronchodilator therapy and oral corticosteroids[39]. The majority of patients with acute asthma respond well to this treatment. For the few with severe acute asthma who do not, the next step is usually the addition of intravenous Aminophylline.

In non-respiratory wards, Bucknall et al reported that fewer adult patients received oral steroids[1]. At this time, we had no information on how many children with acute asthma were treated in accordance with these recognised standards. The third section of the case note document was, therefore, designed to collect detailed information about the acute care.

Part 4. Asthma History

An admission to hospital with acute asthma often represents a failure of community management. During any admission, every effort should therefore, be made to identify the cause of and circumstances leading to the exacerbation [39]. This information is used to guide modifications of the asthma therapy after hospitalisation. Accordingly, it was judged important to review performance in this area systematically .

Part 5. Continuing In-patient management and observation

Peak flow monitoring

Patients should not normally be discharged until their symptoms have resolved and their lung function has returned to normal[39]. In most patients, lung function can be easily assessed by measuring peak flow. For most patients, normal lung function has returned when the peak flow is above 75% of predicted or best level, and diurnal variation (equal to highest peak flow

minus lowest, divided by the highest multiplied by 100) in each 24 hours is less than 25%[39].

It is not clear whether the same criteria are appropriate for children. Also, measurement of peak flow is entirely dependent on a patient's ability to perform the manoeuvre. Children less than 5 years of age usually are unable to perform forced manoeuvres consistently[44].

Part 6. Discharge Planning and Follow-up

Prior to discharge patients should be provided with advice about their asthma and have their asthma treatment reviewed[39]. It is recognised that this is often done poorly. For example, adults treated in non-respiratory wards were less likely to have their regular inhaled therapy increased at discharge[1].

Patients or parents should be given be given clear information about their asthma treatment, how to take the therapy, and what actions and treatment to take in an acute attack. They also should be given simple advice on how to recognise a bad attack, and when and how to seek medical advice. It is clearly recommended that such advice should be written. Asthma guidelines consider hospital outpatient follow-up after an acute asthma admission, usually within 4 weeks of discharge, to be an important component of care[39]. The final section of the case note document was designed to gather information about this important area.

Coding of the completed casenote documents

All patient personal details were recorded on the front page of the case note document. To ensure confidentiality, this page was detached from the form

once it was completed. Thereafter the case note document was identified only by a unique study number allocated to every child at admission.

The case note document was designed so that data recording and data coding could be completed simultaneously. Such an approach not only saves time but also reduces the chances of coding errors, which can occur when transferring information onto separate coding sheets. Thus as the data was recorded onto the case-note form, it was simultaneously coded in the coding box in the far right hand side margin.

How the questions were coded

The majority of questions required answers to be chosen from a list of carefully constructed options with codes e.g. page 1 (Appendix 1), Question 26: Referral to hospital, Answer: 1-self/parent, 2-GP, 3-999, 4-other, 5-not known. The appropriate answer was circled in the case note form and the number entered into the corresponding coding box. For answers that recorded actual measurements e.g. page 3 (Appendix 1), Question 47: oxygen saturation. The actual measurement was recorded into the corresponding box. For any questions to which the information could not be found a missing data code of "999" was used.

Morbidity questionnaire

A questionnaire was developed for the second part of the study investigating outcome in the random sample of children selected for follow-up. The questionnaire was designed to obtain information on the child's current asthma symptoms in the few weeks after discharge from hospital (Appendix 2) and was mailed to parents 3 weeks after their child's discharge from

hospital. It was to be completed at home by the parents unsupervised. In completing it, the parents were instructed to pick one answer per question and circle their chosen response (see Appendix 2). A stamped addressed envelope was enclosed for returning the questionnaire to the sender. The outcome questionnaire was used in both areas and were sent out by the author in GGHB and by the part-time the research nurses in FVHB.

Design

The first part of the outcome questionnaire (Questions 1-19) was based on the "Index of perceived symptoms in asthmatic children" questionnaire developed specifically by Dr. Tim Usherwood[45] as a research tool for investigating asthma outcome. Usherwood's questionnaire uses a closed format five point, fixed response. This has the advantage over open-ended questions of both eliciting a more detailed response and being easier to code for data analysis. It also speeds up the time to complete the questionnaire as less time is spent pondering over what to answer. This type of approach is well suited to questions about the experience of disease symptoms with responses ranging from 'not at all' to 'every day'. One disadvantage of Usherwood's questionnaire is that there was no facility for an undecided response.

Usherwood's questionnaire was designed to give 3 scores of asthma morbidity:- day disturbance, night disturbance and disability. To simplify the calculation of the scoring, Usherwood recommended that two items (item 4 and 12) are omitted. The first 4 items then constitute the day time score, while the next 8 the disability score, and the final 3 the nocturnal score. These scores were calculated as specified by Usherwood[45].

A number of additional questions designed by the author were included in the questionnaire. Where possible, they followed the same style as Usherwood's original questions. Questions 20-22 sought more specific information about the child since discharge from hospital. Question 23 asked who in hospital had checked that the child could take the inhaled treatment properly. Questions 24, 25, 26, 27 and 28 asked the parents about their response to hypothetical situations[46] with questions such as: "What can you do with the relieving treatment in a bad attack?".

The final questions (29-36) were adapted from the asthma knowledge questionnaire contained in American National Education Programme, Teach your patients about asthma - a Clinicians guide[47]. The purpose of this was to try and get some information on the parents' knowledge of asthma.

Piloting the forms

During the first six months of the study, these two forms were developed and piloted. It was the 25th version of the casenote form that was actually used in the audit. Two paediatric physicians (the respiratory specialist from GGHB, and the paediatrician responsible for the respiratory cases in Forth Valley) were involved in the development of the form. During this time the author and the two research nurses from Forth Valley worked together on piloting the forms using case notes of children recently discharged from hospital. Discrepancies were sorted out, and the three developed a common coding dictionary. The arrangement was that should they come across a response which had not been allowed for they should leave it blank and contact the author. In fact, this only happened on a very few occasions.

The outcome questionnaire was piloted in the out patient department, in the Royal Hospital for Sick Children, Glasgow. Parents attending out patients for review of their child's asthma following hospitalisation were approached by the author, and asked to complete the questionnaire. Their evaluation of the questions and layout proved invaluable. As the Usherwood questionnaire had previously been validated and published no changes were made to these questions. We were keener to have comments on the author designed questions. As noted, where possible they had used the Lickert style format. Small changes were made as a result of such comments e.g. Q21:

Before piloting

Question - "Is your child better since coming home from hospital?"

Possible Answers - Yes; Better but not back to normal; No

One of the parents suggested using "*getting there*" instead of "better but not back to normal" as to her that meant the same as the original rather long-winded statement.

After piloting

Question - "Is your child better since coming home from hospital?

Answer - Yes; Getting there; No

Identification of children and data collection

The identification of patients in two health boards areas was slightly different and will be discussed separately.

GGHB

Case note document

During the study, the author visited the A & E department every morning and examined the attendance register. The details of all children over the age two

admitted into the medical wards with asthma or symptoms suggestive of asthma, including wheezing, difficulty breathing or cough, were noted. Using this provisional list the author then confirmed the whereabouts of all these children, and reviewed their clinical notes in detail. A child was accepted for entry into the study only if i.) a diagnosis of acute asthma was confirmed by the doctor on the ward, and ii.) if asthma treatment, i.e. nebulised bronchodilator had been prescribed.

Each ward was given an identifying code followed by sequential numbering from 1 - 225. For example for Ward A the identity code was 1, so the numbers went from 1001 to 1225, Ward B code 2 from 2001-2225, Ward C code 3 from 3001 to 3225, and Ward D code 4 from 4001 to 4225. Then as each child was admitted into the respective ward, they were allocated a study number in strict order of admission. This allowed the author to identify which ward each child was admitted into by the code at the beginning of the study number and allowed easy grouping by ward during analysis.

Morbidity questionnaire

Four randomisation lists were prepared before the audit started, one for each of the four wards. Using the coded study numbers the author made four wall charts and listed in order the ward study numbers with a space for the child's name. Then by working through the lists of 225 numbers in blocks of 8, 2 cases from every 8 were randomly picked for follow-up. This was done manually using 8 pieces of card, 2 of which had crosses on. The author literally pulled the 8 cards out of a box noting on the board the two numbers selected. Although this was tedious and time consuming it had advantages. Firstly, it ensured that each group, in this case each ward, would be equally represented. Secondly, it meant that there could be no sample bias. Use of

coded study numbers also ensured anonymity of the data collection forms during data entry.

Patients were assigned a number on the list in order of admission to their respective wards. Children were excluded from this system if they had previously been admitted during the period of the study and thus they had only one chance of selection throughout the study. Any patient readmitted retained their original study number, allowing record linkage. No parent refused to take part in the study.

Forth Valley

Case note document

Once the nurses had identified possible patients they followed the same routine as the author in Glasgow. The working diagnosis was confirmed using identical criteria. Children satisfying the inclusion criteria were allocated a study number.

Morbidity questionnaire

The author prepared 2 random lists using the same method described above. The nurses in FVHB used the same technique, allocating the study numbers in strict order of admission, omitting children who had been admitted before during the study.

Completing the case note document

The case note document was usually completed within 48 hours of discharge. This arrangement worked satisfactorily, in both areas.

Data analysis

Data entry

Once the casenote documents had been completed they were checked by the author for any missing data. After this preliminary checking was completed, the author took the anonymised forms to the data preparation department at the University of Glasgow where they were entered into computer using double punching. The data were returned in ASCII format and were then formatted into Microsoft Windows SPSS or Minitab Version 8 (Extended) for analysis. Analysis was performed on a Viglen Genie Professional 4DX.

Statistics

The results of the hospital in-patient audit have been presented as simple descriptive statistics as appropriate: mean, median, and range for continuous variables and number (percent) for categorical variables. Differences between groups, were investigated, where appropriate, using contingency tables and chi-square testing. Median scores from the morbidity questionnaire were compared using appropriate non-parametric tests (Mann Whitney U test or Kruskal Wallis test). Readmissions were modelled using statistical techniques for the analysis of survival data and were analysed using Cox's proportional hazard model using the package BMDP. A P value of less than 0.05 was considered signifcant.

Ethical approval

The study was approved by the Ethics Committee of the Royal Hospital for Sick Children (Appendix 3 - Letter of Approval)

Limitations of the study

One potential limitation of this audit must be acknowledged. Data was only collected if the relevant item had been recorded in the clinical records. If the item under study was absent, it was assumed that the item had not been completed or collected. Practical clinical experience suggests that most often failure to record equates with failure to perform. However, this was not formally investigated.

RESULTS

General Observations

Numbers of asthma admissions

During the year of the study, 727 acute asthma admissions occurred in children over two years of age (Glasgow (GGHB): 580; Forth Valley (FVHB): 147;Table 3). Since approximately 20% of children were admitted on more than one occasion these 727 admission occurred in 572 children (GGHB-456, FVHB-116). Clinical details were available from the cases notes for every admission.

The children in GGHB were very similar to those admitted in FVHB in terms of age, and sex. Children in GGHB, however, had a median duration of stay in hospital one day longer than those in FVHB (Table 3).

Seasonal effect on admissions

Asthma admissions occurred throughout every month of the study (Figure 4). As previous studies have reported[48, 50], there was a large seasonal variation. The highest monthly numbers of admissions were noted in September (n=123), October (n=68) and February (n=71) compared to a monthly average of around 55 (mean 55.9, median 57, range (10-123)). The large number of autumn admissions has also been a finding in previous studies[48, 49, 51].

Specific Observations on Asthma Management

Community response

Part 1. Referral to hospital

Overall, the children had followed one of two principle "routes " to hospital, either via the GP or by self-referral (Table 4). Only a small number (22 children, 3.2%) had been directly admitted after an out-patient consultation and an even smaller number had contacted the emergency services directly via a 999 call from home (6 children, 0.82%). Information was missing for 4 patients, and efforts to find it anywhere in the clinical documentation failed.

There were interesting differences when account was taken of previous admissions (Table 4). The referral pattern was broken down into groups, depending on previous admissions. It is evident that the balance between self-referral and GP referral changed depending on whether or not the child had been admitted previously. GP referral became less common as the number of previous admissions rose, and the number of self-referrals progressively increased (Table 4). The pattern was similar in both areas but the proportion of GP referrals was greater in FVHB both for first and all admissions (Table 5), perhaps reflecting the more rural nature of FVHB and the greater distances to hospital.

2. Treatment before referral to hospital

Less than half of the children in either area received oral steroids in the 7 day period immediately prior to the admission (Table 6). There were some differences between health board area. Patients in FVHB were more likely to have been given nebulised bronchodilator therapy and oral steroids (Table 6). Surprisingly, the treatment was little different even if the child had had a previous admission with acute asthma. From the information as reported in

the hospital case notes, the community response to an acute asthma attack appeared somewhat disappointing.

When the same admissions were examined with respect to treatment given in the community for the first vs subsequent admissions with acute asthma, there was no real evidence of more aggressive therapy being initiated in those children having more than one admission (Table 6). This no doubt partly reflects the fact that fewer of the "Multis" saw their GP (only 41.3%). Nevertheless, the record of initiating oral steroids in primary care, particularly in those children who already had had an acute asthma admission within the last 12 months, was disappointing. It suggests both that clear plans of action for future asthma exacerbations had not been worked out for the majority of children admitted to hospital and that the GPs had not adjusted their response to take account of the previous admission.

Hospital Response

Part 2. Assessment of attack severity

The second section of the audit document focused on the medical and nursing staff assessment of the attack severity in the first 12-24 hours.

a. Nursing staff assessment

The first contact in both areas was usually with the nursing staff. In each hospital nurses were responsible for making an initial recording of the child's vital signs (temperature, pulse and respiratory rate). They were also expected to measure oxygen saturation by pulse oximetry, and peak flow using a mini-Wright peak flow meter, where appropriate. Examination of the observation charts showed that baseline pulse and respiratory rates were measured as planned immediately before the child was assessed by the doctor or

commenced on treatment in nearly all children (pulse rate: GGHB-99.82% vs. FVHB-100%; respiratory rate: GGHB-99.32% vs FVHB-99.59%). There were more striking differences for SaO_2 and peak flow. In GGHB, 543 (97.6%) had SaO_2 recorded compared to 117 (75.6%) in FVHB. The situation was reversed for peak flow assessment in children over five prior to any nebulised bronchodilator treatment. In these children only 43.4% (148/341) had had a pre-bronchodilator measurement, with GGHB doing considerably worse (35.4%) than FVHB (74.3%).

b. Medical staff assessment

For the purposes of the study, a medical staff assessment of severity was recorded as present only if it was documented within either the A/E notes or the subsequent ward "clerk in". Later comments e.g. a brief casenote mention on the third day of admission were not accepted.

Some aspects of the medical staff assessment were better than others (Table 7). In both health board areas, the most frequently recorded variable was the presence of wheeze. Between the two health board areas there were significant differences in the noting of assessment of speech ability, hyperinflation, air entry, presence of crepitations, pulsus paradoxus, and overall assessment of attack severity. Of these, only speech assessment was recorded as being noted more frequently in Forth Valley.

Part 3: Emergency treatment in hospital and investigations

a. Nebulised bronchodilator, oral steroids, oxygen and Aminophylline

There was no significant difference between the health boards in any of the 4 central treatments of acute asthma (Table 8)[39]. The drug treatment of acute asthma in hospital in both health board areas was, in general excellent with

over 90% of children receiving both nebulised bronchodilator therapy and oral corticosteroids.

The place of IV aminophylline in the management of acute asthma has been the subject of continuing debate[52]. There is no doubt that the drug is difficult to use because of the high risks of toxicity, its interactions with other drugs, and the narrow therapeutic margin. The BTS Guidelines suggest that IV Aminophylline be reserved for patients whose condition is severe and who fail to improve on oxygen, steroids, and β_2 agonists[39]. It was, therefore, of considerable interest to find that only a very small percentage of children received it in both areas (GGHB: 5.2% vs FVHB: 4.8%;Table 8).

b. Oxygen therapy

The BTS guidelines also recommend that oxygen saturation be maintained above 92%. It is worth noting that an initial saturation below 91% in children has been found to discriminate between a favourable and an unfavourable outcome in that children with acute asthma attending A&E departments with a saturation below 91% usually had to be admitted[53].

In this audit, the mean index saturation was 91.4% (median 92%; range 46-100). This represents the first saturation recorded in A&E before the first dose of nebulised bronchodilator is administered. In 325/669 (47.1%) the SaO_2 was 91% or less. Information on whether or not a child received oxygen was sought from medical, nursing, or prescription notes or vital signs charts. Despite the evidence of hypoxaemia at presentation, only 20.4% in GGHB, and 24.8% in FVHB received oxygen therapy at any stage during their hospital stay (Table 9). Indeed, when the saturation levels were graded into 3 levels, there was a considerable number of number of children with

saturations below 90% recorded in A&E who did not subsequently receive any oxygen therapy.

d. Tests

Chest X-rays were performed in about a quarter of admissions in both areas (GGHB: 28.4% vs FVHB: 22.4%). It was of interest that in Forth Valley chest X-ray was considerably less common as the children became older (8%) than in Glasgow (Table 10). In this study, whether the X-ray was abnormal or not was not recorded. A previous study suggested that only around 5% of children with their first asthma attack will have abnormalities on chest X-ray[54]. Thus, a rate of 20-30% is higher than is probably necessary. In those children who had a chest X-ray performed, hospital initiated antibiotic usage was uncommon, with only a small proportion of children receiving both (Table 10).

Few children had blood taken (Full blood count: GGHB - 7.6% vs FVHB - 0.7%; urea and electrolytes: GGHB - 4.7% vs FVHB - 0.7%). In particular, blood gases were performed quite uncommonly (GGHB: 2.6% vs FVHB- 1.4%). This probably reflects the fact that oxygen saturation meters are now so commonly available in paediatric units.

Part 4. Assessment of asthma history and chronic symptoms

A knowledge of a child's asthma history, particularly the presence of chronic symptoms and usual asthma medications, is important for the planning of the child's future long term treatment. In this part of the form, the recording of details of information about chronic symptoms and asthma history was investigated. The whole of the current clinical record was reviewed and details of asthma history, if present at any time during the admission, were

noted. Overall there was little evidence of any systematic attempt to investigate either the events preceding the admission or the chronic asthma symptoms in either health board area (Table 11). Less than half of the children had recorded evidence that chronic asthma symptoms had been assessed. Children in Glasgow were more likely to be questioned about triggers of their asthma.

It was anticipated that questioning this area might be performed better in the specialist respiratory ward (C) in Glasgow. While there was some evidence of greater attention to the underlying symptoms, the overall assessment of preceding asthma symptoms and control was still disappointingly poor (Table 12).

Part 5. In-patient management and observation - Peak flow monitoring

There was barely any in-hospital peak flow monitoring recorded in either health board area, either at the time of admission or later during the hospitalisation. The BTS guidelines state that all patients should have a peak flow at the time of admission and discharge included in the GP's discharge letter. Of 341 children over five (and therefore, old enough to perform an adequate peak flow) only 33.4% (114/341) had a peak flow recorded on the day of discharge.

Part 6. Discharge planning

Deficiencies in discharge planning were most striking (Table 13). Although the majority of children were discharged home with some form of bronchodilator therapy, not every patient apparently had their device technique checked.

There was little evidence in the clinical records of any serious attempt to provide the child or parents with any advice or instruction on how to deal with asthma in the future. In particular, there was very little evidence that parents were given information about asthma or a written asthma management plan. Discharge planning was slightly better in the specialist respiratory ward with better attention paid to checking device technique, arranging home peak flow monitoring, giving written asthma advice, and arranging follow-up. However, the level of information and written asthma advice, particularly, recorded in the clinical records as given was still very low (Table 14).

Another important area of interest, was whether prophylactic anti-asthma therapy had been started or increased at discharge (Table 15). The pattern here is more complicated. It is evident that Cromoglycate was used much more frequently in Glasgow and hardly at all in FVHB. In particular, those admitted in FVHB on Cromoglycate were changed to corticosteroids. In both areas, there were substantial numbers of children who were prescribed inhaled corticosteroids after a first admission. In both areas, the number of children on prophylactic therapy was higher in those having multiple admissions. With multiple admissions in FVHB no children admitted with a history of multiple admissions were on Cromoglycate but 74% were on inhaled corticosteroids. By discharge, around 84% of those with multiple admissions were on inhaled corticosteroids.

Outcome - morbidity

One hundred and sixty three children (GGHB-127, FVHB-36) were randomly selected for outcome follow up and were sent an outcome questionnaire. No parents refused to take part. The response rate to the first mailing was very

high. Non-responders to the first mailing (n =19) were sent one further mailing. Questionnaires were finally returned by 152 parents (GGHB: 120 vs FVHB: 32), an overall response rate of 93.2% (GGHB: 94.5% vs FVHB: 88.9%). The two outcome groups were again similar in terms of sex, age and length of hospital stay (Table 16).

Asthma morbidity assessed on the outcome questionnaire at three weeks after discharge from hospital.

For each of the 152 questionnaires a score was calculated for the three sub-sections of the questionnaire (day symptoms, night symptoms and disability) as described in the original publication[45]. In the original publication, the range of scores is from 0-4, with a low score reflecting low morbidity. For each ward, the scores were aggregated and a median score calculated. This allowed a comparison to be made of the outcome in relation to the type of care received (Table 17). There was no significant differences on any of the 3 scores between the two health board areas (day, night or disability: Mann Whitney U test: P=NS). Within GGHB, further testing showed there was no significant difference in morbidity as measured by any of the 3 scores at follow-up between any of the 4 wards in GGHB (Kruskal-Wallis: P=NS).

Parental asthma knowledge assessed by the asthma knowledge quiz

Parental knowledge of asthma was assessed by a short quiz in the outcome questionnaire (Table 18). Six questions (1, 2, 4, 5, 6 & 8) were answered very well. However there were two questions (3 & 7) which seemed to cause the parents difficulty. Both related to asthma control.

The results suggest that although the majority of parents appeared to have good level of basic information about asthma, such as knowing that it was common in childhood (92.8%, 141 subjects) they showed poor awareness of the underlying control of the disease. This is perhaps hardly surprising in view of the lack of attention to the provision of asthma information, PEF monitoring, device monitoring and written guidance around discharge .

Even families who had experienced a recent acute admission showed poor understanding of spotting signs of the impending asthma. When combined with the knowledge from the earlier part of this study, that GPs and/or carers had not prescribed oral steroids or treated attacks aggressively with bronchodilator therapy in the community in most of the children who were admitted, the stage was set for readmissions. Indeed, the relative under treatment in the community in these children may actually have served to emphasise to carers the idea that acute asthma can only be treated effectively in hospital.

