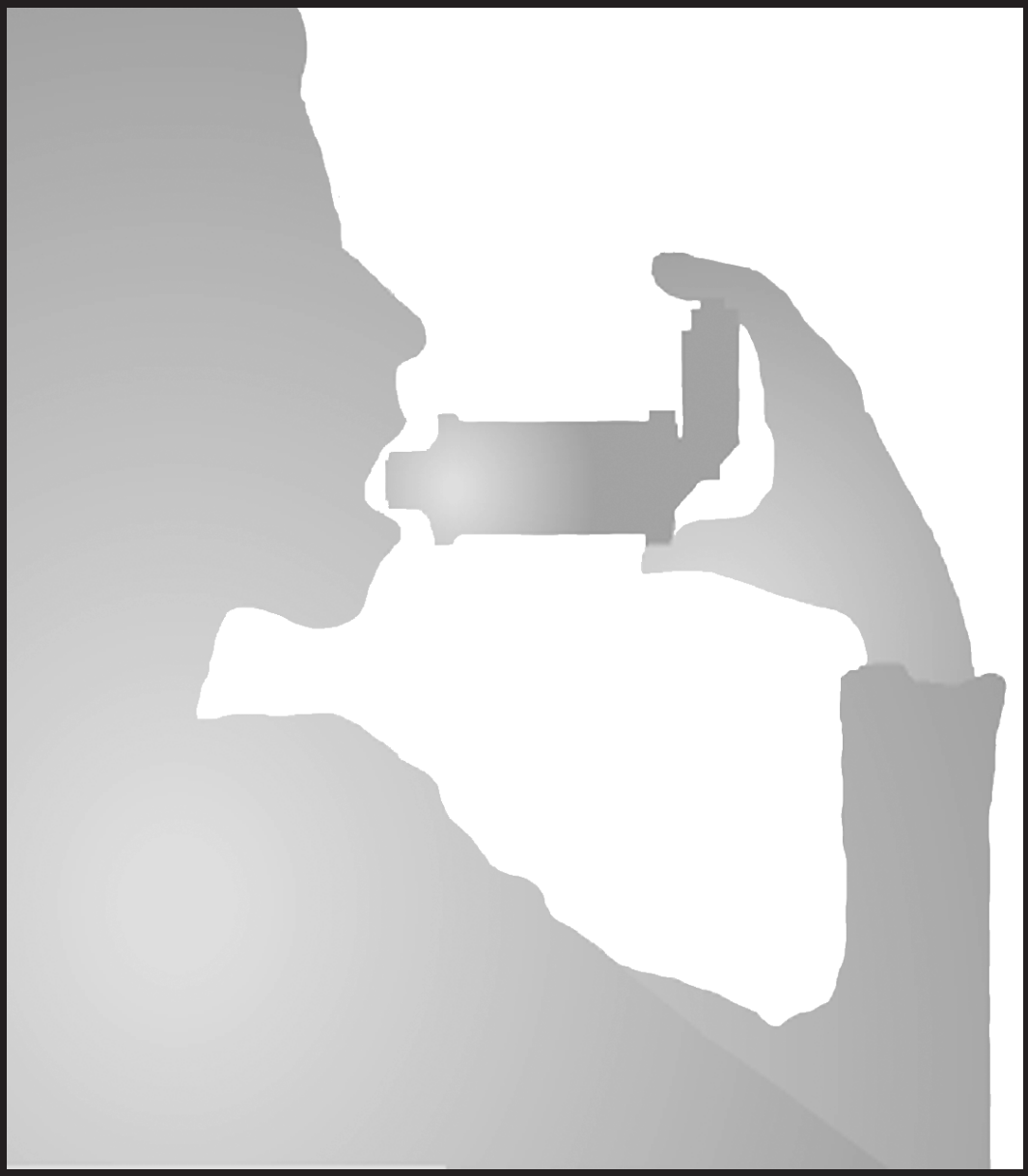

Epidemiology of Asthma in Michigan

2004 Surveillance Report

AIM Asthma Initiative of Michigan
FOR HEALTHY LUNGS

Michigan Department of Community Health
MDCH
Jennifer M. Granholm, Governor
Janet Olszewski, Director

Epidemiology of Asthma in Michigan: 2004 Surveillance Report

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Epidemiology of Asthma in Michigan: 2004 Surveillance Report

Executive Summary

Asthma is a chronic inflammatory disorder of the airways characterized by wheezing, shortness of breath, chest tightness or discomfort, and/or cough. According to national guidelines, asthma can be controlled through careful disease management, including the use of:

- ✧ Objective measures of lung function to diagnose the disease, assess its severity and monitor the course of therapy,
- ✧ Environmental control measures to avoid or eliminate factors that precipitate asthma symptoms or exacerbations (e.g., tobacco smoke, furred or feathered pets, dust mites and cockroaches),
- ✧ Pharmacologic therapy for long-term management of asthma to reverse and prevent airway inflammation, as well as rescue medications to manage acute asthma exacerbations, and
- ✧ Patient education that fosters a partnership among the patient, his or her family, and clinicians.[1]

If appropriate disease management is available and utilized, people with asthma can expect to:

- ✧ Prevent asthma symptoms during the day and night,
- ✧ Not miss school or work because of their asthma,
- ✧ Have no or minimal need for emergency department visits or hospitalizations,
- ✧ Maintain normal activity levels,
- ✧ Have normal or near-normal lung function, and
- ✧ Have no or minimal side effects from their medication[1].

According to the national guidelines, the expected standards of care for people with persistent asthma[1] include (but are not limited to):

- ✧ Visits to a physician for asthma management every 1-6 months,

[1] Persistent asthma is defined according to HEDIS® specifications: in the year prior to the prevalence measurement year having (1) ≥ 4 asthma medication dispensing events OR (2) ≥ 1 emergency department visits for asthma OR (3) ≥ 1 hospitalization for asthma OR (4) ≥ 4 outpatient visits for asthma and ≥ 2 asthma medication dispensing events.

- ✧ Primary care follow up after emergency department visit or hospitalization for asthma,

- ✧ Referral to a specialist when appropriate,

- ✧ Prescription of an inhaled corticosteroid, with long acting beta agonist added if needed, and

- ✧ Disease management adequate to enable the patient to use fewer than six canisters of rescue medications each year.[1]

Asthma in Michigan: Key Findings and Recommendations

Prevalence of Asthma

Most recent data indicate that:

- ✧ 213,600 children and 654,100 adults currently have asthma in Michigan.
    - o Prevalence of asthma in Michigan adults is slightly higher than that for the nation as a whole.
    - o Prevalence is higher among adult females than adult males.
    - o Prevalence decreases with increasing income among adults.

- ✧ Seventeen percent of public middle and high school students in Michigan say that they have asthma now.
    - o Prevalence is higher among black students than white students.

Recommendation:

Michigan needs to improve its ability to collect information on the number of people with asthma in all Michigan populations. Information on the number of people with asthma is not available for all age groups (particularly young children) or subpopulations (for example, Arab/Chaldean or Hispanic populations). Data are also not available at the level of geographic detail that would aid in planning and conducting asthma interventions (e.g., county, city or school district levels).

Asthma Management and Quality of Life in Adults

Based on available data, asthma has a significant impact on Michigan adults with asthma:

- ✧ Over one-half of Michigan adults with asthma had an asthma attack in the last year.

- ✧ Compared to the general adult population, adults with asthma are more likely to report that their general health is fair or poor (24.6% vs. 14.9 %).

- ✧ 20 percent are experiencing asthma symptoms every day.

- ✧ Adults with asthma missed an average of 10.1 days of work or school because of their asthma each year.

Many Michigan adults with asthma are still not attaining goals for routine management of asthma:

- ✧ Less than half (42%) reported that they used an asthma medication daily.

- ✧ Only 22% of adults with asthma had 2 or more routine check ups in the last year. In other words, nearly 80% of adults with asthma do not meet national recommendations for physician visits for asthma.

- ✧ 19% had an asthma visit to the emergency department or urgent care clinic. These types of visits should be preventable with good asthma management.

***Recommendations*:**

The MDCH Asthma Program should work with organizations that have administrative data sources (Medicaid, Medicare, and data from commercial insurers) and performance measurement initiatives (e.g., Michigan Quality Improvement Consortium) to develop an administrative data system that would provide a better understanding of asthma management in children and adults.

Patient and provider awareness of the goals of therapy and basic aspects of asthma management must be increased.

The use of smoking cessation classes for people with asthma, as well as their family members, should be encouraged. Family members of people with asthma should be encouraged not to smoke around them (in the house, in the car, etc).

Appropriate Asthma Medication Use in Michigan's Medicaid Managed Care Enrollees[5]

Based on national guidelines, everyone who has persistent asthma should be on a daily long-term control medication for their asthma. Data are available on the percent of Michigan Medicaid enrollees who have filled at least one prescription for a long-term asthma medication in the last year.

- ✧ 65% of Michigan Medicaid enrollees with asthma (ages 5-56) had filled at least one prescription for appropriate long-term control asthma therapy in 2002.

- This is an improvement over the rate for 2001.
- Michigan's performance on this measure is higher than the nation's. [5]

***Recommendation*:**

Medicaid and its managed care plans should continue their efforts to increase the use of inhaled corticosteroids and other long term control medications among people with persistent asthma.

The Michigan Asthma Advisory Committee should act to raise awareness of the importance of inhaled corticosteroids and other long-term control medications among people with asthma and health care providers.

The MDCH Asthma Program should work with commercial insurers to see what the rate of appropriate medication use is in the privately insured population.

Asthma Management in Schools

Schools, from day-care to post-secondary, play a significant role in the daily and acute management of asthma in children. An asthma attack in school is dangerous for a child and disruptive to the entire system. According to the Centers for Disease Control and Prevention[6], schools should consider six strategies for addressing asthma:

1. Establish management and support systems for asthma-friendly schools.
2. Provide appropriate school health and mental health services for students with asthma.
3. Provide asthma education and awareness programs for students and school staff.
4. Provide a safe and healthy school environment to reduce asthma triggers.
5. Provide safe, enjoyable physical education and activity opportunities for students with asthma.
6. Coordinate school, family, and community efforts to better manage asthma symptoms and reduce school absences among students with asthma.

In 2000, the Michigan School Code[7] was amended to allow Michigan public and nonpublic school children to carry and self-administer prescribed asthma medications on school grounds and during school-sponsored activities under certain conditions.

Based on the School Health Education Profile results, Michigan has some positive aspects to asthma management in schools. Principals of schools serving students in grades 6 through 12 reported that:

- ✧ 95% of schools assure immediate access to medications prescribed by a physician and approved by parents, as in accordance with the state law described above.

- ✧ 95% encourage full participation in physical education and activity when students with asthma are doing well.

- ✧ 80% provide modified physical education and activities as indicated by the student's asthma action plan.

However, there is clearly room for improvement in the asthma management in school:

- ✧ 10% indicated that there is a full time registered nurse at the school.

- ✧ 21% provide intensive case management for students with asthma who are missing 10 or more school days per year.

- ✧ 50% educate school staff about asthma.

- ✧ 28% educate students with asthma about asthma management.

- ✧ 23% teach asthma awareness to all students in at least one grade.

Furthermore, a survey of public school staff conducted by the Michigan Department of Community Health indicated that 73% of school staff (including principals, teachers, paraprofessionals, custodial staff, and school nurses) did not view asthma as a threat in their school.[8]

***Recommendations**:*

MDCH and MDE should continue to:

- ✧ Raise awareness of asthma as a serious disease in schools among school staff.

- ✧ Support local asthma coalition initiatives to raise awareness of the state law allowing children to carry and use their inhaler in school.[7]

- ✧ Encourage the use of case management activities and education for children with diagnosed asthma that is affecting their school performance.

Work-Related Asthma

Michigan is fortunate to be one of only four states funded by the National Institute of Occupational Health and Safety to conduct surveillance of work-related asthma. Data from the Behavioral Risk Factor Survey and the Sentinel Events and Notification of Risk System (SENSOR) indicate that:

- ✧ 10% of Michigan adults with current asthma report that their asthma is work-related.

- ✧ The incidence of new cases of work-related asthma is highest in the manufacturing industries.[9]

- ✧ The most common exposures associated with work-related asthma are isocyanates and metal working fluids.[9]

- ✧ Incidence of work-related asthma is higher among blacks than whites.[9]

***Recommendations*:**

MDCH should ensure that healthcare providers are aware on how to diagnose and manage work-related asthma.

MDCH should continue to seek funding for operating the SENSOR system to identify cases of work-related asthma.

The MDCH asthma program should continue to fund work-related outreach and education activities to employers and employees.

Outpatient Visits Due to Asthma

Data on the number of visits to physician offices, urgent care clinics, or emergency departments for asthma are not available on a statewide population basis in Michigan.

***Recommendations*:**

The Michigan Department of Community Health needs to develop a system for monitoring routine and urgent outpatient visits for asthma, in particular, emergency department visits for asthma.

The Asthma Epidemiology and Surveillance Work Group of the Michigan Asthma Advisory committee has suggested that MDCH add asthma to its list of reportable diseases to aid in developing this system.

Hospitalizations Due to Asthma

Asthma hospitalizations are considered preventable with appropriate asthma management. Despite this, asthma causes an average of 15,545 hospitalizations each year.

- ✧ Asthma hospitalization rates are highest in young children (0-4 years).

- ✧ Hospitalization rates for black residents for the period 1999-2001 were four times the rate for white residents.

- ✧ Hospitalization rates for white persons dropped between 1990 and 2001. There was no change in the rate for black persons during this time, thereby increasing the racial disparity in asthma hospitalization rates between 1990 and 2001.

- ✧ Rates are higher in low-income areas of the state. As income increases, asthma hospitalization rates decrease, regardless of age.

- ✧ Genesee, Saginaw, and Wayne counties have the highest asthma hospitalization rates.

***Recommendations*:**

Health care provider education and quality of care activities should be targeted to areas with the highest hospitalization rates.

More information is needed on why rates are higher in some areas and demographic groups than others. This information could be used to develop programs that effectively address racial and geographic disparities in asthma hospitalization rates.

Asthma Mortality

Fortunately asthma mortality is a relatively infrequent event. However, the majority of asthma deaths, particularly in children and young adults, should be preventable with good asthma management. In Michigan:

- ✧ Asthma causes 160 deaths each year, including approximately 30 deaths in individuals under 34 years of age.

- ✧ Asthma mortality rates are higher among females than males.

- ✧ Rates are highest in older age groups.

- ✧ Rates are significantly higher among black residents than white residents.

- ✧ Rates for black residents actually increased between 1990 and 2001.

The Michigan Department of Community Health is conducting a review of asthma deaths occurring in people 2-34 years of age. The purpose of this review is to identify risk factors that could be modified to prevent future asthma deaths in young people. Based on the review of 2002 asthma deaths, those risk factors are:

- ✧ Inadequate prescription of steroids by health care providers.

- ✧ Patient compliance with asthma management (i.e. failure to use steroids, follow up with medical care, eliminate triggers).

- ✧ Lack of health insurance and regular medical care with a primary care physician.

- ✧ Need for specialist referral and pulmonary function testing for high-risk asthma patients.

***Recommendation*:**

Michigan Department of Community Health should continue to review asthma deaths in children and young adults to identify preventable risk factors for those deaths. Based on reviews of the 2002 asthma deaths, an expert panel developed a series of recommendations for preventing future deaths. Highlights are:

Provider education programs are needed to raise awareness of:

- ✧ The severity of asthma as a fatal disease.

- ✧ The dangers of overuse of short term rescue medications.

- ✧ The importance of using inhaled corticosteroids for long-term management.

- ✧ The need to refer high-risk patients to specialists.

- ✧ The need for pulmonary function testing as a routine part of asthma management.

Asthma education for patients needs to focus on the importance of the use of inhaled steroids, even when the patient is “feeling well”.

There are also system level recommendations from the expert panel:

- ✧ Case management is needed for high-risk asthma patients.

- ✧ Insurance coverage for people with asthma needs to be improved.

- ✧ A system to limit the number of rescue medication refills that can be obtained without active physician approval should be developed.

For more information on the Asthma Mortality Review, please see *2002 Annual Report on Asthma Deaths Among Individuals Aged 2-34 Years in Michigan* on the Asthma Initiative Website, (http://www.getasthmahelp.org/02AsthmaMortalityAnnRpt.pdf).

Cost

Cost estimates based on national figures suggest that Michigan spends over $270 million in direct medical costs for asthma alone.[4]

***Recommendation*:**

MDCH needs to develop Michigan-specific estimates of asthma costs, including local level estimates.

Healthy People 2010

The U.S. Department of Health and Human Services has developed *Healthy People 2010*, a set of disease prevention and health promotion objectives for the nation to achieve over the first decade of the new century. Although neither the United States nor Michigan have met all the *Healthy People 2010* targets for asthma, Michigan has had some success in reaching particular asthma objectives for some populations:

- ✧ Michigan is demonstrating progress toward meeting the target asthma hospitalization rates overall and among whites.

- ✧ Conversely, asthma hospitalization rates for blacks age 5 to 64 are moving away from the *Healthy People 2010* target.

- ✧ Recent data from Michigan counties reveal that 9 counties have met the target asthma hospitalization rate for persons age 5 to 64 years.

- ✧ The most recent mortality rates indicate that Michigan has met the target rate for adults age 65 years and older.

***Recommendation*:**

Michigan's surveillance of asthma is incomplete, due to the lack of data systems available for analysis. It is important to acquire new sources of data, particularly emergency department information, to measure Michigan's progress toward meeting all the *Healthy People 2010* targets.

The Michigan Asthma Advisory Committee unanimously voted that the State should adopt the *Healthy People 2010* objectives for asthma and that they should establish systems to gather data for the *Health People 2010* objectives they currently cannot measure.

Despite some encouraging results, there remains a dramatic racial disparity in asthma hospitalization rates of Michigan. Efforts to reduce the burden of asthma in Michigan must address this issue.

Conclusion

Asthma presents a significant burden and challenge in Michigan. Adverse asthma outcomes that could be prevented still occur among Michigan residents. Racial and geographic disparities exist in asthma utilization and severe outcomes. In some cases, this disparity is increasing over time.

A complete copy of this report and additional data on asthma hospitalizations and asthma can be found on the Internet at http://www.michigan.gov/mdch.

Any additional questions or concerns about this report should be directed to:
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Table of Contents

Asthma is a chronic inflammatory disorder of the airways characterized by airway hyper-responsiveness to stimuli, variable airflow limitation, and respiratory symptoms, including wheezing, shortness of breath, tightness or discomfort in the chest and/or dry cough.

Causes and Risk Factors

Whether or not a person develops asthma depends on a complex interaction of genetics and environmental factors that are not fully understood. However, allergies, a family history of allergy, and perinatal exposure to tobacco smoke have been implicated as risk factors for developing asthma.

Factors that can exacerbate existing asthma (i.e., can cause or trigger an asthma attack) are much better understood. Exacerbations can result from exposure to viral upper respiratory infections, pollen, molds, pet dander, cockroaches, dust mites, tobacco smoke, wood smoke, household chemicals, workplace exposures and some types of air pollution. Exercise, aggravating conditions that are not properly treated (e.g. rhinitis, gastroesophageal reflux), and stress can also trigger or exacerbate existing asthma. The particular triggers that will exacerbate asthma vary by the individual.

Asthma Management

Asthma cannot be cured, but it can be controlled through careful disease management. The National Heart, Lung, and Blood Institute recommends four components of appropriate management, including:

- ✧ "Use of objective measures of lung function to assess the severity of asthma and to monitor the course of therapy,
- ✧ Environmental control measures to avoid or eliminate exposure to factors that precipitate asthma symptoms or exacerbations,
- ✧ Comprehensive pharmacologic therapy for long-term management to reverse and prevent the airway inflammation characteristic of asthma,
- ✧ Patient education that fosters a partnership among the patient, his or her family, and clinicians."[1]

With appropriate disease management, people with asthma can:

- ✧ Prevent chronic asthma symptoms and exacerbations during the day and night,
- ✧ Maintain normal activity levels,
- ✧ Have normal or near-normal lung function, and
- ✧ Have no or minimal side effects.[1]

People whose asthma is adequately managed should not experience sleep disruption or miss days of school or work because of their asthma. In addition, they should have no (or minimal) need for emergency department visits or hospitalizations.[1]

According to the national guidelines[1], the expected standards of care for persistent asthma include (but are not limited to):

- ✧ Visits to physician for asthma management every 1-6 months,
- ✧ Primary care follow up after an emergency department visit or hospitalization for asthma,
- ✧ Spirometry at the time of diagnosis, after treatment is initiated to assess effectiveness, and at least every 1-2 years thereafter,
- ✧ Referral to an asthma specialist when appropriate,
- ✧ Prescription of an inhaled corticosteroid, with long acting beta agonist or other adjunct therapy added if needed,
- ✧ Management adequate to enable the patient to use fewer than six canisters of rescue medications each year.[1]

Asthma Surveillance

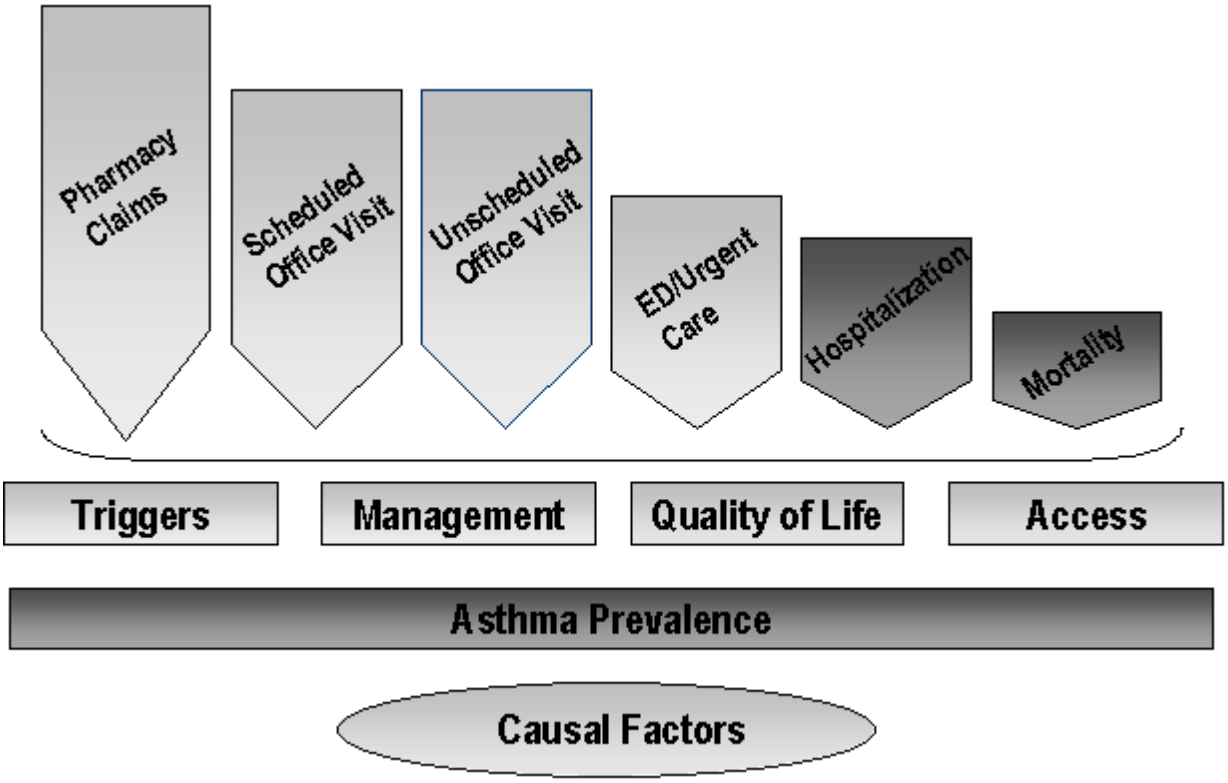
Surveillance is the ongoing systematic collection, analysis, interpretation, and timely dissemination of health data. The purpose of a surveillance system is to monitor trends in the disease and its management in order to prevent or better control the disease within the population.[2] The purposes of asthma surveillance are to:

- ✧ Understand the impact of asthma, including the number of people affected, its severity in the population, and its cost,
- ✧ Monitor trends in treatment and management in the population,
- ✧ Monitor exposure to asthma triggers, and
- ✧ Assist in evaluating the effect of interventions designed to reduce the burden of asthma.

Surveillance of asthma is complicated by the lack of an accepted diagnostic “gold standard”, limited available data on the occurrence and management of asthma, a great deal of variation in disease severity within and between individuals, and varying levels of control over symptoms. Epidemiologic study is further complicated by the need to understand both the factors that cause the onset of the disease and the factors that trigger asthma attacks or exacerbations in persons with existing asthma.

Figure 1 depicts the ideal surveillance system for asthma that would describe all aspects of asthma occurrence and management.

Figure 1: Asthma Surveillance Model



Starting at the bottom of the model, causal factors are factors that cause a person who does not have asthma to develop the disease. These factors are not very well understood at this point and MDCH does not conduct surveillance of any causal factors, other than occupational exposures, at this point.

The next box, asthma prevalence, describes the aggregate number of people who currently have or have ever had asthma.

The four smaller boxes represent factors that impact people's experience with asthma. These factors determine the level of health care utilization and the outcomes people with asthma experience.

- ✧ The term "triggers" refers to those factors or substances that can cause asthma symptoms or exacerbations in people who already have asthma, as described above.

- ✧ Asthma management is an all-encompassing category that refers to efforts by patients and health care providers to control the disease. The category is meant to capture aspects of management such as patient education, use of asthma action plans, appropriate medical follow up after adverse asthma events, and use of lung function testing. This type of information is needed to understand where a system of care or management is failing to control the disease. The importance of asthma

management surveillance is reflected by its inclusion in the *U.S. Healthy People 2010* asthma objectives, even though indicators and data sources are not yet available.

- ✧ Quality of life represents the impact that asthma has on individuals with asthma, their caretakers, and their families. Quality of life indicators include the frequency of asthma-related symptoms, activity limitations, lost work and school time (or other activities), perception of health, and beliefs about ability to manage the disease.

- ✧ Access to care refers to insurance coverage for all aspects of asthma clinical management, quality primary care for asthma, and appropriate referral to specialty care and services (skin prick testing, pulmonary function testing).

Across the top of the model are six figures meant to represent both health care interactions and asthma outcomes:

- ✧ Pharmacy data refers to the prescription and use of asthma medications, which can be measured using administrative data sources and surveys. If linked with asthma severity, these data would be useful in assessing whether persons with asthma are taking appropriate medications as indicated by national guidelines.

- ✧ The number of scheduled or unscheduled office visits can tell us the rate at which people with asthma use primary and specialty care services to routinely manage their asthma; and the rate at which they require assistance with exacerbations. The frequency of visits is impacted by access to care, costs of treatment, and changes in exposure to risk factors.

- ✧ The number of emergency department visits describes the number of people with severe or poorly controlled asthma who come to the emergency department (ED). Reasons for asthma ED visits range from visits to end asthma exacerbations that could not be controlled by the patient, to preventable visits made by people with inadequate access to medical care, to improper utilization of the health care system (e.g. going to the ED for regular prescription refills or visits by people who are not on adequate medication to begin with).

- ✧ As with emergency department visits, data on hospitalizations due to asthma are a valuable measure of health care utilization for persons with asthma. They are an indirect measure of the prevalence, severity, and control of asthma in the population. Hospitalization data may also be a measure of inadequate access to medical care or improper utilization of the health care system.

- ✧ Mortality due to asthma is the severest impact of asthma and an indicator of possible health care system failure. Although a relatively rare event, it is a very important event because many asthma deaths can be prevented.

Asthma surveillance at the national level provides information on many but not all of these surveillance indicators.

