

# **The Burden of Asthma in Tennessee**

**Tennessee Department of Health**

**Office of Policy, Planning and Assessment  
Surveillance, Epidemiology and Evaluation**

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*The authors would like to thank the Division of Health Statistics, Tennessee Department of Health for providing hospital discharge data, death data and Behavioral Risk Factor Surveillance System data. They would also like to thank the Department of Preventive Medicine, Vanderbilt University and the Tennessee Bureau of TennCare for providing TennCare billing data.*

**Suggested Citation:**

Office of Policy, Planning and Assessment (2008). The Burden of Asthma in Tennessee. Tennessee Department of Health, Nashville, TN.

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# Key Findings

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## Asthma Prevalence

- There was no increase or decrease in asthma prevalence in Tennessee between 2000 and 2006.
- Current prevalence of asthma in Tennessee was 8.5% in children and 8.4% in adults.
- Among adults, asthma was more common among women than men. However, among children asthma prevalence rates were higher among boys.
- Asthma was more common among black children than white children. However, there were no racial differences in asthma prevalence among adults.
- Asthma prevalence increased with decreasing income and education.

## Health Care Utilization and Cost

### • Inpatient Hospitalizations

- Between 1997 and 2006, there was no increase or decrease in inpatient hospitalizations for a primary diagnosis of asthma in Tennessee. However, hospitalizations for which asthma was listed as a secondary diagnosis approximately doubled.
- In 2006, there were 8,041 inpatient hospitalizations for a primary diagnosis of asthma, and the hospitalization rate was 133/100,000.
- Among children, boys had higher hospitalization rates than did girls. Among adults, females had higher hospitalization rates.
- Blacks had higher asthma hospitalization rates than whites at all ages.
- Inpatient hospitalization rates were highest among young children (1-4 years old) and among the elderly (65+ years old).
- Inpatient hospitalizations for asthma peaked during the fall (October and November) and were at their lowest in the summer (June and July).
- Hospital stays for asthma ranged from 0 to 66 days, with a median of 3 days. Median length of stay was longest among the elderly.

### • Emergency Department Visits

- Between 1997 and 2006, emergency department (ED) visits for a primary diagnosis of asthma increased 35%, while those for a secondary diagnosis of asthma more than quadrupled.
- In 2006, there were 35,567 ED visits for a primary diagnosis of asthma, and the ED visit rate was 604/100,000.
- Among children, boys had higher ED visit rates than girls. Among adults, females had higher rates.
- Blacks had higher ED visit rates than whites at all ages.
- ED visit rates were highest among young children and decreased with increasing age. However, elderly patients were more likely to be subsequently admitted to the hospital following an emergency department visit than younger adults and children.
- Seasonal trends in ED visits were similar to those observed for inpatient hospitalizations.

### • Hospital Charges

- Between 1997 and 2006, per visit inpatient hospitalization charges for a primary diagnosis of asthma increased 60% and per visit outpatient hospitalization charges increased 136%.
- In 2006, inpatient charges averaged \$10,434 per visit and outpatient charges averaged \$1,361 per visit.
- Both inpatient and outpatient per visit charges were similar among females and males, and slightly higher among blacks compared to whites.
- Both inpatient and outpatient per visit charges were highest among the elderly.

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## Key Findings *cont.*

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### Asthma among TennCare Enrollees

- **Prevalence**
  - Between 2004 and 2006, the prevalence of asthma among TennCare enrollees was 10.6%.
  - Prevalence was higher among females than among males and higher among whites than among blacks.
  - Asthma prevalence was highest among young children.
- **Inpatient Hospitalizations and Emergency Department Visits**
  - Between 1995 and 2006, there was no increase or decrease in inpatient hospitalizations for a primary diagnosis of asthma among TennCare enrollees. However, hospitalizations for any asthma diagnosis almost doubled.
  - During this same time period, ED visits for a primary asthma diagnosis approximately doubled and those for any asthma diagnosis more than quadrupled.
  - In 2006, the inpatient hospitalization rate for primary asthma was 368/100,000 and the ED visit rate was 1,255/100,000 – both rates were higher than those observed in the overall Tennessee population.
  - Hospitalization and ED visit rates for both a primary and for any asthma diagnosis were higher among females than among males and higher among blacks than among whites.
  - Young children had the highest hospitalization and ED visit rates for primary asthma.
  - Elderly adults had the highest inpatient hospitalization rate for any asthma and the lowest ED visit rate for any asthma.
- **Physician Visits**
  - Between 1995 and 2004, there was an increase in physician visits for any diagnosis of asthma among TennCare enrollees. However, due to a steep decline in 2004-2006, the overall trend in physician visits between 1995 and 2006 was not statistically significant.
  - In 2006, the physician visit rate for any asthma diagnosis was 8,768/100,000.
  - Physician visit rates were higher among females than males, but similar among blacks and whites.
  - Young children had the highest physician visit rates.
  - The majority of TennCare healthcare encounters for primary asthma were physician visits (82%). Whites had a higher percentage of physician visits (as compared to in- and outpatient hospitalizations) than did blacks.
  - The odds of having an ED visit for primary asthma were higher among those who had not visited a physician in the past 18 months than among those who had seen a physician.

### Asthma Mortality

- Between 1995 and 2006, the asthma mortality rate in Tennessee declined.
- In 2006, the mortality rate for a primary diagnosis of asthma was 13.1 deaths per million people in Tennessee. For any asthma diagnosis the mortality rate was 31.5/1,000,000.
- The mortality rate for primary asthma was similar among females and males, while the mortality rate for any asthma diagnosis was slightly higher among females.
- The mortality rates for both primary and any asthma diagnosis were higher among blacks than whites.
- Elderly adults had the highest asthma mortality rates.
- Between 1999 and 2006, persons with a secondary asthma diagnosis had greater odds of dying due to an underlying diagnosis of heart disease than did those without a secondary asthma diagnosis.

# Introduction

## What is asthma?

Asthma is a chronic, inflammatory disease of the airways. This inflammation makes the airways of people with asthma very sensitive, and they tend to react strongly to various stimuli (i.e. asthma triggers).<sup>1</sup> Table 1 shows a list of common things that can trigger asthma symptoms. When asthma symptoms become worse than usual, it is called an asthma episode or attack.<sup>1</sup>

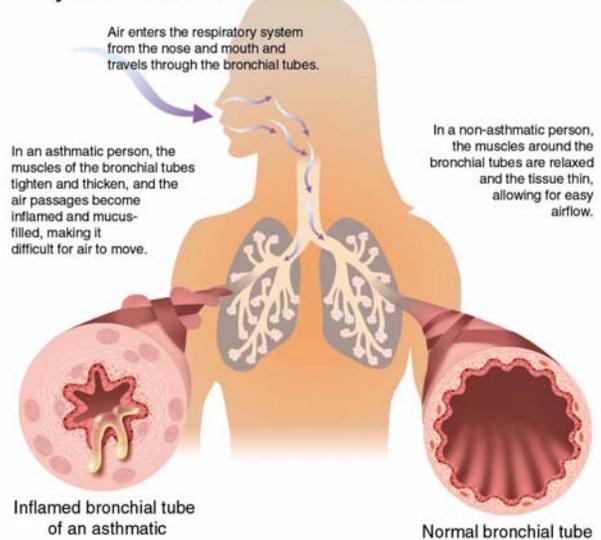
During an asthma attack, the airways react in the following three ways:

- 1) inflammation increases and the lining of the airways become swollen;
- 2) muscles around the airways tighten up; and
- 3) cells in the airways produce more mucus.<sup>1</sup>

As a result, the airways become narrower and the flow of air into and out of the lungs becomes restricted (Figure 1). This narrowing leads to symptoms such as wheezing, coughing, chest tightness and difficulty breathing.<sup>1</sup> In severe asthma attacks, the airways close so much that not enough oxygen gets to vital organs and the condition becomes life-threatening.<sup>1</sup>

**Figure 1.**

### Why asthma makes it hard to breathe



Source: American Academy of Allergy, Asthma and Immunology

**Table 1. Asthma Triggers<sup>1,2</sup>**

Animal dander
Dust mites
Cockroaches
Pollen
Mold
Tobacco smoke
Air pollutants (e.g. ozone)
Strong odors or scented products/chemicals
Cold air or changes in weather
Physical exertion (including exercise)
Strong emotions or stress
Certain medications (e.g. aspirin, beta-blockers)
Sulfites (preservatives in foods such as dried fruit and wine)
Gastroesophageal reflux disease (GERD)
Respiratory infections

Asthma is a chronic disease – once a person develops asthma he or she is likely to have it for a lifetime.<sup>3</sup> Even when it is not causing symptoms, it is still there and can flare up at any time.<sup>3</sup> Although asthma can not be cured, it *can* be controlled and managed. Effective asthma management reduces the need for hospitalizations and urgent care visits and enables patients to enjoy normal activities.<sup>4</sup>

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# Introduction *cont.*

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## What causes asthma?

The exact cause of asthma (i.e. what causes the initial airway inflammation) is unclear. Individuals with a family history of asthma are more likely to develop it.<sup>1</sup> In addition, exposure early in life to tobacco smoke, infections and some allergens may also increase one's chance of developing asthma.<sup>1</sup> However, although the exact cause of asthma is unknown, there are many recognized asthma triggers that can lead to asthma symptoms and attacks (Table 1). Asthma triggers vary from person to person, and an individual can be sensitive to one or more triggers.<sup>1</sup>

## Why is asthma a problem?

Approximately 22 million persons in the United States have asthma; 6.5 million of them children less than 18 years of age.<sup>5</sup> The burden of asthma affects not only these individuals, but also their families and society in terms of lost work and school, lessened quality of life, and avoidable emergency department visits, hospitalizations, and deaths.<sup>6</sup>

Although there is no cure for asthma, there are effective means available to control the disease and prevent asthma attacks. Yet, in 2005, an estimated 12.2 million Americans – over one-half of current asthma sufferers – reported having at least one asthma attack during the previous year.<sup>5</sup> These asthma attacks, together with general management of the disease, require a large amount of medical care.<sup>7</sup> Nationwide, asthma was responsible for the following in 2005:

- 12.8 million physician office visits<sup>5,8</sup>
- 1.8 million emergency department visits<sup>5,9</sup>
- 488,594 hospitalizations<sup>5</sup>
- 3,857 deaths.<sup>10</sup>

The annual economic cost of asthma in the United States is estimated at \$19.7 billion, of which \$14.7 billion are for direct medical expenses.<sup>5</sup> Prescription drugs represent the largest single direct medical expenditure at \$6.2 billion, and albuterol (a bronchodilator used to treat asthma and other airway diseases), is the fifth most frequently prescribed medicine at ambulatory care visits.<sup>7,11</sup> In addition to direct medical expenses, asthma is also responsible for \$5 billion in indirect costs related to lost productivity. In 2003, 10.1 million work days and 12.8 million school days were missed as a result of asthma, and it is the most common cause of school absenteeism due to chronic conditions.<sup>12,13</sup>

As the first comprehensive, statewide asthma report, this document describes the burden of asthma in Tennessee in terms of disease prevalence, medical facility utilization and associated cost, and mortality. It examines time trends as well as disparities among people with different demographic characteristics such as age, gender, race, ethnicity, and county of residence. In addition, it describes the asthma burden among those covered by the state's expanded Medicaid program (i.e. TennCare). It is the authors' hope that this report will offer the most up-to-date picture possible of the burden of asthma in Tennessee, inform health professionals, policy makers and the general public of the importance of this disease and its impact on personal health, the health care system and society, and bring individuals and organizations together to decrease the burden of this disease in Tennessee.

# Prevalence

Symptoms and clinical manifestations of asthma are episodic. There may be symptom-free periods and/or the disease process may appear to resolve, and in many cases the diagnosis may be made only after an extended period of observation and testing.<sup>14</sup> As a result, prevalence is a more appropriate means of describing the burden of asthma in a population than is incidence.<sup>14</sup> The prevalence rate of a disease is the proportion of persons in a population who have the disease at a specific point in time or over a specified period of time. In the case of asthma, prevalence is often determined through the use of surveys. There are currently several available sources of survey data regarding asthma, including the Behavioral Risk Factor Surveillance System (BRFSS), the National Health Interview Survey (NHIS) and the National Survey of Children's Health (NSCH).<sup>a</sup> These listed surveillance systems collect data on both lifetime and current asthma prevalence.

The BRFSS and NHIS define lifetime asthma as a positive response to the question “*Have you ever been told by a doctor, nurse or other health care professional that you had asthma?*”<sup>b</sup> Current asthma is defined as a positive response to the lifetime asthma question, as well as a positive response to the subsequent question “*Do you still have asthma?*” The questions used in the NSCH are similar, but are answered by a parent on behalf of the child. Although the questions used by the various surveillance systems are comparable, the results of each will vary due to sampling design.

This section focuses on asthma prevalence in the United States and in Tennessee since 2000. Core asthma questions were not included in the BRFSS until 2000 and the NSCH did not begin until 2003. Although asthma questions were included in the NHIS as early as 1980, comparisons between earlier and later estimates are problematic due to the absence of a current prevalence measure from 1997 to 2000 and to a change in the definition of current asthma prevalence in 2001.<sup>c,15</sup>

Nationally, the NHIS found that the prevalence of asthma increased between 1980 and 1996.<sup>15</sup> Determining whether prevalence continued to increase subsequently is complicated for the reasons mentioned above. However, since 2001, no significant changes in asthma prevalence have been observed (Figure 2).<sup>5,15</sup>

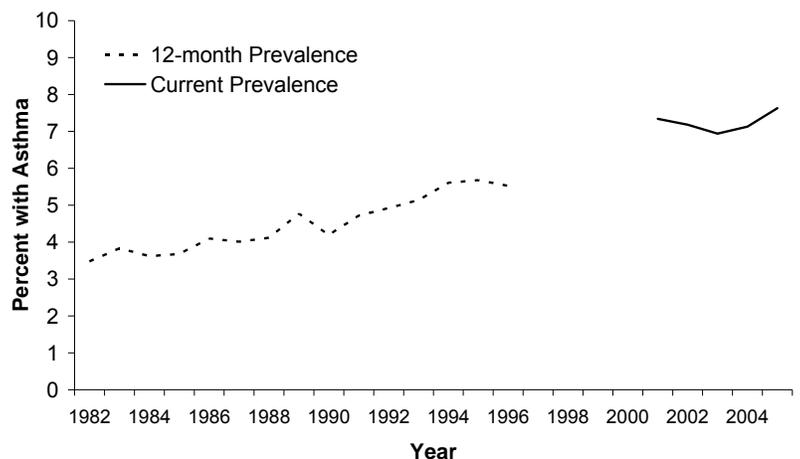


Figure 2. Twelve-month and current prevalence of asthma, United States, 1982-2005 (NHIS)

<sup>a</sup> See Technical Notes for detailed descriptions of each of these surveillance systems.

<sup>b</sup> The wording of this question is slightly different in each survey – please see Technical Notes.

<sup>c</sup> Prior to 1997, the NHIS used the question “During the past 12 month, did anyone in the family have asthma?” which was referred to as 12-month asthma prevalence.

# Prevalence cont.

## Adult Asthma Prevalence

- Based on BRFSS data, the lifetime prevalence of asthma among adult Tennesseans ( $\geq 18$  years) averaged 12.7% between 2004 and 2006. This represents approximately 570,000 people with asthma in the state.
- During this same time period, the current prevalence of asthma averaged 8.4%.
- Between 2000 and 2006, there was no statistically significant increase or decrease in the lifetime or current prevalence of asthma in Tennessee (Figure 3).

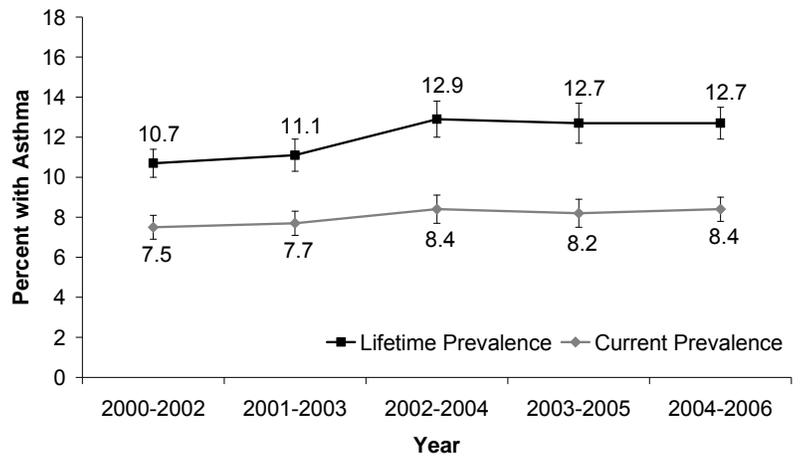


Figure 3. Lifetime and current asthma prevalence in adults, Tennessee, 2000-2006 3-year moving average (BRFSS)

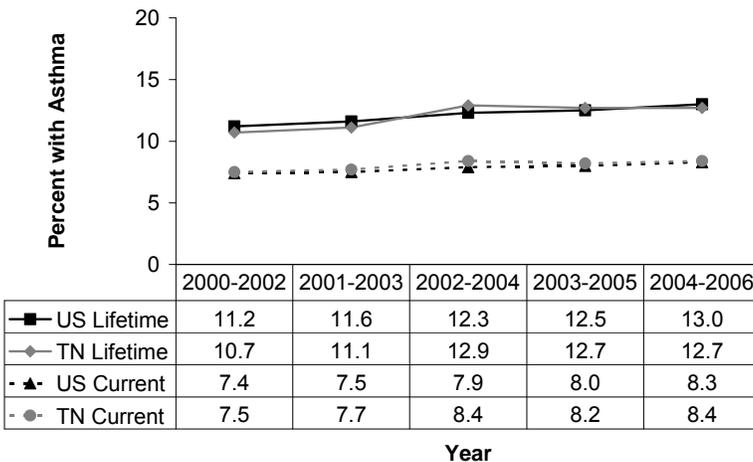


Figure 4. Lifetime and current asthma prevalence in adults, Tennessee and the United States, 2000-2006 3-year moving average (BRFSS)

- Between 2000 and 2006, both lifetime and current asthma prevalence rates in Tennessee were similar to rates for the entire United States (Figure 4).<sup>16</sup>

## The Global Burden of Asthma

Asthma is one of the most common chronic diseases in the world. It is estimated that approximately 300 million people in the world currently have asthma, with the prevalence of asthma in different countries ranging from 1% to 18% of the population. The prevalence of asthma increases as communities adopt modern lifestyles and become urbanized. 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.

Source: Bousquet J, Bousquet PJ, Godard P, Duares J-P. The Public Health Implications of Asthma. *Bulletin of the World Health Organization* 2005; 83(7):548-554.

# Prevalence cont.

## Adult Asthma Prevalence cont.

- Asthma prevalence estimates from the NHIS tend to be slightly lower than those obtained from the BRFSS. Based on NHIS data, the lifetime and current prevalence of asthma among U.S. adults ( $\geq 18$  years) averaged 10.1% and 6.8%, respectively, between 2003 and 2005 (Figure 5).<sup>17</sup> Based on BRFSS data, these rates were 12.5% and 8.0%, respectively.
- State-specific asthma prevalence rates are not available from the NHIS. However, region-specific rates for 2003-2005 are presented in Figure 5. The lifetime and current prevalence of asthma for adults among the four states in the south east central region (Tennessee, Kentucky, Mississippi, and Alabama) were 10.1% and 7.0%, respectively, which were similar to rates for the entire United States.<sup>17</sup>

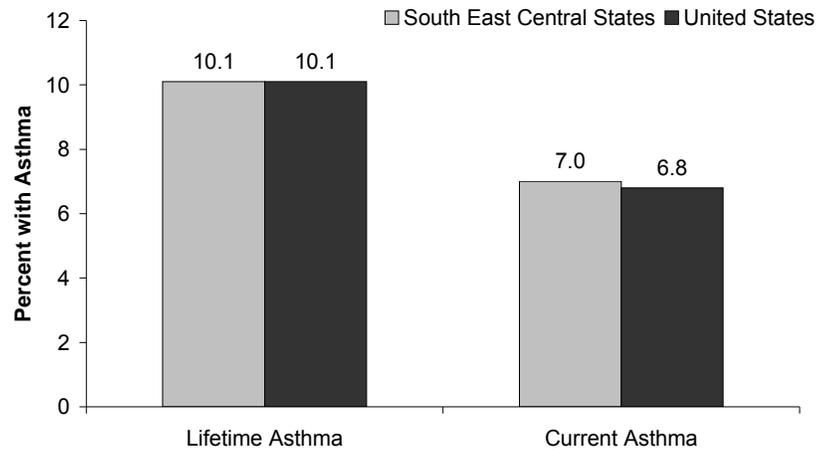


Figure 5. Lifetime and current asthma prevalence in adults, south east central states (TN, KY, MS, AL) and the United States, 2003-2005 average (NHIS)

- For comparison, state-specific asthma prevalence rates from the BRFSS for 2003-2005 are presented in Figures 6 and 7. Among the four south east central states, Kentucky had the highest asthma prevalence rates and Mississippi had the lowest.<sup>16</sup>

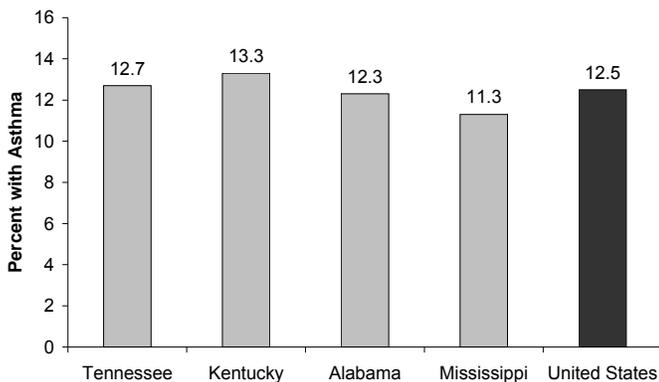


Figure 6. Lifetime asthma prevalence in adults, south east central states and the United States, 2003-2005 average (BRFSS)

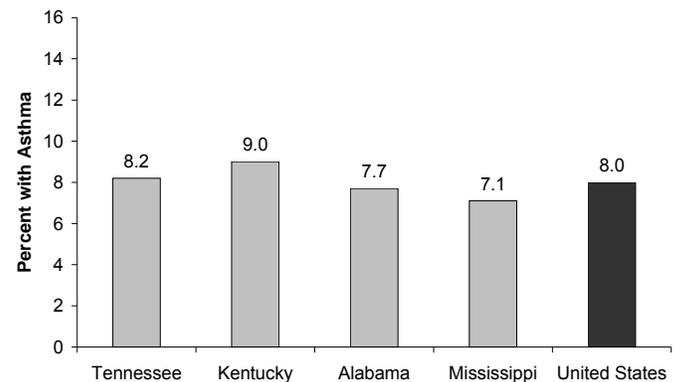
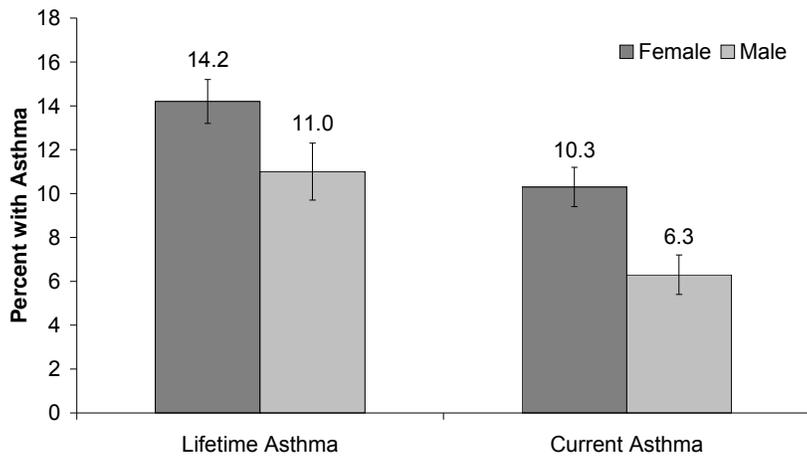


Figure 7. Current asthma prevalence in adults, south east central states and the United States, 2003-2005 average (BRFSS)

# Prevalence cont.

## Adult Asthma Prevalence cont.



- Based on 2004-2006 Tennessee BRFSS data, both lifetime and current asthma prevalence rates were higher among adult females than adult males (Figure 8).
- Average lifetime prevalence was 14.2% for females and 11.0% for males.
- Average current prevalence was 10.3% for females and 6.3% for males.

Figure 8. Lifetime and current asthma prevalence in adults by gender, Tennessee, 2004-2006 average (BRFSS)

- There were no statistically significant differences in average lifetime or current asthma prevalence in white non-Hispanics compared to black non-Hispanics (Figure 9).
- Average lifetime and current asthma prevalence among Hispanics (14.1% and 13.0%, respectively) was higher than for non-Hispanics (12.6% and 8.3%, respectively). However, these differences were not statistically significant.