Outcome - re-admissions

Readmissions were carefully monitored throughout the audit and for over a year afterwards. Over the year it was confirmed that a number of children were readmitted with acute asthma, some on up to six occasions. The maximum number of admissions in the year was six. During the one year of the audit readmissions accounted for 21% of the year's asthma admissions (Table 19). This was then examined in more detail and related to the actual ward the children were treated in (Table 20). Readmissions varied between 14.5% and 25%. The specialist respiratory ward did not have the lowest rate, at 16.8% (range 14.5-25).

Survival analysis

As noted, the patient database was continued for another 14 months after the audit ended. This meant that readmissions could continue to be closely monitored. Readmission dates were collected up until 31/3/94, the end date, a further 14 months after the completion of the audit.

A survival analysis was performed to explore which factors influenced whether or not a child was readmitted (Table 21). This type of analysis investigates the time until the occurrence of an "event". In the clinical situation this is frequently death, relapse or some other clear end point. In this study, "first readmission" was the end point. In this analysis, data for children not readmitted was "censored" at the end of data collection (31/3/94).

A number of potential explanatory variables, which it was hypothesised might affect survival, were investigated. These included age, sex, ward type (specialist vs non-specialist), number of previous asthma admissions and usual asthma maintenance drugs. In addition, baseline oxygen saturation, as an index of physiological disturbance and hence attack severity was also investigated. An initial analysis using a log rank test investigated the effect of individual variables and suggested that previous admissions, age, and drug therapy before admission; all had a significant effect on survival when examined individually (Table 21).

A formal multivariate analysis was then carried out to investigate the combined effects of these explanatory variables on survival. A Cox Proportional Hazards model was fitted to the data in a forward stepwise manner. In this type of analysis, the single most significant explanatory variable is entered into the the model at the first step. At each later step, the

next most significant remaining variable is entered, its significance being judged conditional on the variabls already in the model. The process stops when all statistically significant explanatory variables have been entered. In the present analysis, only previous admissions and age were entered.

An important finding from the survival analysis was that ward type (specialist vs non-specialist in GGHB) did not have an effect on outcome. Thus in this study specialist respiratory care in children did not affect readmissions in the long term. This is in keeping with the findings from the outcome questionnaire which showed no difference in the reported asthma symptoms in children treated in the respiratory specialist ward at the 3 week questionnaire follow-up.

It is of interest that by the time data collection ended (at 31/3/94 - 14 months later) the proportion of subjects who had readmitted had increased to 29.7% from the 21.4% reported at the end of the 12 months of the audit in Glasgow. This suggests that if admissions are monitored for longer time periods the proportion who readmit does increase with time. This is in keeping with the findings reported by Mitchell et al[33]. However, the 29.7% of children readmitted for Glasgow at 26 months is substantially less than the 51% at 24 months quoted by Mitchell. The relevance of a subsequent admission over a year after the index admission is unclear.

DISCUSSION - Study 1

Summary of findings

This audit is the first prospective study of paediatric asthma care in Scotland and provides comprehensive information on the current standard of hospital management, not previously available. It also provides information relating to paediatric asthma admission patterns and factors affecting readmission.

It has examined the hospital management in three paediatric units in two large health board areas and has developed a comprehensive document for investigating hospital care that was easily interpretable within the different areas, providing accurate information for comparison. This is in marked contrast to the difficulties reported by Langton-Hewer et al[40], who reported that out of an original 53 pieces of information sought, 17 (32%) were unanswerable, due, according to the authors, to missing information or ambiguity in the question posed. Only 21 questions (39.6%) were answered in a similar way by the majority of hospitals taking part in the audit. The document used in the present study was longer with the total number of questions at nearly 100. Despite this the form was easy to use, and could be completed in under 15 minutes. We suspect that the our careful preparation, and fine tuning of the casenote form through extensive piloting on site ironed out many potential problems before the data collection began.

We also found less variation in practice between the two areas than that noted by Langton-Hewer[40]. However, our study gathered information on all admissions as opposed to the multicentre audit which only reviewed those fulfilling the three suggested BPA measures for poor outcome ((i) length of stay >72 hours, (ii) patients readmitted within 2 weeks and (iii) those admitted within 24 hours of being seen in A&E).

The median length of stay in GGHB was 3 days (Interquartile range:2 - 4days), and 2 days in FVHB (Interquartile range:1 - 2days). Only 5.9% were readmitted within 2 weeks of discharge, indicating that the proposed poor outcome indicators will indeed exclude the majority of admissions. However, such a restrictive definition may not necessarily focus on the children with the most severe or troublesome asthma or those who received suboptimal treatment. It may be that the number of previous admissions in the last 12 months may be a more reliable marker of poor outcome.

The authors also described difficulties in interpreting information regarding source of referral of the admission, due to the differences in facilities at the different centres, as patients were admitted both via A&E and direct to wards. In fact these differences apply to our audit also, with the Childrens Hospital in Glasgow having its own A&E department, FVHB do not, and often the patients go direct to the ward. Despite this we found it easy to determine whether the GP had referred the patient in the first place.

There were also problems with apparent differences in practice. For example for the question "Was oxygen given?" the positive responses from the six hospitals varied considerably, ranging from 0-96%. Although in our audit oxygen was probably underused, the percentages were remarkably similar in the two health board areas, GGHB-20.4% vs FVHB-24.8% (Table 9).

General observations with regard to paediatric admissions

Admissions and Readmissions

Over the period of the study, there was a further rise in the annual admissions, continuing the established upward trend (Figure 3) described

nationally [6]. A large number of the children admitted were under the age of two. As the audit excluded these children the difference between our admission numbers recorded in the audit (n=580) and the overall number of admissions for the same period (n=1219) obtained from the Information Services Department, GGHB, represents children in this age group. Similarly we also saw some seasonal effect with the highest monthly admissions noted during September, in both GGHB and FVHB (Figure 3).

The audit also confirmed that readmission is common in childhood. At 21.4% the number of readmissions at 12 months is similar to other published work in both adults (20% Bucknall [1]), and children (24% Mitchell [35]).

The balance of care between hospital and community

We found evidence that primary care management of acute asthma was sometimes less than optimal. Given that many asthma attacks can be dealt with effectively in the community by treatment of inhaled bronchodilator therapy and oral steroids, the numbers of children starting these treatments in the community was disappointingly low. Even if account is taken of the large number of patients self-referred, this does not account for the number of children not receiving acute treatment pre-admission.

Increased self referral

The audit confirmed a high number of self referrals. Interestingly, this was influenced both by area and by the number of previous admissions (Table 5). As the previous admissions increased so did the number of self referrals. The higher rate of GP referrals in FVHB for first admissions may reflect the GP being more accessible, or indeed closer than the hospital. Also the chances

of getting the patient's own GP may be higher in a more rural area, perhaps making it more likely for patients to use the GP.

Findings in relation to the pilot study

The audit confirmed that readmission was a problem, and that during the 12 months there were a number of children who had more than one admission, some up to six admissions. In view of the findings that hospital admissions in the previous year was shown to be a risk factor for death and readmission reported by Crane [36] this pattern of readmission was worrying. The parents in Urquhart's study had answered that 25.8% had more than 5 previous admissions ever [41]. However, in this audit we found that only 11.% (50/456) had 5 or more previous asthma admissions at time of first admission during the study year.

For the purpose of the audit the number of previous asthma admissions was obtained by the author and research nurses actually counting previous admission forms in each patients case-notes. As there is no retrospective computerised record held in either hospital of this information this was the best way to determine the number of previous asthma admissions for each child. This method obviously takes account neither of any admissions in other areas, as may occur on holidays, nor of families moving to other areas. Both factors should have operated during both studies. Since there is no reason to suspect differences in the numbers in either category with time these factors would not be expected to account for the differences observed between the two studies. The parents in Urquhart's study most likely calculated the number of previous hospital admissions from memory or perhaps personal records and it is therefore possible that they overestimated the extent of

previous admissions to hospital. Parents may also have included visits to the A & E department.

Detailed aspects of care

In-patient care

In general the drug treatment of the acute attack was very good with over 90% of children in both areas receiving nebulised bronchodilators and oral corticosteroids (Table 8). Only the use of oxygen was less than might have been expected. It is of interest to compare the use of two of these key treatments (nebulised bronchodilator figures) given with the situation in Bucknall's adult audit[1, 55], where in the specialist respiratory ward 83% of patients received steroid, and 66.7% noted as receiving oxygen.

It was reassuring to see that the severity indicators most often performed in both areas were the degree of accessory muscle use, presence of cyanosis, degree of air entry, and the presence of wheeze. When assessing severity of asthma the degree of accessory muscle use correlates most closely with lung function, followed by the degree of dyspnoea and wheezing[56]. Pulsus paradoxus was rarely recorded, but is probably not appropriate in children[57, 58]. Even in adults it is a poor guide to severity and compares poorly with peak flow, which relates directly to airway calibre[59].

The inpatient observation and attention to asthma history was less good even in the respiratory ward. The most neglected area appeared to be the amount of school absence that was attributed to the child's asthma. Up to 60% of those children who wheeze regularly report days off school every year[60]. School absence due to asthma gives a good overall impression of the asthma control and the extent to which it interferes with the child's normal lifestyle,

and should not be so frequently neglected . However, the most obvious deficiencies were apparent in the discharge planning phase where there often appeared to be little attempt to address ongoing chronic problems.

In relation to the two health boards

In the main the treatment and outcome in the two health board areas was similar. In particular, no difference was noted in the emergency treatment (Table 8). In both areas, the numbers of children receiving aminophylline were small.

A similar number of chest X-rays were performed in each area (GGHB-28.4%, FVHB-22.4% Table 10). As a rule a chest x-ray is not indicated for first asthma attacks in children[54], unless there are signs of pyrexia, tachypnoea, or focal breath sounds. These figures are similar to Langton-Hewer's findings in the pilot national audit, falling somewhere around the middle of the range (3-47) he described for the percentage of children having a chest X-ray performed[40].

Differences between specialist and non-specialist

Overall there was no evidence of difference in care resulting from admissions to a specialist. This contrasts strikingly with the situation in adults[1]. The acute treatment was as good in all the non-specialist wards. Whether this difference is due to the influence of consensus guidelines which emerged after Bucknall's audit is impossible to determine. There were some differences noted between the specialist respiratory and the non-specialist

wards with a greater emphasis on objective monitoring, device technique and written discharge information.

In the main, these few differences between specialist and non-specialist care did not appear to influence outcome in terms of readmission with acute asthma or in asthma morbidity which suggests that in children factors affecting outcome may be slightly different or affected by things other than the medical expertise of the team caring for the children.

Possible difference in paediatrics

The findings of the audit in relation to factors affecting outcome concur with many of Mitchell's findings of risk factors for readmission in children [33], suggesting common themes despite the different locations.

The children in our study were slightly older (median age 4.99 years) than those studied by Mitchell (median age 3.4 years), on account of the fact that he included all children aged 0-14. However the organisation of care was very similar with the admissions distributed among four medical wards. The in-patient treatment the two groups received was similar although more children in Glasgow received oral steroids (93% GGHB vs 63.4% Auckland). In a similar analysis the variables which remained in the multivariate analysis as significant in determining survival were sex (female), IV theophylline, previous admissions, and age of<5yrs at index admission.

These are interesting findings in view of the fact that we also found that both the number of previous admissions and age were significant in determining survival. Both studies found that the ward (medical team) had no influence on the subsequent outcome. An advantage for children admitted to the Auckland

hospital is they are readmitted under the care of the same team. In Glasgow, although in theory this should happen, in practice it does not. A number of children readmitted had been in all of the 4 wards during the audit year. Despite this the continuity of care in Auckland appeared to make no difference in terms of readmission.

Summary

The study demonstrated that that apart from the inappropriately low use of oxygen the key pharmacological treatments of acute asthma were given to virtually all patients. There were a number of areas where the care given did appear disappointing. The most striking of these was in the area of in advising about the future management of asthma.

In planning future efforts to improve outcome, this area of "discharge planning" was decided as the area to focus on.

STUDY 2

INTRODUCTION

The findings of the first study demonstrated that outcome in children following hospitalisation for acute asthma care was disappointing. In particular, there was a high number of readmissions and evidence of continuing morbidity after discharge. Several areas where care in hospital was less than optimal were highlighted. The area of most concern centred around care planning before discharge. In the second study, we chose to explore the impact that careful attention to detail in discharge planning might have on readmissions and ongoing morbidity. The specific hypothesis was that that appropriate clinical interventions around the time of discharge could reduce the number of readmissions (Hypothesis 2) and the aim to develop a plan that could reduce the number of readmissions.

Background - evidence on the impact of discharge planning

Over the last decade a number of reports have described specific asthma management programmes which have focused on factors such as asthma knowledge, and recognition and management of exacerbations. In the main these interventions have aimed to improve a patient's asthma management skills. Although the studies have varied considerably in content (Figures 5 & 6) a proportion have shown significant effects in reducing hospital readmission after introducing education programmes which include management plans[61, 64].

As readmission was a problem identified in our first study, the various components of these studies were examined. Some specific examples are highlighted in the following section.

Examples of the impact of asthma disease management programmes

Acute asthma in adults

Osman et al[65] have recently reported on a group of 43 patients (referred to as "singles") who had been admitted four years earlier in 1991, and had successfully avoided further admission with asthma. This group was compared to a group of 70 who had their first admission in 1991 (referred to as "firsts"). The "singles" were significantly more likely to say that regular use of their inhaled steroid was important in avoiding attacks and that they used oral steroids at the first sign of an attack. The "singles" were also found to be more likely to have received specialist care. Osman concluded that behaviour patterns towards the self-management of asthma could be positively influenced by a single hospital admission under the care of a specialist. This change was sustained over a time in that there was a long-term reduction in hospital admissions[65].

Yoon et al[62] randomised 76 asthmatic patients after hospital admission to a three hour group intervention. The intervention included a 40 minute interactive lecture with visual aids and a twenty minute video discussing drug therapy and its correct use. Patients were taught how to adjust drug doses according to PEF measurement and a treatment plan. The primary objectives were to improve asthma control and reduce readmission rates. During the ten month observation period the readmission rate for the educated group was one seventh that of the control group ($P<0.001$) with reduced attendance at A&E ($P<0.001$). Although the intervention group showed improvement in asthma knowledge and self management skills no improvement in lung function was observed. Despite this, Yoon concluded that substantial changes in illness behaviour could be achieved with such brief education

programmes, which clearly outweighed the disappointing effect on airway function.

Osman et al[61] randomised 801 adults attending out patients to an enhanced education programme, containing personalised patient booklets issued every four months versus the standard verbal education at outpatient visits. Annual admission rates for the educated group were 0.09 admissions/year (n=42) compared to 0.19 admissions/year in the control group (n=47) after controlling for time in education, and excluding the more severe patients. Among all patients who continued to suffer sleep variation the reported frequency of sleep disturbance was less in the education group. No difference was seen between either group for days of restricted activity, use of oral steroids, number of GP consultations, nor any significant interaction between ownership of peak flow meter and education. Osman concluded that an asthma education in the form of personalised computerised asthma booklets can reduce hospital admissions and improve morbidity in hospital outpatients.

These studies illustrate how improving asthmatic disease management skills in adult patients can produce significant long term benefits, such as reduced hospitalisations. The effect on morbidity is less convincing.

Paediatric studies

The studies investigating the benefits of disease management programmes in children have mostly been conducted in the USA, and have shown some benefit, although the numbers of subjects studied are much smaller and not always subject to controls.

Results From the USA

A number of American studies have reported on asthma education programmes for children, commonly called "Asthma Care Training". The precise details vary from study to study with different durations of learning periods and educational approaches (Figure 6). For example, Lewis et al in Los Angeles used 76 children selected from an allergy clinic[63]. The programme was initiated in an outpatient setting. The interventions included 5 teaching sessions, each one hour long for the "experimental" groups and 4.5 hrs of lectures for the "controls". This study had a number of limitations: it was conducted on middle class families; the researchers knew which child had received the educational package; and all the children were attending specialist paediatric allergy clinics. Nevertheless, the study found that there were fewer ($P<0.05$) hospital admissions and visits to the emergency room ($P<0.01$) in the experimental group ($n=48$) when compared to the controls ($n=28$) accompanied by increases in knowledge and changes in beliefs in both groups, and significant changes in self-reported compliance behaviours in the experimental group.

In another small study of 26 children, Fireman et al recruited 26 patients from a paediatric allergy clinic and split them into two experimental groups[64]. Their asthma intervention included 4 hours of individual instruction, group classes, and telephone contact with an asthma nurse for help. The nurse also used the telephone to keep regular contact with the families. These interventions resulted in improved outcome with fewer overall hospitalisations (4 vs 0) and emergency room visits (13 vs 1) in the nurse-educated group. The parents of the children in the nurse-educated group also indicated that their children knew how to prevent the development of an attack through earlier recognition of symptoms combined with the earlier use of appropriate therapy.

Children admitted to hospital have also been studied. Hospital admission provides a captive audience and an opportunity to introduce asthma management skills to families at a time when asthma is likely to be at the forefront of their attention. Taggart et al used ward based staff nurses to deliver a two hour educational programme which included video tapes, activity books and discussions with the children[66]. The children showed increased knowledge about asthma and better recognition of the early warning signs. In addition, during a 15 month period of follow-up those children classified as having severe asthma by Taggart were shown to have fewer visits to the emergency room ($P<0.01$). Unfortunately, the study did not include a control group and only a relatively small number of children, 40, completed the programme. However, this study is unique in that it trained staff nurses on the ward to deliver the programme successfully integrating a disease education programme into routine medical care.

British Experience

There are very few British studies that have evaluated asthma management programmes in children. Charlton et al evaluated a package delivered via an asthma nurse clinic based in a district general hospital[67]. This study effectively used the model of a General Practice based nurse-run asthma clinic and implemented it in a hospital setting. The children were recruited from November 1989-90 and had been either admitted with acute asthma or were attending a hospital outpatient department. Ninety one children aged 3 - 14 years were randomly assigned to either an intervention IG (n=48) or control group CG (n=43). The outcome was assessed by asthma symptoms (patients kept diaries), questionnaires completed at the beginning and end of the study, and the number of visits to GP and hospital admissions. The intervention group received a 45 minute standardised interview and

assessment with the nurse. This involved filling out a questionnaire and a history of the child's asthma, including allergy status, provoking factors, regular medications and current symptoms, during which the patient's device technique was also. During the interview, the nurse provided the child with a management plan based on peakflow monitoring using colour coding to alert the child and family to an action zones. At 3 monthly intervals thereafter, the families were sent a letter reminding them it was time to attend their GP or practice nurse to have their asthma reviewed. The control group received a shorter, less thorough interview of 15 minutes duration, and were provided with a peak flow meter and action chart. This one was in black and white.

The study lasted for 2 years. The parents of eighty children completed questionnaires at the beginning and end of the study. The questionnaires showed a high level of morbidity in both groups before entering the study. The group randomised to the intervention arm were somewhat more symptomatic than the controls with 40% (IG) vs 31% (CG) recording more than two wheezy attacks per week and 60% (IG) vs 50% (CG) dyspnoea on walking. The number of hospital visits in the previous six months was very similar 27 (IG) vs 23 (CG). At completion of the study patients / parents in the intervention group recorded more excellent responses to an acute attack ($P<0.01$) and less inappropriate responses ($P<0.02$) than the control group. There were trends to less time lost from school and fewer GP consultations but the numbers were too small to reach statistical difference. Although the intervention group had fewer 23% vs 31% visits to the GP a higher number of patients in the IG required hospital admission 12% vs 3%. Thus while the nurse run asthma clinic produced some modification of symptoms in the intervention group it did not reduce hospital admissions.

Summary of the studies

Most of these studies have limited direct relevance since few have been implemented in children. The programmes used are often not appropriate to children, nor particularly practical or easily repeatable. However, they are of considerable theoretical interest as they suggest that behavioural interventions can have significant impact on subsequent disease morbidity. Although much information comes from adults, and often from different health care structures there are common features that point out what may be the essential components for a successful intervention (Figure 5 & 6). Consistent features would seem to have included a focus on improving self management skills[61, 63, 67, 71], the provision of written information[61, 66, 70, 73], and individual specialist discussion sessions[63, 66, 70, 74]. Most of these studies have used nurses as the main educators[64, 66, 71, 73, 74].

What might be the ideal asthma management programme for children?

From reviewing the evidence, it appeared important to include the key features identified above: a focus on improving self management skills; the provision of written information; and a specialist discussion session. One area not previously included in the above studies, but shown to be effective in reducing return visits to A&E departments in children[75] has been the provision of a course of steroid tablets to treat an acute exacerbation at home as a component of the management plan. The results of Study 1, also suggested that at the present time an admission with asthma did not seem to lead to any increase in the use of oral steroid in subsequent admissions. This too was, therefore, included as an important part of any home management plan.

In developing a disease management programme, it was recognised that managing asthma at home is a complex challenge, requiring a variety of skills: taking medication, responding to symptoms, trying to prevent exposure to triggers and coping with attacks on top of getting on with the rest of life. The challenge was always to put together a comprehensive but practical package.

In developing such a programme, it was considered crucial to establish whether it was effective. The format chosen to do this was the randomised controlled study.

METHODS

Developing an intervention programme

Home management skills

Conventionally, objective monitoring in asthma has usually been based on peak flow measurements. However, there have been problems with such an approach in children. Firstly, young children will not be able to use peak flow meters and the values obtained can be unreliable[44]. Secondly, parents may not comply in making the necessary measurements at the right times. Thus peak flow meter use may be better confined to times when the child is symptomatic. As a consequence, home management plans in children may be more effective if symptom based[76]. Monitoring symptoms and altering asthma treatment accordingly is also likely to be more easily incorporated into a family's daily routine. However, the parent's appreciation of symptoms and appropriate actions may be quite different from that of the physician or nurse. For example, parents may significantly underestimate the significance of important warning signs such as night cough, and breathlessness[26]. In planning the present study, we, therefore, decided on a symptom based approach supplemented where appropriate (or desired) by peak flow measurements.

The problem of how to improve parental knowledge of symptoms and appropriate actions was tackled by reviewing and building on the results obtained from the asthma knowledge quiz in the first study (Table 18). This had shown that the parents in the random sample (n=152) already had a good understanding of asthma prevalence (92.8%), triggers (73%) efficacy of treatment (86.9%), and the importance of exercise (87.5%). In contrast 137 (90.1%) thought asthma attacks occurred without warning and 116 (76.3%) thought that people with asthma had no means of telling if their asthma was

well controlled. This suggested that it was necessary to introduce and/or emphasise methods of recognising signs of early deterioration and ways of monitoring their child's asthma at home. In thinking about an asthma management programme, therefore, an important first aim was to improve families appreciation of the early signs of asthma deterioration. By alerting parents to simple signs of asthma deterioration it was envisaged that it would be possible to develop a plan that would encourage them to make appropriate, planned treatment changes.