Asthma in the United States

- **Prevalence:** In 2001 Asthma affected over 20 million people, including about 8.7 percent of children under 18 and 6.9 percent of adults. About 60 percent of these people experienced an asthma attack during 2001.[3] The prevalence of asthma has increased dramatically since 1980, particularly among children.[4] Asthma is the most common chronic disease of childhood and the number one cause of chronic disease related absenteeism in schools.
- **Quality of Life:** Suboptimal asthma care causes about 7.5 million avoidable sick days each year.[5]
- **Pharmacy:** The majority of people with persistent asthma in Medicaid or commercial health plans in 2002 filled at least one prescription for a long-term asthma control medication (62.8% and 67.9% respectively). [5]
- **Physician Office Visits:** Asthma visits were 1.3 percent of all visits to physicians' offices in 2001.[6]
- **Hospital Outpatient Visits:** Asthma made up 1.5 percent of all hospital outpatient department visits in 2001[7], including 1.5 percent of all ED visits in 2001.[8]
- **Hospitalizations Due to Asthma:** The 2001 hospitalization rate due to asthma was 16.0 per 10,000. Rates are higher in children under age 15 (30.1 hospitalizations per 10,000 population) than in adults (8.4, 14.3, and 21.4 hospitalizations per 10,000, ages 15-44, 45-64, and 65 or older, respectively). [9] Rates were significantly higher among blacks than among whites.
- **Mortality:** Over 4200 people died from asthma in 2001, including 513 who were under the age of 35 at the time of their death.[10]
- **Cost:** Asthma accounts for an estimated $12.7 billion dollars in direct and indirect costs each year.[11]

Asthma in Michigan: The Current Report

This surveillance report describes the available descriptive epidemiology of asthma among Michigan residents by age, sex and race, as well as by county, season and year whenever possible. This report will provide information on:

- Asthma prevalence in Michigan children and adults,
- Asthma management and quality of life among adults with asthma,
- Asthma management in Michigan middle and high schools,
- Work-related asthma prevalence and occupational exposures,
- Numbers and rates of asthma hospitalizations,
- Numbers and rates of asthma deaths,
- Michigan's progress towards achieving the *US Healthy People 2010* asthma objectives, and
- The cost of asthma in Michigan.

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Section 1: Asthma Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population. The Michigan prevalence estimates of lifetime and current asthma provided in this section are based on self-report, population-based surveys.

Lifetime asthma prevalence is the proportion of survey respondents that reported, "yes" to the question: Have you ever been told by a doctor, nurse, or health professional that you had asthma?

Current asthma prevalence is the proportion of survey respondents who reported that in their lifetime a health care professional told them they have asthma and reported "yes" to the question: Do you still have asthma?

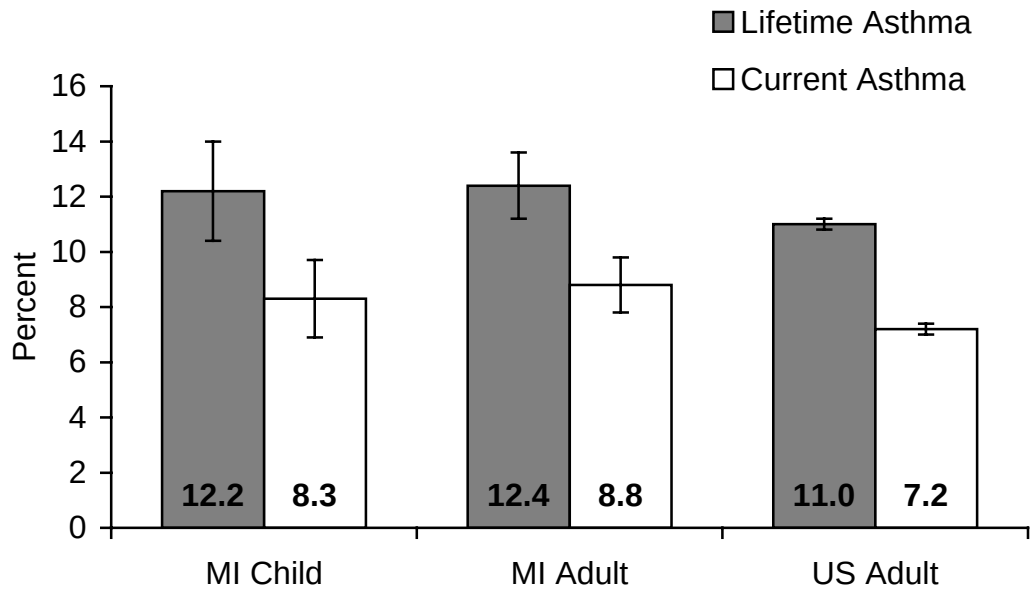
The Michigan Behavioral Risk Factor Survey (BRFS) is the source of most estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Data are collected quarterly by telephone interview; a sample of telephone numbers is selected using a list-assisted, random-digit dialed methodology.

From this survey, the prevalence of asthma can be determined for adults (≥ 18 years) and children (< 18 years). Data for children are based on information provided by an adult respondent about children living in their home. Due to small sample size, descriptive information regarding children is limited, precluding prevalence analysis by age, race, and sex strata.

The Youth Tobacco Survey (YTS) was created to support the design, implementation, and evaluation of state level tobacco control programs. A two-stage sampling scheme is used to select public middle and high schools, followed by classes within those schools. Children in grades 6 through 12 are eligible to participate. The questionnaire is self-administered and its core questions ask about a variety of tobacco issues, including use, secondhand smoke exposure, ability to purchase, and attitudes about tobacco. Michigan first administered the YTS in 2001 and repeats it every 2 years. In addition to the core tobacco-related questions, Michigan added questions regarding lifetime and current prevalence of asthma. (Current asthma prevalence is estimated using the question "Do you have asthma now?") From this survey, prevalence of asthma can be determined for children in middle school (grades 6 through 8) and high school (grades 9 through 12). These can be further stratified by sex and race.

Data from the BRFS and YTS are designed to estimate prevalence statewide. The current sample sizes for these surveys are inadequate to assess prevalence of asthma at smaller geographical levels. Once more years of BRFS data have been collected, multiple years of data can be combined to provide certain regional estimates of adult asthma prevalence in Michigan.

Figure 1.1: Prevalence of Lifetime and Current Asthma for Children (<18 Years) And Adults (≥18 Years), Michigan and United States, 2001

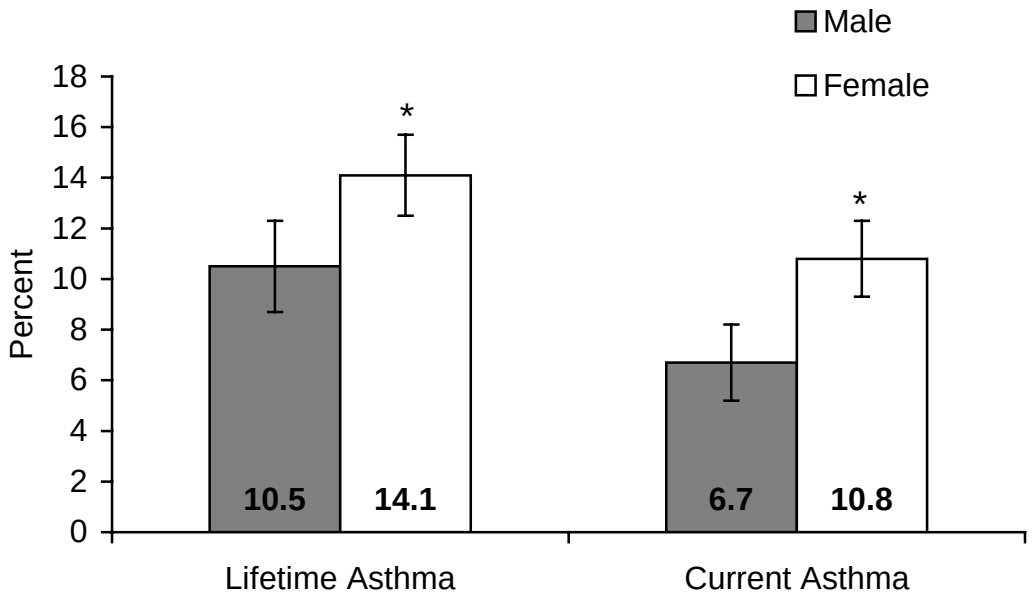


Lifetime Asthma (95% CI)	12.2% (10.4, 14.0)	12.4% (11.2, 13.6)	11.0% (10.8, 11.2)
Current Asthma (95% CI)	8.3% (6.9, 9.7)	8.8% (7.8, 9.8)	7.2% (7.0, 7.4)

Data Sources: Behavioral Risk Factor Survey, Michigan and United States, 2001

- ✧ 12.2% of children (<18 years) have been told in their lifetime that they had asthma. 8.3% of children (213,600) currently have asthma.
- ✧ 12.4% of adults (≥18 years) have been told in their lifetime that they had asthma. 8.8% of adults (654,100) currently have asthma.
- ✧ Among children, the prevalence of lifetime and current asthma is similar to those for adults in Michigan.
- ✧ The prevalence estimate of current asthma for Michigan adults (≥18 years) is higher than that for the United States.
- ✧ Among adults with current asthma in Michigan, 54.6% have experienced an asthma attack in the previous 12 months.

Figure 1.2: Prevalence of Lifetime and Current Asthma for Adults (≥18 Years) By Sex, Michigan, 2001



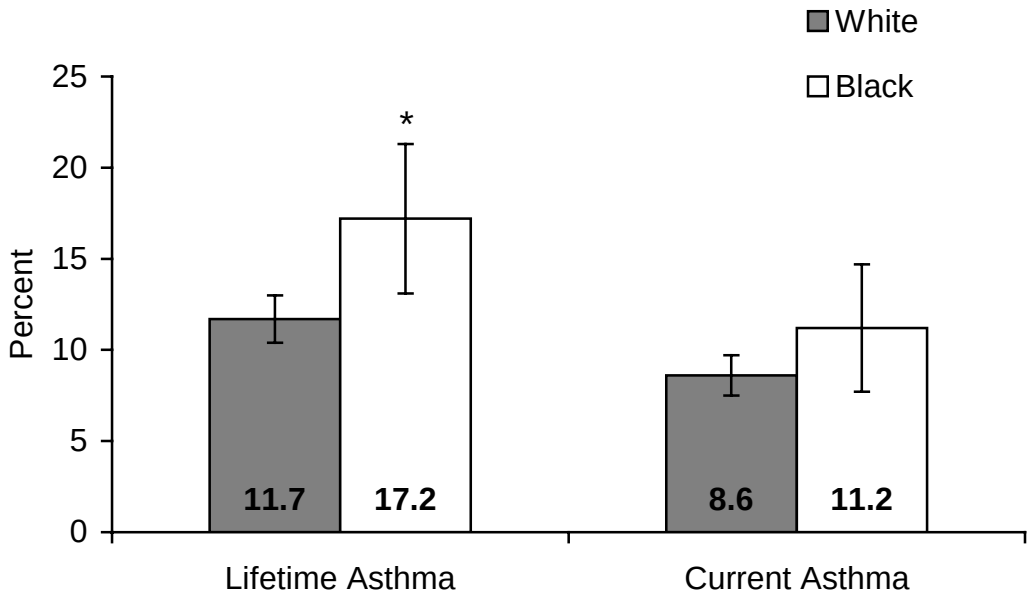
Male (95% CI)	10.5% (8.7, 12.3)	6.7% (5.2, 8.2)
Female (95% CI)	14.1% (12.5, 15.7)	10.8% (9.3, 12.3)

*Significant results from *t*-test comparing prevalence between males and females, p<0.05.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ 10.5% of adult males (≥18 years) have been told in their lifetime that they had asthma. 6.7% currently have asthma.
- ✧ 14.1% of adult females (≥18 years) have been told in their lifetime that they had asthma. 10.8% currently have asthma.
- ✧ The prevalence of lifetime and current asthma among adults (≥ 18 years) is significantly higher for females than males, (p<0.05).
- ✧ 3.7% (2.5, 4.9) of adult males in Michigan currently have asthma that began in childhood versus 2.9% (2.0, 3.8) that began in adulthood.
- ✧ 3.4% (2.5, 4.3) of adult females in Michigan currently have asthma that began in childhood versus 7.0% (5.8, 8.2) that began in adulthood.

Figure 1.3: Prevalence of Lifetime and Current Asthma for Adults (≥18 Years) By Race, Michigan, 2001



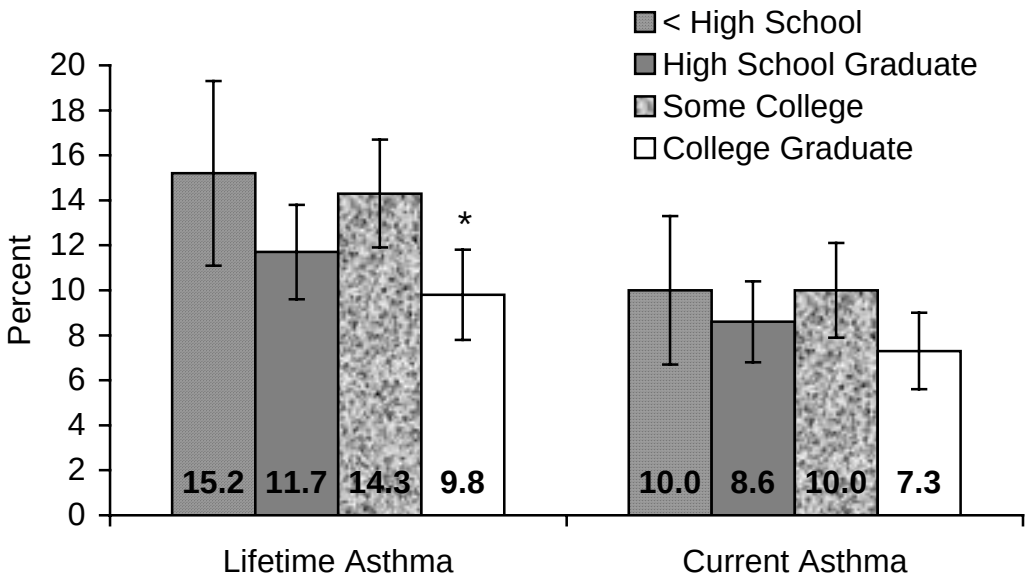
White (95% CI)	11.7% (10.4, 13.0)	8.6% (7.5, 9.7)
Black (95% CI)	17.2% (13.1, 21.3)	11.2% (7.7, 14.7)

*Significant results from *t*-test comparing prevalence between whites and blacks, p<0.05.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ 11.7% of white adults (≥18 years) have been told in their lifetime that they had asthma. 8.6% currently have asthma.
- ✧ 17.2% of black adults (≥18 years) have been told in their lifetime that they had asthma. 11.2% currently have asthma.
- ✧ The prevalence of lifetime asthma among adults (≥ 18 years) is significantly higher for blacks than whites, (p<0.05). Current asthma prevalence does not differ significantly by race.

Figure 1.4: Prevalence of Lifetime and Current Asthma for Adults (≥18 Years) By Education, Michigan, 2001



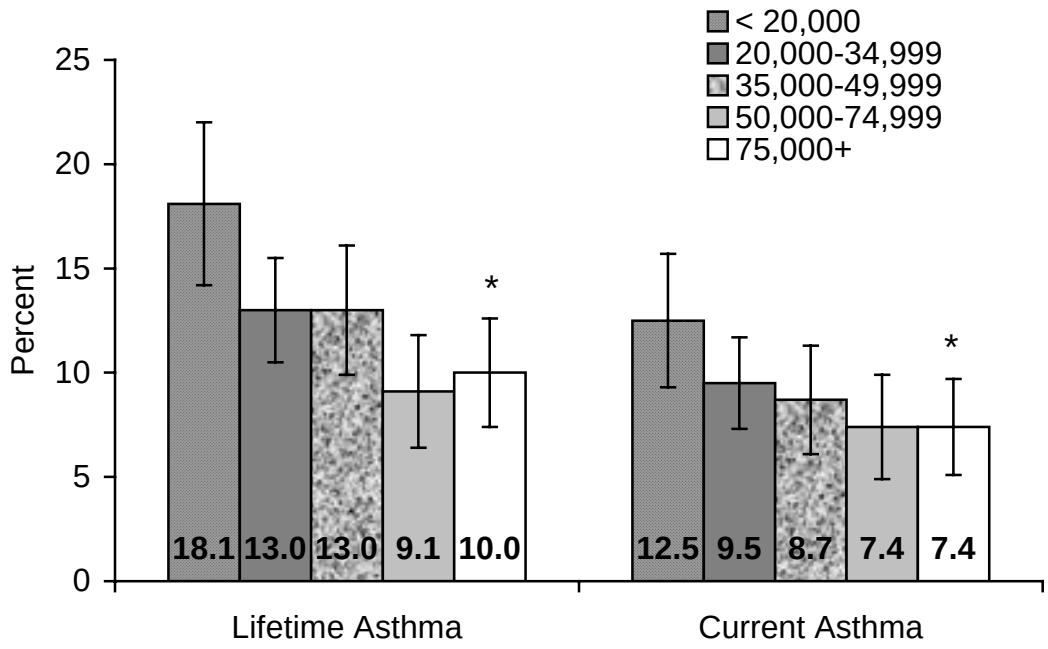
< High School (95% CI)	15.2% (11.1, 19.3)	10.0% (6.7, 13.3)
High School Grad (95% CI)	11.7% (9.6, 13.8)	8.6% (6.8, 10.4)
Some College (95% CI)	14.3% (11.9, 16.7)	10.0% (7.9, 12.1)
College Graduate (95% CI)	9.8% (7.8, 11.8)	7.3% (5.6, 9.0)

*Significant results from *t*-test comparing prevalence between those with less than high school and college graduates, p<0.05.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ 15.2% of adults (≥18 years) who have not graduated high school have been told in their lifetime that they had asthma. 10.0% currently have asthma.
- ✧ 9.8% of adults (≥18 years) who have graduated college have been told in their lifetime that they had asthma. 7.3% currently have asthma.
- ✧ The prevalence of lifetime and current asthma among adults (≥ 18 years) is generally similar for groups of different educational attainment. However, there is a significant difference in the prevalence of lifetime asthma for those with less than a high school education compared to those who are college graduates, (p<0.05).

Figure 1.5: Prevalence of Lifetime and Current Asthma for Adults (≥18 Years) By Household Income, Michigan, 2001



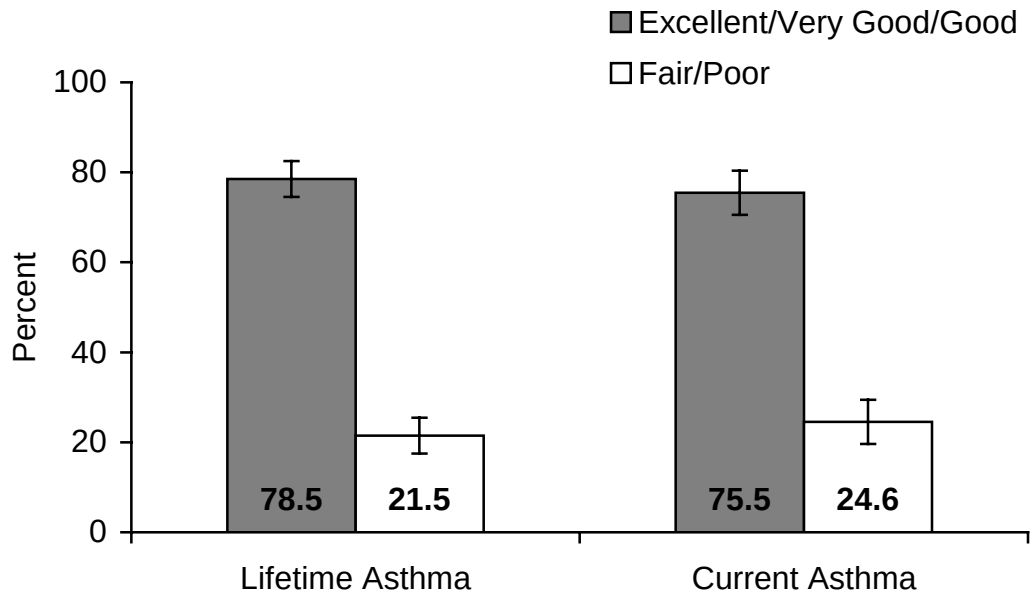
<$20,000 (95% CI)	18.1% (14.2, 22.0)	12.5% (9.3, 15.7)
$20,000-$34,999 (95% CI)	13.0% (10.5, 15.5)	9.5% (7.3, 11.7)
$35,000-$49,999 (95% CI)	13.0% (9.9, 16.1)	8.7% (6.1, 11.3)
$50,000-$74,999 (95% CI)	9.1% (6.4, 11.8)	7.4% (4.9, 9.9)
$75,000+ (95% CI)	10.0% (7.4, 12.6)	7.4% (5.1, 9.7)

*Significant results from *t*-test comparing prevalence between those with household earnings <$20,000 versus ≥$75,000, p<0.05.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Generally, the prevalence of lifetime and current asthma among adults (≥ 18 years) decreases with increasing household income.
- ✧ The prevalence of lifetime and current asthma among adults (≥ 18 years) is significantly higher for those whose household earns less than $20,000 than those whose household earns $75,000 or more, (p<0.05).

Figure 1.6: Perceived Health Status Among Adults (≥18 Years) with Lifetime and Current Asthma, Michigan, 2001

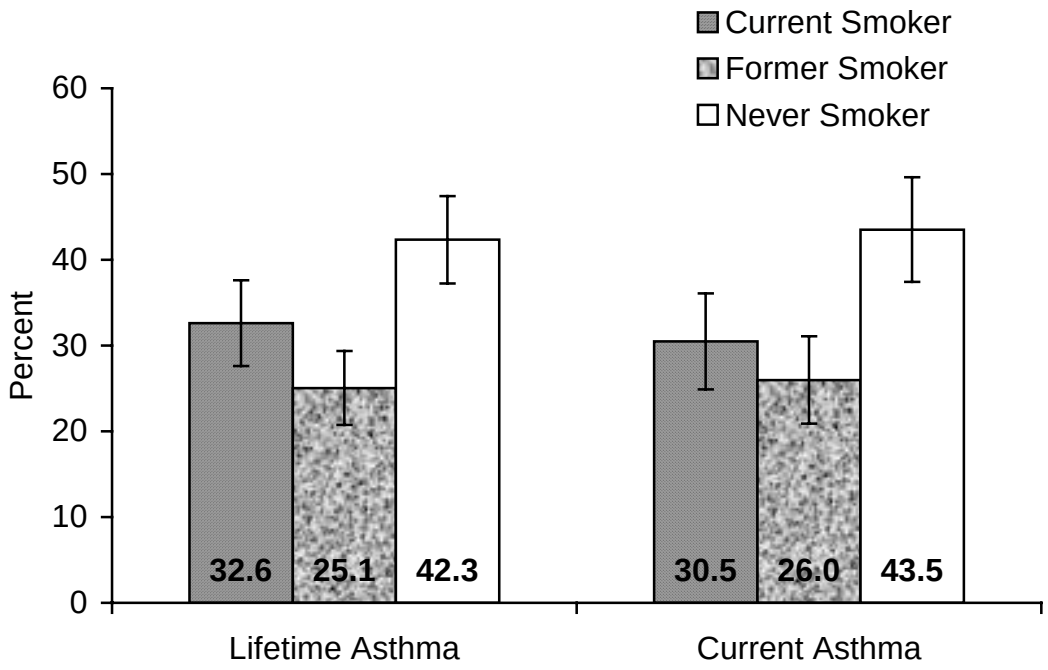


	Lifetime Asthma	Current Asthma
Excellent, Very Good, or Good (95% CI)	78.5% (74.5, 82.5)	75.5% (70.6, 80.4)
Fair/Poor (95% CI)	21.5% (17.5, 25.5)	24.6% (19.7, 29.5)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- For adults who have been told in their lifetime that they have asthma, 78.5% consider themselves in good general health or better. 21.5% consider their general health to be either fair or poor.
- For adults who currently have asthma, 75.5% consider themselves in good general health or better. 24.6% consider their general health to be either fair or poor.
- For the general population of adults in Michigan, 14.9% (95% CI: 13.7%, 16.1%) consider their health to be either fair or poor. More adults with current asthma consider themselves in fair or poor health than those in the general population.

Figure 1.7: Smoking Status Among Adults (≥18 Years) with Lifetime and Current Asthma, Michigan, 2001

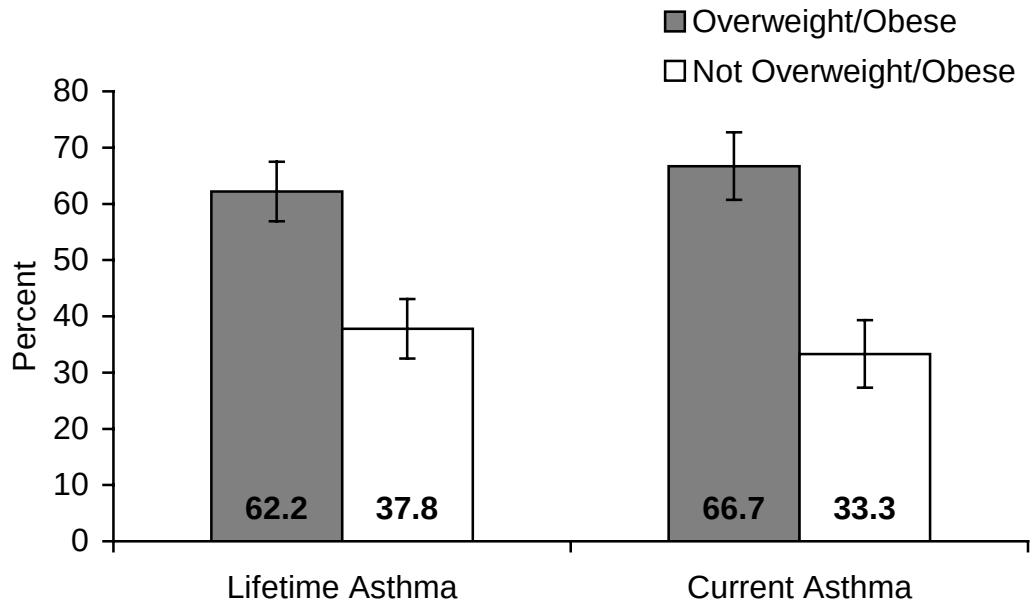


Current Smoker (95% CI)	32.6% (27.6, 37.6)	30.5% (24.9, 36.1)
Former Smoker (95% CI)	25.1% (20.8, 29.4)	26.0% (20.9, 31.1)
Never Smoker (95% CI)	42.3% (37.2, 47.4)	43.5% (37.4, 49.6)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- For adults who have been told in their lifetime that they have asthma, 32.6% are current smokers, 25.1% are former smokers, and 42.3% have never smoked.
- For adults who have current asthma, 30.5% are current smokers, 26.0% are former smokers, and 43.5% have never smoked.
- For the general population of adults in Michigan, 26.1% (95% CI: 24.5%, 27.7%) are current smokers.