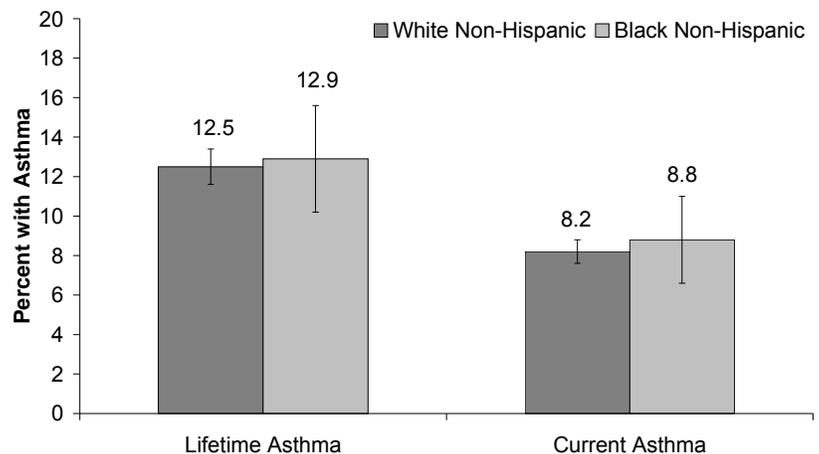


Figure 9. Lifetime and current asthma prevalence in adults by race, Tennessee, 2004-2006 average (BRFSS)

### Four Components of Asthma Care Part 1 – Assessment and Monitoring of Asthma Severity and Control

Asthma severity is assessed to guide clinical decisions for initiating the appropriate medication and other therapeutic interventions. Once therapy is initiated, the emphasis is thereafter changed to assessment of asthma control – the level of control will guide decisions either to maintain or to adjust therapy. The specific measures used to assess severity and control are similar: symptoms, use of medications for quick relief of symptoms, limitations to normal activities due to asthma, pulmonary function and exacerbations. Multiple measures are important because different measures assess different manifestations of the disease and may not correlate with each other. Asthma is a multifaceted disease, and assessment and monitoring should consider both current impairments on quality of life and functional capacity and future risks for adverse events, since each may respond differently to treatment. For example, some patients may have adequate control of symptoms and minimal day-to-day impairment, but still be at significant risk of exacerbations.

Source: National Institutes of Health and the National Heart, Lung and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma*. NIH Publication No. 08-52846, October 2007.

# Prevalence cont.

## Adult Asthma Prevalence cont.

- Between 2004 and 2006, both lifetime and current asthma prevalence were highest among persons with an annual household income of less than \$15,000 (Figures 10 and 11).
- The average lifetime prevalence of asthma among those with an income of less than \$15,000 (21.9%) was almost twice as high as among those with an income of \$15,000 or more (11.3%).
- The average current prevalence of asthma among those with an income of less than \$15,000 (16.8%) was over twice as high as among those with an income of \$15,000 or more (7.2%).

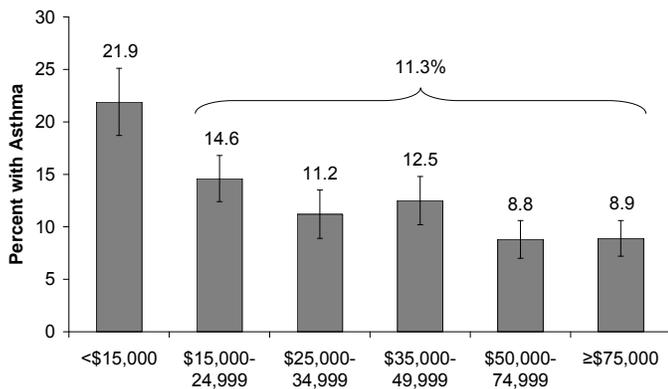


Figure 10. Lifetime asthma prevalence in adults by annual household income, Tennessee, 2004-2006 average (BRFSS)

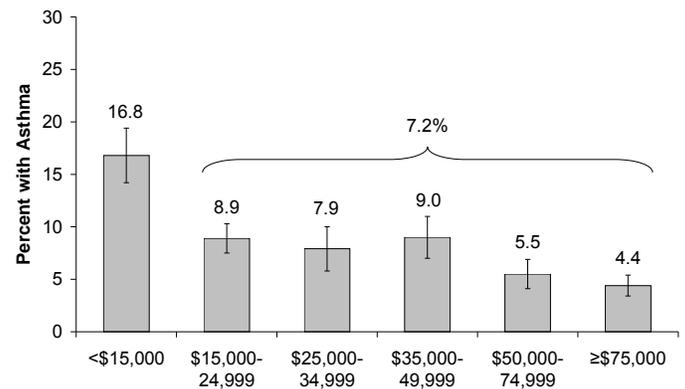


Figure 11. Current asthma prevalence in adults by annual household income, Tennessee, 2004-2006 average (BRFSS)

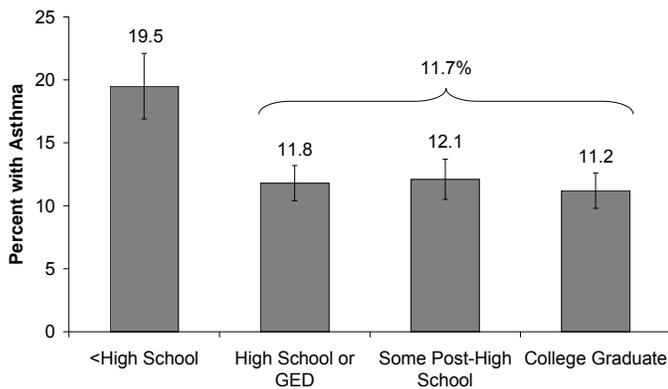


Figure 12. Lifetime asthma prevalence in adults by highest level of education completed, Tennessee, 2004-2006 average (BRFSS)

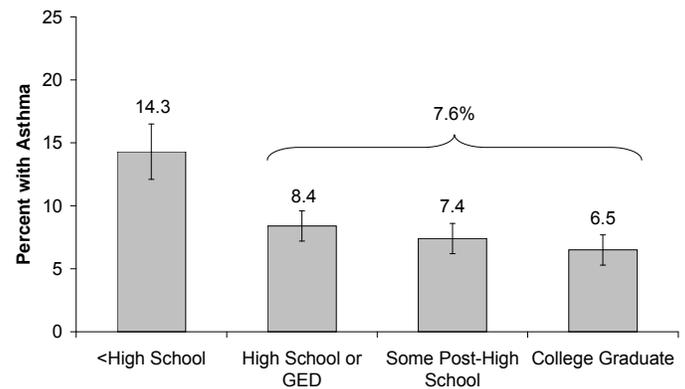


Figure 13. Current asthma prevalence in adults by highest level of education completed, Tennessee, 2004-2006 average (BRFSS)

- Between 2004 and 2006, both lifetime and current asthma prevalence were highest among persons with less than a high school education (Figures 12 and 13).
- The average lifetime prevalence of asthma among those with less than a high school education (19.5%) was 1.7 times as high as among those with higher levels of education (11.7%).
- The average current prevalence of asthma among those with less than a high school education (14.3%) was almost twice as high as among those with higher levels of education (7.6%).

# Prevalence cont.

## Childhood Asthma Prevalence

- State-specific asthma prevalence rates for children (0-17 years) are not available from the NHIS. However, region-specific rates for 2003-2005 are presented in Figure 14.
- The lifetime and current prevalence of asthma for children among the four states in the south east central region (Tennessee, Kentucky, Mississippi, and Alabama) were 12.0% and 8.6%, respectively, compared to 12.4% and 8.7% for the entire United States.<sup>17</sup>

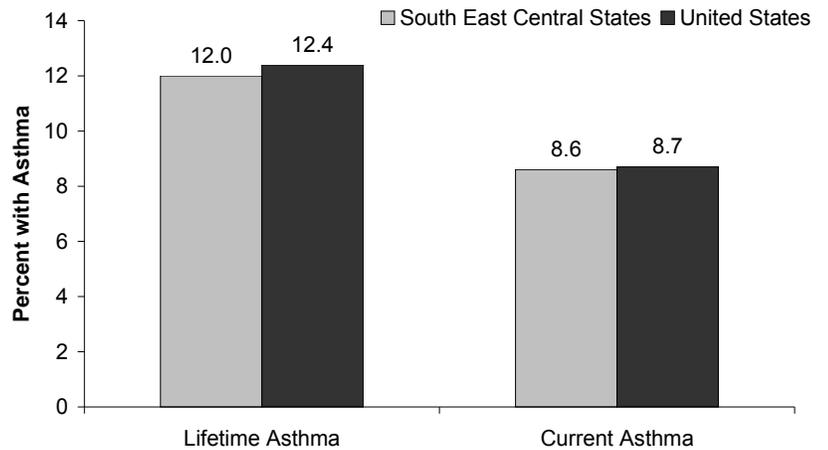


Figure 14. Lifetime and current asthma prevalence in children, south east central states (TN, KY, MS, AL) and the United States, 2003-2005 average (NHIS)

- For comparison, state-specific asthma prevalence rates from the 2003 NSCH are presented in Figures 15 and 16. Among the four south east central states, Kentucky had the highest asthma prevalence rates and Tennessee had the lowest.<sup>5</sup>

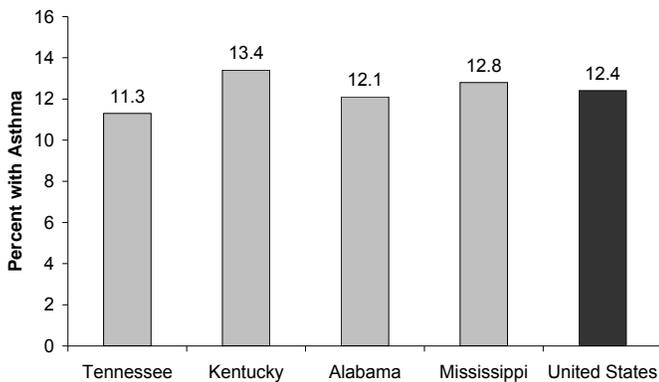


Figure 15. Lifetime asthma prevalence in children, south east central states and the United States, 2003 (NSCH)

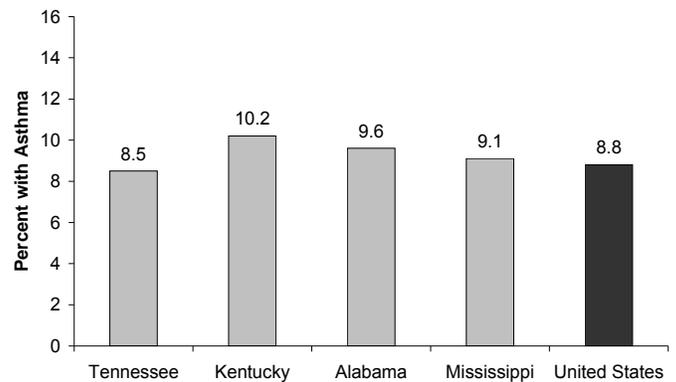


Figure 16. Current asthma prevalence in children, south east central states and the United States, 2003 (NSCH)

# Prevalence cont.

## Childhood Asthma Prevalence cont.

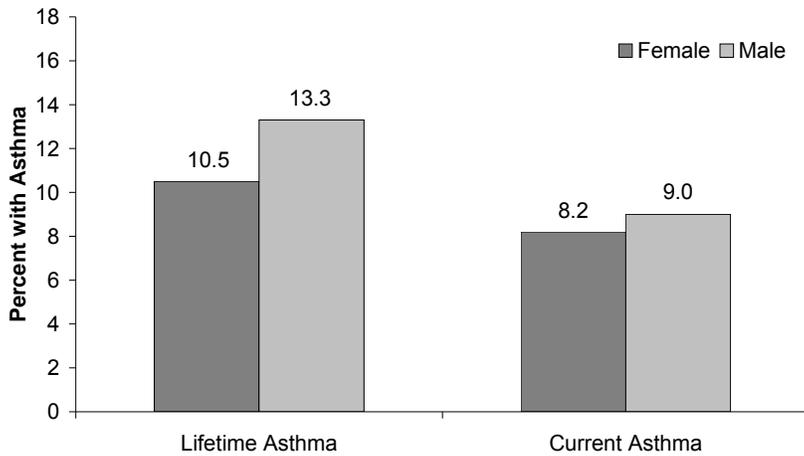


Figure 17. Lifetime and current asthma prevalence in children by gender, south east central states (TN, KY, MS, AL), 2003-2005 average (NHIS)

- Based on 2003-2005 NHIS data, childhood asthma prevalence in the south east central states was higher among black non-Hispanics than white non-Hispanics (Figure 18).
- Average lifetime prevalence was 15.1% for black children and 10.8% for white children.<sup>17</sup>
- Average current prevalence was 10.9% for black children and 7.9% for white children.<sup>17</sup>
- Regional-level asthma prevalence data for Hispanics were not available from the NHIS. However, nationally, lifetime prevalence among Hispanic children was 11.4% and current prevalence was 7.6%. These rates were similar to national-level prevalence rates for white non-Hispanic children.<sup>17</sup>

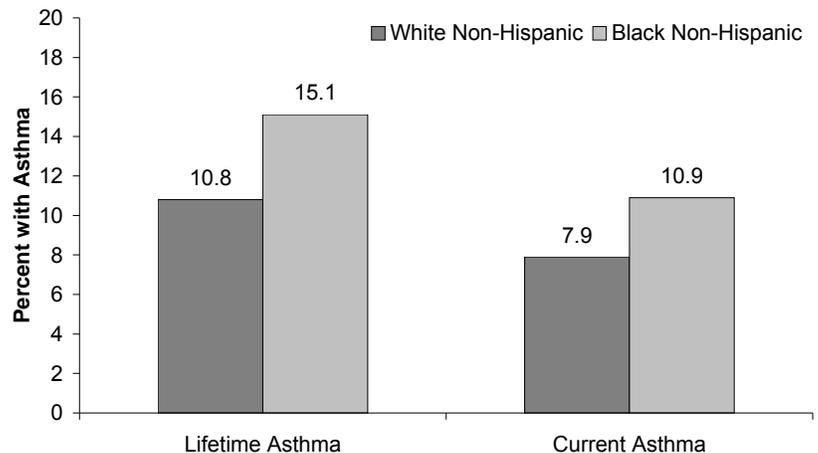


Figure 18. Lifetime and current asthma prevalence in children by race, south east central states (TN, KY, MS, AL), 2003-2005 average (NHIS)

- Based on 2003-2005 NHIS data, childhood asthma prevalence in the south east central states was higher among males than among females (Figure 17). As noted earlier, asthma prevalence *in adults* is higher in females.
- Average lifetime prevalence was 13.3% for boys and 10.5% for girls.<sup>17</sup>
- Average current prevalence was 9.0% for boys and 8.2% for girls.<sup>17</sup>

# Health Care Utilization and Cost

Hospitalizations and emergency department visits are a serious consequence of asthma and an indication of severe and/or poorly managed disease. They are costly both monetarily and in terms of personal suffering, but are largely preventable with appropriate treatment and disease management.<sup>4,6</sup>

Following is a discussion of inpatient hospitalization rates and emergency department visit rates for a primary diagnosis of asthma. Hospital data were obtained from the Hospital Discharge Data System (HDDS), which is described in the Technical Notes. Patient encounters in the HDDS are divided into inpatient and outpatient hospitalizations. Inpatient hospitalizations represent patients who were admitted to the hospital for treatment. Outpatient hospitalizations represent patients who were treated in a hospital setting without being admitted. Both in- and outpatients may have initially been treated in the emergency department, and there is therefore some overlap in inpatient hospitalizations and ED visits. Rates were calculated as the number of inpatient hospitalizations or emergency department visits per 100,000 people in the Tennessee population (i.e. discharge-level analysis) and age-adjusted to the 2000 United States standard population. This is not the same as the number of people hospitalized for asthma, because some individuals may have been hospitalized or visited an emergency department more than once in a given year. The rates presented are a reflection of the burden that asthma places on the health care system in Tennessee.

## Inpatient Hospitalizations for Asthma

- In 2006, there were 8,041 inpatient hospitalizations in Tennessee for a primary diagnosis of asthma, and the rate of asthma hospitalizations was 133/100,000.
- Between 1997 and 2006 there was no statistically significant increase or decrease in the overall asthma hospitalization rate in Tennessee (Figure 19).
- Between 1997 and 2005 the asthma hospitalization rate in Tennessee was consistently lower than that for the entire United States (Figure 19).<sup>5</sup>

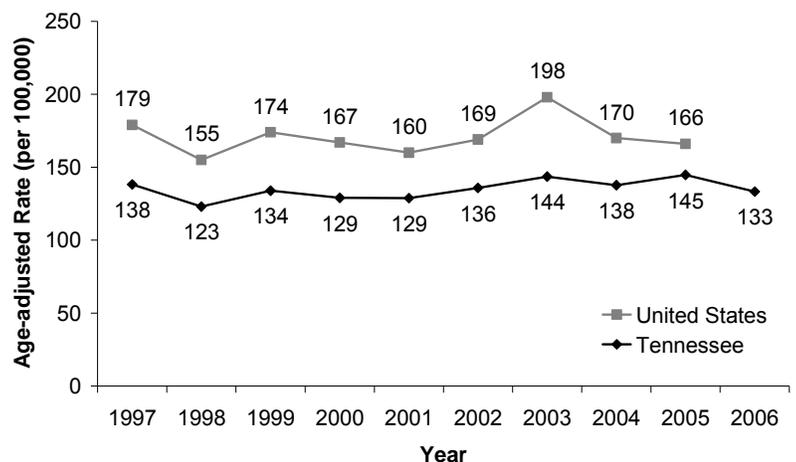


Figure 19. Age-adjusted inpatient hospitalization rate for primary asthma, Tennessee and the United States, 1997-2006 (HDDS, NHDS)

**In 2006, there were 8,041 inpatient hospitalizations in Tennessee for a primary diagnosis of asthma**

- There were small but statistically significant increases in the asthma hospitalization rate among females (3% increase) and whites (4% increase) between 1997 and 2006 (Figures 20 and 21).
- The asthma hospitalization rate for white females increased 12% during this time period. There were no statistically significant increases or decreases in the asthma hospitalization rate among other racial and/or gender groups.

# Health Care Utilization and Cost *cont.*

## Inpatient Hospitalizations for Asthma *cont.*

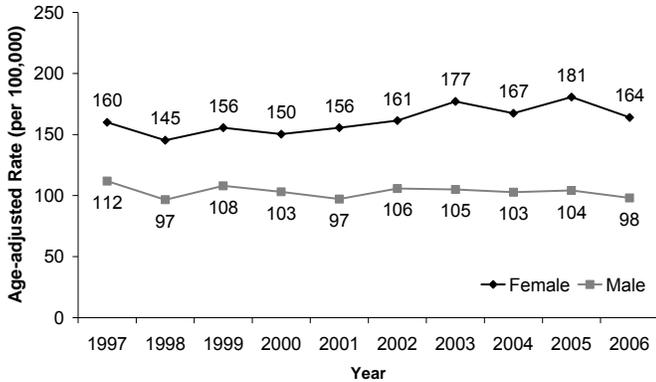


Figure 20. Age-adjusted inpatient hospitalization rate for primary asthma by gender, Tennessee, 1997-2006 (HDDS)

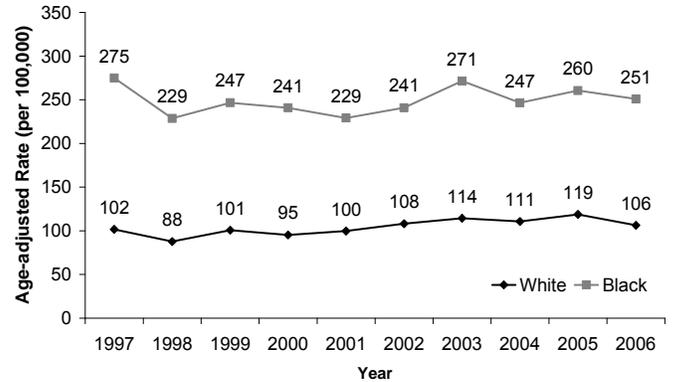


Figure 21. Age-adjusted inpatient hospitalization rate for primary asthma by race, Tennessee, 1997-2006 (HDDS)

- In 2006, the asthma hospitalization rate was higher among females (164/100,000) than males (98/100,000) and higher among blacks (251/100,000) than whites (106/100,000) (Figure 22).
- Black females had the highest asthma hospitalization rate (282/100,000), followed by black males (208/100,000), white females (137/100,000) and white males (72/100,000) (Figure 22).

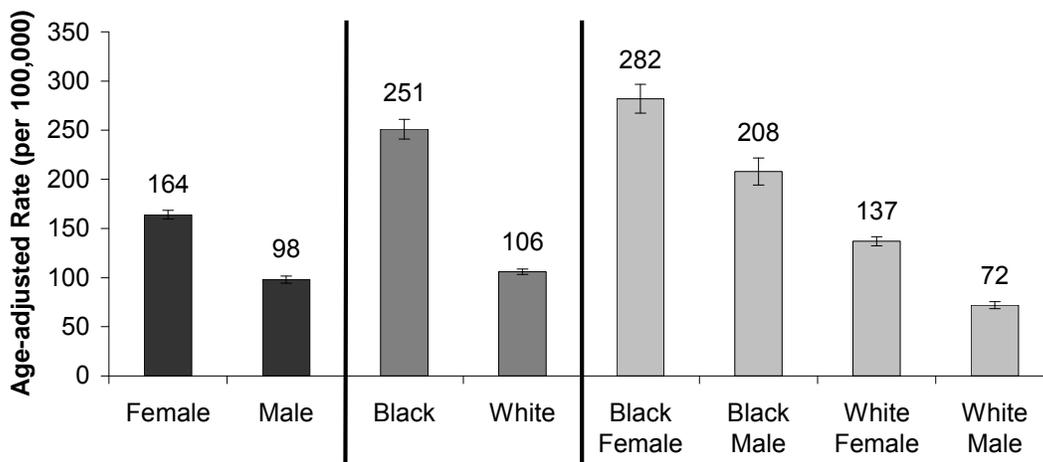


Figure 22. Age-adjusted inpatient hospitalization rate for primary asthma by gender and/or race, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Inpatient Hospitalizations for Asthma *cont.*

- Between 1997 and 2006, there were fewer than one-hundred inpatient hospitalizations for asthma among Hispanics each year.
- Between 2004 and 2006, the average asthma hospitalization rate was 40/100,000 among Hispanics and 135/100,000 among non-Hispanics (Figure 23).

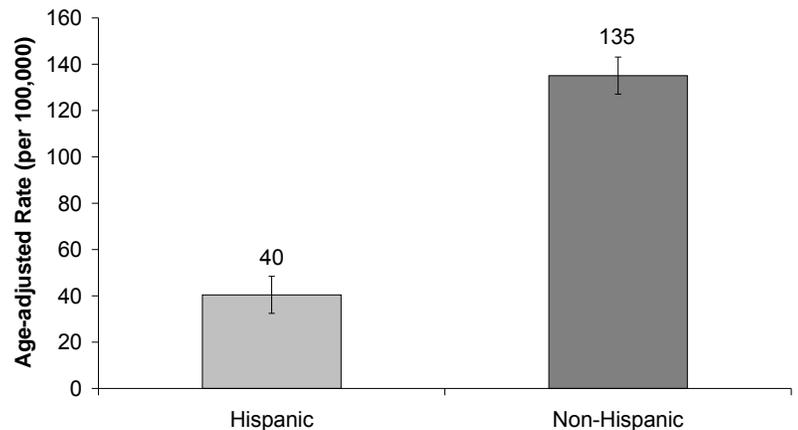


Figure 23. Age-adjusted inpatient hospitalization rate for primary asthma by ethnicity, Tennessee, 2004-2006 average (HDDS)

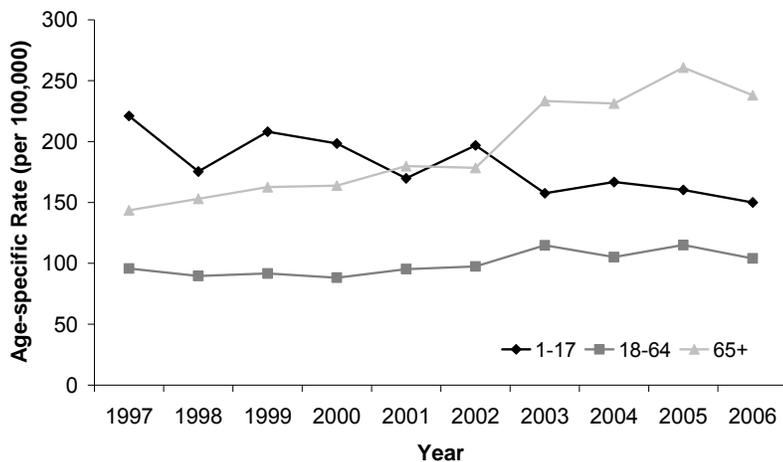


Figure 24. Age-specific inpatient hospitalization rate for primary asthma, Tennessee, 1997-2006 (HDDS)

- Between 1997 and 2006, there was a statistically significant *decrease* in the asthma hospitalization rate among children aged 1-17 years (32% decrease) (Figure 24).
- During that same time period there was a statistically significant *increase* in the asthma hospitalization rate among adults aged 18-64 years (8% increase) and among those aged 65 years and older (65% increase) (Figure 24).

## The Hygiene Hypothesis

The hygiene hypothesis was first developed in the 1980's by E.P. Strachen, who proposed that increases in allergy cases were linked to declining family size, reduced exposure to germs and higher standards of cleanliness. Underlying the hypothesis is the idea that decreased exposures to bacteria and their endotoxins result in an under-stimulated immune system, which then over-reacts when exposed to harmless substances such as pollen, house dust and animal dander, leading to allergies and asthma. Numerous studies have been performed to test the hygiene hypothesis, including studies examining the relationship between allergies and/or asthma and exposures to day care, farms and livestock, antibacterial cleaning products, use of antibiotics and vaginal versus cesarean-section births. To date, the hypothesis has not been developed strongly enough to provide a specific course of action for either prevention or treatment of asthma. However, current evidence is intriguing and substantiates further investigations.

### Sources:

American Academy of Allergy, Asthma and Immunology. Allergy and Asthma Advocate: Winter 2004. Accessed 30 January 2008 at [www.aaaai.org/patients/advocate/2004/winter/hygiene.stm](http://www.aaaai.org/patients/advocate/2004/winter/hygiene.stm).  
Liu AH, Murphy JR. Hygiene Hypothesis: Fact or Fiction? *Journal of Allergy and Clinical Immunology* 2003; 111(3):471-478.

