

Understanding the economic burden of asthma

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The economic impact of asthma is large and growing, and the use of economic outcomes is increasing. Such outcomes serve as the basis for studies of the efficiency of care and are being reported increasingly as outcomes of clinical trials. This article presents the basic components of a cost-of-illness study, the influences that have an impact on these components, the relation of economic indicators to clinical outcomes, and the relative importance of the economic factors for differing groups in society. (*J Allergy Clin Immunol* 2001;107:S445-8.)

Key words: *Cost-of-illness study, direct costs, incidence, indirect costs, prevalence*

Asthma is an important health problem in the United States. In the 1995 National Health Interview Survey, approximately 15 million individuals identified themselves as asthmatics, with approximately 5 million being under the age of 18 years.¹ Asthma morbidity and mortality have increased dramatically in the United States during the last 20 years.² The total cost of asthma in the United States was estimated to be \$4.5 billion in the mid-1980s, whereas in the first half of the 1990s, the estimate increased to a range from \$6.2 to \$10.7 billion (Table I),³⁻⁵ with approximately one third of the costs being attributed to individuals younger than 18 years of age. In the light of the large and growing economic impact of asthma, research on the use of economic outcomes is increasing.

To effectively and correctly use economic outcomes, one must understand how to study the economic impact of a disease through the use of a cost-of-illness study, which is the first step in any economic evaluation of a disease. This article will present the basic components of a cost-of-illness study, the factors that can influence these components, the relation of economic indicators to clinical indicators, and the relative importance of the economic indicators for differing groups in society.

DEFINITION

There are 2 types of cost-of-illness studies: prevalence (the most commonly used) and incidence. In a prevalence cost-of-illness study, the cost of an illness in a population is

measured over a defined period of time, usually a year. Both incident (new) and prevalent (pre-existing) cases are included in this type of analyses. The data available in most administrative databases and government surveys lend themselves to prevalence types of analyses. In an incidence cost-of-illness survey, only new cases appearing during a defined period of time are included. The lifetime cost of the disease is then tracked for those individuals in whom the disease develops during this time period. Both types of studies give an indication of potential cost savings if a disease were eliminated. An incident cost-of-illness study is difficult to perform, however, because accurate knowledge of the natural history of a disease is often lacking, and pre-existing data sets are not designed to allow for this type of analysis.⁶

Two types of costs contribute to the total cost of an illness: direct and indirect. Both types of costs are relevant to this discussion.

DIRECT COSTS

Direct costs include both medical and nonmedical expenses associated with the disease. Medical direct costs include those expenses generated in the disease's prevention, treatment, and rehabilitation. Examples include hospital services, physician services, medications, and diagnostic tests. Nonmedical direct costs include such things as transportation to and from the health provider and purchase of home health care such as wheelchairs, nebulizers, special diets, and help in the home. Other direct costs that usually are not available in existing data sets include over-the-counter medications, alternative or complementary medical services, costs of medical facility construction, disease-specific research, and the cost of training the medical practitioners treating the disease.

The leading contributors to the direct medical cost of asthma in the United States are hospitalization costs and medication, representing approximately two thirds to three quarters of total direct costs.³⁻⁵ Inpatient costs were the leading contributor to direct medical expenses, but estimates based on 1994 data reported medication costs exceeding hospital costs.⁵ Outpatient visits for asthma, in either the office or hospital outpatient department, range from 13% to 23%. Emergency department visits contribute approximately 8%. If one focuses on narrower age ranges, however, important differences can appear. Among children 0 to 4 years of age, 74.1% of direct medical costs were contributed by hospitalizations, whereas among 5- to 17-year-olds, the amount was 34.1%. In contrast, medication costs were only 6.1% of direct medical costs among 0- to 4-year-olds versus 22.3% among 5- to 17-year olds.⁴ Awareness of these cost differences by age group can guide efforts to reduce the costs of asthma.

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TABLE I. Cost (in millions) of asthma in the United States, 1980s and 1990s

	1985	1990	1994
Direct medical costs			
Hospital care			
Inpatient	1,058.8	1,559.6	1,799.9
Emergency department	200.3	295.0	478.6
Outpatient	129.2	190.3	633.0
Physician services			
Inpatient	81.3	146.0	96.7
Outpatient	193.3	347.0	647.4
Medications	712.7	1,099.7	2,452.0
Total direct medical costs	2,375.6	3,637.6	6,107.6
Indirect costs			
School days lost	726.1	899.7	956.7
Loss of work			
Outside employment	284.7	346.3	1,340.6
Housekeeping	406.0	503.0	727.2
Mortality	676.3	819.3	1,616.2
Total indirect costs	2,093.1	2,568.4	4,640.2
All costs	4,468.7	6,206.0	10,748.3

Data from: Weiss KB, Gergen PJ, Hodgson TA. *N Engl J Med* 1992;326:862-6; and from Weiss KB, Sullivan SD, Lyttle CS. *J Allergy Clin Immunol* 2000;106:493-9.

