

Cost-effectiveness of asthma clinic approach in the management of chronic asthma in Australia

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Asthma is a significant chronic health problem in Australia and its control is considered a national priority.¹⁻³ In 2003, the prevalence of asthma in Australia was estimated at 6.8%, affecting around 1.3 million people and contributing about 2.4% of total burden of disease.⁴ Asthma is responsible for a high number of hospitalisations, visits to general practitioner (GP) clinics and emergency departments^{1,2} and associated high costs. Public expenditure on asthma was estimated at \$606 million or 1.2% of total allocated healthcare expenditure in Australia in 2004/05.³

Asthma is inadequately controlled in Australia, despite effective drugs being available and optimal self-management is one of the strategies recommended to improve asthma management.⁵ This strategy has four components:^{6,7} a) asthma education; b) self-monitoring of symptoms or peak expiratory flow using a peak flow meter; c) regular review of asthma severity and treatment by a medical practitioner; and d) a written asthma action plan. The uptake of optimal self-management has declined in the past decade and remains sub-optimal. For example, in South Australia, uptake decreased from 40% in 1995 to 20% in 2001.² At a national level, less than one-quarter of asthma patients had a written asthma action plan in 2004.³ This indicates that a new approach is required to improve asthma self-management in Australia.

The asthma clinic is a recognised concept for asthma management in the UK.^{8,9} Asthma control is best achieved by a combination of a patient-oriented and disease-oriented approach.¹⁰ A nurse-run clinic within a GP service gives an opportunity for such an approach. In this paper, we have modelled the cost-effectiveness of optimal self-management using an asthma clinic approach in Australia in comparison to current practice.

Methods

A randomised controlled trial to explore the feasibility of optimal self-management using the asthma clinic approach was conducted in Australia in 1999.⁸ This trial was used as an operational model for costing asthma clinics in Australia. The effectiveness of such an asthma clinic intervention is estimated based on a Cochrane review for optimal self-management.⁷ As the intervention has immediate benefit, and because there is no evidence of impact on mortality, we deemed it reasonable to model the cost and outcome over a one-year period.

This cost-effectiveness study was part of the larger economic evaluation study 'Assessing Cost-Effectiveness (ACE) Prevention' which uses a healthcare perspective (all healthcare costs are accounted irrespective of who pays for it) and a 3% discount rate.^{11,12} As a part of standardised study protocol, this economic evaluation used 2003 prices to make it

Abstract

Objectives: To compare cost-effectiveness of an asthma clinic that would provide education, promotion of self-monitoring of symptoms, regular review of treatment by a medical practitioner and a written asthma action plan to current practice in Australia.

Methods: A decision tree model was used to compare treatment and improved management using asthma clinics under three scenarios: 1) intervention reduces only emergency department visits; 2) in addition, it leads to a reduction in days out of role; and 3) it also reduces unplanned general practitioner visits and hospitalisations. Evidence from existing published studies was used for asthma incidence, duration, treatment practices and health seeking behaviours. Costs for one year were estimated based on an asthma clinic trial in Australia.

Results: The estimated \$274 million annual cost of asthma clinics is much greater than the potential cost savings of \$11 million resulting from reduced emergency department visits, and an overall potential cost saving of \$85 million resulting from decreased GP visits and hospitalisations. The incremental cost-effective ratio (ICER) is \$24,000 if a reduction in days out of role is quantified as a health benefit in estimating disability-adjusted life years (DALY). If a potential \$85 million in cost-savings from decreased emergency department visits, GP visits and hospitalisation is taken into account, the ICER drops to \$17,000 per DALY averted.

Conclusions: An asthma clinic as an intervention for improving self-management may be cost-effective in Australia if multiple benefits can be achieved.

Implications: A large-scale asthma clinic trial and long-term evaluation of benefits are necessary to obtain stronger evidence on the benefit of asthma clinic approach in Australia.

