THE IMPACT OF ASTHMA ON THE PATIENT, THE FAMILY, AND SOCIETY

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ABSTRACT

This article discusses the impact of asthma on the patient, the family, and society and considers the role of primary care providers and pediatricians in reducing the burden of asthma. Nearly 8% of the US population suffers from asthma. The most recent government data show that asthma-attack prevalence, defined as the proportion of individuals with at least 1 asthma episode in a 12-month period (a crude gauge of the number of individuals who have uncontrolled asthma and are therefore at risk for poor outcomes), was 4.2%. Consistent with its chronicity and its manifestations, including pulmonary function impairment and symptoms of wheezing, cough, dyspnea, and chest tightness, asthma impairs patients' well-being and can significantly interfere with the ability to undertake normal daily activities. Among those with at least 1 asthma attack in the previous year in the 2002 National Health Interview Survey, asthma was responsible for 14.7 million missed school days in children 5 to 17 years old and 11.8 million missed workdays in adults 18 years and older. In keeping with the high prevalence and life impact of asthma, asthma-associated healthcare resource use is substantial. In 2002, asthma was responsible for 13.9 million outpatient visits, 1.9 million emergency department visits, and 484 000 hospitalizations in the United States. The annual economic cost of asthma in the United States is estimated at $14 billion. Children are disproportionately affected by asthma and have higher rates of asthma-associated healthcare use and greater asthma-related activity limitation than adults. These data reflect a growing burden of asthma in terms of morbidity, quality of life, and healthcare costs and demonstrate that asthma care is falling short of National Heart, Lung, and Blood Institute goals. Primary care providers, including pediatricians, play a pivotal role in improving quality of care for asthma given that most cases of asthma are diagnosed and managed in the primary care setting. Evidence suggests that primary care providers’ adherence to national guidelines for asthma care can contribute significantly to reducing the burden of asthma. (Adv Stud Med. 2008;8(3):57-63)

As stated, nearly 8% of the US population suffers from asthma,1 and for many of these patients, asthma is poorly controlled, despite advances in knowledge about asthma pathophysiology and the availability of effective therapy.2,3 Data reflecting the growing burden of asthma in terms of morbidity, quality of life, and healthcare costs demonstrate that asthma care is falling short of National Heart, Lung, and Blood Institute (NHLBI) goals, which include prevention of chronic and troublesome symptoms, maintenance of near-normal pulmonary function and normal activity levels, and prevention of recurrent exacerbations requiring emergency-department visits or hospitalization.4,4 This article discusses the impact of asthma on the patient, the family, and society and considers the role of primary care providers and pediatricians—who are consulted by the majority of patients who have asthma—in reducing the burden of asthma.

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PREVALENCE OF ASTHMA

The prevalence of asthma has increased both in the United States and globally during the past 4 decades. The most comprehensive data on asthma prevalence in the United States come from the National Health Interview Survey (NHIS), an ongoing US population-based disease-surveillance study conducted by the US Centers for Disease Control and Prevention National Center for Health Statistics. NHIS data are drawn from household interviews of a nationally representative sample of the civilian noninstitutionalized population. Information on asthma status in the NHIS was self-reported by individuals ages 18 years or older or collected from an adult family member for children younger than 18 years old. Data from the NHIS survey conducted from January to September 2005, the most recent time period for which data are available, show that 7.7% of individuals of any age in the United States currently have asthma (Figure 1). This prevalence rate exceeds that in the 2 preceding years (2003, 7.1%; 2004, 7.3%). Among males, asthma prevalence was approximately twice as high in those 14 years old or younger (10.7%) than in patients 15 to 34 years old (5.2%) or those at least 35 years old (5.0%; Figure 1). Among females, asthma prevalence did not significantly vary by age (7.5% in patients 0–14 years old; 9.6% in patients 15–34 years old; 9.3% in those at least 35 years old; Figure 1). Sex-adjusted asthma prevalence was highest among non-Hispanic/non-Latino blacks 0 to 14 years old (12.8%) followed by Hispanics or Latinos 0 to 14 years old (9.5%), blacks 15 years old or older (8.4%), whites 0 to 14 years old (7.8%), whites 15 years old and older (7.5%), and Hispanics or Latinos 15 years older or older (5.3%).