# Health Care Utilization and Cost *cont.*

## Inpatient Hospitalizations for Asthma *cont.*

- Asthma hospitalization rates were highest among very young children. As age increased, hospitalization rates decreased sharply until the mid to late teens, and then gradually increased again as age increased. This pattern held true for all gender/race groups. However, asthma hospitalization rates among children were higher for males than females, while among adults they were higher for females (Figure 25). Asthma hospitalizations were higher among blacks than whites at all ages (Figure 26).

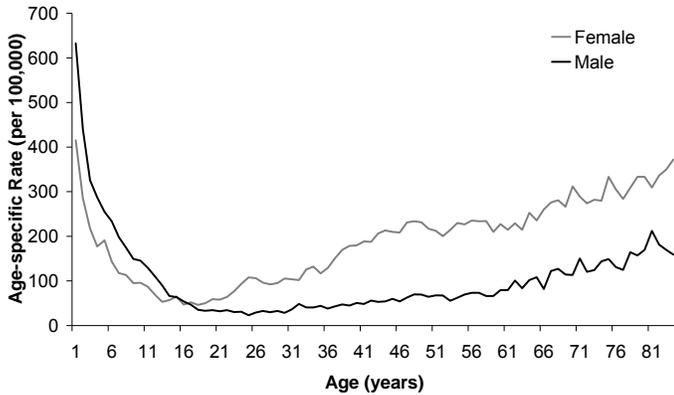


Figure 25. Age-specific inpatient hospitalization rate for primary asthma by gender, Tennessee, 2002-2006 average (HDDS)

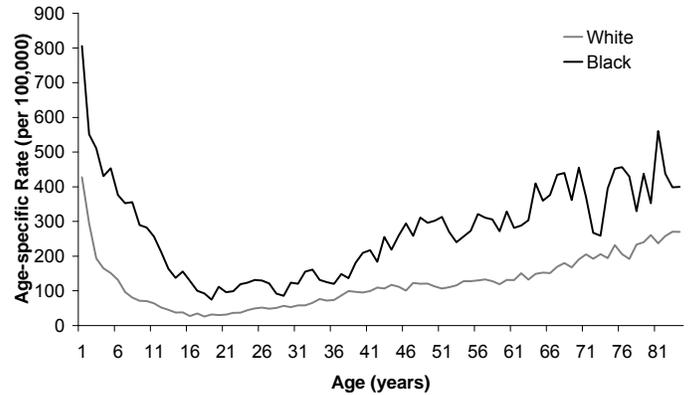


Figure 26. Age-specific inpatient hospitalization rate for primary asthma by race, Tennessee, 2002-2006 average (HDDS)

- In 2006, the asthma hospitalization rate was highest among children aged 1-4 years of age (293/100,000) and lowest among teens aged 11-17 years (66/100,000) (Figure 27).<sup>d</sup>

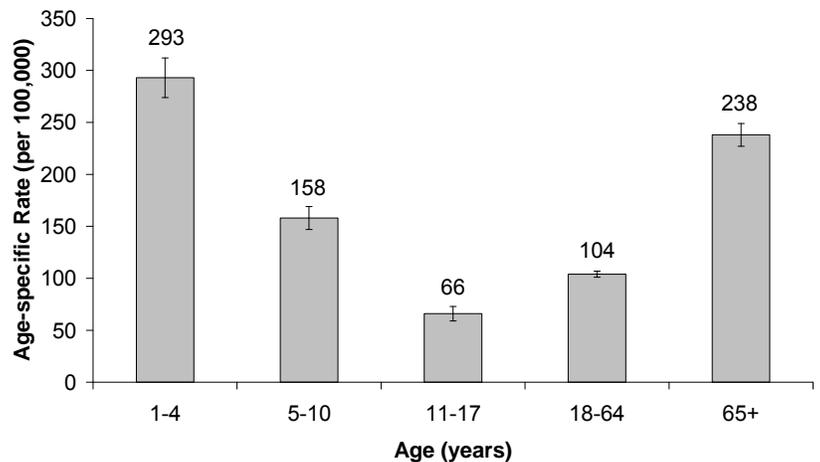


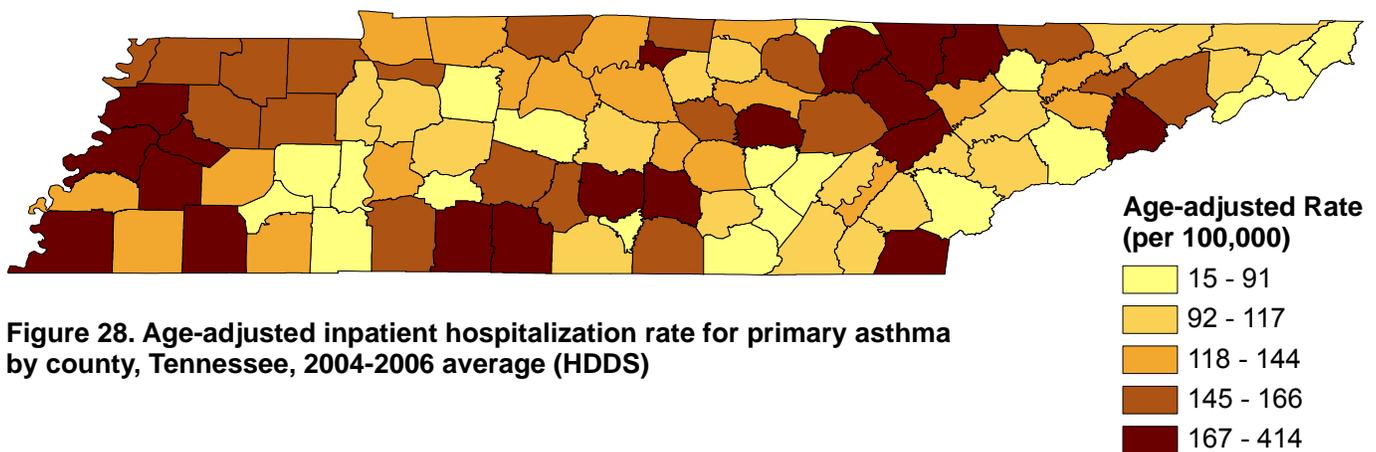
Figure 27. Age-specific inpatient hospitalization rate for primary asthma, Tennessee, 2006 (HDDS)

<sup>d</sup> The age distribution among all inpatient hospitalizations for primary asthma was as follows: 1-4 years 12%, 5-10 years 10%, 11-17 years 5%, 18-64 years 51%, 65 years and over 23%.

# Health Care Utilization and Cost *cont.*

## Inpatient Hospitalizations for Asthma *cont.*

- Between 2004 and 2006, the average age-adjusted inpatient hospitalization rate for primary asthma within individual Tennessee counties ranged from 15/100,000 in Moore County to 414/100,000 in Fentress County (Figure 28). [Detailed county and regional level rates are located in the Appendix.]
- The ten counties with the lowest asthma hospitalization rates were: Moore, Williamson, Lewis, Decatur, Johnson, Dickson, Sequatchie, Union, Henderson and Hardin.
- The ten counties with the highest asthma hospitalization rates were: Cocke, Lauderdale, Hardeman, Haywood, Trousdale, Lawrence, Campbell, Coffee, Polk and Fentress.



**Figure 28. Age-adjusted inpatient hospitalization rate for primary asthma by county, Tennessee, 2004-2006 average (HDDS)**

## Occupational Asthma

Occupational asthma is a form of asthma caused by exposure to dusts, gases and/or vapors in the workplace. Symptoms usually occur while the worker is exposed to a particular substance at work. In some cases, symptoms may develop several hours after the person leaves work, and then subside before he or she returns to work the next day. In early stages of the disease, symptoms usually decrease during weekends or vacations. In later stages, symptoms may occur away from work after exposure to common triggers such as cigarette smoke or house dust. Occupational asthma is usually reversible, but permanent lung damage can occur if exposure to the substance that causes the disease continues.

Workers in hundreds of occupations are exposed to substances in the air that may cause occupational asthma in susceptible people. Many of these substances are very common and not ordinarily considered hazardous. Occupational asthma can occur in almost any line of work, but is most common among workers in the following industries:

- Plastics
- Electronics
- Metalworking
- Baking and food processing
- Rubber
- Painting
- Welding
- Farming
- Chemicals
- Printing
- Oil refining
- Gardening, landscaping and horticulture
- Textiles
- Dyeing
- Cleaning
- Working with animals

Only a small proportion of exposed workers develop occupational asthma. However, it is estimated that 15% of asthma in adults is attributable to work.

### Sources:

American Thoracic Society: Occupational Contribution to the Burden of Airway Disease. *American Journal of Respiratory and Critical Care Medicine* 2003; 167(5):787-797.

American Lung Association. Occupational Asthma Fact Sheet. Accessed 8 January 2008 at [www.lungusa.org](http://www.lungusa.org).

eMedicineHealth. Occupational Asthma Fact Sheet. Accessed 8 January 2008 at [www.emedicinehealth.com](http://www.emedicinehealth.com).

# Health Care Utilization and Cost *cont.*

## Inpatient Hospitalizations for Asthma *cont.*

- In 2006, the length of stay per admission for inpatient asthma hospitalizations ranged from 0 to 66 days, with a mean of 3.3 days and a median of 3 days (Figure 29).
- Median length of stay was 3 days among females and 2 days among males (Figure 30).
- Median length of stay was 2 days among blacks and 3 days among whites (Figure 30).
- Elderly adults aged 65 years and older had the longest median length of stay (4 days), while children less than 18 years old had the shortest (2 days) (Figure 31).

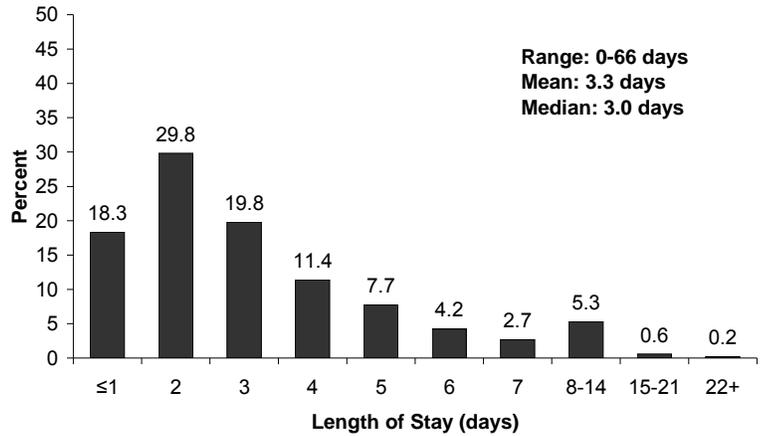


Figure 29. Distribution of length of stay among inpatient hospitalizations for primary asthma, Tennessee, 2006 (HDDS)

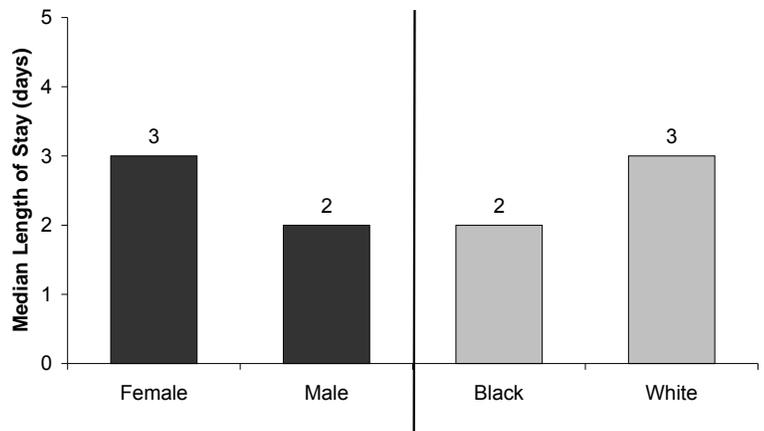


Figure 30. Median length of stay among inpatient hospitalizations for primary asthma by gender or race, Tennessee, 2006 (HDDS)

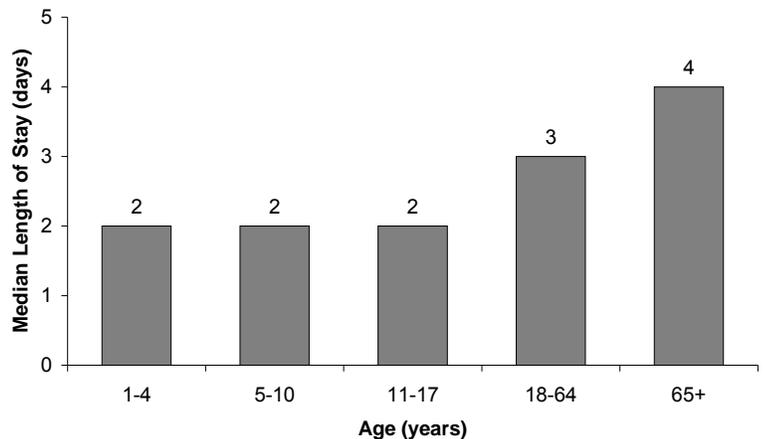


Figure 31. Median length of stay among inpatient hospitalizations for primary asthma by age, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma

As discussed earlier, emergency department (ED) visits for asthma are an indication of severe and/or poorly managed disease and are largely preventable. In 2006, the majority of ED visits for primary asthma were treated as outpatients, but 16% were subsequently admitted to the hospital. The elderly were much more likely than children or younger adults to be admitted following an ED visit for asthma (Figure 32).

It should be noted that the majority of hospitalizations for asthma were *outpatient* hospitalizations (79%) and that among outpatient hospitalizations, the vast majority (98%) were treated in the emergency department (Figure 33). Elderly adults were less likely to be treated as outpatients than were children and younger adults – over one-half of asthma hospitalizations among the elderly were inpatient hospitalizations (Figure 34).

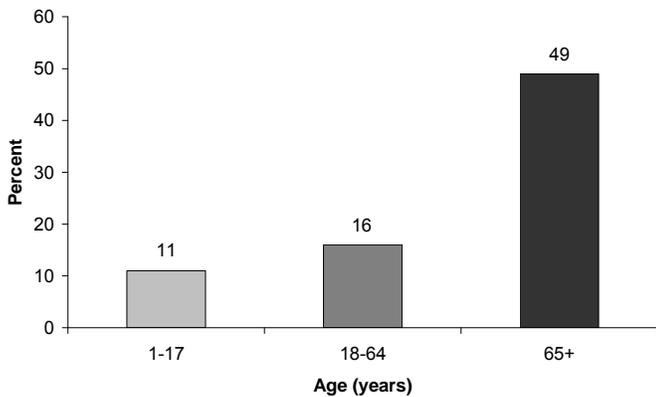


Figure 32. Percentage of emergency department asthma patients admitted to the hospital by age, Tennessee, 2006 (HDDS)

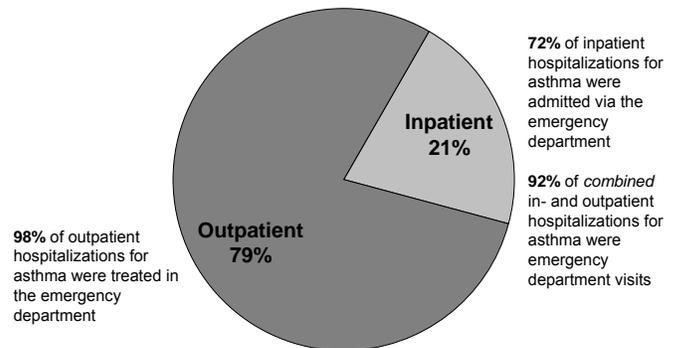


Figure 33. Percentage of inpatient vs. outpatient hospitalizations for primary asthma, Tennessee, 2006 (HDDS)

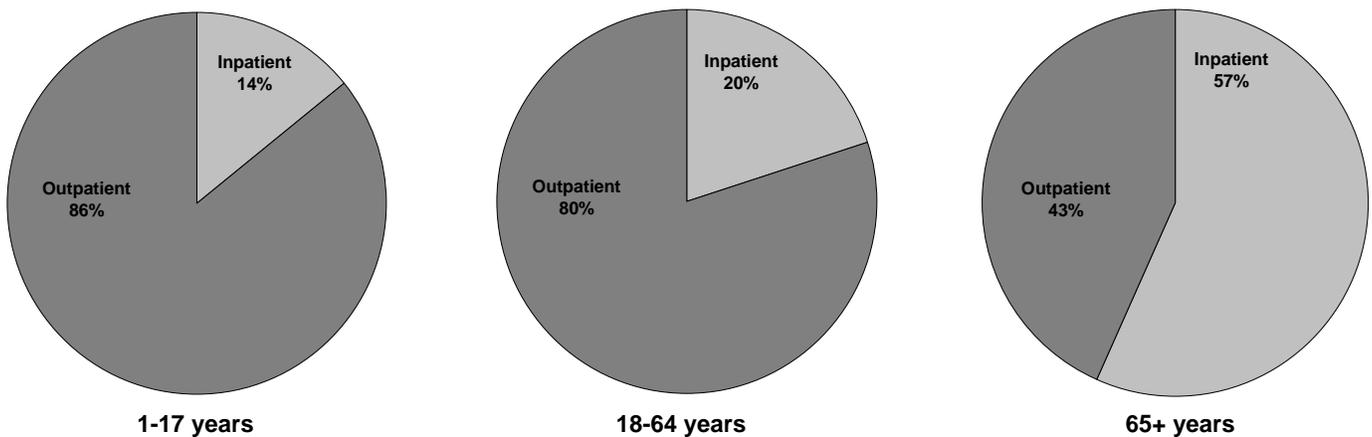


Figure 34. Percentage of inpatient vs. outpatient hospitalizations for primary asthma by age, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma *cont.*

- In 2006, there were 35,567 emergency department visits for a primary diagnosis of asthma in Tennessee, and the rate of ED visits was 604/100,000.
- The ED visit rate for asthma in Tennessee increased 35% from 1997 to 2006 (Figure 35).
- Since 2001, the asthma ED visit rate in Tennessee has been similar to that for the entire United States. Prior to 2001, Tennessee's rate was lower than that for the U.S. (Figure 35).<sup>15,18</sup>

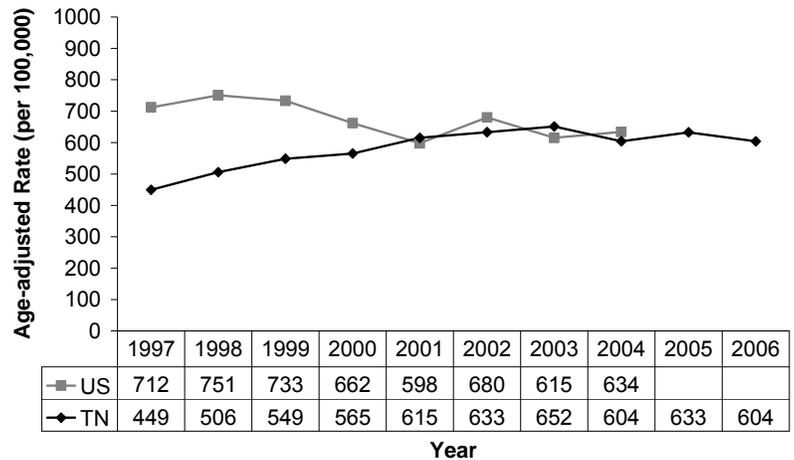


Figure 35. Age-adjusted ED visit rate for primary asthma, Tennessee and the United States, 1997-2006 (HDDS, NHAMCS)

**In 2006, there were 35,567 emergency department visits in Tennessee for a primary diagnosis of asthma**

- There was a statistically significant increase in the ED visit rate among all racial and/or gender groups between 1997 and 2006 (Figures 36 and 37).
- The increase was greatest for white females (55% increase), followed by white males (48%), black males (36%) and black females (33%).

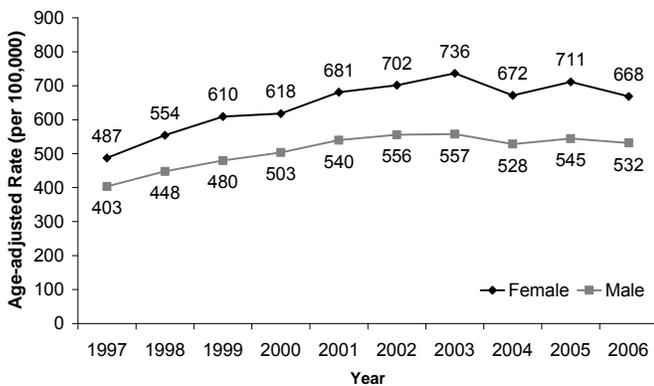


Figure 36. Age-adjusted ED visit rate for primary asthma by gender, Tennessee, 1997-2006 (HDDS)

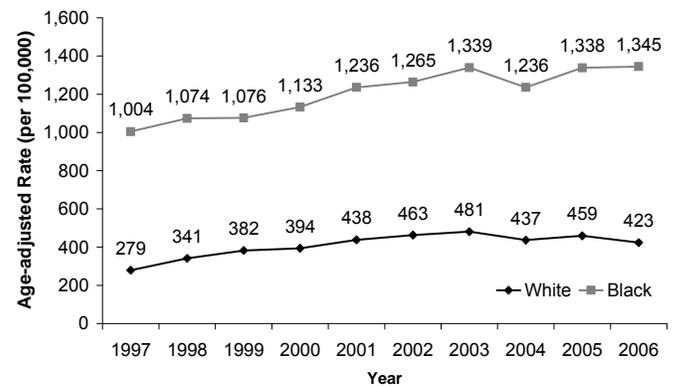


Figure 37. Age-adjusted ED visit rate for primary asthma by race, Tennessee, 1997-2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma *cont.*

- In 2006, the asthma ED visit rate was higher among females (668/100,000) than males (532/100,000) and higher among blacks (1,345/100,000) than whites (423/100,000) (Figure 38).
- Black females and males had the highest asthma ED visit rates (1,338/100,000 and 1,325/100,000, respectively), followed by white females (506/100,000) and white males (336/100,000) (Figure 38).

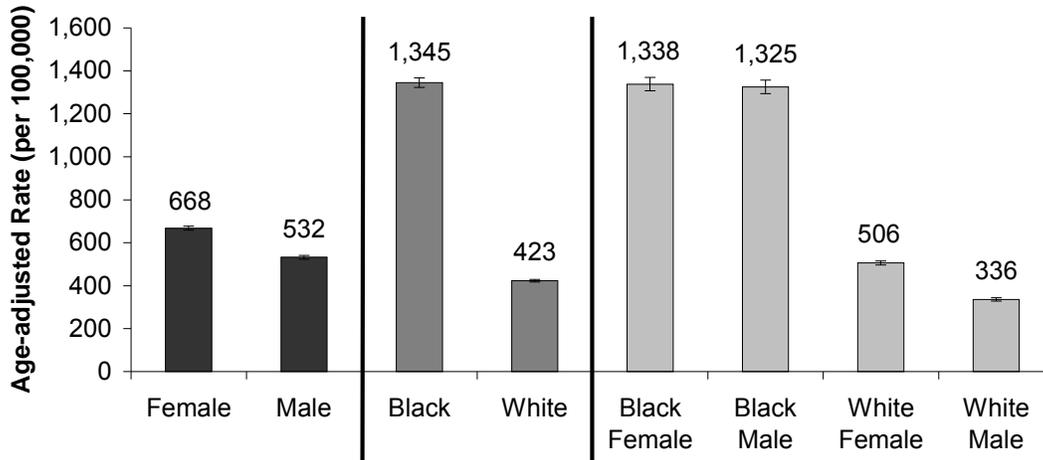
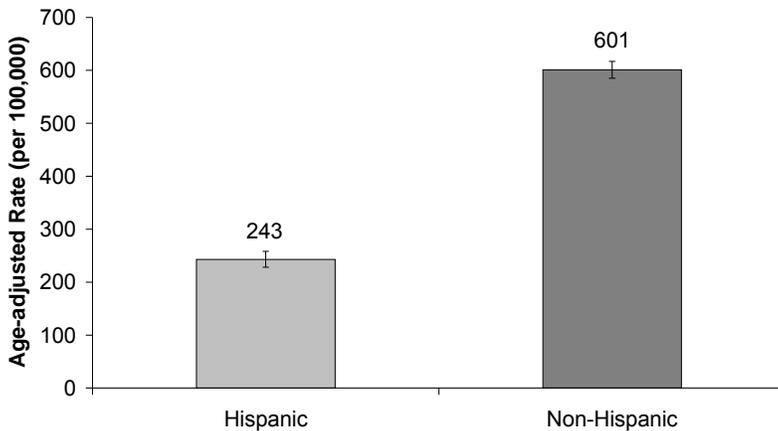


Figure 38. Age-adjusted ED visit rate for primary asthma by gender and/or race, Tennessee, 2006 (HDDS)



- Between 1997 and 2006, there were fewer than six-hundred ED visits for asthma among Hispanics each year.
- Between 2004 and 2006, the average asthma ED visit rate was 243/100,000 among Hispanics and 601/100,000 among non-Hispanics (Figure 39).

Figure 39. Age-adjusted ED visit rate for primary asthma by ethnicity, Tennessee, 2004-2006 average (HDDS)

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma *cont.*

- Between 1997 and 2006, there were statistically significant increases in the ED visit rate for asthma among children aged 1-17 years (23% increase) and among both younger adults (18-64 years) and those 65 years and older (45% increase for each group) (Figure 40).

