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Impact of nurse-led outpatient management of children with asthma on healthcare resource utilisation and costs

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Impact of nurse-led outpatient management of children with asthma on healthcare resource utilisation and costs. A.W.A. Kamps, R.J. Roorda, J.L.L. Kimpen, A.W. Overgoor-van de Groes, L.C.J.A.M. van Helsdingen-Peek, P.L.P. Brand. ©ERS Journals Ltd 2004.

ABSTRACT: The high burden of asthma on healthcare utilisation and costs warrants economic appraisal of management approaches. The authors previously demonstrated that the efficacy of nurse-led outpatient management of childhood asthma was comparable to management by a paediatrician and now report on the healthcare utilisation and costs of both management approaches.

A total of 74 newly referred children with asthma were randomly assigned to a 1-yr follow-up by paediatricians or asthma nurse. Healthcare utilisation was recorded and associated costs calculated for both management approaches.

There were no significant differences in healthcare utilisation except for the total time spent on patient contact (136(n=14) *versus* 187(n=41) min, for patients followed-up by paediatrician and an asthma nurse repectively). Costs within the healthcare sector were reduced by 7.2% in favour of nurse-led care. The reduction in costs was solely attributable to a 17.5% reduction in the costs of outpatient visits. Nurse-led care appeared to be cost-saving even if the duration of follow-up visits would be twice that of doctor's visits. Overall healthcare costs (within and outside the healthcare sector) were 4.1% lower for nurse-led outpatient management compared to traditional medical care.

Nurse-led outpatient management of childhood asthma can be provided at a lower cost than medical care by paediatricians.

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Introduction

The high prevalence of childhood asthma puts a huge burden on healthcare utilisation and healthcare costs. [1–7] To ensure that appropriate management for all children with asthma remains available, existing healthcare resources must be used efficiently. International guidelines advocate comprehensive patient education and regular follow-up in addition to maintenance treatment with inhaled corticosteroids, to achieve successful asthma management [8, 9]. Regular follow-up is recommended to ensure correct use of prescribed drugs and to reinforce the patient's and caregiver's knowledge of asthma and management of the disease. Various intervention studies have demonstrated that patient education, mainly provided by an asthma nurse, resulted in better control of childhood asthma [10–16].

In previous studies, it was shown that a reduction in healthcare utilisation, such as emergency department visits and hospitalisations, can be achieved with adequate asthma control [17, 18]. Furthermore, maintenance treatment with inhaled corticosteroids has been shown to be cost effective [19–21]. The consequences of intervention by asthma nurses on healthcare costs are, however, inconclusive [10, 12, 22–25]. This may be due to the fact that until now, care provided by an asthma nurse has always been additional to routine medical care.

The authors have recently demonstrated that the efficacy of hospital-based outpatient follow-up of children with asthma is comparable to follow-up by a paediatrician in terms of clinical outcome and quality of life [26]. In the current paper the authors now report on healthcare utilisation and healthcare costs of both management approaches.

Materials and methods

Patients and methods

This study was conducted alongside a randomised controlled trial, in which children with asthma were followed-up for a 1-yr period by either an asthma nurse or a paediatrician [26] Children, aged between 2–16 yrs who had been referred by their general practitioner because of insufficient asthma control to the outpatient clinic, were eligible to enter the study after the diagnosis of asthma had been confirmed [8]. The study was approved by the Ethics Review Board of the hospital. All caregivers and patients aged $\geqslant$12 yrs gave written informed consent.

Diagnostic work-up

Allergy was assessed by either a skin-prick test (ALK: Abelló, Nieuwegein, The Netherlands) or radioallergosorbent

test (RAST: Pharmacia, Uppsala, Sweden). For patients $\geqslant 5$ yrs of age lung function was measured (forced expiratory volume in one second expressed as a percentage of the predicted value (FEV1 % pred)) [27] and airways hyperresponsiveness was assessed by methacholine challenge, and expressed as provocative concentration causing a 20% fall in FEV1 (PD20) [28].