A similar pattern of results was found for asthma-attack prevalence, defined as the proportion of individuals with at least 1 asthma episode during the 12 months before the survey. Asthma-attack prevalence provides a crude gauge of the number of individuals who have uncontrolled asthma and are therefore at risk for poor outcomes, such as hospitalization. Overall, 4.2% of individuals of any age experienced at least 1 asthma episode during the 12 months before the survey (Figure 2). This rate slightly exceeds that in the 2 preceding years (2003, 3.9%; 2004, 4.1%). Among males, asthma-attack prevalence was more than 2 times higher in those 14 years old or younger (6.8%) than in patients 15 to 34 years old (2.6%) or those at least 35 years old (2.4%; Figure 2). Among females, asthma-attack prevalence did not significantly vary by age (4.4% in patients 0–14 years old; 5.5% in those 15–34 years old; 4.9% in those at least 35 years old; Figure 2). Sex-adjusted asthma-attack prevalence rates were highest among non-Hispanic/non-Latino blacks 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%) followed by Hispanics or Latinas 0 to 14 years old (6.2%)}
Latinos 0 to 14 years old (5.7%), whites 0 to 14 years old (5.2%), whites 15 years old and older (3.9%), blacks 15 years old and older (3.8%), and Hispanics or Latinos 15 years old or older (3.1%).

**Impact of Asthma on the Patient and the Family**

Consistent with its chronicity and its manifestations, including pulmonary-function impairment and symptoms of wheezing, cough, dyspnea, and chest tightness, asthma impairs patients’ well-being and can significantly interfere with the ability to undertake normal daily activities. Among those with at least 1 asthma attack in the previous year in the 2002 NHIS, asthma was responsible for 14.7 million missed school days in children 5 to 17 years old and 11.8 million missed workdays in adults 18 years and older. These data do not take into account the larger burden of presenteeism (ie, showing up for work but being unable to perform to standards). In 2003 to 2004, limitation of activity because of chronic health conditions was reported for 7% of children younger than 18 years in the United States. Among preschool children, asthma was a leading cause of activity limitation. Only speech problems and mental retardation were associated with greater activity limitation than asthma in this age group (Table 1).

Asthma also affects the lives of family members who provide care for patients with asthma. In a study of children with persistent asthma and their caregivers, approximately 33% of caregivers missed work during the 12-month study because of their child’s asthma. The amount of work lost was strongly and negatively correlated with the degree of asthma control as assessed by use of rescue medication, nocturnal symptoms, impairment of activities, and asthma crises. Caregivers of children with poorly controlled asthma were 8 times more likely to lose more than 5 days of work during the study period than caregivers of children with well-controlled asthma.

### Asthma-Associated Healthcare Resource Use

In keeping with the high prevalence and life impact of asthma, asthma-associated healthcare resource use is substantial. Data on healthcare resource use attributed to asthma come from the US Centers for Disease Control and Prevention National Ambulatory Medical Care Survey, a nationally representative survey on the

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<tr>
<th>Table 1. Selected Chronic Health Conditions Causing Limitation of Activity Among Children, United States, 2003–2004</th>
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<tr>
<td><strong>Number of children with activity limitation per 1000 population</strong></td>
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<td>Younger than 5 Years</td>
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<td>Speech problem</td>
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<td>Asthma/breathing problem</td>
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<td>Mental retardation/other developmental problem</td>
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<td>Other mental, emotional, behavioral problem</td>
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<td>Learning disability</td>
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<td>Data from National Asthma Education and Prevention Program.</td>
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<th>Table 2. Asthma-Related Healthcare Resource Use in the United States, 2002</th>
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<tr>
<td><strong>Outpatient Visits</strong></td>
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<td>Female</td>
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<td>Age</td>
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<td>≥18 years old</td>
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Data are expressed as units per 10 000 population.

Data from US Centers for Disease Control and Prevention.
use of ambulatory medical care services in the United States, and the National Hospital Discharge Survey, a national probability survey on characteristics of patients discharged from nonfederal, short-stay hospitals in the United States. The following statistics were compiled for 2002, the most recent year for which published data are available (Table 2). 
• Asthma was the reason for 13.9 million outpatient visits, or 492 outpatient visits per 10,000 people. The frequency of outpatient visits among children ages 0 to 17 years (687 per 10,000 individuals) substantially exceeded that among adults 18 years and older (181 per 10,000 individuals). The number of asthma-related outpatient visits per 10,000 people was higher in females (585) than males (384) and was similar between blacks (482) and whites (493). (Data on healthcare resource use among Hispanics were not reported in the 2002 summary.)
• Asthma was responsible for 1.9 million emergency department visits, or 67 per 10,000 people. The frequency of emergency department visits among children ages 0 to 17 years (100 per 10,000 individuals) substantially exceeded that among adults 18 years and older (24 per 10,000 individuals). Emergency department visits were particularly frequent among children ages 0 to 4 years (162 per 10,000). The number of asthma-related emergency department visits per 10,000 people was similar between females (69) and males (65) and higher in blacks (217) than whites (45).
• Asthma was the reason for 484,000 hospitalizations, or 17 per 10,000 people. The frequency of asthma-related hospitalizations among children ages 0 to 17 years (27 per 10,000 individuals) substantially exceeded that among adults 18 years and older (13 per 10,000 individuals). Asthma-related hospitalizations were particularly frequent among children ages 0 to 4 years (59 per 10,000). The number of asthma-related hospitalizations per 10,000 people was similar between females (19) and males (14) and higher in blacks (36) than whites (11).

