Impact of a nurse-led home management training programme in children admitted to hospital with acute asthma: a randomised controlled study

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Abstract

***Background* – Re-admissions to hospital in childhood asthma are common with studies reporting that 25% or more of children will be re-admitted within a year. There is a need for strategies to reduce re-admissions.**

***Methods* – A prospective randomised control study of an asthma home management training programme was performed in children aged two years or over admitted with acute asthma. Two hundred and one children were randomised at admission to either an intervention group (n = 96) which received the teaching programme or a control group (n = 105). A nurse-led teaching programme used the current attack as a model for the management of future attacks and included discussion, written information, subsequent follow up and telephone advice aimed at developing and reinforcing individualised asthma management plans. Parents were also provided with a course of oral steroids and guidance on when to start them.**

***Results* – The groups were similar in degree of social deprivation, length of stay, number of previous admissions, acute asthma treatment, and asthma treatment at discharge. Subsequent re-admissions were significantly reduced in the intervention group from 25% to 8% in individual follow up periods that ranged from two to 14 months ($\chi^2 = 9.63$; $p = 0.002$). This reduction was not accompanied by any increase in subsequent emergency room attendances nor, in the short term, by any increase in urgent community asthma treatment. The intervention group also showed significant reductions in day and night morbidity 3–4 weeks after admission to hospital.**

***Conclusions* – A nurse-led asthma home management training programme administered during a hospital admission can significantly reduce subsequent admissions to hospital for asthma. Acute hospitalisation may be a particularly effective time to deliver home management training.**

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Over the last two decades there has been a dramatic rise in admissions to hospital for childhood asthma.[1 2] Asthma re-admissions are also common. For example, Senthilsevan recently reported that re-admission rates (asthma re-admissions/all asthma admissions) for children from all 134 hospitals in Saskatchewan Province, Canada were between 20% and 30% during the decade 1980–9.[3] Mitchell *et al* reported higher rates in children in New Zealand[4] and there is even some evidence that re-admissions may be increasing.[5] The need to develop strategies to reduce the high re-admission rate in childhood asthma has been highlighted.[4]

At the Royal Hospital for Sick Children, Glasgow we also noted that asthma re-admissions were common with approximately 21% of children being re-admitted within a year. This occurred despite the fact that over 90% of the children admitted to hospital received nebulised bronchodilators and oral corticosteroids. Care around discharge was, however, less satisfactory – for example, only 10% were noted to have been given written instructions about their treatment.

There are now many published studies on the use of asthma self-management programmes to decrease asthma morbidity. Several narrative reviews have evaluated the existing paediatric literature and found positive results for some programmes and inconclusive results for others.[6–9] Howland *et al* commented that many of the studies do not stand up to rigorous scientific scrutiny.[8] Limitations included small sample sizes, lack of a control group, and a reliance on a select population of volunteers. There was also substantial variation in the asthma education programmes used and their duration. A more recently published meta-analysis of home management training programmes in children with asthma confined to randomised control trials of adequate quality also concluded that such programmes did not seem to reduce morbidity.[10] This analysis concluded by suggesting that teaching programmes designed for targeted audiences with well defined characteristics such as disease severity might be more likely to show benefits.

In an attempt to reduce our high asthma re-admission rate and to address deficiencies in discharge care we planned to introduce a nurse-led home management training programme. We specifically hypothesised that such a training programme delivered during an admission for acute asthma would reduce subsequent re-admissions. However, such an approach is expensive to implement and, as the above evi-

dence summarises, has not unequivocally decreased morbidity. To evaluate its impact on morbidity and provide evidence for its continued use we therefore introduced the programme as a randomised control study. This report describes the observed outcomes.

Methods

SUBJECTS

The study was performed in the four medical wards of the Royal Hospital for Sick Children, Glasgow, a large children's hospital providing care for a population of approximately 173 000 children under 14 years of age in the Greater Glasgow Health Board Area in the West of Scotland.