In terms of developing appropriate educational materials those described and used in studies in the USA were often excellent. Particularly good was the booklet "Teach your patients about asthma" which is was full of interesting ideas for teaching children and families about asthma in an easily understandable friendly way[47]. However, none of the available materials highlighted all of the main issues raise above. Further, there are fundamental differences both of culture and health care systems between the USA and the United Kingdom. As a consequence, it was felt that it would be better to develop material more tailored to the United Kingdom.

Having identified key components and identified educational objectives, we set about developing a local asthma management plan, which would be identified as the "Home management plan". All the materials used were created or developed by the author.

The "Home Management Plan"

The final plan contained five parts (Booklet, review discussion session, asthma credit card, asthma ansaphone and appointment for the nurse-run asthma clinic) all discussed in more detail in the following section.

1. The "Going home with asthma" booklet

The design

The available patient targeted educational material about asthma, both for parents and children, was carefully reviewed. As outlined, no single resource contained all the desired elements in an appropriate patient friendly form. Accordingly, the author designed and created a small booklet using desktop publishing facilities (Pagemaker V, Aldus Corporation in conjunction with a Hewlett Packard IIc Scanner). The use of desk top publishing allowed material to be changed easily during the booklet's development. Despite the technology, the design process was slow and very time consuming taking approximately four months in total. In the end it proved possible to create a tailor-made, visually rich guide for children and parents.

The final 22 page booklet was principally based on material produced by the National Asthma Campaign. It was designed to give basic practical advice about asthma at home to a family. The cover was a bright cheerful orange, with a picture of a little boy sunk into an armchair (Appendix 4). The aim was to create an impression of a child at home with asthma. The book was deliberately full of illustrations in an effort to break up the text and make it appealing to look at, and quick and easy to read.

The contents

The topics included in the booklet were chosen carefully. Unpublished information from the National Asthma Campaign telephone help-line, established in 1990, highlighted that amidst the 10,000 calls received each year there were some questions which recurred many times. The most repeated questions asked about (i) facts about the medication (ii) side effects from the medication (iii) how to prevent asthma and (iv) what are peakflow

meters. Although the majority of the callers (47%) are adult asthma sufferers, 38% are parents of children with asthma. This information combined with the results of the asthma quiz in our first study were used to pin down the basic information to put into the booklet particularly concentrating providing parents with information in areas which they had wanted to know about or areas where their knowledge seemed deficient.

The final booklet was in four sections:

Part 1 - "About asthma"

The booklet starts with an introduction about the programme (called the "Going Home with Asthma Programme") and what it offered the family. This was followed by some basic explanations of how asthma affects children and how it can be treated. The section on treatment discuss the differences between relievers (bronchodilators) and preventers (prophylaxis). There is a bigger section specifically about corticosteroids and their side effects. Fears about steroid treatment are known to be very common. This section ("Steroid treatment for asthma - the facts") tried to provide parents with some simple information and reassurance. The information also stressed that short-term use of oral steroids was safe.

Part 2 - "Asthma at home"

Part 2 called "Asthma at home" provided information on how children could use a peak flow meter to monitor their asthma at home. It was followed by simple ideas for measures that can be taken to make the house a better environment for asthma sufferers with the emphasis on house dust mite avoidance. An example of different problems that might be occur in different rooms (e.g. smoking in the living room) was shown.

Part 3 - "coping with asthma attacks"

Part 3 was a crucial section for the development of home management skills. The specific aim was to encourage the parents to recognise the warning signs and triggers in their own child as the basis for early intervention. On page 15 there is a list of signs of an impending asthma attack taken from "Teach your patients about asthma"[47]. This was a very important part as it became the basis of the future emergency management plan for the child's asthma. The parents were encouraged to identify any signs they had seen in the few days prior to the current hospital admission. There was also a space for the author to write down the details of the final management plan which the family were given at discharge. The section concluded by listing situations when urgent medical advice should be sought.

Part 4 - "Everything else!"

Part 4 encompassed topics which did not fit well into any of the other sections. It included some guidance on problems with asthma which may crop up at school, criteria for keeping a child off school, and when to call the doctor. If the family wished, a National Asthma Campaign School Asthma card was also completed. If the family had experienced problems already the author offered to contact the school on their behalf.

Piloting the "Going home with asthma" booklet

During its evolution, the booklet was extensively reviewed and criticised by parents and colleagues involved in paediatric asthma care. These colleagues included: Greta Barnes, Director of the Asthma Training Centre, Stratford-upon-Avon, Andrew Rutherford, the Publications Editor of the National Asthma Campaign, London and Edwina Wooler, Cathy Meade, and Jane

Hobbs, the Specialist Paediatric Respiratory Sisters at the Children's Hospital in Brighton and their generous help is gratefully acknowledged.
Many of the illustrations were based on a very successful but now out of print comic magazine (The Winner) produced by the National Asthma Campaign. Fortunately, as our booklet was designed for use in a specific study rather than commercial distribution and as the original magazine was out-of print the publications editor at the National Asthma Campaign generously allowed the use of this material in the present study.

2. A review discussion session

A major component of the most studies has been an extended period of interaction with an educator, teacher or nurse. For example, the Charlton et al[67] included a 45 minute interview with the parents. Patients with asthma often feel that there is not enough time spent discussing their disease with a doctor or a nurse (Unpublished information from a survey conducted for The National Asthma Campaign in December 1993). When questioned 78% of members, 37% of whom are parents of children with asthma, said they had not had a satisfactory discussion with their doctor or nurse. Interestingly they expressed no preference for whether this was with a nurse or a doctor. Therefore, we felt that a period of time should be made available to the parents specifically for that purpose. Rather than subject the parents to one long session it was decided to split the session into three parts (discussed in more detail on page 81). These contacts were directed to reviewing with the parents the information contained in the "Going Home with Asthma" booklet.

3. The asthma credit card

Every parent was also given an "asthma credit card" as a written summary of their home management plan.

Background

The idea of an asthma credit card originated in New Zealand where it was first evaluated in Maori adults recently treated and discharged from an urban hospital emergency department[77]. The card outlined an asthma management plan based on self-assessment of PEF monitoring and symptoms. It was printed on either side of a plastic credit card sized card. When first introduced, the mean PEF increased, the number of nights with disturbed sleep and days out of action were all reduced by about 50% (disturbed sleep 30.4% vs 16.9% days out of action 3.8% vs 1.7%) in the subjects who received one. The subjects commented favourably on the usefulness of the card. For situations when the asthma deteriorated, more (28%) found the PEF guide helpful than the symptoms (7%).

The original study had a number of limitations. Additionally, the study did not evaluate the use of an asthma credit card in children. However, in view of the importance attached to providing written guidance we felt the "credit card" approach had considerable practical attractions. In this study, we chose to give written advice to each parent summarising each child's individualised asthma management programme using this format.

The design

Since the original design was based on symptoms and peak flow it was particularly appropriate for the present study and accordingly the original

design was not altered much. Around the time of the study similar cards were released by Pharmaceutical Companies and the National Asthma Campaign. However the original design was preferred and it was also thought important to use non-promotional material. Consequently, only slight changes were made to the original design (Appendix 5). Economic constraints meant that the author made her own cards. Appropriate replicas were easily produced on site using desktop publishing facilities and then laminated. The finished card was sufficiently strong to last for the duration of the study. In use the author wrote the plan onto the laminated surface of the card with a permanent marker pen.

Using the card as a management plan

The card summarised a stepwise approach to deteriorating asthma, recognised either by increasing symptoms, or if appropriate decreasing peak flow, and what to do with the asthma therapy in response. Guidance for when to commence a short course of oral steroids was also incorporated. The appropriate dose of oral steroids for the child's weight (2mgs/kg as calculated for the dose received in hospital) was entered on both sides. For the study the parents were free to decide whichever they a plan based on symptoms or one based on peak flow. A peak flow meter was not mandatory.

4. The asthma ansaphone

The study of Fireman included phone support from an asthma nurse[64]. In view of the success of the National Asthma Campaign telephone helpline, we decided some access to local telephone support would be a useful addition for the families. For the duration of the study, telephone support from Monday to Friday during working hours of 8 a.m. till 5 p.m. was provided by the author. Parents could phone for advice and, if necessary, they could then be

seen at a clinic that week or as an emergency, if this was indicated. The telephone service was not intended to substitute for the GP or the hospital casualty service but was intended purely as support or a resource centre for parents and families if they needed help after discharge. For times when the nurse was busy the parents could leave a message on an ansaphone. The ansaphone message stressed the point, that if emergency advice was needed the parents should contact the GP or the receiving medical doctor at the hospital.

5. The Nurse run asthma clinic

The fourth and final component of the package was a nurse-run asthma follow-up clinic. This was included as there is some evidence principally from adult studies that access to specialist follow-up improves outcome[78]. The main purpose of the clinic appointment was to reinforce the advice and plan developed in hospital. By reviewing the patients at a relatively short time within discharge if problems were occurring they could be picked up and acted upon swiftly.

As the author had already completed the Diploma in Asthma Care in October 1991, it was decided to make the clinic nurse led rather than doctor led. The clinic was held in the same out-patient area as the respiratory clinic. If the author was concerned about any of the patients they could be seen that afternoon by the respiratory specialist.

Evaluating the programme

Rigorous evaluation of the effect of the "Going Home with Asthma Programme" was planned and it was decided that the most testing and

appropriate method of evaluation would be to use the format of a randomised controlled study.

The primary outcome for the study was defined as readmission to hospital at any time during the study period . This was monitored by careful review of the A&E register with data collated in an asthma admission database as in the first study. Asthma morbidity was studied as a secondary outcome and was measured by parent reported symptoms using morbidity questionnaires similar to those used in the first study.

Development of Data Collection Forms

Case-note form

In order to check that randomisation produced similar groups, a shorter more focused version of the in-hospital case note form used in the first study was completed by the author at discharge for every study patient (Appendix 7). The main use for this information was to check that there were no significant differences in severity or treatment between the randomised groups.

Morbidity questionnaire

Ongoing symptoms were assessed with the morbidity questionnaire used for the audit. The only change to the original was the removal of the asthma quiz which was replaced by a single page (Appendix 8) enquiring about the parents views and feelings on their child's asthma. We were keen to receive some feedback from the parents on their experience of the programme and their evaluation of the support offered. Both closed and open-ended questions were included which gave the parents an opportunity to express their views about the programme and, if they wished, their feelings about their child's asthma.

Since substance of both the casenote document and outcome had been evaluated carefully during the first study, they were not piloted again.

Plan of Study

The study took place over eighteen months from August 93 to January 95. The first 6 months (Aug.93 to Jan.94) were used for the development and piloting of the discharge programme. Data collection then ran prospectively for one year from Jan 94-Mar 95. Children were randomised at admission to either an intervention group, which received the discharge programme, or a control group which continued to receive present asthma care. Randomisation was carried out using the same card drawing method as the first study.

Subjects

Children over two years were included in the study during their first asthma admissions in the study period. As in the first study, children under two were excluded.

Setting

The study was formed in the four medical wards of the Royal Hospital for Sick Children, Glasgow. Before the study started, all the consultants were sent an letter explaining the study. All agreed to allow their patients to be included and on no occasion did the medical staff ask for a child randomised to the intervention group to be excluded from the study.

There was some initial reluctance from the medical staff in the three non-specialist wards to prescribe the short course of oral steroids at time of discharge. The main worry at the time was that the parents might use them inappropriately. In such situations it was decided that the author should discuss this with the parents at the review in the clinic. Often the parents themselves were keen to have such treatment at home in order to react promptly to future episodes. On such occasions the respiratory specialist would review the child at the clinic appointment and prescribe the oral steroids if he was satisfied it was appropriate.

Identification of patients

Patients were again identified using the A & E attendance register in exactly the same way as in the GGHB part of the earlier study. Daily asthma admissions through A/E were monitored. All suitable patients were assessed after admission to confirm the diagnosis and age. If the child was suitable for inclusion they were allocated a study number in the true order of admission.

Implementing the discharge programme

Discussion/review session

Session 1 - Introduction

At the initial session, the author introduced herself, and over 10-15 minutes briefly explained her role. The programme was explained to parents as an attempt by the hospital to improve the service to children with asthma and their families. This initial brief discussion session provided an opportunity to identify early in the hospitalisation parents specific questions or uncertainties about their child's asthma. At this time, the author would give the child and

parent the "Going home with asthma" booklet and ask them to read it and note any questions before the second meeting. The booklet was introduced as a little bit of advice about lots of different aspects of asthma. If the family wanted more detailed information, then the leaflets produced by the National Asthma Campaign were used to supplement it.

Session 2 - Progress

A second meeting with the parents usually took place later on the first day. This meeting was longer, usually lasting around 30 minutes but varied in length depending on the parent's response. At this meeting, their child's asthma history was reviewed, discussing, in detail, the sequence of events preceding the admission while they were still fresh in the parents' mind. The author was careful to pace the introduction of new information to avoid introducing too avoid overloading he parents. During the discussions, there was a clear emphasis on identifying specific triggers that the parents had noticed in their child. This focused approach was felt more appropriate than a more general discussion about asthma triggers. The sense of capitalising and building on the parents own observation and intuition was encouraged during the discussions. It was reinforced using the list of asthma warning signs in the asthma booklet (Appendix 4, page 15). Inevitably, the parents picked out at least one or two items on the list. When the signs of forthcoming attacks were described in this way the parents seemed to understand better how they could recognise such signs in the future. Thus the previous admission was used as a prototype asthma attack on which to construct the management plan.

Session 3 - Discharge

A final meeting took place close to the actual time of discharge, after the medical staff had decided on the the child's medical treatment. This meeting was used to explain the discharge plans and included explaining the therapy regime prescribed by the medical staff (It should be noted that descisions about therapy were always made by the medical staff without intervention from the author). Special reference was made to the continued use of bronchodilator therapy as the child continued to improve. The importance of nocturnal symptoms was stressed and reacting to them during the day. Recent work has highlighted the need to provide written advice patients about their treatment. In this case, written guidance was provided in the form of the 'credit card plan'. All details of the child's discharge treatment were recorded in the child's case notes by the author. An appointment was arranged for the nurse-run asthma clinic.

The control group

The author made no contact made with the control group, who received the standard asthma care.

The nurse-run asthma clinic

Procedure at the clinic

The review session provided an opportunity to reinforce the advice given in hospital[39]. It was organised for two weeks after discharge. The session involved reviewing the symptoms and checking the medication regime, checking device technique, and peakflow if appropriate. In order to ensure standardisation of each appointment the author used a clinic review form

(Appendix 9). The form was designed to focus on the essential requirements of follow up based on the BTS guidelines checklist for assessing outcome.

If the author was not happy with the child's condition then the case was reviewed with the respiratory physician and appropriate changes would be made.

This form was filed in the patients case notes, in exactly the same way as a record of a review at a medical out-patient clinic, ensuring that the information was available at any subsequent hospital attendance. If the child was well, no further appointments at the nurse run clinic were made. Exceptions to this were children who had been prescribed cromoglycate prophylaxis at time of discharge who did not have further follow up with medical staff. To ensure that someone reviewed whether or not the cromoglycate prophylaxis had been effective, a second appointment would be given for 6 weeks post discharge. The author had made a point of stressing the 4-6 week period before maximum effect and it would have seemed odd if there had not been a plan of action if Cromoglycate failed.

Sending out the outcome questionnaire

The questionnaires were sent to the family in the third week post discharge. They were asked to complete the questionnaire when it arrived, usually around the 4th week post-discharge. If the questionnaire was not returned by week 5, the author sent out a reminder with a second questionnaire. Thus the majority of questionnaires were completed between 4-6 weeks post discharge. If the second questionnaire was not returned no further ones were sent as the time period would then have changed.

Data analysis

Data was entered into Minitab and SPSS spreadsheets for analysis.

Statistics

Many of the results were largely descriptive and are presented as described earlier. Categorical data was analysed using chi-square analysis. Median scores from the morbidity questionnaire were compared using appropriate non-parametric tests (Mann Whitney U test). Readmissions were modelled using statistical techniques for the analysis of survival data and were analysed using Cox's proportional hazard model as before.

Ethical permission

The project was submitted to the Ethics committee. Their view was that the study was a response to areas of deficient care and did not require consent (Appendix 6). Formal consent was not, therefore, requested from the parents.

Limitations

One potential problem with the study became apparent soon after the study started. In order for every child in the intervention group to receive exactly the same intervention the patients had to be identified within 24 hours of admission and the author had to make contact with the family. Randomisation could only occur on a day that the author was present in the hospital. Practically, it was not possible for the author to be available every day throughout the study year. The solution adopted was to randomise only on days when the author was in the hospital. Patients were only recruited during Monday to Friday. To monitor for any selection bias, at the end of the study

all suitable patients who were admitted but not-randomised were identified and were investigated retrospectively as a third group (non-randomised patients (NR)). This created a second control group where information on the primary outcome, readmission, but not morbidity, was collected.

RESULTS

Asthma admissions

During the study year, 201 children with asthma suitable for inclusion in the study were admitted. Full details on the hospital treatment were available for all these children. Randomisation divided the group into 96 in the intervention group (IG) and 105 in the control group (CG) (Table 22). Clinical details were also collected on a further 82 children identified at the end of the study as children who would have been suitable for inclusion but who were admitted on days when they could not be followed through (the non-randomised group (NR)).

The intervention and control group were investigated prospectively. Data on the non-randomised group were collected retrospectively from the case notes. Outcome questionnaires could not be completed for this group. Thus information on the NR group is only available for the primary outcome.

The characteristics of the three groups were found to be similar (Table 22). The median age of the IG was slightly higher at 6, than the other two groups. The median number of previous asthma admissions were the same for all three groups (2 admissions).

The Effectiveness of Randomisation

1. Community response

Although the main focus of the second study was the outcome after the discharge programme, aspects of the community response and the in-patient

care were recorded so that the care of the two groups could be compared. This also allowed a comparison to be made with the 1992 audit.
There was no evidence of any change in the primary care management of acute symptoms in the days before hospital admission. Less than 11% (IG: 9.37%, CG: 10.5%) of either group received any oral steroids in the 7 days prior to the admission. In view of this, it was not surprising to find that in either group there was little evidence of the use of asthma management plans. In fact, only a small proportion of patients in either group had any record of having any form of asthma management plan (IG:5/96, 5.2%, CG:14/105,13%).

2. In-patient hospital care

Analysis of the data from the casenote document showed that the in-patient treatment the three groups received was similar (Table 23). There was no difference in the number of children who received nebulised bronchodilator, oral steroids, oxygen, or IV Aminophylline. In fact slightly more children received oxygen therapy than in the first study (overall 20.3% in study 1 to 36.9% overall in study 2). This may simply have been a result of the raised awareness of asthma care following the audit. The use of IV Aminophylline was again reserved only for the few children not responding to the conventional treatment of nebulised bronchodilator, oral steroids and oxygen (5.2% in study 1 to 9.5% in study 2).

3. Discharge planning

a. Changes in asthma treatment

Slightly more children in the CG were receiving bronchodilator therapy pre-admission than the IG (Table 24), although there was no difference in the

bronchodilator therapy post discharge. There was no difference in terms of asthma prophylaxis, pre- and post- admission, although more children in the CG were receiving asthma prophylaxis prior to the index admission reported in the study. This may have suggested that in fact the children in the control group were suffering more significant asthma symptoms prior to the admission, however this was not formally assessed in the study. In contrast the number of previous admission for asthma were similar for both groups (Table 22). As this was shown to be an important indicator of readmission in the first study, this suggested that the overall severity of asthma in the two groups was similarly distributed.

b. Device technique assessment

The majority of patients in both groups had an assessment made of their ability to use the chosen device (Table 24). This was slightly higher in the intervention group at 98% in comparison to the controls at 91.4% and represented a change from the first study. Again the higher rate in the control group may have been an effect of the study, as the presence of the author on the wards may have increased the staff's awareness of the needs of asthmatic children. Checking inhaler technique was not a component of the discharge package in hospital. Instead it was assessed at the nurse run asthma clinic appointment, recognising the importance of making sure the child could use the device correctly [39]. Checking technique in this way was arranged to avoid disturbing existing hospital arrangements where the physiotherapists are usually responsible checking inhaler technique on medical request. As the study was not providing a service to all children admitted with asthma, we aimed not to avoid changes to routine practice.

When a comparison was made between the two groups in respect of the remaining components of the discharge programme (Table 24), there was a clear difference in what was provided for the family to take home. When a comparison was made against the control group it was clear that the intervention group had been discharged with more written discharge plans ($P<0.0001$) and peak flow meters ($P=0.015$). Sixteen children (16/96, 16.7%) in the intervention group were discharged early without the author being notified and consequently were not given a written home management plan. These subjects were given a written plan when they attended the nurse run clinic. These figures provide clear evidence that the home management programme at the very least had positively altered aspects of the process of care.

Telephone calls to the asthma ansaphone

The telephone support was available to all 96 parents in the intervention group. In fact only 10 parents phoned the line, on at least one occasion. There were no calls that were deemed inappropriate. The commonest reason for calling tended to be for advice on their child's condition. For the parents who rang an appointment could be made at the nurse run asthma clinic if appropriate. In general, for the small number who used it, the telephone support seemed to work well in dealing with post-discharge problems.

Attendance at the nurse-run asthma clinic

Attendance at the follow-up nurse run clinic was excellent with an attendance of 87.6% (84/96 subjects). Since most medical review clinics at the hospital run with a default rate of 20-25%, attendance was at a very high level.

Primary outcome measure - readmissions with asthma

Asthma admissions were monitored throughout the study by the author. Readmission was defined as in study one: any child who had a subsequent asthma admission after an index admission during the study period. There was an obvious and significant difference in the number of readmissions in the control group compared with the intervention group (Table 25).

What happened with time - Survival analysis

Readmissions occurring during the study were closely monitored up until 27/3/95 via the asthma database, 2 months after randomisation ended (Jan 95), a total time of 14 months. This shorter time of readmission monitoring compared to Study 1 was to allow for completion of data analysis.

A survival analysis was again performed to explore the factors influencing whether or not a child was readmitted (using methods and exploring the same factors as described earlier on page 54). Children not re-admitted were "censored" at the last date of data collection (27/3/95). The survival analysis investigated the effect of the explanatory variables also used in the first study (again described on page 54) with the addition of IV Theophylline intervention, i.e. previous admissions, previous drug therapy, sex, oxygen saturation, age and IV Theophylline (Table 26).

Theophylline was entered this time around for two reasons. Firstly, the use of theophyllline is usually restricted to those patients who do not respond to the conventional first line emergency treatment, hence indicating children with more severe episodes. Secondly, Mitchell et al[33] in a study published in 1994

had found that IV theophylline was associated with a decreased risk of readmission (see Discussion Study 1, Possible differences in paediatrics).

The initial analysis examined the effect of each variable individually on survival to establish whether differences among groups were statistically significant. This suggested that the intervention, previous admissions and previous drugs were all significant in determining survival.

