

The public health implications of asthma

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Abstract Asthma is a very common chronic disease that occurs in all age groups and is the focus of various clinical and public health interventions. Both morbidity and mortality from asthma are significant. The number of disability-adjusted life years (DALYs) lost due to asthma worldwide is similar to that for diabetes, liver cirrhosis and schizophrenia. Asthma management plans have, however, reduced mortality and severity in countries where they have been applied. Several barriers reduce the availability, affordability, dissemination and efficacy of optimal asthma management plans in both developed and developing countries. The workplace environment contributes significantly to the general burden of asthma. Patients with occupational asthma have higher rates of hospitalization and mortality than healthy workers. The surveillance of asthma as part of a global WHO programme is essential. The economic cost of asthma is considerable both in terms of direct medical costs (such as hospital admissions and the cost of pharmaceuticals) and indirect medical costs (such as time lost from work and premature death). Direct costs are significant in most countries. In order to reduce costs and improve quality of care, employers and health plans are exploring more precisely targeted ways of controlling rapidly rising health costs. Poor control of asthma symptoms is a major issue that can result in adverse clinical and economic outcomes. A model of asthma costs is needed to aid attempts to reduce them while permitting optimal management of the disease. This paper presents a discussion of the burden of asthma and its socioeconomic implications and proposes a model to predict the costs incurred by the disease.

Keywords Asthma/epidemiology/therapy/economics; Workplace; Disease management; Epidemiologic surveillance; Health care costs; Cost of illness; World Health Organization; Socioeconomic factors; Forecasting/methods; Models, Theoretical (*source: MeSH, NLM*).

Mots clés Asthme/épidémiologie/thérapeutique/économie; Poste travail; Gestion maladie; Surveillance épidémiologique; Coût soins médicaux; Coût maladie; Organisation mondiale de la Santé; Facteur socioéconomique; Prévision/méthodes; Modèle théorique (*source: MeSH, INSERM*).

Palabras clave Asma/epidemiología/terapia/economía; Lugar de trabajo; Manejo de la enfermedad; Vigilancia epidemiológica; Costos de la atención en salud; Costo de la enfermedad; Organización Mundial de la Salud; Factores socioeconómicos; Predicción/métodos; Modelos teóricos (*fuentes: DeCS, BIREME*).

Arabic

Bulletin of the World Health Organization 2005;83:548-554.

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Introduction

Health economics is receiving more attention as decision-makers — including purchasers, physicians and patients — seek a more comprehensive understanding of the impact of adopting new health care strategies in developed and developing countries. Formal economic evaluation is playing an increasingly important role in health care decision-making, including that related to asthma (1).

Asthma, a chronic disease that affects both children and adults, has been the focus of clinical and public health interventions during recent years. In the present paper we discuss firstly the burden of asthma including the trends in prevalence, severity, mortality and disability-adjusted life years (DALYs)

as well as the barriers to its optimal management. Secondly, the role of the workplace environment as a contributor to the general burden of asthma will be examined. Thirdly, surveillance of asthma as part of the WHO noncommunicable disease (NCD) surveillance programme for disease management will be examined. Finally, we review the direct and indirect costs of asthma and how they can be optimized and predicted.

Burden of asthma

Importance of noncommunicable diseases in developed and developing countries

There is no doubt that, for the next 10–20 years, communicable diseases will remain the predominant health problem for the

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Ref. No. 04-012773

(Submitted: 14 May 2004 – Final revised version received: 26 December 2004 – Accepted: 6 January 2005)

populations of many developing countries. Worldwide, NCDs represent 43% of the burden of disease and this is expected to increase in the future, particularly in developing countries (2). There is already evidence that the prevalence of certain NCDs, such as diabetes, asthma, chronic obstructive pulmonary disease (COPD), epilepsy and hypertension, is increasing rapidly in some low-income countries (3).