International comparisons of direct medical costs are hindered by the inability to directly relate costs from one country to another. More meaningful information can be obtained by looking at percent contributions of the various components of direct medical costs. Contrasting the 2 population-based studies done in the United States^{3,4} with a study of a US Health Maintenance Organization,⁷ and studies from Canada⁸ and Australia,⁹ an intriguing difference appears (Table II). The percent of direct costs associated with hospitalization costs appears to be inversely correlated with the percent of direct costs associated with medications. This relationship may reflect the well-known fact that adequately managed asthma can reduce hospitalizations.¹⁰ In general, adequate treatment would imply an increase in medication costs, because most asthmatic patients tend to be undertreated.¹¹ Further support is given to this relationship by a more recent report of asthma costs from the mid-1990s in the United States, which reported medication costs increased while hospitalization costs decreased since the mid-1980s.⁵

A number of caveats must be kept in mind when direct costs are being evaluated. Although the term "cost" has been used throughout this article and is used in most economic evaluations, the economic values are usually set by charges because actual cost data are not available. There is no fixed relation between charges and costs. Charges are inflated over cost to account for such things as unpaid debt, future replacement costs, and disallowed charges.¹² Another important influence is the selection of which cost to use in setting an economic value on a good or service. This selection can influence the dollar amount of direct cost and its applicability to a population. For example, in 1995 the per diem cost of asthma hospital treatment varied greatly across the United States, ranging from \$1319 in the East South Central Region to \$2395 in the Pacific Region, with the US average beginning at \$1640.¹³ Obviously, the use of the US average in a high-cost region would underestimate the economic importance of hospitalization.

The presence of comorbidities such as sinusitis can make asthma harder to control and thus generate more direct medical costs. When one compares the direct medical costs of one disease versus another, asthma versus sinusitis for instance, the argument could be made that part of the "excess" cost of asthma resulting from the coexistence of sinusitis should more correctly be assigned to sinusitis rather than asthma. A cost-of-illness study of sinusitis took this approach and estimated that 10% of the direct medical cost of asthma could be assigned to sinusitis.¹⁴ The distribution of severity in the groups studied, especially in subnational studies, can greatly influence the direct costs. A study in Northern Spain reported that for every dollar spent on medical costs for patients with mild asthma, \$1.80 was spent for patients with moderate asthma, and \$4.79 was spent for patients with severe asthma.¹⁵ A German study reporting only direct medical costs found that among children, for every deutsche mark spent on patients with mild asthma, DM 1.09 was spent for patients with moderate asthma and DM 1.63 for patients with severe asthma.¹⁶

INDIRECT COSTS

Indirect costs measure a different aspect of the impact of asthma. Indirect costs are sometimes called opportunity costs and are the value of resources lost as a result of time absent from work or other usual daily activity as a result of illness. Hodgson⁶ defined indirect costs as "output lost because of cessation or reduction of productivity due to morbidity or mortality." Indirect costs include days missed from work, including both outside employment and housework, school days lost (caretaker needs to refrain from usual daily activities to care for the child), and loss of future potential earnings as a result of premature death. Other types of indirect costs that are not usually included are the impact on the quality of life on the family as a result of illness of one member or reduced productivity at work as a result of illness in oneself or a family member.

TABLE II. Components of asthma direct medical costs: different systems of care

	Hospital	Outpatient care (emergency department and office/clinic)	Medication
United States-Population studies			
Weiss	46.9%	22.9%	30.2%
Smith	54.4%	29.7%	15.9%
United States-Health Maintenance Organization			
Stemple*	32%	29%	38%
Canada			
Krahn*			
Low estimate	26.9%	28.9%	40.9%
High estimate	20.5%	45.9%	31.1%
Australia			
Mellis	13.1%	29.8%	57.1%

Data from: Weiss KB, Gergen PJ, Hodgson TA. N Engl J Med 1992;326:862-6; Smith DH, Malone DC, Lawson KA, Okamoto LJ, Battista C, Saunders WB. Am J Respir Crit Care Med 1997;156:787-93; Stempel DA, Hedblom EC, Durcanin-Robbins JF, Sturm LL. Arch Fam Med 1996;5:36-40; Krahn MD, Berka C, Langlois P, Detsky AS. Can Med Assoc J 1996;154:821-31; and Mellis CM, Peat JK, Bauman AE, Woolcock AJ. Med J Aust 1991;155:522-8.

*Total does not equal 100% because some of direct costs were assigned to a Miscellaneous category.

Indirect costs are not included in many cost-of-illness analyses because existing data sets do not routinely collect this type of information. A large portion of the indirect costs depends on self-report, which can be influenced by one's perception of an illness and social support network. For example, some persons will go to work regardless of their state of health, whereas others will take a sick day with the first sniffle. Also, the type of child care available to a family can determine whether an illness in the child will result in lost productivity for the parents.