Asthma Mortality

Asthma mortality has increased in the past 2 decades in western countries, including the United States. In 2002, the most recent year for which US mortality statistics were published, asthma was the cause of 1.5 per 100,000 deaths in the United States (0.3 per 100,000 in children ages 0–17 years and 1.9 per 100,000 in adults ages 18 years and older). Deaths due to asthma per 100,000 individuals were more frequent among females (1.7) than males (1.2), and among non-Hispanic blacks (3.7) than Hispanics (1.4) or non-Hispanic whites (1.2). The higher death rate in non-Hispanic blacks than in other ethnic groups in the United States has been attributed to several factors, including lack of access to healthcare, more severe asthma, genetic determinants, and higher prevalence of asthma.

Economic Cost of Asthma

The annual economic cost of asthma in the United States is estimated at $14 billion, a value that includes both direct and indirect costs. Direct costs, or those associated with the delivery of healthcare, include components such as the cost of medications, hospitalizations, emergency department visits, office visits, and medical tests and procedures. Indirect costs are those associated with illness-attributed lost or reduced productivity. Data from a cross-sectional survey of 401 adults with asthma drawn from a random sample of northern California pulmonologists, allergist-immunologists, and family practitioners suggest that lost workplace productivity and pharmaceuticals account for the majority of the economic costs of asthma. The total average annual cost of asthma per person was $4912, of which 65% ($3180) was direct costs and 35% ($1732) was indirect costs. The main components of direct costs included pharmaceuticals ($1605 per person per year), hospital admissions ($463), and non-emergency department ambulatory visits ($342). The main components of indirect costs included cessation of work ($1062 per person per year) and loss of workdays among those remaining employed ($486). The costs attributed to presenteeism may far exceed those due to loss of workdays. Self-reported disease severity was strongly and directly related to total annual per-person costs, which were $2646, $4530, and $12,813 for mild, moderate, and severe asthma, respectively.

Childhood Asthma

The epidemiologic and outcomes data described earlier in the article suggest that children are dispro-
portionately affected by asthma. In fact, asthma is the most common chronic disease of childhood and the leading cause of hospitalizations in children. The peak incidence of asthma occurs during the first year of life, and 8 of 10 children who develop asthma experience their first episode of wheezing before their third birthday. The onset of more than 80% of cases of persistent asthma is estimated to occur before the age of 6 years. Difficult to distinguish from other respiratory conditions and challenging to manage in the very young patient, childhood asthma is underdiagnosed and undertreated. Poorly controlled asthma is particularly of concern in the growing child because it may impact emotional, intellectual, and physical development (eg, restricting children’s activities, such as running, walking, and vocalizing, impairing children’s emotional health, and causing children to miss school or other intellectual or social activities). Poorly controlled asthma in childhood is also of concern because it may lead to more rapid progression of disease and deterioration of pulmonary function than well-controlled asthma.

**Asthma Pathophysiology**

Conversely, good control of childhood asthma may prevent or mitigate the development of more serious asthma or irreversible airway obstruction later in life. Recent advances in understanding of asthma pathophysiology suggest the importance of achieving good asthma control early in the course of the disease. Asthma is manifested by chronic airway inflammation leading to bronchial hyperresponsiveness with symptoms, including wheezing, cough, dyspnea, and a feeling of tightness in the chest. The inflammation is caused by myriad cells (eg, mast cells, neutrophils, eosinophils, and macrophages) and mediators (eg, cytokines, chemokines, histamine, leukotrienes, thromboxanes, and reactive oxygen species), the relative contributions of which to asthma pathogenesis may vary depending on patient- and context-specific factors. Contradicting the historical conception of all forms of asthma as reversible, recent evidence suggests that asthma is associated with airway remodeling or permanent structural changes, including subbase-ment membrane fibrosis, smooth muscle hyperplasia, angiogenesis, and glandular hyperplasia. Although the clinical significance of airway remodeling has not been established, airway remodeling may contribute to progression of asthma and could lead to progressive loss of lung function. The structural changes that characterize airway remodeling have been identified in mild and moderate asthma as well as severe fatal asthma.