The next step was to carry out a further survival analysis repeating the analysis using all the covariates (home management plan group, previous admissions, previous drug, sex, oxygen saturation, IV theophylline and age). Analysis was performed using a Cox's Proportional Hazards Model. This analysis showed that the only significant factors remaining were previous admissions and the intervention (Table 26).

How does this compare to the survival analysis for study 1

The findings from survival analysis for study 1 showed that in the Cox's Proportional Hazards Model previous admissions ($p<0.0001$) and age ($p=0.001$) were the only significant factors affecting survival (Table 21). The findings of the second study differed in that previous admissions were significant, but not age. Table 22 indicates that the intervention group were slightly older on average than the control and non-randomised groups. Since children were assigned to treatment groups at random, this effect must be simply an unfortunate and unusually extreme result of sampling variability. A Chi-square test of association confirmed a detectable difference in the age groups of the intervention and control group with fewer children from the younger age group in the intervention group. In view of this finding, the Cox Proportional Hazards Modelling was repeated, with subjects being stratified

into 3 separate age categories, 2.001-5, 5.001-10, 10.001+ (as shown on Table 26). This did not affect the original findings. Both previous admissions and intervention remained significant at less than 5%. This analysis confirmed the original finding that the home management programme was associated with a reduced risk of readmission, even after age had been accounted for (Figure 7). In conclusion, both previous admissions and the home management programme were found to be significant in determining survival.

Secondary outcome measure - morbidity

Reported symptoms

Two hundred and one outcome questionnaires were sent to the parents of the 201 admissions. Overall 129 (64.2%) were returned, 98 in the first mailing and a further 31 after a second mailing (Table 22). The responses were CG - 62.9% vs IG - 65.6%. This was lower than in the first study and was somewhat disappointing. The reasons for this reduction in response were not clear. It was of interest to note that despite the personal contact with the author for parents in the intervention group the response rate was very similar to that of the control group.

A score was calculated for each of the 129 questionnaires in exactly the same way as described in Study 1. For each questionnaire a score was derived for three components (day score, night score and disability score). As before the scores were aggregated, a median score was calculated and scores for the two groups were compared (Table 27). There were significant differences on both the day and night score (Day score: Mann Whitney U test: P=0.005; Night score: Mann Whitney U test: P=0.0002). There was no difference evident between the two groups for the disability score (Mann

Whitney U test: P=NS). Thus the patients in the intervention group had fewer reported symptoms. It is of interest to compare this with the first study which had shown that care in specialist respiratory ward led to no difference in the outcome (Table 17).

Further treatment

There was no difference noted in the number of children in either group who had received further steroid tablets following discharge (Table 28). A small number of children in both groups had received further steroids following discharge, although there was no difference in the number of days treatment children in the two groups had received. Despite this, the majority of parents in both groups reported that they felt their child was better since coming home from hospital (Table 28).

The parent satisfaction questions

In this final section, we were keen to find out how the parents felt about their child's asthma and their asthma knowledge. Surprisingly there was no difference in the two groups when asked about their estimation of their understanding of their child's asthma since time of diagnosis (Table 29). However when asked about their estimation of their present understanding the parents in the intervention group scored slightly higher, with only 3.1% indicating they felt it could be improved compared to 18.2% of the control group parents.

DISCUSSION

The most striking finding in this study was the substantial difference in readmission in children assigned to the intervention group compared with the control group (8.3% vs 24.8%; χ^2=9.631, P=0.002). Since the rate in the control group was similar to both the non-randomised group (21.95%) and the historical rate from the Study 1 (21.4%), the intervention appeared to have brought about a substantial *reduction* in readmission rate.

The study also showed significant improvement in the secondary outcome with lower morbidity in the patients in the intervention group, both in regard to the day (P=0.0005) and night (P=0.0002) symptom scores (Table 27). It is particularly noteworthy that these striking improvements were achieved without any differences being present in terms of therapy, during or at discharge and therefore cannot be attribute to differences in the pharmacological treatment of the children's asthma.

The study therefore differs from the majority of paediatric studies by achieving a reduction in both hospital readmissions and asthma symptoms[66, 67, 69, 71].

This observed reduction in readmission rate is similar to the findings in some of the adult studies[61, 62]. Yoon[62] showed fewer readmissions at 10 months with only 1/28 (3.6%) of the intervention group being readmitted, compared to 7/28 (25%) in control group. Osman demonstrated in their complete study population of 801 subjects that the mean number of hospital admissions over the study year in the educated group were 0.17 compared to 0.20 in the control group. However, in this study these differences were only significant

in the more severe patients, and in the less severe patients, only after time in education had been taken into account .

Our findings also compare favourably with paediatric studies. Charlton[67] showed no difference in hospital admissions, in fact the children in the intervention group in his study had more hospital admissions. However there were reductions in two of the morbidity variables assessed by symptoms reported by the parents in daily diary cards. In the intervention group there was a lower median score for night wheeze, and activity restriction, although only activity restriction was significantly different ($P<0.05$) (Table 27). For lung function assessed by PEF monitoring the children in the intervention group had less time spent with lung function below 30% of best ($P<0.05$). There was however a reduction in the amount of school absence and in the number of home visits by the GP in the intervention group. It is worth noting that the major components of these two studies were similar in that they both incorporated a nurse-run clinic, introduced asthma management plans, and included a detailed discussion session with the nurse. The main differences were that the children in Charlton's study were not randomised at time of admission, and they were not given an asthma booklet. In view of our better outcomes, we speculate that that interventions introduced around time of hospital admission have a greater chance of being successful. This would be in agreement with Osman's finding in adults [65] that hospital admission may alter patient behaviour and reduce subsequent hospital admissions.

Did the intervention group have different severity of asthma?

Taggart et al found that only those children with severe asthma benefited from their hospital based intervention[66]. In our study the intervention group was randomly selected and thus included children with a range of asthma

severity. Although we did not attempt to measure asthma severity in terms of previous symptoms in either group prior to the admission study, the groups had similar characteristics, and more importantly the same median number of previous admissions.

Differing asthma symptoms pre-admission

The study achieved good results in terms of reported ongoing symptoms with a clear difference evident between the two groups post discharge (Table 27). This difference occurred despite similar proportions of children in each groups being prescribed asthma prophylactic therapy at discharge (Table 24). One criticism of our findings in this area might be that we did not have a record of baseline symptoms in the two groups prior to the study and therefore did not know definitely that the intervention group had not experienced fewer symptoms pre admission. The main reason for not assessing symptoms pre-admission was simply with all subjects in both groups having recently had an acute exacerbation quantitating the degree of symptoms prior to the study would have be difficult. Although this approach is perfectly reasonable in studies recruiting from the outpatient department, such as Charlton[67], it was thought less appropriate for our study. However, we found no evidence supporting the possibility that children in the intervention group had fewer asthma symptoms pre-admission.

It is possible that if behaviour toward the asthma can be altered by admission a similar beneficial effect might be observed in compliance with asthma therapy. Although we did not monitor drug compliance in either group there is a possibility that the intervention group had fewer symptoms as a result of receiving adequate prophylaxis or more bronchodilator therapy when symptomatic. Fireman[64] found that self reported compliance was better in

parents of children participating in the intervention groups. The nurse educated patients in their study were found to have used twice as much oral bronchodilators than the comparison group, although how this was quantified is not made clear[63]. This finding is backed up by data collected in a telephone survey at the end of the study. Nine of the thirteen parents in the educated group who said their child had improved during the asthma programme, attributed the improvement to the better use of the prescribed asthma therapy. Hence, an important effect of this study may be the result of a change in patient/parent attitude toward the use of asthma medication.

This possibility is backed up by unqualified observations made by the author during the study with regard to the parent's response at the inclusion of taking home a spare course of oral steroids, to use in conjunction with the asthma credit card for future exacerbation. This approach was eagerly received by the parents who needed no convincing of the benefits in starting steroid tablets promptly. This suggests that like the parents in Fireman's study[64], the parents in our study felt greater confidence in initiating subsequent acute therapy after learning more about how to recognise and treat future attacks occurring in their children. We did have some information on how the parents themselves rated their knowledge of their child's asthma treatment. Certainly fewer parents in the intervention group felt that their understanding could be improved compared to the control group. Unfortunately, the question did not qualify whether the understanding related to the prophylactic therapy or treatment for an acute attack. Despite the slight inadequacy of the question it does suggest that parents in the intervention group had a better understanding of the asthma treatment.

What about A&E attendances?

We observed no difference in the number of reattendances at A&E between the two groups, or in the number of GP consultations. In contrast, many of the earlier adult and paediatric studies had actually found reductions in A & E attendances and consultations [62, 64, 67, 69, 72, 74]. Whether this is a reflection of increased awareness of asthma in our intervention group is unclear, as the intervention group were clearly less symptomatic than the control group Table 25). While the reasons for the finding are unclear, in economic terms reduced hospital admissions are likely to lead to greater savings. Our study did not involve the primary care team, unlike those of Charlton and Osman which involved direct communication with the GP. This may have been a weakness of our study as a number of parents in Charlton's study actually commented that having their child's asthma diary helped when seeing the GP. The study had no way of measuring whether the diary card influenced the GP management of the asthma.

What was it that made the difference?

The booklet?

The "Going home with asthma" book would appear to have been successful in getting the right messages across to the parents. Unfortunately we did not ask the parents what they thought about it; however the informal feedback was very positive. We also did not specifically measure asthma knowledge between the two groups. Osman et al [61] asked the people to rate the usefulness of the information in the booklet. In the assessment of the first booklet, 81% returned the questionnaire. Seventy three percent (195/269) of the educated group said the most helpful information was that relating to what to do in a serious attack. Like Osman's personalised book the information in the "Going home with asthma" booklet focused on the

management of symptoms rather than asthma knowledge. As both the booklet and the credit card gave guidance in this area this was encouraging.

Was it the nurse-run clinic?

With a very high attendance rate at the nurse-run asthma clinic (87.6%) it would seem the nurse-run clinic was popular with parents. It certainly suggests that the interaction with the asthma nurse during hospitalisation was well received. An interesting fact is that of the 12 families who did not attend for the clinic visit, four of them happened to be among those subsequently readmitted. Whether this had any bearing on the clinic non-attendance was unclear. This good clinic attendance is in marked contrast to Yoon's study [62] who found that despite 185 adults showing initial interest in the education programme when approached in hospital only 76 completed the initial assessment and attended for at least one of the two follow up visits. This fall off became even more marked as time went on, by 10 months only 56 out of the original 76 had actually completed the study. An earlier study by Yoon[79] found that only 31% of adults who expressed an interest in attending an asthma education programme after admission in fact did so. It would seem that adults may be less motivated to apply advice to themselves.

Interestingly, follow up with specialist teams has been shown to improve outcome in adults[78]. In this study there was no difference in the medical follow-up arranged for the two groups (Table 31), so the better outcome was unlikely to be attributed to this. Alternatively substituting medical follow-up for children with the asthma nurse specialist may have made a difference.

Was it simply an effect of better primary care?

Account was taken of the community situation for both groups. This was to ensure that any effect or improvement seen in the intervention group was not a reflection of improvements in primary care. It is unlikely that the lower readmission rate in the intervention group was the result of any primary care effect as we showed that neither group had evidence of pre-existing asthma management plans. Indeed, there seemed to be a continuing reluctance to initiate more aggressive therapy of such as oral steroids. Over the periods of the two studies, there was no evidence of any improvement in the management of acute asthma in primary care. This differs from the situation in hospital where some improvements were observed e.g. better use of oxygen therapy (Table 23).

Was it better hospital care in the intervention group?

The groups received similar inpatient treatment so the better outcome in the intervention group was not simply an effect of better hospital treatment (Table 23). It was reassuring to see that yet again despite the absence of any formal written asthma protocol acute asthma management in hospital was excellent, with high numbers of children receiving nebulised bronchodilator and oral steroids. The number of children who received oxygen had increased. Since the mean oxygen saturation at admission had increased (92.8% compared to 92.0%) and the duration of hospital stay had shortened there is little evidence this was due to an increase in the severity of asthma at admission. It may represent a small improvement in practice as consequence of the continuing studies. It was also encouraging to see that so many patients in the control group were discharged with adequate bronchodilator therapy and on asthma prophylactic therapy (Table 24). Exactly why more changes to the regular

asthma medication occurred in the second study is unclear but it again suggests that the overall management of asthma had improved perhaps because of the studies and the influence of the nurse. These small changes in practice illustrate the importance of using a randomised controlled design in evaluating interventions rather than relying only on historical controls.

General observations of the asthma admissions

Overall the total number of patients from the combined three groups (IC, CG, NR) was only 283, was much lower than the 580 asthma admissions observed in the first audit. Yet, the annual statistics for 1994 showed that there was only a very small reduction in the number of asthma admissions during the year (1,243 for 1993 and 1,107 for 1994) (Figure 3). However, that still leaves a substantial difference between the number of asthma admissions eligible for inclusion and the total admitted. Both of the two years studied (1992 and 1994) excluded children under the age of two years, which probably account for the differences. Also the annual statistics report the number of children discharged with the ICD codes for asthma and wheeze (493.0 and 493.9 respectively), which is probably more accurate as it is coded by the medical staff on the ward. The identification of children for both studies had relied on the records in the A/E department. This worked well for Study 1. However the accuracy of this method for future studies is questionable as it did not prove as reliable as in previous years. Clearly for the future there has to be some formal monitoring of asthma admissions, if ongoing assessment of asthma care is to be performed.

Observations of the readmissions

There were few admissions in the 14 days after discharge (Table 30). This suggests that early readmission as defined by BPA (within 2 weeks) is probably not helpful as an outcome indicator. The patients in the intervention group appeared to readmit earlier, which suggests that despite enhanced discharge planning a number of children will readmit anyway.

Summary

The structured home management plan used in this study was brief in comparison to those used in other studies and was well received by both the families and the staff. Despite this it achieved significant improvements in readmissions and asthma morbidity without any evidence of concomitant changes in pharmacological asthma treatment.

CONCLUSION

These studies have confirmed the original hypotheses. The outcome for children admitted with an acute exacerbation of asthma was poor with evidence of ongoing morbidity and a high number of readmissions. Further a successful intervention to improve the situation was developed. However, many challenges remain if the outcome for children with acute asthma is to be improved further. Some of the immediate challenges are briefly outlined.

Improved discharge planning for "all"

As a result of the success of these studies, the home management programme developed will in the future be used for all asthma admissions to the Royal Hospital for Sick Children, Glasgow. However, with such a large number of annual admissions it is not likely that one nurse will be able to review and follow up every child admitted with acute asthma. The challenge will be to develop a method of implementation that does not dilute the gains achieved. The approach developed by Taggart et al[66] where a disease education programme was integrated into routine nursing care may be one way forward.

This study has emphasised the power of clinical audit in evaluating medical care. Continuing audit will be vital for monitoring the effectiveness of any new programme. Changes introduced must be evaluated to establish that they do indeed achieve the desired effects.

Improving the community response

One area where improvements do appear to be needed is in the management of acute asthma in primary care. We suspect that if earlier

treatment could be initiated within the community there could be a further reduction in the number of children admitted to hospital. A strategy of integrated care as developed for the GRASSIC study in Aberdeen may be one way forward[80]. The main strength of that scheme was the provision of better liaison between primary and secondary care. The GRASSIC study recruited adults attending as outpatients. In view of the evidence that strategies introduced around the time of hospital admission can reduce hospital admissions and influence morbidity it may well be that such an integrated care scheme starting at the time of hospital admission may lead to more definite benefits. It is also possible that it may be more effective when focused on children.

REFERENCES

1. Bucknall CE, Robertson C, Moran F, Stevenson RD. Differences in hospital asthma management. Lancet 1988;1:748-50.

2. Storr J, Barrell E, Lenney W. Rising asthma admissions and self referral. Arch Dis Child 1988;63:774-9.

3. Anderson HR, Bailey P, West S. Trends in the hospital care of acute childhood asthma 1970-8: a regional study. B M J 1980;281:1191-4.

4. Conway SP, Littlewood JM. Admission to hospital with asthma. Arch Dis Child 1985;60:636-9.

5. Anderson HR. Increase in hospital admissions for childhood asthma: trends in referral, severity, and readmissions from 1970 to 1985 in a health region of the United Kingdom. Thorax 1989;44:614-9.

6. Lung & Asthma Information Agency. Trends in hospital admissions for asthma. 1995;Factsheet 95/1.

7. Hyndman SJ, Willliams DRR, Merrill SL, Lipscombe JM, Palmer CR. Rates of admission to hospital for asthma. B M J 1994;308:1596-600.

8. Bucknall CE, Kendrick S. Asthma trends. Emergency admissions increasing in Scotland (letter). BMJ 1994;309:604.

9. Park ES, Golding J, Carswell F, Stewart-Brown S. Preschool wheezing and prognosis at 10. Arch Dis Child 1986;61:642-6.

10. Hill R, Williams J, Tattersfield A, Britton J. Change in use of asthma as a diagnostic label for wheezing illness in children. B M J 1989;299:898.

11. Strachan DP, Anderson HR. Trends in hospital admission rates for asthma. B M J 1992;304:819-20.

12. Luyt DK, Burton P, Brooke AM, Simpson H. Wheeze in preschool children and its relation with doctor diagnosed asthma. Arch Dis Child 1994;71:24-30.

13. Editorial. The nebuliser epidemic. Lancet 1984;1:789-90.

14. Bendefy IM. Home nebulisers in childhood asthma:survey of hospital supervised use. B M J 1991;302:1180-1.

15. Laroche CM, Harries AV, Newton RCF, Britton MG. Domiciliary nebulisers in asthma:a district survey. B M J 1985;290:1611-3.

16. Anderson HR. Is the prvalence of asthma changing. Arch Dis Child 1989;64:172-5.

17. Burr ML, Butland BK, King S, Vaughan-Williams E. Changes in asthma prevalence: two surveys 15 years apart. Arch Dis Child 1989;64:1452-6.

18. Robertson CF, Heycock E, Bishop J, Nolan T, Olinsky A, Phelan PD. Prevalence of asthma in Melbourne schoolchildren: changes over 26 years. B M J 1991;302:1116-8.

19. Ninan TK, Russell G. Respiratory symptoms and atopy in Aberdeen school children: evidence from two surveys 25 years apart. B M J 1992;304:873-5.

20. Burney PGJ, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973-86. B M J 1990;300:1306-10.

21. Austin J, Russell G, Adam MG, Mackintosh D, Kelsey S, Peck DF. Prevalence of asthma and wheeze in the Highlands of Scotland. Arch Dis Child 1994;71:211-6.

22. Barry DM, Burr ML, Limb ES. Prevalence of asthma among 12 year old children in New Zealand and South Wales:a comparative study. Thorax 1991;46:405-9.

23. Robertson CF, Bishop J, Sennhauser FH, Mallol J. International comparison of asthma prevalence in Children: Australia, Switzerland, Chile. Pediatr Pulmonol 1993;16:219-26.

24. Clifford RD, Radford M, Howell JB, Holgate ST. Prevalence of respiratory symptoms among 7 and 11 year old schoolchildren and association with asthma. Arch Dis Child 1889;64:1118-25.

25. Mitchell EA. International trends in hospital admission rates for asthma. Arch Dis Child 1985;60:376-8.

26. Archer LNJ, Simpson H. Night coughs and diary card scores in asthma. Arch Dis Child 1985;60:473-4.

27. Chowienczyk PJ, Parkin DH, Lawson CP, Cochrane GM. Do asthmatic patients correctly record home spirometry measurements? B M J 1994;309:1618.

28. Ninan TK, Russell G. Is exercise testing useful in a community based asthma survey? Thorax 1993;48:1218-21.

29. Lee DA, Winslow NR, Speight ANP, Hey EN. Prevalence and spectrum of asthma in childhood. B M J 1983;286:12581256-1258.

30. Simpson H, Forfar JO, Grubb DJ. Arterial blood gas tensions and pH in acute asthma in childhood. B M J 1968;3:460-4.

31. Strachan DP, Anderson HR, Limb ES, O'Neill A, Wells N. A national survey of asthma prevalence, severity and treatment in Great Britain. Arch Dis Child 1994;70:174-8.

32. Evans D, Mellins RB. Educational programs for children with asthma. Paediatrician 1991;18:317-28.

33. Mitchell EA, Bland JM, Thomson JMD. Risk factors for readmission to hospital for asthma in childhood. Thorax 1994;49:33-6.

34. Mitchell EA, Cutler DR. Paediatric admissions to Auckland Hospital for asthma from 1970-1980. N Z Med J 1984;97:67-70.

35. Mitchell EA, Burr D. Comparison of the characteristics of children with multiple admissions to hospital with asthma with those with a single admission. N Z Med J 1987;100:736-8.

36. Crane J, Pearce N, Burgess C, Woodman K, Robson B, Beasley R. Markers of risk of asthma death or readmission in the 12 months following a hospital admission for asthma. Int J Epidemiol 1992;21:737-44.

37. DeLacey G. What is audit? Why should we be doing it? Hospital Update 1992;June:459-64.

38. Harrison BDW. Audit in respiratory Disease. Respir Med 1991;85:47-51.

39. British Thoracic Society. Guidelines on the management of asthma. Thorax 1993;48:S1-24.

40. Langton-Hewer S, Hambleton G, McKenzie S, et al. Asthma Audit; a multicentre pilot study. Arch Dis Child 1994;71:167-9.

41. Urquhart KN. A study of childhood asthma and housing conditions. 1991;1-74.[Thesis in part fulfillment of the Master of Public Health Degree, University of Glasgow. December 1991]

42. Registrar General Scotland. Annual Report. 1992;No. 138.

43. British Thoracic Society. Death from asthma in two regions of England. B M J 1982;285:1251-5.

44. Sly PD, Cahill P, Willet K, Burton P. Accuracy of mini peak flow meters in indicating lung function in children with asthma. B M J 1994;308:572-4.

45. Usherwood TP, Scrimgeour A, Barber JH. Questionnaire to measure perceived symptoms and disability in asthma. Arch Dis Child 1990;65:779-81.

46. Sibbald B. Patient self care in acute asthma. Thorax 1989;44:97-101.

47. National Heart Lung and Blood Institute. Teach your patients about asthma - A clinicians guide. 1992;No. 92-2737.

48. Khot A, Burn R, Evans N, Lenney C, Lenney W. Seasonal variation and time trends in childhood asthma in England and Wales 1975-81. B M J 1984;289:235-7.

49. Khot A, Evans N, Lenney W. Seasonal trends in childhood asthma in south east England. B M J 1983;287:1257-8.

50. Storr J, Lenney W. School holidays and admissions with asthma. Arch Dis Child 1989;64:103-7.

51. Lung & Asthma Information Agency. Seasonal variations in asthma. 1993;Factsheet 93/4.

52. Hendeles L, Weinberger M, Szefler S. Safety and efficacy of theophylline in children with asthma. J Pediatr 1992;120:177-83.