Education and treatment plan

During the prerandomisation visit, all patients and their caregivers received asthma education by the asthma nurse, including information about the mechanisms and triggers of the disease, use of controller and reliever medication, management of acute symptoms, advice on timing and reasons for medical consultation, and recommendations for environmental avoidance. Comprehensive inhalation instruction was given, and the patient's inhalation technique was repeatedly checked until correct. The initial visit to the clinic was concluded with the paediatrician discussing medical treatment with the patient and caregivers. Drug treatment for all patients included maintenance therapy with inhaled fluticasone propionate (200–500 $\mu g \cdot day^{-1}$), and use of inhaled salbutamol as needed for relief of symptoms. The dose of fluticasone propionate chosen was dependent on the dose prescribed by the general practitioner and the reported response to it. These drugs were prescribed by dry powder inhaler (Diskus™, GlaxoSmithKline, Zeist, The Netherlands) or by metered dose inhaler with spacer (Babyhaler™ or Volumatic™, GlaxoSmithKline, Zeist, The Netherlands), depending on the patient's age and the demonstrated ability to use the inhaler correctly.

Follow-up visits

Patients were randomised to follow-up by an asthma nurse or a paediatrician. Regular follow-up visits were scheduled for 1, 3, 6, and 12 months after randomisation. Additional follow-up visits were planned according to the judgment of the asthma nurse or the paediatrician. Patients were followed-up by the same healthcare provider throughout the study.

The asthma nurse could consult the paediatrician at all times for medical queries about patients under their follow-up. For patients followed-up by the paediatrician, intercurrent consultations by the asthma nurse were not allowed. The nurse-led asthma care was provided by two board certified asthma nurses who had at least 3 or 8 yrs experience with childhood asthma, respectively.

Adjustment of medication

At each visit, after evaluation of the level of asthma control, predefined adjustments of medication were made according to a protocol. The initial dose of fluticasone propionate was maintained during the first 3 months of the study if adequate control (little symptoms, a minimal use of salbutamol: $\leqslant 3$ times per week according to the diary; and no exacerbation of asthma in the last month) of the patient's asthma was achieved. At subsequent visits the dose was tapered off to the lowest effective dose required to maintain control. If the patient's asthma was considered to be inadequately controlled (frequent use of salbutamol; frequent or severe exacerbations of asthma) the dose of fluticasone propionate was doubled. In the remaining cases, the dose of fluticasone propionate was continued.

If asthma control could not be achieved with fluticasone propionate 500 $\mu g \cdot day^{-1}$ for patients treated by an asthma nurse, the paediatrician was consulted to judge if continuation of the study was acceptable.

Data collection

At each visit, a standardised history was taken. During the two weeks prior to each follow-up visit, patients kept a diary in which they recorded symptoms of asthma, and use of salbutamol. They were also asked to record all days of asthma related absence from school (patients $\geqslant 4$ yrs of age), use of concurrent medication, and extra visits to their general practitioner because of respiratory symptoms. These data were collected at each follow-up visit and double-checked by the healthcare provider.

Healthcare costs

The authors calculated all costs related to the outpatient management of children with asthma by either a paediatrician or an asthma nurse. The costs were split into two sections those which occurred within the healthcare sector and those that were incurred outside of it [29]. The costs within the healthcare sector included the following: 1) costs of prescriptions (fluticasone propionate, salbutamol, prednisolone, antibiotics); 2) outpatient visits to a paediatrican or an asthma nurse (including prerandomisation visit, educational session, and all follow-up visits); 3) visits to general practitioner because of respiratory symptoms; 4) emergency department visits; and 5) hospitalisations. Travel costs, and costs of production loss were defined as costs outside the healthcare sector. The number of days of absence from school was taken as a reference for the number of days lost from work or housekeeping by one of the caregivers [30].

The aim of this cost analysis was to assess the difference in costs between outpatient management of children with asthma by paediatrician or asthma nurse. Scheduled diagnostics (lung function at each follow-up visit and methacholine challenge tests) were not included. All costs are presented in Euros. Costs of visits to either the paediatrician or the asthma nurse were calculated based on hourly wages (€111.7 and €28.9, respectively). The initial visit to the paediatrician lasted 30 min and the standard educational session given by one of the asthma nurses lasted 45 min. The duration of all follow-up visits to the asthma nurses was recorded. A basis of 15 min was taken as a basis for calculating costs of follow-up visits to the paediatrician, as this is the standard time scheduled for follow-up visits in our outpatient clinic.