In developing countries, chronic respiratory diseases (CRDs) represent a challenge to public health because of their increasing frequency and severity, and the projected trends and economic impact (4, 5). Health care planners are also faced with the consequence of a dramatic increase in tobacco use and must establish priorities for the allocation of limited resources.

Trends in prevalence

Asthma is one of the most common chronic diseases in the world. It is estimated that around 300 million people in the world currently have asthma (6). In the global burden of asthma report of the Global Initiative for Asthma, the prevalence of asthma in different countries has been considered to range from 1% to 18% of the population (see Fig. 1; web version only, available: <http://www.who.int/bulletin>) (6).

The prevalence of asthma increases as communities adopt modern lifestyles and become urbanized (5). With the proportion of the world's population living in urban areas projected to increase from 45% to 59% in 2025, there is likely to be a marked increase in the number of people with asthma worldwide over the next two decades. It is estimated that there may be an additional 100 million people with asthma by 2025 (6).

However, the prevalence of asthma and allergy may decrease in children in some countries with a high prevalence of the disease (7). In some countries, an increasing prevalence of allergic rhinitis, but not asthma has been observed (8). It is therefore possible that the increase in the asthma epidemic is coming to an end in some countries (Fig. 2).

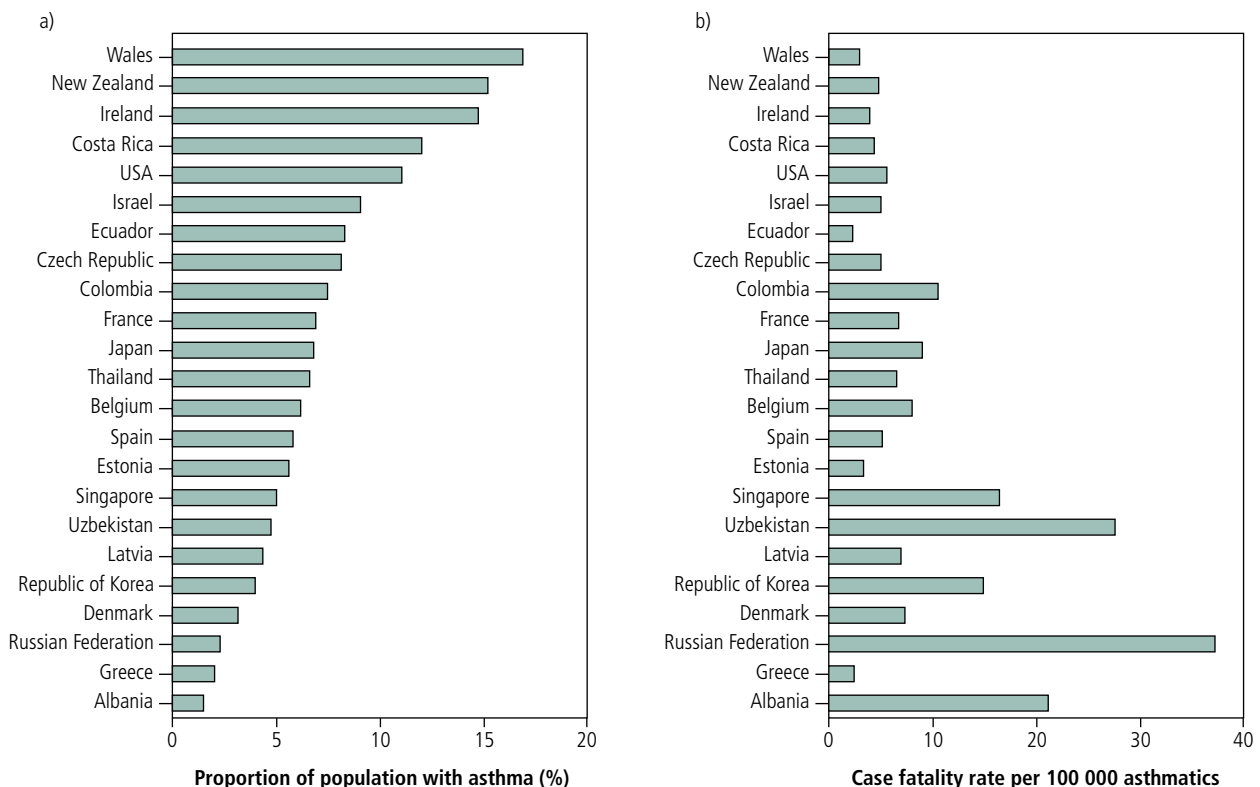
Trends in severity and mortality