Key words: asthma clinic, cost-effectiveness, optimal self-management

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comparable to other economic evaluations conducted under that project. The protocol assumed '\$50,000 per DALY prevented' as a threshold to determine whether an intervention was 'cost-effective'. This cut-off point was based on available empirical evidence on public health funding decisions and recommendations by the Pharmaceutical Benefits Advisory Committee.^{12,13}

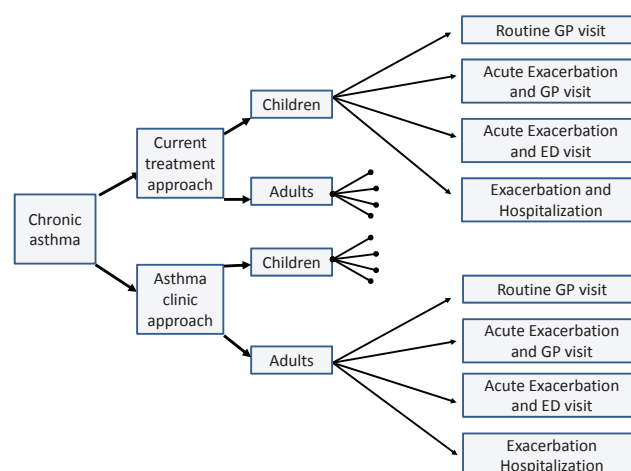
Model

As our analysis is driven by the structure of the asthma clinic in an Australian trial⁸ we have represented the yearly cost and outcomes of the trial in a simple decision tree model (Figure 1). Our economic evaluation model has two arms: one for current practice of asthma management, and the other for the proposed scenario of an asthma clinic approach. Each arm has four probable events for children and adults: routine GP visits, unscheduled GP visits, emergency department visits and hospitalisations. These events are not mutually exclusive; an individual may have more than one event in the one-year period. Mortality due to asthma is not accounted in the model for two reasons. First, we do not have any evidence for the impact of optimal self-management on mortality. Second, the asthma mortality rate in Australia has been declining rapidly³ and is very low over a one-year period in our model. Mortality from other causes was not considered because it is common to both arms.

Current treatment

Current treatment was quantified based on the proportion of people having symptoms of asthma, the number of visits

Figure 1: Decision tree model for the economic evaluation of asthma clinic intervention.



made¹⁻³ to GP clinics and emergency departments, and number of hospitalisations from a nationwide telephone interview conducted between December 2003 and January 2004¹⁴ (Table 1).

Asthma clinic approach (intervention)

In the intervention arm, we assumed the asthma clinic operated in GP practices and would constitute an education session by a practising specialist nurse followed by a GP consultation.⁸ The

Table 1: Parameters used in cost-effectiveness analysis of asthma clinic approach for chronic asthma management in Australia.

Parameters	Mean Value (95%CI)	Distribution	Reference
Probability			
Australian population (2003)	19,881,469	-	15
Number of Asthma cases (2003)	1,321,041	-	4
GP asthma clinic encounter/100 Australian population (2002-03)	12	Beta	2
Routine GP visits/person/year (base case)	1.8	-	2, 4, 15
Routine GP visits/person/year (intervention)	4.7	Gamma	8
Number of unscheduled GP visits/ year (base case)			
children	0.43	Dirichlet	14
adults	0.27		
Number of emergency department visits/year (base case)			
children	0.24	Dirichlet	14
adults	0.14		
Number of hospitalisations/year (base case)			
children	0.08	Dirichlet	14
adults	0.08		
Intervention effectiveness			
Acute exacerbation and GP visits	0.73 (0.59-0.91)	Lognormal	7
Acute exacerbation and emergency department visits	0.78 (0.67-0.91)	Lognormal	7
Acute exacerbation and hospitalisations	0.58 (0.44-0.77)	Lognormal	7
Disability weight (DW)			
Days out of role (used on disability weight)	0.81 (0.65-1.01)	Lognormal	7
DW-adults (base case)	0.07	Beta	4, 14, 16
DW-children (base case)	0.052	Beta	
DW-adults (intervention)	0.061	Beta	4, 14, 16
DW-children (intervention)	0.047	Beta	

GP=general practitioner; CI= confidence interval

session would include spirometry, instruction on using peak flow meters and inhalers, a written asthma management plan and provision of an asthma diary card. The asthma clinic was assumed to be operational for three hours a week and providing three asthma sessions of one-hour per person over a six-month period.