Figure 1.8: Weight Status Among Adults (≥18 Years) with Lifetime and Current Asthma, Michigan, 2001

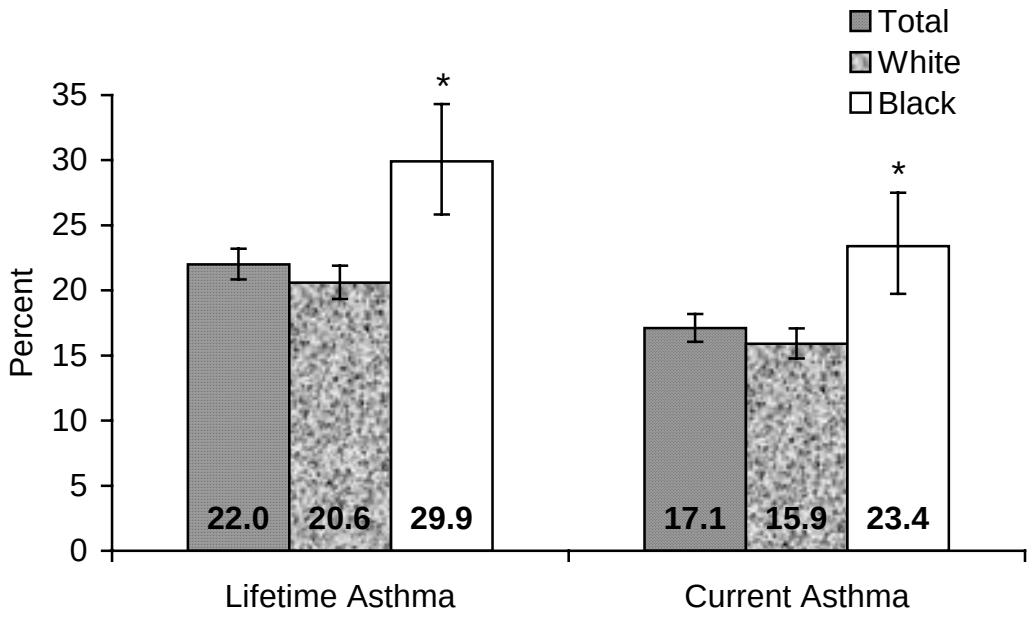


Overweight/Obese (95% CI)	62.2% (56.9, 67.5)	66.7% (60.7, 72.7)
Not Overweight/Obese (95% CI)	37.8% (32.5, 43.1)	33.3% (27.3, 39.3)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- For adults who have been told in their lifetime that they have asthma, 62.2% are either overweight or obese.
- For adults who currently have asthma, 66.7% are either overweight or obese.
- For the general population of adults in Michigan, 60.4% (95% CI: 58.6%, 62.2%) are obese or overweight.

Figure 1.9: Prevalence of Lifetime and Current Asthma among Middle and High School Students[1], By Race, Michigan, 2001



Total (95% CI)	22.0% (20.9, 23.2)	17.1% (16.1, 18.2)
White (95% CI)	20.6% (19.3, 21.9)	15.9% (14.8, 17.1)
Black (95% CI)	29.9% (25.8, 34.3)	23.4% (19.8, 27.5)

[1]Middle School: Grades 6 through 8, High School: Grades 9 through 12
*Significant results from binomial test comparing prevalence between whites and blacks, $p<0.05$.

Data Source: Youth Tobacco Survey, Michigan, 2001

- ✧ 20.6% of white middle and high school students in Michigan have been told in their lifetime that they had asthma. 15.9% currently have asthma.
- ✧ 29.9% of black middle and high school students in Michigan have been told in their lifetime that they had asthma. 23.4% currently have asthma.
- ✧ For middle and high school students, lifetime and current asthma prevalence is significantly higher for black students than for white students, ($p<0.05$).
- ✧ No significant difference in asthma prevalence was observed by individual grade or sex, (data not shown).

Section 2: Asthma Management and Quality of Life

Appropriate disease management improves the quality of life of persons with asthma. There are many ways to describe asthma management and quality of life, such as symptom frequency, activity limitations, perception of disease, in terms of the goals of asthma therapy, and whether standards of asthma care, as described in the introduction, are met.

Pharmacotherapy of asthma is determined by the severity of the individual case. The national guidelines define severity classes and recommend the appropriate medication regimen to maintain long-term control. There are two different types of medication – one for long-term control, which should be taken daily, and another for treating acute symptoms.

Michigan has limited information regarding asthma management and the quality of life of people with asthma. Portions of the Michigan Behavioral Risk Factor Survey asthma module are designed to measure these concepts. The asthma module is administered to adult (≥18 Years) respondents who report that they currently have asthma. It asks questions regarding urgent and routine health care utilization, activity limitations due to asthma, symptom frequency, and asthma medication use. The limited sample size of this survey precludes subgroup analysis. In the future, data for multiple years will be combined so that we can describe the quality of life and disease management for subpopulations with asthma.

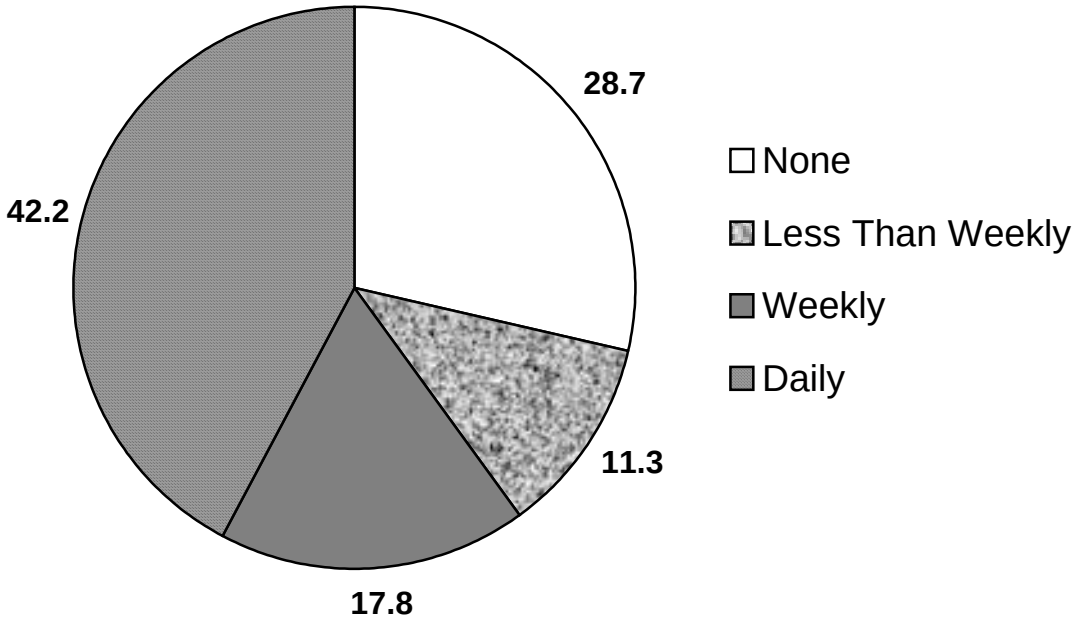
The BRFS asthma module does not directly ask about asthma severity and its medication questions do not distinguish between the medication types. From this survey, it is impossible to determine whether respondents are managing their asthma appropriately. For more information about asthma severity and appropriate pharmacologic therapy, please visit the website of the Asthma Initiative of Michigan. (http://www.getasthmahelp.org)

The School Health Education Profile (SHEP) survey provides information regarding asthma management for some children in Michigan. A systematic equal-probability sampling strategy is used to produce representative samples of schools serving students in grades 6 through 12. A questionnaire is administered to both the school principal and the lead health education teacher during the spring semester. This survey has been administered in Michigan every other year since 1996. In 2002, questions regarding school-based asthma management activities were added to the principal's questionnaire.

For those with persistent asthma, the recommended primary therapy for long-term control of their disease is inhaled corticosteroids. Excerpts from the "Michigan Medicaid HEDIS® 2002 Statewide Aggregate Report," presented in this section give the prevalence of appropriate medication use (i.e. long-term controllers) for the Medicaid population with persistent asthma, as defined by HEDIS® specifications. This measure is derived from health care utilization claims data collected at the state level.

There are additional health plan activities currently underway that will provide opportunities to measure asthma management and quality of life. For more information about these activities, please visit the websites of the Michigan Quality Improvement Consortium (http://www.mqic.org), the Michigan Association of Health Plans for the ”Taking on Asthma” program (http://www.mahp.org), or the National Committee on Quality Assurance, (http://www.ncqa.org/Programs/HEDIS/).

Figure 2.1: Frequency of Asthma Medication[1] Use in the Past 30 Days Among Adults (≥18 Years) with Current Asthma, Michigan, 2001



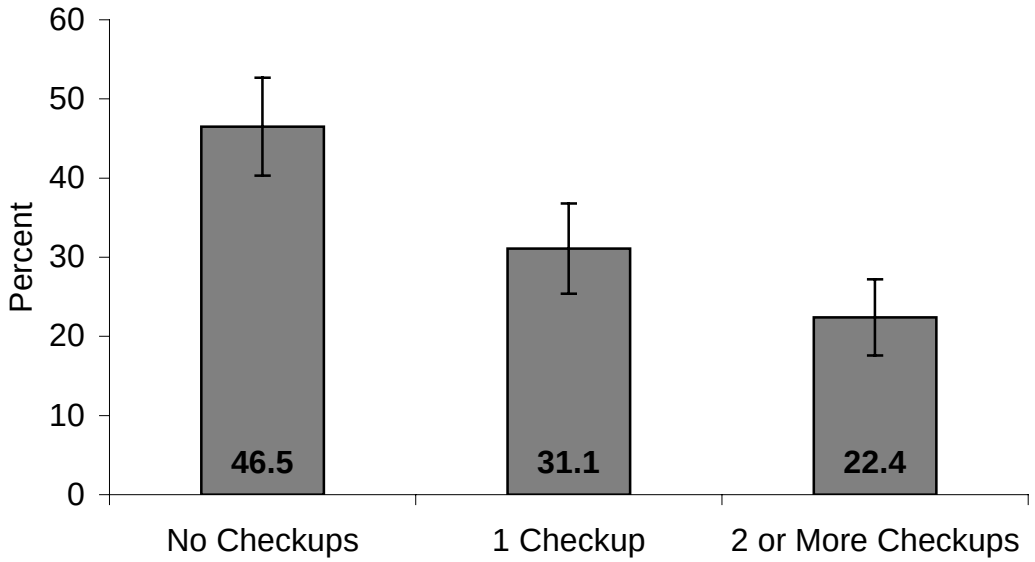
None (95% CI)	28.7% (23.2, 34.2)
Less than Weekly (95% CI)	11.3% (7.0, 15.6)
Weekly (95% CI)	17.8% (13.2, 22.4)
Daily (95% CI)	42.2% (36.1, 48.3)

[1]Prescription medications, not over the counter medications.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Nearly half of adults with current asthma report that they use medication daily to manage their disease.
- ✧ Asthma medications are prescribed depending on the severity of symptoms and lung function. There are two different types of medication – one for long-term control, which should be taken daily, and another for treating acute symptoms. It is difficult to interpret the data presented here without knowing the severity of the respondent's asthma and the type of medication taken the past 30 days.

Figure 2.2: Percent of Adults (≥18 Years) with Current Asthma that have Seen a Health Care Professional for a Routine Checkup of their Asthma in the Past 12 Months, Michigan, 2001

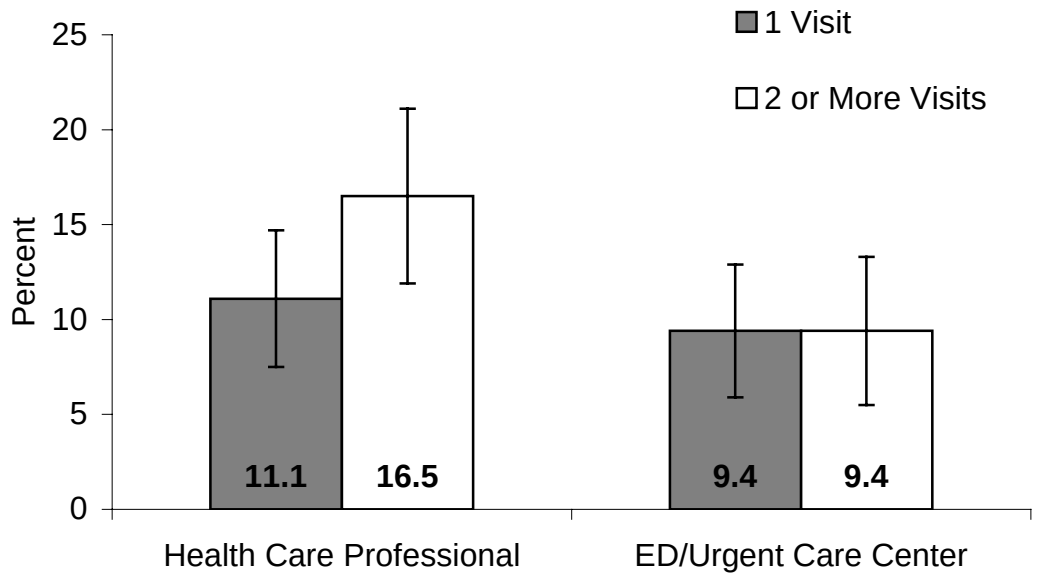


Percent	46.5%	31.1%	22.4%
(95% CI)	(40.3, 52.7)	(25.4, 36.8)	(17.6, 27.2)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Nearly a quarter of Michigan adults with current asthma have had 2 or more routine asthma checkups in the past year.
- ✧ It is recommended that persons with asthma see a health care professional at least twice a year, even more frequently if their asthma is severe or difficult to control. Nearly 80% of adults with current asthma in Michigan do not meet this recommendation.

Figure 2.3: Percent of Adults (≥18 Years) with Current Asthma that have Sought Urgent Asthma Treatment from either a Health Care Professional or Emergency Department/Urgent Care Center in the Past 12 Months, Michigan, 2001

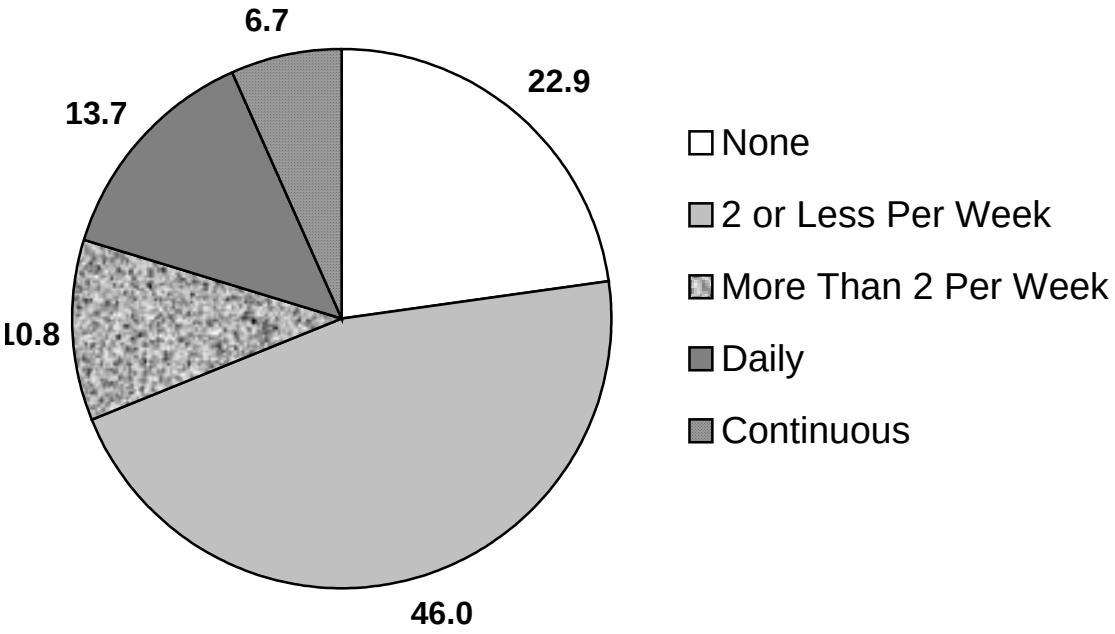


1 Visit (95% CI)	11.1% (7.5, 14.7)	9.4% (5.9, 12.9)
2 or More Visits (95% CI)	16.5% (11.9, 21.1)	9.4% (5.5, 13.3)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Most of Michigan's adults with current asthma do not visit their doctor or the emergency department for urgent asthma treatment.
- ✧ The goal of asthma therapy is to have minimal to no emergency department visits for asthma. 18.8% of adults with current asthma have visited the emergency department or urgent care center for urgent asthma treatment in the past 12 months.

Figure 2.4: Occurrence of Asthma Symptoms in the Past 30 Days Among Adults (≥18 Years) with Current Asthma, Michigan, 2001

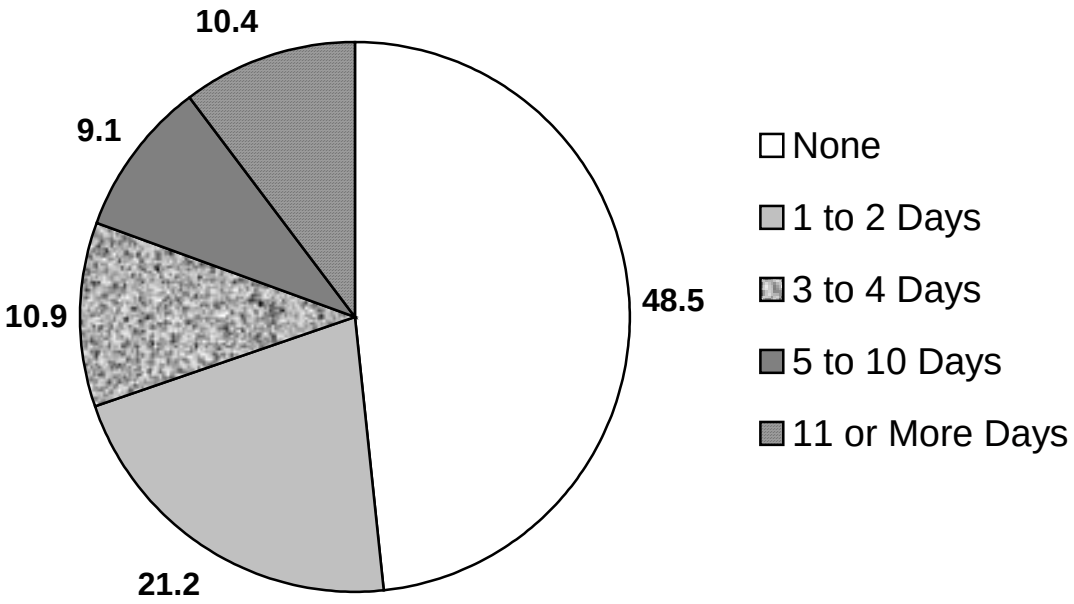


None (95% CI)	22.9% (17.7, 28.1)
2 or Less per Week (95% CI)	46.0% (39.8, 52.2)
More than 2 per Week (95% CI)	10.8% (7.1, 14.5)
Daily (95% CI)	13.7% (9.8, 17.6)
Continuous (95% CI)	6.7% (2.8, 10.6)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Nearly a quarter of adults with current asthma do not experience any symptoms of their disease during a given month.
- ✧ Daily or continuous symptoms of asthma affect about one fifth of Michigan's adults with current asthma. The goal of treatment is to experience no asthma symptoms. Daily or continuous symptoms, therefore, are an indicator of poorly controlled disease.
- ✧ Among those with current asthma in Michigan, 54.6% have experienced an asthma attack in the previous 12 months, (data not shown).

Figure 2.5: Occurrence of Sleep-Disturbing Asthma Symptoms in the Past 30 Days Among Adults (≥18 Years) with Current Asthma, Michigan, 2001

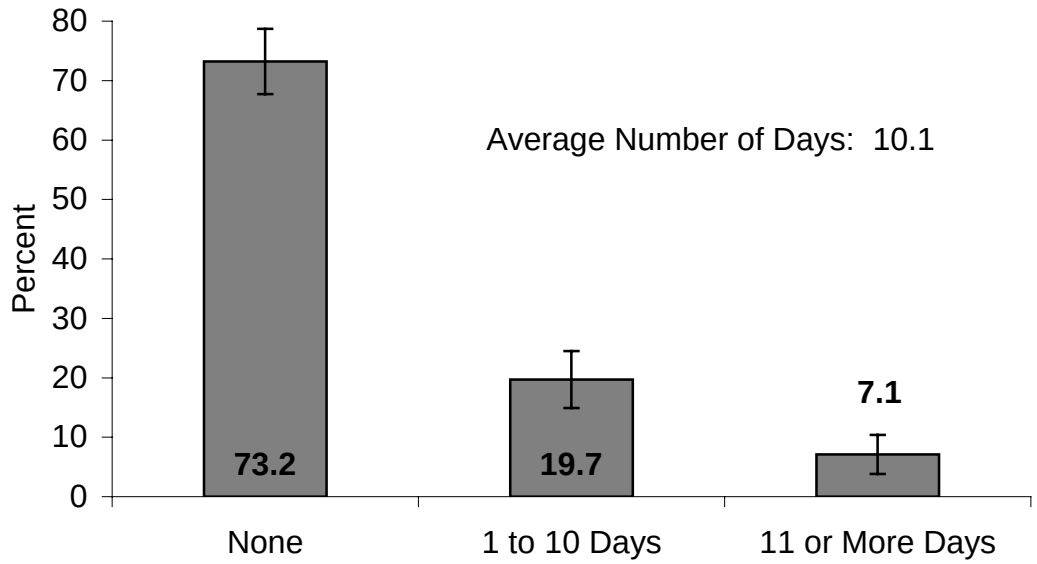


None (95% CI)	48.5% (41.1, 55.6)
1 to 2 Days (95% CI)	21.2% (15.5, 26.9)
3 to 4 Days (95% CI)	10.9% (6.9, 14.9)
5 to 10 Days (95% CI)	9.1% (4.8, 13.4)
11 or More Days (95% CI)	10.4% (6.2, 14.6)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Sleep-disturbing symptoms of asthma affect one fifth of Michigan adults with current asthma five or more days during a given month.
- ✧ A goal of asthma therapy is to experience no sleep-disturbing symptoms.

Figure 2.6: Number of Days Unable to Work or Carry Out Usual Activities due to Asthma in the Past 12 Months for Adults (≥18 Years) with Current Asthma, Michigan, 2001



Percent	73.2%	19.7%	7.1%
(95% CI)	(67.7, 78.7)	(14.9, 24.5)	(3.8, 10.4)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ The majority of adults with current asthma (73.2%) in Michigan do not experience any days where they are unable to carry our work or usual activities due to their asthma.
- ✧ The average number of work/activity days lost per year due to asthma among adults with current asthma is 10.1.
- ✧ About one quarter of adults with current asthma experience at least 1 day a year where they are unable to work or carry out their usual activities.

A Note on Asthma Severity Classification

According to national guidelines for the diagnosis and management of asthma, it is important to classify asthma patients according to the severity of their disease. By doing so, health care providers can administer the appropriate medication. The guidelines prescribe the following criteria for the asthma classifications: severe persistent, moderate persistent, mild persistent, and mild intermittent.

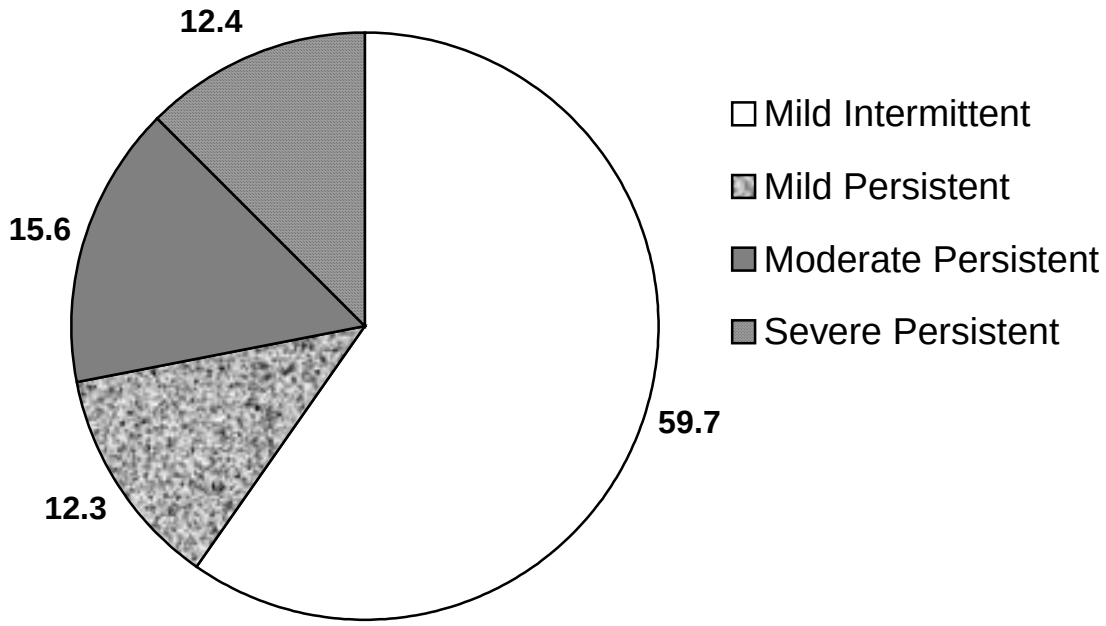
			Adults and children age > 5 years who can use a spirometer or peak flow meter.	
Classification	Symptoms/Day	Symptoms/Night	FEV1 or PEF*	PEF Variability
Severe Persistent	Continual	Frequent	≤ 60	> 30
Moderate Persistent	Daily	> 1/week	> 60 - < 80	> 30
Mild Persistent	> 2/week, but < 1 time/day	> 2/month	≥ 80	20 – 30
Mild Intermittent	≤ 2/week	< 2/month	≥ 80	< 20

*Percentage predicted values for forced expiratory volume in 1 second (FEV1) and percentage of personal best for peak expiratory flow (PEF).

In the following 2 figures (Figures 2.7 and 2.8), the analysis is stratified by asthma severity. In these cases, asthma severity was imputed from responses to the asthma module questions regarding symptom frequency on the Behavioral Risk Factor Survey. (BRFS) The classification, based on the criteria set forth by the national guidelines, is outlined below. Since lung function measures (FEV1 and PEF) are not available from the BRFS, the severity classification is based only on the frequency of day and nighttime symptoms.

Classification	Frequency of Day Symptoms in Past 30 Days	Number of Days Symptoms Made it Difficult to Sleep in Past 30 Days
Severe Persistent	Continuous	> 10
Moderate Persistent	Daily, Not Continuous	5 – 10
Mild Persistent	> 2 times/week	3 – 4
Mild Intermittent	≤ 2 times/week or None	1 – 2, or None

Figure 2.7: Severity[1] Distribution for Adults (≥18 Years) with Current Asthma, Michigan, 2001



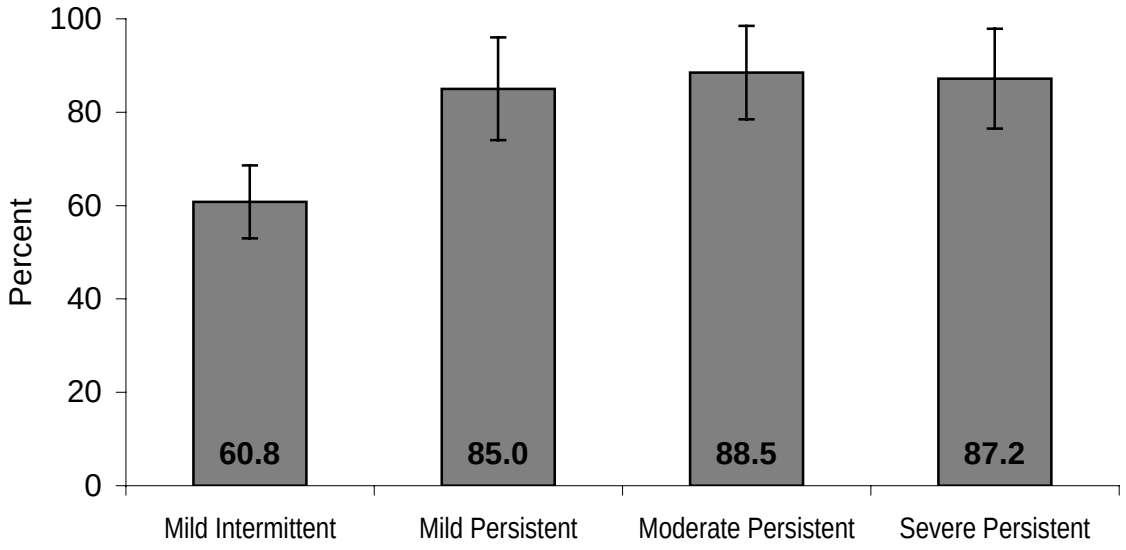
Mild Intermittent (95% CI)	59.7% (53.7, 65.7)
Mild Persistent (95% CI)	12.3% (8.5, 16.1)
Moderate Persistent (95% CI)	15.6% (11.2, 20.0)
Severe Persistent (95% CI)	12.4% (8.5, 16.3)

[1]Asthma severity of the respondents was determined by the highest level of severity of their daytime or nighttime symptoms.