Although the information on asthma mortality is unreliable in many countries, it is estimated that asthma accounts for about 250 000 deaths per year worldwide (6). There are large differences between countries, and, unexpectedly, the rate of asthma deaths does not parallel prevalence (Fig. 1). Many of the deaths are preventable, being due to suboptimal long-term medical care and delay in obtaining help during the final attack. The countries with the highest death rates are those in which controller therapy is not available (6). In the USA, death rates have increased within the past 20 years, but only in poor minority groups whose access to health care is inadequate (9). In many countries, deaths due to asthma have declined recently as a result of better management.

The number of hospitalizations of patients with asthma is another measure of asthma severity, but cannot be obtained in most developing countries (10). In countries where national asthma management plans have been implemented, hospitalization rates have decreased (11).

Childhood asthma accounts for many lost school days and may deprive the affected children of both academic achievement and social interaction.

Fig. 1. Prevalence and mortality from asthma



Disability-adjusted life years

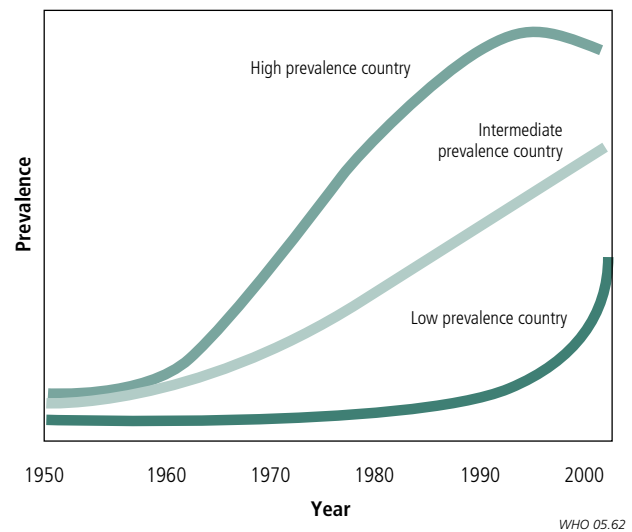
Collecting information on non-fatal health outcomes of disease and injury has been largely neglected in health planning because of the conceptual and definitional complexity of measuring morbidity and disability in populations. DALYs, which were launched by the World Bank and backed by WHO as a measure of the Global Burden of Disease (GBD), combine morbidity and mortality (12). The number of DALYs currently lost due to asthma worldwide has been estimated to be about 15 million per year (6). Worldwide, asthma accounts for around 1% of all DALYs lost, which reflects the high prevalence and severity of the disease. The number of DALYs lost due to asthma is similar to that for diabetes, cirrhosis of the liver and schizophrenia.

Barriers to successful management

Several barriers have been shown to reduce the availability, affordability, dissemination and efficacy of optimal asthma therapies (5, 6).