53. Geelhoed GC, Landau LI. Predictive value of oxygen saturation in emergency evaluation of asthmatic children. B M J 1988;297:395-6.

54. Gershel JC, Goldman HS, Stein REK, Shevlov SP, Ziprkowski M. The usefulness of chest radiographs in first asthma attacks. N Engl J Med 1983;309:336-9.

55. Bucknall CE, Robertson C, Moran F, Stevenson RD. Management of asthma in hospital: a prospective audit. B M J 1988;296:1637-9.

56. Kerem E, Canny G, Tibshirani R, et al. Clinical-Physiologic correlations in acute asthma of childhood. Pediatrics 1991;87:481-6.

57. Galant SP, Groncy CE, Shaw KC. The value of pulsus paradoxus in assessing the child with status asthmaticus. Pediatrics 1978;61:46-51.

58. Canny GJ, Reisman J, Healy R, et al. Acute asthma:observations regarding the management of a pediatric emergency room. Pediatrics 1989;83:507-12.

59. Pearson MG, Spence DPS, Ryland I, Harrison BDW. Value of pulsus paradoxus in assessing acute severe asthma. B M J 1994;307:659

60. Anderson HR, Bailey PA, Cooper JS, Palmer JC, West S. Morbidity and school absence caused by asthma and wheezing illness. Arch Dis Child 1983;58:777-84.

61. Osman LM, Abdalla MI, Beattie JAG, et al. Reducing hospital admission through computer supported education for asthma patients. B M J 1994;308:568-71.

62. Yoon R, McKenzie DK, Bauman A, Miles DA. Controlled trial evaluation of an asthma education programme for adults. Thorax 1993;48:1110-6.

63. Lewis CE, Rachelefsky G, Lewis MA, De La Sota A, Kaplan M. A randomised trial of asthma care training for kids. Pediatrics 1984;74:478-86.

64. Fireman P, Gilbert A, Friday GA, Gira C, Vierthaler WA. Teaching self management skills to asthmatic children and their parents in an ambulatory care setting. Pediatrics 1981;68:341-8.

65. Osman L, Friend JAR, Legge JS, Douglas DG. Successful avoidance of hospital re-admission in acute asthma. Eur Respir J 1994;7:13s

66. Taggart VS, Zuckerman AE, Sly RM, et al. You can control asthma: Evaluation of an asthma education programme for hospitalised inner-city children. Patient Education and Counselling 1991;17:35-47.

67. Charlton I, Antonios AG, Atkinson J, Campbell MJ, Mackintosh T, Schapira D. Asthma at the interface: bridging the gap between general practice and a district general hospital. Arch Dis Child 1994;70:313-8.

68. Garret J, Fenwick J, Taylor G, Mitchell EA, Stewart J, Rea H. Prospective controlled evaluation of the effect of a community based asthma education centre in a multiracial working class neighbourhood. Thorax 1994;49:976-83.

69. McNabb WL, Wilson-Pessano SR, Hughes GW, Scamagas P. Self-management education of children with asthma: AIR WISE. American Journal of Public Health 1994;75:1219-20.

70. Taggart VS, Zuckerman AE, Lucas S, Acty-Lindsey A, Bellanti JA. Adapting a self management education program for asthma for use in an outpatient clinic. Ann Allergy 1987;58:173-8.

71. Parcel G, Nader PR, Tiernan K. A Health Education Program for Children with Asthma. Developmental and Behaviour Pediatrics 1980;1:128-32.

72. Hilton S, Sibbald B, Anderson HR. Controlled evaluation of the effects of patient education on asthma morbidity in general practice. Lancet 1986;1:26-9.

73. Wilson SR, Scamagas P, Gernan DK, et al. A controlled trial of two forms of self management education for adults with asthma. American Journal of Medicicne 1993;94:564-76.

74. Charlton, I, Charlton G, Broomfield J, Campbell M. An evaluation of a nurse-run asthma clinic in general practice using an attitudes and morbidity questionnaire. Fam Pract 1992;9:154-60.

75. Connet GJ, Warde C, Wooler E, Lenney W. Audit strategies to reduce hospital admissions for acute asthma. Arch Dis Child 1993;69:202-5.

76. Charlton I, Charlton G, Broomfield J, Mullee MA. Evaluation of peak flow and symptoms only self management plans for control of asthma in general practice. B M J 1990;301:1355-9.

77. D'Souza W, Crane J, Burgess C, et al. Community-based asthma care: trial of a "credit card" asthma self management plan. Eur Respir J 1994;7:1260-5.

78. Zeiger RS, Heller S, Mellon MH, Wald J, Falkoff R, Schatz M. Facilitated referral to asthma specialist reduces relapse in asthma emergency room visits. J Allergy Clin Immunol 1991;87:1160-8.

79. Yoon R, McKenzie DK, Miles DA, Bauman A. Characteristics of attenders and non-attenders at an asthma education programme. Thorax 1991;46:886-90.

80. Drummond N, Abdalla M, Buckingham JK, et al. Integrated care for asthma: a clinical, social, and economic evaluation. B M J 1994;308:559-63.

TABLES

Table 1: Parent reports of total numbers of hospital admissions for asthma in 334 children who had an admission for acute asthma during 1990.

Admissions	Numbers of parents reporting	% of Total	Cum %
1	130	38.9	38.9
2	53	15.9	54.8
3	35	10.5	65.3
4	30	9.0	74.3
5	13	3.9	78.2
6-10	44	13.2	91.4
11-20	13	3.9	95.3
>20	16	4.8	100
Total	**334**	**100**	

Table 2: Ward types at the centres taking part in the audit study

GGHB		*FVHB*	
Ward A	Medical Paediatric/ Academic	Ward E	Medical Paediatric
Ward B	Medical Paediatric	Ward F	Medical Paediatric
Ward C	Academic / Respiratory Paediatric		
Ward D	Medical Paediatric / Academic		

Table 3: Details of children over two years of age admitted with acute asthma during Jan 1992 - Jan 1993 in Glasgow (GGHB) and Forth Valley (FVHB).

	GGHB	FVHB
No. of children	456	116
No. of episodes	580	147
Sex (M:F)	2.1:1	2.1:1
Median age (years)	4.99	4.91
Median length stay (days)	3	2

Table 4: Mode of referral to hospital (GGHB and FVHB).

Type of admission	Self-referral (%)	GP Referral (%)
First ever asthma admission ("Firsts" = 262)	65 (24.8)	191 (72.9)
Single admission during audit ("Singles" = 310)	114 (36.8)	179 (57.7)
Readmission during audit ("Multis" = 155)	81 (52.3)	64 (41.3)

Table 5: Source of referral in relation to asthma admission history

	GGHB (%)	FVHB (%)
First admission		
Self	57/207 (27.5)	8/49 (16.3)
GP	150/207 (72.5)	41/49 (83.7)
All admissions		
Self	167/348 (48.0)	28/90 (31.1)
GP	181/348 (52.0)	62/90 (68.9)

Table 6: Community response to the acute asthma attack in children who were admitted in GGHB and FVHB.

	Inhaled β2 agonist		Nebulised β2 agonist		Oral steroids	
	GGHB	FVHB	GGHB	FVHB	GGHB	FVHB
Self referred	84/224	15/36	47/224	6/36	25/224	6/36
(%)	37.5	41.7	21.0	16.7	11.2	16.7
GP referred	101/331	24/103	96/331	57/103	56/331	41/103
(%)	30.5	23.3	29.0	55.3	16.9	39.8
Index admission	140/456	31/116	113/456	51/116	64/456	37/116
(%)	30.7	26.7	24.8	44.0	14.0	31.9
Readmissions	55/124	9/31	33/124	13/31	21/124	12/31
(%)	44.4	29.0	26.6	41.9	16.9	38.7

Table 7: Medical staff assessment of severity of asthma attacks in GGHB and FVHB.

Clinical Sign or Assessment	GGHB (n=580)	FVHB (n=147)
Pulsus paradoxus	24 (4.1%)	22 (15.0%)
Cyanosis	405 (69.8%)	97 (66.0%)
Breathless/distressed	260 (44.8%)	61 (41.5%)
Speech ability	163 (28.1%)	77 (52.4%)
Accessory muscle use	435 (75.0%)	103 (70.1%)
Hyperinflation	294 (50.7%)	25 (17.0%)
Air entry	490 (84.5%)	87 (59.2%)
Wheeze	575 (99.1%)	141 (95.9%)
Crepitations	266 (45.9%)	35 (23.8%)
Overall assessment	163 (28.1%)	17 (11.6%)

Table 8: Drug therapy used in acute treatment of asthma.

Treatment	GGHB n = 580 n (%)	FVHB n = 147 n (%)
Nebulised bronchodilator	577 (99.5%)	144 (98.0%)
Oral steroids (including IV)	539 (92.9%)	140 (95.2%)
Oxygen	117 (20.2%)	29 (19.7%)
IV Aminophylline	30 (5.2%)	7 (4.8%)

Table 9: Saturation ranges against oxygen given (including both high and low flow oxygen).

Area	No. with SaO_2 measured	No. receiving O_2 therapy	No. of Children with Saturations in Range:		
			100-95.01	**95-90.01**	**<90**
			n (%)	**n (%)**	**n (%)**
GGHB (n = 580)	573	117	7 (1.2)	38 (6.6)	72 (12.6)
FVHB (n = 147)	117	29	2 (1.7)	9 (7.7)	18 (15.4)

Table 10: Proportion of children who had a chest xray performed, proprtion of those X-rayed who also received antibiotics

	GGHB		FVHB	
		%		%
Chest X-ray performed	165/580	28.4	33/147	22.4
Age range 2.01-5 years	88/309	28.5	21/77	27.3
Age range 5.01-10 years	54/196	27.6	10/45	22.2
Age range 10.01-15 years	23/75	30.7	2/25	8.0
Antibiotics prescribed (including oral and IV)	36/165	21.8	6/33	18.2

Table 11: Differences in recorded history between the two health boards.

Asthma symptoms	GGHB	FVHB
Triggers for attacks	211/580 (36.4%)	34/147 (23.1%)
Sleep disturbance	196/580 (33.8%)	54/147 (36.7%)
Wheeze in mornings	167/580 (28.8%)	15/147 (10.2%)
Exercise induced asthma	175/580 (30.2%)	53/147 (36.0%)
School absence	58/402 (14.4%)	5/77 (6.5%)

Table 12: Comparison of recorded asthma histories in the respiratory ward (C) versus the non-respiratory wards (A,B,D) in Royal Hospital for Sick Children, Glasgow.

Asthma symptoms	Respiratory	Non-respiratory
Triggers for attacks	66/155 (42.6%)	144/425 (33.9%)
Sleep disturbance	77/155 (49.7%)	119/425 (28.0%)
Wheeze in mornings	70/155 (45.2%)	97/425 (22.9%)
Exercise induced asthma	69/155 (44.5%)	106/425 (24.9%)
School absence	20/119 (16.8%)	38/285 (13.3%)

Table 13: Evidence of discharge planning as recorded in the medical records in GGHB and FVHB.

Treatment	GGHB	FVHB
Prescription of bronchodilator	500/580 (86.2%)	144/147 (98.0%)
Device technique checked	428/580 (73.8%)	61/147 (41.5%)
Given a peak flow meter (children over 5 years)	71/271 (26.2%)	24/70 (34.3%)
Written managment plan (Asthma card)	61/580 (10.5%)	Never recorded in FVHB medical notes
Educational information	5/580 (0.9%)	1/147 (0.7%)
Follow-up appointment arranged	559/580 (96.4%)	147/147 (100.0%)
Anti-smoking advice given	12/580 (2.1%)	8/147 (5.4%)

Table 14: Discharge planning in respiratory vs non-respiratory wards in GGHB.

Treatment	Respiratory	Non-respiratory
Prescription of bronchodilator	155/155 (100.0%)	417/425 (98.1%)
Device technique checked	133/155 (85.8%)	295/425 (69.4%)
Given a peak flow meter (children over 5 years)	50/105 (47.6%)	21/404 (5.2%)
Written managment plan (Asthma card)	48/155 (31.0%)	13/425 (3.1%)
Educational information	2/155 (1.3%)	3/425 (0.7%)
Follow-up appointment arranged	139/155 (89.7%)	336/425 (79.1%)
Anti-smoking advice given	5/155 (3.2%)	7/425 (1.7%)

Table 15: Changes to asthma prophylaxis pre- and post admission for both the "Firsts" and the "Multis".

	"FIRSTS"			"MULTIS"		
	Specialist n=119	Non-specialist n=337	FVHB n=116	Specialist n=36	Non-specialist n=88	FVHB n=31
Pre-admission						
Cromoglycate	10 (8.4)	46 (13.6)	7 (6.0)	4 (11.1)	24 (27.3)	0
Inhaled steroids	51 (42.9)	66 (19.6)	43 (37.1)	22 (61.1)	37 (42.0)	23 (74.2)
Post-admission						
Cromoglycate	23 (19.3)	65 (19.3)	3 (2.6)	8 (22.2)	18 (20.4)	0
Inhaled steroids	75 (63.0)	143 (42.4)	73 (62.9)	27 (75.0)	61 (69.3)	26 (83.9)

Table 16: Random sample characteristics

	GGHB (n=120)	FVHB (n=32)
Sex (M:F)	1.89:1	1.13:1
Median age (years)	4.85	5.5
Median length of stay (days)	2	2

Table 17: Morbidity questionnaire results, Glasgow and Forth Valley

Scoring for all questions in the three categories as follows. Not at all = 0, A few days = 1, Some days = 2, Most days = 3, Every day/night = 4.

Ward	Day score (maximim 16) Median (range)	Disability score (maximum 32) Median (range)	Night score (maximum 12) Median (range)
A	5.0 (1 - 16)	6.0 (0 - 28)	3.5 (0 - 11)
B	5.0 (0 - 14)	10.0 (0 - 26)	5.0 (0 - 11)
C - (Resp)	5.0 (1 - 13)	4.0 (0 - 29)	5.0 (0 - 9)
D	4.0 (0 - 11)	2.0 (0 - 17)	4.0 (0 - 10)
E - Stirling	4.5 (1 - 9)	3.0 (0 - 19)	3.0 (0 - 8)
F - Falkirk	6.0 (1 - 13)	3.5 (0 - 15)	4.0 (1 - 8)

	Day score	Disability score	Night score
Mann Whitney (GGHB vs FVHB)			
P value	0.909	0.480	0.520
Kruskal Wallis (Wards in GGHB only)			
P value	0.870	0.076	0.616

Table 18: Asthma quiz results in the 152 completed questionnaires

Question (correct answer)	Correct answer given	(%) of 152 questionnaires with answer
1. Asthma is common in childhood (T)	141	92.8
2. Asthma is an emotional or psychological disease (F)	111	73.0
3. Asthma episodes can occur without warning (F)	15	9.9
4. Many different things can bring on an asthma attack (T)	142	93.4
5. Asthma cannot be cured, but it can be controlled (T)	132	86.9
6. There are different types of treatment to control asthma (T)	145	95.4
7. People with asthma have no way to tell their asthma is controlled (F)	36	23.7
8. People with asthma should avoid exercise (F)	133	87.5

Table 19: Overall outcome in terms of readmissions and A & E reattendances.

	GGHB	FVHB	Overall
Readmissions (no of readmissions /no of patients)	124/580 (21.4%)	31/147 (21.1%)	155/727 (21.3%)
Re-attended A & E (available for outcome group only)	8/120 (6.7%)	4/32 (12.5%)	12/152 (7.9%)
Re-attended GP (available for outcome group only)	14/120 (11.7%)	3/32 (9.4%)	17/152 (11.2%)

Table 20: Readmissions for ward / health board area

Health board area		Numbers	%
GGHB			
	Ward A	22/110	20.0
	Ward B	18/107	16.8
	Ward C (Respiratory)	21/119	17.6
	Ward D	30/120	25.0
FVHB			
	Ward E	8/55	14.5
	Ward F	12/61	19.7

Table 21: Survival analysis for Glasgow until 31/3/94.

Explanatory variable	Groups	P value (log rank test)	Comments
Ward	A, B, C, D	0.65	NS
Sex	M, F	0.33	NS
Previous admissions	0, 1, 2+	< 0.0001	last group is particularly at risk
Age	2.001-5, 5.001-10, 10.001+	0.0005	youngest group is particularly at risk
Oxygen saturation	<87, 88-91, 92-95, 96+	0.74	NS
Drug before admission	none, cromoglycate, inhaled steroids	0.0001	generally risk increases with severity of condition

Cox Proportional Hazard Model: only Previous Admissions ($p < 0.0001$) and then Age ($p = 0.0005$) were significant on multivariate analysis

Table 22: Characteristics of the three groups

	Intervention	Control	Non-randomised
Total numbers	96	105	82
Questionnaire Responders	63 (65.6%)	66 (62.9%)	N/A
M:F	62:34	62:43	51:31
Sex ratio	1.82:1	1.44:1	1.64:1
Median age (years)	6.0	4.6	4.9
Median length of stay (days)	2	2	2
Median number of previous admissions	2	2	2

Table 23: In-patient hospital care

	Intervention (n=96)	Control (n=105)	Non-randomised (n=82)
Nebulised bronchodilator	96 (100.0%)	104 (99.0%)	82 (100.0%)
Oral steroids	93 (96.9%)	101 (96.2%)	79 (96.4%)
Oxygen	38 (39.6%)	39 (37.1%)	28 (34.1%)
IV Aminophylline	8 (8.4%)	10 (9.5%)	9 (11.0%)

Table 24: Evidence of discharge planning in the study groups.

	Intervention (n=96)	Control (n=105)
Bronchodilators pre-admission	77/96 (80.2%)	97/105 (92.4%)
Bronchodilators post-admission	96/96 (100.0%)	104/105 (99.0%)
Prophylaxis pre-admission	47/96 (49.0%)	66/105 (62.9%)
Prophylaxis post-admission	76/96 (79.2%)	86/105 (81.9%)
Device technique check	94/96 (97.9%)	96/105 (91.4%)
Peakflow meter (over 5yrs old)	36/54 (66.7%)	20/47 (42.6%)
Asthma card	80/96 (83.3%)	24/105 (22.9%)
Appointment (OPD or GP)	59/96 (61.5%)	80/105 (76.2%)

Table 25: Primary outcome measure - hospital readmissions

	Intervention (n=96)	Control (n=105)	P value	Non-randomised (n=82)
Re-admitted	8 (8.3%)	26 (24.8%)	0.002	18 (22.0%)
Re-attended A/E	7 (7.3%)	7 (6.7%)	NS	8 (9.8%)
Re-attended GP	11 (11.5%)	7 (6.7%)	NS	N/A

Table 26: Cox's survival analysis for home management programme study.

Explanatory variable	Groups	P-value	comments
Home management programme	intervention, control	0.011	patients in intervention less likely to be readmitted
Previous admissions	0, 1, 2+	<0.0001	patients with previous admissions are more likely to be admitted
Previous drugs before admission	none, cromoglycate, inhaled steroids	0.031	inhaled steroid group more at risk of readmission
Sex	M, F	0.317	NS
Oxygen saturation	<87, 88-91, 92-95, 96+	0.735	NS
IV Theophylline	given, not given	0.8212	NS
Age	2.001-5, 5.001-10, 10.001+	0.2432	NS

Cox's Proportional Hazard Model: previous admissions (P<0.0001) and home management programme (P = 0.049) were only factors that remained in the model.

Repeating the analysis, after stratifying using age, previous admissions (P <0.0001) and home management plan (P=0.03) were only factors significant.

Table 27: Morbidity questionnaire

Scoring for all questions in the three categories as follows. Not at all = 0, A few days = 1, Some days = 2, Most days = 3, Every day/night = 4.

Ward	Day score Median (range)	Disability score Median (range)	Night score Median (range)
Intervention	4.0 (0-16)	4.0 (0-32)	4.0 (0-12)
Control	7.0 (0-16)	8.0 (0-32)	6.0 (0-12)
Mann Whitney test	P=0.0005	0.0778	P=0.0002

Table 28: The remaining questions on the outcome questionnaire.

Question		IG (n=63)	CG (n=66)
Is your child better (yes + getting there)		60 (95.2%)	59 (89.4%)
Has your child had more steroids			
	Yes	11 (17.5%)	14 (21.2%)
If so, how many days: Median, (range)		0 (0 - 9)	0 (0 - 9)
	Mean (days)	1.5	1.8
Has your child missed school because of asthma?			
	Yes	20/55 (36.4%)	19/54 (35.2%)
If so, how many days: Median, (range)		2.0 (0 - 9)	1.0 (0 - 17)

Table 29: Answers to questions about parent's understanding asthma.

Question		IG (n=63)	CG (n=66)
Do you have a better understanding of asthma now than when your child was diagnosed?			
	Yes	59 (93.7%)	61 (92.4%)
	No	4 (6.3%)	5 (7.6%)
How good an understanding do you have about your child's asthma treatment?			
	Could be better	2 (3.2%)	12 (18.2%)
	Average	21 (33.3%)	26 (39.4%)
	Very good	36 (57.1%)	27 (40.9%)

Table 30: Days until readmission based on survival times

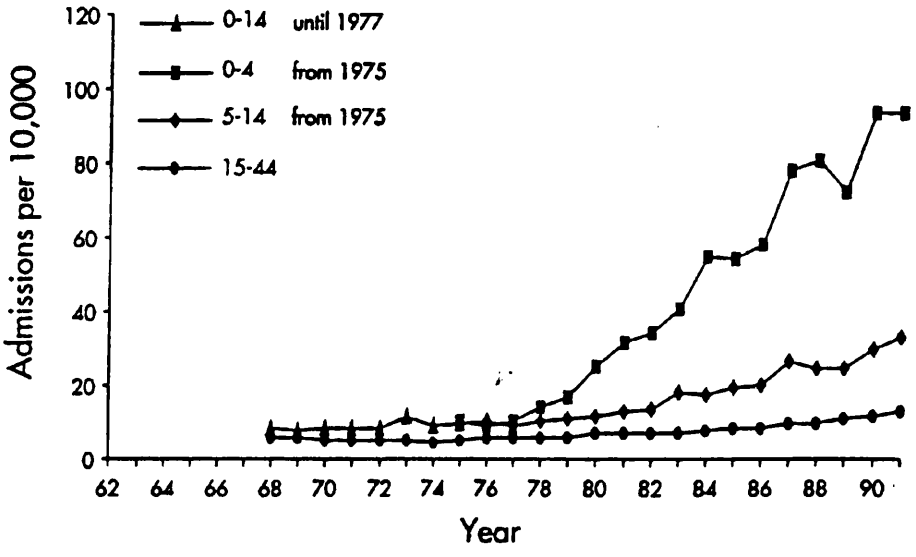
Time	Readmitted		%		Cum %	
	IG (n=8)	CG (n=26)	IG	CG	IG	CG
0-30	3	4	37.5	15.4	37.5	15.4
30-60	1	3	12.5	11.6	50.0	27.0
60-90	1	5	12.5	19.2	62.5	46.2
90-120	1	4	12.5	15.4	75.0	61.6
120-150	0	3	0	11.6	75.0	73.2
150-180	0	1	0	3.8	75.0	77.0
180-210	0	1	0	3.8	75.0	80.8
210-240	1	2	12.5	7.7	87.5	88.5
>240 days	1	3	12.5	11.5	100.0	100.0

Table 31: Follow-up appointments for the readmissions.