All children over two years of age admitted with acute asthma between January 1994 and January 1995 were eligible. Children under two years with acute wheezing were excluded for two reasons – firstly, because bronchiolitis, an acute wheezing illness which occurs mainly in children under two years and is caused by a viral infection, is difficult to distinguish from asthma, and secondly, because there is less agreement about the nature and diagnosis of asthma in young children under two years of age.[11]

The study was reviewed and approved by the ethics committee of the Royal Hospital for Sick Children. It was their view that the proposed nurse-led training programme addressed an identified clinical deficiency and that the randomised introduction did not require informed consent. Accordingly, detailed written informed consent was not sought from either group before randomisation or, in the intervention group, before the training programme which was introduced as usual care. After verbal explanation no children or parents refused to receive the home management training. For both the groups ("intervention" and "control" or usual care) all clinical care, including decisions about drug management and medical follow up, were determined by their attending paediatrician following standard practice. Parents within the control group were not aware that other children were receiving the educational intervention nor that subsequent admissions were being tracked.

RANDOMISATION

Randomisation was performed before the study by drawing cards and allocating each sequential future admission to either an intervention or a control group. Eligible children with acute asthma were then entered at admission into the pre-assigned groups. In order to standardise the intervention for each child in the intervention group children had to be identified and families contacted within 24 hours of admission. This was not always practical, particularly at weekends when the nurse was not available. The solution adopted was to recruit only on Monday to Friday when the asthma nurse (PM) was available. To monitor for any resulting selection bias, clinical information – including details of hospital re-admissions and re-attendances – on all children eligible but not randomised was collected retrospectively. The study was not confined to children having their first ever admission for asthma and included children with a varying number of previous admissions (table 1). However, children were eligible for randomisation only on the first admission with acute asthma during the study year.

INTERVENTION

For the study a structured asthma education and home management training programme was developed. In order to minimise variations in its delivery the package was implemented by one trained specialist asthma nurse (PM). The package consisted of review discussion sessions, written information and advice, and subsequent follow up and telephone advice.

Review discussion sessions

The study nurse briefly met all parents within 24 hours of admission and then had, on average, two further longer teaching/discussion sessions with each family, amounting in total to about 45 minutes.

Written information and advice

At the first meeting each family was given a highly visual "Going home with asthma" booklet developed specifically to provide basic practical advice about asthma. The booklet included chapters about the nature of asthma, its triggers, and its treatment including the use and side effects of corticosteroids. It also described signs commonly present in impending asthma attacks[12] and encouraged parents to recognise such signs in their own children. The booklet was used as the focus of discussion in the two subsequent meetings. In particular, the symptoms and signs identified by the parent as preceding the child's present attack were used as the basis of an individualised symptom based asthma management plan. Parents of children over five were also provided with a peak flow meter and instructed about flow monitoring. They were free to choose whether they preferred a plan based on peak flow measurements or symptoms, or both.

A written summary of the agreed management plan was provided for each family on a credit card sized card.[13] Each family was also provided with a course of oral steroids with guidance on when to start them.

Subsequent follow up and telephone advice

All children in the intervention group were given one appointment 2–3 weeks after discharge for a nurse-run asthma clinic where the previous advice and home management plan were reviewed and reinforced. Throughout the study telephone advice from the nurse was available to the study group about aspects of chronic management.

Table 1 Characteristics of the study groups and their inpatient asthma care

	Intervention group (n=96)	*Control group (n=105)*	*Non-randomised group (n=82)*
M:F	62:34 (1.82:1)	62:43 (1.44:1)	51:31 (1.64:1)
Age			
2–5 years	40 (41.7%)	58 (55.2%)	42 (51.2%)
5–10 years	41 (42.7%)	25 (23.8%)	32 (39.0%)
>10 years	15 (15.6%)	22 (21.0%)	8 (9.8%)
Median (range) age (years)	6.0 (2.0–13.1)	4.23 (2.0–15.3)	4.93 (2.1–13.4)
Median (range) deprivation score*	5.5 (1–7)	6.0 (1–7)	5 (1–7)
Median (range) length of stay (days)	2 (1–11)	2 (1–13)	2 (0–9)
Median (range) number of previous admissions	2 (0–8)	2 (0–19)	2 (0–8)
Median (range) days follow up	210 (63–428)	209 (64–428)	254 (64–432)
Nebulised bronchodilator	96 (100%)	104 (99.0%)	82 (100%)
Oral steroids	93 (96.9%)	101 (96.2%)	79 (96.3%)
Oxygen therapy	38 (39.6%)	39 (37.1%)	28 (34.1%)
Intravenous aminophylline	8 (8.3%)	10 (9.5%)	9 (11.0%)

* Deprivation score based on postcode[15]: 1 = least deprived, 7 = most deprived.