- *Economic and generic barriers.* These include poverty, poor education, illiteracy, lack of sanitation and poor infrastructure (13).
- *Cultural barriers.* These include multiplicity of languages, as well as religious and cultural beliefs (13).
- *Environmental barriers.* These include tobacco smoking, indoor and outdoor pollution, occupational exposure and nutrition. Poor nutrition is common in developing countries, whereas obesity and overweight are increasing in high- and middle-income countries as well as in the urban areas of low-income countries.
- *Drug and device availability and accessibility.* In many countries, there is still poor accessibility to drugs despite the Bamako Initiative launched over 15 years ago (14). There is also a lack of resources for the diagnosis of CRD in low-income countries. For CRD programmes to be effective, producers of high-quality generic drugs will need to be identified, and medications added to national lists of essential drugs and included in procurement procedures (15). The members of the World Trade Organization (WTO) issued a historic Ministerial Declaration in Doha in 2002 to protect public health and promote access to medicines for all (16).
- *Traditional medicine.* In many countries, alternative and complementary medicine is commonly used. In developing countries with many traditional healers, traditional medicine is extremely important and may often be the only available therapy. Treatment with traditional medicines is usually the first step in the management of diseases because of beliefs of patients and taboos, the inaccessibility of health care and high drug costs. In many places, traditional and modern medicine have tended to work in tandem. Research is needed to assess the efficacy of traditional medicine alone or in combination with effective drugs in the treatment of persistent asthma. If efficacy is demonstrated, cost-effectiveness studies are critical and should be initiated. Because the cost of drugs is often high, the use of appropriate traditional medicine was promoted at the fifty-fifth World Health Assembly. Unfortunately, there have as yet been no large controlled studies on the efficacy of traditional remedies in treating CRD.
- *Large differences in health care systems.* Differences exist even within high-income countries and are far more marked between middle- and low-income countries.

Fig. 2. Trends in prevalence of asthma



- *Gaps, relevance and the integration of different guidelines in developing countries.* Most guidelines for CRD have been proposed for countries where all drugs are available and affordable. Moreover, they do not necessarily take into account economic and generic barriers, and are difficult to apply to the majority of the population of low-income countries. They therefore need to be adapted to the local conditions. For example, guidelines for asthma management in developing countries were proposed in the International Union for Tuberculosis and Lung Diseases (IUATLD) asthma guide (17).
- *The lack of symptom-based guidelines.* There is a lack of symptom-based guidelines that can be applied, rather than disease-based approaches, to the management of all CRDs. The WHO practical approach to lung health (www.who.int/gtb/policyrd/PAL/assessments.htm) is a syndromic approach to the management of patients who attend primary health care facilities for respiratory symptoms. It targets the various health workers, nurses, doctors and managers in primary health care settings with successful tuberculosis (TB) control programmes in low- and middle-income countries (18). Such a symptom-based approach also needs to be developed and implemented in high-income countries using tools adapted to the local situation and health system.

Occupational asthma

Evidence is accumulating that the workplace environment contributes significantly to the general burden of asthma (19, 20), but information on prevalence is difficult to obtain in most countries. In both developed and developing countries, occupational asthma represents a public health problem with economic implications (5). If workers are removed from exposure to the trigger substance as soon as they start to develop symptoms, they are likely to make a complete recovery. If exposure continues, however, symptoms are likely to become increasingly severe and may persist after exposure to the offending substance has ended.

Patients with occupational asthma have higher rates of hospitalization and mortality than healthy workers (21).

WHO noncommunicable disease surveillance programme

Effective prevention strategies for NCDs do exist. However, they require specific data on risk factors so that priorities can be set appropriately and targeted interventions developed and monitored. The WHO Global NCD Risk Factor Surveillance Initiative responds directly to this need. This project is managed by the Cross Cluster Surveillance Initiative of the Noncommunicable Diseases and Mental Health cluster (ncd_surveillance@who.int).

The project will be considered successful, if, at the end of a 5-year period the following targets have been met.

- The first global assessment of country-specific burden, patterns and trends in major risk factors and identification of the gaps to be filled has been published.
- Half of the WHO Member States have conducted at least one survey following the WHO Global NCD Risk Factor Surveillance strategy.
- The awareness of the potential usefulness of surveillance for NCD risk factors in public health decision-making is raised.

Other surveillance programmes have also been launched. The Centers for Disease Control and Prevalence (CDC) outlined a strategy to improve the timeliness and geographical specificity of asthma surveillance as part of a comprehensive public health approach to asthma surveillance.