Group	Medical OPD	Chest clinic	GP follow-up	No follow-up arranged
Intervention (n=8)	3 (37.5%)	4 (50%)	0	1 (12%)
Control (n=26)	8 (30.8%)	12 (46.1%)	2 (7.7%)	4 (15.4%)

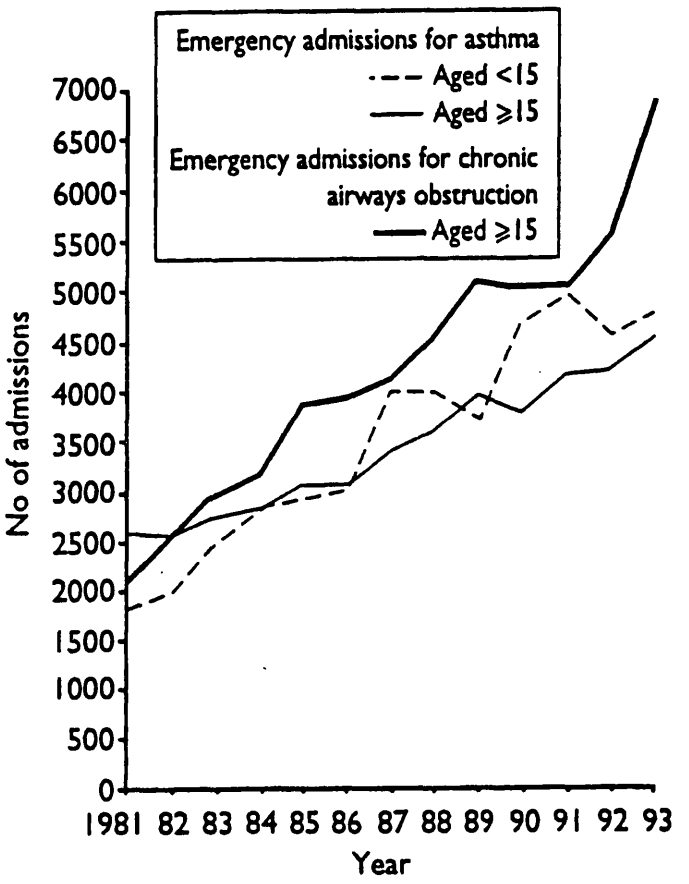
FIGURES

Figure 1: Age-specific hospital admission rates for asthma, ages 0-44, males and females combined, Scotland, 1968-91.



Source: Scottish Hospital In-Patient Statistics

Figure 2: Numbers of emergency admissions for asthma and for chronic airways obstruction (not elsewhere coded), Scotland, 1981-93.



Numbers of emergency admissions for asthma and for chronic airways obstruction (not elsewhere coded), Scotland, 1981-93.

Figure 3: Number of discharges with asthma / wheezing in children of all ages from the Royal Hospital for Sick Children, 1981-94

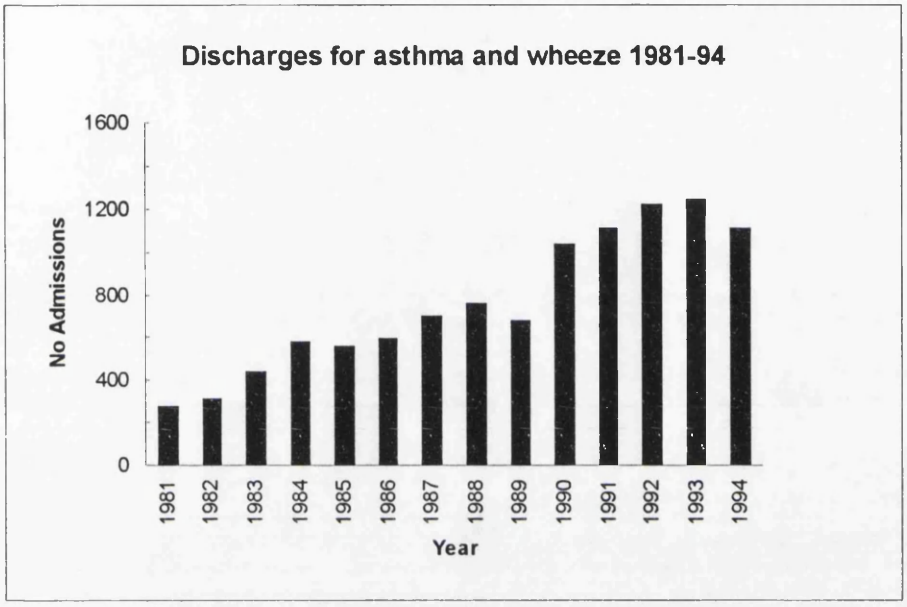


Figure 4: Seasonal effect of asthma admissions

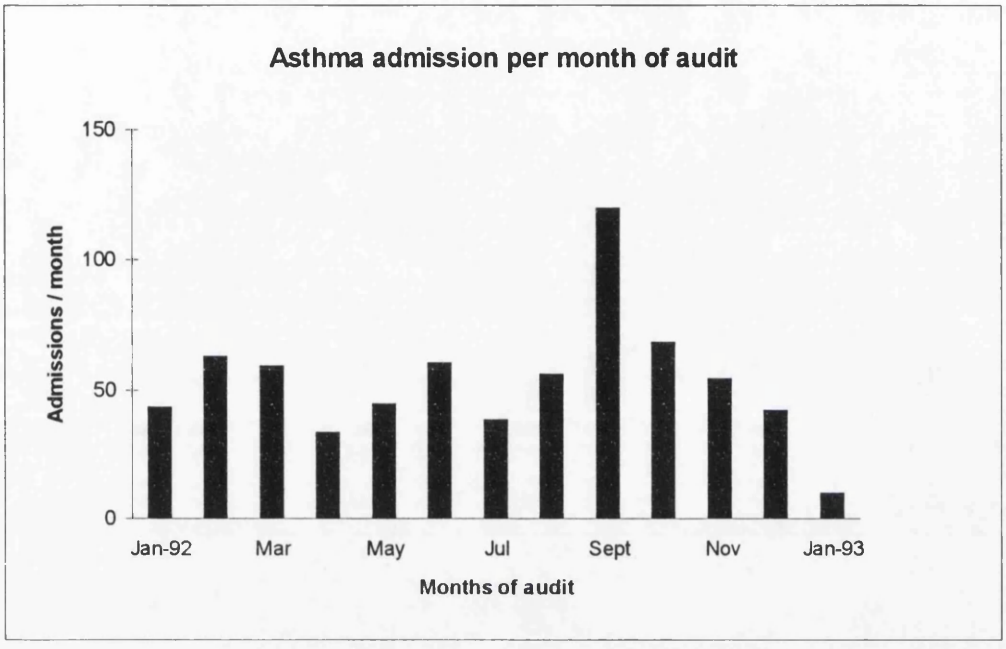


Figure 5: Review of studies evaluating adult asthma education programmes

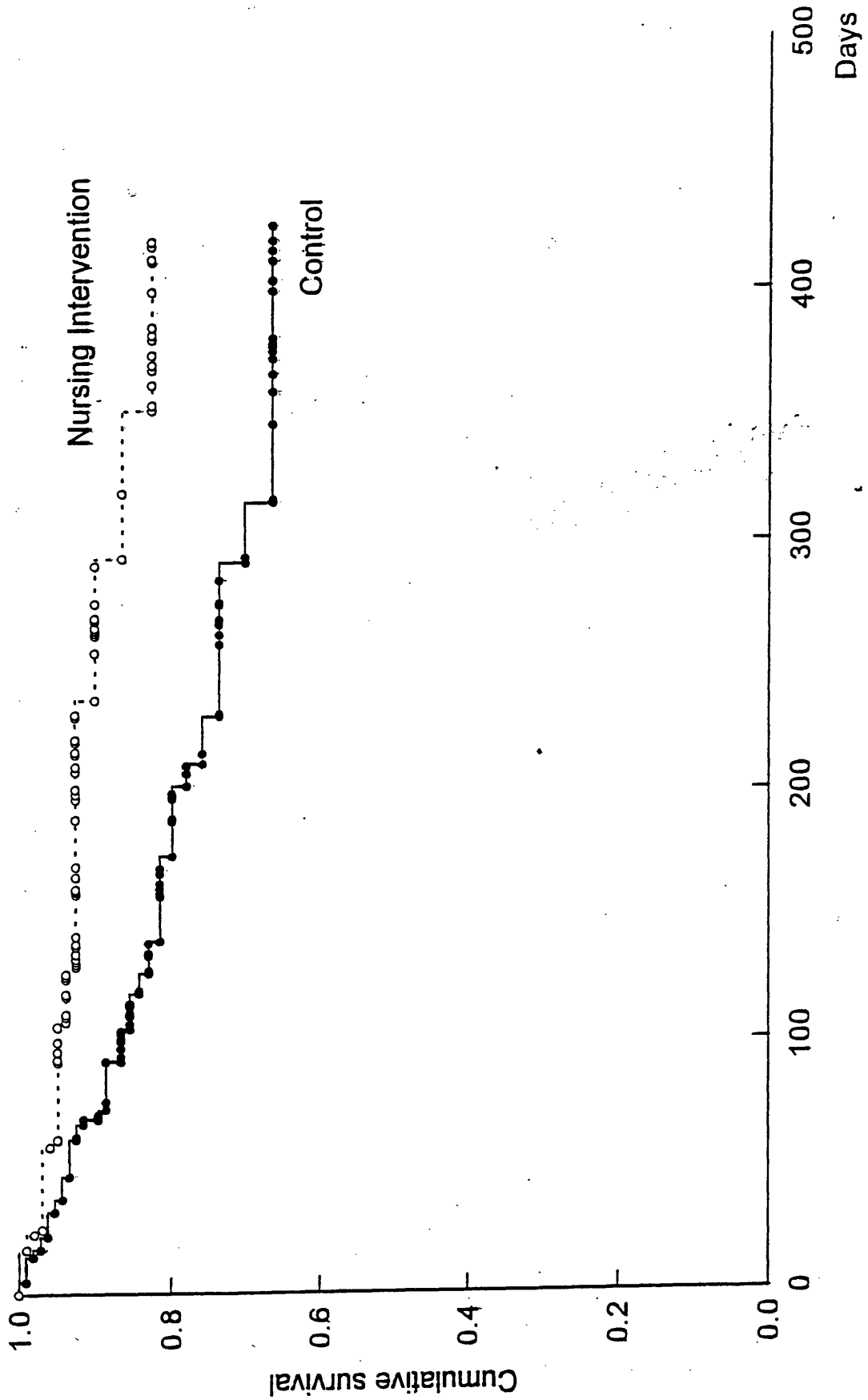
Author	Control group Y/N (sample size)	Educational component	Outcomes	Hospital Admissions	ER / AE visits
Garret[68]	Y (500)	Community Education Centre: Taught pathophysiology of asthma, triggers, asthma medications, inhaler technique, PF and diary, SMP*	↑asthma knowledge ↑self-management skills Additional social help in IG* No change in smoking patterns	NS	NS
Yoon[62]	Y (86)	Group educations 2.5-3 hrs including 40 min lecture 20 min video on drug therapy Individual self-man training	↑ knowledge both groups No difference in spirometry ↑ self-management skills in intervention group	p<.001	p<.0001
Hilton[72]	Y (274)	Booklet written by S.Hilton Sent treatment card at 1 mth Interview with own doctor Sent audio tapes at home	No change in morbidity ↑ knowledge in all groups No change in self-management skills	NS	NS
Wilson[73]	Y (310)	4 treatments; group educ, individual educ, workbook, usual control.	↑ symptom control ↑ symptom free days No reduction in medical care utilisation.	NS	NS
Osman[61]	Y (801)	Personalised booklets, issued every 4 months reviewed by GP 3/12 reviewed by hospital annually	No change in days of restricted activity, drug prescriptions, GP visits, or oral steroids	<0.05	NS
Charlton[74]	N (105)	Interview of asthma history Check inhaler technique Drug action explained	No change in school loss or work loss	NS	P=.02

Figure 6: Review of studies evaluating paediatric asthma education programmes

Author	Control group Y/N (sample size)	Educational component	Outcomes	Hospital Admissions	ER/A&E visits
Fireman[64]	Y (26)	4 hours teaching in group classes Telephone access & regular contact with nurse Given booklet	↓ school absences ↓ asthma attacks (p<.01)	↓ 4 v 0 (IG vs CG)	↓ 13 v 1 (IG vs CG)
Lewis[63]	Y (76)	5- 1 hr group sessions Interview / discussion Colour SMP* (Control B&W SMP) Advice on control of allergens & triggers	↑ knowledge both groups ↑ reported self compliance Savings $180 /child/yr	↓ (P<.05)	↓ (P<.01)
Taggart[66]	. N (40)	Written info for child Written info for parent Audio-visual materials Interpersonal communication Nurse discussion for child	↑ knowledge ↑ response to warning signs ↑ self-management techniques	NS	↓ P<.01 in severe group only
Taggart[70]	N (12)	Increasing parent & child skills Nurse discussion Physician discussion Given written pamphlet	↑ knowledge of triggers, warning signs & appropriate behaviour	No Record	No visits ocurred
Parcel[71]	Y (53)	Patient education book group teaching, role playing 40 min class /wk for 24 wks	↑ knowledge ↓ anxiety	No Record	No Record
Charlton[67]	Y (91)	Education and colour coded SMP Nurse-run clinic Nurse interview discussion Diary cards & PF meter	↓school absences IG ↓ GP home visits IG ↓ activity reduction IG ↓ PEF <30% best	↑ in IG	Fewer
McNabb[69]	Y (14)	Goal setting, self-evaluation self-monitoring 30 min diagnostic interview 4 individual 45 min educ sessions	↑ knowledge & self-management changes	No record	fewer

***SMP = Self management Plan, *IG = Intervention group**

Figure 7: Survival curve for Study 2



APPENDICES

Appendix 1 - Case note form

GLASGOW/ FALKIRK/ STIRLING PAEDIATRIC ASTHMA STUDY

HOSPITAL IN-PATIENT AUDIT QUESTIONNAIRE

STUDY NUMBER | | | | |

NAME	
HOSPITAL NUMBER	
DATE OF BIRTH	
ADDRESS	
ADDRESS	
POST CODE	
TELEPHONE NUMBER	

HOSPITAL AREA GLASGOW/FALKIRK/STIRLING	
CONSULTANT	
COMPLETED BY	

Version 1/feb 92

01 - 04
STUDY NUMBER

01 - 04 ☐☐☐☐

05
CARD NUMBER

05 [1]

06 - 09
POST CODE

06 - 09 ☐☐☐☐

10 - 15
DATE OF BIRTH

10 - 15 ☐☐☐☐☐☐

16 - 21
DATE OF ADMISSION

16 - 21 ☐☐☐☐☐☐

22 - 25
TIME (24 HOUR CLOCK)

22 - 25 ☐☐☐☐

26
REFERRAL TO HOSPITAL

26 ☐

1 self/parent
2 GP referral
3 999
4 other
5 not known

27 - 32
COMMUNITY RESPONSE

Action	Parent	GP	Not relevant	No record
PEFR	1	2	3	4
Inhaled b2-agonist	1	2	3	4
Nebulised b2-agonist	1	2	3	4
Double inh-steroids	1	2	3	4
Start oral steroids	1	2	3	4
SC/IM/IV BD	1	2	3	4

27 - 32 ■☐☐☐☐☐

☐

33
SEX

34 - 35
NUMBER OF PREVIOUS ASTHMA ADMISSIONS

36
SPEED OF ONSET OF ATTACK

1 <12 hours
2 < or = one day
3 1 - 3 days
4 4 - 7 days
5 >7days
6 no information

37 - 43
MAINTENANCE DRUG THERAPY

Name	Not on	Takes regularly	As needed	No record
B2-agonist	1	2	3	4
Intal	1	2	3	4
Inh-steroids	1	2	3	4
Oral steroids	1	2	3	4
Theophylline	1	2	3	4
Volmax	1	2	3	4
Trial drug	1	2	3	4

44
TRIGGER FOR THIS ATTACK

1 cold/virus
2 dusts/pollen
3 animals/birds/feathers
4 exercise
5 food stuffs/drinks
6 not known
7 no information

45

Present device used for "relieving" drugs

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 no information
9 none

45 ☐

46

Present device used for "preventative" drugs

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler//turbohaler
5 autohaler
6 MDI
7 oral
8 no information
9 none

46 ☐

ASSESSMENT OF ATTACK SEVERITY (999 = not done)
(observations 1st done in hospital)

47 - 49
Oxygen saturation ☐☐☐

50 - 52
Pulse ☐☐☐

53 - 54
Respiratory rate ☐☐

55 - 57
Temperature ☐☐☐

58 - 60
Peak flow ☐☐☐

61 - 63
Predicted PEFR ☐☐☐

<5 = 999
no height = 888

64 - 66
Height* no height = 888

(*available from
PEFR chart
Drug Kardex
Nurses chart
this clerk in)

64 - 66 ☐☐☐

67 - 68
% of predicted PEFR achieved

67 - 68 ☐☐

INITIAL MEDICAL ASSESSMENT

69
Pulsus Paradoxus

1 recorded
2 no information

69 ☐

70
Cyanosis

1 yes
2 no
3 no information

70 ☐

71
Breathlessness/Distress

1 mild
2 moderate
3 severe
4 no information
5 not distressed

71 ☐

72
Speech ability

1 unaffected
2 complete sentences
3 words only
4 unable to speak
5 no information

72 ☐

73
Accessory muscle use/recession

1 present
2 absent
3 no information

73 ☐

74
Hyper-inflation

1 present
2 not present
3 no information

74 ☐

75
Air entry/Breath sounds

1 reduced
2 unaffected
3 no information

75 ☐

☐

76
Wheeze/Rhonchi

1 present
2 absent
3 no information

76 ☐

77
Creps/crackles

1 present
2 absent
3 no information

77 ☐

78
Overall assessment
(by SHO/Reg in A/E)

1 mild
2 moderate
3 severe
4 no information

78 ☐

79
Full blood count

1 performed
2 no information

79 ☐

80
Urea and electrolytes

1 performed
2 no information

80 ☐

01 - 04
STUDY NUMBER

01 - 04 ☐☐☐☐

05
CARD NUMBER

05 **2**

06
Blood gases

1 performed
2 no information

06 ☐

07 - 09
Results PO2

999 = not done

07 - 09 ☐☐☐

10 - 11
Results PCO2

10 - 11 ☐☐

12
Chest X-Ray

1 performed
2 no information

12 ☐

☐

13
Admitted direct to

1 ward
2 ITU

13 ☐

STABILISING DRUGS GIVEN

14 - 15
Weight (in kgs) 88 = not done

14 - 15 ☐☐

16
Nebulising B2-agonist (frequency)

1 hourly
2 two hourly
3 three hourly
4 four hourly
5 six hourly
6 more than 6 hrly
7 once only dose
8 not given

16 ☐

17
Steroids (route)

1 oral
2 IV
3 oral + IV
4 not given

17 ☐

18 - 19
Total daily dose of oral steroids given (mgs)

18 - 19 ☐☐

20
Theophylline level

1 performed
2 not performed
3 not on drug
4 not recorded

20 ☐

21 - 23
Aminophylline **Bolus** dose(mgs)

21 - 23 ☐☐☐

24 - 26
Aminophylline **Infusion** dose/hour(mgs)

24 - 26 ☐☐☐

27
Aminophylline/nebuliser

1 Nebuliser prescribed correctly
2 Aminophylline correct, nebuliser wrong
3 Nebuliser correct, aminophylline wrong
4 Both prescribed incorrectly
5 not on them
6 both prescribed correctly

27 ☐

28
Maintenance oxygen administration(without nebuliser)

28 ☐

1 low flow(nasal)
2 high flow(mask)
3 not recorded in case notes
4 not given
5 no information

29
Antibiotics administration (route)

29 ☐

1 oral
2 intravenous
3 oral + IV
4 not given

ASKING THE RIGHT QUESTIONS

30
Known triggers of asthma attacks (in this patient)

30 ☐

1 colds
2 exercise
3 dust and pollens
4 animals and birds
5 foods/drinks
6 more then one of these
7 none of these
8 no information

31
Family history of atopy

31 ☐

1 mother
2 father
3 mother and father
4 sibling
5 sibling and parents
6 no family history
7 no information

SMOKING

32
Mother, female guardian

32 ☐

1 non smoker
2 less than 10/day
3 10-20/day
4 more than 20/day
5 no information
6 no amount given

☐

33
Father, male guardian

1 non smoker
2 less than 10/day
3 10-20/day
4 more than 20/day
5 no information
6 no amount given

33

34
Details of any sleep disturbance

1 available in notes
2 no information

34

35
Details of morning wheeze

1 available in notes
2 no information

35

36
Details of execise induced wheeze

1 available in notes
2 no information

36

37
Amount of school absence before attack

1 available in notes
2 no information
3 not at school

37

38 - 44
MAKING THE RIGHT CHANGES

Name	Not on /stopped	Started	Increased	No change
B2-agonist	1	2	3	4
Intal	1	2	3	4
Inh-steroids	1	2	3	4
Oral steroids	1	2	3	4
Theophylline	1	2	3	4
Volmax	1	2	3	4
Trial drug	1	2	3	4

38 - 44

45
Device chosen for "relieving" drug

45 ☐

1 nebuhaler/volumatic
2 nebuliser
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 no information
9 none

46
Device for "preventative" drug

46 ☐

1 nebuhaler/volumatic
2 nebuliser
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 no information
9 none

47
Review of device technique

47 ☐

1 assessed
2 not assessed
3 no information

48
Frequency of b2-agonist

48 ☐

1 not commenced
2 prn when wheezy
3 at defined times then prn
4 at defined times continuously
5 no information

49
Frequency of Intal

49 ☐

1 not commenced
2 three times a day
3 four times a day
4 no information

☐

50
Inhaled steroids dose

1 not on
2 50
3 100
4 200
5 400
6 more than 400
7 nebulised >400
8 no information

50 ☐

51
Frequency of inhaled steroids

1 not on them
2 twice/day
3 3 times/day
4 4 times/day
5 no information

51 ☐

READY OR NOT FOR DISCHARGE

52 - 53
Days of oral steroid course in hospital

52 - 53 ☐☐

54 - 55
Further days of steroids planned at discharge
(back to baseline / zero)

54 - 55 ☐☐

Reversibility demonstrated on day of discharge:

56 - 58
PEFR pre BD

999 = not done
888 = no height

56 - 58 ☐☐☐

59 - 61
% of predicted PEFR

no height = 888

59 - 61 ☐☐☐

62 - 64
PEFR post BD

62 - 64 ☐☐☐

65 - 67
% of predicted PEFR

65 - 67 ☐☐☐

☐

DISCHARGE PLANNING

68 -73
DATE OF DISCHARGE

68 - 73 | | | | | | |

74
Peak flow meter

1 already have
2 given
3 no information
4 not relevant < 5 yrs

74 |

75
Asthma card

1 already have
2 given
3 no information

75 |

76
Educational material

1 given
2 no information

76 |

77
Follow up appointment

1 medical OPD
2 Chest clinic
3 GP
4 no follow up
5 no information
6 keep outstanding appt

77 |

78 - 80
Weeks till appointment (999 = none)

78 - 80 | | | 9 |

01 - 04
STUDY NUMBER

01 - 04 | | | | |

05
CARD NUMBER

05 | 3 |

06
Anti-smoking advice

1 given
2 not relevant
3 no information

06 |

THE WARD DISCHARGE LETTER/SUMMARY, FOR THE GP

07

Was there a copy of the discharge summary in the notes

07 ☐

1 yes
2 no

08

Was it legible

08 ☐

1 yes
2 no
3 no letter

09

Were the drugs recorded on it

09 ☐

1 yes
2 no
3 no drugs
4 no letter
5 not complete

10

Was the actual PEFR from the morning of discharge recorded on it

10 ☐

1 yes
2 no
3 no letter
4 <5 yrs old

11

PREVIOUS HISTORY OF A SUDDEN SEVERE ATTACK IN THIS PATIENT

11 ☐

1 yes
2 no
3 no information

☐

Appendix 2 - Morbidity Questionnaire

UNIVERSITY OF GLASGOW

PROFESSOR FORRESTER COCKBURN
Samson Gemmell Chair of Child Health

DR. T. L. TURNER
Leonard Gow Lecturer

DR. M. D. C. DONALDSON
DR. M. B. DRUMMOND
DR. A. KERR
DR. J. Y. PATON
Senior Lecturers

University Department of Child Health
Royal Hospital for Sick Children
Yorkhill, Glasgow G3 8SJ

Telephone: 041-339 8888
Fax: 041-357 2785

Dear Parent of:

Each year more than 1000 children with asthma are admitted to the Royal Hospital for Sick Children. This makes asthma the commonest reason for admission to this hospital.