Effectiveness

The Cochrane review on the benefits of optimal self-management of asthma on emergency department visits, hospitalisations, unscheduled GP visits and days out of role (Table 1) showed variable results.⁷ The review presented the efficacy results in two methods: percentages of subjects involved and mean number of days/visits. The benefit on emergency department visits was consistent in both methods. The hospitalisations and unscheduled GP visits benefits were significant when expressed as a percentage but not in terms of number of visits. The benefit on days off from work was inconclusive in both the methods. As the 95% confidence interval just spanned unity, we used the measure with its uncertainty interval in the model. The effectiveness data presented here accounts for treatment compliance failure as the patient dropout rate ranged from 0 to 54%⁷ in the papers reviewed.

Prevalence

The prevalence of asthma was derived from the Australian Burden of Disease study conducted in 2003, polling prevalence studies based on a positive airway hyper-responsiveness test and wheezing in the past 12 months.⁴

Routine GP visits

The Australian Centre for Asthma Monitoring has reported that the annual number of GP visits for asthma-related problem is equal to 12% of Australian population in 2003² (Table 1). This translates into 1.8 GP visits per person with asthma per year.^{2,4,14} For the intervention arm, we used 4.7 GP visits per person per year based on the asthma clinic trial.⁸

Disability weight

The disability weight (DW) for symptomatic asthma (0.229) was derived from the Australian Burden of Disease study⁴ which had

estimated DW using a regression model based on the Survey of Disability, Aging and Carers conducted by Australian Bureau of Statistics in 1998. The disability weight for asymptomatic asthma (0.03)¹⁴ was obtained from a Dutch study.¹⁶ A telephone survey in Australia estimated 20% of adult days and 11% of child days were symptomatic.¹⁴ We adjusted the combined DW for the proportion of time adults and children were symptomatic (20% and 11%) and asymptomatic (80% and 89%) to obtain a final combined DW of 0.07 for adults and 0.052 for children (Table 1). We have considered the relative risk (RR) of optimal self-management on days out of role (RR=0.81; 95%CI=0.65-1.01) as a proxy for the improvement in the quality of life and applied it to the 20% and 11% symptomatic adult and child days respectively and derived a final intervention disability weight of asthma of 0.061 for adults and 0.047 for children. Thus, the disability weight used for the intervention arm is dependent on the RR for optimal self-management on days out of role and thereby accounts for improved quality of life due to reduced emergency department visits and reduced hospitalisations.

Cost estimation

Intervention costs were calculated as per the Australian asthma clinic trial⁸ (Table 2). In the trial, 69% of chronic asthma patients completed three sessions, 13% attended none and the rest attended one to two sessions.⁸ Based on this, we calculated 6.4 hours of nurse time per person per year. The hourly wage of nurses was estimated based on a salary survey from 2005,¹⁷ whereas a GP consultation charge was calculated as per the Australian Medical Benefit Scheme guidelines.¹⁸ The emergency department visits and hospitalisation costs in two age categories were obtained from Australian hospital statistics for public hospitals.¹⁹ Since GP consultation fee, emergency department visit and hospitalisation costs are deterministic under the Australian Medical Benefit Scheme, no probabilistic distribution patterns were assigned to them as a standardised methodology under ACE Prevention Project.

The cost of accommodating an asthma clinic was not calculated separately because the clinical trial on which costing was based had used existing space in GP clinics for the sessions. Furthermore, the space cost for an asthma clinic is built into the GP consultation charges and there is some evidence that GP practices accommodating

Table 2: Cost calculations used in cost-effectiveness analysis of asthma clinic approach for chronic asthma management in Australia.