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ 59.7% of adults with current asthma experience symptoms consistent with a severity classification of mild intermittent.
- ✧ About 30% of adults with current asthma experience symptoms consistent with a severity classification of moderate to severe persistent, which require more aggressive treatment and monitoring of their disease.

Figure 2.8: Use of Asthma Medications[1] in the Past 30 Days Among Adults (≥18 Years) with Current Asthma by Asthma Severity[2], Michigan, 2001



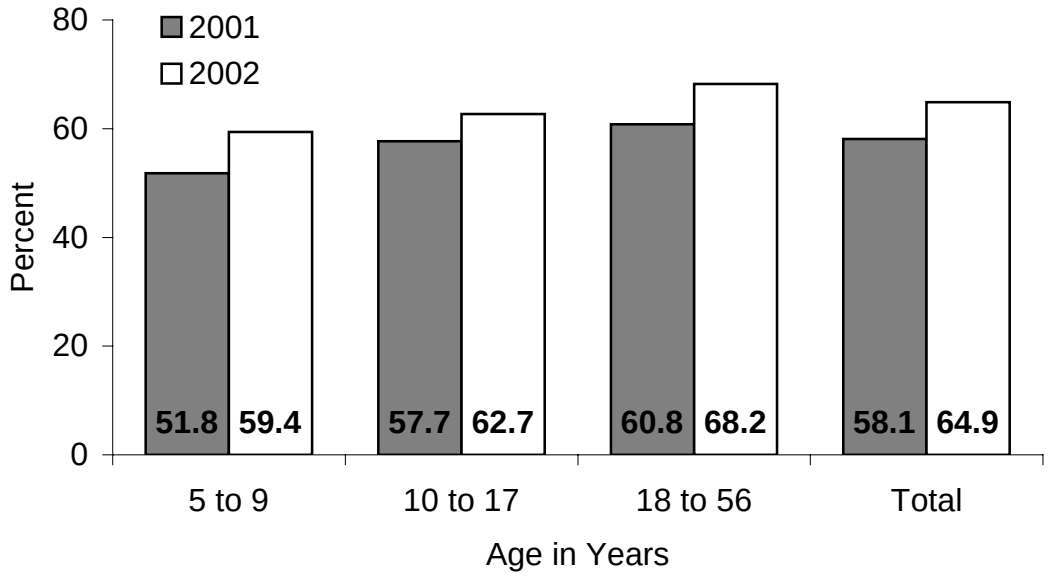
[1]Prescription medications, not over the counter medications.
[2] Asthma severity of the respondents was determined by the highest level of severity of their daytime or nighttime symptoms.

Percent	60.8%	85.0%	88.5%	87.2%
(95% CI)	(53.0, 68.6)	(74.0, 96.0)	(78.5, 98.5)	(76.5, 97.9)

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

- ✧ Daily long-term controller medication is recommended for the management of mild, moderate, and severe persistent asthma.
- ✧ Asthma medications are prescribed depending on the severity of symptoms and lung function. There are two different types of medication – one for long-term control, which should be taken daily, and another for treating acute symptoms. It is difficult to interpret the data presented here without knowing the type of medication taken the past 30 days.
- ✧ It is encouraging that the majority of persons with current asthma have used some sort of prescription medication for their asthma. This indicates that an opportunity for intervention exists where persons with asthma are accessing the health care system.

Figure 2.9: Use of Appropriate Medications[1] for Persons in Medicaid with Persistent Asthma[2] by Age Group, 5 to 56 Years, Michigan, 2001-2002



[1]Appropriate medications for persons with persistent asthma are long-term controllers.

[2] Persistent asthma is defined according to HEDIS® specifications: in the year prior to the prevalence measurement year having (1) ≥ 4 asthma medication dispensing events OR (2) ≥ 1 emergency department visits for asthma OR (3) ≥ 1 hospitalization for asthma OR (4) ≥ 4 outpatient visits for asthma and ≥ 2 asthma medication dispensing events.

Source: Michigan Medicaid HEDIS 2002 Statewide Aggregate Report, Health Services Advisory Group, Inc., December 2002.

- ✧ There is improvement in the percent of persons age 5 to 56 years with persistent asthma having filled at least 1 prescription for a long-term control medication in the Medicaid population.
- ✧ The greatest improvement in the HEDIS measure is observed for children 5 to 9 years with persistent asthma.

Table 2.1: Prevalence of School-based Asthma Management Activities Among Public Schools with Grade 6 or Higher, Michigan, 2002.

Activity	Percent of Schools
Full time registered nurse provided.	10%
Identify and track all students with asthma.	74%
Obtain and use an asthma action plan for all students with asthma.	39%
Assure immediate access to medications prescribed by a physician and approved by parents.	95%
Provide intensive case management for students with asthma missing 10 or more school days per year.	21%
Educate school staff about asthma.	52%
Educate students with asthma about asthma management.	28%
Teach asthma awareness to all students in at least 1 grade.	23%
Encourage full participation in physical education and physical activity when students with asthma are doing well.	95%
Provide modified physical education and physical activities as indicated by the student's asthma action plan.	80%

Data Source: School Health Education Profile Survey, 2002

- ✧ In some areas, it appears that Michigan schools are implementing important asthma management strategies.
- ✧ Only 39% of schools obtain and use an asthma action plan for their students with asthma.
- ✧ Asthma education of students and staff appears to be an area of needed improvement in Michigan schools.

Section 3: Work Related Asthma

There are two types of work-related asthma: new onset either from sensitization or irritation, and aggravation of pre-existing asthma. A person is considered to have work-related asthma from sensitization to a workplace exposure if they:

- have a physician diagnosis of asthma.
- have onset of respiratory symptoms associated with a particular job that improve or are relieved when the patient is not working.
- work with a known occupational allergen, or have evidence of an association between work exposures and a decrease in pulmonary function testing. [1]

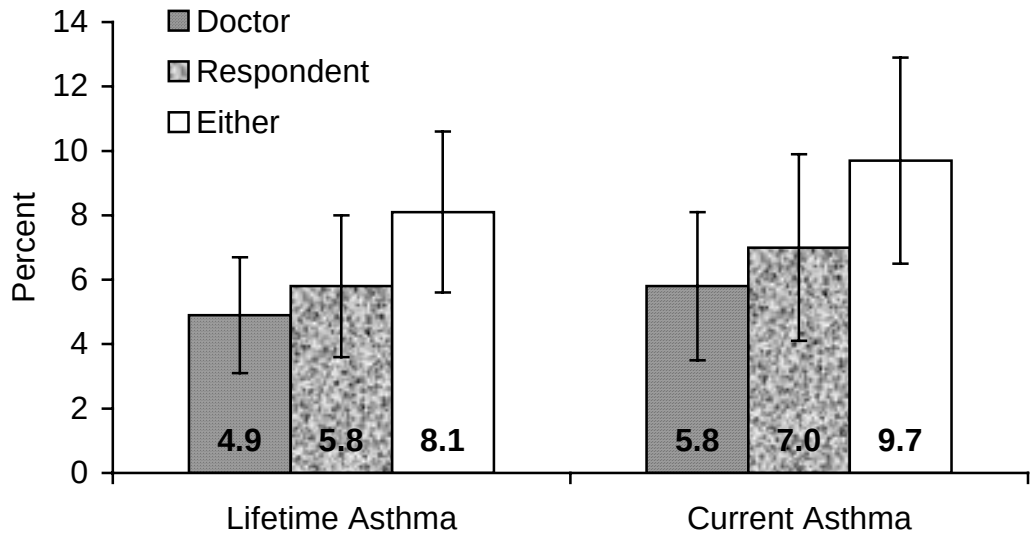
If a person only meets the first two criteria then they are considered to have possible work-related asthma. If a person had physician-diagnosed asthma before beginning work and their asthma becomes worse at a particular job, they are considered to have work aggravated asthma. If a person develops asthma for the first time immediately after an acute exposure to an irritating substance at work, they are considered to have reactive airways dysfunction syndrome (RADS).

The Sentinel Event Notification System of Occupational Risk (SENSOR) is an ongoing surveillance system that identifies index cases of work-related asthma in Michigan. The two major sources used to identify persons with work-related asthma are reports from physicians, and reports from hospitals. Once an individual is identified to have work-related asthma from one of these sources, he/she is interviewed to confirm the work-relatedness of their condition. An industrial hygiene investigation may be conducted at the patient's workplace, where co-workers are interviewed to determine if other individuals are experiencing similar breathing problems from the exposure(s). An industrial hygienist conducts air monitoring for any suspected allergens and reviews the company's health and safety program. Excerpts from the “Annual Report on Work-Related Asthma in Michigan” presented in this section give the incidence of work-related asthma in Michigan and what types of industry exposures pose the greatest risk. To see the report in its entirety, visit http://web2.chm.msu.edu/oem/asthma/02AsthmaAnnRpt_ALL.pdf.

Portions of the Michigan Behavioral Risk Factor Survey asthma module are designed to estimate the self-reported prevalence of work-related asthma in Michigan. The survey asks whether the respondent or their doctor considered their asthma work-related. The asthma module is administered to adult (18 Years and older) respondents who report that they currently have asthma. The limited sample size of this survey precludes subgroup analysis.

[1] Rosenman KD, Reilly MJ, and Kalinowski DJ. 2002 Annual Report on Work-Related Asthma in Michigan. http://web2.chm.msu.edu/oem/asthma/02AsthmaAnnRpt_ALL.pdf

Figure 3.1: Proportion of Adults (≥18 Years) whose Lifetime or Current Asthma May be Work-Related, Michigan, 2001



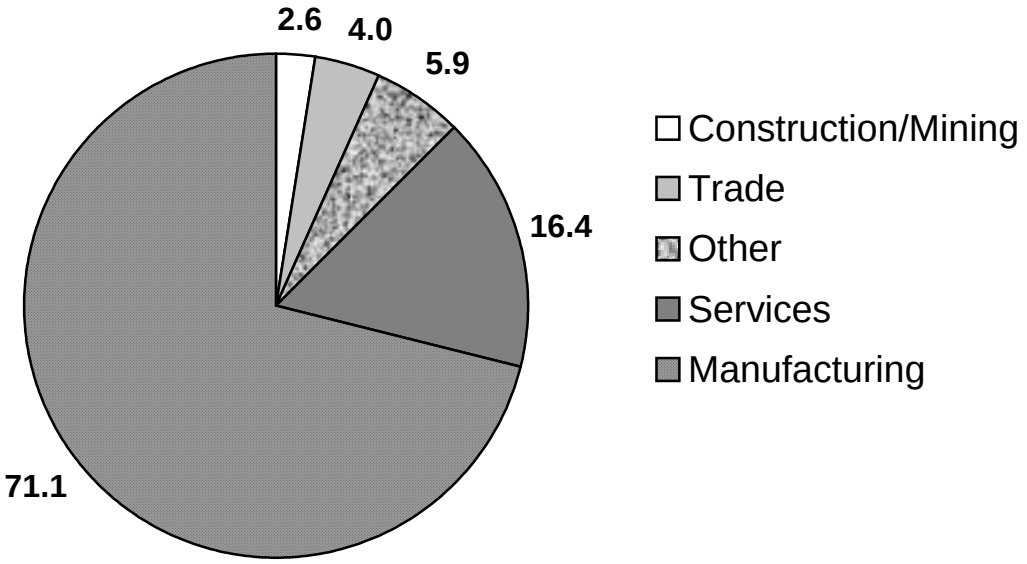
Doctor[1] (95% CI)	4.9 (3.1, 6.7)	5.8 (3.5, 8.1)
Respondent[2] (95% CI)	5.8 (3.6, 8.0)	7.0 (4.1, 9.9)
Either[3] (95% CI)	8.1 (5.6, 10.6)	9.7 (6.5, 12.9)

[1]Persons told by a doctor or medical person that their asthma was related to a job they ever had.
[2]Persons who told a doctor or medical person that their asthma was related to a job they ever had.
[3]Either "(1)" or "(2)".

Data Source: Behavioral Risk Factor Survey, Michigan, 2001

✧ Almost 10% of Michigan adults with current asthma report that they or their doctor have identified their condition as work-related.

Figure 3.2: Proportion of Confirmed Work-Related Asthma Patients by Major Industry Type, Michigan, 1988-2001



Manufacturing (Number)	71.1% (1,267)
Services (Number)	16.4% (292)
Other (Number)	5.9% (105)
Trade (Number)	4.0% (72)
Construction/Mining (Number)	2.6% (46)

Source: Rosenman KD, Reilly MJ, and Kalinowski DJ. 2002 Annual Report on Work Related Asthma in Michigan, (http://web2.chm.msu.edu/oem/asthma/02AsthmaAnnRpt_ALL.pdf).

- ✧ The overall incidence of work-related asthma in Michigan is 3.4 per 100,000 workers.
- ✧ The largest number of incident cases of work-related asthma in Michigan was reported for the manufacturing industry.
- ✧ Within the manufacturing industry, the employees of the automobile manufacturing and foundries experience the highest incidence of work-related asthma.

Table 3.1 Characteristics of Persons with Confirmed Work-Related Asthma, Michigan, 1988-2001

	Percent
Sex	
Male	50.7
Female	49.3
Race	
White	76.9
Black	18.2
Hispanic	2.4
Alaskan/American Indian	0.9
Asian	0.4
Other	1.2
Smoking Status	
Current	20.0
Former	40.1
Never	39.9
Personal History of Allergies or Asthma Yes	44.3
No	55.7
County of Employment	
Wayne	25.9
Oakland	13.5
Macomb	9.6
Other	51.0

*Source: Rosenman KD, Reilly MJ, and Kalinowski DJ. 2002 Annual Report on Work Related Asthma in Michigan, (*http://web2.chm.msu.edu/oem/asthma/02AsthmaAnnRpt_ALL.pdf *).*

- ✧ Persons with work-related asthma in Michigan are most frequently white, which is reflective of the population. However, the rate of work-related asthma in blacks is 2.1 times greater than among whites, (5.4 vs. 2.6/100,000 population).
- ✧ Persons with work-related asthma are more likely to be former or never smokers than current smokers.
- ✧ Most persons with work-related asthma do not have a personal history of asthma or allergies.
- ✧ Persons with work-related asthma are most frequently employed in southeast counties of Michigan, which is reflective of the population.

Section 4: Hospitalization for Asthma

Preventable hospitalizations are those where timely and effective ambulatory care can prevent the onset of an illness or condition, control an acute episode of an illness, or manage a chronic disease or condition so that hospitalization is unnecessary. Asthma hospitalizations are considered preventable because patients with asthma should be able to stay out of the hospital if they have and use good asthma management techniques.

Hospitalization data was acquired from the Michigan Inpatient Database for the years 1990 to 2001. All hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from reporting acute care hospitals in contiguous states are included in this database. It includes virtually all hospitalizations in Michigan and for Michigan residents during this time period.

There is no *confirmed* case classification for an asthma hospitalization. In accordance with the case definition for a *probable* asthma hospitalization recommended by the Council for State and Territorial Epidemiologists (CSTE), all inpatient hospitalizations are selected from the database where asthma was the primary reason for the stay.[1] These are hospitalizations with primary discharge diagnosis coded to the International Classification of Disease (ICD) Version-9-CM codes 493.XX.

These data are the number of inpatient hospitalizations for asthma. This is not the same as the number of individual people hospitalized for asthma. An individual can be hospitalized more than once for the same condition during the study period and multiple hospitalizations cannot be distinguished from this data source. From these data, age-adjusted asthma hospitalization rates are calculated and presented per 10,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions.

Hospitalization rates for demographic or geographic units with a small number of events (less than or equal to 20 events) or a small population size (less than 5,000 population) are not calculated because these rates are statistically unstable. In addition, to protect the identity of persons who have been hospitalized, counts less than 5 are not presented in this report.

To determine if asthma hospitalization rates follow an increasing or decreasing trend over the 12-year period 1990-2001, the Spearman Correlation Coefficient and its accompanying statistical Rank Correlation Test are utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and asthma hospitalization rate, without making any assumption about the underlying distribution of the data. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused a change in asthma hospitalization rates.

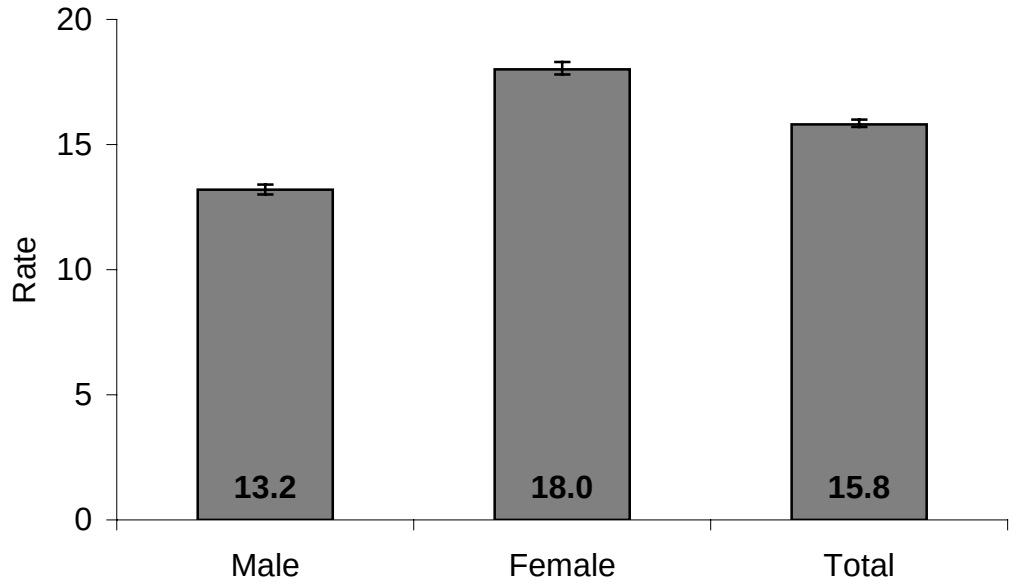
[1] Council for State and Territorial Epidemiologists, Position Statement 1998-EH/CD 1.

Ninety five percent confidence intervals are computed for hospitalization rates where more than one year of data are combined. The confidence interval estimates the statistical uncertainty of the asthma hospitalization rate and can be used to test whether a specific measure is statistically different between groups. Average asthma hospitalization rates are considered statistically different between groups if their 95% confidence intervals do not overlap. This technique is used to compare rates for demographic subpopulations, such as male versus female, and geographical subpopulations, such as county versus state.

Estimates of cost for asthma hospitalization visits in Michigan are taken from data provided by the 2001 Healthcare Cost and Utilization Project (HCUP). For more information and available data, visit the website for the Agency for Healthcare Research and Quality at HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/data/hcup/hcupnet.htm.

Additional information about hospitalizations due to asthma is available in Section 6: Healthy People 2010 Objectives for Asthma, pp. 66 - 78.

Figure 4.1: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Sex, Michigan, All Ages, 1999-2001



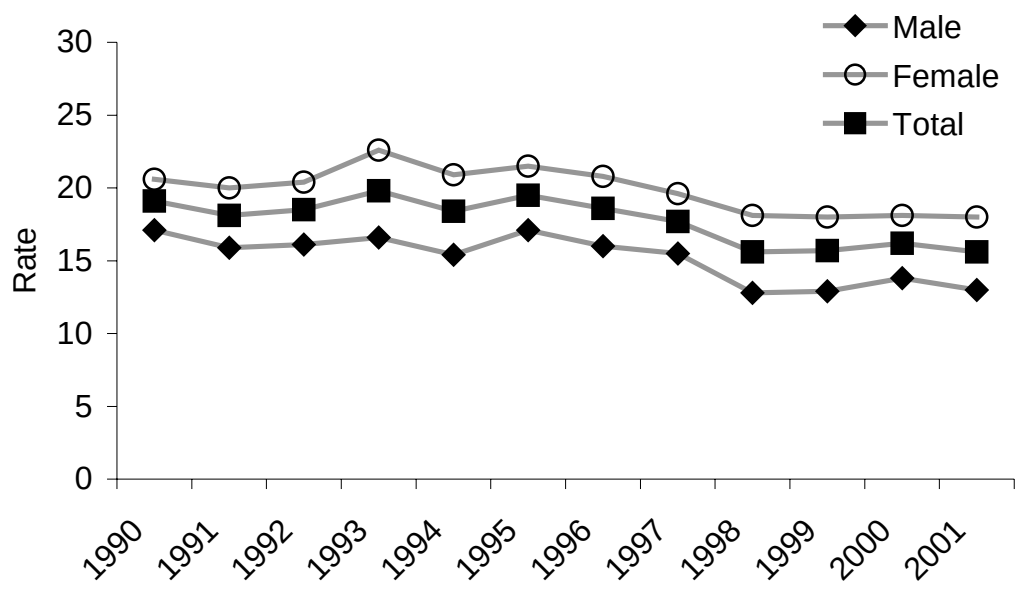
Rate	13.2	18.0	15.8
(95% CI)	(13.0, 13.4)	(17.8, 18.3)	(15.7, 16.0)
Count	19,245	27,388	46,634

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average number of hospitalizations due to asthma per year in Michigan, 1999 to 2001, is 15,545.
- ✧ The asthma hospitalization rate in Michigan, 1999 to 2001, is 15.8 per 10,000 population.
- ✧ Asthma hospitalization rates, 1999 to 2001, are higher among females (18.0 per 10,000 population) than males, (13.2 per 10,000 population).
- ✧ In 2001, the average cost of an asthma hospitalization in Michigan was $7,001. (HCUPnet: http://www.ahrq.gov/data/hcup/hcupnet.htm, Accessed on 05/28/2004)
- ✧ In 2001, the average cost of an asthma hospitalization for males in Michigan was $6,209, whereas for females it was $7,522. (HCUPnet: http://www.ahrq.gov/data/hcup/hcupnet.htm, Accessed on 05/28/2004)

Figure 4.2: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Sex and Year, Michigan, All Ages, 1990-2001



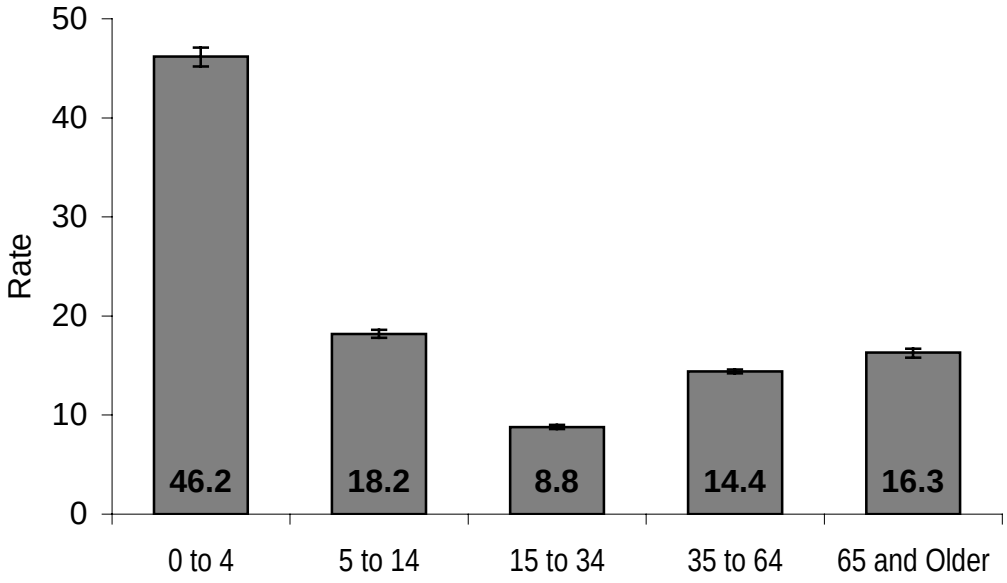
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	Male Rate	(Count)	Female Rate	(Count)	Total Rate	(Count)
1990	17.1	(7,951)	20.6	(9,834)	19.1	(17,790)
1991	15.9	(7,451)	20.0	(9,648)	18.1	(16,995)
1992	16.1	(7,666)	20.4	(9,927)	18.5	(17,597)
1993	16.6	(7,929)	22.6	(11,043)	19.8	(18,975)
1994	15.4	(7,339)	20.9	(10,269)	18.4	(17,609)
1995	17.1	(8,275)	21.5	(10,668)	19.5	(18,945)
1996	16.0	(7,725)	20.8	(10,333)	18.6	(18,058)
1997	15.5	(7,546)	19.6	(9,774)	17.7	(17,320)
1998	12.8	(6,199)	18.1	(9,089)	15.6	(15,289)
1999	12.9	(6,229)	18.0	(9,155)	15.7	(15,385)
2000	13.8	(6,745)	18.1	(9,141)	16.2	(15,886)
2001	13.0	(6,271)	18.0	(9,092)	15.6	(15,363)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2001, there has been a significant overall decline in asthma hospitalization rates in Michigan for males, females, and all persons combined, (Total: ρ= -0.73, p<0.01; Male: ρ= -0.75, p<0.01; Female: ρ= -67, p<0.05).