We are conducting a study on childhood asthma to find out how effective your child's stay in hospital was. Did it improve your child's asthma?

The study has 2 parts to it. In the first part we will be studying the case notes of all the children admitted to RHSC, looking at the care they received when they were unwell. In the second part we want to follow up a small group of children from part 1 to find out how quickly they got back to normal after the asthma attack. YOU and YOUR CHILD have been selected for part 2 of the study.

If you do not want to help please feel free to say **NO**.

We would like you to complete a questionnaire at home, 3 weeks after your child has been discharged. We will arrange a suitable time to go over and collect the completed questionnaire from you. This appointment will be arranged with you before your child is sent home from hospital.

ALL THE INFORMATION THAT YOU GIVE WILL BE KEPT STRICTLY CONFIDENTIAL.

If you would like a copy of the results and final report of the study let us know and we will add your name to the mailing list.

We are confident that the information you give will help to improve the care that children with asthma get in the future. Thank you for your help.

Yours faithfully

P J Madge

Sister P Madge
Asthma Research Nurse

Jean Y. Paton

Dr J Y Paton
Senior Lecturer in Paediatric Respiratory Disease
Consultant Paediatrician

START EACH QUESTION WITH:

"SINCE COMING HOME FROM HOSPITAL"

CHOOSE ONE ANSWER ONLY

This column is for office use only

1. Your child has been wheezy during the day	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	12 ☐
2. Your child has coughed during the day	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	13 ☐
3. Your child has complained of being short of breath	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	14 ☐
4. Your child has complained of a pain in the chest	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	15 ☐
5. Exertion (eg running) has made your child breathless	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	16 ☐

☐

START EACH QUESTION WITH:

"SINCE COMING HOME FROM HOSPITAL"

CHOOSE ONE ANSWER ONLY

This column is for office use only

6. Your child has stayed indoors because of wheezing or coughing	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	17 ☐
His/her asthma has stopped your child from playing with his/her friends	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	18 ☐
8. Your child's education has suffered due to the asthma	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	19 ☐
9. Asthma has stopped your child from doing all the things that a boy/girl should do at this age	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	20 ☐
10. Your child's asthma has interfered with his/her life	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	21 ☐

☐

START EACH QUESTION WITH:

"SINCE COMING HOME FROM HOSPITAL"

CHOOSE ONE ANSWER ONLY

This column is for office use only

11. Asthma has limited your child's activities	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	22 ☐
12. Taking his/her asthma treatment has interrupted your child's life	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	23 ☐
13. Your child's asthma has limited YOUR activities	*Every day*	*Most days*	*Some day*	*A few days*	*Not at all*	24 ☐
14. You have had to make adjustments to family life because of your child's asthma	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	25 ☐
15. Your child has coughed at night	*Every night*	*Most nights*	*Some nights*	*A few nights*	*Not at all*	26 ☐

☐

START EACH QUESTION WITH:

"SINCE COMING HOME FROM HOSPITAL"

CHOOSE ONE ANSWER ONLY

This column is for office use only

16. Your child's sleep has been disturbed by wheezing — *Every night* | *Most nights* | *Some nights* | *A few nights* | *Not at all* — 27 ☐

17. Your child has been woken by wheezing or cough — *Every night* | *Most nights* | *Some nights* | *A few nights* | *Not at all* — 28 ☐

18. Your child has woken up needing extra asthma treatment — *Every night* | *Most nights* | *Some nights* | *A few nights* | *Not at all* — 29 ☐

19. Your child needed extra asthma treatment in the morning for tightness in the chest — *Every day* | *Most days* | *Some days* | *A few days* | *Not at all* — 30 ☐

☐

THESE QUESTIONS ASK ABOUT THE TREATMENT YOUR CHILD IS ON. CHOOSE ONE ANSWER ONLY.

This column is for office use only

20. Has your child been to hospital or your family doctor for any **urgent** asthma treatment since coming home?

Once | *More than once* | *Not at all*

31 ☐

21. Is your child better since coming home?

No | *Getting there* | *Yes*

32 ☐

22. Is your child getting any "inhaled" anti-wheeze treatment?

Every day | *When needed* | *Not at all*

33 ☐

23. In hospital who checked if your child could take the "inhaled" treatment properly?

Doctor | *Nurse* | *Physio* | *Don't know* | *Not on any*

34 ☐

☐

THE QUESTIONS ON THIS PAGE CAN HAVE MORE THAN ONE ANSWER. CIRCLE ALL THE ANSWERS YOU THINK ARE CORRECT

This column is for office use only

24. Which of the following signs can help show an attack coming on?	*Don't know*	*Low Peak*	*Using more drugs*	*Disturbed sleep*	35 ☐
25. What can you do with the **relieving** treatment in a bad attack?	*Normal dose*	*Give more often*	*Don't know*	*Not on any*	36 ☐
26. What can you do with the **preventative** treatment in a bad attack?	*Normal doses*	*Double doses*	*Don't know*	*Not on any*	37 ☐
27. If you see an attack coming on, when would you start **steroid tablets**?	*Decide yourself*	*Ask the GP*	*Don't know*	*Don't have any*	38 ☐
28. How would you get medical advice for an attack?	*Phone GP*	*Routine GP visit*	*Urgent GP visit*	*Go to the hospital*	39 ☐

☐

THESE QUESTIONS ARE FROM OUR "ASTHMA QUIZ"

HAVE A GO AT HOME, WE WILL GIVE YOU THE ANSWERS AT THE HOME VISIT. CHOOSE ONE ANSWER ONLY.

GOOD LUCK!

This column is for office use only

29. Asthma is common in childhood — *True* *False* *Unsure* 40 ☐

30. Asthma is an emotional or psychological disease — *True* *False* *Unsure* 41 ☐

31. Asthma episodes can occur suddenly without warning — *True* *False* *Unsure* 42 ☐

32. Many different things can bring on an asthma attack — *True* *False* *Unsure* 43 ☐

☐

THESE QUESTIONS ARE FROM OUR "ASTHMA QUIZ"

HAVE A GO AT HOME, WE WILL GIVE YOU THE ANSWERS AT THE HOME VISIT. CHOOSE ONE ANSWER ONLY.

GOOD LUCK!

This column is for office use only

33. Asthma cannot be cured but it can be controlled — *True* *False* *Unsure* — 44 ☐

34. There are different types of treatment/medicines to control asthma — *True* *False* *Unsure* — 45 ☐

35. People with asthma have no way to tell how well there asthma is being controlled — *True* *False* *Unsure* — 46 ☐

36. People with asthma should avoid exercise — *True* *False* *Unsure* — 47 ☐

THAT IS THE END OF THE QUESTIONNAIRE. THANK YOU FOR TAKING THE TIME TO HELP WITH OUR STUDY.

☐

Appendix 3 - Ethics Comittee Letter of Approval Study 1

The Queen Mother's Hospital

Our Ref:

Your Ref:

Enquiries to:

YORKHILL
GLASGOW G3 8SJ
Telephone: 041-339 8888

TLT/KB

19th February, 1992

Dr J Y Paton,
Senior Lecturer,
Department of Child Health,
RHSC, Yorkhill

Dear Dr Paton,

Asthma in childhood - Audit of current hospital practice and Nebuliser use

These protocols were recently discussed at the Yorkhill Ethics Committee. The Committee did not feel that there was an Ethics issue involved but were grateful for an opportunity to see the documentation. We wish you every success with this study.

Yours sincerely,

T L Turner
Secretary of the
Ethics Committee

Appendix 4 - Booklet

YORKHILL NHS TRUST

Going Home with Asthma

The Asthma Nurse Clinic

Appendix 4 - Booklet

THIS BOOK BELONGS TO:

_____

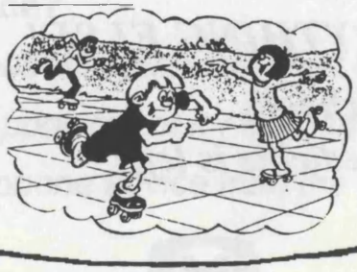
_____

Age: _____

Address: _____

_____

School: _____



Index

Appendix 4 - Booklet

PART 1 - About Asthma

The "Going home with Asthma" Programme

What is it?

A support and advice programme to help you and your child after being in hospital with asthma.

We want to help you / your child

- *to have no more admissions*
- *to prevent future asthma attacks*
- *to be active without symptoms*
- *to sleep all night without symptoms*
- *to avoid possible side-effects from medicines*
- *to have the best peak flow (if old enough)*

What will it include?

- *A treatment plan for ' what to do at home'*
- *An appointment for the asthma nurse clinic*
- *Telephone advice from the asthma nurse*

Introducing the Asthma Nurse Clinic

Every year some 800 children are admitted to Yorkhill hospital with asthma. Some of them need to come back to out- patients for regular check ups. Often the clinics are busy and you may feel there is not enough time for all your questions to be answered. The new Asthma Nurse Clinic will be available to you as an extra. It will **not** take the place of your ordinary appointment.

At the new Asthma Nurse Clinic you will

- *be seen by an Asthma Sister*
- *be given plenty time to ask questions*
- *be seen by a doctor if necessary*
- *be kept up to date with new ideas*
- *have your inhaler technique checked*

The clinic will be held on a Thursday afternoon in Area C, Out-Patients, beside the Respiratory Clinic

Appendix 4 - Booklet

Common Questions about Asthma and the Treatment

What is asthma?

Asthma is a disease which affects the airways and breathing. It can affect people of all ages, but is most common in childhood. About 1 in 10 children have asthma.

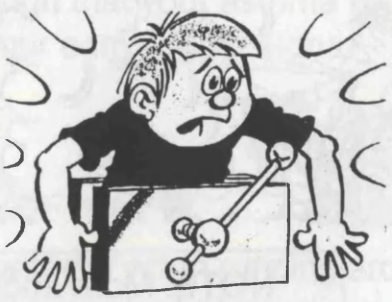
What are the commonest symptoms of asthma?

- *shortness of breath*
- *wheezing*
- *tightness in the chest*
- *cough lasting more than a week*

(in children these often happen with exercise or during the night)

What happens during an attack of asthma?

The lining of the airways becomes swollen and inflamed. The airways produce a thick mucous. The muscles around the airways tighten and make the airways narrower. These changes block the flow of air and make it hard to breathe. It can feel like breathing through a straw.



What Starts off Asthma Attacks?

People with asthma have airways that are super sensitive to things that do not normally bother people. These things are called triggers. The airways become swollen, produce too much mucus and tighten up.

Triggers are different for different people. However the commonest trigger for most people with asthma is a cold (usually a viral infection).

Here are some other triggers that some people with asthma are sensitive to:

- *cigarette smoke*
- *house dust (more later)*
- *animal fur / feathers*
- *pollens*

NOTE: More about asthma triggers in the house on pages 10-13.

Appendix 4 - Booklet

What about the Medicines?

There are 2 kinds of medicines for asthma, *relievers* and *preventers*

Relievers (Bronchodilators - usually blue inhalers)
They relieve asthma symptoms by relaxing the muscles around the airway. The commonest are *Ventolin(salbutamol)* and *Bricanyl(terbutaline)*. You take these when you are wheezy or before exercise.

Preventers (usually brown or red and white inhalers)
They prevent asthma symptoms, by stopping the swelling in the airways before it causes asthma symptoms. You must take these every day. The main ones are *Intal (cromoglycate)*, *Pulmicort (budesonide)* & *Becotide (beclomethasone)*.

NOTE: To get the best from your inhalers you must use them properly - we will check this at the clinic

Tips for using your reliever
Use early. Take at the earliest sign that your asthma is getting worse. Watch out for your early trigger signs.

Exercise / sport
Most children with asthma get wheezy when running around doing sports or exercise. Use the reliever before exercising.

Steroid treatment for asthma - the facts.

What are steroids?

Steroids are a range of chemicals made by both the body and artificially. There are different types of steroids. The ones used in asthma treatment are called corticosteroids.

Why do we use steroids in asthma?

Steroids work by reducing the amount of inflammation, swelling and mucus in the airway. They are different from the relievers and only begin to work over a period of time.

How are they given?

There are 3 different ways that steroids can be given. By **inhaler** for daily preventative treatment. By **tablets** for use in chronic asthma, and for short courses to cure an acute attack. By **injection** for the very ill in hospital, or for childen who have an upset tummy and can't keep down the tablets. Prednisolone is the most common tablet.

NOTE: Steroids used for asthma are different from the body building (anabolic) steroids that athletes

What about Side Effects from Steroids?

We do not see many side effects in children as they tend to be on low doses of inhaled steroids or only have short courses of tablets for acute attacks. Side effects are more common in adults, or people with severe asthma that require doses high enough to give side effects. In children the side effects might be slowing of growth, or mouth infections.

This is why when you come to the clinic we are always on the look out for side effects. In children we measure their height regularly, and examine inside the mouth.

A short course of tablets for acute severe asthma

If the symptoms of asthma continue despite being on a preventative inhaler then a short course of steroid tablets may be given. A short course lasting a few days will have few side effects, even on high doses. There is no need to tail the dose off when it is a short course.

For more information ask for the National Asthma Campaign **Steroid treatment for asthma** booklet

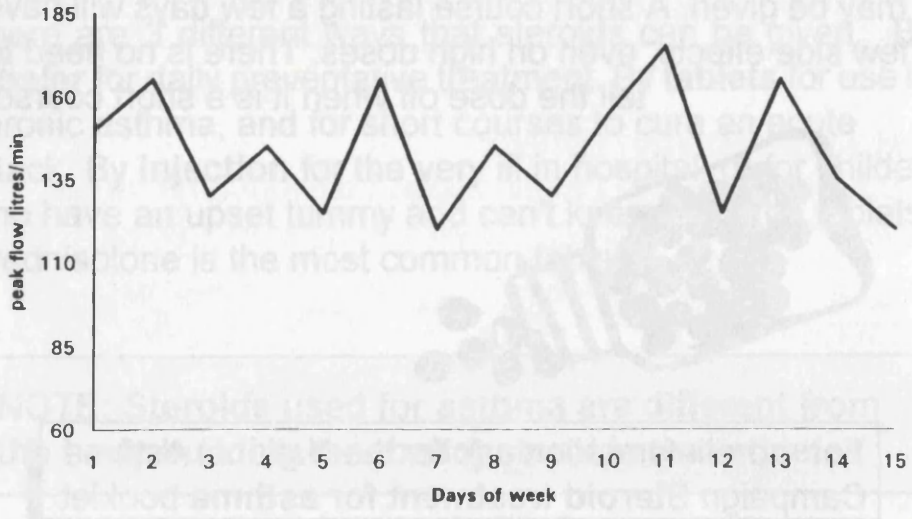
Part 2 - Asthma at Home

Measuring Asthma with a peak flow meter

"Peak flow" is a measurement of how fast you can blow out. How fast you blow will depend on whether your airways are wide or narrow. If they have become narrowed because of asthma you will find it difficult to blow out. This makes it a useful measurement of the severity of your asthma.

A normal value depends on your age and your height. Your best Peak Flow will be close to the normal value for your height. If you have an asthma attack then your Peak Flow will be much lower.

BELOW is a peak flow chart showing how variable your peak flow can be, especially before an "attack".



Appendix 4 - Booklet

How to use a Peak Flow Meter

- *put indictor to zero*
- *stand up*
- *take a deep breath*
- *seal your lips around the mouthpiece*
- *blow out as hard and as fast as you can*
- *write down the number you get*
- *repeat all this 2 more times*
- *write down the highest number*

Some children find it helpful to do their peak flow every day, in the morning and the evening.

You can start doing peak flows when you are old enough to go to school. If you do them when you are too young they are not very accurate.

Avoiding Asthma Triggers

There are triggers all around you and it is impossible to avoid all of them. Some situations you have no control over, like the weather! However, here are some tips.

- *avoid cigarette smoke*
- *avoid animals you are allergic to*
- *in summer avoid long grass*
- *wash soft toys or put in freezer monthly*
  (In freezer for 6 hours then hoover)
- *exercise indoors on colder days*
- *ease yourself gently into vigorous exercise*

Cutting down Household Dust

Can household dust be completely removed? No, it is not possible to cut it down completely. However, there are plenty of things to do to cut it down and make it less irritating to you and your asthma.

FIGHT THE MITE!

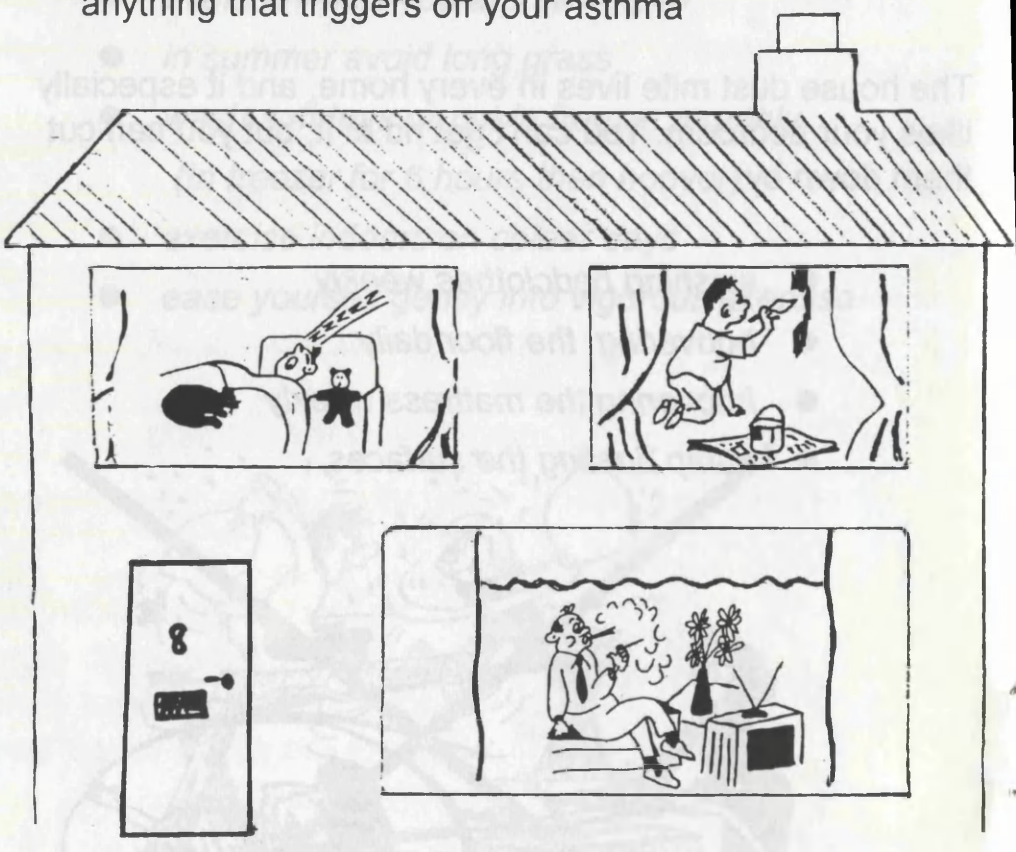
The house dust mite lives in every home, and it especially likes your bedroom. You can't get rid of it, but you can cut them down by:

- *washing bedclothes weekly*
- *hoovering the floor daily*
- *hoovering the mattress weekly*
- *damp dusting the surfaces*

Finding triggers in your home

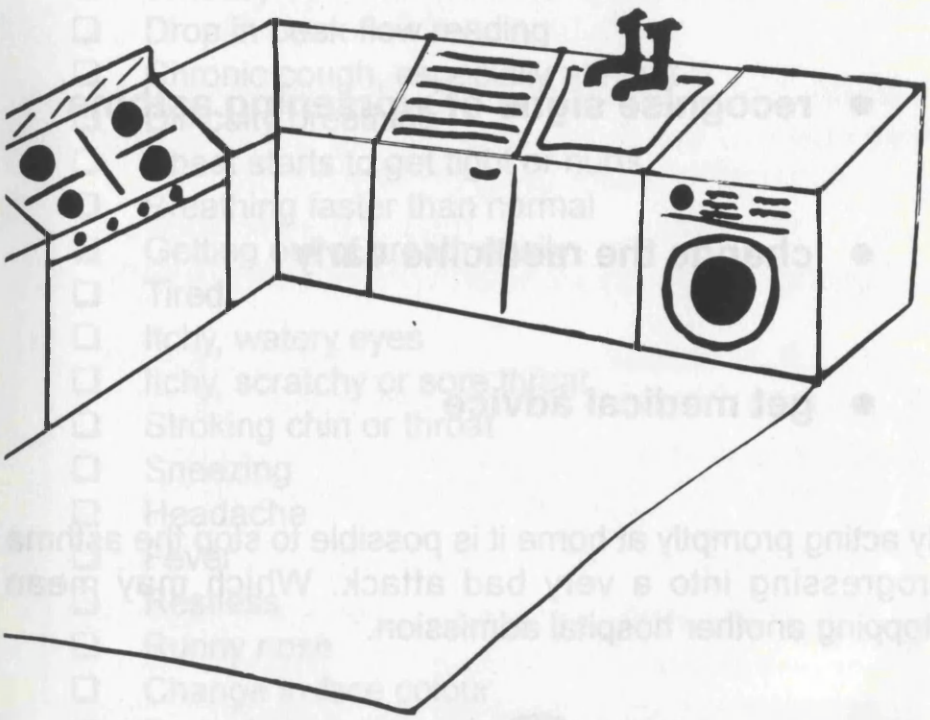
Have close look at the house BELOW, can you see the asthma TRIGGERS in the rooms? There are at least 5.