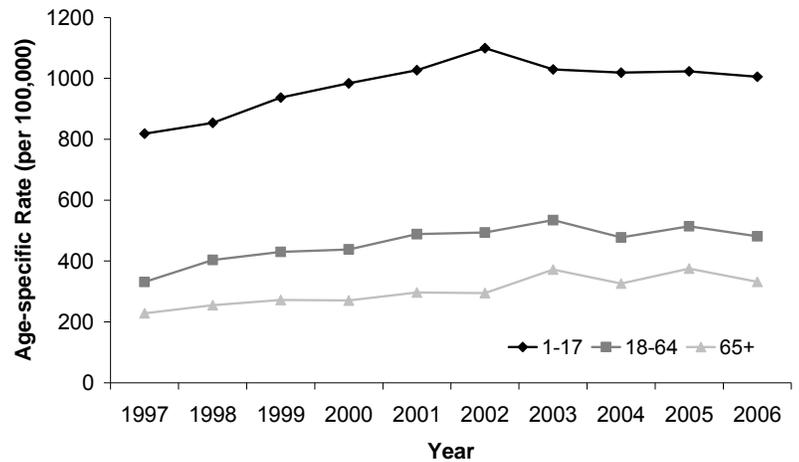


Figure 40. Age-specific ED visit rate for primary asthma, Tennessee, 1997-2006 (HDDS)

- Emergency department visit rates for asthma were highest among very young children and decreased with increasing age. This pattern was similar for all gender/race groups. However, ED visit rates among children were higher for males than females, while among adults they were higher for females (Figure 41). ED visits for asthma were higher among blacks than whites at all ages (Figure 42).

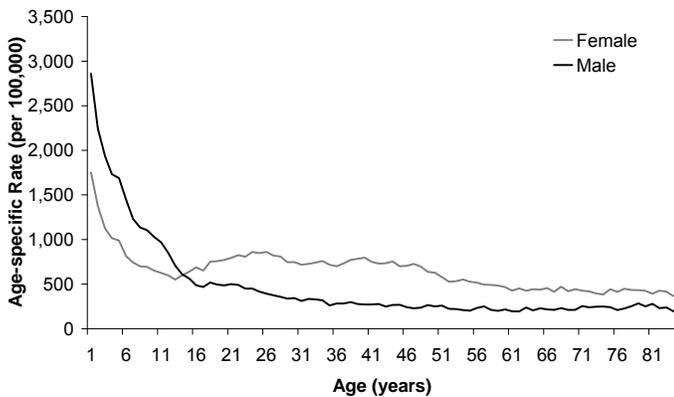


Figure 41. Age-specific ED visit rate for primary asthma by gender, Tennessee, 2002-2006 average (HDDS)

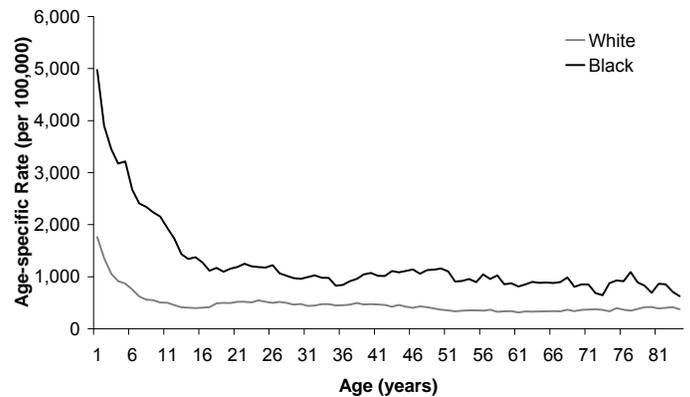
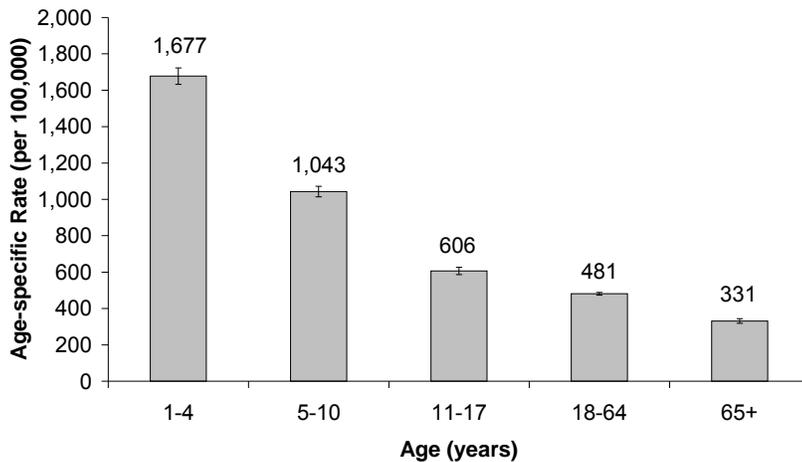


Figure 42. Age-specific ED visit rate for primary asthma by race, Tennessee, 2002-2006 average (HDDS)

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma *cont.*



- In 2006, the ED visit rate for asthma was highest among children aged 1-4 years of age (1,677/100,000) and lowest among adults aged 65 years and older (331/100,000) (Figure 43).<sup>e</sup>

Figure 43. Age-specific ED visit rate for primary asthma, Tennessee, 2006 (HDDS)

### Four Components of Asthma Care Part 2 – Education for a Partnership in Care

A partnership between the clinician and the person with asthma is crucial for effective asthma management. By working together, an appropriate treatment can be selected, and the patient can learn self-management skills necessary to control the disease. Key educational messages that should be taught and reinforced by health care providers at every opportunity include basic facts about asthma, the role of medications and the differences between long-term control and quick-relief drugs, and patient skills. Patient skills critical for asthma management include taking medications properly; identifying and avoiding environmental exposures that worsen a patient's asthma; self-monitoring to assess asthma control and recognize early signs and symptoms of worsening asthma; using a written asthma action plan; and seeking medical care as appropriate. Self-management education reduces urgent care visits, hospitalizations, and limitations on activities, and improves health status, quality of life and perceived control of asthma. It is an integral component of effective asthma care and should be treated as such by health care providers.

Source: National Institutes of Health and the National Heart, Lung and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma*. NIH Publication No. 08-52846, October 2007.

### Four Components of Asthma Care Part 3 – Control of Environmental Factors and Co-morbid Conditions That Affect Asthma

If patients who have asthma are exposed to irritants or inhalant allergens to which they are sensitive, their asthma symptoms may increase and precipitate an asthma attack. Substantially reducing exposure to these factors may reduce inflammation, symptoms and need for medication. A list of common asthma triggers is included in the introduction to this report (Table 1). In addition to environmental triggers, several co-morbid conditions also impede asthma management. They include allergic bronchopulmonary aspergillosis, gastroesophageal reflux disease (GERD), obesity, overweight, obstructive sleep apnea, rhinitis, sinusitis, stress and depression. Recognition and treatment of these conditions may improve asthma control.

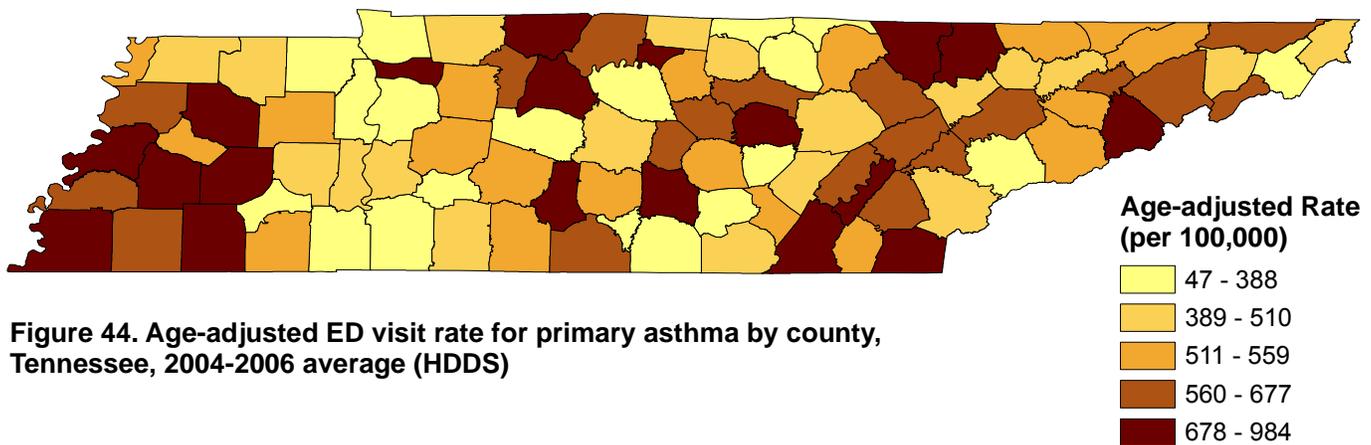
Source: National Institutes of Health and the National Heart, Lung and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma*. NIH Publication No. 08-52846, October 2007.

<sup>e</sup> The age distribution among all ED visits for primary asthma was as follows: 1-4 years 15%, 5-10 years 15%, 11-17 years 10%, 18-64 years 53%, 65 years and over 7%.

# Health Care Utilization and Cost *cont.*

## Emergency Department Visits for Asthma *cont.*

- Between 2004 and 2006, the average age-adjusted emergency department visit rate for primary asthma within individual Tennessee counties ranged from 47/100,000 in Pickett County to 984/100,000 in Scott County (Figure 44). [Detailed county and regional level rates are located in the Appendix.]
- The ten counties with the lowest emergency department visit rates were: Pickett, Moore, Lewis, Clay, Wayne, Williamson, Stewart, Grundy, Humphreys and Henry.
- The ten counties with the highest emergency department visit rates were: Houston, Trousdale, Campbell, Meigs, Coffee, Hardeman, Shelby, Cocke, Haywood and Scott.



**Figure 44. Age-adjusted ED visit rate for primary asthma by county, Tennessee, 2004-2006 average (HDDS)**

## Poverty and Asthma

When considering the association between poverty and asthma, it is important to distinguish between factors that cause asthma, and those that contribute to asthma severity and exacerbation. There is a lack of consistent evidence that some aspect of poverty *causes* asthma. Many possible risk factors for asthma (e.g. smoking, air pollution, cockroach exposure) are more prevalent in poor communities. However, even in reports which take these factors into consideration, the association between poverty and asthma has been inconsistent.

There *is* overwhelming evidence that exacerbations of asthma, as evidenced by emergency department visits, hospitalizations and deaths, are related to poverty or to groups that are prevalent in poor sectors of society. There are many possible reasons for this association. The poor are more likely to under-use primary care services, lack a crisis management plan, and be under-medicated. They are more likely to live in adverse environmental conditions that expose them to asthma triggers such as those listed above, and are exposed more frequently than other groups to psychosocial problems within the family and community. A lack of education may lead to poor communication with doctors and poor compliance with treatment recommendations.

Poverty may help explain some of the racial disparities in asthma. However, it has been observed that asthma is more prevalent in black children living in inner cities, as well as in black children not living in poverty, suggesting that the association between race and asthma is not entirely attributable to poverty.

Source: Rona RJ. Asthma and Poverty. *Thorax* 2000; 55(3):239-244.

# Health Care Utilization and Cost *cont.*

## Seasonal Asthma Trends

As seasons change, different asthma triggers are present in the air (e.g. pollens in the spring and outdoor molds in the fall). As a result, asthma symptoms often vary over time due to these changing environmental triggers. Following is a discussion of seasonal trends in inpatient hospitalizations and emergency department visits for a primary diagnosis of asthma.

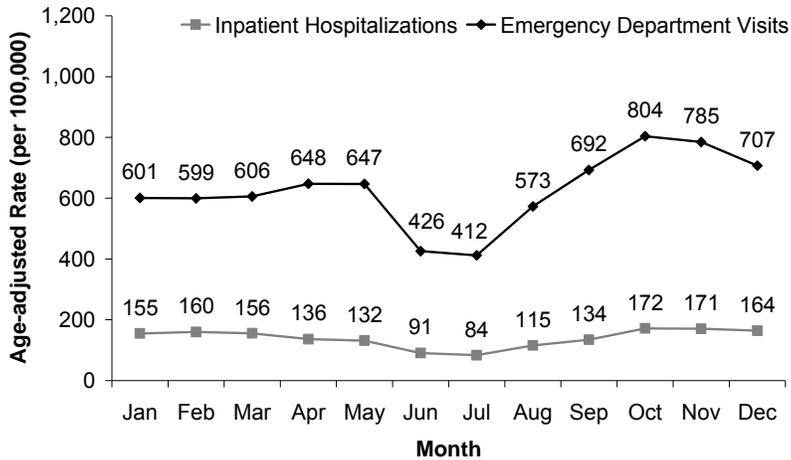


Figure 45. Age-adjusted inpatient hospitalization and ED visit rates for primary asthma by month, Tennessee, 2002-2006 average (HDDS)

- Between 2002 and 2006, average monthly rates for inpatient hospitalizations and emergency department visits were highest in October and November and were lowest in June and July (Figure 45).
- Monthly inpatient hospitalization and ED visit rates were at their lowest in June and July among both children (1-17 years) and adults (18 years and older). However, peak asthma rates were different among the two groups (Figures 46 and 47).
- Among children, inpatient hospitalizations and ED visits peaked in October and November. Among adults these peaks occurred in the winter months. In general, “peak” rates were less pronounced among adults than among children.

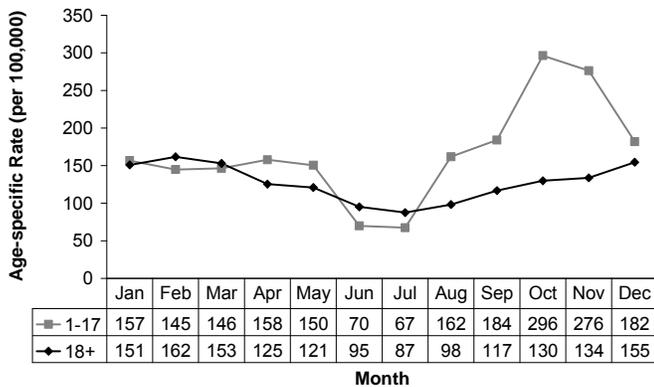


Figure 46. Age-specific inpatient hospitalization rate for primary asthma by month, Tennessee, 2002-2006 average (HDDS)

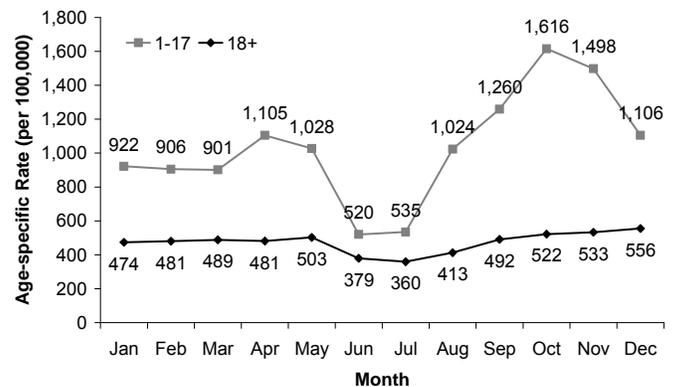


Figure 47. Age-specific ED visit rate for primary asthma by month, Tennessee, 2002-2006 average (HDDS)

# Health Care Utilization and Cost *cont.*

## Multiple Hospital Visits for Asthma

The rates of inpatient hospitalizations and emergency department visits for primary asthma that were presented in the previous sections were based on the total number of hospitalizations or ED visits. As was noted previously, this is not the same as the number of people hospitalized for asthma because some individuals may have been hospitalized and/or visited an emergency department more than once during a given year. In this section, we will discuss multiple asthma hospitalizations among *unique* patients.

- In 2006, there were 29,758 unique individuals with one or more inpatient and/or outpatient hospital visits for a primary diagnosis of asthma. The number of hospital visits per patient ranged from 1 to 42, with a mean of 1.3 visits and a median of 1 visit.
- The majority of individuals (83.5%) had a single asthma hospital visit in 2006, while the remaining 16.5% had two or more (Figure 48).

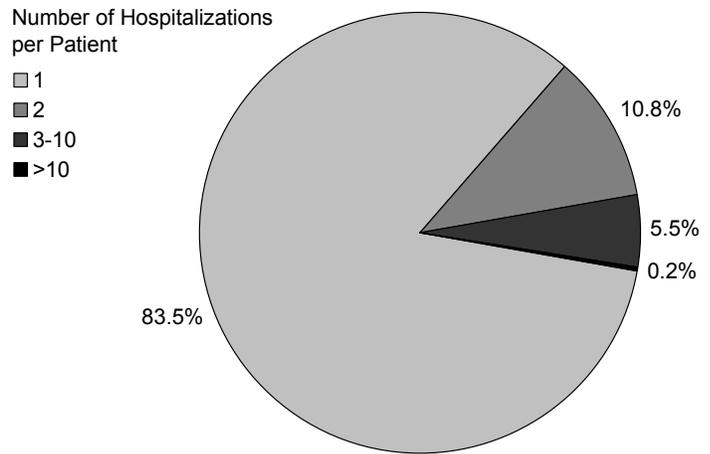


Figure 48. Distribution of number of hospitalizations for primary asthma among unique patients, Tennessee, 2006 (HDDS)

- The same percentage of females and males (16.5%) had two or more hospital visits for a primary diagnosis of asthma. Twenty-two percent of blacks had multiple asthma hospital visits compared to 13.7% of whites (Figure 49).
- The percentage of individuals with two or more asthma hospital visits was similar in children (17.3%) and younger adults (16.7%), compared to 11.6% among elderly adults (Figure 50).

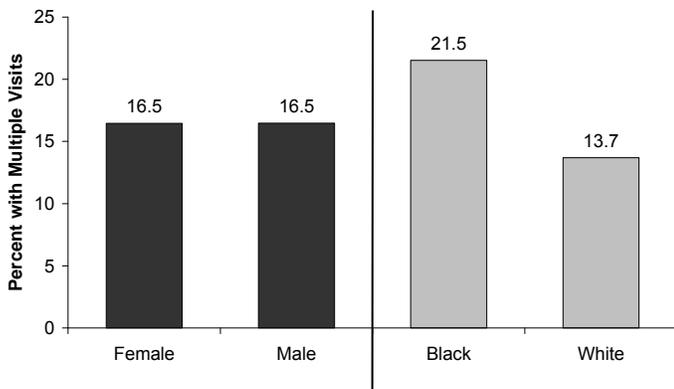


Figure 49. Percentage of unique patients with multiple hospitalizations for primary asthma by gender or race, Tennessee, 2006 (HDDS)

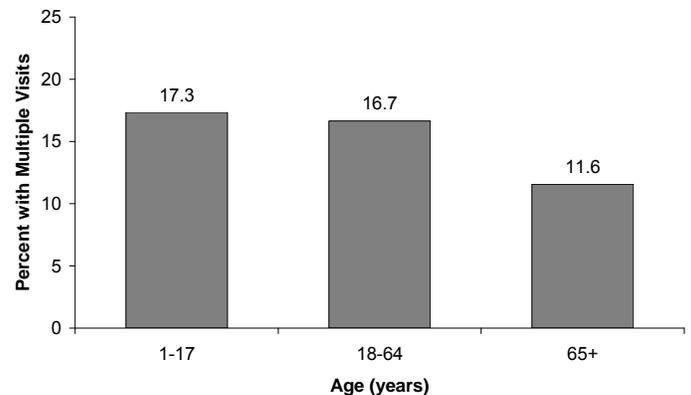


Figure 50. Percentage of unique patients with multiple hospitalizations for primary asthma by age, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost cont.

## Secondary Diagnosis of Asthma

The previous discussion of inpatient hospitalizations and emergency department visits was based on a primary diagnosis of asthma. It was noted that since 1997 the inpatient hospitalization rate for primary asthma has remained stable and the emergency department visit rate has increased 35%. During that same time period, however, both inpatient hospitalizations and ED visits for which asthma is listed as a *secondary* diagnosis increased more dramatically.

- Among inpatient hospitalizations for a primary diagnosis other than asthma, the rate of hospitalizations for which there was a secondary diagnosis of asthma approximately doubled between 1997 and 2006, from 246 to 519/100,000 (Figure 51).<sup>f</sup>
- Among ED visits for a primary diagnosis other than asthma, the rate of ED visits for which there was a secondary diagnosis of asthma more than quadrupled between 1997 and 2006, from 283 to 1,331/100,000 (Figure 52).<sup>g</sup>

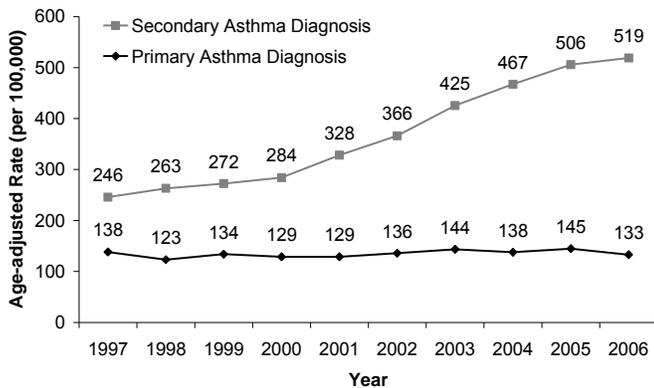


Figure 51. Age-adjusted inpatient hospitalization rate for primary or secondary asthma, Tennessee, 1997-2006 (HDDS)

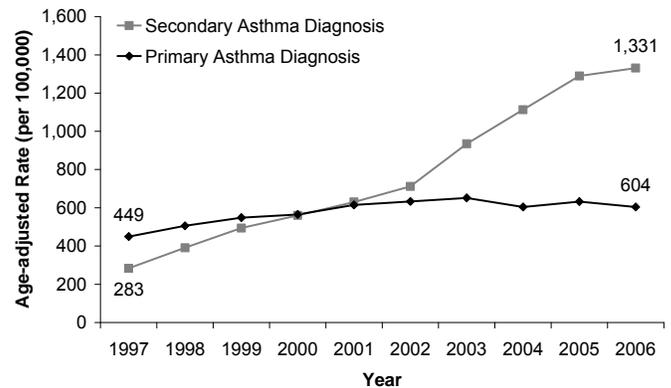


Figure 52. Age-adjusted ED visit rate for primary or secondary asthma, Tennessee, 1997-2006 (HDDS)

## Asthma and Obesity

Many countries, including the United States, have witnessed large increases in the prevalence of both obesity and asthma during the past several decades. The concurrent increases in these two conditions raise the possibility that the two may be connected and it has been suggested that obesity may not only increase the risk for developing asthma, but may also increase the severity of the disease. Prospective studies conducted among adults have been fairly consistent in finding that excess weight is associated with the subsequent development of asthma. The literature examining obesity and asthma severity has been less consistent, although several interventional studies have shown that weight loss can lead to fewer symptoms, better pulmonary function tests and the need for less medication. Additional research is needed to clarify the mechanisms responsible for the improvement in the clinical status of these patients. Despite this need for further research, the National Asthma Education and Prevention Program recognizes overweight and obesity as co-morbid conditions affecting asthma management and currently recommends that overweight and obese asthma patients lose weight as a means of improving asthma control.

### Sources:

Ford, ES. The Epidemiology of Obesity and Asthma. *Journal of Allergy and Clinical Immunology* 2005; 115(5):897-909.

National Institutes of Health and the National Heart, Lung and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma*. NIH Publication No. 08-52846, October 2007.

<sup>f</sup> Between 1997 and 2006, the percentage of inpatient hospitalizations for which at least one secondary diagnosis field was completed increased by 7%.

<sup>g</sup> Between 1997 and 2006, the percentage of emergency department visits for which at least one secondary diagnosis field was completed increased by 30%.

# Health Care Utilization and Cost *cont.*

## Secondary Diagnosis of Asthma *cont.*

- Primary and secondary asthma diagnoses were also examined jointly. In 2006 there were 106,728 unique hospital patients with any diagnosis of asthma (i.e. each individual had at least one inpatient and/or outpatient hospitalization for which there was a primary or secondary asthma diagnosis).
- The age-adjusted rate for any asthma diagnosis was 1,781/100,000. This represented an increase of 141% since 1997 (Figure 53).
- There was a statistically significant increase in the rate of any asthma diagnosis among all gender, racial and age groups.

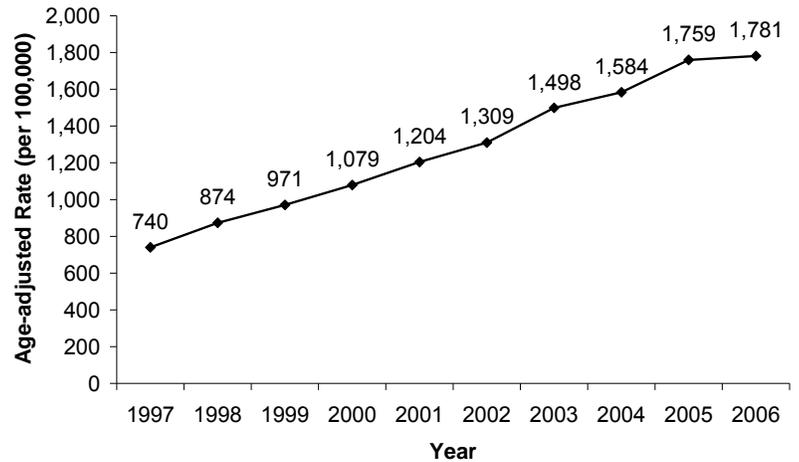


Figure 53. Age-adjusted rate for any diagnosis of asthma, Tennessee, 1997-2006 (HDDS)

- In 2006, the any asthma rate was higher among females (2,176/100,000) than males (1,353/100,000) and higher among blacks (2,496/100,000) than whites (1,586/100,000) (Figure 54).
- Black females had the highest rate of any asthma diagnosis (2,839/100,000), followed by black males and white females (2,038/100,000 and 1,997/100,000, respectively) and finally by white males (1,156/100,000) (Figure 54).