Figure 4.3: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] by Age Group, Michigan, All Ages, 1999-2001



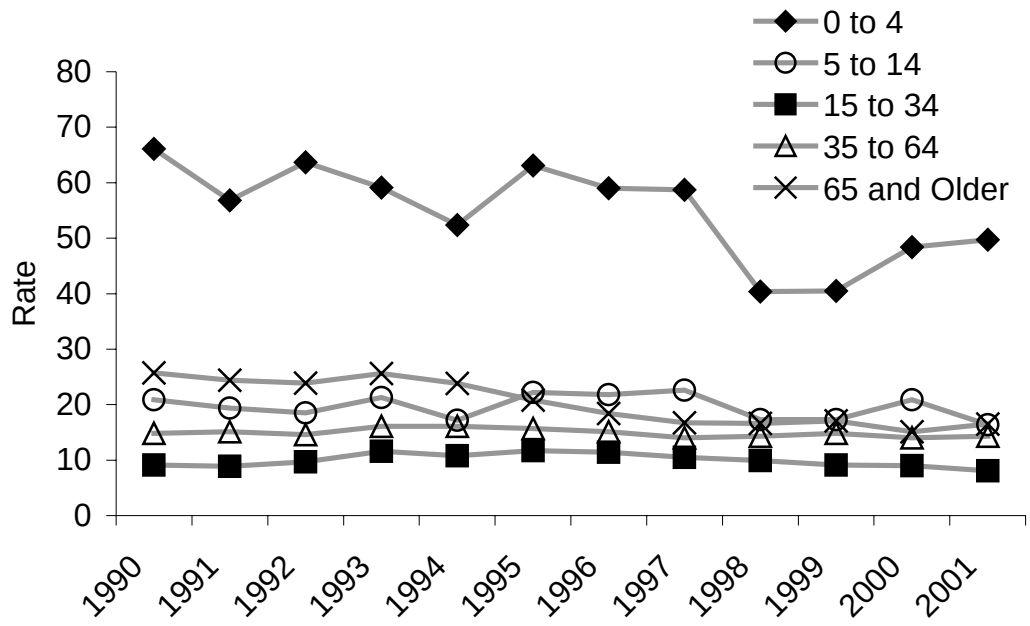
Rate	46.2	18.2	8.8	14.4	16.3
(95% CI)	(45.2, 47.1)	(17.8, 18.6)	(8.6, 9.0)	(14.2, 14.6)	(15.8, 16.7)
Count	9,323	7,870	7,281	16,194	5,966

[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The highest age-specific asthma hospitalization rate in Michigan, 1999 to 2001, is among children ages 0 to 4 years, (46.2 per 10,000 population).
- ✧ The lowest age-specific asthma hospitalization rate in Michigan, 1999 to 2001, is among young adults ages 15 to 34 years, (8.8 per 10,000 population).
- ✧ Asthma hospitalization rates increase with age group after age group 15 to 34 years.
- ✧ In 2001, the average cost of an asthma hospitalization generally increases with age, ranging from $4,927 for children less than 1 year to about $9,836 for adults age 65 years and older. (HCUPnet: http://www.ahrq.gov/data/hcup/hcupnet.htm, Accessed on 05/28/2004)

Figure 4.4: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] by Age Group and Year, Michigan, All Ages, 1990-2001



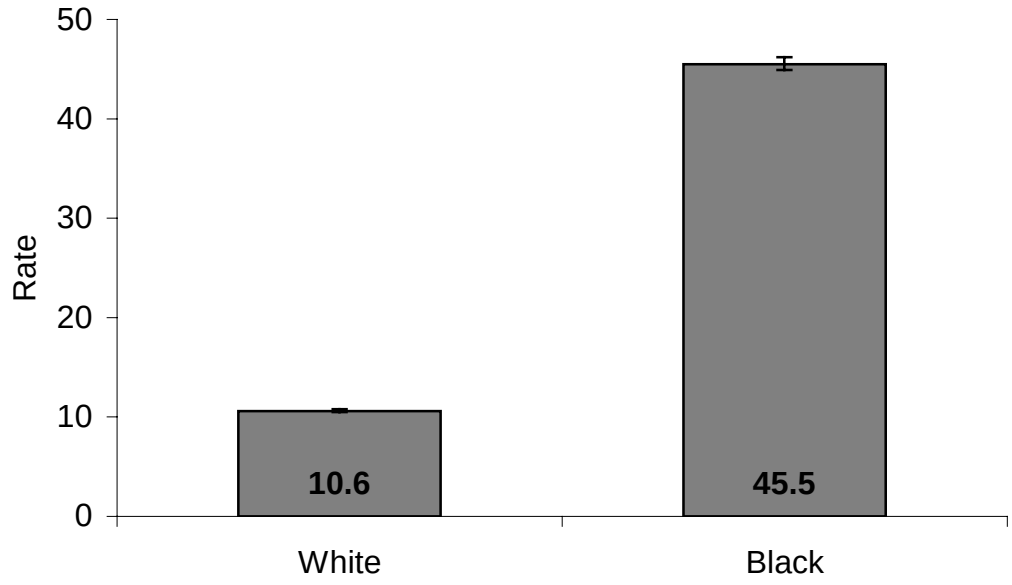
[1] Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	0 to 4		5 to 14		15 to 34		35 to 64		65 and Older	
	Rate	(Count)	Rate	(Count)	Rate	(Count)	Rate	(Count)	Rate	(Count)
1990	66.1	(4,712)	20.9	(2,826)	9.1	(2,709)	14.8	(4,694)	25.7	(2,849)
1991	56.8	(4,106)	19.4	(2,666)	8.9	(2,628)	15.1	(4,838)	24.4	(2,757)
1992	63.7	(4,638)	18.5	(2,571)	9.7	(2,839)	14.6	(4,795)	23.9	(2,754)
1993	59.1	(4,291)	21.3	(2,972)	11.6	(3,352)	16.1	(5,369)	25.6	(2,991)
1994	52.4	(3,783)	17.2	(2,418)	10.8	(3,081)	16.1	(5,509)	23.8	(2,818)
1995	63.1	(4,457)	22.2	(3,152)	11.7	(3,341)	15.7	(5,493)	20.8	(2,502)
1996	59.0	(4,092)	21.8	(3,113)	11.4	(3,220)	15.1	(5,401)	18.4	(2,232)
1997	58.7	(4,019)	22.6	(3,244)	10.5	(2,959)	14.0	(5,065)	16.7	(2,033)
1998	40.4	(2,734)	17.3	(2,491)	9.9	(2,755)	14.3	(5,275)	16.6	(2,034)
1999	40.5	(2,725)	17.3	(2,497)	9.1	(2,526)	14.8	(5,547)	17.1	(2,090)
2000	48.4	(3,257)	20.9	(3,010)	9.0	(2,502)	14.0	(5,264)	15.1	(1,853)
2001	49.7	(3,341)	16.4	(2,363)	8.1	(2,253)	14.3	(5,383)	16.5	(2,023)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2001, there has been a significant overall decline in asthma hospitalization rates in Michigan for persons age 0 to 4 years and 65 years and older, (0 to 4: ρ= -0.75; 65 and older: ρ= -0.95; all $p<0.01$).

Figure 4.5: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Race[4], Michigan, All Ages, 1999-2001



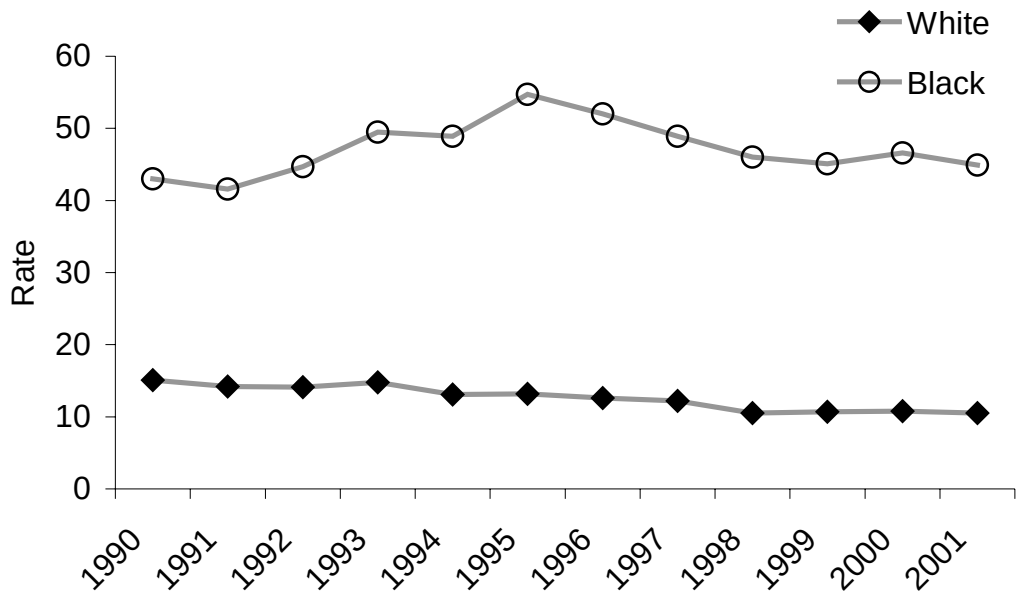
	White	Black
Rate	10.6	45.5
(95% CI)	(10.5, 10.8)	(44.9, 46.2)
Count	26,038	19,865

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 census population.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The asthma hospitalization rate for white persons in Michigan, 1999 to 2001, is 10.6 per 10,000 population.
- ✧ The asthma hospitalization rate for black persons in Michigan, 1999 to 2001, is 45.5 per 10,000 population.
- ✧ While white persons in Michigan experience the greatest absolute burden of asthma hospitalization, black persons have a higher asthma hospitalization rate. The rate among blacks is over 4 times the rate among whites.
- ✧ In 2001, the average cost of an asthma hospitalization for white persons in Michigan was $6,564, whereas for black persons was $7,137. (HCUPnet: http://www.ahrq.gov/data/hcup/hcupnet.htm, Accessed on 05/28/2004)

Figure 4.6: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Race[4] and Year, Michigan, All Ages, 1990-2001



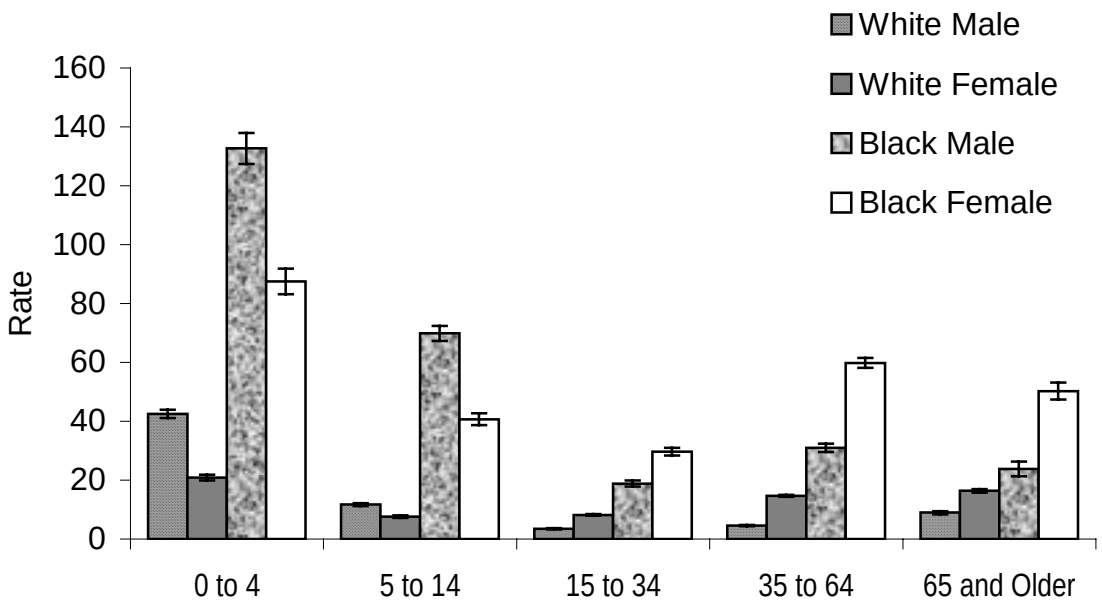
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2] Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 census population.

Year	White Rate	White (Count)	Black Rate	Black (Count)
1990	15.1	(11,791)	43.0	(5,800)
1991	14.2	(11,148)	41.6	(5,715)
1992	14.1	(11,165)	44.7	(6,209)
1993	14.8	(11,757)	49.5	(6,948)
1994	13.1	(10,488)	48.9	(6,858)
1995	13.2	(10,586)	54.7	(8,031)
1996	12.6	(10,140)	52.0	(7,603)
1997	12.2	(9,849)	48.9	(7,246)
1998	10.5	(8,522)	46.0	(6,607)
1999	10.7	(8,716)	45.1	(6,459)
2000	10.8	(8,781)	46.6	(6,888)
2001	10.5	(8,541)	44.9	(6,518)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Between 1990 and 2001, there has been a significant overall decline in asthma hospitalization rates in Michigan for white persons, (ρ= -0.94, p<0.01). There is no significant trend observed for black persons during this time period.
- ✧ Additional information regarding racial disparity in asthma hospitalization rates is available in *Section 6: Healthy People 2010 Objectives for Asthma*, pp 66-78.

Figure 4.7: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] by Sex, Age Group, and Race[3], Michigan, All Ages, 1999-2001



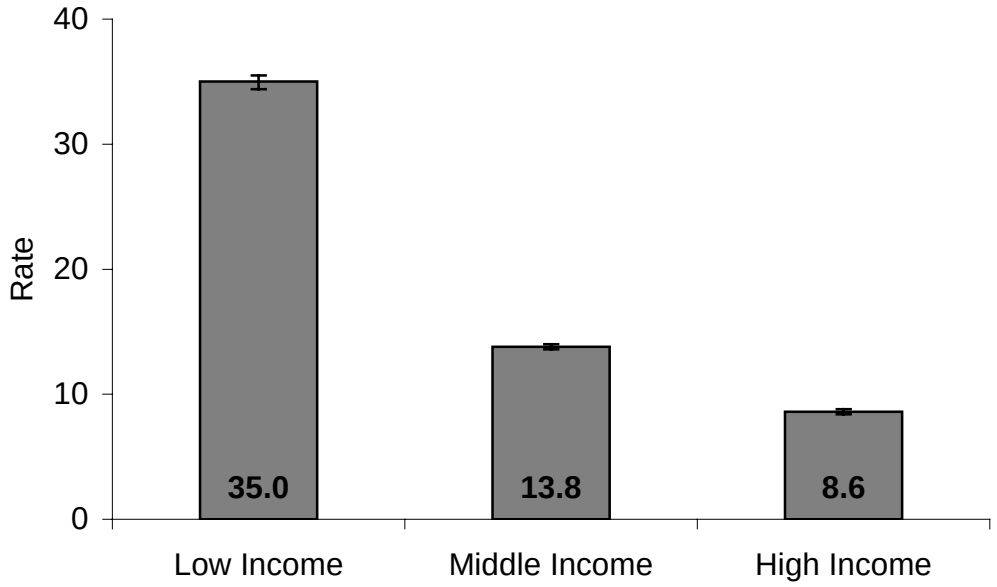
[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[3]For records that are missing data for race, race was assigned based on the 1990 census population.

Rate	0 to 4	5 to 14	15 to 34	35 to 64	65 and Older
White Male	42.5	11.7	3.5	4.6	9.0
(95% CI)	(41.1, 43.9)	(11.2, 12.2)	(3.3, 3.7)	(4.4, 4.8)	(8.4, 9.5)
Count	3,482	2,056	1,192	2,213	1,178
White Female	20.9	7.6	8.2	14.7	16.4
(95% CI)	(19.9, 21.9)	(7.2, 8.0)	(7.9, 8.5)	(14.4, 15.0)	(15.8, 17.0)
Count	1,635	1,272	2,728	7,105	3,177
Black Male	132.7	69.9	18.8	31.0	23.8
(95% CI)	(127.4, 138.0)	(67.3, 72.4)	(17.8, 19.9)	(29.6, 32.4)	(21.3, 26.3)
Count	2,450	2,848	1,200	1,946	355
Black Female	87.5	40.7	29.7	59.8	50.2
(95% CI)	(83.1, 91.8)	(38.7, 42.7)	(28.4, 31.0)	(58.1, 61.5)	(47.4, 53.1)
Count	1,550	1,588	2,043	4,713	1,172

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Male children have higher asthma hospitalization rates than female children in Michigan, 1999 to 2001.
- ✧ Adult females have higher asthma hospitalization rates than adult males in Michigan, 1999 to 2001.
- ✧ Black persons experience the highest rates of asthma hospitalization, 1999 to 2001, regardless of age group or sex.

Figure 4.8: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Income[4], Michigan, All Ages, 1999-2001



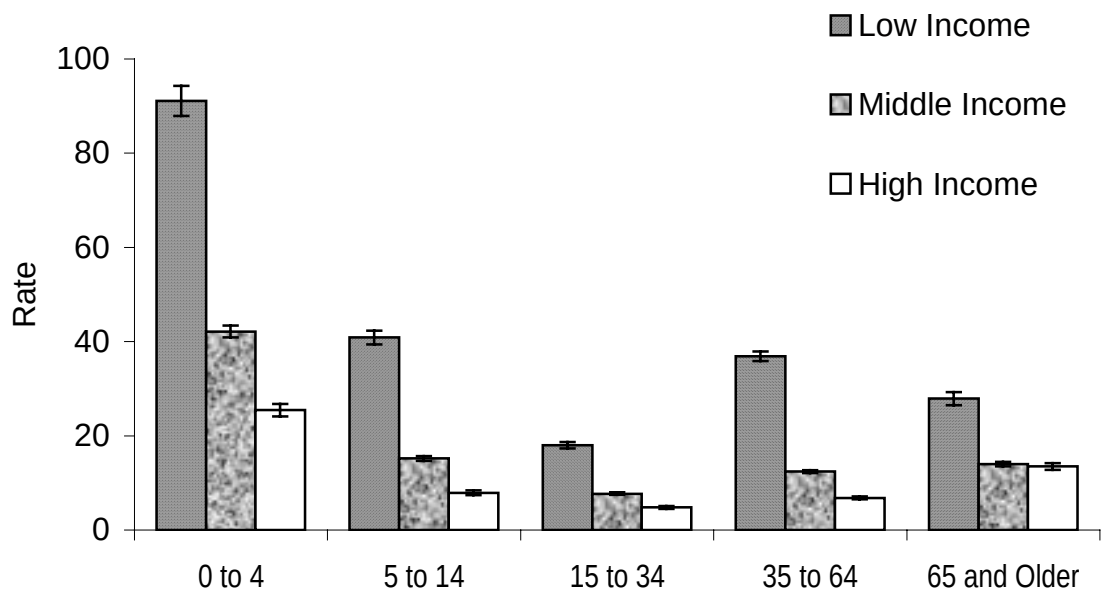
Rate	35.0	13.8	8.6
(95% CI)	(34.4, 35.5)	(13.6, 14.0)	(8.4, 8.8)
Count	15,840	23,018	7,139

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population is taken from the US Census 2000.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]High income=top 20% of Michigan's zip code areas, as determined by median household income from Census 2000; Low income=bottom 20% of Michigan's zip code areas, as determined by median household income from Census 2000; All others are considered middle income.

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The asthma hospitalization rate for low-income zip code areas in Michigan, 1999 to 2001, is 35.0 per 10,000 population.
- ✧ The asthma hospitalization rate for high-income zip code areas in Michigan, 1999 to 2001 is 8.6 per 10,000 population.
- ✧ As zip code area income group increases, the hospitalization rate for asthma decreases.

Figure 4.9: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] by Age Group and Income[3], Michigan, All Ages, 1999-2001



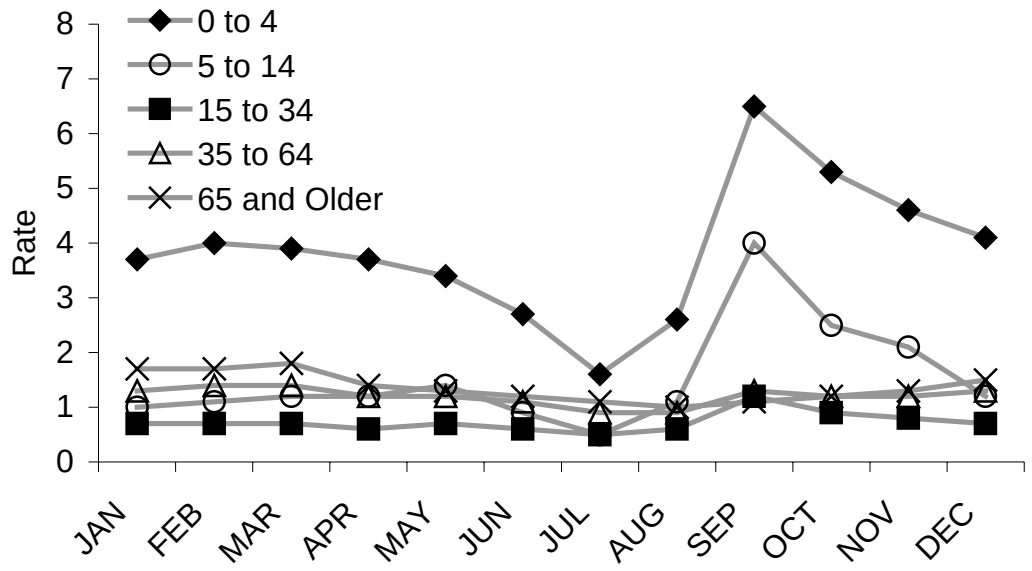
[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[3]High income=top 20% of Michigan's zip code areas, as determined by median household income from Census 2000; Low income=bottom 20% of Michigan's zip code areas, as determined by median household income from Census 2000; All others are considered middle income.

Rate	0 to 4	5 to 14	15 to 34	35 to 64	65 and Older
Low Income	91.1	40.9	18.0	36.9	27.9
(95% CI)	(87.9, 94.3)	(39.4, 42.3)	(17.3, 18.7)	(35.9, 37.9)	(26.5, 29.3)
Count	3,103	3,050	2,505	5,613	1,569
Middle Income	42.1	15.2	7.7	12.4	14.0
(95% CI)	(40.9, 43.4)	(14.7, 15.7)	(7.5, 8.0)	(12.1, 12.7)	(13.5, 14.5)
Count	4,680	3,721	3,662	7,931	3,024
High Income	25.5	7.9	4.8	6.8	13.5
(95% CI)	(24.1, 26.8)	(7.4, 8.4)	(4.5, 5.1)	(6.5, 7.1)	(12.8, 14.2)
Count	1,438	1,013	997	2,427	1,264

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Children 0 to 4 years have the highest asthma hospitalization rates, 1999 to 2001, regardless of the median income in their zip code.
- ✧ As zip code area income group increases, the hospitalization rate for asthma decreases, regardless of age.

Figure 4.10: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] by Age Group and Month of Admission, Michigan, All Ages, 1999-2001



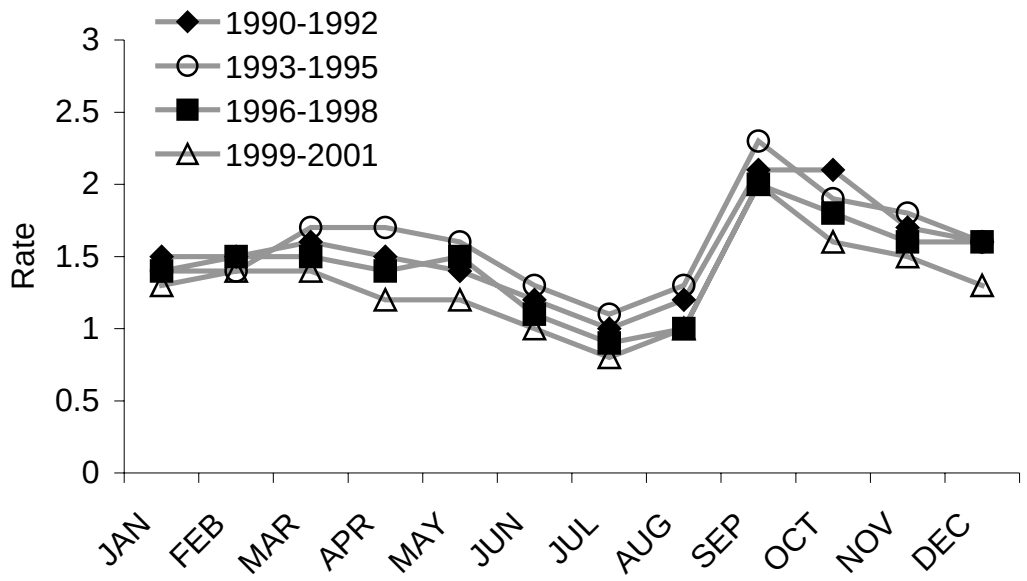
[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	0 to 4	5 to 14	15 to 34	35 to 64	65 and Older
	Rate (Count)	Rate (Count)	Rate (Count)	Rate (Count)	Rate (Count)
JAN	3.7 (752)	1.0 (430)	0.7 (587)	1.3 (1,506)	1.7 (623)
FEB	4.0 (810)	1.1 (470)	0.7 (602)	1.4 (1,609)	1.7 (632)
MAR	3.9 (797)	1.2 (525)	0.7 (594)	1.4 (1,577)	1.8 (657)
APR	3.7 (755)	1.2 (509)	0.6 (526)	1.2 (1,324)	1.4 (513)
MAY	3.4 (685)	1.4 (597)	0.7 (593)	1.2 (1,305)	1.3 (466)
JUN	2.7 (538)	0.9 (392)	0.6 (501)	0.6 (1,199)	1.2 (437)
JUL	1.6 (324)	0.5 (225)	0.5 (403)	0.9 (1,014)	1.1 (414)
AUG	2.6 (526)	1.1 (462)	0.6 (487)	0.9 (1,042)	1.0 (356)
SEP	6.5 (1,316)	4.0 (1,723)	1.2 (1,008)	1.3 (1,469)	1.1 (398)
OCT	5.3 (1,060)	2.5 (1,086)	0.9 (735)	1.2 (1,394)	1.2 (448)
NOV	4.6 (925)	2.1 (927)	0.8 (625)	1.2 (1,333)	1.3 (470)
DEC	4.1 (835)	1.2 (524)	0.7 (620)	1.3 (1,422)	1.5 (552)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The highest asthma hospitalization rates occur in the fall and winter months, whereas the lowest rates occur in the summer months.
- ✧ The seasonal pattern in Michigan asthma hospitalization rates occurs for all age groups, 1999 to 2001.
- ✧ Children ages 0 to 4 years experience the most pronounced seasonal variation in asthma hospitalizations, 1999 to 2001.

Figure 4.11: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by Month of Admission and Year, Michigan, All Ages, 1990-2001



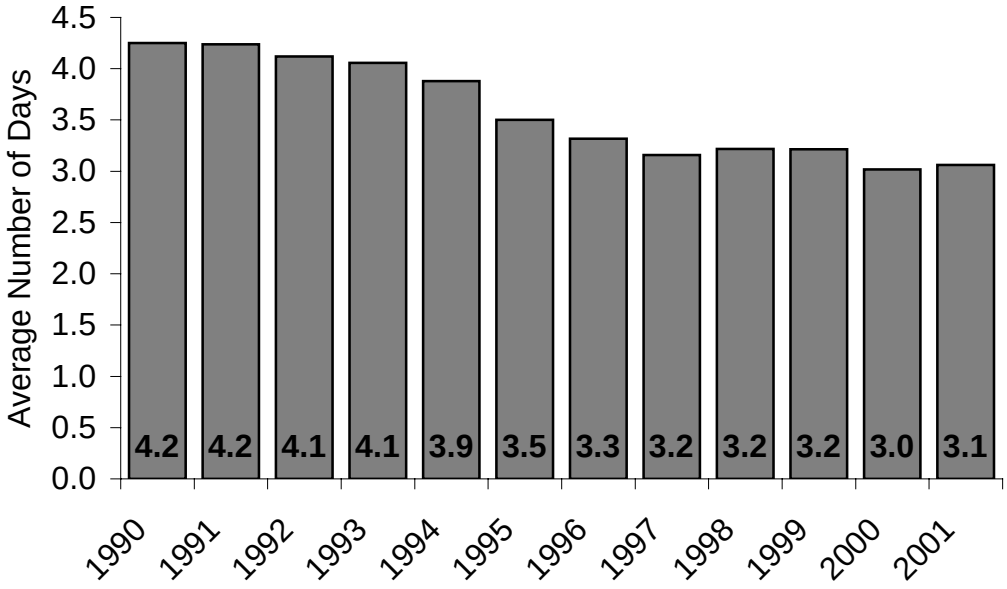
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2] Population estimates are taken from the Michigan population estimates, 1991,1994,1997,and 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Month	1990-1992 Rate	(Count)	1993-1995 Rate	(Count)	1996-1998 Rate	(Count)	1999-2001 Rate	(Count)
JAN	1.5	(4,164)	1.4	(3,902)	1.4	(4,201)	1.3	(3,898)
FEB	1.5	(4,179)	1.4	(4,132)	1.5	(4,404)	1.4	(4,123)
MAR	1.6	(4,604)	1.7	(4,939)	1.5	(4,277)	1.4	(4,150)
APR	1.5	(4,371)	1.7	(4,859)	1.4	(4,032)	1.2	(3,627)
MAY	1.4	(4,073)	1.6	(4,524)	1.5	(4,261)	1.2	(3,646)
JUN	1.2	(3,301)	1.3	(3,668)	1.1	(3,215)	1.0	(3,067)
JUL	1.0	(2,867)	1.1	(3,160)	0.9	(2,590)	0.8	(2,380)
AUG	1.2	(3,441)	1.3	(3,676)	1.0	(3,040)	1.0	(2,873)
SEP	2.1	(6,071)	2.3	(6,676)	2.0	(5,846)	2.0	(5,914)
OCT	2.1	(5,998)	1.9	(5,674)	1.8	(5,445)	1.6	(4,723)
NOV	1.7	(4,810)	1.8	(5,111)	1.6	(4,666)	1.5	(4,280)
DEC	1.6	(4,503)	1.6	(4,736)	1.6	(4,690)	1.3	(3,953)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Regardless of year, the seasonal pattern of asthma hospitalizations is similar.