Cost item	Value (LL, UL); distribution	Reference
GP consultation cost	\$30.2	18
ED visits cost (age <50 years)	\$301	19
ED visits cost (age >49 years)	\$346	19
Hospitalisation cost (age <50 years)	\$1,655	19
Hospitalisation cost (age >49 years)	\$2,509	19
Hourly cost of nurse	\$24.46 (\$15.72, \$42.0); Triangle	17
Hours of nurse session/person/year	6.4; Gamma	8
One way travel cost per GP visit	\$3.7 (\$2.2, \$5.2); Triangle	22, 23
Travel time for GP visit	15 min (5,25); Triangle	estimate
Waiting time for GP visit	30 min (20,40); Triangle	estimate
Hourly wage of a patient	\$17.44 (\$12.44,\$24.44); Triangle	24

LL= lower limit; UL=upper limit; GP=general practitioner; ED=emergency department

asthma clinics have more scheduled visits compared to clinics without asthma clinics,²⁰ which would offset some of the space cost. The cost of a spirometer was not accounted for, as it was not provided under the trial and we assumed a GP clinic would have one as part of routine management of chronic asthma. The cost of increased medication consumption due to the intervention was not calculated as per the evidence available from a Norfolk, UK, study.²¹ This study had reported that an increase in consumption of regular bronchodilators in the intervention was compensated by a decrease in consumption of oral steroids and acute nebulizers, with no net change in medication cost.

As the Australian asthma clinic trial lasted only six months, we have annualised the costs. Year 2003 prices were used as a reference for cost estimation.¹¹ Cost-effectiveness was estimated with and without travel and patient time costs estimated, as shown in Table 2.

Uncertainty analysis

Because of the ambiguity in measures of benefit, a sensitivity analysis was conducted in three scenarios:

Scenario 1 (emergency department visit benefit only): This scenario assumed the intervention had benefits only on reducing emergency department visits, but not on health outcomes. Therefore, the analysis was reduced to that of a cost difference between current practice and intervention.

Scenario 2 (emergency department visit and health benefit): This scenario assumed the intervention had benefits on reducing the emergency department visits and days off from work. The benefits on days out of role were applied as a proportional reduction in disability weights.

Scenario 3 (complete benefit): This scenario assumed the intervention had benefits on reducing the emergency department visits, unscheduled GP visits, hospitalisations and days out of role.

The assumptions of using effectiveness results from the Cochrane review, which predominantly came from an adult population, were tested in sensitivity analysis by estimating separate cost-effectiveness ratio for children and adults.

The uncertainty analysis was done in Excel 2003 with Ersatz 1.1 boot strap add-in for Monte Carlo simulation.²⁵

Results

Costs and incremental cost-effectiveness ratio (ICER)

A national implementation of the asthma clinic intervention would cost \$274 (95%CI=\$203-\$360) million annually with \$11 million as a cost offset in the first two scenarios and \$85 million in the third (Table 3). The ICER is \$24,000 and \$17,000 per DALY averted in Scenario 2 (reduction in emergency department visits and health benefit) and in Scenario 3 (with additional reductions in unscheduled doctor visits and hospitalisation) respectively. Inclusion of time and travel increases ICER.

A separate analysis segregating children and adults did not show much difference in the cost-effectiveness between the two groups, although cost-effectiveness ratio was better in adults compared with children (Table 3). This was because about 85% of overall costs and 91% of intervention benefits occurred in adults.

Cost-effectiveness plane

The Monte Carlo simulation results from 2,000 iterations are presented in a cost-effectiveness plane²⁶ along with a \$50,000/DALY threshold line of willingness to pay (Figure 2). The results on the right-hand side of this threshold line are cost-effective and the ones on the left are cost-ineffective. The graph shows some results on the left of y-axis, which indicates a small probability (0.6%) of health loss with a net additional cost of intervention.

A total 91% of situations in Scenario 2 (reduction in emergency department visits and health benefit) and 96% of situations in Scenario 3 (with additional reductions in unscheduled doctor visits and hospitalisation) are cost-effective at \$50,000/DALY threshold limit, when time and travel costs are excluded. The probability of becoming cost-effective decreases further when time and travel costs are included (Table 3).

Multivariate sensitivity analysis

The main variable driving the uncertainty in the results in all three scenarios are the nurse's salary, the duration of asthma sessions and the relative risk of intervention on days out of role.