OUTCOMES

Primary outcome: subsequent admissions to hospital

The principal focus of this study was the impact of the home management training programme on asthma re-admissions so the primary outcome was the number of subsequent admissions to hospital with acute asthma. All hospital admissions for acute asthma were monitored during the study allowing any child who was re-admitted to be identified. A re-admission was defined as any child who had a subsequent asthma admission after an index admission during the study period of 14 months. Decisions to admit were made by the clinical staff in the emergency room who had no information on whether the child had been in the intervention or control group.

Secondary outcomes

(1) Subsequent attendances at the emergency room: after an index admission any subsequent attendance at the hospital emergency room during the study period was also noted.

(2) Asthma morbidity: a morbidity questionnaire (based on the index of perceived symptoms developed by Usherwood[14]) to assess asthma symptoms was sent to families in both groups four weeks after discharge from hospital. This instrument gives three scores for asthma morbidity: day disturbance, night disturbance, and disability. An additional question on attendance at the family practitioner for urgent asthma treatment in the period following discharge was also included.

DATA ANALYSIS

Data were summarised using standard descriptive statistics (mean and standard deviation for continuous data, median and range for discrete data). Hypotheses about proportions were tested using χ^2. Medians were compared using the Mann-Whitney U test. Subsequent admissions to hospital were analysed using statistical techniques for the analysis of survival data, principally Cox's proportional hazard model. p values of less than 0.05 were considered significant.

All analyses were performed on an IBM compatible computer using Minitab vs 8 or SPSS for Windows.

Table 2 Comparison between control and intervention groups of asthma treatment before admission, and asthma treatment and follow up arranged during the index admission

	Intervention group (n=96)	*Control group (n=105)*	*p value*
Bronchodilators before admission	77 (80.2%)	97 (92.4%)	0.012
Bronchodilators after admission	96 (100%)	104 (99.0%)	NS
Inhaled prophylaxis before admission	47 (49.0%)	60 (57.1%)	NS
Inhaled prophylaxis after admission	76 (79.2%)	86 (81.9%)	NS
Review of inhaled device technique	94 (97.9%)	96 (91.4%)	0.044
Follow up hospital medical appointment	59 (61.5%)	80 (76.2%)	0.024

Results

Two hundred and eighty three children over two years of age with acute asthma were admitted of which 201 were randomised into the study, 96 into the intervention group and 105 into the control group. The intervention and control groups were similar in terms of median length of stay, median number of previous admissions, and acute asthma therapy. Information on socioeconomic deprivation, derived from post code,[15] was no different between the groups with both showing high levels of deprivation. The children randomised to the intervention group were slightly older at six years (table 1). Physician initiated asthma treatment is shown in table 2. At discharge there was no significant difference in the use of inhaled bronchodilator or prophylactic therapy. Use of devices was checked in over 90% of both groups, although slightly more frequently in the intervention group. In contrast, medical follow up was actually arranged more frequently in the control group.

Another 82 children (non-randomised group) would have been eligible for inclusion but were admitted on days when they could not be followed. Clinical details including inpatient hospital treatment for these children are also summarised in table 1. It can be seen that these children were very similar to the children in the two study groups. Outcome questionnaires were not completed by the non-randomised group and only data on re-admissions and re-attendances at the emergency room were available.

PRIMARY OUTCOME

Asthma re-admissions were monitored until two months after randomisation ended, a total

Table 3 Hospital re-admissions and emergency room re-attendances with acute asthma

	Intervention group	*Control group*	*Non-randomised group*
Re-admitted to hospital	8 (8.3)*	26 (24.8)	18 (22.0)
Re-attended hospital emergency room	7 (7.3)	7 (6.7)	8 (9.8)
Re-attended family practitioner**	11 (11.5)	7 (6.7)	N/A

Values in parentheses are percentages.
*$\chi^2 = 9.63$; $p = 0.002$ (intervention group versus control group).
**Re-attended family practitioner 3–4 weeks following discharge for urgent asthma treatment.