Figure 4.12: Average Length of Stay for a Hospitalization due to Asthma[1] by Year, Michigan, All Ages, 1990-2001



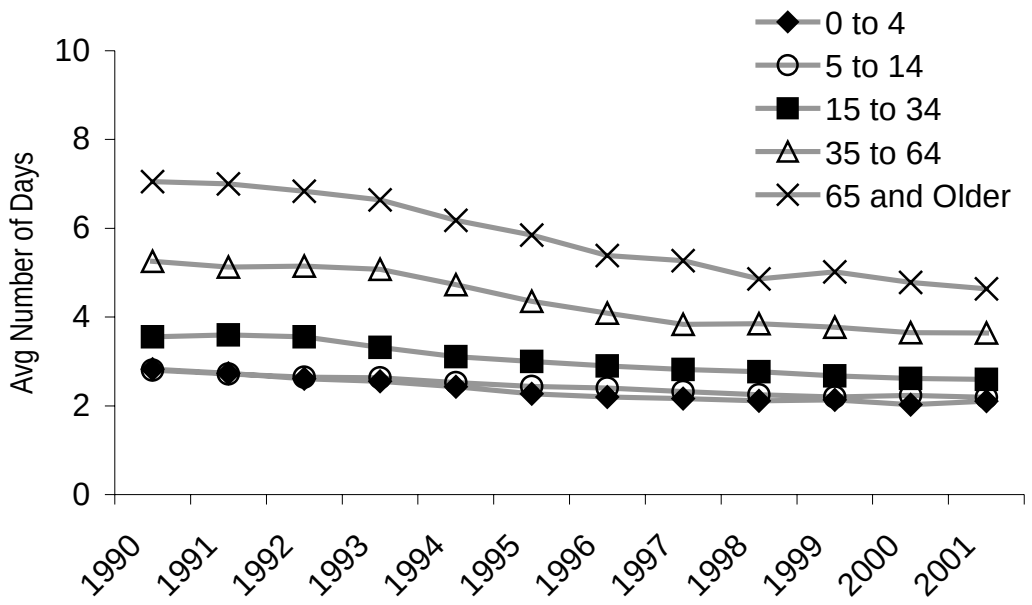
[1]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	Average Number of Days	Standard Deviation	Range
1990	4.2	4.7	1 - 317
1991	4.2	5.2	1 - 351
1992	4.1	4.2	1 - 153
1993	4.1	4.3	1 - 164
1994	3.9	4.1	1 - 151
1995	3.5	3.2	1 - 103
1996	3.3	3.2	1 - 137
1997	3.2	3.2	1 - 162
1998	3.2	3.0	1 - 108
1999	3.2	3.5	0 - 253
2000	3.0	2.6	1 - 84
2001	3.1	2.8	1 - 80

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Between 1990 and 2001, there has been a significant overall decline in the average length of stay for an asthma hospitalization in Michigan, (Spearman's ρ= -0.982, $p<0.01$).
- ✧ Available data cannot indicate the reason(s) for the decline in the length of stay for an asthma hospitalization. Contributing factors may include improvement in disease management, decline in disease severity, diagnostic changes, or hospital policy modifications.

Figure 4.13: Average Length of Stay for a Hospitalization due to Asthma[1] by Age Group and Year, Michigan, All Ages, 1990-2001



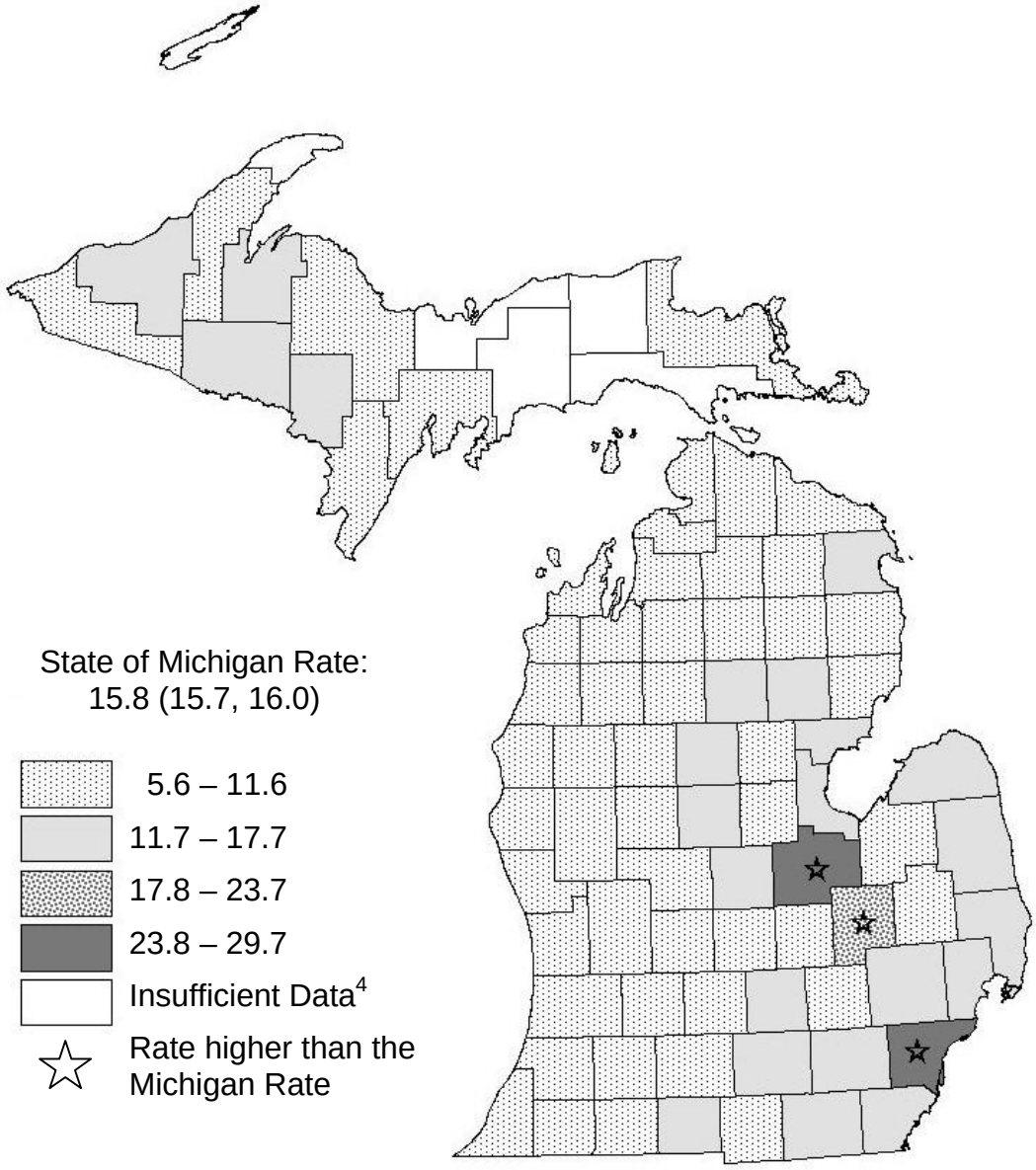
[1]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

Year	0 to 4 Avg (Std Dev)	5 to 14 Avg (Std Dev)	15 to 34 Avg (Std Dev)	35 to 64 Avg (Std Dev)	65 and Older Avg (Std Dev)
1990	2.8 (1.8)	2.8 (1.5)	3.6 (3.0)	5.3 (6.2)	7.0 (6.5)
1991	2.7 (1.8)	2.7 (1.6)	3.6 (3.5)	5.1 (4.9)	7.0 (9.7)
1992	2.6 (1.5)	2.6 (1.6)	3.6 (2.7)	5.1 (4.8)	6.8 (6.7)
1993	2.5 (1.7)	2.6 (1.7)	3.3 (2.4)	5.1 (5.0)	6.6 (6.6)
1994	2.4 (2.9)	2.5 (1.7)	3.1 (2.6)	4.7 (4.8)	6.2 (5.1)
1995	2.3 (1.6)	2.4 (1.6)	3.0 (2.4)	4.4 (3.6)	5.8 (4.8)
1996	2.2 (1.6)	2.4 (2.1)	2.9 (2.7)	4.1 (3.9)	5.4 (4.0)
1997	2.2 (1.5)	2.3 (1.4)	2.8 (3.7)	3.8 (3.3)	5.3 (4.7)
1998	2.1 (1.3)	2.2 (1.5)	2.8 (3.0)	3.9 (3.3)	4.9 (3.7)
1999	2.1 (5.0)	2.2 (1.4)	2.7 (1.9)	3.8 (3.2)	5.0 (4.0)
2000	2.0 (1.4)	2.2 (1.4)	2.6 (2.5)	3.7 (2.9)	4.8 (3.6)
2001	2.1 (2.1)	2.2 (1.4)	2.6 (2.1)	3.6 (3.0)	4.6 (3.8)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ The average length of stay for an asthma hospitalization generally increases with age.
- ✧ Between 1990 and 2001, there has been a significant overall decline in the length of stay for an asthma hospitalization in Michigan, in all age groups, (0 to 4: ρ= -.977, 5 to 14: ρ= -.979, 15 to 34: ρ= -.989, 35 to 64: ρ= -.981, 65 and older: ρ= -.991; all $p<0.01$).

Figure 4.14: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by County of Residence, Michigan, All Ages, 1999-2001



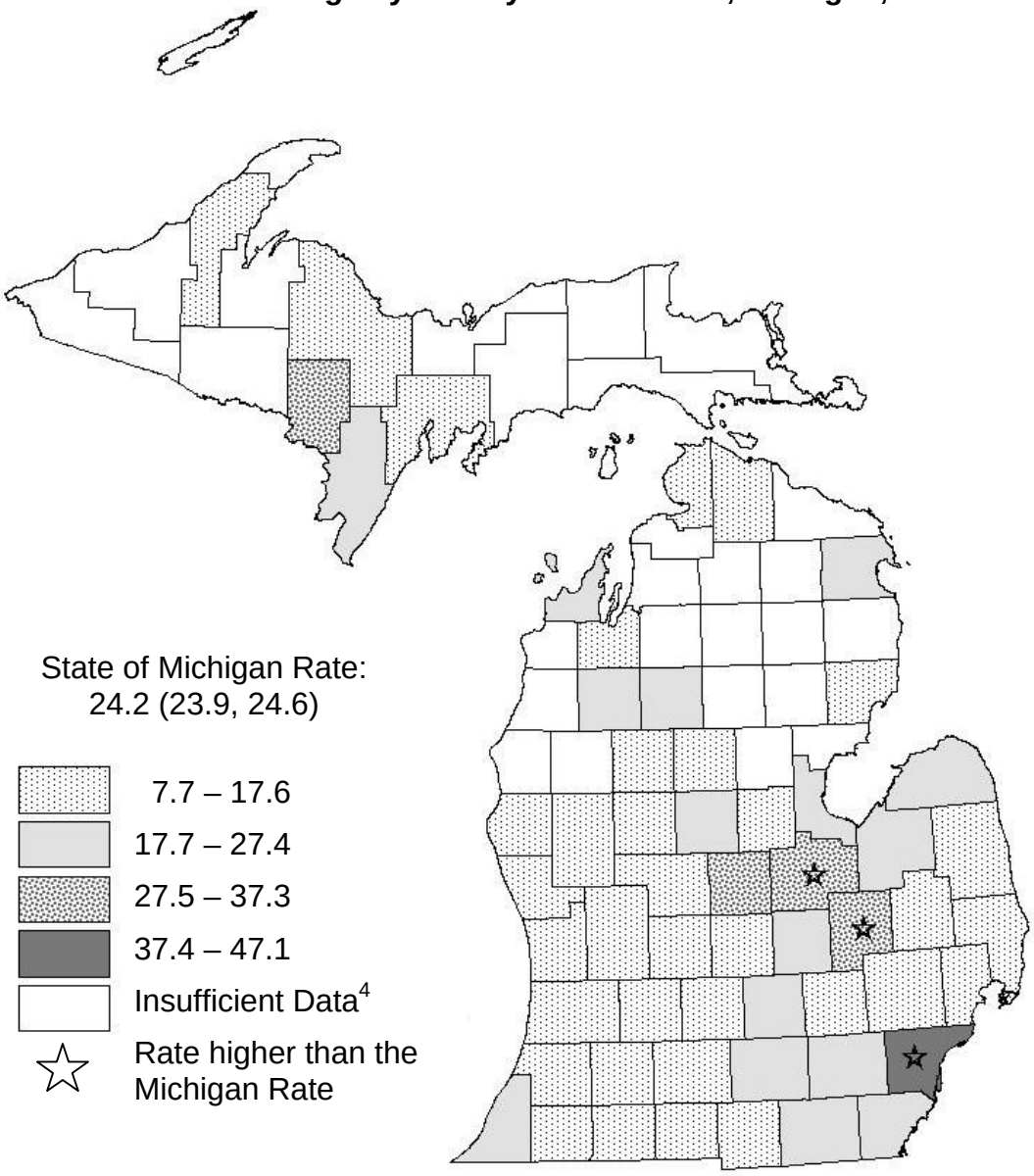
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Genesee, Saginaw, and Wayne counties have the highest hospitalization rates for asthma, significantly higher than that for the entire State of Michigan.

See Table 1 in Appendix for supporting data.

Figure 4.15: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Children < 18 Years of Age by County of Residence, Michigan, 1999-2001



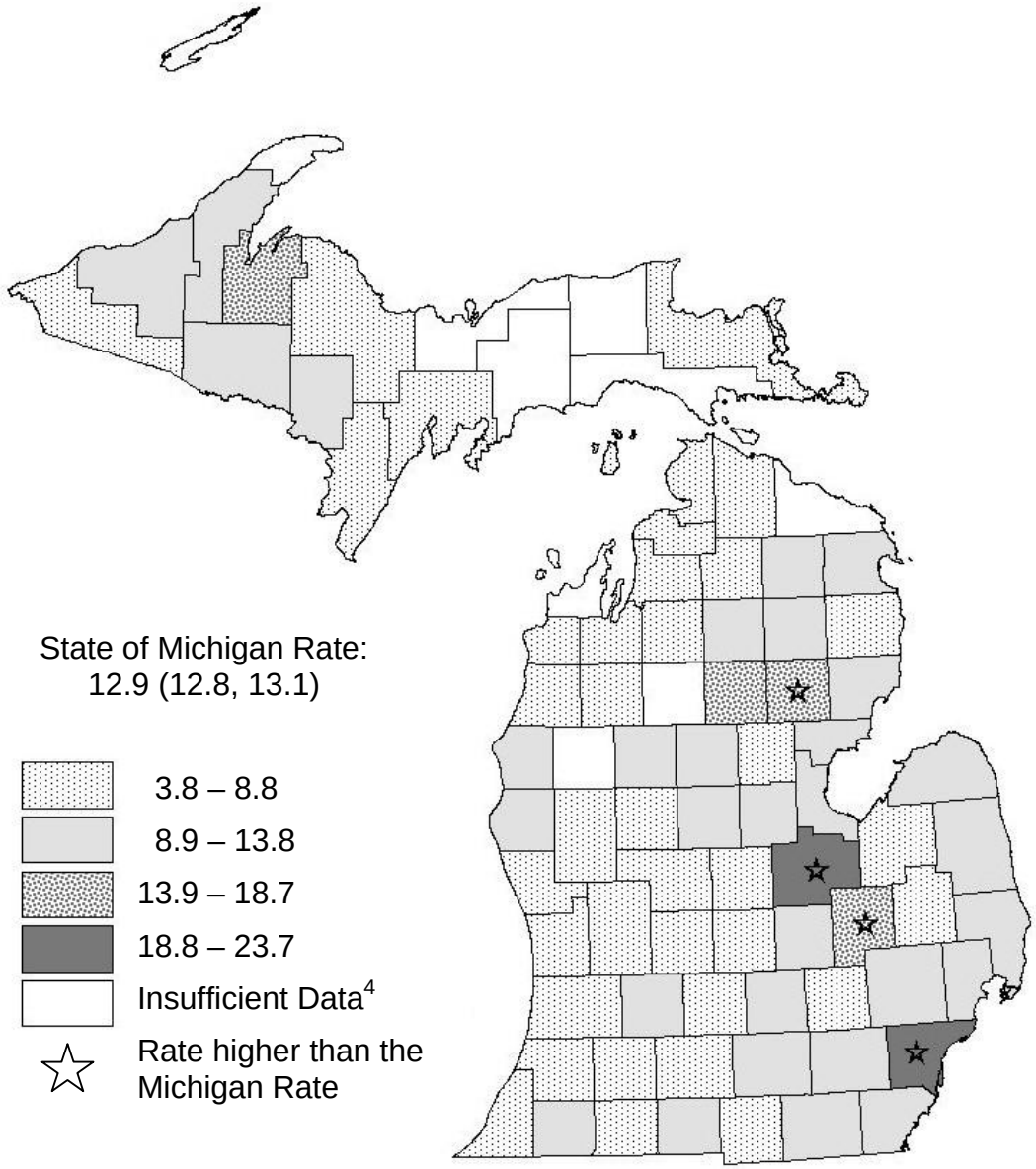
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ For children less than 18 years of age, Genesee, Saginaw, and Wayne counties have asthma hospitalization rates that are significantly higher than that for children in the entire State of Michigan.

See Table 2 in Appendix for supporting data.

Figure 4.16: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Adults ≥ 18 Years of Age by County of Residence, Michigan, 1999-2001



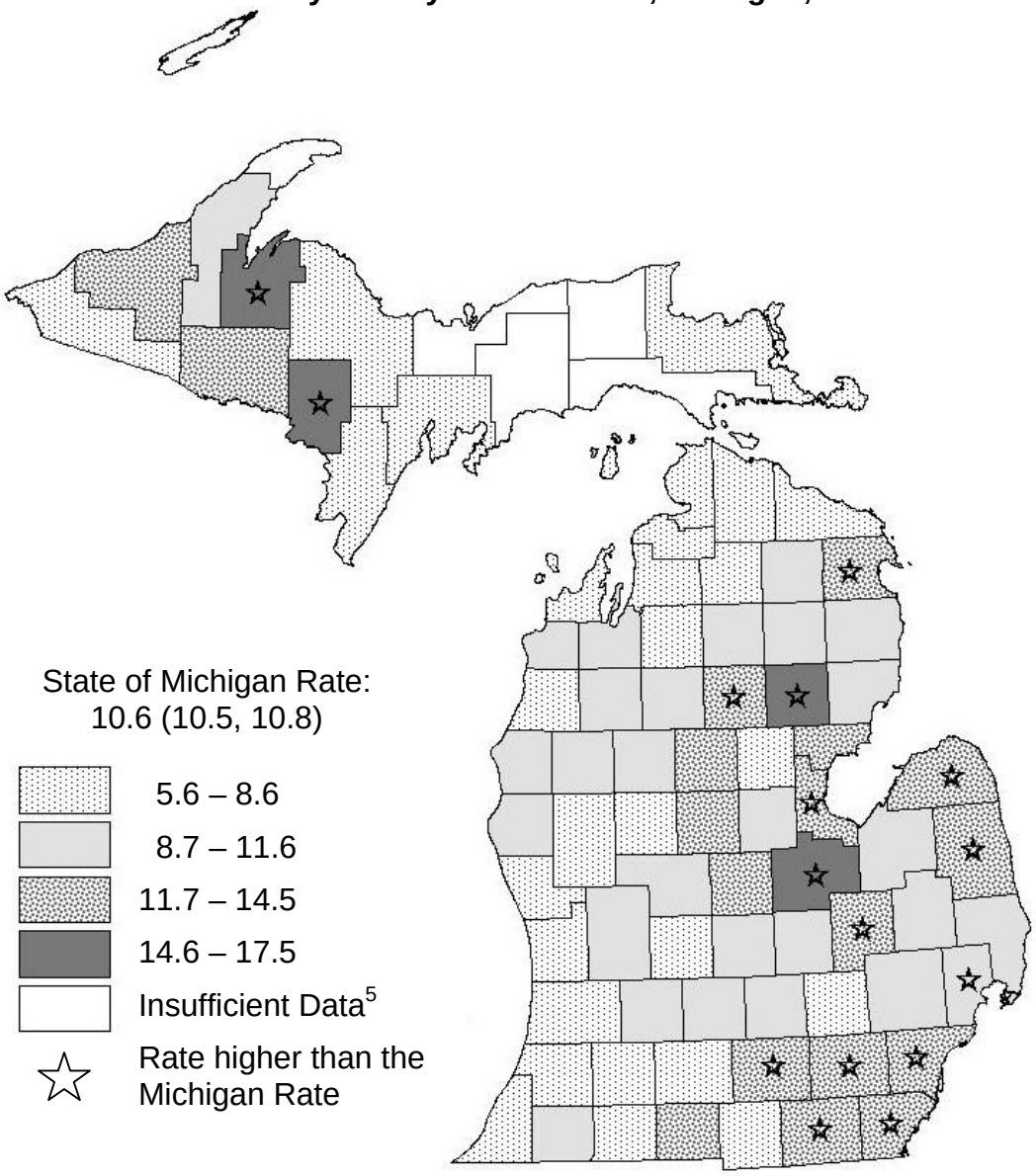
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ For adults 18 years of age or older, Genesee, Ogemaw, Saginaw, and Wayne counties have asthma hospitalization rates that are significantly higher than that for adults in the entire State of Michigan.

See Table 3 in Appendix for supporting data.

Figure 4.17: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for White[4] Persons by County of Residence, Michigan, 1999-2001



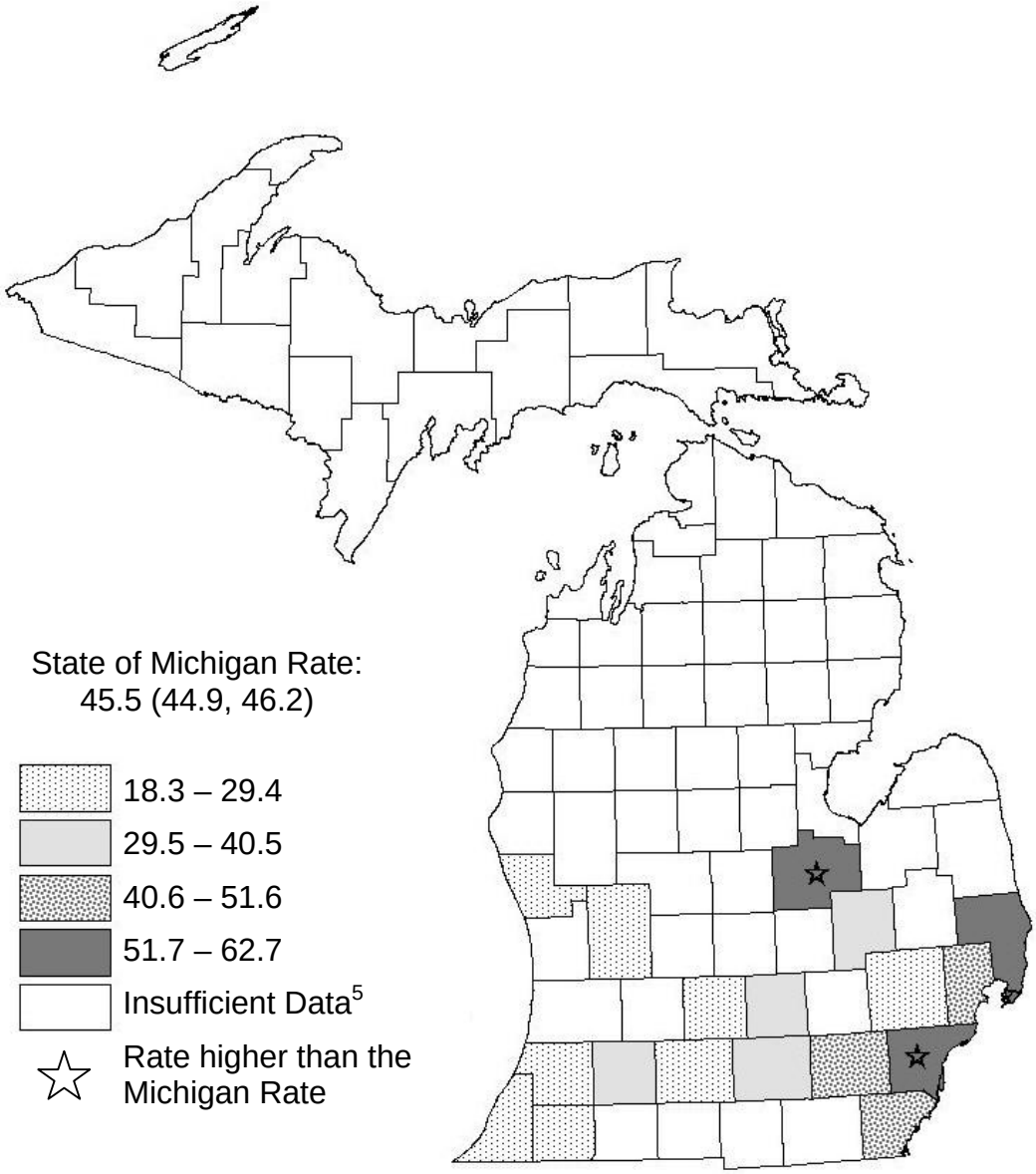
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 census population.
[5]Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ For white people, 16 counties have asthma hospitalization rates that are significantly higher than that for the entire State of Michigan: Alpena, Baraga, Bay, Dickenson, Genesee, Huron, Jackson, Lenawee, Macomb, Monroe, Ogemaw, Roscommon, Saginaw, Sanilac, Washtenaw, and Wayne.

See Table 4 in Appendix for supporting data.

Figure 4.18: Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Black[4] Persons by County of Residence, Michigan, 1999-2001



[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 census population.
[5]Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ For black people, Saginaw and Wayne counties have asthma hospitalization rates that are significantly higher than that for the entire State of Michigan.

See Table 5 in Appendix for supporting data.

Section 5: Asthma Mortality

Successful asthma management reduces symptoms and improves quality of life. Failure to maintain good control of the disease results in a higher risk of mortality. Death due to asthma is a rare and preventable event, indicative of access to care problems or difficulties in self-management.

Mortality data are acquired from the Michigan Resident Death Files for the years 1990 to 2001. This database includes all deaths in Michigan and deaths of Michigan residents where the death occurred out-of-state.

As recommended by the Council for State and Territorial Epidemiologists[1], deaths where asthma is primary cause are selected from these data. From 1990 to 1998, these are deaths with primary cause coded to International Classification of Disease (ICD) Version-9 codes 493.XX. Deaths occurring from 1999 to 2001 are classified according to ICD Version 10; ICD-10 codes for asthma are J45 and J46.

The ICD-10 coding scheme is different and more detailed than its predecessor, ICD-9. Deaths coded with ICD-10 are not directly comparable to deaths coded with ICD-9. The comparability ratio between ICD-9 and ICD-10 for asthma is 0.8938.[2] That is, for every 100 asthma deaths coded with ICD-9, only 89.38 would be coded as asthma using ICD-10. Therefore, for the analyses presented in this section, deaths occurring from 1990-1998 are adjusted for the ICD-9 to ICD-10 comparability ratio.

Age-adjusted asthma mortality rates are calculated and presented per 1,000,000 population. Rates are age adjusted so that valid comparisons can be made between populations of different age distributions.

Mortality rates for demographic units with a small number of events (less than 5 events) or a small population size (less than 5,000 population) are not calculated because these rates are statistically unstable. In addition, to protect the identity of persons who have been hospitalized, counts less than 5 are not presented in this report.