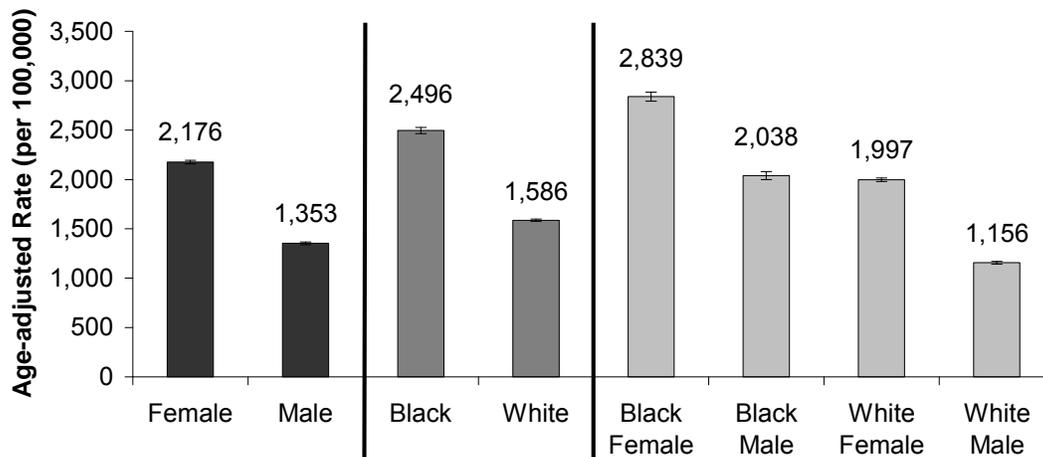
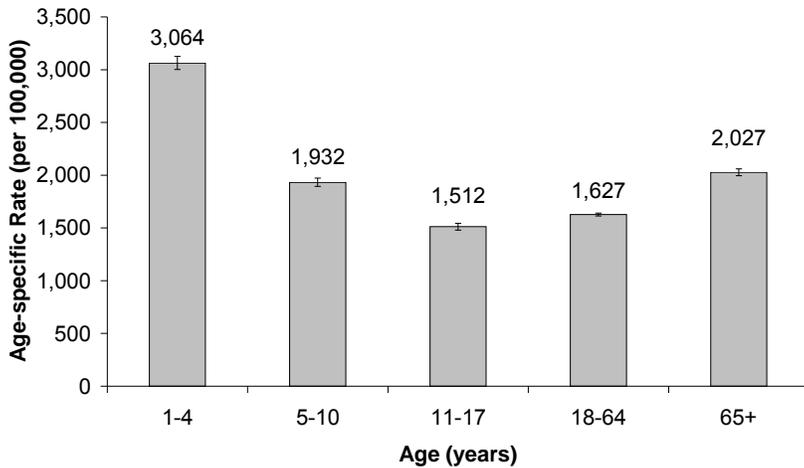


Figure 54. Age-adjusted rate for any diagnosis of asthma by gender and/or race, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Secondary Diagnosis of Asthma *cont.*



- In 2006, the rate of any diagnosis of asthma was highest among children aged 1-4 years of age (3,064/100,000) (Figure 55).

Figure 55. Age-specific rate for any diagnosis of asthma, Tennessee, 2006 (HDDS)

### Smoking and Asthma

Although it might be expected that asthma patients would have a lower prevalence of smoking because of its harmful effects on respiratory function, smoking rates among asthmatic patients are, in fact, relatively similar to those of the general population. This is true in Tennessee, where smoking prevalence is 25% among both persons with current asthma and among those without the disease (2004-2006 TN BRFSS data).

There is conflicting evidence regarding the risk of active smoking in the development of asthma; however, a common finding is that cigarette smoking exacerbates asthma symptoms. Smoking has been associated with several adverse effects on clinical, physiological, radiological and inflammatory features of asthma. Asthmatics who smoke have more frequent symptoms, accelerated decline in lung function, reduced efficacy of asthma medications, poorer asthma control, increased hospitalizations, and increased mortality compared to non-smokers. Smoking on the job can also increase the risk of occupational asthma as the heat from burning tobacco can change workplace chemicals into more harmful substances as they are inhaled through a cigarette.

Second-hand smoke is also harmful to asthma sufferers. It is a powerful asthma trigger and when an asthmatic is exposed to second-hand smoke, he or she is more likely to experience wheezing, coughing and shortness of breath. Quitting smoking and avoiding second-hand smoke are both key to successful asthma management.

#### Sources:

Shavit O, Swern A, Dong Q, *et al.* Impact of Smoking on Asthma Symptom, Healthcare Resource Use, and Quality of Life Outcomes in Adults with Persistent Asthma. *Quality of Life Research* 2007; 16(10):1555-1565.

Chaudhuri R, McSharry C, McCoard A, *et al.* Role of Symptoms and Lung Function in Determining Asthma Control in Smokers with Asthma. *Allergy* 2008; 63(1):132-135.

The Mayo Clinic. Occupational Asthma Fact Sheet. Accessed 8 January 2008 at [www.mayoclinic.com/health/occupational-asthma/DS00591](http://www.mayoclinic.com/health/occupational-asthma/DS00591).

WebMD. Asthma Guide: Smoking and Asthma. Accessed 10 January 2008 at [www.webmd.com/asthma/guide/smoking-and-asthma](http://www.webmd.com/asthma/guide/smoking-and-asthma).

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma

The Hospital Discharge Data System collects information on hospital charges billed to insurance companies and to patients. Actual payments paid to hospitals were likely less than the amounts billed. However, examining billed charges provides some insight into the hospital costs associated with asthma.

- In 2006, hospital charges for a primary asthma diagnosis totaled \$125.6 million in Tennessee. This represented 0.5% of the \$25.5 billion charged for all hospital visits that year.
- Sixty-nine percent of asthma charges (\$87.3 million) were for inpatient hospitalizations and 31% (\$38.4 million) were for outpatient hospitalizations. This was almost identical to the distribution of in- and outpatient charges for all diagnoses.
- Medicare was charged for the greatest percentage of inpatient asthma charges (40.1%), followed by other insurance (24.1%), TennCare (24.0%), self-pay (6.4%) and other or unknown payer (5.4%) (Figure 56).
- TennCare was charged for the greatest percentage of outpatient asthma charges (41.8%), followed by other insurance (25.3%), self-pay (13.4%), Medicare (12.4%) and other or unknown payer (8.1%) (Figure 56).

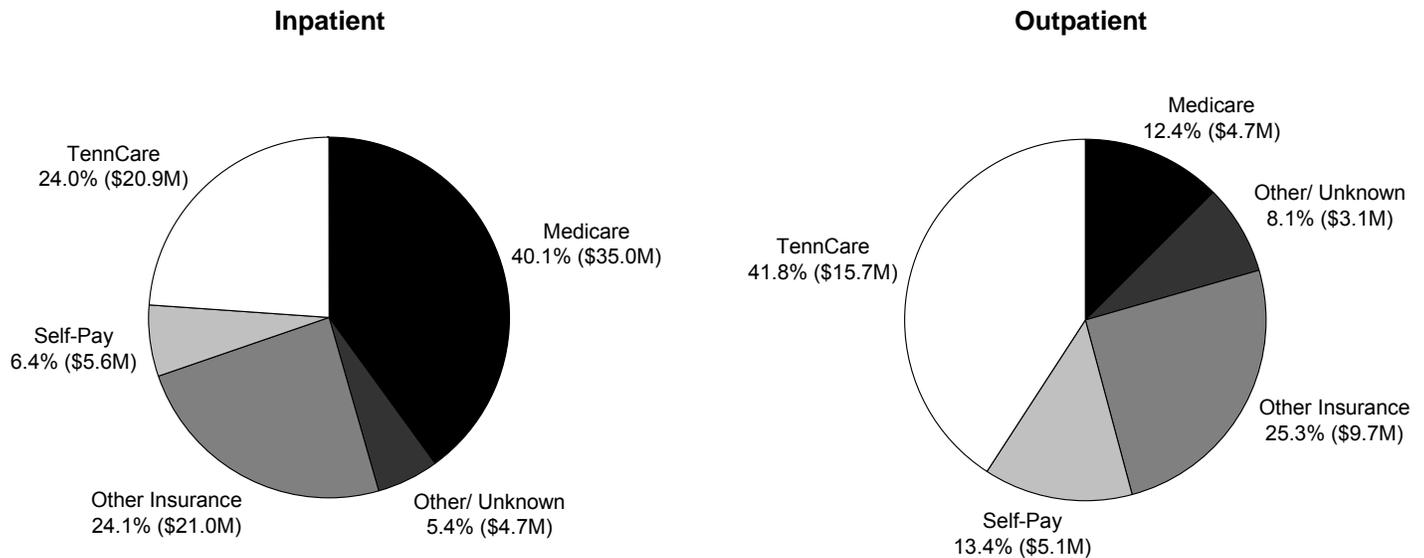


Figure 56. Total inpatient or outpatient hospital charges for primary asthma by payer, Tennessee, 2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma *cont.*

- Although 16.5% of unique asthma patients had two or more inpatient and/or outpatient hospitalizations for asthma, they were responsible for 37.1% of total hospital charges for asthma (Figures 57 and 58).

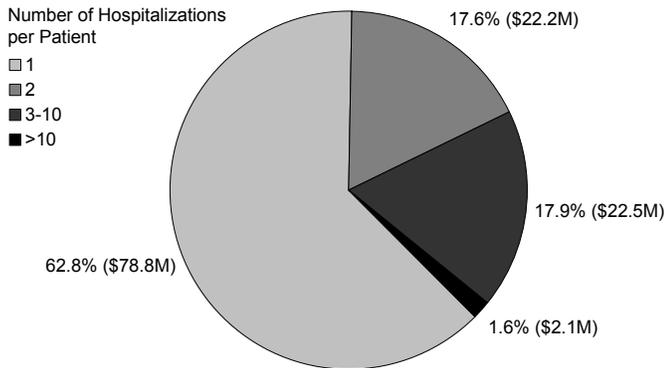


Figure 57. Total hospital charges for primary asthma by number of hospitalizations, Tennessee, 2006 (HDDS)

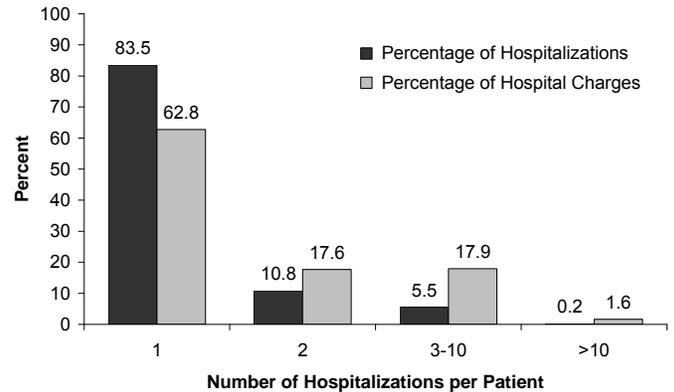


Figure 58. Distribution of hospitalizations and hospital charges by number of hospitalizations, Tennessee, 2006 (HDDS)

## Barriers to Asthma Control

Controlled asthma is characterized by minimal to no symptoms during the day and at night, no asthma attacks, no emergency visits to physicians or hospitals, minimal need for rescue medications, no limitations on physical activities and exercise, nearly normal lung function and minimal or no side-effects from medication. With the medical treatments currently available it is theoretically possible to achieve control in the majority of patients. Yet a substantial number of patients appear to tolerate suboptimal treatment. In addition, patient perceptions of asthma control and prevalence of symptoms are often mismatched, with patients who consider their asthma well controlled still reporting daily symptoms.

There are a number of possible reasons for poor asthma control:

- Co-morbidities (e.g. rhinitis, COPD)
- Severe therapy-resistant disease
- Ongoing exposure to triggers
- Inadequate assessment
- Misdiagnosis
- Inadequate treatment
- Ineffective delivery of treatment (e.g. poor inhaler technique)
- Limited treatment effectiveness
- Inadequate use of action plans
- Low patient and physician expectations
- Low adherence to agreed asthma therapy
- Functional and psychological problems affecting willingness to use therapy
- Over-reliance on complimentary/alternative treatment
- Not attending medical consultations
- Patients do not perceive symptoms as indicative of poor control

The level of asthma control achieved reflects the behavior of both health care professionals and patients. Understanding reasons for poor control in individual patients requires health care professionals to identify both the clinical and behavioral factors involved, and good communication between providers and patients is key to setting *and achieving* realistic goals for asthma control.

### Sources:

Holgate ST, Price D, Valovirta E. Asthma out of control? A structured review of recent patient surveys. *BMC Pulmonary Medicine* 2006; 6(S1).  
 Horne R, Price D, Cleland J, *et al.* Can asthma control be improved by understanding the patient's perspective? *BMC Pulmonary Medicine* 2007; 7(8).

# Health Care Utilization and Cost cont.

## Hospital Charges for Asthma cont.

Following is a discussion of per visit, per patient and per capita hospitalization charges for a primary diagnosis of asthma. Charges were age-adjusted to the 2000 United States standard population and inflation-adjusted to 2006 dollars. Per visit charges represent the average charges for a hospital visit for asthma, and were calculated separately for inpatient and outpatient hospitalizations. Per patient charges represent the average hospital charges for each unique asthma patient, and were calculated based on combined inpatient and outpatient hospitalizations. Per capita charges were also based on combined hospitalizations and represent the average hospital charges for asthma for each person in the Tennessee population. Per visit and per patient charges reflect the financial impact on patients and their payers, while per capita charges reflect the financial burden on the entire population.

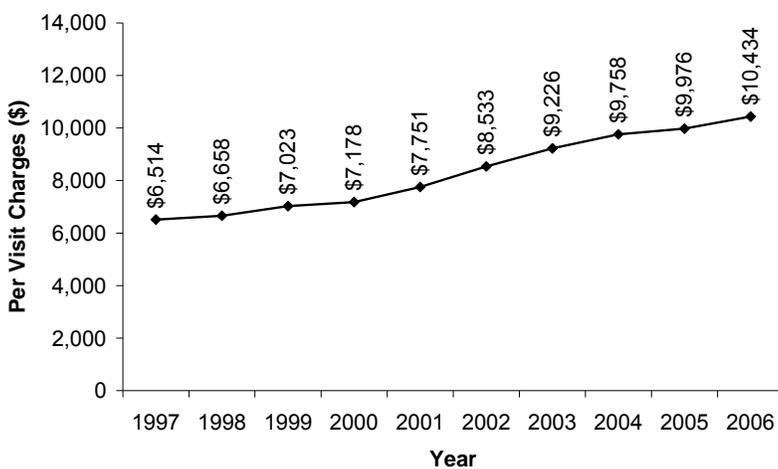


Figure 59. Age- and inflation-adjusted per visit charges for inpatient hospitalizations for primary asthma, Tennessee, 1997-2006 (HDDS)

- In 2006, per visit charges for inpatient asthma hospitalizations averaged \$10,434.
- Between 1997 and 2006, there was a statistically significant increase in per visit inpatient hospitalization charges (60% increase) (Figure 59).
- During this same time period there was a statistically significant increase in per visit inpatient hospitalization charges among all gender, race and age groups.

- In 2006, per visit charges for outpatient asthma hospitalizations averaged \$1,361.
- Between 1997 and 2006, there was a statistically significant increase in per visit outpatient hospitalization charges (136% increase) (Figure 60).
- During this same time period there was a statistically significant increase in per visit outpatient hospitalization charges among all gender, race and age groups.

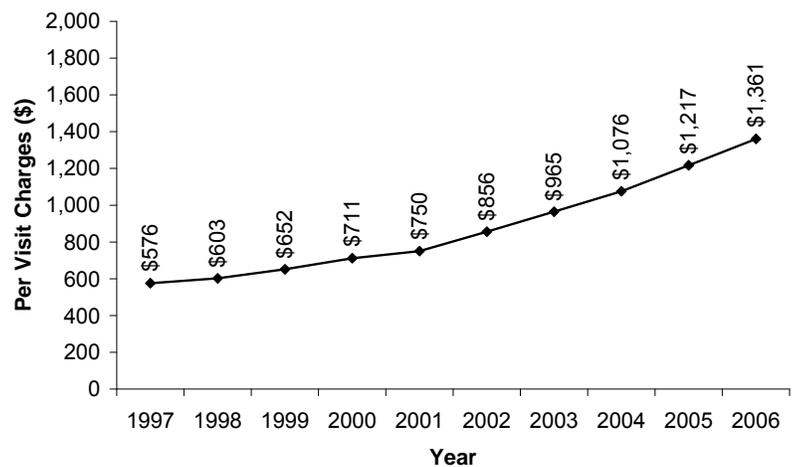


Figure 60. Age- and inflation-adjusted per visit charges for outpatient hospitalizations for primary asthma, Tennessee, 1997-2006 (HDDS)

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma *cont.*

- Total and average per visit asthma hospitalization charges for 2006 by gender, race, gender/race combined and age group are presented in Table 2.
- Per visit charges for both inpatient and outpatient asthma hospitalizations were similar among females and males, although total charges were higher among females (Figure 61).
- Per visit charges for both inpatient and outpatient asthma hospitalizations were slightly higher among blacks than among whites (Figure 62).
- Per visit inpatient asthma hospitalization charges increased with increasing age (Figure 63). Per visit charges for outpatient asthma hospitalizations were similar among those less than 65 years of age and highest among those 65 years and older (Figure 64).

**Table 2. Total and Per Visit Asthma Hospitalization Charges, Tennessee, 2006 (HDDS)<sup>h</sup>**

	Inpatient Hospitalizations		Outpatient Hospitalizations	
	Total Charges (million \$)	Per Visit Charges (\$)	Total Charges (million \$)	Per Visit Charges (\$)
<b>Tennessee</b>	87.3	10,434	38.4	1,361
<b>Female</b>	59.9	10,480	21.7	1,355
<b>Male</b>	27.4	10,390	16.6	1,367
<b>Black</b>	28.0	11,597	18.3	1,580
<b>White</b>	57.4	9,952	19.1	1,212
<b>Black female</b>	17.6	11,709	9.4	1,606
<b>White female</b>	41.3	10,022	11.9	1,204
<b>Black male</b>	10.4	11,342	8.9	1,528
<b>White male</b>	16.2	9,890	7.2	1,230
<b>1-4 years old</b>	6.1	6,546	5.7	1,201
<b>5-10 years old</b>	5.5	7,279	5.0	1,121
<b>11-17 years old</b>	3.3	8,732	3.5	1,060
<b>18-64 years old</b>	45.5	11,512	20.6	1,312
<b>65+ years old</b>	25.4	14,112	2.6	1,886

<sup>h</sup> Total charges by race and by gender and race combined do not sum to the Tennessee total due to missing data on race. Total charges by age group do not sum to the Tennessee total because age-specific data are not presented for infants less than 1 year old. Per visit charges (except those for specific age groups) are age-adjusted.

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma *cont.*

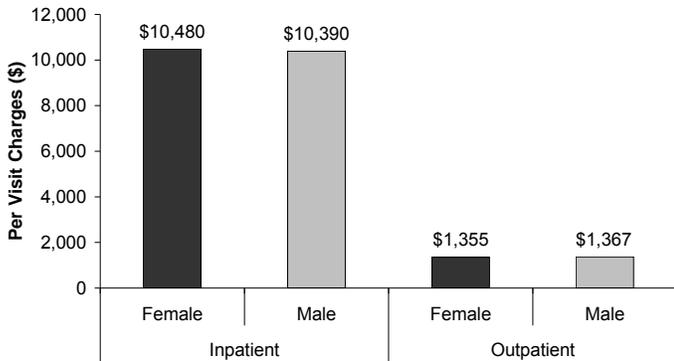


Figure 61. Age-adjusted per visit charges for in- or outpatient hospitalizations for primary asthma by gender, Tennessee, 2006 (HDDS)

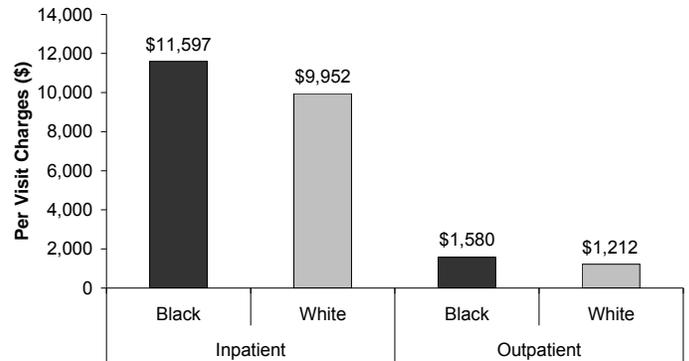


Figure 62. Age-adjusted per visit charges for in- or outpatient hospitalizations for primary asthma by race, Tennessee, 2006 (HDDS)

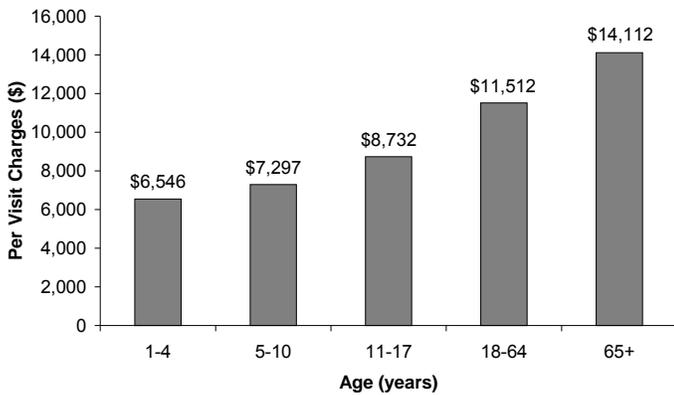


Figure 63. Age-specific per visit charges for inpatient hospitalizations for primary asthma, Tennessee, 2006 (HDDS)

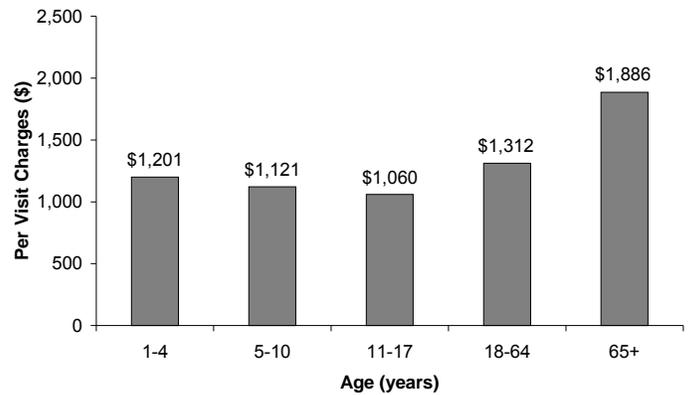


Figure 64. Age-specific per visit charges for outpatient hospitalizations for primary asthma, Tennessee, 2006 (HDDS)

### Four Components of Asthma Care Part 4 – Adequately Managing Asthma with Medicine

Medications for asthma are categorized into two general classes: Long-term control medications and quick-relief medications. Long-term control medications are used daily to achieve and maintain control of persistent asthma. The most effective are those that attenuate the underlying inflammation characteristic of asthma. They include corticosteroids (inhaled corticosteroids are the most consistently effective long-term control medication for persistent asthma), cromolyn sodium and nedocromil, immunomodulators, leukotriene modifiers, long-acting beta<sub>2</sub> agonists, and methylxanthines. Quick-relief medications are used to treat acute symptoms and exacerbations. They include short-acting beta<sub>2</sub> agonists (the treatment of choice for relief of acute symptoms), anticholinergics, and systemic corticosteroids.

Source: National Institutes of Health and the National Heart, Lung and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma*. NIH Publication No. 08-52846, October 2007.

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma *cont.*

- Average per patient asthma hospitalization charges for 2006 by gender, race, gender/race combined and age group are presented in Table 3. Each patient had one or more inpatient and/or outpatient hospitalization for a primary diagnosis of asthma.
- Per patient asthma hospitalization charges in Tennessee averaged \$4,817 in 2006.
- Per patient asthma charges were slightly higher among females (\$4,894) than among males (\$4,608).
- Per patient asthma charges were higher among blacks (\$5,966) than among whites (\$4,366).
- Per patient asthma charges among adults aged 65 years and older (\$10,414) were more than double those among younger adults (\$4,536) and four times as high as those among children less than 18 years of age (approximately \$2,500).

**Table 3. Per Patient Asthma Hospitalization Charges (\$), Tennessee, 2006 (HDDS)<sup>i</sup>**

<b>Tennessee</b>	4,817
<b>Female</b>	4,894
<b>Male</b>	4,608
<b>Black</b>	5,966
<b>White</b>	4,366
<b>Black female</b>	5,937
<b>White female</b>	4,502
<b>Black male</b>	6,059
<b>White male</b>	4,044
<b>1-4 years old</b>	2,614
<b>5-10 years old</b>	2,549
<b>11-17 years old</b>	2,324
<b>18-64 years old</b>	4,536
<b>65+ years old</b>	10,414

## Cockroaches and Asthma

Cockroaches are one of the most common and allergenic of indoor pests. The proteins found in cockroach saliva are particularly allergenic, but the body and droppings of cockroaches also contain allergenic proteins. Recent studies have found a strong association between the presence of cockroaches and increases in the severity of asthma symptoms in individuals who are sensitive to cockroach allergens.

Cockroaches are commonly found in crowded cities and the southern regions of the United States. These pests are common even in the cleanest of crowded urban areas and older dwellings, and can be found in all types of neighborhoods. Strategies available to control cockroaches and limit exposure to their allergens include the following:

- Keep food and garbage in closed, tight lidded containers. Never leave food out in the kitchen.
- Do not leave out pet food or dirty food bowls.
- Eliminate water sources that attract these pests, such as leaky faucets and drain pipes.
- Mop the kitchen floor and wash countertops at least once a week.
- Plug up crevices around the house through which cockroaches can enter.
- Limit the spread of food around the house and especially keep food out of bedrooms.
- Use bait stations and other environmentally safe pesticides to reduce cockroach infestations.