The cost of a course of prednisone was calculated based on a 5-day course of 2 $mg \cdot kg^{-1} \cdot day^{-1}$ (maximum 60 $mg \cdot day^{-1}$). Costs of antibiotics were calculated based on a 7-day course. Costs of medication (retail prices) were obtained from the Dutch Drug Compendium (2000) [31]. The cost of visits to the general practitioner (€17 per visit), travel costs (€0.12 per km), and costs due to loss of productivity (€8 per hour independent of paid or unpaid labour), were obtained from the Dutch Manual for Costing in Economic Evaluations [29].

Statistical analyses

The mean daily dose of fluticasone during the study was calculated (cumulative dose divided by treatment days) for each patient. From the diary, the mean percentage of symptom-free days and the percentage of rescue medication-free days were calculated for each patient. Patient characteristics are

Table 1. – Baseline characteristics of patients treated by paediatrician or an asthma nurse

	Paediatrician	Asthma nurse
Patients n	37	37
Age yrs	6.8±3.5	5.9±3.6
Sex		
Male	22	25
Female	15	12
% mild persistent asthma	24.3	18.9
% moderate persistent asthma	64.9	70.3
% severe persistent asthma	10.8	10.8
Allergy % positives	64.9	56.8
Family history of asthma % positive[#]	48.6	40.5
ICS dose in $\mu g \cdot day^{-1}$[¶]	204±198	238±233
FEV1 % predicted[+] (range)	98.7±11.9 (59.9–117.3)	96.6±15.6 (69.3–118.4)
PD20 geometric mean μg (range)	117.5 (9.1–1565)	64.6 (6.5–440)

All data are presented as mean±SD unless otherwise specified. ICS: inhaled corticosteroids (fluticasone equivalent) FEV1: forced expiratory breath in one second; PD20: provocative dose causing 20% fall in FEV1: [#]: parent or sibling diagnosed with asthma; [¶]: 78% of patients had already been prescribed inhaled corticosteroids (fluticasone propionate n=34, beclomethasone n=14, budesonide n=10); [+]: patients ⩾5 yrs of age performed lung function measurements (n=24 in paediatrician group, n=19 in asthma-nurse group).

presented as means±SD or proportions. Healthcare utilisation and costs are presented as medians and ranges. Differences in clinical characteristics and healthcare utilisation between groups were analysed using the Mann-Whitney U-test, and Chi-square test as appropriate.

Results

Baseline characteristics of the patients are presented in table 1. A total of 73 (98.6%) of the patients completed the study. Only one patient, randomised to follow-up by an asthma nurse, was excluded from the study after being diagnosed with tracheomalacia.

Healthcare utilisation

Healthcare utilisation for both treatment groups is presented in table 2. Asthma nurses asked patients to return for additional follow-up visits more often than did paediatricians ($p<0.001$). The mean (SD) duration of the first nurse-led follow-up visit was 29.0 (5.2) min. The second and third follow-up visits lasted 19.4 (7.2) and 18.3 (6.3) min, respectively. Subsequent nurse-led follow-up visits lasted approximately 15 min.

During the study, there were no hospitalisations or visits to the emergency department because of acute severe asthma. The mean (SD) total time spent on patient contact was 136 (14) min and 187(41) min for patients followed-up by paediatrician or asthma nurse, respectively ($p<0.001$).

There were no significant differences in utilisation of other healthcare resources. The mean overall healthcare costs (within and outside of the healthcare sector) per patient associated with both management approaches are presented in table 3. The only significant difference in costs between both treatment groups was the cost of outpatient visits. The asthma nurses consulted a paediatrician in 8.7% of all patients' visits. The paediatricians were most commonly consulted to perform a physical examination in cases of inadequate asthma control. The cost of these ad hoc consultations is accounted for in the cost of outpatient visits to the asthma nurse.

The costs of outpatient visits (including prerandomisation visit, educational session, and all follow-up visits) were statistically significantly lower (reduction of 17.5%) if follow-up was provided by an asthma nurse instead of a paediatrician ($p<0.0001$). Fluticasone propionate accounted for 95 and 95.9% of the total costs of medication for patients followed-up by an asthma nurse or paediatrician, respectively. Follow-up by an asthma nurse resulted in a reduction in costs of 7.2% within the healthcare sector. The overall healthcare costs were, on average, 4.1% lower for patients treated by an asthma nurse.