Table 3: Median costs and incremental cost-effectiveness ratio for three scenarios under asthma clinic approach.

Costs and benefits	Scenario-1 (emergency department visit benefit only) (95%CI)	Scenario-2 (emergency department visit and health benefit) (95%CI)	Scenario-3 (complete benefit) (95%CI)
Cost offset-all	-\$11 (-\$17 to -\$5)	-\$11 (-\$17 to -\$5)	-\$85 (-\$118 to -\$57)
Net cost-all (million \$, without time and travel cost)	263 (192-351)	263 (192-351)	189 (110-280)
Health benefit-all (DALY)	-	11,000 (2,000-19,000)	11,000 (2,000-19,000)
ICER (without time and travel cost) – all	-	24,000 (12,000-93,000)	17,000 (7,000-66,000)
ICER (without time and travel cost)	-		
Adults (15+)		22,000 (11,000-82,000)	15,000 (6,000-59,000)
Children (0-15)		39,000 (20,000-142,000)	25,000 (9,000-99,000)
ICER –all (with time and travel cost)	-	30,000 (16,000-124,000)	20,000 (9,000- 82,000)
Probability acceptability at \$50,000/DALY threshold – all	-		
Without time and travel cost		91%	96%
With time and travel cost		84%	94%

CI=confidence interval; DALY=disability adjusted life years; ICER= incremental cost- effectiveness ratio



Figure 2:
Incremental cost-effectiveness ratio presented in cost-effectiveness plane.

Discussion

An asthma clinic intervention to improve optimal self-management could be cost-effective in Australia, when presumed benefits on unscheduled GP visits, emergency department visits, hospitalisations and days out of role are taken into account. Although this presumed health benefit leads to some cost saving on balance, it needs a lot of additional money to implement the asthma clinic intervention.

A previous study in Australia had analysed the cost-effectiveness of optimal management and current practice compared to no treatment for asthma.²⁷ The ICER was \$7,000 per DALY for optimal management and \$14,000 per DALY for current practice compared to no treatment. However, the study assumed an improvement in the service delivery and treatment adherence to optimal levels without any intervention, which is unlikely to happen. Instead, we have costed an asthma clinic intervention as a practical approach for service delivery to improve asthma management. Inclusion of intervention costs makes our ICER higher than reported by Simonella et al.²⁷

The main limitation of our study is the ambiguity in the evidence on health outcomes and cost consequences from the Cochrane review.⁷ The evidence on unscheduled GP visits and days out of role was less robust with fewer than five studies in the review. We have tried to deal with this by a rigorous quantification of uncertainty and by presenting results for three scenarios of presumed benefits. Furthermore, the Cochrane review intervention effectiveness includes studies recruiting patients from hospitals, EDs or outpatient clinics, which are likely to have higher baseline morbidity than the general population. The impact of intervention in the general population could therefore be lower in Australia. Similarly, the Cochrane review presented intervention benefits in adults, while

we applied it across age groups. The benefits – as well as costs – could be different for children and adults, which was not adequately accounted in our analysis due to lack of data. However, our subgroup analysis showed that an asthma clinic intervention is similarly cost-effective in both adults and children.

The cost estimates were based on a small asthma clinic trial and therefore may not reflect the true costs of national implementation. Furthermore, the cost of up-skilling the nurse practitioners to deliver the intervention were not included as it was assumed that trained nurses were available for the intervention. One of the key drivers of cost-effectiveness, the hourly salary of nurses, is demand-driven and may increase when there is a high demand for nurses for asthma clinics. Another key cost-driver, the duration of an asthma clinic, may differ in different settings. Besides the feasibility of a large-scale asthma clinic approach, the availability of trained nurses and GP acceptance and willingness for the asthma clinic need to be evaluated. Additionally, demographic characteristics such as income and employment, and distance from the facility, are likely to affect the uptake of the program from the patient side, which will vary across the country.

In conclusion, an asthma clinic as an intervention for improving optimal self-management, could be cost-effective in Australia when multiple benefits are considered. A large-scale asthma clinic trial and evaluation of long-term benefits are necessary to strengthen the evidence base.

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