### Sources:

National Institute of Environmental Health Sciences. Cockroaches Fact Sheet. Accessed 10 January 2008 at [www.niehs.nih.gov/health/topics/conditions/asthma/cockroaches.cfm](http://www.niehs.nih.gov/health/topics/conditions/asthma/cockroaches.cfm).  
Environmental Protection Agency. Indoor Environmental Asthma Triggers: Cockroaches and Pests. Accessed 10 January 2008 at [www.epa.gov/asthma/pests.html](http://www.epa.gov/asthma/pests.html).

<sup>i</sup> Per patient charges (except those for specific age groups) are age-adjusted.

# Health Care Utilization and Cost *cont.*

## Hospital Charges for Asthma *cont.*

**Table 4. Per Capita Asthma Hospitalization Charges (\$), Tennessee, 2006 (HDDS)<sup>j</sup>**

Tennessee	21
Female	26
Male	15
Black	47
White	15
Black female	52
White female	20
Black male	39
White male	10
1-4 years old	37
5-10 years old	22
11-17 years old	12
18-64 years old	17
65+ years old	37

- Average per capita asthma hospitalization charges for 2006 by gender, race, gender/race combined and age group are presented in Table 4.
- Per capita asthma hospitalization charges in Tennessee averaged \$21 in 2006.
- Per capita asthma charges were higher among females (\$26) than among males (\$15).
- Per capita asthma charges were higher among blacks (\$47) than among whites (\$15).
- Per capita asthma charges were highest among elderly adults aged 65 years and older and among children aged 1-4 years (\$37 each) and lowest among children aged 11-17 years (\$12).

## Mold and Asthma

Molds are microscopic fungi that produce tiny spores to reproduce. These spores continually waft through indoor and outdoor air. In areas with well defined seasons, outdoor molds first appear in early spring and thrive until the first frost. In temperate climates, such as the southern United States, they may be active year round. Outdoor molds grow in moist shady areas and are common in soil, decaying vegetation, compost piles, rotting wood and fallen leaves. Indoor molds can be found year round. They thrive in dark, warm, humid and musty environments such as damp basements, cellars, attics, bathrooms and laundry rooms.

Mold and its spores are powerful allergens in people who are sensitive to them, and exposure can lead to asthma symptoms and attacks. Strategies available to limit exposure to molds include the following:

- Wash visible mold off hard surfaces and dry completely. Absorbent materials (e.g. carpeting) may need to be replaced if contaminated with mold.
- Use a dehumidifier or air conditioner to maintain relative humidity below 50%.
- Vent bathrooms, kitchens and clothes driers to the outside.
- Fix leaky plumbing or other sources of water.
- Avoid raking leaves, mowing lawns or working with peat, mulch, hay or dead wood.
- Keep windows closed.

### Sources:

National Institute of Environmental Health Sciences. Mold Fact Sheet. Accessed 10 January 2008 at [www.niehs.nih.gov/health/topics/conditions/asthma/mold.cfm](http://www.niehs.nih.gov/health/topics/conditions/asthma/mold.cfm).  
Environmental Protection Agency. Indoor Environmental Asthma Triggers: Mold. Accessed 10 January 2008 at [www.epa.gov/asthma/mold.html](http://www.epa.gov/asthma/mold.html).

<sup>j</sup> Per capita charges (except those for specific age groups) are age-adjusted.

# Asthma among TennCare Enrollees

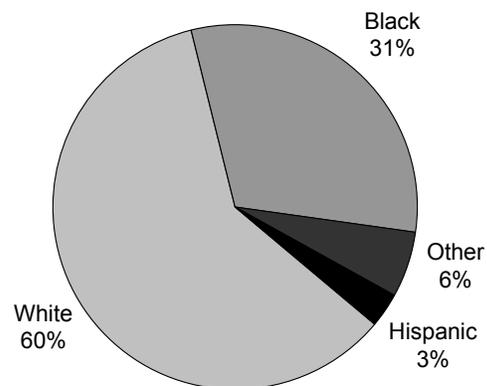
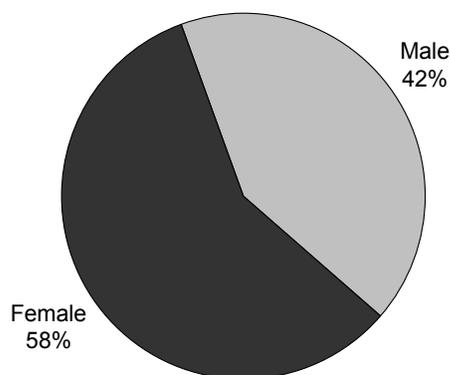
TennCare is a government-operated health insurance program designed for low income individuals and for those whose health condition or employment status make it difficult to access private insurance.<sup>19</sup> It consists of individuals eligible for Medicaid, as well as those who are not eligible for Medicaid but who are uninsured or uninsurable. The criteria for TennCare eligibility have changed sporadically from its inception in 1994, with the most significant changes occurring in the fall of 2005. Despite these changes, TennCare continues to serve a subset of the state's population with lower socioeconomic status.

TennCare data includes claims submitted by health care professionals and institutions for reimbursement of services provided. The data examined in this report include claims for physician services, inpatient and outpatient hospitalizations, ambulance transportation services, durable medical equipment, and nursing care facilities. In this section, the asthma disease burden among the special TennCare population is discussed.

## TennCare Facts

- TennCare was created in 1994 as a project under a Medicaid waiver from the federal government to demonstrate that the use of managed care principles could generate savings that would enable the state to cover more than the Medicaid-eligible population.
- The core TennCare population consists of those eligible for Medicaid, most of whom are low-income children and families, pregnant women, disabled people, women needing treatment for breast or cervical cancer, and those requiring care in a nursing facility. The expanded population includes children who are not eligible for Medicaid, but who lack access to insurance or meet other criteria.
- Pregnant women and children are a special focus of TennCare – about one in every two babies born in Tennessee is on TennCare.
- Tennessee is the only state in the country to enroll its entire Medicaid population *and* other eligible individuals in managed care.
- TennCare spent \$8.6 billion in fiscal year 2005. Spending was reduced to \$6.9 billion in fiscal year 2006 after implementation of TennCare reform in August 2005.

Source: "Healthy Families, Healthy Communities." Bureau of TennCare 2005-2006 Annual Report. State of Tennessee.



TennCare Enrollees by Gender or Race as of December 31, 2005<sup>19</sup>

# Asthma among TennCare Enrollees *cont.*

## Asthma Prevalence among TennCare Enrollees

Following is a discussion of the prevalence of asthma among TennCare enrollees. Rates were calculated as the percentage of unique individuals with a primary and/or secondary diagnosis of asthma (i.e. any diagnosis of asthma) in any TennCare claim file and age-adjusted to the 2000 United States standard population. Three years combined claim data were used to determine prevalence in order to capture as many asthma patients as possible. However, the following rates may still underestimate the true prevalence because some asthmatics may not have accessed care in given years or may have been seen for conditions unrelated to their asthma.

- Between 2004 and 2006, there were 205,177 TennCare enrollees with at least one reimbursement claim with asthma listed as a primary and/or secondary diagnosis, and the asthma prevalence rate was 10.6%.
- Between 1995 and 2006, there was a statistically significant increase in the prevalence of asthma among TennCare enrollees (Figure 65).
- Time trends in asthma prevalence by gender and race were similar to those for the overall TennCare population (Figure 66).
- Time trends in asthma prevalence among children, adults and the elderly were also similar to those for the overall TennCare population.
- Detailed regional and county level prevalence rates are located in the Appendix.

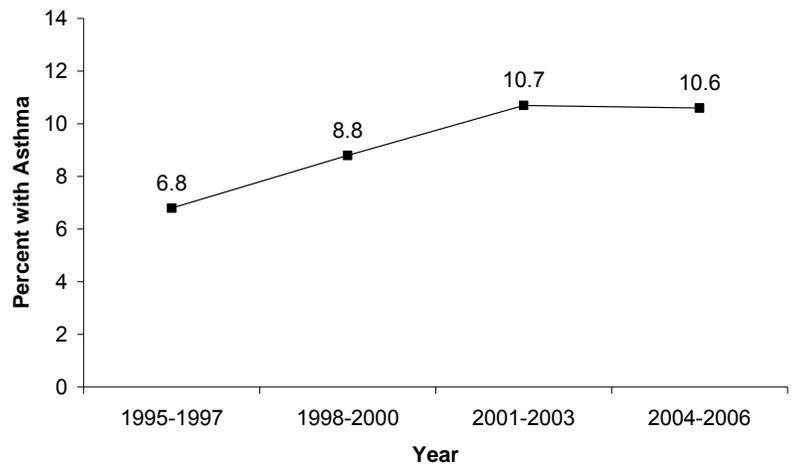


Figure 65. Age-adjusted prevalence of any diagnosis of asthma in any claim file, TennCare enrollees, 1995-2006 (*TennCare*)

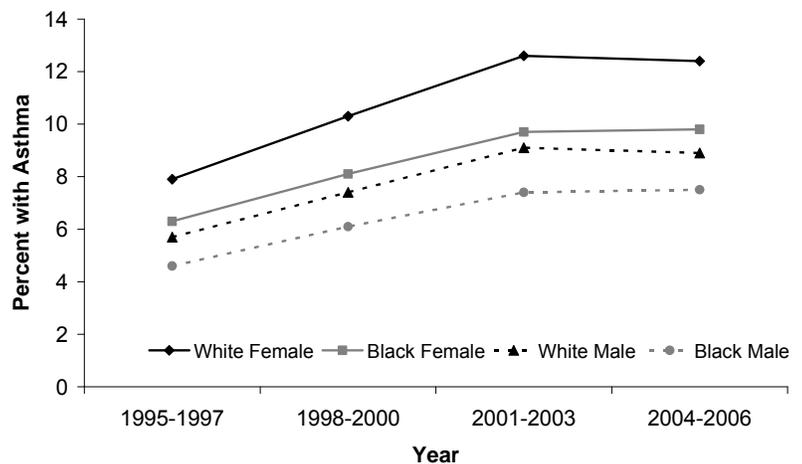


Figure 66. Age-adjusted prevalence of any diagnosis of asthma in any claim file by gender and race, TennCare enrollees, 1995-2006 (*TennCare*)

# Asthma among TennCare Enrollees *cont.*

## Asthma Prevalence among TennCare Enrollees *cont.*

- Between 2004 and 2006, asthma prevalence among TennCare enrollees was higher among females (11.7%) than males (8.6%). Prevalence was highest among whites (11.0%) and lowest among Hispanics (5.3%) (Figure 67).
- White females had the highest asthma prevalence rate (12.4%), followed by black females (9.8%), white males (8.9%) and black males (7.5%) (Figure 67).

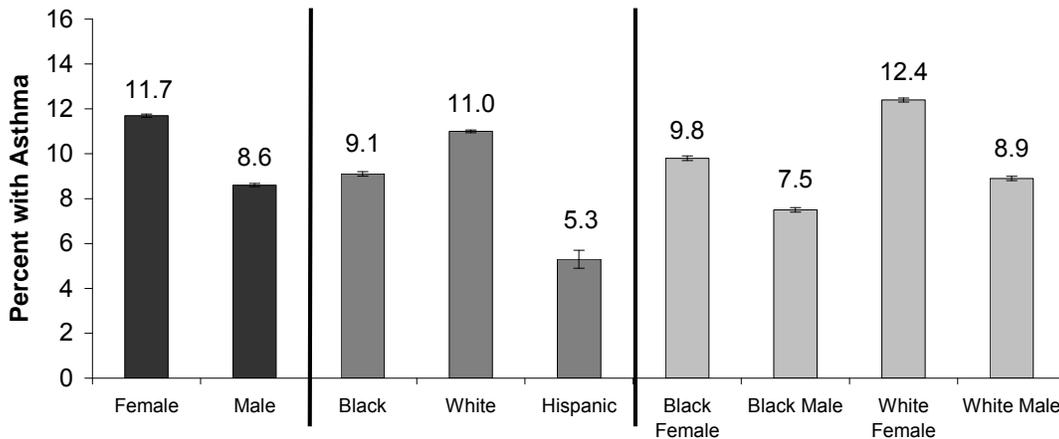
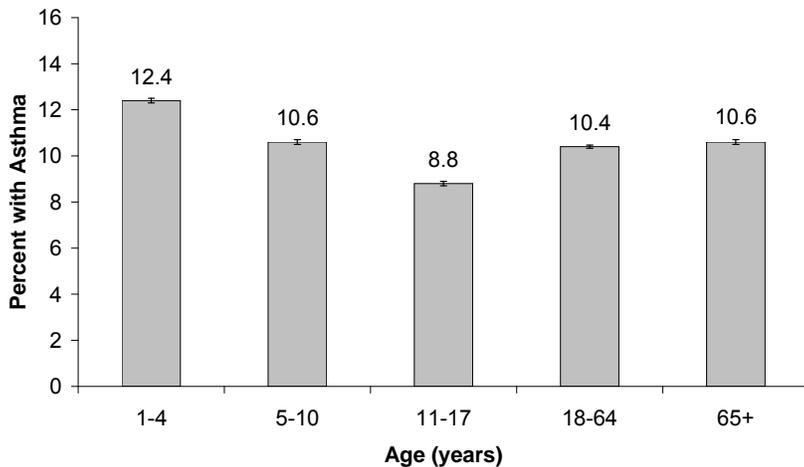


Figure 67. Age-adjusted prevalence of any diagnosis of asthma in any claim file by gender and/or race/ethnicity, TennCare enrollees, 2004-2006 (*TennCare*)



- Asthma prevalence was highest among young children 1-4 years of age (12.4%), and lowest among teens 11-17 years of age (8.8%) (Figure 68).

Figure 68. Age-specific prevalence of any diagnosis of asthma in any claim file, TennCare enrollees, 2004-2006 (*TennCare*)

# Asthma among TennCare Enrollees *cont.*

Following is a discussion of TennCare inpatient hospitalization rates and emergency department visit rates for both a primary diagnosis of asthma and for any diagnosis of asthma. Rates were calculated as the number of inpatient hospitalizations or emergency department visits per 100,000 people enrolled in TennCare (i.e. discharge-level analysis) and age-adjusted to the 2000 United States standard population. This is not the same as the number of people hospitalized for asthma because some individuals may have been hospitalized or visited an emergency department more than once in a given year. The rates presented are a reflection of the burden that asthma places on the TennCare system.

## TennCare Inpatient Hospitalizations for Asthma

- In 2006, there were 5,126 inpatient hospitalizations for a primary diagnosis of asthma among TennCare enrollees, and the hospitalization rate for primary asthma was 368/100,000.

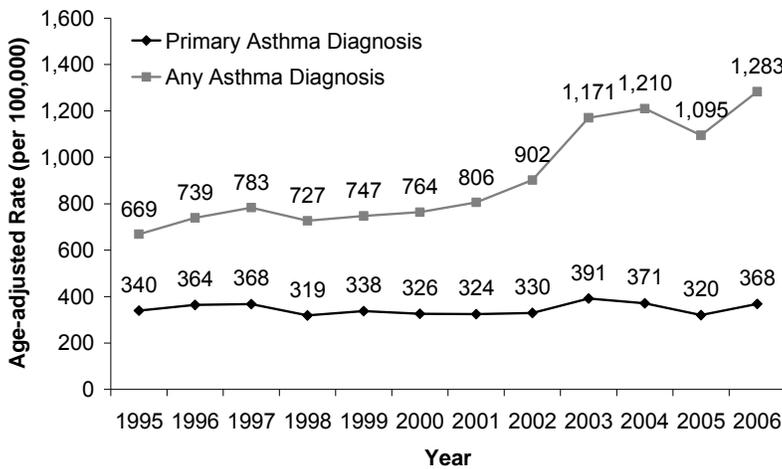


Figure 69. Age-adjusted inpatient hospitalization rate for primary or any asthma diagnosis, TennCare, 1995-2006 (TennCare)

- During the same year, there were 15,780 inpatient hospitalizations where asthma was listed as a primary and/or secondary diagnosis (i.e. any asthma diagnosis), and the hospitalization rate for any asthma was 1,283/100,000.
- Between 1995 and 2006, there was no statistically significant increase or decrease in the hospitalization rate for primary asthma. However, the hospitalization rate for any asthma diagnosis almost doubled during this period of time (Figure 69).

- In 2006, the inpatient hospitalization rates for both primary and any asthma diagnosis were higher among females than among males (Figure 70).
- The hospitalization rate for primary asthma was 429/100,000 among females and 258/100,000 among males.
- The hospitalization rate for any asthma was 1,532/100,000 among females and 860/100,000 among males.

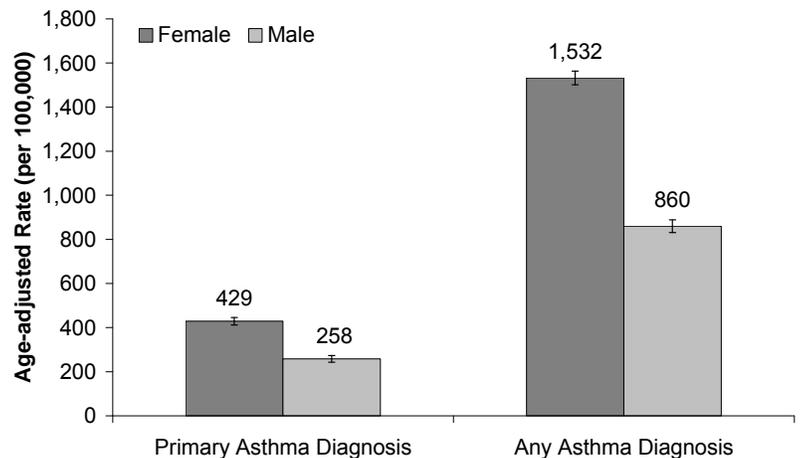


Figure 70. Age-adjusted inpatient hospitalization rate for primary or any asthma by gender, TennCare, 2006 (TennCare)

# Asthma among TennCare Enrollees *cont.*

## TennCare Inpatient Hospitalizations for Asthma *cont.*

- Despite the fact that asthma prevalence among TennCare enrollees was higher among whites than blacks, hospitalization rates for both primary and any asthma diagnosis were higher among blacks (Figure 71).
- The hospitalization rate for primary asthma was 456/100,000 among blacks and 313/100,000 among whites.
- The hospitalization rate for any asthma was 1,319/100,000 among blacks and 1,219/100,000 among whites.
- Hispanics had the lowest inpatient hospitalization rates for asthma, although there was not a statistically significant difference between whites and Hispanics for primary asthma hospitalizations (Figure 71).

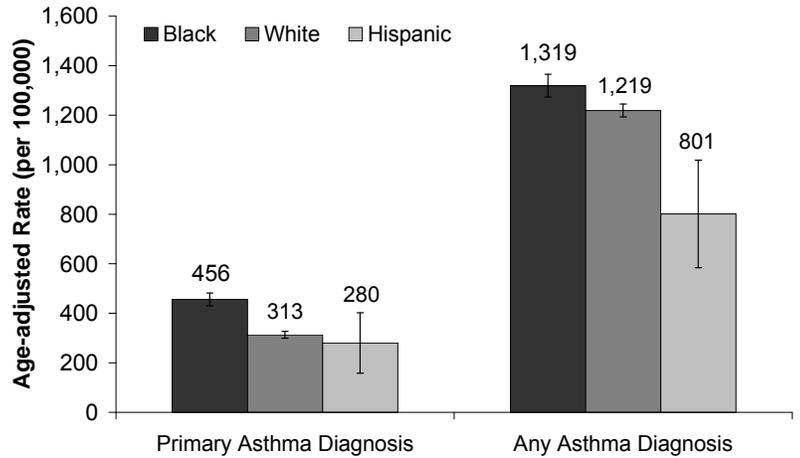


Figure 71. Age-adjusted inpatient hospitalization rate for primary or any asthma by race and ethnicity, TennCare, 2006 (*TennCare*)

- The hospitalization rate for primary asthma was highest among children aged 1-4 years, whereas for any diagnosis of asthma the hospitalization rate was highest among the elderly (Figures 72 and 73).<sup>k</sup>

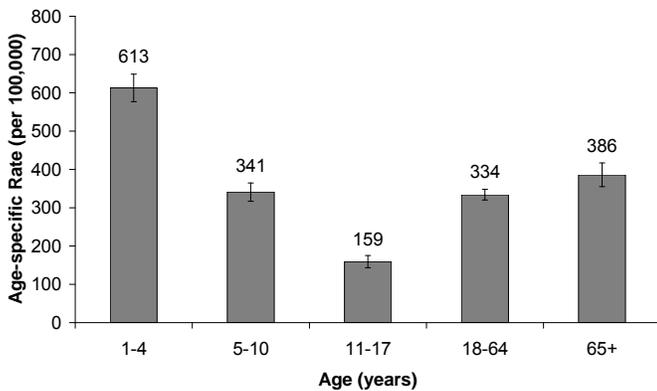


Figure 72. Age-specific inpatient hospitalization rate for primary asthma, TennCare, 2006 (*TennCare*)

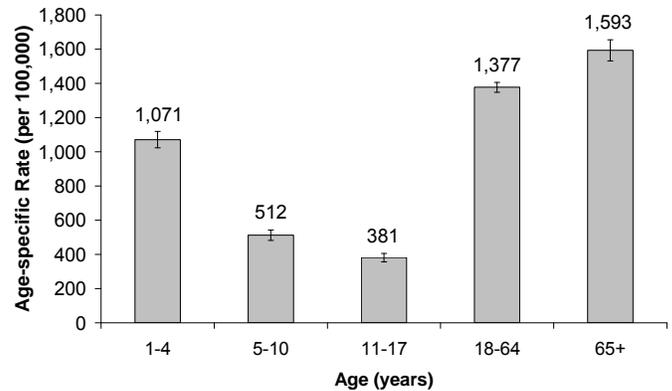


Figure 73. Age-specific inpatient hospitalization rate for any asthma, TennCare, 2006 (*TennCare*)

<sup>k</sup> The age distribution among all inpatient hospitalizations for primary asthma was as follows: 1-4 years 21%, 5-10 years 15%, 11-17 years 7%, 18-64 years 41%, 65 years and over 12%.

# Asthma among TennCare Enrollees *cont.*

## TennCare Inpatient Hospitalizations for Asthma *cont.*

- The time trends and gender and racial differences in inpatient hospitalizations observed in the TennCare data were similar to those observed in the hospital discharge data system (HDDS). However, hospitalization rates among TennCare enrollees were higher than those observed in the overall population. The inpatient hospitalization rate for a primary diagnosis of asthma was 368/100,000 for TennCare compared to 133/100,000 for HDDS in 2006.
- Detailed county and regional level inpatient hospitalization rates are located in the Appendix.

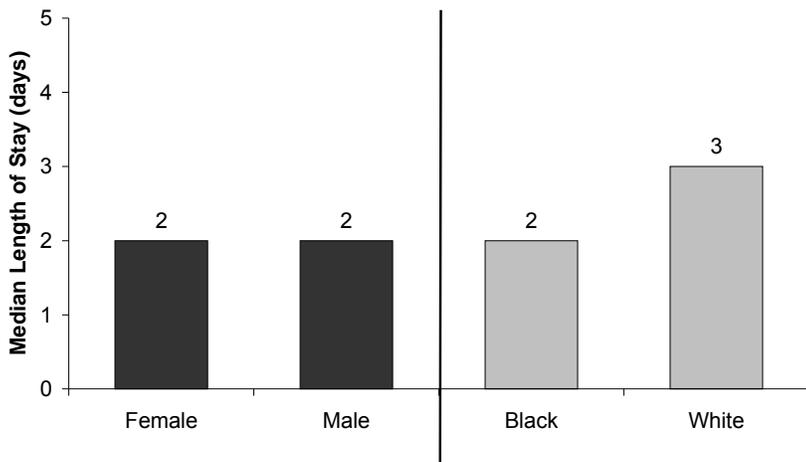


Figure 74. Median length of stay among inpatient hospitalizations for primary asthma by gender or race, TennCare, 2006 (*TennCare*)

- In 2006, the length of stay per admission for inpatient asthma hospitalizations among TennCare enrollees ranged from 0 to 119 days, with a mean of 2.6 days and a median of 2 days.
- The median length of stay among TennCare enrollees (2 days) was shorter than that observed in the HDDS (3 days).
- Median length of stay was 2 days among both males and females (Figure 74).
- Median length of stay was 2 days among blacks and 3 days among whites (Figure 74).
- Elderly adults aged 65 and older had the longest median length of stay (3 days), while children aged 1-4 had the shortest (1 day) (Figure 75).

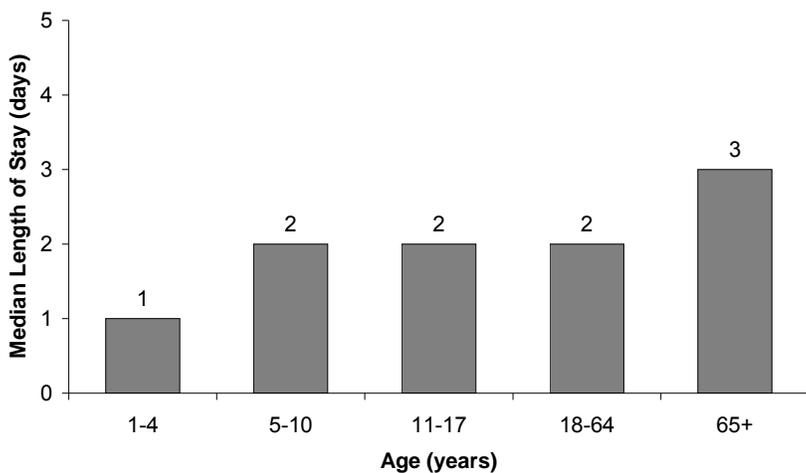


Figure 75. Median length of stay among inpatient hospitalizations for primary asthma by age, TennCare, 2006 (*TennCare*)

# Asthma among TennCare Enrollees *cont.*

## TennCare Emergency Department Visits for Asthma

- In 2006, there were 19,383 emergency department visits for a primary diagnosis of asthma among TennCare enrollees, and the ED visit rate was 1,255/100,000.
- During the same year, there were 57,313 ED visits where asthma was listed as a primary and/or secondary diagnosis (i.e. any asthma diagnosis), and the ED visit rate was 4,085/100,000.
- Between 1995 and 2006, there were statistically significant increases in the ED visit rates for both primary and any asthma. The primary asthma rate approximately doubled, whereas the any asthma rate more than quadrupled (Figure 76).