Cumulative costs of follow-up

Cumulative costs within the healthcare sector for both management approaches are presented in figure 1. For nurse-led care, the cost of a scheduled follow-up visit to the paediatrician at the end of the study is included in the cost of the first visit, as this was part of the standard care for patients followed up by an asthma nurse. Costs of nurse-led care are therefore higher at the start of the study compared to care by paediatricians alone. As is pointed out in figure 1, healthcare

Table 2. – Healthcare utilisation of patients followed-up by paediatrician and asthma nurse during 1-yr follow-up

	Paediatrician	Asthma nurse	p-value
Fluticasone propionate (daily dose)[#]	200 (0–636)	200 (0–500)	0.75
Salbutamol (daily use)	0.1 (0–3.4)	0.2 (0–1.1)	0.14
Prednisolone	0 (0–2)	0 (0–2)	0.37
Antibiotics[¶]	0 (0–2)	0 (0–4)	0.43
Additional outpatient visits	0 (0–2)	2 (0–5)	<0.0001
Extra visits to general practitioner	0 (0–3)	0 (0–3)	0.11
Hospitalisations	0	0	
Emergency department visits	0	0	

All data are presented as median(range). [#]: median daily dose during the study; [¶]: mean number of courses per pat during the study.

Table 3. – Healthcare costs per patient in Euros when followed-up by paediatrician and asthma nurse during 1-yr follow-up

	Paediatrician	Asthma nurse	p-value
Medication[#]	128.5 (0–473.2)	140.4 (0–276.6)	0.67
Outpatient visits	189.2 (105.4–245.0)[¶]	156.0 (105.4–199.3)[+]	<0.0001
Extra visits to GP	0 (0–48.9)	0 (0–48.9)	0.13
Total costs within healthcare sector	330.8 (105.4–695.0)	307.4 (112.6–480.6)	0.13
Productivity loss	0 (0–1344.0)	0 (0–1472.0)	0.74
Travel costs	17.3 (1.0–69.1)	23.6 (1.9–60.5)	0.12
Total costs outside healthcare sector	25.0 (1.0–1349.8)	35.5 (1.9–1513)	0.51
Overall healthcare costs	357.2 (116.4–1532.2)	342.6 (115.0–1865.3)	0.62

All data are presentated as median(range). [#]: cumulative costs of fluticasone propionate, salbutamol, prednisolone, and antibiotics. [¶]: includes prerandomisation visit, educational session, and all follow-up visits. [+]: includes prerandomisation visit, educational session, all follow-up visits, and consultations by paediatrician.

costs of nurse-led care start to be cost-saving compared to traditional medical care from 1.8 follow-up visits onwards.

A sensitivity analysis was performed to test several assumptions in the cost analysis. The impact of the duration of follow-up visits on the costs within the healthcare sector was assessed using two scenarios. The first scenario assumed that all follow-up visits to the asthma nurse lasted as long as standard follow-up visits to a paediatrician (15 min), while the second scenario assumed that they all lasted 30 min. The results demonstrate that nurse-led care was consistently cost-saving for these assumptions (fig. 1).

Discussion

This study shows that costs of nurse-led outpatient management of childhood asthma are lower than traditional asthma management by a paediatrician. Healthcare utilisation was comparable between patients followed-up by asthma nurse or paediatrician except for the number of follow-up visits. The reduction in costs of outpatient management was solely attributable to the implementation of a less expensive asthma specialist.

Asthma nurses spent significantly more time on patient contact than did paediatricians, to achieve the same level of control for their patients' asthma. This may be explained by the fact that asthma nurses not only discussed asthma management issues but also provided comprehensive patient education. During further follow-up, the mean time spent per patient contact was reduced.

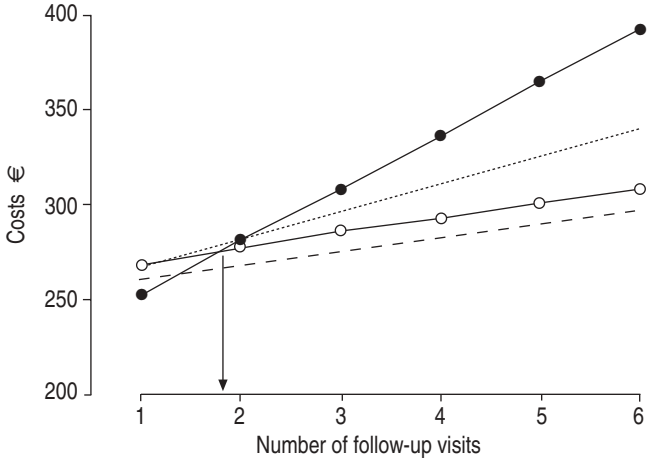

Fig. 1. – Cumulative costs of follow-up care by asthma nurse (○) and paediatrician (●). For nurse-led care, the cost of a follow-up visit to the paediatrician at the end of the study is included, as this was part of the standard care for patients followed-up by an asthma nurse. The arrow indicates where the line of nurse-led and paediatrician-led care intersect. From this point onward, nurse led follow-up is cost-saving. The costs of two scenarios, assuming that all follow-up visits to the asthma nurse lasted 15 min (– – –) and 30 min (·····), respectively, are also represented.