Socioeconomic implications

Direct and indirect costs

The economic cost of asthma is considerable both in terms of direct medical costs (such as hospital admissions and the cost of pharmaceuticals) and indirect medical costs (such as time lost from work and premature death) (6, 22). Direct costs represent approximately 1–3% of total medical expenditures in most countries. In 1998, the economic burden of asthma in the United States was estimated to be US\$ 12.7 billion. Indirect costs account for over 50% of the total costs. Asthma-related costs are largely attributable to pharmaceuticals, hospitalizations and visits to emergency departments as well as days of work lost (23). Intangible costs such as those incurred by a low quality of life are very difficult to measure. Both the direct and indirect costs of asthma to an employer are substantial (23).

The costs of asthma depend on severity of disease (24, 25) and the extent to which exacerbations are avoided or at least controlled (26). Patients with difficult-to-treat or suboptimally controlled asthma consume a disproportionate share of asthma health care resources (27).

Other factors that increase the costs related to asthma have been highlighted, for example, exposure to second-hand tobacco smoke increases health care utilization in children with asthma (28). Comorbidities such as allergic rhinitis increase asthma costs. In some studies, children of low socioeconomic status were likely to require more resources because of their asthma (29, 30).

Underdiagnosed asthma is common. Many children with underdiagnosed asthma miss school and require emergency department visits, although those with a current diagnosis of asthma report more utilization of resources (31).

In developing countries, childhood asthma has significant adverse effects on the child's daily activities, schooling,

family life and finances. In India, the median monthly expenditure on a child's medication was reported to be *rupees* 333, i.e. about one third of monthly per capita income (32).

Attempts to improve patient care and reduce costs

In order to reduce costs and improve quality of care, employers and health plans are exploring more precisely targeted ways to control rapidly rising health costs. Disease management programmes, which focus on patients with chronic conditions such as asthma and diabetes, are gaining importance (33). Even though the chronic care model has the potential to improve care and reduce costs, several obstacles still hinder its widespread adoption.

National disease management plans for asthma now exist in many countries (11) and some have resulted in a dramatic reduction in mortality and severity, thereby reducing costs (11). For example, the French Government issued an initiative on 28 January 2002 for better management and prevention of asthma (<http://www.sante.gouv.fr>). This plan proposes several activities for the next 5 years: prevention at school, better care and management in emergency units, development of asthma education, consideration of occupational asthma and the proposal of guidelines for follow-up. The effectiveness of a multicomponent self-management programme in those at risk was demonstrated in school-aged children with asthma (34).

Poor control of asthma symptoms is a major issue that can lead to adverse clinical and economic outcomes. Although they are mostly observational, cost-effectiveness studies have provided sufficient evidence for the cost-effectiveness of treatment with inhaled steroids, combinations of inhaled corticosteroids and long-acting β_2 -agonists (35). Early and long-term treatment with inhaled corticosteroids was found to be cost-effective in patients with mild persistent asthma of recent onset (36). Education and self-management programmes for people with severe asthma were also found to be cost-effective (37–39).

The National Cooperative Inner-City Asthma Study (NCICAS) investigated the effectiveness of interventions. A multifaceted asthma intervention programme reduced the number of days on which symptoms occurred and was cost-effective for inner-city children with asthma. In children with more severe disease, the intervention was substantially more effective and reduced costs compared with those seen in control children (40). School-based health centres (41) and social worker-based intervention can boost outcomes and cut costs in inner-city dwellers with asthma (42). Specialist nurse interventions were found to reduce unscheduled asthma care in a deprived multi-ethnic area of London, England (43). Organizations serving this type of population in both developed and developing countries should consider such a strategy as part of a comprehensive disease-management programme for asthma.

In some countries, nurses are specialized in asthma care and care given by asthma nurses improves outcomes and reduces costs in primary health care (44). Moreover, it was shown that nurse-led outpatient management of childhood asthma can be provided at a lower cost than medical care by paediatricians (45).