We have left out the kitchen. Have a look around at home and see if you can find anything that triggers off your asthma



What about triggers in the kitchen?

Have a try at guessing some of the triggers that you might find in the kitchen. Why not draw them in. Don't worry if you cannot think of any. We can always go over it at the clinic visit.



Have a think about what you might do in the kitchen, or find in the cupboards there.

Part 3 - Coping with an Attack

The next part of the booklet will try to show you how to use use this new information to cope with your child's asthma at home. This is explained as steps of action to take. Each step is explained in more detail over the next pages.

- **recognise signs of worsening asthma**
- **change the medicine early**
- **get medical advice**

By acting promptly at home it is possible to stop the asthma progressing into a very bad attack. Which may mean stopping another hospital admission.

Appendix 4 - Booklet

Signs of asthma coming on

Asthma attacks do not usually happen without warning. Most children have warning signs that occur hours before the symptoms.Can you recognise yours? Tick the ones you recognise, or add any others.

- ❑ Wheezy
- ❑ Drop in peak flow reading
- ❑ Chronic cough, especially at night
- ❑ Difficulty breathing
- ❑ Chest starts to get tight or hurts
- ❑ Breathing faster than normal
- ❑ Getting out of breath easily
- ❑ Tired
- ❑ Itchy, watery eyes
- ❑ Itchy, scratchy or sore throat
- ❑ Stroking chin or throat
- ❑ Sneezing
- ❑ Headache
- ❑ Fever
- ❑ Restless
- ❑ Runny nose
- ❑ Change in face colour
- ❑ Dark circles under eyes
- ❑ Mood change
- ❑ Very tearful
- ❑
- ❑

Change the medicines early!

As soon as you see the warning signs - take action

- double dose of _____
  (intal / steroid inhaler)
- use _____ every 3 or 4 hours

(reliever either Ventolin /Bricanyl)

Call the doctor/ Asthma Nurse and tell them what you have done - If the Symptoms getting worse despite this

- start _____ mgs of prednisolone
  (short course of steroid tablets 2mg/kg)
- continue _____ every 3 or 4 hrs
  (reliever, Ventolin /Bricanyl)
- if this does not work get your child seen by a doctor

If your child gets worse despite this he/she will probably have to go to hospital.

NOTE: This information is also written on your asthma action plan credit card

When to get urgent medical advice

Some signs which tell you that things are not going well are:

- *the wheeze worsening an hour or so after the Ventolin/Bricanyl*
- *the peak flow going down even after the Ventolin/Bricanyl*
- *the breathing gets more difficult*
- *can't talk without stopping for breath*

REMEMBER: It may be dangerous to take your child to hospital yourself if you live far away. Don't make the mistake of getting caught out miles away from home and the hospital. Call an ambulance if you are in any doubt.

Part 4 - Everything Else

Problems at School or Nursery

School staff are not always prepared to cope with asthma attacks. Often they stop children with asthma doing exercise in case they get wheezy.

We can get round this problem by giving the school staff advice and making sure that children with asthma take their **reliever** before any exercise. To do this children must be allowed to carry their reliever with them and be able to use it when they are wheezy.

We can give you a National Asthma Campaign School Card to give to the teacher. The card lists when you should take your treatment, what to do if an attack happens and who to contact.

It is impossible to list all the problems, if you have experienced other problems note them down and we can try to solve them for you together.

_____

_____

_____

Appendix 4 - Booklet

When to stay off school or nursery

You can probably go to school with these symptoms

- *stuffy nose, but no wheezing*
- *some wheezing that goes away after medicine*
- *able to do usual daily activities*
- *no extra effort needed to breathe*
- *peak flow within normal range (above 70% of best value)*

You should probably stay home with these symptoms

- *infection, sore throat*
- *a fever, temperature*

You should stay home and contact the doctor if

- *the wheezing comes back very soon after taking the medicine*
- *the breathing is very fast, with difficulty*
- *peak flow is going down , towards worst levels*

How much Medicine is in the Cannister?

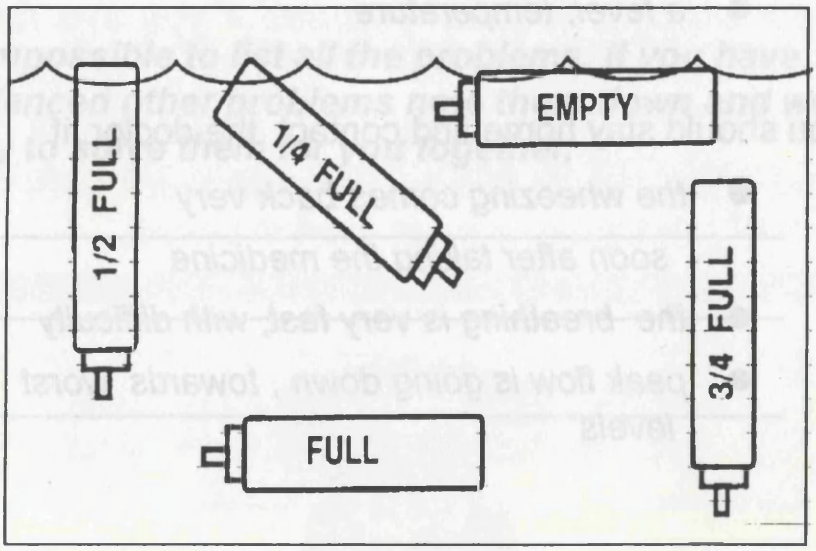
Have you ever wondered how much medicine is left in your inhaler?

The turbohaler has a red line which appears when you are down to your last 20 doses. For the diskhalers, or rotahalers and spinhalers you can count the blisters or capsules.

But what can you do with a cannister?

There is an easy way to find out. Put the cannister in a glass of water, and watch what happens. You can see from the picture that the position in the water tells you how full it is. This can be really handy if you are going away from home and will not be near your GP.

'Never run out of reliever'



Appendix 4 - Booklet

Questions to ask at the clinic.

When you come to the clinic it is difficult to remember everything you wanted to ask. Why not write them down as they crop up.

_____

_____

_____

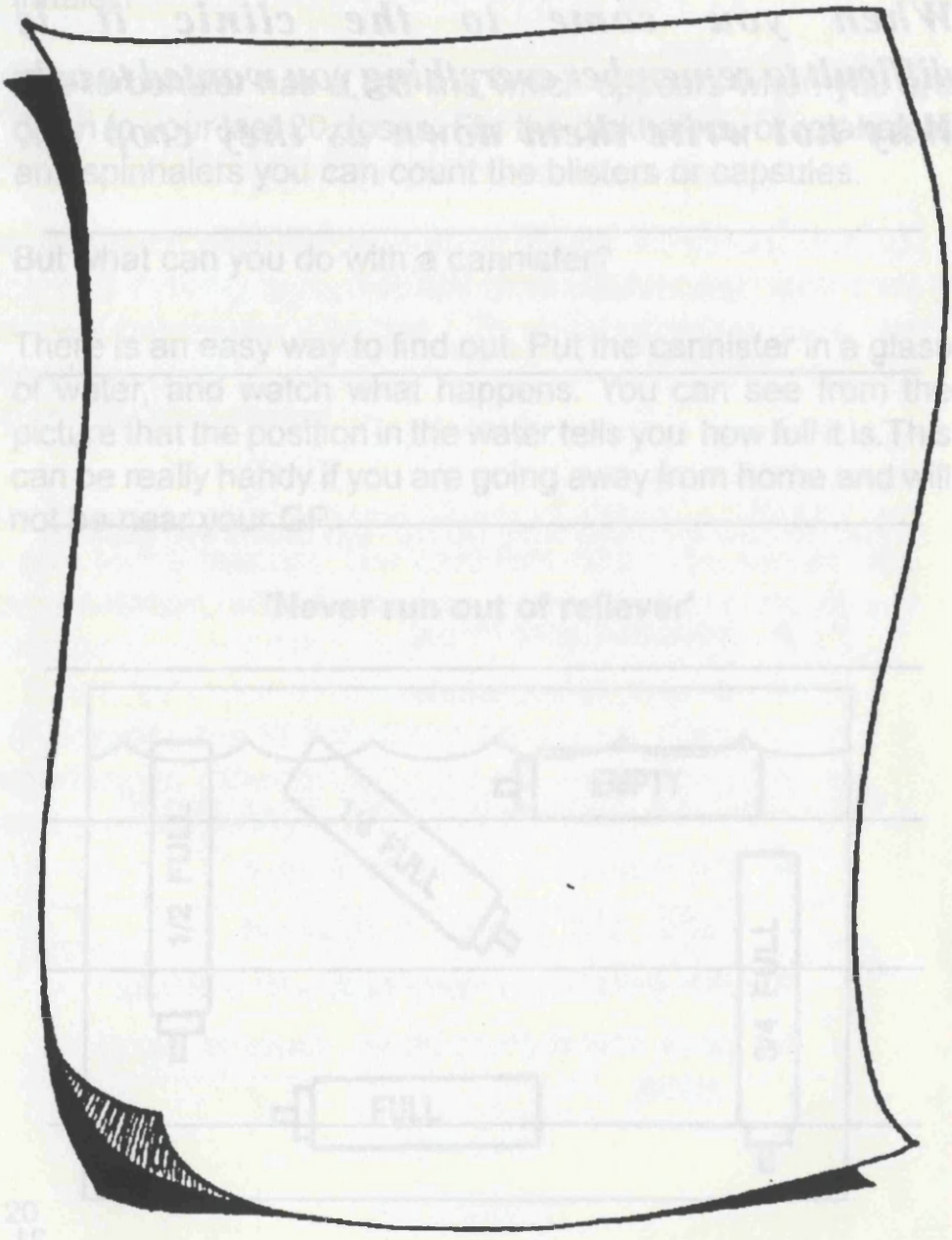
_____

_____

_____

_____

Competition time! We need a new picture for the cover. Why not have a go. At the end of the year we shall pick a winner.



Appendix 4 - Booklet

Appendix 5 - Asthma credit card

ASTHMA ACTION PLAN

Name: _____

	Peak Flow	Action to take
1		Stay on regular treatment
2		*Double dose of*
3		*Start prednisolone* *mgs*
4		Call emergency Dr or 999

	Symptom	Action
1	No symptoms	Stay on regular treatment
2	Start of a cold/ cough/wheeze	*Double dose of*
3	More wheezy & out of breath	*Start prednisolone* *mgs*
4	Getting worse despite action	Emergency Dr / 999

Sister Madge Tel: 201- 0670 (direct line)

Appendix 6 - Ethics Committee Letter of Approval Study 2

The Queen Mother's Hospital

Our Ref:
Your Ref:
Enquiries to:

YORKHILL
GLASGOW G3 8SJ
Telephone: 041-339 8888

TLT/KB

15th September, 1992

Dr J Y Paton,
Senior Lecturer in
Paediatric Respiratory Disease,
DCH,
RHSC, Yorkhill

Dear Dr Paton,

'Closing the loop in childhood asthma' - Can nursing intervention improve the outcome in children hospitalised with asthma

Thank you for sending us the protocol for this study. We do not believe it has an ethics issue but we felt that it was an extremely worthwhile project.

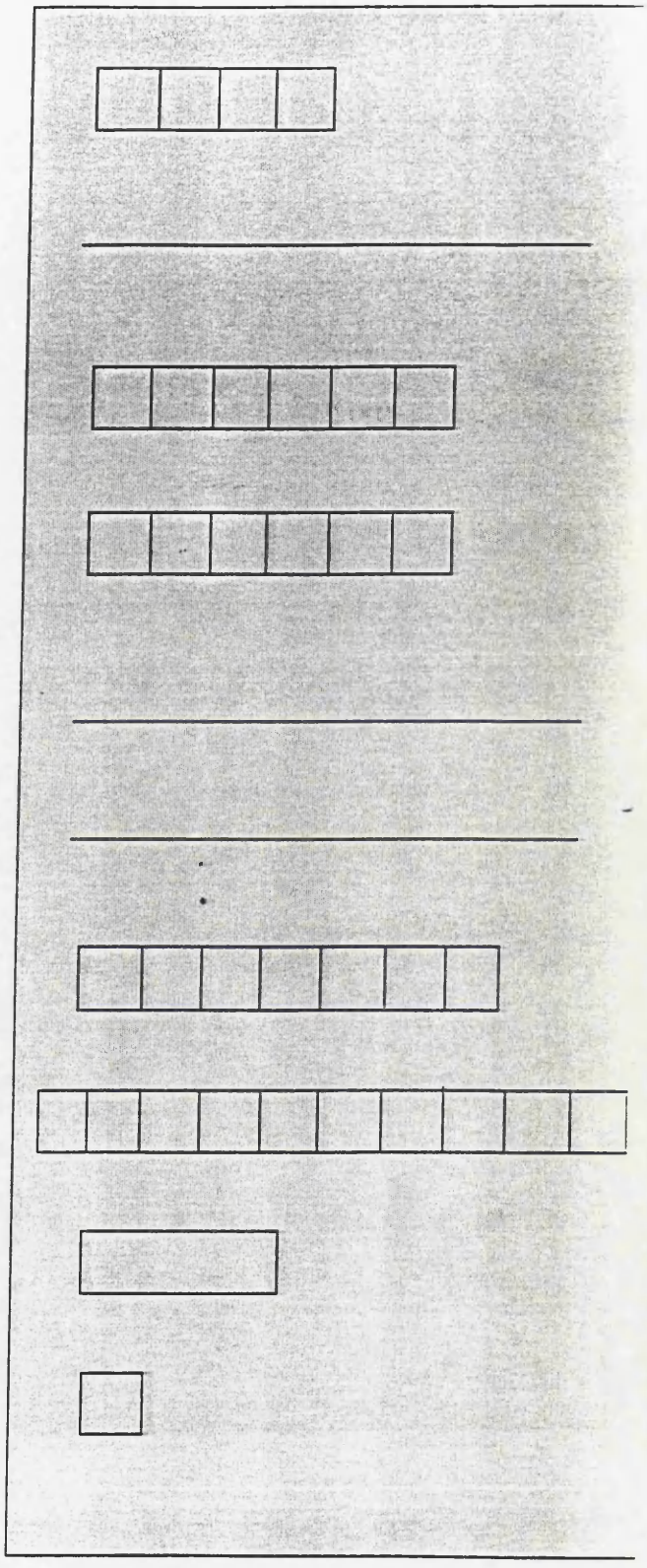
We wish you every success with it.

Yours sincerely,

T L Turner
Secretary of the
Ethics Committee

Appendix 7 - Case note form Study 2

NRAC AUDIT 1994 - IN-PATIENT AUDIT QUESTIONNAIRE



Study Number

NAME

Hospital Number

Date of birth

Address

Post Code

Telephone Number

CONSULTANT

NRAC PATIENT
1= Yes, 2= no

Date completed ___ / ___ / ___

14. Self management plan

1 no SMP
2 GP SMP
3 Hospital SMP
4 P Madge SMP

33 ☐

15. Device for **RELIEVER**

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 not known
9 none

34 ☐

16. Device for **PREVENTER**

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 not known
9 none

35 ☐

17. Initial Sa O2

35-38 ☐☐☐

18. Initial PEFR (999 not done, 888<5yrs)

39-41 ☐☐☐

19. Nebulised Salbutamol

1 yes
2 no

42 ☐

20. Oral Prednisolone (acute course in hospital)

1 yes
2 no

43 ☐

21. Oxygen therapy

1 yes
2 no

44 ☐

22. Intravenous theophylline

1 yes
2 no

45 ☐

☐

DISCHARGE PLANNING

23. Changes to asthma prophylaxis [46]

1 no prophylaxis
2 cromoglycate
3 inhaled Steroid
4 ICS + oral steroids
5 no prophylaxis

24. Dose changes (prophylaxis) [47]

1 no change
2 increased
3 decreased
4 no prophylaxis
5 started

25. Device for **RELIEVER** [48]

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 not known
9 none

26. Device for **PREVENTER** [49]

1 nebuliser
2 nebuhaler/volumatic
3 rotahaler/spinhaler
4 diskhaler/turbohaler
5 autohaler
6 MDI
7 oral
8 not known
9 none

27. Peak flow meter [50]

1 already have
2 given
3 < 5yrs
4 no information

28. Inhaler technique checked [51]

1 ward staff
2 P Madge
3 not done
4 no information

29. Asthma card

1 ward staff
2 P Madge
3 not given
4 no record

52 ☐

30. Follow up appointment

1 Medical OPD
2 Respiratory clinic
3 GP
4 none
5 no record

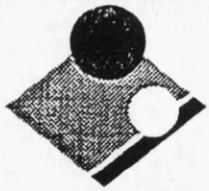
53 ☐

31. Date of discharge

54-5[illegible] ☐☐☐☐☐☐

☐ *(Madge, P., Paton, JY. January 1994)*

Appendix 8 - Morbidity Questionnaire Study 2



YORKHILL NHS TRUST

Children's Asthma Questionnaire

Thank you for helping with our asthma study. This questionnaire is being sent to parents c carers of children who have been in Yorkhill with asthma during 1994. The study is looking a ways to improve asthma care in children. There are 24 questions, asking about your child' asthma, and how it affects the rest of the family. Please complete the questionnaire **TODAY** an return it to the hospital in the SAE provided. It should take about **10 minutes.** Thank you.

J. Y. Paton

Dr JY Paton
Consultant Paediatrician

P. Madge

Sister P Madge
Asthma Research Sister

Here is a sample question and answer showing what to do:

Your child has been wheezy during the day	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*

TIPS

- *answer truthfully!*
- *circle your answer*
- *only **ONE** answer per question*

*for **HELP** ring Sister Madge (Yorkhill)*
Tel: 339-8888 Extension 4670

The questions begin over the page →

(PICK ONE ANSWER ONLY)

For office use only

1. Your child has been wheezy during the day	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	1
2. Your child has coughed during the day	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	2
3. Your child has complained of being short of breath	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	3
4. Your child has complained of a pain in the chest	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	4
5. Exertion (eg running) has made your child breathless	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	5
6. Your child has stayed indoors because of wheezing or coughing	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	6
7. His/her asthma has stopped your child from playing with his/her friends	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	7
8. Your child's education has suffered due to asthma	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	8

(PICK ONE ANSWER ONLY)

For offic use only

9. Asthma has stopped your child from doing things that a boy/girl should do at this age	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	9
10. Your child's asthma has interfered with his/her life	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	10
11. Asthma has limited your child's activites	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	11
12. Taking his/her asthma treatment has interrupted your child's life	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	12
13. Your child's asthma has limited YOUR activities	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	13
14. You have had to make adjustments to family life because of your child's asthma	*Every day*	*Most days*	*Some days*	*A few days*	*Not at all*	14
15. Your child has coughed at night	*Every night*	*Most nights*	*Some nights*	*A few nights*	*Not at all*	15
16. Your child's sleep has been disturbed by wheezing	*Every night*	*Most nights*	*Some nights*	*A few nights*	*Not at all*	16

(PICK ONE ANSWER ONLY)

For office use only

17. Your child has been woken by wheezing or cough

Every night | *Most nights* | *Some nights* | *A few nights* | *Not at all*

18. Your child has woken up needing extra asthma treatment

Every night | *Most nights* | *Some nights* | *A few nights* | *Not at all*

19. Has your child needed extra asthma treatment in the morning for tightness in the chest?

Every day | *Most days* | *Some days* | *A few days* | *Not at all*

20. Has your child been back to hospital or Gp for urgent asthma treatment since discharge *(eg nebuliser)*

Hospital | *GP* | *NO*

If so how many times? ☐

21. Is your child better since coming home from hospital?

YES | *NO* | *Getting There*

22. Is your child getting daily 'preventative' asthma treatment (eg, Intal, Pulmicort or Becotide)

YES | *NO*

23. Has your child had another course of steroid tablets since coming home from hospital?

YES | *NO*

If yes, how many days? ☐

24 Has your child missed school or nursery (because of asthma) since coming home from hospital

YES | *NO* | *Not at*

If yes, how many days ☐

For office use only

How long has your child been diagnosed with asthma? _____ *months / years*

How serious would you describe your child's asthma?	*Very serious*	*Fairly serious*	*Not very serious*	*Not at all serious*

Can you remember how you felt when you were first told that your child had asthma? In a few words:

_____

Do you feel you have a better understanding of asthma now than when your child was first diagnosed?	*YES*	*NO*

How good an understanding would you say you have about precisely what your child's asthma treatment is all about?	*Very good*	*Average*	*Could be better*

Which, if any, of the following have you been given or shown by the doctors and nurses in the hospital when your child was ready to go home?

1 *Peak flow meters and charts (usually for school age children)*
2 *Information booklets about asthma*
3 *Written instructions on treatment and how it works*
4 *Advice on what to do if the asthma gets worse*
5 *Information for your child's school*

Were you happy with the treatment and information you were given in hospital?

_____

What else would you have liked to know about your child's ashma?

_____

_____

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Appendix 9 - Clinic Checklist

Nurse-run Asthma Clinic Review

Date: ____ / ____ / ____

Current asthma medication

1. _____
2. _____
3. _____
4. _____
5. _____

Patient details

Symptoms

Days off school _____

Daytime wheeze/cough _____

Night-time wheeze/cough _____

Exercise limitation _____

Medication

Bronchodilator use _____

Device Technique _____

Spirometry

(if over 5yrs)

Predicted PEFR:

	PEFR	FEV1	FVC
Spiro 1			
Spiro 2			
Spiro 3			

Self management plan SMP

(Reinforcing SMP with regard to)

Understanding PEFR monitoring _____

Response to increased symptoms _____

When to get medical advice _____

Comments / summary _____

_____

_____

_____

Signed: