

## Long-term reduction in asthma morbidity following an asthma self-management programme

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**ABSTRACT:** The adult "credit card" asthma self-management plan has been shown to be an effective and acceptable system for reducing asthma morbidity when introduced as part of a 6 month community-based asthma programme. The aim of the present study was to assess the effectiveness of the credit card plan 2 yrs after the end of the programme.

Markers of asthma morbidity and use of medical services were compared during the 12 months before enrolment, and 2 yrs after completing the 6 month asthma programme.

Of the 69 participants who originally enrolled in the 6 month asthma programme, 58 were surveyed 2 yrs after completion of the programme. These participants showed a significant improvement in all but one of the asthma morbidity measures. The proportion waking most nights with asthma in the previous 12 months decreased from 29 to 9% ( $p=0.02$ ), emergency visits to a general practitioner decreased from 43 to 16% ( $p=0.001$ ), hospital emergency department visits with asthma decreased from 19 to 5% ( $p=0.02$ ) and hospital admissions decreased from 17 to 5% ( $p=0.04$ ). Only 24% of patients reported that they usually monitored their peak flow rate daily, but this increased to 73% during a "bad" attack of asthma.

A long-term reduction in asthma morbidity and requirement for acute medical services can result following the introduction of the adult credit card asthma self-management plan. Adult patients with asthma are most likely to undertake peak flow monitoring preferentially during periods of unstable asthma, rather than routinely during periods of good control.

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There is increasing evidence to suggest that asthma self-management plans can provide major benefits for adult asthmatics experiencing moderate to severe morbidity [1-6] as opposed to mild asthma where their efficacy may be limited or more difficult to assess [7, 8]. However, there are still a number of unresolved issues regarding their use in the long-term treatment of adult asthma [9]. One important doubt relates to their long-term effectiveness, as most studies have involved short-term programmes of up to 12 months. This contention seems reasonable given previous experience suggesting that health education programmes generally demonstrate only short-term benefits that are unlikely to be sustained without regular review.

Another issue is the uncertainty concerning the essential components of an effective self-management programme. The studies demonstrating efficacy have usually introduced self-management plans that include the self-assessment of asthma severity through recognition of key symptoms and monitoring of peak flow. This has provided a system that helps the patients to titrate the dose of regular inhaled corticosteroids in accordance with changes in asthma severity, as well as providing guidelines for the early use of oral corticosteroids and seeking of medical

assistance in severe attacks [9]. As a result, from a narrow scientific viewpoint, it becomes virtually impossible to determine the relative importance of the different components of the plan or of the intervention factors when a successful result is accomplished [10].

More recently, the role of regular peak flow monitoring in all patients with asthma has been questioned. This relates to concerns that peak flow monitoring may fail to detect some exacerbations characterized by symptoms severe enough to justify a course of oral steroids [11], that compliance may be poor [12] and that symptom-based self-management plans may be of similar efficacy to those based on peak flow in the treatment of mild asthma [13]. As a result, there is uncertainty as to the optimal way in which management plan guidelines should be applied in practice, including which patients should be advised to monitor their peak flows [8].

The "credit card" plan uses guidelines for the self-management of asthma, based on patient self-assessment of peak expiratory flow (PEF) recordings and symptoms, printed onto two sides of a plastic "credit card". We have previously shown that this system of self-management can be an effective and acceptable tool in improving asthma

morbidity in selected groups of patients with severe asthma [4, 5]. However, to date its introduction as part of an educational package and its subsequent impact have been assessed only after relatively short intervention periods.

In this paper we describe the long-term effectiveness of the credit card plan 2 yrs after we completed the original 6 month community-based programme. During this interval, participants were discharged to their general practitioners to carry on their "usual care" without any further input from our research team. Therefore, this allowed us not only to assess the long-term effectiveness of the plan independently of our standardized education package, but also to ascertain what self-management skills this community had now developed.

## Methods

### *The initial Wairarapa asthma programme*

The original introduction of the adult credit card asthma self-management plan through a community-based programme has been described in detail previously [4, 14]. The study involved introducing the management plan in a series of clinics that were held on marae (the traditional Maori community centre) in the Wairarapa area, and were organized by Maori community health workers from that area. During the study the Maori community health workers also arranged transport for participants where necessary, maintained contact with the participants and encouraged them to complete their diaries. Prior to its commencement, the nature of the programme was also discussed with the general practitioners in the area. The general practitioners were also informed of each participant's involvement in the study and notes were sent regarding their progress and recommended changes in management during and at the conclusion of the intervention period.

The study involved an intervention trial over 6 months comparing markers of asthma morbidity, requirements for acute medical services and prescribed drug therapy before and after the introduction of the self-management plan. During the initial run-in period of 8 weeks, participants were given a peak flow meter (if they did not already have one) and completed daily diaries on whether they had woken from sleep with asthma or coughing, whether they had a day "out of action" and the best value from two morning pre-bronchodilator PEF recordings.

Every month, the participants also recorded the number of occasions on which nebulized medications were used, courses of oral corticosteroids, hospital emergency department visits and hospital admissions. Following this initial 8 week period, the self-management plan was introduced at a clinic by one of the four physicians in the study team. The participants were then followed for a further 16 weeks with a second clinic being held after 8 weeks.

The clinics focused on the following key points: the inflammatory basis of asthma; the use of regular inhaled steroids to reduce the frequency and severity of attacks; the use of bronchodilators for relief of symptoms or prior to known aggravating stimuli (rather than according to a regularly scheduled regimen); adequate drug delivery through appropriate inhaler technique or change to dry-powder or

spacer delivery systems; and the recognition and appropriate self-management of unstable asthma through use of the credit card plan.

### *Follow-up surveys*

Following enrolment in the initial intervention study (time (t)=0 months), participants underwent a run-in period after which the credit card plan was introduced (t=2 months) and they were followed for a further 4 months (t=6 months). Following the 6 month trial the participants were discharged by standardized letter to the care of their usual general practitioner. No further educational or therapeutic involvement was undertaken with the participants or general practitioners by our research group during the 24 month period after the asthma programme. Twelve months after the programme was completed, a 1 yr follow-up study was carried out (t=18 months) with a further 2 yr follow-up study 12 months later (t=30 months). Each follow-up survey was performed in the month of August.

The questions used to measure markers of asthma morbidity and use of medical services in the enrolment survey (t=0) were worded identically in each follow-up questionnaire (t=18 and t=30). The only exception was the instructions given to interviewers at 30 months when asking the question "how many days out of action have you had in the last year?" At 30 months the definition of "days out of action" (off work or school or any day when your asthma prevented you from doing something you otherwise would have done) was made explicit by interviewers, whereas at zero months and 18 months it had been used only as a guide to enable interviewers to classify participant responses. In addition, at 30 months self-management behaviour was assessed by questioning participants on how they "usually" used their PEF meter/plan and how they used these tools if their asthma was "getting worse" or if they had a "bad attack" of asthma.

### *The adult asthma self-management plan*

The self-management plan provided two methods of self-assessment of asthma control: symptoms and PEF recording. The method for self-assessment using PEF recording was printed on one side and the symptom-based approach on the reverse side of a small plastic card, the size of a standard credit card [4]. For both methods of assessment, there are four general stages in which treatment guidelines are recommended. These guidelines are based on either the development of increasingly severe symptoms or decrease in PEF recording from the patients previous "best". For each stage of deterioration clear instructions were written on what self-management steps to take and when to seek help. These were tailored to individual patients and their requirements and were written directly on the card. Similarly, the patient's individual therapy, inhaled steroid or bronchodilator and the name and telephone number of emergency help was also written on the card.

### *Data analysis*

Data were entered onto an IBM-compatible personal computer (PC) and analysed using PC SAS (SAS Institute

Inc., Cary, NC, USA) [15]. Each before-and-after analysis was performed using the same pool of follow-up participants in each comparison group. The before-and-after comparisons at t=0 months, t=18 months and t=30 months were carried out using McNemars test with continuity correction for paired nonparametric data. In addition, a Chi-squared test for trend was used to assess time trends.

**Results**

*Participants*

Of the 69 participants who were initially enrolled (t=0 months) in the intervention trial, 46 participants took part in the first follow-up survey at 18 months and 58 participants took part in the final follow-up survey at 30 months. No data were collected on the reasons for nonparticipation at the 18 month follow-up; at the 30 month follow-up four declined to participate and seven were lost to follow-up, primarily because they had moved from the area. Table 1 shows the baseline data collected at enrolment in the Wairarapa asthma programme (t=0 months). It shows that the participants in the 1 yr and 2 yr follow-up surveys had similar baseline characteristics to the overall group of study participants at enrolment. This suggests that participants involved in the two follow-up surveys are reasonably representative of the original study group.

*1 yr follow-up*

For the 46 participants, all markers of asthma morbidity and health service utilization showed an improvement 12 months after completion of the intervention trial (table 2). However, it was only the more frequent markers (*i.e.* the less severe markers) that showed statistically significant improvements; other markers (*i.e.* the more severe markers) generally showed similar improvements, but these were not statistically significant because of the small numbers involved.

Table 2. – Before and after comparison of markers of asthma morbidity and health service utilization for participants completing the 1 yr follow-up study (n=46)

	Before	After	p-value
Nonemergency visits to a doctor	80 (37)	35 (16)	<0.001
Emergency visits to a general practitioner	39 (18)	13 (6)	0.004
Emergency visits to a hospital emergency department	20 (9)	15 (7)	0.58
Hospital admissions	17 (8)	9 (4)	0.22
Woken by asthma most nights in the last year	30 (14)	11 (5)	0.02
More than 7 days out of action	17 (8)	7 (3)	0.11

Values are presented as percentages of the total number of subjects, and absolute number of subjects in parenthesis. All outcomes are for the previous 12 months.

Table 3. – Before and after comparison of markers of asthma morbidity and health service utilization for participants completing the 2 yr follow-up study (n=58)

	Before	After	p-value
Nonemergency visits to a doctor	81 (47)	40 (23)	<0.001
Emergency visits to a general practitioner	43 (25)	16 (9)	0.001
Emergency visits to a hospital emergency department	19 (11)	5 (3)	0.02
Hospital admissions	17 (10)	5 (3)	0.04
Woken by asthma most nights in the last year	29 (14)	9 (5)	0.02
More than 7 days out of action	17 (10)	17 (10)	1.00

Values are presented as percentages of the total number of subjects, and absolute number in parenthesis. All outcomes are for the previous 12 months.

*2 yr follow-up*

At the 2 yr follow-up (table 3), there was a significant improvement in all but one of the markers of asthma morbidity and health service utilization. The number of participants reporting "more than 7 days out of action" was the same as preintervention levels, but other markers of severe asthma such as emergency department visits, hospital admissions and "most nights woken with asthma" improved.

Table 1. – Baseline characteristics of participants initially enrolled in the Wairarapa asthma programme and those completing the 1 yr and 2 yr follow-up surveys

	Enrolment participants (n=69)	1 yr participants (n=46)	2 yr participants (n=58)
<b>Demography</b>			
Mean age yrs	38	36	38
Females n	55 (80)	36 (88)	48 (83)
Smokers n	32 (46)	19 (41)	27 (47)
<b>Use of medical services</b>			
Nonemergency visit to doctor n	54 (78)	37 (80)	47 (81)
Emergency visit to general practitioner n	28 (41)	18 (39)	25 (43)
Hospital emergency department visit n	13 (19)	8 (17)	11 (19)
Hospital admissions n	10 (14)	8 (17)	10 (17)
<b>Asthma morbidity</b>			
Woken with asthma/coughing most nights n	20 (29)	14 (30)	14 (24)
Greater than 7 days "out of action" n	15 (22)	8 (17)	10 (17)
<b>Asthma self-management</b>			
Peak flow meter n	37 (54)	27 (59)	32 (55)
Written management plan n	9 (13)	7 (15)	8 (14)

Values in parenthesis are percentages.

Table 4. – Trend in markers of asthma morbidity and health service utilization for participants completing both the 1 yr and 2 yr follow-up studies (n=41)

	Before	1 yr after	2 yrs after	p-value
Nonemergency visits to a doctor	83 (34)	39 (16)	37 (15)	<0.001
Emergency visits to a general practitioner	41 (17)	15 (6)	12 (5)	0.002
Emergency visits to a hospital emergency department	20 (8)	17 (7)	7 (3)	0.10
Hospital admissions	17 (7)	10 (4)	5 (2)	0.07
Woken by asthma most nights in the last year	29 (12)	12 (5)	10 (4)	0.02
More than 7 days out of action	17 (7)	7 (3)	15 (6)	0.70

Values are presented as percentages of the total number of subjects, and absolute number in parenthesis. All outcomes are for the previous 12 months.

### Trends over time

For the 41 participants completing the initial survey, 1 yr follow-up survey and 2 yr follow-up survey, there was a significant trend in improvement in three of the six measures of asthma control (table 4). There was also a nonsignificant improvement in the proportion of visits to an emergency department and the proportion of hospital admissions over this period.

### Self-management

At 30 months, 24% of participants reported that they usually monitored their peak flow rates daily or more often, but this increased to 73% during a "bad" attack of asthma. Fifty (86%) of the participants increased the amount of their inhaled steroids at some stage in the preceding 12 months, of which 48% referred directly to the plan to help them decide to do so. Approximately equal proportions (45 versus 41%) had referred to either the "peak flow" or "symptom" sides to help decide to initiate this increase in their inhaled steroids. Twenty five (43%) participants had taken a course of prednisone for their asthma in the preceding 12 months, of whom 40% had referred to the plan to self-initiate this management.

## Discussion

This study is apparently the first long-term follow-up of participants who have completed an asthma self-management programme. In a group of patients with relatively severe asthma, a long-term reduction in asthma morbidity and requirement for acute medical services was achieved through the credit card self-management plan system of care. It suggests that self-assessment and self-management skills learnt through the introduction and use of the credit card plan are likely to be maintained in the long-term in adult asthmatic patients.

The interpretation of these findings is dependent on the validity of the outcome measures of asthma morbidity and requirement for acute medical services used in this study. The two measures of asthma morbidity, "woken by asthma most nights" and more than "7 days out of action", are both subjective and likely to be influenced by recall and interpretation, although there is no reason to believe that these problems would differ between the time periods being com-

pared. The reasons for the different pattern for "more than 7 days out of action", in comparison with other outcome measures, is unclear, but the change in the instructions for interviewers for this question may account for the lack of evidence of improvement of this measure over time.

The measures of utilization of acute medical services are more likely to reflect real improvements in asthma morbidity [16]. The requirement for acute medical services declined progressively throughout the 2 yr period, with a reduction of approximately two-thirds in emergency visits to a general practitioner or emergency department, and a similar reduction in hospital admissions. Indeed, from a clinical perspective, the reduction in hospital admissions and emergency department visits is also likely to reflect a reduction in the risk of mortality as both are recognized risk factors for asthma mortality [17]. Our findings are also consistent with the observation of ABRAMSON *et al.* [18] that cases of asthma death were less likely to have had a written management plan than controls with nonfatal asthma hospital admissions.

Other considerations include the influence of the health-care system in which the management plan was used and the cultural issues relating to the Maori community that participated in this study. Maori are disadvantaged in terms of socio-economic status and access to medical care [19], a situation that contributed to our decision to undertake the study in this particular community, working in partnership with Maori community health workers using marae-based clinics. This system of delivery of the management plan is likely to be relatively unique to New Zealand, although analogous approaches may apply in other disadvantaged communities in other countries. For example, a similar self-management plan was found to be effective in a socio-economically depressed community in lower Eastside, New York city when introduced through an intensive hospital-based outpatient treatment and education programme [20]. It is likely that the efficacy of the credit card management plan may well apply to other populations, although the appropriate method of delivery will vary.

The findings relating to self-management behaviour were of interest when one considers the likely requirement to refer to the asthma self-management plan in the long term. One feature that was generally followed by the patients at some time was the instruction to increase the dose of their inhaled corticosteroids in response to worsening asthma. This intervention was undertaken by over 80% of the patients at some stage during the last year of the study period. On about one half of the occasions, this increase

occurred following direct reference to the plan. With respect to starting a course of oral corticosteroids in the situation of an asthma attack, 40% did so without the requirement for a medical consultation. These findings suggest that the initial introduction and experience with the plan as part of an educational programme may lead to self-management skills and behaviour that are maintained long term. In particular, this may emphasize the importance of the plan as an *aide-mémoire* for the attainment of self-management skills if the steps are simple to carry out.

These findings complement those from the randomized controlled study of guided self-management from Finland, in which compliance with self-management instructions was assessed [1]. Over a 12 month period patients followed their instruction to double the dose of inhaled corticosteroids on 62% of occasions when the peak flow fell to <85%. On most of these occasions the inhaled corticosteroid dose was increased during the first day on which the peak flow values fell below this level and the patients maintained the higher dose for at least 1 week. With respect to the instruction to start oral corticosteroids when the peak flow fell to <70%, this was followed on 77% of occasions. Although compliance with the regular use of inhaled corticosteroids was not directly assessed in this study, the observation that similar doses of inhaled corticosteroids were prescribed before and after introduction of the self-management plan suggests that the improvement in morbidity noted in this study was related to improved compliance, rather than an increased prescribed dose of this therapy.

One issue that the present study has not addressed is the level of peak flow at which therapeutic interventions were undertaken. The credit card plan suggests falls in peak flow to less than 80% and 60% of predicted value or best achieved values for doubling the dose of inhaled corticosteroids and starting a course of oral steroids, respectively. In contrast, the plan employed in the Finnish study and which was shown to be effective in the management of asthma, utilized levels of 85% and 70% for these corresponding therapeutic interventions [1]. In view of the efficacy demonstrated using these different systems, appropriate therapeutic guidelines within this range of peak flow levels could be recommended, according to the doctor's preference and the individual requirements of the patient.

With respect to peak flow monitoring, this was undertaken by patients during periods of unstable asthma, rather than when under good control. This observation is consistent with previous reports of poor compliance with daily peak flow monitoring when patients have stable asthma [12, 21], yet good compliance in association with a management plan during symptomatic exacerbations of asthma [1]. This would suggest that after a period of intensive peak flow monitoring and instruction in the use of management plans, during which the patient attains the necessary knowledge and self-management skills, patients can be advised to preferentially monitor their peak flows during periods of unstable asthma. While these guidelines are likely to be suitable for most patients, it still seems advisable to recommend that more frequent peak flow monitoring is undertaken by patients at high risk of morbidity or mortality, or those recognized as poor perceivers of asthma severity [22]. One pragmatic approach would be to recommend that, apart from patients who are unable to per-

ceive deteriorating asthma or those with "brittle asthma", patient recognition of nocturnal asthma or increased beta agonist use should prompt a doubling of the dose of their inhaled steroids, commencement of peak flow monitoring and a formal following of their management plan.

In conclusion, this study suggests that a long-term reduction in asthma morbidity and requirement for acute medical services can result following the introduction of the adult "credit card" asthma self-management plan. It also suggests that the self-management skills learnt through the intensive introduction and use of the plan are maintained long term.

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