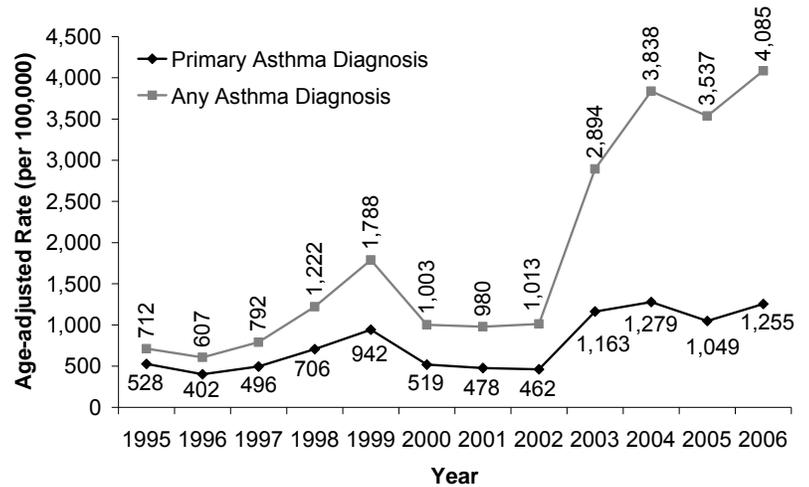


Figure 76. Age-adjusted ED visit rate for primary or any asthma diagnosis, TennCare, 1995-2006 (*TennCare*)

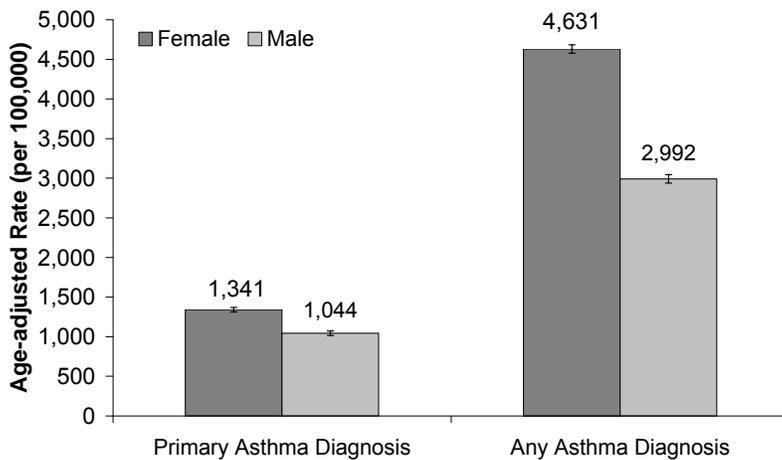


Figure 77. Age-adjusted ED visit rate for primary or any asthma by gender, TennCare, 2006 (*TennCare*)

- In 2006, the ED visit rates for both primary and any asthma diagnosis were higher among females than among males (Figure 77).
- The ED visit rate for primary asthma was 1,341/100,000 among females and 1,044/100,000 among males.
- The ED visit rate for any asthma was 4,631/100,000 among females and 2,992/100,000 among males.

# Asthma among TennCare Enrollees *cont.*

## TennCare Emergency Department Visits for Asthma *cont.*

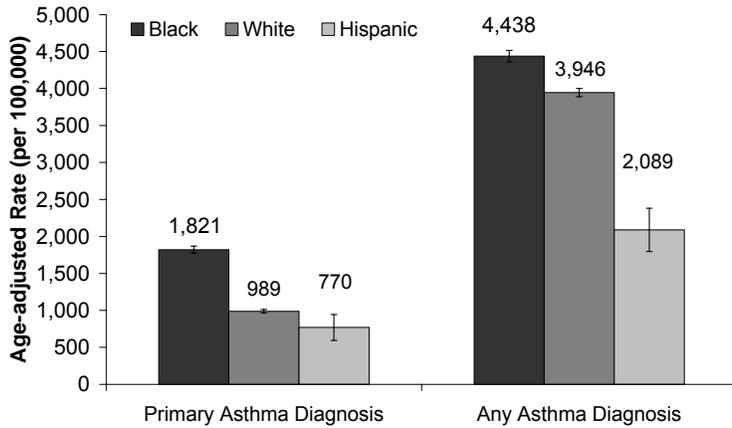


Figure 78. Age-adjusted ED visit rate for primary or any asthma by race and ethnicity, TennCare, 2006 (TennCare)

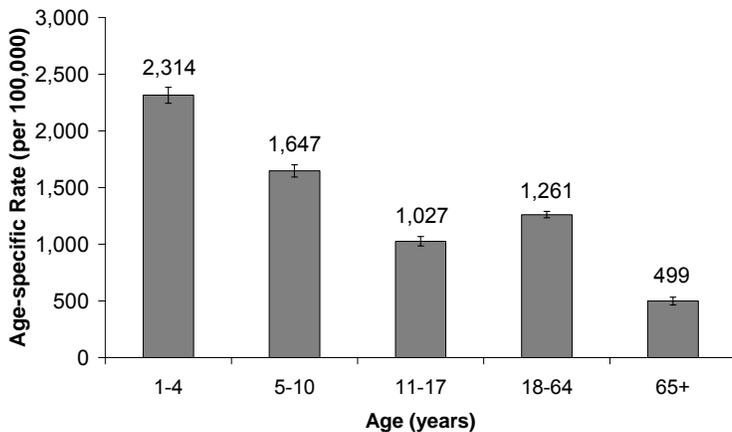


Figure 79. Age-specific ED visit rate for primary asthma, TennCare, 2006 (TennCare)

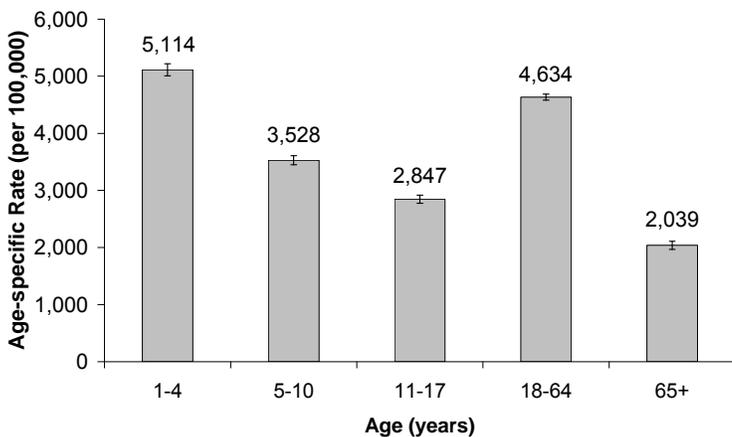


Figure 80. Age-specific ED visit rate for any asthma, TennCare, 2006 (TennCare)

- Despite the fact that asthma prevalence among TennCare enrollees was higher among whites than blacks, the ED visit rates for both primary and any asthma diagnosis were higher among blacks. Hispanics had the lowest ED visit rates (Figure 78).
- The ED visit rate for primary asthma was 1,821/100,000 among blacks, 989/100,000 among whites and 770/100,000 among Hispanics.
- The ED visit rate for any asthma was 4,438/100,000 among blacks, 3,946/100,000 among whites and 2,089 among Hispanics.
- Children aged 1-4 years had the highest ED visit rates for both primary and any asthma, while elderly adults aged 65 years and older had the lowest rates for both (Figures 79 and 80).<sup>1</sup>
- The time trends and gender and racial differences in ED visits observed in the TennCare data were similar to those observed in the hospital discharge data system. However, ED visit rates among TennCare enrollees were higher than those observed in the overall population. The ED visit rate for a primary diagnosis of asthma was 1,255/100,000 for TennCare compared to 604/100,000 for HDDS in 2006.
- Detailed county and regional level ED visit rates are located in the Appendix.

<sup>1</sup> The age distribution among all ED visits for primary asthma was as follows: 1-4 years 21%, 5-10 years 19%, 11-17 years 12%, 18-64 years 41%, 65 years and over 4%.

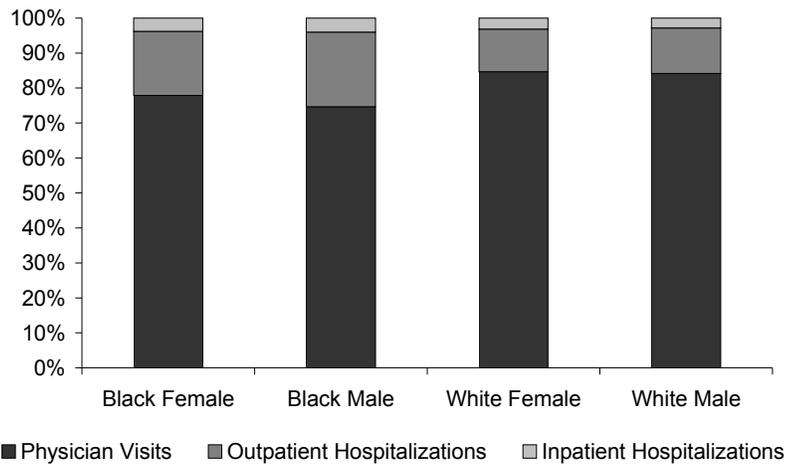
# Asthma among TennCare Enrollees *cont.*

## TennCare Physician Visits for Asthma

In addition to information on inpatient hospitalizations and emergency department visits for asthma (which, as noted above, are a reflection of severe and/or poorly managed disease), data from TennCare also include information about physician visits for asthma. Regular checkups with a health care provider are an important aspect of asthma management and are key to controlling the disease and to preventing exacerbations requiring emergency care and/or hospitalization. Checkups may be required from every two weeks to every six months, depending on a patient's level of control and the need to adjust therapy.<sup>6</sup>

Following is a discussion of physician visits among TennCare enrollees for which asthma was listed as a primary and/or secondary diagnosis (i.e. any asthma diagnosis). Rates were calculated as the number of physician visits per 100,000 people enrolled in TennCare (i.e. discharge-level analysis) and age-adjusted to the 2000 United States standard population. Note that between 2004 and 2006, it was not possible to distinguish between primary and secondary diagnoses of asthma in the TennCare physician visit files, and therefore only rates for any asthma diagnosis are presented.

- In 2006, the majority of TennCare health care encounters for asthma were physician visits (82%). Fifteen percent were outpatient hospitalizations and 3% were inpatient hospitalizations.<sup>m</sup> Note that most outpatient hospitalizations (74%) were emergency department visits.
- Among different racial/gender groups, a similar percentage of health care encounters (3-4%) were inpatient hospitalizations (Figure 81).
- The percentage of physician visits was higher among whites than among blacks, while the percentage of outpatient hospitalizations was higher among blacks (Figure 81).



**Figure 81. Percentage of visit types for asthma by gender and race, TennCare, 2006 (TennCare)<sup>m</sup>**

- In 2006, the number of physician visits per unique patient ranged from 1 to 49, with a mean of 2.1 visits. This was slightly less than in previous years. Between 1995 and 2004, the mean number of physician visits fluctuated between 2.5 and 2.6.
- The majority of individuals (61%) had a single physician visit in 2006. Nineteen percent had two visits and 21% had three or more visits.

<sup>m</sup> Percentages were based on the number of inpatient and outpatient hospitalizations for primary asthma and the number of physician visits for any asthma. Durable medical equipment, ambulance services, and nursing home services were not included in the analysis.

# Asthma among TennCare Enrollees *cont.*

## TennCare Physician Visits for Asthma *cont.*

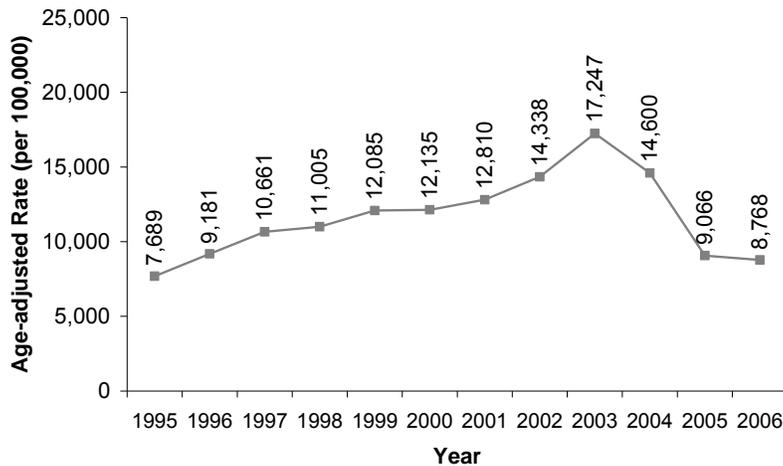


Figure 82. Age-adjusted physician visit rate for any asthma diagnosis, TennCare, 1995-2006 (*TennCare*)

- In 2006, there were 123,639 physician visits for any diagnosis of asthma among TennCare enrollees, and the physician visit rate for any asthma was 8,768/100,000.
- Between 1995 and 2004, there was a statistically significant increase in the physician visit rate for any diagnosis of asthma (Figure 82).
- There was a marked decrease in physician visits for asthma in 2005, and the overall trend in the rate of physician visits between 1995 and 2006 was not significant.<sup>n</sup>

### Exercising with Asthma

Exercise is a common trigger of asthma. People with exercise-induced asthma are believed to be more than usually sensitive to changes in the temperature and humidity of the air. During exercise, the air breathed in through the mouth is cold and dry, and the contrast between the warm air in the lungs and the cold inhaled air can trigger an attack. Many people with asthma avoid exercise because they fear an asthma attack. However, one of the goals of asthma management is to maintain a healthy lifestyle, which includes exercise and other physical activities. With good disease control and a well planned exercise program persons with asthma should be able to enjoy the benefits of exercise without experiencing asthma symptoms.

Precautions that can help reduce the chances of an exercise-induced asthma attack include the following:

- Consulting a doctor before beginning an exercise program.
- Taking asthma medicines as prescribed prior to exercise.
- Choosing activities that are less likely to trigger an attack. These include activities that require short bursts of activities interspersed with breaks, such as walking, hiking, swimming, baseball, and golfing.
- Warming up and cooling down properly.
- Avoiding other asthma triggers such as cold air, pollen and air pollutants.
- Avoiding exertion when you have a respiratory tract infection.

#### Sources:

eMedicineHealth. Exercise-Induced Asthma Fact Sheet. Accessed 24 January 2008 at [www.emedicinehealth.com](http://www.emedicinehealth.com).

WebMD. Asthma Guide: Exercise and Asthma. Accessed 24 January 2008 at [www.webmd.com/asthma/guide/exercising-asthma](http://www.webmd.com/asthma/guide/exercising-asthma).

<sup>n</sup> A similar decrease in physician visits was observed for all disease diagnoses, not just asthma. The total number of physician visits dropped from 15.2 million in 2004 to 11.1 million in 2005. The average number of visits per enrollee also dropped from 10 visits in 2004 to 7 visits in 2005. These findings suggest that the sudden decrease in the asthma physician visit rate in 2005 was more likely due to changes in TennCare program practices than to a reduction in the asthma burden.

# Asthma among TennCare Enrollees *cont.*

## TennCare Physician Visits for Asthma *cont.*

- In 2006, the physician visit rate for any asthma diagnosis was higher among females (9,925/100,000) than among males (6,610/100,000) (Figure 83).
- The rate of physician visits was similar among blacks (8,887/100,000) and among whites (8,504/100,000), and lowest among Hispanics (5,298/100,000) (Figure 84).
- Children aged 1-4 had the highest rate of physician visits (10,322/100,000) (Figure 85).

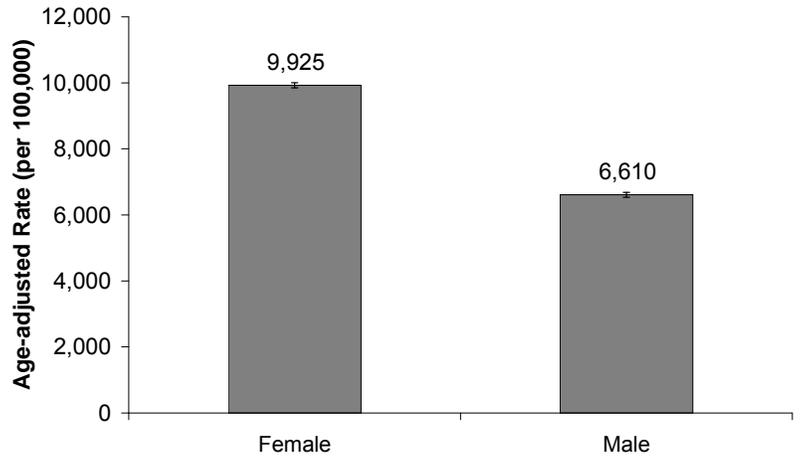


Figure 83. Age-adjusted physician visit rate for any asthma diagnosis by gender, TennCare, 2006 (*TennCare*)

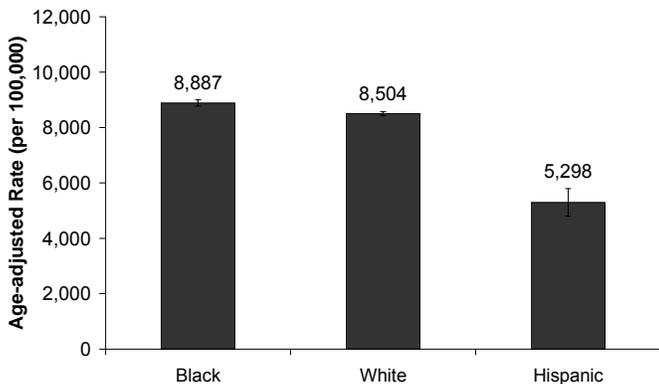


Figure 84. Age-adjusted physician visit rate for any asthma diagnosis by race and ethnicity, TennCare, 2006 (*TennCare*)

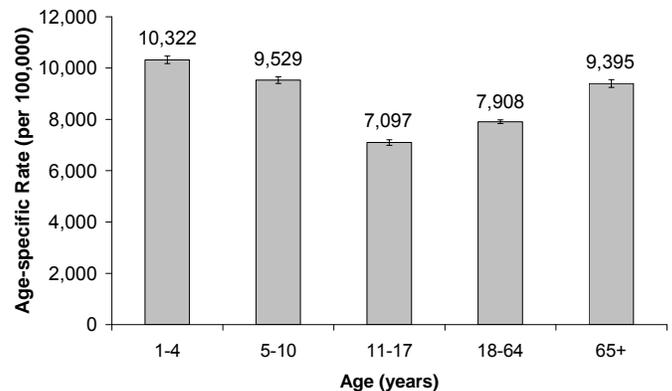


Figure 85. Age-specific physician visit rate for any asthma diagnosis, TennCare, 2006 (*TennCare*)

## Asthma and Flu Shots

Upper respiratory tract infections are an important trigger of asthma and an important source of morbidity and mortality among persons with the disease. Influenza is a major cause of these upper respiratory tract infections and the Centers for Disease Control and Prevention recommends that persons with asthma receive annual influenza vaccinations. However, only one in three adults with asthma receive the flu vaccine, and among those 18-49 years of age only one in five get a flu shot. Influenza vaccination rates are even lower among children with asthma (9-25%).

Asthmatic patients may be reluctant to be vaccinated against influenza for several reasons. They may not perceive a need or may not be aware of the need for such vaccinations. They may also be concerned about possible adverse effects of vaccinations on their asthma. Yet, flu shots have been shown to be safe in children and adults. Patients with asthma are recommended to have regular follow-up visits to ensure control of their asthma. These visits provide important opportunities to administer the influenza vaccine to patients with asthma and to remind them of the need to receive such vaccinations.

Source: Ford ES, Mannino DM, Williams SG. Asthma and Influenza Vaccination: Findings from the 1999-2001 National Health Interview Surveys. *Chest* 2003; 124(3):783-789.

# Asthma among TennCare Enrollees *cont.*

## TennCare Physician Visits for Asthma *cont.*

As mentioned above, regular checkups with a health care provider are an important aspect of asthma management and are key to controlling the disease and to preventing exacerbations requiring urgent care. We examined whether physician visits influenced subsequent emergency department visits for asthma among TennCare enrollees.

We identified TennCare enrollees who had an inpatient and/or outpatient hospitalization for a primary diagnosis of asthma in 2006, and determined whether each hospitalization was the result of an emergency department visit. Each individual was then traced back 18 months from the day of his or her first asthma hospitalization to determine if they had seen a physician during that time period. Individuals were divided into those who had not seen a physician at all, those who had seen a physician at least once for a primary and/or secondary asthma diagnosis and those who had seen a physician for a condition or conditions other than asthma.

- Compared to persons who had had a physician visit for asthma, the odds of having an emergency department visit for a primary asthma diagnosis were greater among both those who had not seen a physician and among those who had seen a physician for a condition or conditions other than asthma (Table 5).<sup>o</sup>
- Compared to persons with a physician visit for asthma, the odds of an asthma ED visit were 60% greater among those with a non-asthma physician visit.
- Compared to persons with a physician visit for asthma, the odds of an asthma ED visit were two-and-a half times as great among those with no physician visit.

**Table 5. Odds of having an emergency department visit for asthma, TennCare, 2006 (*TennCare*)<sup>o</sup>**

Physician Visit Status	Odds Ratio (95% CI)
Yes (for asthma)	--
Yes (for condition other than asthma)	1.6 (1.5-1.7)
No	2.5 (2.0-3.2)

## Asthma Action Plans

An asthma action plan is a written, customized plan developed by a doctor or asthma specialist to help someone with asthma manage their disease. Asthma action plans can be organized in a number of ways, but may include any of the following: a list of asthma triggers, a list of routine asthma symptoms and what to do if these symptoms occur, the name and dose of daily asthma medication(s), the name and dose of rescue medication(s) to be taken during an attack, emergency telephone numbers, and instructions about when to contact a doctor or seek emergency care. Plans should be reviewed with a healthcare provider at least once a year and updated as necessary. Asthma action plans are collaborative efforts between patients and health care providers, and there is evidence that written plans not only facilitate communication between the two, but also play a key role in successful self-management of the disease.

### Sources:

WebMD. Asthma Guide: Developing an Asthma Action Plan. Accessed 8 February 2008 at [www.webmd.com/asthma/guide/developing-an-asthma-action-plan](http://www.webmd.com/asthma/guide/developing-an-asthma-action-plan)  
Hodder R. The paradox of adult asthma control: "Who's in control anyway?" *Canadian Respiratory Journal* 2007; 14(4):229-234.

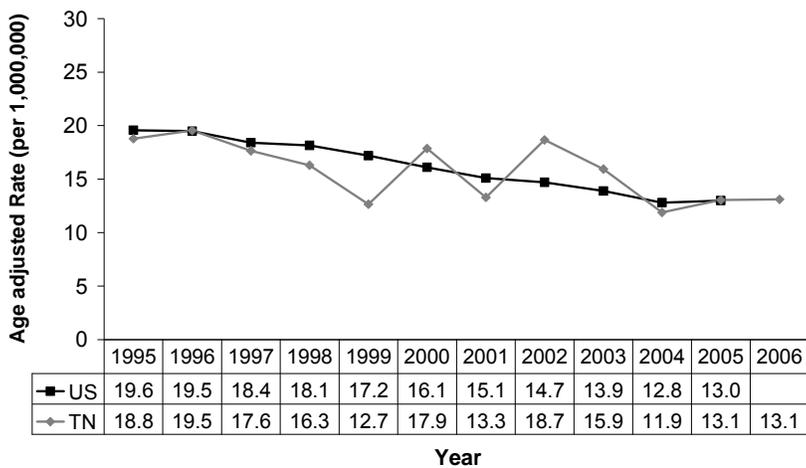
<sup>o</sup> Age, gender and race were controlled for in the analysis.

# Mortality

Deaths due to asthma, though uncommon, are largely preventable and represent a breakdown in effective disease management. Following is a discussion of mortality due to asthma, both as the underlying (or primary) cause of death and as a contributing (or secondary) cause of death. Death data were obtained from the Death Statistical System (DSS), which is described in the Technical Notes.

Since 1999, asthma deaths have been coded under the ICD-10 classification. Prior to 1999, the ICD-9 classification system was in use. Deaths before and after 1999 cannot be compared without adjusting for this change in coding. The National Center for Health Statistics reported a comparability ratio of 0.8938 for the coding of asthma mortality under ICD-10 as compared to ICD-9 coding.<sup>20</sup> This means that approximately 11% fewer deaths would be coded as indicating asthma as the primary cause of death under ICD-10 compared to those same deaths coded under ICD-9.<sup>15</sup> The mortality rates in this report for years prior to 1999 have been comparability adjusted to allow for comparison with data from more recent years.

## Deaths due to an Underlying Diagnosis of Asthma



- In 2006, there were 80 deaths due to an underlying diagnosis of asthma in Tennessee, and the asthma mortality rate was 13.1/1,000,000.
- Between 1995 and 2006, there were several large fluctuations in the asthma mortality rate in Tennessee. However, during this time period there was still a statistically significant decrease in the asthma mortality rate (Figure 86).<sup>p</sup>
- In some years the asthma mortality rate in Tennessee was higher than the national rate, and in some years it was lower. By comparing the rates for all years, there was no statistically significant difference between Tennessee and the United States, and both had similar decreases in asthma mortality between 1995 and 2005 (Figure 86).<sup>15,18</sup>

Figure 86. Age-adjusted mortality rate for underlying asthma, Tennessee and the United States, 1995-2006 (DSS, NVSS)<sup>p</sup>

<sup>p</sup> Mortality rates prior to 1999 were comparability adjusted to account for ICD revisions – please see Technical Notes.