To determine if asthma mortality rates follow an increasing or decreasing trend over the 12-year period 1990-2001, the Spearman Correlation Coefficient, and its accompanying statistical Rank Correlation Test, are utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case, year and asthma death rate, without making any assumption about the underlying distribution of the data. This statistical test does not determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused a change in asthma mortality rates.

Ninety five percent confidence intervals are computed for asthma mortality rates where more than one year of data are combined. The confidence interval estimates the

[1] Council for State and Territorial Epidemiologists, Position Statement 1998-EH/CD 1.
[2] Anderson RN, Miniño AM, Hoyert DL, Rosenberg HM. Comparability of Cause of Death Between ICD-9 and ICD-10: Preliminary Estimates. National Vital Statistics Reports; 49(2). Hyattsville, Maryland: National Center for Health Statistics, 2001.

statistical uncertainty of the mortality rate and can be used to test whether rates are statistically different between groups. Average asthma mortality rates are considered statistically different between groups if their 95% confidence intervals do not overlap. This technique is used to compare rates for demographic subpopulations, such as male versus female.

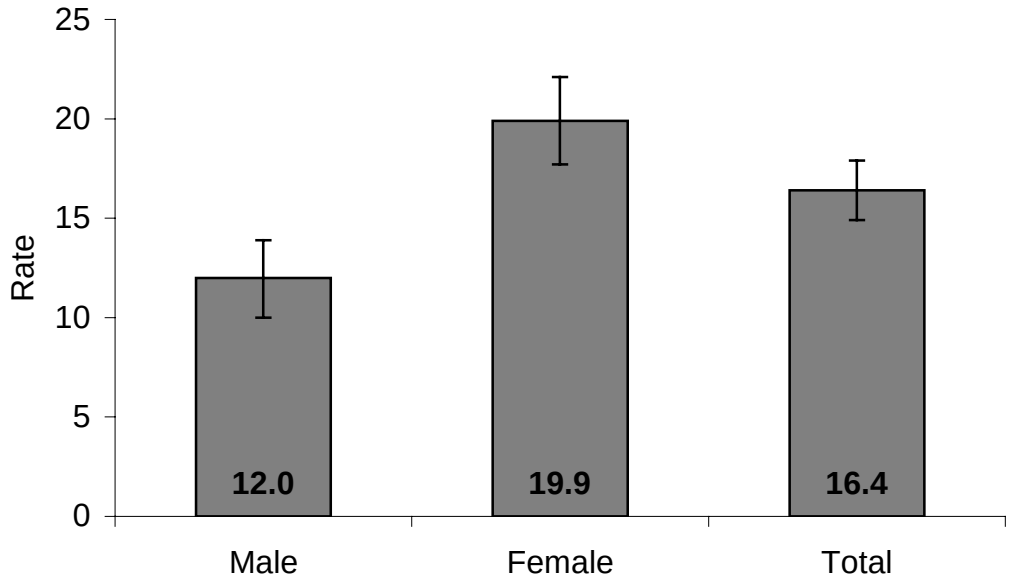
Additional information about asthma mortality is available in Section 6: Healthy People 2010 Objectives for Asthma, pp. 66 - 78.

MDCH is currently conducting a review of asthma deaths occurring in people 2-34 years of age. The purpose of this review is to identify risk factors that could be changed or addressed to prevent future asthma deaths in young people. Based on the review of 2002 asthma deaths, those risk factors are:

- ✧ Inadequate prescription of inhaled corticosteroids by health care providers.
- ✧ Patient noncompliance with asthma management, (i.e. failure to use steroids, follow up with medical care, eliminate or avoid triggers).
- ✧ Lack of health insurance and regular medical care with a primary care physician.
- ✧ Need for specialist referral and pulmonary function testing for high-risk asthma patients.

For more information on the Asthma Mortality Review, please see *2002 Annual Report on Asthma Deaths Among Individuals Aged 2-34 Years in Michigan* on the Asthma Initiative Website, (http://www.getasthmahelp.org/02AsthmaMortalityAnnRpt.pdf).

Figure 5.1: Rates[1, 2] (per 1,000,000) of Mortality due to Asthma[3] by Sex, Michigan, All Ages, 1999-2001



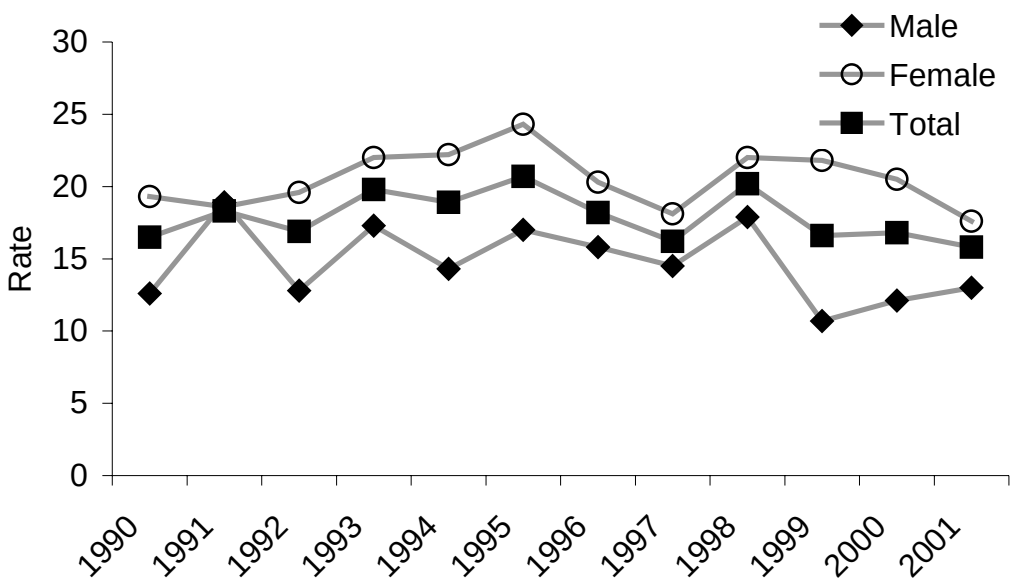
	Male	Female	Total
Rate	12.0	19.9	16.4
(95% CI)	(10.0, 13.9)	(17.7, 22.1)	(14.9, 17.9)
Count	156	323	479

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ The asthma mortality rate in Michigan, 1999 to 2001, is 16.4 per 1,000,000 population.
- ✧ Asthma mortality rates, 1999 to 2001, are higher among females (19.9 per 1,000,000 population) than males, (12.0 per 1,000,000 population).

Figure 5.2: Rates[1, 2] (per 1,000,000) of Mortality due to Asthma[3, 4] by Sex and Year, Michigan, All Ages, 1990-2001



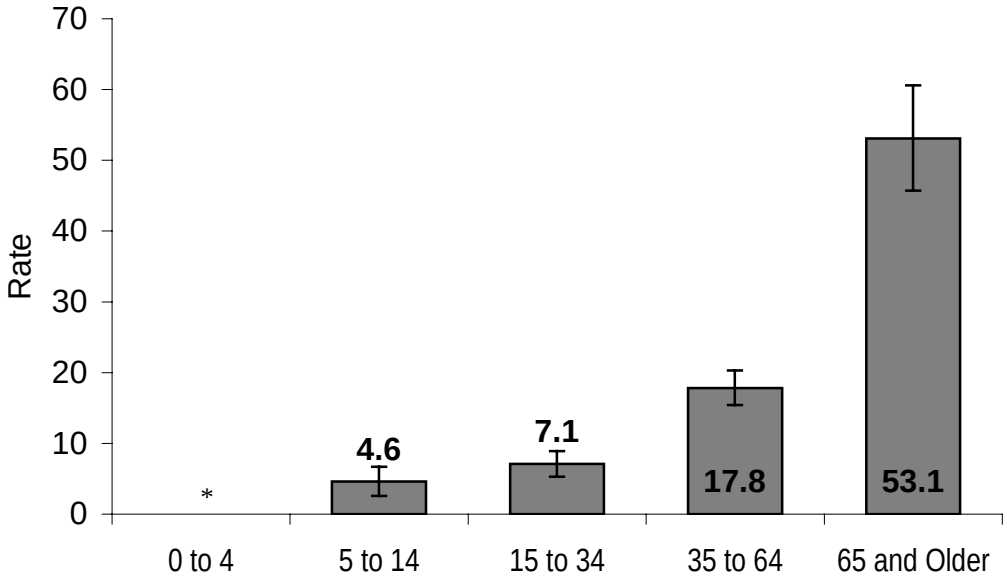
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method.
[2]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[3]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[4]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.

Year	Male Rate (Count)	Female Rate (Count)	Total Rate (Count)
1990	12.6 (50)	19.3 (93)	16.5 (143)
1991	18.9 (69)	18.6 (92)	18.3 (160)
1992	12.8 (51)	19.6 (98)	16.9 (148)
1993	17.3 (67)	22.0 (110)	19.8 (176)
1994	14.3 (58)	22.2 (116)	18.9 (173)
1995	17.0 (68)	24.3 (126)	20.7 (194)
1996	15.8 (64)	20.3 (107)	18.2 (170)
1997	14.5 (54)	18.1 (100)	16.2 (153)
1998	17.9 (74)	22.0 (121)	20.2 (194)
1999	10.7 (47)	21.8 (115)	16.6 (162)
2000	12.1 (53)	20.5 (111)	16.8 (164)
2001	13.0 (56)	17.6 (97)	15.8 (153)

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

✧ There is no significant trend in Michigan asthma mortality rates between 1990 to 2001 for males, females, or all persons combined, (Males: ρ=-0.29; Females: ρ=-0.03; Total ρ= -0.29; All p>0.3).

Figure 5.3: Rates[1] (per 1,000,000) of Mortality due to Asthma[2] by Age Group, Michigan, All Ages, 1999-2001



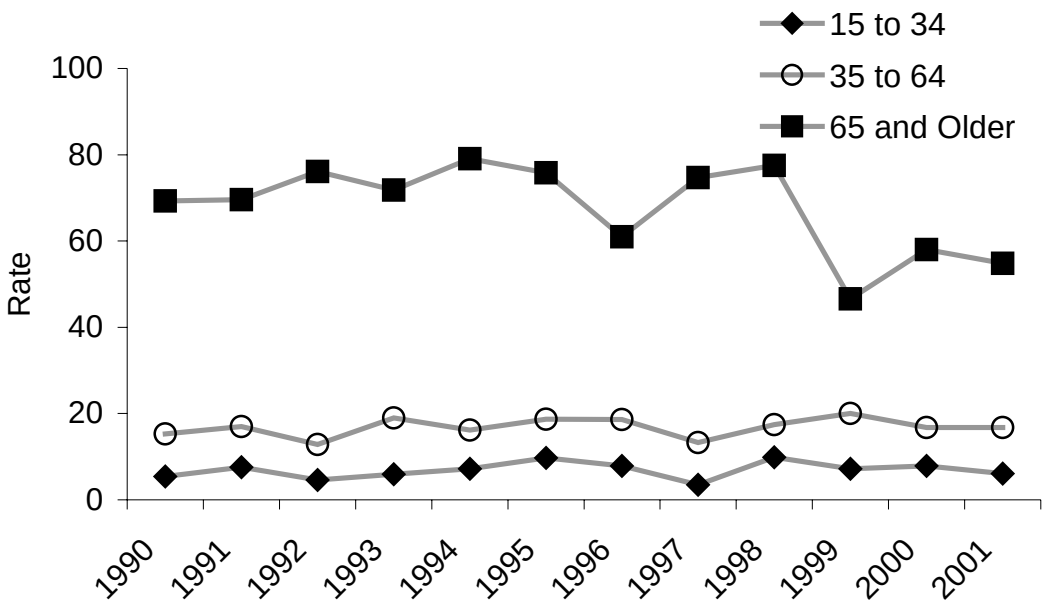
Rate		4.6	7.1	17.8	53.1
(95% CI)	*	(2.6, 6.7)	(5.3, 8.9)	(15.4, 20.3)	(45.7, 60.6)
Count		20	59	201	195

[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
*Number of deaths < 5 and > 0.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ Asthma mortality rates increase with age group.
- ✧ The highest age-specific asthma mortality rate in Michigan, 1999 to 2001, is among adults ages 65 years or older, (53.1 per 1,000,000 population).

Figure 5.4: Rates[1] (per 1,000,000) of Mortality due to Asthma[2,3] by Age Group and Year, Michigan, Age 15 and Older, 1990-2001



[1] Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2] Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[3]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.

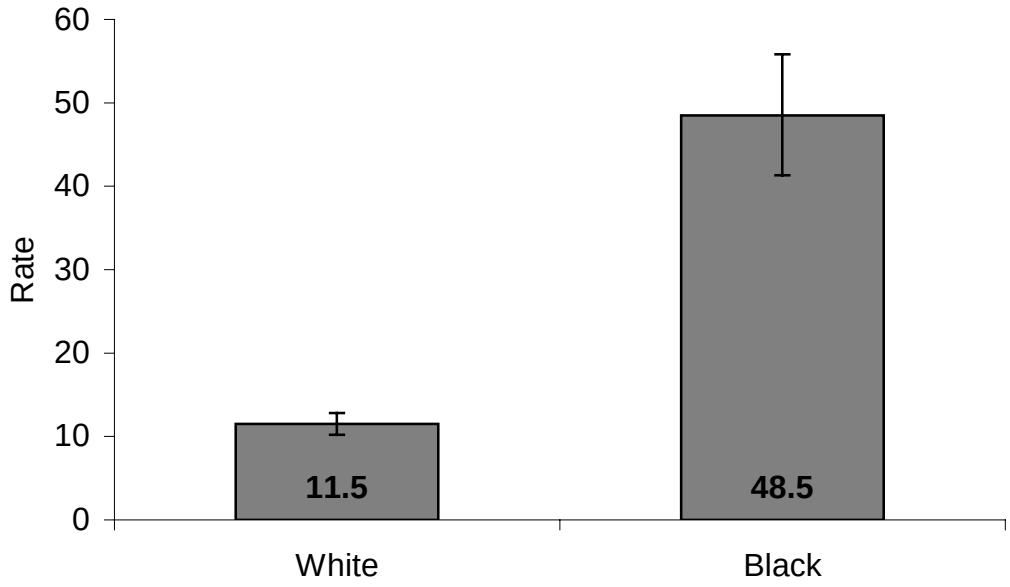
Year	0 to 4 Rate (Count)	5 to 14 Rate (Count)	15 to 34 Rate (Count)	35 to 64 Rate (Count)	65+ Rate (Count)
1990	(0)	*	5.4 (17)	15.3 (49)	69.3 (77)
1991	*	*	7.6 (23)	17.0 (55)	69.6 (79)
1992	*	*	4.6 (14)	12.8 (43)	76.1 (88)
1993	*	5.1 (8)	5.9 (17)	19.0 (64)	71.8 (85)
1994	*	*	7.2 (21)	16.2 (56)	79.1 (94)
1995	*	4.4 (7)	9.7 (28)	18.7 (66)	75.8 (92)
1996	*	4.4 (7)	7.9 (23)	18.6 (67)	61.0 (75)
1997	(0)	*	3.5 (10)	13.3 (49)	74.7 (92)
1998	*	3.1 (5)	9.9 (28)	17.4 (65)	77.5 (95)
1999	*	6.3 (9)	7.2 (20)	20.0 (75)	46.6 (57)
2000	*	4.2 (6)	7.9 (22)	16.8 (63)	58.0 (71)
2001	*	3.5 (5)	6.1 (17)	16.8 (63)	54.8 (67)

*Number of deaths < 5 and > 0.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

✧ There is no significant trend in Michigan age-specific asthma mortality rates over the time period from 1990 to 2001, (15 to 34: ρ=0.31; 35 to 64: ρ=0.24; 65+: ρ=-0.42; All p>0.1).

Figure 5.5: Rates[1, 2] (per 1,000,000) of Mortality due to Asthma[3] by Race, Michigan, All Ages, 1999-2001



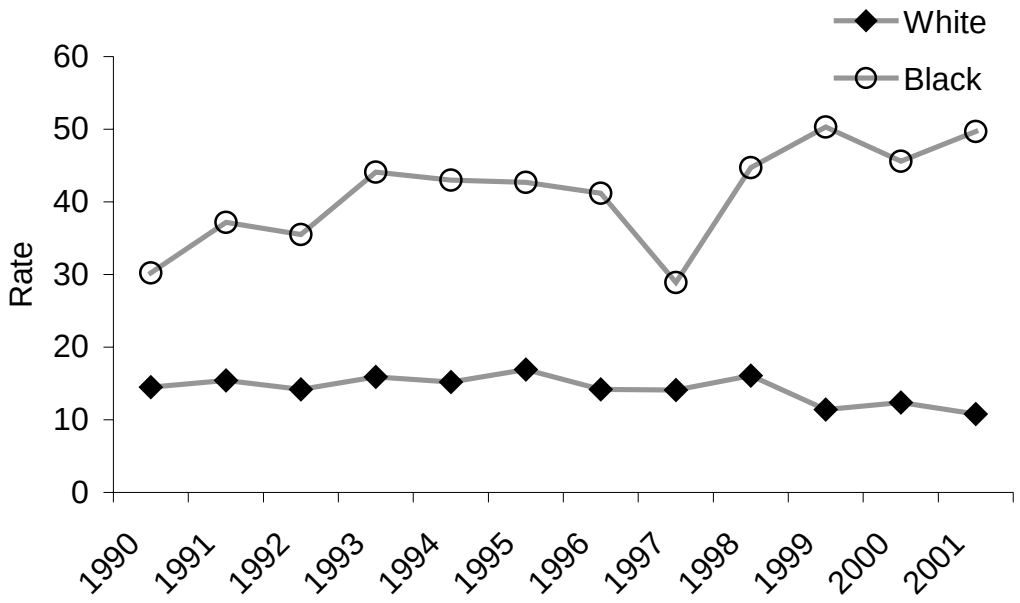
	White	Black
Rate	11.5	48.5
(95% CI)	(10.2, 12.8)	(41.3, 55.8)
Count	292	180

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ The asthma mortality rate for white persons in Michigan, 1999 to 2001, is 11.5 per 1,000,000 population.
- ✧ The asthma mortality rate for black persons in Michigan, 1999 to 2001, is 48.5 per 1,000,000 population.
- ✧ The mortality rate for black persons is over 4 times the rate for white persons.

Figure 5.6: Rates[1, 2] (per 1,000,000) of Mortality due to Asthma[3,4] by Race and Year, Michigan, All Ages, 1990-2001



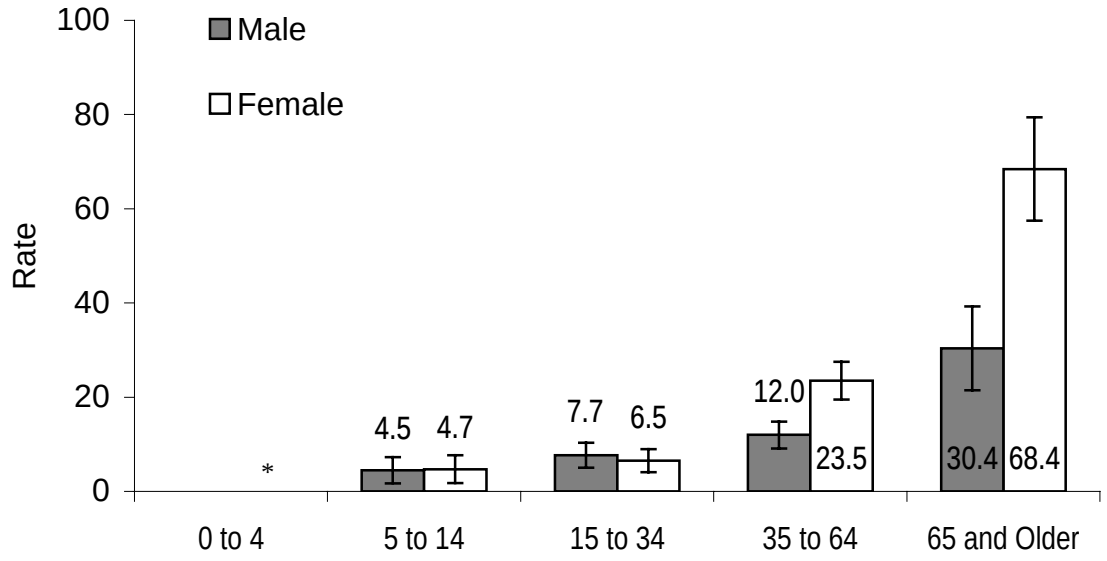
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method.
[2]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[3]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[4]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.

Year	White Rate (Count)	Black Rate (Count)
1990	14.5 (110)	30.2 (33)
1991	15.4 (116)	37.2 (44)
1992	14.2 (110)	35.5 (37)
1993	15.9 (122)	44.1 (52)
1994	15.2 (121)	43.0 (51)
1995	16.9 (137)	42.7 (54)
1996	14.2 (115)	41.2 (53)
1997	14.1 (117)	28.9 (33)
1998	16.1 (135)	44.7 (57)
1999	11.4 (96)	50.3 (64)
2000	12.4 (105)	45.6 (56)
2001	10.8 (91)	49.7 (60)

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ For black persons, there is a significant overall increase in asthma mortality rates from 1990 to 2001, (ρ=0.71, p<0.05). There is no significant trend observed for white persons, (ρ=-0.55, p>0.05).
- ✧ The difference between the asthma mortality rates for whites and blacks demonstrates a significant overall increase from 1990 to 2001, (ρ=0.72, p<0.01).

Figure 5.7: Rates[1] (per 1,000,000) of Mortality due to Asthma[2] by Sex and Age Group, Michigan, All Ages, 1999-2001



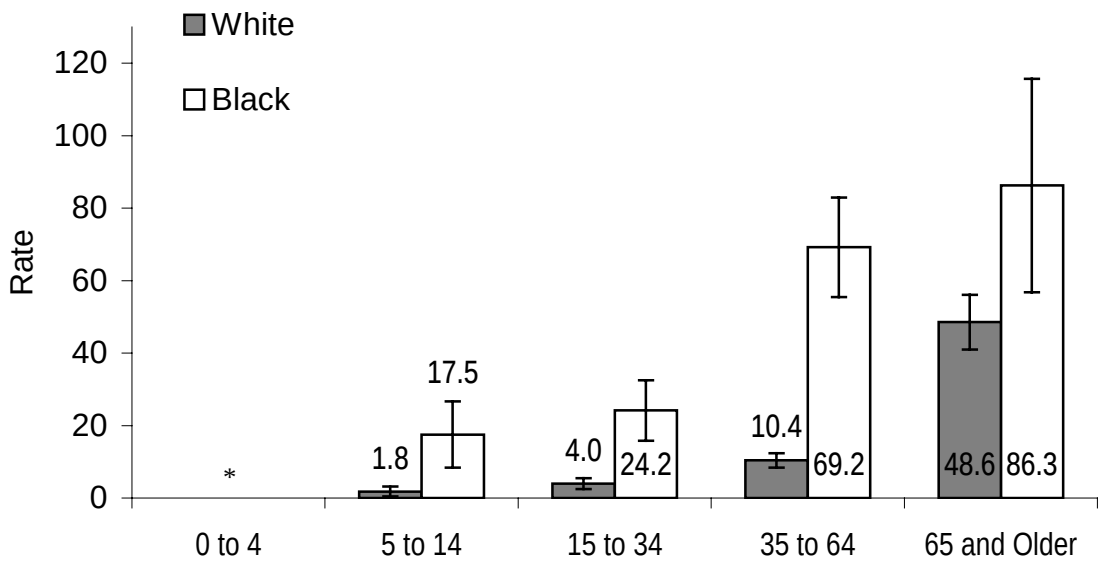
[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
*Number of deaths < 5 and > 0.

Rate	0 to 4	5 to 14	15 to 34	35 to 64	65+
Male		4.5	7.7	12.0	30.4
(95% CI)	*	(1.7, 7.3)	(5.0, 10.3)	(9.1, 14.8)	(21.5, 39.3)
Count		10	32	66	45
Female		4.7	6.5	23.5	68.4
(95% CI)	*	(1.8, 7.7)	(4.1, 9.0)	(19.5, 27.5)	(57.5, 79.4)
Count		10	27	135	150

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ Females age 65 years and older experience the highest asthma mortality rate, 1999 to 2001, (68.4 per 1,000,000 population).
- ✧ Although the majority of asthma deaths occur in ages 35 and older, deaths do occur among adolescents and young adults. Death due to asthma is generally preventable.

Figure 5.8: Rates[1] (per 1,000,000) of Mortality due to Asthma[2] by Race and Age Group, Michigan, All Ages, 1999-2001



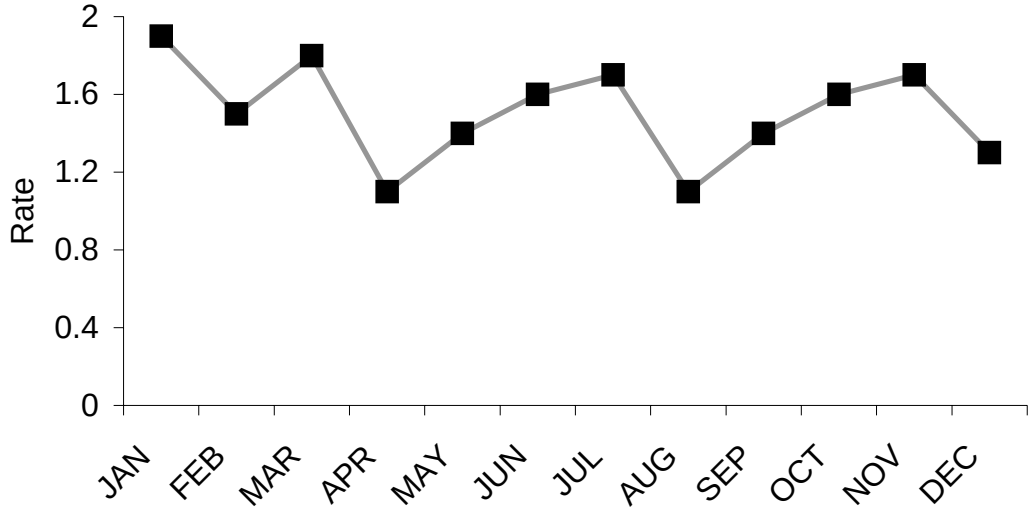
[1] Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
*Number of deaths < 5 and > 0.

Rate	0 to 4	5 to 14	15 to 34	35 to 64	65+
White		1.8	4.0	10.4	48.6
(95% CI)	*	(0.4, 3.2)	(2.5, 5.5)	(8.4, 12.4)	(41.0, 56.1)
Count		6	27	100	158
Black		17.5	24.2	69.2	86.3
(95% CI)	*	(8.4, 26.7)	(15.8, 32.5)	(55.5, 82.9)	(56.8, 115.7)
Count		14	32	98	33

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ Black persons age 35 years and older experience the highest asthma mortality rate, 1999 to 2001.
- ✧ Black persons experience higher asthma mortality rates than white persons, regardless of age group.