Occupational asthma makes a substantial contribution to the total costs of the disease (20, 23). These costs are expected to rise with its increasing prevalence. Intervention strategies for effective prevention and control at the workplace (before asthma has developed) should lessen the burden of long-term

illness and its impact on public health costs (19). Early recognition of occupational asthma is an essential step in preventing the onset of severe persistent asthma which could progress even after exposure to the hazardous occupational agent has ceased. Most patients with occupational asthma have rhinitis which often occurs before the onset of bronchial symptoms. In order to prevent the onset and progression of persistent asthma in subjects exposed to known risk factors, it is important to be able to detect the early stages of occupational asthma by identifying nasal symptoms.

Because many patients with asthma are elderly and may suffer from other NCDs, the integration of management programmes for multiple chronic diseases will be the next step in coordinating and improving the care of patients with multiple CRDs as well as in reducing costs (46). Clinical guidelines for CRDs and for other NCDs will need to be integrated into "meta-guidelines" that combine the contents of individual practice guidelines and can be easily applied by general practitioners and other health care workers.

Modelling of predicted costs

Sophisticated models for predicting asthma costs have been proposed. These include probabilistic sensitivity analysis for decision trees with multiple branches using the Dirichlet distribution in a Bayesian framework (47). A Markov model has been used to estimate the cost-effectiveness of alternative asthma treatments (48). However, these models only attempt to assess costs associated with medications and/or asthma exacerbations.

A more global model should be envisaged that would take into account the following.

- The natural history of asthma which is a chronic-episodic disease characterized by acute, symptomatic episodes of varying severity (49).
- The expected trends in prevalence and morbidity related to asthma within the next 15 years.
- The role of indoor allergens (tobacco smoke) and outdoor environmental allergens (pollution), nutrition and occupation in the onset, severity and/or persistence of asthma. Changes in exposure should, however, be considered because the impact of these environmental factors and their comorbid effects are likely to change considerably within the next 15 years as a result of preventive measures (e.g. smoking cessation campaigns) and also because of the exposure to new (or as yet unidentified) causes.

- Comorbidities (e.g. asthma and rhinitis, asthma and COPD in smokers) in terms of costs and of the efficacy of drugs in treating asthma.
- Asthma affects quality of life, work and school. People with asthma have significant absenteeism from school and work. Patients with asthma and also with rhinitis have an impaired productivity at work or performance at school.
- Ageing of the population is a phenomenon that will increasingly affect the management of asthma in the future.
- The implementation of guidelines for the management of asthma has been shown to reduce the burden of the disease. In particular, morbidity and mortality from asthma have been reduced in some countries. However, patients' adherence to treatment is still poor. The impact of therapeutic strategies for asthma using published guidelines and the adherence of patients to treatment should also be included in the model. The model should incorporate treatment availability and trends which differ between countries.
- It is important to model the socioeconomic costs of asthma according to the different health systems.

Conclusion

The burden of asthma is substantial due to its high prevalence, morbidity and mortality both in developed and developing countries. The trends in prevalence, severity and mortality show that currently the problem is increasing more in developing countries than in developed ones. Barriers to the optimal management of asthma exist throughout the world, but poorer access to, and availability of, drugs in developing countries is a cause of great concern. The workplace environment contributes significantly to the general burden of asthma. Patients with occupational asthma have higher rates of hospitalization and mortality than workers who don't suffer from the condition. The surveillance of asthma as part of a global WHO programme is essential for successful disease management. The economic cost of asthma is considerable both in terms of direct medical costs (such as hospital admissions and the cost of pharmaceuticals) and indirect medical costs (such as time lost from work and premature death). It is essential to attempt to reduce these costs. Poor control of asthma symptoms is a major issue that can lead to adverse clinical and economic outcomes. Models are needed to attempt to reduce asthma costs, while permitting optimal management of the disease. ■

Competing interests: none declared.