The human capital approach is used to assign an economic value to the wages lost to morbidity and premature mortality. This approach assigns a salary level for lost wages based on the salary level of other individuals in the reference population with similar sociodemographic characteristics, including education and training. This approach tends to assign a lower value of lost wages to women and minorities.⁶

Morbidity costs are the most important component of indirect costs, contributing approximately two thirds to three quarters of the total indirect cost of asthma.^{3,5,8} In the group under 18 years of age, in which relatively few asthma deaths occur, morbidity costs make up approximately 80% to 90% of indirect costs.^{3,5} When looking at nonmortality-related indirect costs for all ages, combined days of school lost contribute between one third to one half of the indirect cost attributed to morbidity, with losses in employment both inside and outside of the home making up the rest.³⁻⁵ When indirect costs associated with employment are further dissected, the economic value of housework lost was reported to range from 24% to 28% of the nonmortality-related indirect costs associated with asthma.^{3,5}

RELATIVE IMPORTANCE OF DIRECT AND INDIRECT COSTS

Both direct and indirect costs are important contributors to the total cost of asthma (Table III). Indirect costs contribute approximately 40% of the total cost of asthma

TABLE III. Relative importance of direct and indirect costs: All ages

	Direct (%)	Indirect (%)
Mortality included in indirect costs		
United States (Weiss)	58.6	41.4
Canada (Krahn)		
Low	59	41
High	61.1	38.9
Mortality not included in indirect costs		
United States (Smith)	88.4	11.6
New South Wales, Australia (Mellis)	77	23
Switzerland (Szucs)	61	39
Singapore (Chew)	50.8	49.2

Data from: Weiss KB, Gergen PJ, Hodgson TA. N Engl J Med 1992;326:862-6; Krahn MD, Berka C, Langlois P, Detsky AS. Can Med Assoc J 1996;154:821-31; Smith DH, Malone DC, Lawson KA, Okamoto LJ, Battista C, Saunders WB. Am J Respir Crit Care Med 1997;156:787-93; Mellis CM, Peat JK, Bauman AE, Woolcock AJ. Med J Aust 1991;155:522-8; Szucs TD, Anderhub H, Rutishauser M. Eur Respir J 1999;13:281-6; and Chew F-T, Goh DY-T, Lee B-W. Aust N Z J Med 1999;29:228-33.

in population studies from the United States and Canada,^{3,8} whereas for other studies from the United States and around the world that did not include mortality in the estimates of indirect costs, the range was somewhat lower, from 12% to 49%.^{4,9,17,18}

COST AS OUTCOME

Both direct and indirect costs have a very important role to play in outcomes research. It is important, however, to understand the limitation of economic outcomes. Significant cost savings can be realized without changing the clinical course of the disease. For example, a study looking at the impact of an asthma intervention based on peak flow monitoring found a reduced emergency department use among members of the intervention group, resulting in a significant cost savings. Yet other

indicators of asthma activity (reported waking at night with asthma, β -agonist use, self-reported asthma severity) were not different between the intervention and control groups.¹⁹ Furthermore reported cost savings do not necessarily represent long-term effectiveness. For example, an intervention aimed at asthmatic patients seen in an emergency department was able to reduce emergency department use for only the first 4 months of a 1-year follow-up, even though an evaluation of the intervention over the 1-year period appeared to be cost-effective.²⁰

For 2 reasons, caution is warranted when economic data are used to identify individuals for targeting an intervention. First, costs are not evenly distributed across the population of asthmatic persons. In a nationally representative study in the United States, 80% of the resources were used by 20% of the asthmatic persons,⁴ whereas in a practice-based study in Northern Spain, 14% of asthmatic persons accounted for 47% of the cost of asthma.¹⁵ Thus a population with high asthma costs may be driven by relatively small subgroups, and an intervention aimed at the whole population will not be as effective as identifying high users. Unfortunately, even when high users are identified, there is no certainty that this high level of resource use will continue. For example, in an observational study among 0- to 16-year-old children participating in the Medicaid program in Allegheny County, Pennsylvania, only 30% of the extra-high users of hospital services remained extra-high users the next year; 57% had become low users.²¹

Although a cost-of-illness study gives a perspective on the economic burden of asthma in a population, it does not reflect what is happening with the individual patient or family unit. Few studies have recorded the expenses of individual families, but the 2 that have reported the impact of asthma suggest that the expenditures for asthma can range up to 30% of the family gross income.^{22,23}

CONCLUSIONS

The importance of economic outcomes will continue to grow in the foreseeable future. They will be used for 2 reasons: to determine whether an effective treatment is also a cost-efficient treatment and to allow government and health care delivery organizations to ensure appropriate use of resources. It should always be kept in mind that a positive economic outcome is not necessarily synonymous with a positive clinical outcome.

Many factors influence the economic impact of an illness, such as which cost components are included in the analyses, the cost assigned to these components, and the population studied. Failure to take these differences into account can make any comparison across studies misleading.

When economic outcomes are used, it is important to understand the target audience and where the level of impact will be. If one looks at economic costs from a societal perspective, both direct and indirect costs are important. From a payer/provider perspective, the direct costs tend to carry greater weight because these costs

influence the cost of doing business. As patient satisfaction increases in importance as a guide to care, however, indirect costs take on a greater importance. At the family/individual level, direct costs matter only as a function of insurance coverage: the more extensive the coverage is, the less important they are. Indirect costs have a much greater impact on individuals and families, because these costs reflect the functioning and quality of life of the individual and the family in the presence of this disease.

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