# Mortality *cont.*

## Deaths due to an Underlying Diagnosis of Asthma *cont.*

- In 2006, the asthma mortality rate was similar among females (12.6/1,000,000) and males (13.7/1,000,000) (Figure 87).
- The asthma mortality rate was higher among blacks (33.1/1,000,000) than among whites (9.4/1,000,000) (Figure 87).
- The asthma mortality rate was lowest among children 1-17 years of age (6.5/1,000,000) and highest among adults aged 65 years and older (41.0/1,000,000) (Figure 88).

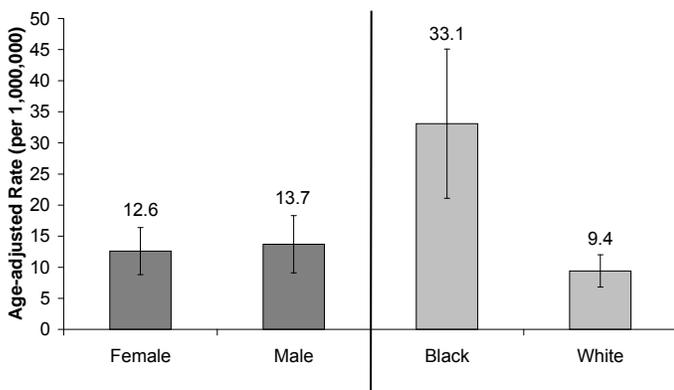


Figure 87. Age-adjusted mortality rate for underlying asthma by gender or race, Tennessee, 2006 (DSS)

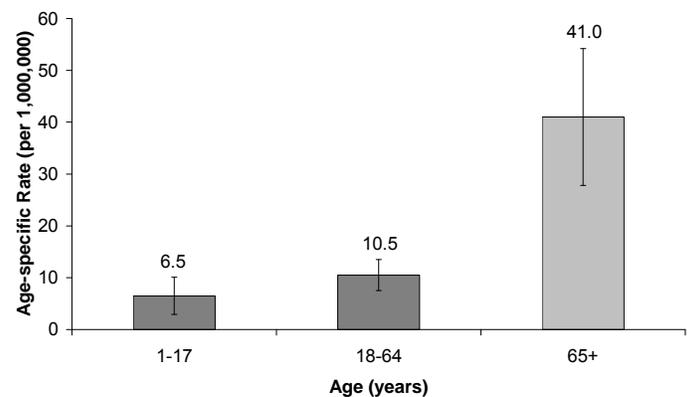


Figure 88. Age-specific mortality rate for underlying asthma, Tennessee, 2006 (DSS)

## Asthma in the Elderly

Asthma is common among older persons, affecting approximately 4 to 8% of those over the age of 65 years. However, despite its prevalence, late onset asthma is often underdiagnosed and undertreated. Underdiagnosis can occur for a number of reasons. The perception of airway obstruction declines with age and older persons may underreport their symptoms. Physicians may attribute difficulty breathing and other symptoms to other common conditions among the elderly, such as congestive heart failure, lung cancer, infection and vocal cord dysfunction, or to poor physical conditioning. Finally, it is sometimes difficult to distinguish between asthma and chronic obstructive pulmonary disease (COPD) among patients with a history of smoking.

Although the general principals of disease management are the same in both young and old patients, there are a number of considerations specific to elderly patients with asthma. These include adverse effects of medications (especially among persons with co-morbid conditions), drug interactions in older patients taking multiple medications, and effective medication delivery, especially with respect to the use of inhalers. Improper use of inhalers is common among the elderly, who need to be taught good inhaler technique in order to improve delivery of medications to the lungs, minimize adverse effects and reduce the need for oral corticosteroids. Despite these challenges, proper diagnosis and treatment can significantly enhance the quality of life of older persons with asthma.

### Sources:

Kitch BT, Levy BD, Fanta CH. Late Onset Asthma: Epidemiology, Diagnosis and Treatment. *Drugs and Aging* 2000; 17(5):385-397

Barua P, O'Mahony MS. Overcoming Gaps in the Management of Asthma in Older Patients: New Insights. *Drugs and Aging* 2005; 22(12):1029-1059.

# Mortality cont.

## Deaths due to Any Diagnosis of Asthma

Several studies have found that persons with asthma have an increased risk of death from causes other than asthma. For example, one such study found that patients who had a hospitalization for treatment of asthma also had a six-fold increased risk of death from other lung diseases and from cardiovascular diseases compared with the general population.<sup>21</sup> Indeed, examining asthma mortality based solely on primary cause of death may underestimate the magnitude of asthma-related mortality.<sup>22</sup> Between 1990 and 2001, asthma mortality rates in the United States were over two times higher using multiple cause-of-death data compared to using underlying cause alone.<sup>22</sup> Following is a discussion of asthma mortality trends in Tennessee where asthma was listed as an underlying and/or a contributing cause of death (i.e. any asthma diagnosis).

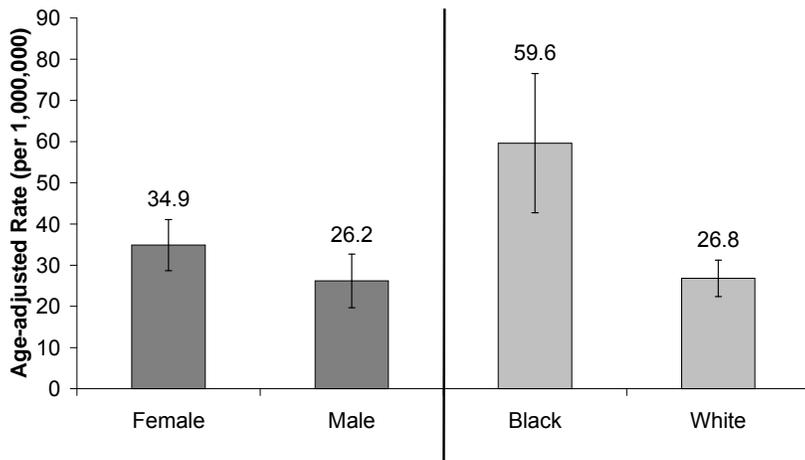


Figure 89. Age-adjusted mortality rate for any asthma by gender or race, Tennessee, 2006 (DSS)

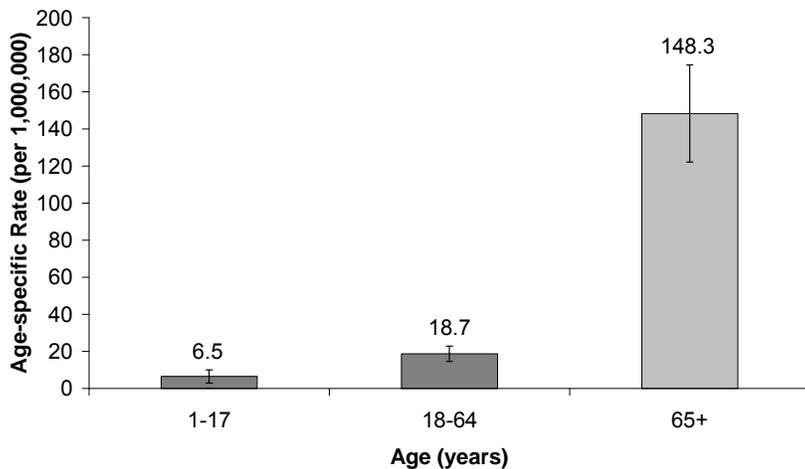


Figure 90. Age-specific mortality rate for any asthma, Tennessee, 2006 (DSS)

- In 2006, there were 192 deaths for which asthma was listed as an underlying and/or contributing cause of death, and the mortality rate for any asthma diagnosis was 31.5/1,000,000.
- Between 1999 and 2006, the annual mortality rates for any diagnosis of asthma were approximately two to two-and-a-half times those for an underlying asthma diagnosis alone.
- In 2006, the mortality rate for any asthma diagnosis was slightly higher among females (34.9/1,000,000) than among males (26.2/1,000,000) (Figure 89).
- Racial and age differences in mortality rates for any asthma diagnosis were similar to those for an underlying diagnosis of asthma.
- The any asthma mortality rate was higher among blacks (59.6/1,000,000) than among whites (26.8/1,000,000) (Figure 89).
- The any asthma mortality rate was lowest among children 1-17 years of age (6.5/1,000,000) and highest among adults aged 65 years and older (148.3/1,000,000) (Figure 90).

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# Mortality cont.

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## Deaths due to Any Diagnosis of Asthma cont.

- Between 1999 and 2006, persons who had a secondary diagnosis of asthma had greater odds of dying due to an underlying diagnosis of heart disease than did those who did not have a secondary diagnosis of asthma. The odds ratio was 2.0 (95% CI 1.7-2.3).<sup>q</sup>
- The odds ratio was highest among black males. The odds of dying from heart disease among black males with a secondary asthma diagnosis were 3.7 times as high as among those without secondary asthma (Table 6).
- Among other racial/gender groups, the odds of dying from heart disease were approximately two times as high among those with a secondary asthma diagnosis (Table 6).

**Table 6. Odds of dying of heart disease among those having a secondary asthma diagnosis, Tennessee, 1999-2006 (DSS)<sup>q</sup>**

Gender	Race	Odds Ratio (95% CI)
Black	Male	3.7 (2.1-6.6)
White	Male	2.4 (1.8-3.2)
Black	Female	2.1 (1.4-3.1)
White	Female	1.9 (1.6-2.3)

## Asthma in Schools

Approximately 1 out of every 10 school children in the United States has asthma and it is one of the most common causes of absenteeism. However, when asthma is well-managed it is far less likely to result in sick days and proper asthma control offers other benefits to students as well. These benefits include the child's ability to sleep well at night and focus at school during the day; to spend his or her time at school in the classroom and not the nurse's office; to avoid anxiety or embarrassment about flare-ups and asthma symptoms; and to study, play sports, go on field trips and fully participate in all school activities.

Because children spend a large part of their day there, schools are an important partner in management of this disease. Asthma-friendly schools have policies and procedures that help students and their families learn about asthma management, allow students to successfully manage their asthma during school hours and school events, and facilitate communication with the family and the family's medical care provider about the child's asthma. It is important that parents of children with asthma ask their doctor for a written asthma action plan for the school, and that they meet with school staff to discuss the plan and ensure that quick-relief medication is immediately available in the event of a flare-up.

The CDC's School Health Profiles is a biennial survey of school principals and health education teachers which addresses various health issues, including asthma. The 2004 survey of Tennessee school principals found that 78% of schools identified and tracked all students with asthma; 60% obtained and used asthma action plans for all students with asthma; and 55% educated school staff about asthma.

### Sources:

Merkle SL, Wheeler LS, Gerald LB, Taggart VS. Introduction: Learning From Each Other About Managing Asthma in Schools. *Journal of School Health* 2006; 76(6):202-204.

National Jewish. Back-to-School Health Tips for Children with Asthma. Accessed 11 January 2008 at [www.nationaljewish.org/disease-info/diseases/asthma/living/work-school-play](http://www.nationaljewish.org/disease-info/diseases/asthma/living/work-school-play).

Kids Health. School and Asthma Fact Sheet. Accessed 11 January 2008 at [www.kidshealth.org/parent/medical/asthma/school\\_asthma.html](http://www.kidshealth.org/parent/medical/asthma/school_asthma.html).

Grunbaum JA, Di Piatra J, McManus T, Kann L. *School Health Profiles: Characteristics of Health Programs among Secondary Schools (Profiles 2004)*. Atlanta, GA: Centers for Disease Control and Prevention, 2005.

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<sup>q</sup> The analysis excluded persons with an underlying diagnosis of asthma, and results were adjusted for age and year of death.

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## Summary

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Although overall asthma prevalence in Tennessee has not increased since 2000, prevalence among TennCare enrollees (i.e. those with low socioeconomic status) has risen since 1995. Hospitalization rates and hospital charges for asthma have also increased, and gender, racial and age disparities in prevalence, hospitalizations and mortality persist. Hospitalizations, emergency department visits and deaths due to asthma are all indicative of severe and/or poorly managed disease and are costly both monetarily and in terms of personal suffering. However, such severe consequences are largely preventable with appropriate treatment and disease management. The trends and differences noted in this report therefore indicate a need for additional asthma prevention and control efforts in the state. The information contained in this report is important for health professionals, policy makers, and other individuals and organizations interested in asthma and in the health of the people of Tennessee. It can be used to guide planning efforts, to target interventions, and to serve as a baseline to track asthma trends and evaluate efforts to decrease the burden of this disease.

## Appendix – Regional and County Data

The following tables present detailed asthma data for individual health department regions and counties in Tennessee. Included are data from the hospital discharge data system (inpatient hospitalization and ED visit rates) and from the TennCare billing system (prevalence, inpatient hospitalization and ED visit rates). All rates are age-adjusted, 2004-2006 annual averages for primary asthma, except for TennCare asthma prevalence which is the prevalence of any diagnosis of asthma for the three year period from 2004-2006.

### Metropolitan Regions

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Davidson	134	726	9.7	427	1,575
Hamilton	91	682	11.6	290	1,470
Knox	105	580	11.6	289	1,267
Madison	126	725	10.7	381	1,371
Shelby	187	854	7.8	406	1,374
Sullivan	104	677	11.3	238	1,378

### East Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Anderson	118	405	11.8	307	886
Blount	117	388	10.5	305	944
Campbell	271	746	16.2	442	959
Claiborne	156	515	15.2	472	1,106
Cocke	222	878	14.3	465	1,449
Grainger	123	470	11.9	231	743
Hamblen	158	623	13.5	354	1,200
Jefferson	131	556	12.9	280	920
Loudon	94	600	11.0	217	1,014
Monroe	89	467	11.2	71	581
Morgan	212	609	9.0	219	757
Roane	188	569	13.4	481	1,120
Scott	173	984	13.8	297	1,345
Sevier	91	534	10.5	185	797
Union	69	434	11.2	188	851
<b>Region Total</b>	<b>140</b>	<b>547</b>	<b>12.6</b>	<b>328</b>	<b>1,008</b>

## Appendix – Regional and County Data *cont.*

### Mid-Cumberland Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Cheatham	132	582	12.2	344	1,696
Dickson	65	514	11.5	207	1,026
Houston	153	736	9.1	335	703
Humphreys	96	305	10.7	255	589
Montgomery	137	447	10.2	238	675
Robertson	153	716	11.4	376	1,483
Rutherford	115	483	10.4	337	1,038
Stewart	133	289	9.6	132	827
Sumner	144	598	13.2	364	1,473
Trousdale	261	738	9.7	555	1,352
Williamson	58	271	8.4	196	968
Wilson	118	350	9.3	440	999
<b>Region Total</b>	<b>115</b>	<b>464</b>	<b>10.9</b>	<b>325</b>	<b>1,152</b>

### Northeast Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Carter	80	336	14.6	248	752
Greene	164	669	16.7	399	1,379
Hancock	111	543	10.0	166	660
Hawkins	91	519	10.7	194	1,104
Johnson	62	429	11.2	161	775
Unicoi	83	597	10.8	180	919
Washington	113	478	12.6	324	1,016
<b>Region Total</b>	<b>109</b>	<b>501</b>	<b>13.2</b>	<b>273</b>	<b>1,015</b>

## Appendix – Regional and County Data *cont.*

### Northwest Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Benton	98	337	9.7	220	612
Carroll	148	557	8.7	335	897
Crockett	171	533	9.0	314	820
Dyer	217	605	10.7	438	992
Gibson	159	734	9.9	358	1,107
Henry	154	311	8.2	301	435
Lake	151	513	10.5	201	823
Obion	153	454	8.4	570	853
Weakley	166	430	10.8	395	849
<b>Region Total</b>	<b>162</b>	<b>519</b>	<b>9.5</b>	<b>369</b>	<b>859</b>

### South Central Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Bedford	172	552	10.3	427	1,146
Coffee	279	793	14.4	724	1,491
Giles	209	541	11.5	545	1,163
Hickman	98	559	9.7	189	781
Lawrence	268	432	10.9	411	718
Lewis	61	173	10.4	174	270
Lincoln	117	559	8.6	325	991
Marshall	156	709	12.7	199	988
Maury	153	533	11.5	218	718
Moore	15	144	12.2	306	1,277
Perry	128	466	6.7	257	683
Wayne	147	256	8.9	430	571
<b>Region Total</b>	<b>178</b>	<b>545</b>	<b>11.2</b>	<b>386</b>	<b>997</b>

## Appendix – Regional and County Data *cont.*

### Southeast Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Bledsoe	79	470	10.0	207	1,018
Bradley	97	546	11.0	300	1,405
Franklin	153	388	12.4	374	731
Grundy	98	295	9.3	253	477
Marion	81	468	10.3	357	967
McMinn	105	566	11.7	564	865
Meigs	133	750	10.3	403	1,258
Polk	347	711	12.2	812	1,154
Rhea	99	630	10.1	223	978
Sequatchie	65	519	10.7	222	1,042
<b>Region Total</b>	<b>118</b>	<b>528</b>	<b>10.7</b>	<b>362</b>	<b>1,079</b>

### Southwest Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Chester	90	333	8.0	323	817
Decatur	62	510	6.8	131	594
Fayette	143	666	10.6	507	1,429
Hardeman	251	809	11.2	481	1,327
Hardin	78	349	10.1	214	661
Haywood	255	880	8.9	516	1,372
Henderson	77	418	8.1	154	688
Lauderdale	230	733	9.2	540	1,472
McNairy	118	529	8.8	386	1,345
Tipton	128	587	8.1	247	887
<b>Region Total</b>	<b>145</b>	<b>591</b>	<b>9.1</b>	<b>357</b>	<b>1,123</b>

## Appendix – Regional and County Data *cont.*

### Upper Cumberland Region

County	Hospital Discharge Data System		TennCare Billing System		
	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)	Asthma Prevalence (%)	Inpatient Hospitalizations (visits per 100,000)	Emergency Department Visits (visits per 100,000)
Cannon	129	672	12.5	293	1,226
Clay	128	235	10.0	824	678
Cumberland	160	500	9.7	316	848
Dekalb	157	625	11.7	422	1,323
Fentress	414	550	10.6	594	653
Jackson	113	427	12.6	197	1,055
Macon	166	388	10.6	255	712
Overton	154	372	10.4	254	867
Pickett	89	47	11.1	205	253
Putnam	139	589	12.8	319	1,160
Smith	103	513	9.9	232	836
Van Buren	90	367	12.1	363	954
Warren	143	529	11.3	282	1,026
White	190	720	15.9	380	1,072
<b>Region Total</b>	<b>159</b>	<b>520</b>	<b>11.5</b>	<b>346</b>	<b>941</b>

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# Technical Notes

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## DATA SOURCES

**Behavioral Risk Factor Surveillance System (BRFSS):** The BRFSS is an annual, CDC-funded, state-administered, random-digit-dialed telephone survey of the U.S. non-institutionalized population, 18 years of age and older, which gathers self-reported data on certain health conditions and behavioral risk factors. For BRFSS data, the terms “white” and “black” refer to persons of non-Hispanic origin only, and the terms “Hispanic” and “non-Hispanic” refer to ethnicity regardless of race. The question used by BRFSS to determine lifetime asthma prevalence is as follows: “Have you ever been told by a doctor, nurse or other health care professional that you had asthma?” BRFSS data for the U.S. and for states other than Tennessee were derived from the BRFSS website as referenced in the text. As such, no statistical tests were performed due to lack of necessary data. For Tennessee data, time trends were analyzed using linear regression and two way comparisons of prevalence rates (e.g. male vs. female) were tested for significance using a chi-square test. *P*-values of less than 0.05 were considered significant. Unless otherwise indicated, trends and differences noted in the text were statistically significant. Ninety-five percent confidence intervals are provided in the graphs.

**National Health Interview Survey (NHIS):** The NHIS is a multi-purpose health survey conducted annually by the National Center for Health Statistics (NCHS). Data are collected through personal household interviews conducted by interviewers employed and trained by the U.S. Bureau of the Census according to procedures specified by NCHS. One adult and one child (if any children under 18 years are present) are randomly selected from each household and information on each is collected using a questionnaire. The question used by NHIS to determine lifetime asthma prevalence is as follows: “Have you ever been told by a doctor or other health care professional that you had asthma?” NHIS data were derived from NHIS websites and published reports as referenced in the text. As such, no statistical tests were performed due to lack of necessary data.

**National Survey of Children’s Health (NSCH):** The NSCH is a module of the State and Local Area Integrated Telephone Survey, conducted by the National Center for Health Statistics. The survey was administered to a random-digit-dialed sample of households with children less than 18 years of age – one child was randomly selected from all children in each identified household to be the subject of the survey. The respondent was the parent or guardian who knew the most about the child’s health and health care. The question used by NSCH to determine lifetime asthma prevalence is as follows: “Has a doctor or health professional ever told you that [child’s name] has asthma?” NSCH data were derived from NSCH websites and published reports as referenced in the text. As such, no statistical tests were performed due to lack of necessary data.

**Hospital Discharge Data System (HDDS):** The HDDS is an annual state-based compilation of data on patients discharged from all acute care hospitals licensed by the Tennessee Department of Health. The HDDS does not include federal facilities (i.e., VA hospitals, etc.) or facilities licensed by the Tennessee Department of Mental Health and Developmental Disabilities. The analyses were limited to the records of Tennessee residents. For HDDS data, the terms “white” and “black” refer to persons of any ethnicity and the terms “Hispanic” and “non-Hispanic” refer to ethnicity regardless of race. Hospitalization rates by Hispanic status excluded three hospitals due to questionable ethnicity designations. Hospital charges were adjusted to 2006 dollars to account for inflation. Trends were analyzed using linear regression and were statistically significant (*p*-value < 0.05) unless otherwise indicated in the text. Ninety-five percent confidence intervals for hospitalization rates by gender, race, gender/race combined, ethnicity, and age group are provided in the graphs. Comparisons between groups (e.g. male vs. female) were considered significant if confidence intervals did not overlap. No statistical testing was performed on billed hospital charges.

**National Hospital Discharge Survey (NHDS):** The NHDS is a national probability survey that collects information on inpatients discharged from non-Federal short-stay hospitals in the United States. A detailed description of the NHDS can be found at <http://www.cdc.gov/nchs/about/major/hdasd/nhdsdes.htm>. National-level data from the NHDS was derived from previously published reports as referenced in the text.

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## Technical Notes *cont.*

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### DATA SOURCES *cont.*

**National Hospital Ambulatory Medical Care Survey (NHAMCS):** The NHAMCS is a national probability survey that collects information on the utilization and provision of ambulatory care services in hospital emergency and outpatient departments. A detailed description of the NHAMCS can be found at <http://www.cdc.gov/nchs/about/major/ahcd/nhamcsds.htm>. National-level data from the NHDS was derived from previously published reports as referenced in the text.

**Death Statistical System (DSS):** The DSS is an annual state-based compilation of mortality data. The analyses were limited to the records of Tennessee residents. For DSS data, the terms “white” and “black” refer to persons of any ethnicity. Trends were analyzed using linear regression and were statistically significant ( $p$ -value < 0.05) unless otherwise indicated in the text. Ninety-five percent confidence intervals for mortality rates by gender, race, and age group are provided in the graphs. Comparisons between groups (e.g. male vs. female) were considered significant if confidence intervals did not overlap.

**National Vital Statistics System (NVSS):** The NVSS is the mechanism by which the National Center for Health Statistics (NCHS) collects and disseminates information on vital events (births, deaths, marriages, and divorces). Mortality data are based on information from all death certificates filed in the 50 states and the District of Columbia. A detailed description of the NVSS can be found at <http://www.cdc.gov/nchs/nvss.htm>. National-level data from the NVSS was derived from previously published reports as referenced in the text.

**TennCare Billing Data (TennCare):** TennCare data include both enrollment and claims data. Enrollment data contain information such as coverage period and demographic characteristics of all beneficiaries. Claims data contain claims for services provided by professionals (physician services, ambulance services, and durable medical equipment) and institutions (inpatient and outpatient hospital services). The number of enrollees, which was used as the denominator for rate calculations, was determined as the number of unique recipients who were enrolled in TennCare at any time during specific data year(s). The age of each enrollee was calculated as of December 31<sup>st</sup> of that data year. For TennCare data, the terms “white” and “black” refer to persons of non-Hispanic origin and the term “Hispanic” refers to ethnicity regardless of race. Ninety-five percent confidence intervals for hospitalization rates by gender, race/ethnicity and age group are provided in the graphs. Comparisons between groups (e.g. male vs. female) were considered significant if confidence intervals did not overlap.

### DISEASE CLASSIFICATION

The diagnosis codes used for disease classification in the HDDS and TennCare data were ICD9-CM. Asthma was defined using all ICD9-CM codes beginning with 493. The diagnosis codes used to define asthma in the DSS prior to 1999 were all ICD9 codes beginning with 493. Beginning in 1999, asthma was defined using all ICD10 codes beginning with J45 and J46. Deaths before and after 1999 cannot be compared without adjusting for this change in coding. Therefore, the mortality rates in this report for years prior to 1999 have been comparability adjusted (comparability ratio = 0.8938) for the change to ICD coding. The diagnosis codes for heart disease in the DSS were all ICD9 codes beginning with 390-398, 402, 404-429 and all ICD10 codes beginning with I00-I09, I11, I13, I20-I51.

### AGE-ADJUSTMENT

All rates and hospital charges were age-adjusted to the 2000 standard United States population with a 10-year age interval (i.e. 11 age groups) using the direct method of standardization.

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