Résumé

Incidences de l'asthme sur la santé publique

L'asthme est une maladie chronique très courante dans toutes les tranches d'âge, qui fait l'objet de diverses interventions cliniques et actions de santé publique. La mortalité comme la morbidité dues à l'asthme sont importantes. A l'échelle planétaire, le nombre d'années de vie corrigées de l'incapacité perdues à cause de l'asthme est similaire à celui résultant des diabètes, de la cirrhose du foie ou de la schizophrénie. Des programmes de prise en charge de l'asthme ont néanmoins permis de réduire la mortalité liée à l'asthme et la gravité de cette maladie dans les pays où ils ont été mis en œuvre. Plusieurs obstacles s'opposent à la disponibilité, à l'accessibilité économique, à la diffusion et à l'efficacité de programmes optimaux de prise en charge de

l'asthme, aussi bien dans les pays développés que dans les pays en développement. L'environnement de travail contribue pour une part importante à la charge générale d'asthme. Les malades atteints d'asthme professionnel présentent des taux d'hospitalisation et de mortalité plus élevés que les travailleurs en bonne santé. Il est absolument nécessaire que la surveillance de l'asthme s'intègre dans un programme mondial de l'OMS. Les coûts économiques de cette maladie sont considérables, tant par leur composante médicale directe (séjours hospitaliers et médicaments, par exemple), que par leur composante médicale indirecte (absences au travail et décès prématuré, par exemple). Les coûts directs sont conséquents dans la plupart des pays. En vue de réduire ces

coûts et d'améliorer la qualité des soins, les employeurs et les responsables de programmes sanitaires étudient des moyens mieux ciblés pour maîtriser les coûts de santé en augmentation rapide. La mauvaise maîtrise des symptômes de l'asthme est un problème majeur, pouvant avoir des conséquences préjudiciables sur le plan

clinique et économique. Il est nécessaire de disposer d'un modèle des coûts de l'asthme permettant d'étayer les tentatives pour les réduire et d'optimiser la prise en charge de la maladie. Le présent article décrit la charge que fait peser l'asthme sur la santé publique et les incidences socioéconomiques de cette maladie.

Resumen

Repercusión del asma en la salud pública

El asma es una enfermedad crónica muy común que afecta a todos los grupos de edad y constituye el objetivo de diversas intervenciones clínicas y de salud pública. Tanto la morbilidad como la mortalidad por asma son importantes. El número de años de vida ajustados en función de la discapacidad (AVAD) perdidos como consecuencia del asma en todo el mundo es similar al de la diabetes, la cirrosis hepática y la esquizofrenia. Sin embargo, los planes de tratamiento del asma han reducido la mortalidad asociada y su gravedad en los países donde se han aplicado. Hay varios obstáculos que reducen la disponibilidad, la asequibilidad, la difusión y la eficacia de los planes de tratamiento óptimo del asma tanto en los países desarrollados como en los países en desarrollo. El entorno de trabajo contribuye sensiblemente a la carga general de asma. Los pacientes con asma ocupacional tienen mayores tasas de hospitalización y mortalidad que los trabajadores sanos. La vigilancia del asma como parte de un programa mundial de la OMS es una necesidad esencial. El costo económico del asma

es considerable, y ello incluye tanto los costos médicos directos (por ejemplo los de los ingresos hospitalarios y las preparaciones farmacéuticas) como los costos médicos indirectos (entre ellos las horas de trabajo perdidas y las muertes prematuras). Los costos directos son notables en la mayoría de los países. A fin de reducir los costos y de mejorar la calidad de la atención, los empleadores y los planes de salud están estudiando mecanismos más precisos para controlar unos costos sanitarios rápidamente crecientes. El control deficiente de los síntomas del asma constituye un serio problema que puede tener consecuencias clínicas y económicas adversas. Hace falta un modelo de los costos asociados al asma para coadyuvar a las iniciativas encaminadas a reducirlos sin dejar de aplicar un tratamiento óptimo contra la enfermedad. En este artículo se analizan la carga de asma y sus repercusiones socioeconómicas y se propone un modelo para predecir los costos que acarrea la enfermedad.

Arabic

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