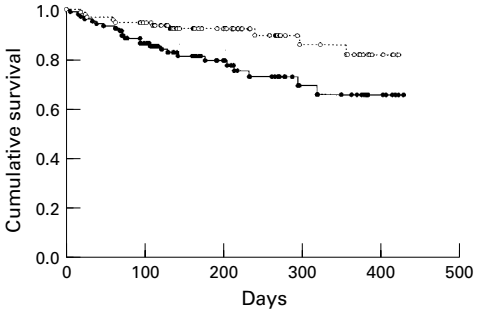

Figure 1 Cumulative survival curve showing time to re-admission for the intervention (○) and control (●) groups. Because the survival curve adjusts for the differing length of follow up, the percentages "surviving" (not re-admitted) are not directly applicable to table 3.

of 14 months in all, when the re-admission data were censored. This gave individual follow up periods of 2–14 months. A simple χ^2 test (table 3) indicated that the re-admission rate was significantly lower in the intervention group (8.3%) than in the control group (24.8%).

Survival analysis was then used to explore whether or not re-admission was influenced by group type (control versus intervention), number of previous asthma admissions, previous asthma drug therapy, oxygen saturation on admission, whether intravenous theophylline was used,[4] age, and sex (table 3, fig 1). An initial analysis using a log rank test examined the effect of each individual variable on survival. Group, number of previous admissions, and prophylactic asthma therapy were all significant. Applying Cox's proportional hazards model and entering explanatory variables in a stepwise manner from the full list of variables above, the only significant remaining factors were the number of previous admissions and group.

Randomisation resulted in a difference in age structure between groups with fewer younger children in the intervention group (table 1). Because of this, the Cox's proportional hazard analysis was repeated after stratifying for age. Both previous admissions and group remained significant ($p<0.0001$; $p = 0.03$). Thus, the structured home management training programme remained significantly associated with a reduced risk of re-admission even after age had been accounted for (table 4).

Table 5 Median (range) morbidity at 3–4 weeks after discharge as assessed by parent completed postal questionnaire

	Intervention group	*Control group*	*p value**
Day score	4.0 (0–16)	7.0 (0–16)	0.0005
Night score	4.0 (0–12)	6.0 (0–12)	0.0002
Disability score	4.0 (0–32)	8.0 (0–32)	0.078

*Mann-Whitney U test.

SECONDARY OUTCOMES

Emergency room re-attendances

There was no difference in the number of emergency room attendances between the two groups nor any difference in re-attendance at the family practitioner in the 3–4 weeks following discharge for urgent asthma treatment (table 3).

Morbidity

Morbidity questionnaires were returned by 129 families (63 intervention group (65.6%) and 66 control group (62.9%)). Day, night, and disability scores were calculated for each subject and scores for the two groups were compared (table 5). There were significant differences in both day and night scores with children in the intervention group having fewer symptoms. There was no between group difference in the disability score.

We did not monitor how often families in the two groups used the oral steroids provided.

Discussion

Despite a widespread consensus about the treatment of acute childhood asthma,[16 17] the outcome – at least as reflected in the number of hospital re-admissions – is disappointing.[3 4] In this pragmatic, prospective, randomised control study we examined the impact of the introduction of a brief, structured, nurse-led asthma home management training programme administered during admission. The outcome was clear. In the children randomised to receive usual asthma treatment 25% were re-admitted during the study period (individual follow up 2–14 months). This was similar to the number of re-admissions in the group not randomised (table 3), to our own previous observations, and to published data.[3] In striking

Table 4 Parameter estimates for re-admission in the Cox proportional hazards model

Variable	*Estimate of coefficient*	*Estimated standard error*	*Hazard ratio**	*95% confidence interval*
One previous admission	1.3816	0.6363	3.98	(1.12 to 14.21)
Two or more previous admissions	2.1207	0.5572	8.34	(2.74 to 25.41)
Intervention	−0.9486	0.4236	0.39	(0.17 to 0.90)

*The ratio of the hazard function for children with the given feature compared with the hazard function for a baseline control group with no previous admission.

contrast, re-admissions fell significantly from 25% to 8% in the intervention group. This decrease in re-admissions was not accompanied by any subsequent increase in emergency room use nor, at least in the short term, by any increase in the reported attendance for urgent community asthma treatment immediately following discharge. The intervention group also showed significant reductions in day and night morbidity scores assessed using a morbidity questionnaire 3–4 weeks after discharge from hospital.