Although five visits were scheduled during the study period, the total number of visits was not limited during the study. This resembles everyday practice in which the frequency of return visits depends on the patient's severity of asthma, and on the clinical practice of the individual physician. In our clinic, newly referred patients, diagnosed with asthma, visit the outpatient clinic ~4 to 5 times during the first year. Healthcare costs of nurse-led care were higher compared to traditional medical care up to 1.8 follow-up visits. With more follow-up visits, nurse-led care was cost-saving even if the time spent on patient contact would be twice that of doctor's follow-up visits.

The authors believe that the reduction in healthcare costs associated with nurse-led asthma management is realistic and not restricted to this research setting. This is supported by the fact that only costs of outpatient visits were significantly different between these management approaches. As there is a substantial difference in hourly wages of specialised nurses and physicians, we have no reason to believe that in another healthcare setting nurse-led care will not be cost-saving. However, the macro-economic and socio-economic consequences of implementation of nurse-led outpatient management of childhood asthma need to be evaluated [32]. Firstly, it should be decided whether the reduction of healthcare costs is sufficient value for money to reallocate asthma management in secondary care from paediatricians to asthma nurses and whether the necessary investments in employing asthma nurses can be gained back by the expected cost savings in the long run. Secondly, patients and parents need to be willing to have their asthma managed primarily by an asthma nurse rather than by a paediatrician. This may require considerable public relations efforts, emphasising that this new approach to asthma management in secondary care will allow more children with asthma to be referred to secondary care and with less delay. This will result in earlier disease control which is undoubtedly an advantage for the patient's quality of life and to public health in general.

The cost analysis of this study may be limited to this specific population of children with asthma. More severe asthma might yield additional costs for controller and reliever medication, and possibly for visits to the general practitioner or hospital admissions. Earlier work has shown that hospital admissions and emergency department visits account for a substantial proportion of healthcare costs [33]. In the present study there were no hospitalisations or visits to the emergency department room for acute severe asthma, confirming that with the appropriate control of asthma, morbidity, hospitalisation

and emergency department visits can be reduced [17, 18]. For other populations with less optimal control the cost analysis may be less favourable. Additional long term studies are needed to confirm the findings of this cost analysis of nurse-led outpatient management in patients with more severe asthma.

Previous studies have evaluated the effect of educational intervention by asthma nurses on the costs of management of asthma both in children and adults [10, 12, 22–25]. The economical consequences of these interventions were inconclusive. Some of these studies reported a cost reduction [10, 12, 22, 23], whilst others found that extra investments were needed to achieve a reduction in healthcare utilisation of the patients [24, 25]. In these studies, however, the asthma nurse intervention was additional to the routine medical care. To the best of the authors′ knowledge this is the first study on childhood asthma in which traditional physician care was substituted by nurse-led care, resulting in a reduction of healthcare costs. This confirms previous studies in which nurse-led care in adults with selected chronic disorders in primary care was more cost-effective than traditional physician-led care [34–36]. In secondary care results in adults have been conflicting. Whilst costs of nurse-led follow-up care of patients with lung cancer were lower than those of conventional medical follow-up, [37] a nurse-led outpatient clinic for adults with bronchiectasis resulted in an increased use of healthcare resources. [38]

Conclusion

With the present study the authors demonstrated that nurse-led outpatient management of childhood asthma is cost-saving compared to traditional medical care. Previously, the authors showed that the efficacy of nurse-led management was comparable to management by a paediatrician in achieving disease stability, with similar improvements in airway hyperresponsiveness, and quality of life [26]. Implementation of such nurse-led outpatient follow-up care will have a considerable impact on the use of healthcare resources for this population of children with asthma. In addition to a reduction in costs of outpatient follow-up, a nurse-led asthma clinic allows the paediatrician to see more newly referred patients, and reduce waiting lists.

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