Asthma appears to involve repetitive cycles of exacerbation and remission with underlying persistent or chronic inflammation. This pathology results in structural changes to the airways that over time can become permanent (airway remodeling). Although some evidence, reviewed in more detail by Drs Schleimer and Patel in this monograph, suggests that early initiation of anti-inflammatory therapy for asthma can retard or prevent the loss of lung function or the progression to irreversible structural changes in the airways and airway remodeling, other data suggest otherwise—studies in children treated with steroids have shown little to no disease modifying effects of corticosteroids even when begun early in infancy/childhood. Nevertheless, because of benefits in reducing symptoms, exacerbations, and the need for rescue medications, anti-inflammatory therapy with inhaled corticosteroids is recommended as a cornerstone of asthma therapy at all levels of disease severity in current treatment guidelines.

Advances in the genetics and genomics of asthma, an area of active research, offers the potential for better understanding of asthma pathophysiology and improvement in therapy. Several genes and chromosomal regions linked to asthma and related respiratory diseases have been identified. Likewise, gene loci that modify the atopic response as well as nonspecific inflammation and airway reactivity have been found. Polymorphisms in the gene for the β2 adrenergic receptor may determine response and account for adverse effects of β agonist therapy in patients with asthma. Genetic and genomic research thus might help improve the ability to target asthma therapy and maximize the institution of the most appropriate therapy in the individual patient.

**Conclusions**

Notwithstanding advances during recent decades in the basic science of asthma and its treatments, the detrimental humanistic and economic consequences of asthma remain substantial. The guidelines by the National Asthma Education and Prevention Program (NAEPP) for the diagnosis and management of asth-
ma were developed to help improve asthma care, decrease asthma-associated morbidity and mortality, and reduce the economic and societal burdens of asthma. The 2007 revised guidelines include new material emphasizing the importance of vigilant asthma control as well as new information on aspects of asthma management, including treating childhood asthma, controlling environmental factors that can cause asthma symptoms, selecting pharmacotherapy, and educating patients. Although the guidelines have been in place for several years and have been widely disseminated and publicized, they have not been effectively implemented in many healthcare settings. Moreover, NHLBI goals of asthma care—prevention of symptoms and exacerbations; maintenance of normal pulmonary function and activity levels; provision of well-tolerated, effective pharmacotherapy; minimization of the need for emergency department visits or hospitalizations; and achieving patients’ expectations of asthma care—have not been met for many patients with asthma.3,5

The failure to achieve the NHLBI goals of asthma care in many patients is illustrated by results of a nationally representative survey conducted after publication of the guidelines and administered to 2509 patients with asthma or parents of children with asthma. Thirty-one percent (31%) of patients with asthma indicated that the disease limits their lifestyle, and 45% said that they cannot do things they would like to do because of asthma. Activity limitations were reported by 64% of adults with asthma compared to 26% of a national cross-sectional sample of 1000 adults in the general public. Approximately 33% of patients with asthma (30%) reported being awakened at night because of breathing problems at least once a week. Use of rescue inhalers at least once daily was reported by 25% of patients with mild intermittent asthma, 33% with mild persistent asthma, 53% with moderate persistent asthma, and 73% with severe persistent asthma.

Primary care providers, including pediatricians, can play a pivotal role in improving quality of care for asthma in the United States given that most cases of asthma are diagnosed and managed in the primary care setting. Evidence suggests that primary care providers’ adherence to NAEPP guidelines for asthma care can contribute significantly to reducing the burden of asthma. For example, a citywide disease-management program designed to increase primary care providers’ adherence to NAEPP guidelines was found to reduce healthcare resource use among a cohort of 3748 children with asthma in a study conducted in Hartford, Connecticut. After primary care providers’ enrollment in the disease-management program, paid claims for inhaled corticosteroids increased by 25%, and provider adherence to the guidelines increased to 96% from a pre-enrollment baseline of 38%. These trends coincided with a 35% decrease in hospitalizations, a 27% decrease in emergency department visits, and a 19% decrease in outpatient visits among children with asthma whose providers participated in the program. Improvement in asthma outcomes is thus achievable. Primary care providers, who constitute the front line of asthma care, and pediatricians, who provide care for the segment of the population most affected by asthma, can effect positive results by implementing asthma guidelines and keeping abreast of the most current findings in asthma pathophysiology and advances in therapy.

REFERENCES

5. Braman SS. The global burden of asthma. Chest. 2006;130:4S-12S.