While the attending medical staff were fully aware of the study, it was designed not to interfere with their established clinical practice. For the intervention group the aim was to complement but not supplant or alter usual management. Consequently, the results in the intervention group are all the more striking when it is noted that differences in the medical management of the acute episode, in the length of stay, in the prescribed inhaled therapy at discharge, and in planned medical follow up were, indeed, minimal.

In this study we did not investigate behavioural or educational outcomes. Other studies have clearly shown that asthma education programmes can improve asthma knowledge and treatment compliance. Bernard-Bonnin *et al*[10] have pointed out that these outcomes are more directly related to the teaching intervention and are therefore likely to be less susceptible to confounding factors that might "dilute" the impact of teaching interventions on measures of morbidity. In using re-admission as the primary outcome we have, in effect, used a more rigorous test of the impact of our programme.

Like Mitchell *et al*,[4] we noted that the number of previous admissions was a significant risk factor for re-admission. We did not find that characteristics of the individual (age and sex) or severity of the condition (as reflected in oxygen saturation at admission, use of intravenous theophylline) influenced re-admission. In particular, there was no evidence that the use of intravenous theophylline was associated with a decreased risk of re-admission. However, there were very substantial differences in our practice where 8–10% of children received intravenous theophylline compared with 98% in Mitchell's study. The differences in average age between the studies probably reflect the fact that our study excluded children below two years.

The individualised asthma management plans developed for children under five were based on symptoms. In children over five years of age a peak flow meter was issued but the plans were developed in terms of both symptoms and peak flow and parents were given the option of using which ever they preferred. The success of a symptom based approach in this childhood population echoes the findings of Charlton *et al*.[18] One important feature of our teaching programme was to provide parents with a check list of prodromal features of acute asthma to compare with their own experience.[12] We think this encouraged them to use their experience of their child's attacks as the basis for the recognition and management of future episodes. Although the teaching programme was relatively brief, it embodied a number of elements that have been identified as "principles of behaviour change and health education" such as the use of multiple methods, individualisation, relevance, feedback, and reinforcement.[19]

There are a number of other important points which should be emphasised. Although Glasgow has a high rate of urban deprivation, confirmed in the children studied by deprivation scores based on post code (table 1),[15] the training programme was introduced in a health care system free at the point of access. Thus financial constraints were unlikely to limit or bias the population studied.

Most importantly, perhaps, the study was not restricted to children having their first asthma admission with the median number of previous admissions being two, thus reflecting children with more severe asthma. Mitchell *et al* also studied an educational programme in similar children admitted to hospital with asthma.[20] However, in contrast, they found subsequent hospital admissions were increased in the intervention group. Two important differences from that study should be highlighted. Our teaching programme was delivered during admission when parents may be particularly receptive. Clark *et al*[21] have also noted a significant reduction in both use of the emergency room and admissions to hospital with self-management training when comparison was restricted to a small group of children who had been admitted to hospital during the preceding year. Similarly, Osman *et al* found that hospital admission seemed to offer an opportunity to influence patient self-management behaviour and the later risk of re-admission in adult asthmatic patients.[22] Hospital admission may therefore be a key window of opportunity for maximising the impact of home management training programmes.

Another important difference from the study by Mitchell may be that we provided the parents with a short course of oral corticosteroids with instructions to start this if an exacerbation occurred, avoiding delay due either to a delay in consulting their family doctor or to reluctance of the doctor to start corticosteroids. We did not, however, monitor how frequently courses of oral steroids were started in the two groups.

It has been suggested that re-admissions within 72 hours of hospital admission might be an outcome indicator reflecting the quality of hospital asthma care. We found that re-admissions in both groups were very uncommon immediately after the index admission (fig 1). As a consequence, this outcome is not likely to be a useful index of the quality of care. Instead, we suggest that asthma re-admissions over a much longer time are a better outcome indicator. Avoiding any subsequent admission should then be a major health care goal in childhood asthma.

Because of limited resources, the study training programme was always delivered by one specialist nurse. While this immediately

ensured consistency in implementation, it potentially raises questions about the generalisability of our findings. Notwithstanding, the study showed that substantial reductions in readmissions can be achieved; the challenge now is to realise these reductions in regular practice. The pragmatic randomised introduction has provided evidence to justify extending the programme to all asthmatic children aged over two years admitted to our hospital and has provided a benchmark against which to monitor our subsequent progress.

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