Figure 5.9: Rates[1, 2] (per 1,000,000) of Mortality due to Asthma[3] by Month of Death, Michigan, All Ages, 1999-2001



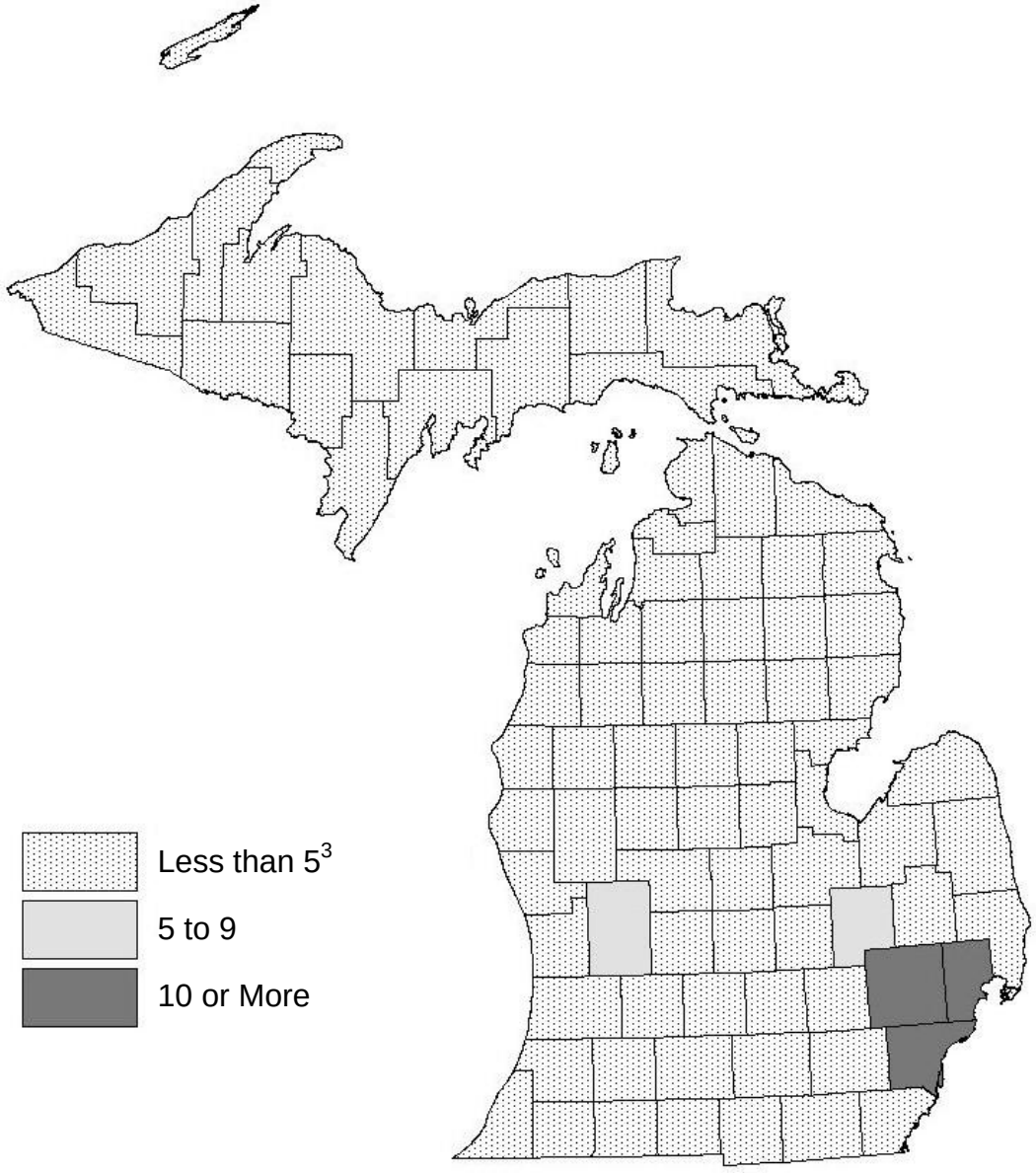
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.

Month	Count	Rate	95% CI
JAN	54	1.9	1.4, 2.4
FEB	43	1.5	1.0, 1.9
MAR	52	1.8	1.3, 2.3
APR	32	1.1	0.7, 1.5
MAY	40	1.4	1.0, 1.8
JUN	46	1.6	1.1, 2.0
JUL	49	1.7	1.2, 2.2
AUG	31	1.1	0.7, 1.4
SEP	42	1.4	1.0, 1.9
OCT	46	1.6	1.1, 2.0
NOV	50	1.7	1.2, 2.2
DEC	39	1.3	0.9, 1.7

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

✧ There is no discernable seasonal pattern in asthma mortality rates over the months of the year, 1999 to 2001.

Figure 5.10: Average Number of Deaths per Year due to Asthma[1,2] by County of Residence, Michigan, All Ages, 1990-2001



[1]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[2]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.
[3]Keweenaw County had 0 deaths from 1990 to 2001. All other counties in this group had at least 1 death.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ There are too few events to calculate statistically stable asthma mortality rates by county.
- ✧ The highest annual average numbers of deaths due to asthma occur in Macomb, Oakland, and Wayne counties. This is at least in part due to the large population size in these counties.

See Table 6 in Appendix for supporting data.

Section 6: Healthy People 2010 Objectives for Asthma

Sponsored by the U.S. Department of Health and Human Services, the *Healthy People 2010* initiative is a comprehensive set of disease prevention and health promotion objectives for the nation to achieve over the first decade of the new century. Created by scientists both inside and outside of government, it identifies a wide range of public health priorities and specific, measurable objectives. It can be used by many different people, states, communities, professional organizations, and others to help them develop and evaluate programs to improve health.

As national benchmarks, the *Healthy People 2010* objectives are used widely at the national, state, and community level. The targets for each asthma objective were chosen based on national baseline data and the pursuit of a "better than best" goal. In utilizing these objectives for asthma, Michigan can direct its efforts to achieving national goals, compare its asthma burden to others, and measure progress over time in achieving the objectives.

For more information about the *Healthy People 2010* initiative, visit their website: http://www.healthypeople.gov.

The Healthy People 2010 Objectives Related to Asthma Outcomes, Management, and Quality of Life:

1-9a. Reduce hospitalization rates for three ambulatory-care-sensitive conditions: **pediatric asthma**, uncontrolled diabetes, and immunization preventable pneumonia and influenza.

Target: 17.3 asthma hospitalizations per 10,000, less than 18 years of age

24-1. Reduce asthma deaths.

Targets:
1 per 1,000,000, age 0 to 4 years
1 per 1,000,000, age 5 to 14 years
2 per 1,000,000, age 15 to 34 years
9 per 1,000,000, age 35 to 64 years
60 per 1,000,000, age 65 years or older

24-2 Reduce hospitalizations for asthma.

Targets:
25 per 10,000, age 0 to 4 years
7.7 per 10,000, age 5 to 64 years*
11 per 10,000, age 65 years or older*

*Age adjusted to the 2000 U.S. standard population.

24-2 Reduce emergency department visits for asthma.

Targets: 80 per 10,000, age 0 to 4 years
50 per 10,000, age 5 to 64 years
15 per 10,000, age 65 years or older

24.4. Reduce activity limitations among persons with asthma.

Target: 10%*

*Age adjusted to the 2000 U.S. standard population.

24.5. Reduce the number of school or workdays missed by persons with asthma due to asthma.

Target: Not Identified; Developmental Objective

24.6. Increase the proportion of persons with asthma who receive formal patient education, including information about community and self-help resources, as an essential part of the management of their condition.

Target: 30%*

*Age adjusted to the 2000 U.S. standard population.

24-7. Increase the proportion of persons with asthma who receive appropriate asthma care according to the National Asthma Education and Prevention Program (NAEPP) Guidelines.[1] Measured as persons with asthma who receive:

- written asthma management plans from a health care provider.
- instruction on how to use a prescribed inhaler properly.
- education about recognizing early signs & symptoms of asthma episodes and how to respond properly, with lessons on peak flow monitoring for those using daily therapy.
- medication regimens that prevent the need for more than 1 canister of short acting inhaled beta agonists per month for relief of symptoms.
- follow-up medical care for long-term management after a hospitalization due to asthma.
- assistance with assessing and reducing exposure to environmental risk factors.

Target: Not Identified; Developmental Objective

[1] Expert Panel on the Management of Asthma. Guidelines for the Diagnosis and Management of Asthma. National Institutes of Health, National Heart, Lung, and Blood Institute. July 1997; No. 97-4051: 1-146.

Comparing Michigan and the U.S. to the *Healthy People 2010* Targets for Asthma

Objective	Age Group	HP 2010 Target	United States [a]	Michigan [a]
1-9a. Reduce pediatric asthma hospitalization rate, (Rate per 10,000).	< 18 Years	17.3	21.4[1]	24.2[6]
24-1. Reduce asthma deaths, (Rate per million).	0-4 Years	1	2.1[2]	< 5 deaths[e]
	5-14 Years	1	3.3[2]	3.5[7]
	15-34 Years	2	5.5[2]	6.1[7]
	35-64 Years	9	15.2[2]	16.8[7]
	≥ 65 Years	60	65.8[2]	54.8[7]
24-2. Reduce hospitalizations for asthma, (Rate per 10,000).	0-4 Years	25	64.0[3]	49.7[6]
	5-64 Years	7.7[b]	12.1[b, 3]	12.6[b, 6]
	≥ 65 Years	11[b]	19.6[b, 3]	16.5[b, 6]
24-3. Reduce emergency department visits for asthma, (Rate per 10,000).	0-4 Years	80	158.5[4]	Data not available
	5-64 Years	50	70.2[4]	
	≥ 65 Years	15	31.8[4]	
24-4. Reduce activity limitations among persons with asthma.	c	10%[b]	20%[b, 5]	Data not available
24-5. Reduce number of school/work days missed due to asthma.	c	d	Data not available	Data not available
24-6. Increase number who receive formal asthma education.	c	30%[b]	13.8%[b, 5]	Data not available
24-7. Increase number who receive appropriate asthma care.	c	d	Data not available	Data not available

Notes:
a. Latest data available that is comparable to the *Healthy People 2010* targets.
b. Age adjusted to the year 2000 U.S. standard population.
c. No specified age group.
d. 2010 target not identified; developmental objective.
e. Insufficient data to compute a stable rate, (Number of deaths < 5, but > 0).

Data Sources: All national data available at the Data 2010 website: http://wonder.cdc.gov/data2010/.
[1]Healthcare Cost and Utilization Project 2001, AHRQ.
[2]National Vital Statistics System-Mortality 2000, CDC, NCHS.
[3]National Hospital Discharge Survey 2000, CDC, NCHS.
[4]National Hospital Ambulatory Medical Care Survey 2000, CDC, NCHS.
[5]National Health Interview Survey 1994-1996, CDC, NCHS.
[6]Michigan Inpatient Database 2001, MDCH.
[7]Michigan Resident Death File 2001, MDCH.

- ✧ Most recent asthma mortality rates indicate that Michigan has met the target rate for adults age 65 and older. For all other targets where data are available, Michigan has not met the *Healthy People 2010* goals.
- ✧ Michigan's surveillance of asthma is incomplete, due to the lack of data systems available for analysis. Therefore, Michigan is unable to measure its progress in meeting all the *Healthy People 2010* goals for asthma.

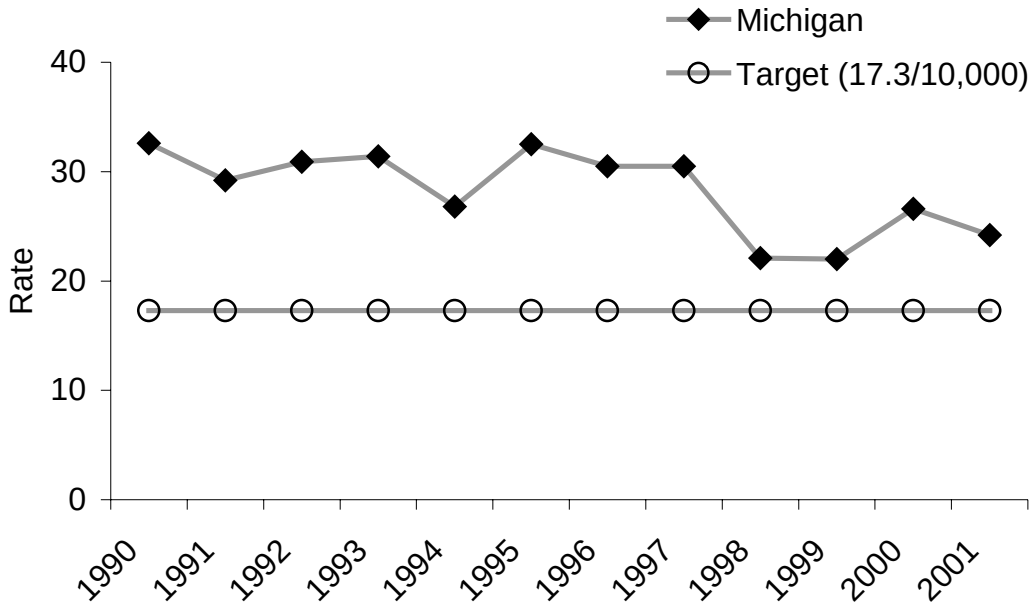
Additional Information

- **Objective 24-3:** Although Michigan does not have data available to compute asthma emergency department visit rates comparable to the *Healthy People 2010* targets, the Michigan Behavioral Risk Factor Surveillance Survey (2001), conducted by the Michigan Department of Community Health, provides an estimate. Among adults (≥ 18 years) reporting that they have current asthma, 18.8% reported having 1 or more visits to the Emergency Room or Urgent Care Center for treatment of asthma in the past 12 months.

- **Objective 24-4:** Michigan does not have data available to determine the proportion of all persons with asthma that experience activity limitations comparable to the *Healthy People 2010* target. However, an estimate can be determined for the adult population from the Michigan Behavioral Risk Factor Surveillance Survey (2001). Among adults (≥ 18 years) who stated that they had current asthma, 34.1% reported limitations in their activities due to any physical, mental, or emotional problems or required the use of special equipment for a health problem. Nearly 27% of adults with current asthma experience at least 1 day a year where they are unable to work or carry out their usual activities due to their asthma.

- **Objective 24-5:** This is a developmental objective and therefore does not have an operational definition. Results from the Michigan Behavioral Risk Factor Surveillance Survey (2001) indicate that adults with asthma (≥ 18 years) experienced an average of 10.3 days of restricted activities due to their asthma. About 25% of adults that currently have asthma experience at least 1 day where they are unable to work or carry out their usual activities due to their asthma.

Figure 6.1: Rates[1] (per 10,000) of Hospitalization due to Asthma[2] Compared to *Healthy People 2010* Target for Objective 1-9a, for Children (<18 Years), Michigan, 1990 to 2001



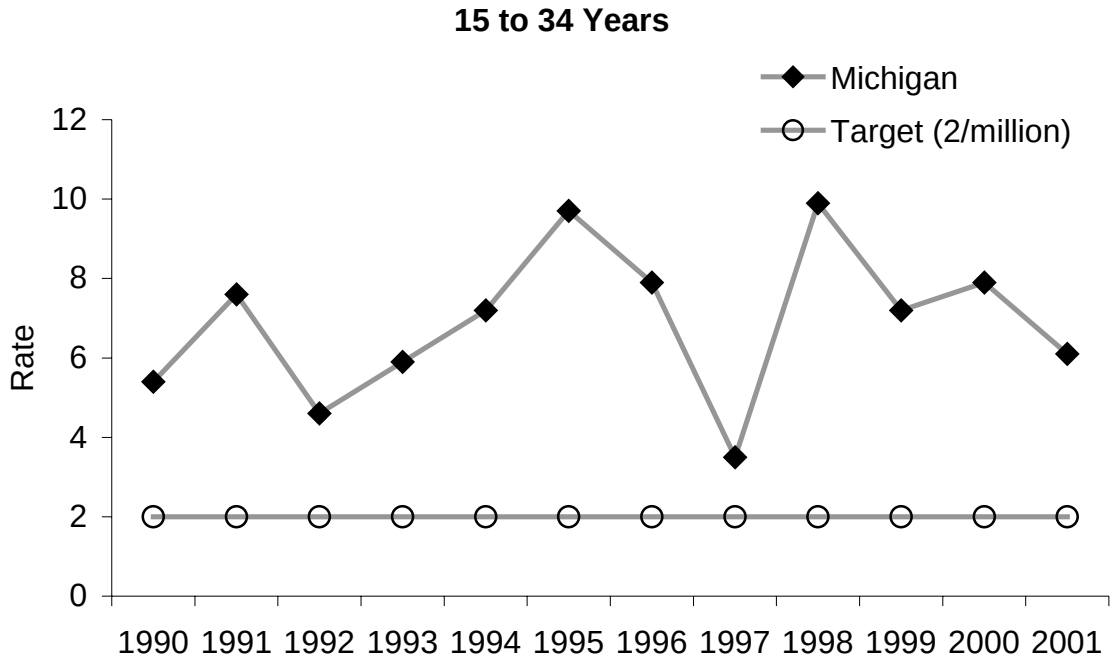
[1]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.

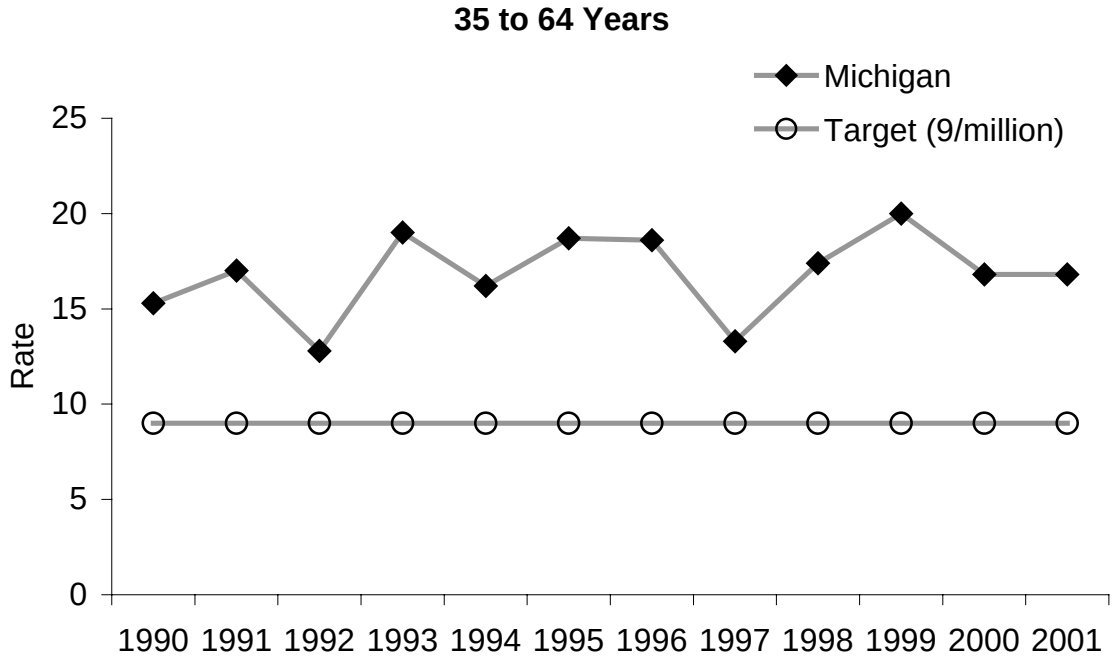
Year	Count	Rate
1990	8,063	32.6
1991	7,254	29.2
1992	7,735	30.9
1993	7,875	31.4
1994	6,757	26.8
1995	8,221	32.5
1996	7,769	30.5
1997	7,742	30.5
1998	5,594	22.1
1999	5,546	22.0
2000	6,693	26.6
2001	6,089	24.2

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

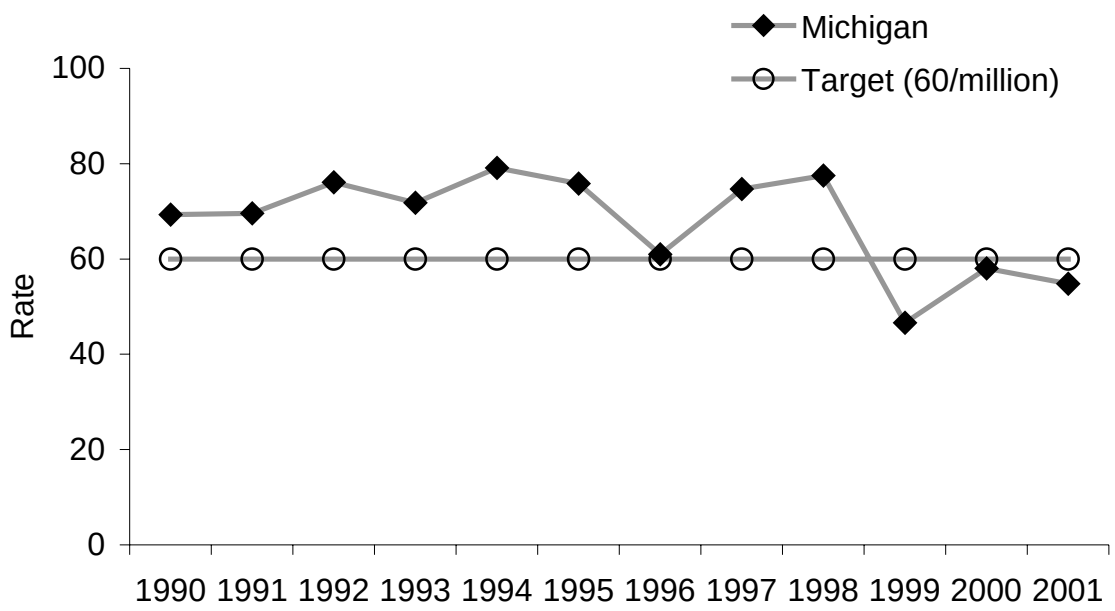
- ✧ All annual Michigan asthma hospitalization rates for children are significantly greater than the *Healthy People 2010* target.
- ✧ Between 1990 and 2001, there has been a significant overall decline in asthma hospitalization rates for this age group in Michigan, toward the *Healthy People 2010* target rate, (ρ=-0.73, p<0.01).

Figure 6.2: Rates[1] (per 1,000,000) of Asthma[2, 3] Mortality by Age Group Compared to *Healthy People 2010* Targets for Objective 24-1, Age >14 Years, Michigan, 1990 to 2001.





65 Years and Older



[1]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[3]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.

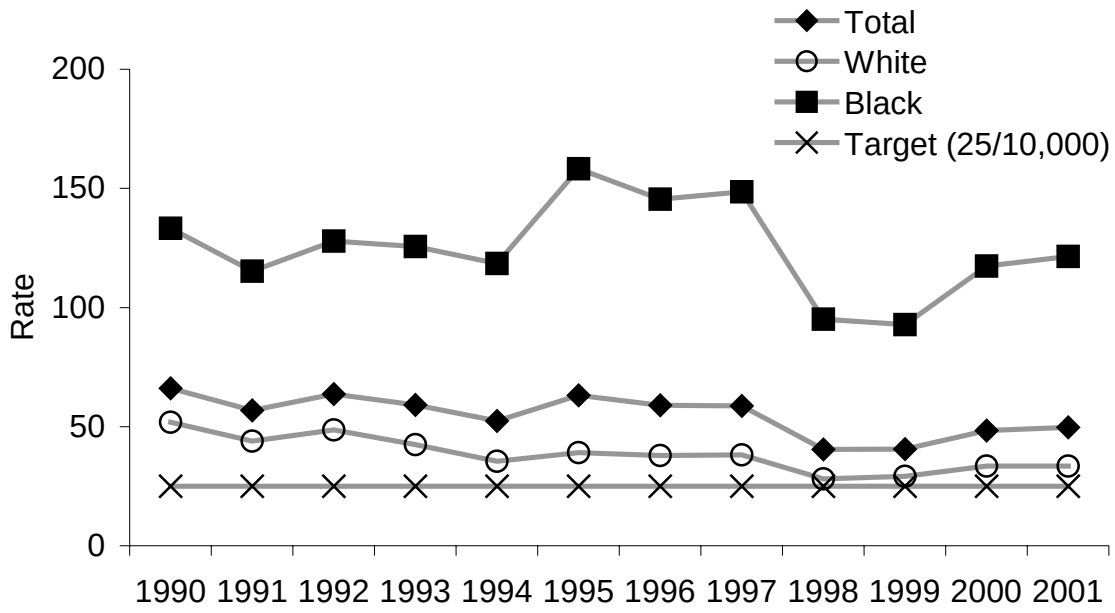
Year	0 to 4 Rate (Count)	5 to 14 Rate (Count)	15 to 34 Rate (Count)	35 to 64 Rate (Count)	65+ Rate (Count)
1990	(0)	*	5.4 (16)	15.3 (48)	69.3 (77)
1991	*	*	7.6 (22)	17.0 (55)	69.6 (79)
1992	*	*	4.6 (13)	12.8 (42)	76.1 (88)
1993	*	5.1 (7)	5.9 (17)	19.0 (63)	71.8 (84)
1994	*	*	7.2 (21)	16.2 (55)	79.1 (94)
1995	*	4.4 (6)	9.7 (28)	18.7 (65)	75.8 (91)
1996	*	4.4 (6)	7.9 (22)	18.6 (66)	61.0 (74)
1997	(0)	*	3.5 (10)	13.3 (48)	74.7 (91)
1998	*	*	9.9 (28)	17.4 (64)	77.5 (95)
1999	*	6.3 (9)	7.2 (20)	20.0 (75)	46.6 (57)
2000	*	4.2 (6)	7.9 (22)	16.8 (63)	58.0 (71)
2001	*	3.5 (5)	6.1 (17)	16.8 (63)	54.8 (67)

*Number of deaths < 5 and > 0.

Data Source: Michigan Resident Death Files, Bureau of Epidemiology, MDCH

- ✧ All of the annual rates of asthma mortality in Michigan are higher than the *Healthy People 2010* target rate for adolescents and adults ages 15 to 34 and 35 to 64.
- ✧ For adults age 65 years and older, asthma mortality rates in recent years have successfully met the *Healthy People 2010* target rate.

Figure 6.3: Rates[1] of Asthma[2] Hospitalization (per 10,000) by Year and Race[3, 4], Compared to *Healthy People 2010* Target for Objective 24-2, Age 0 to 4 Years, Michigan, 1990 to 2001.



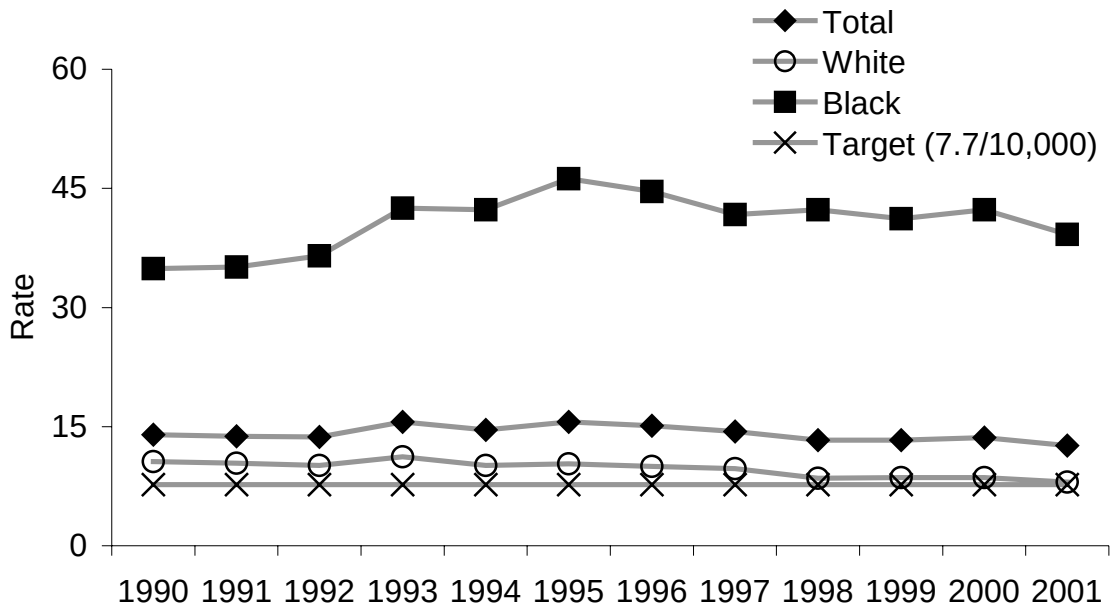
[1]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[3]For records that are missing data on race, race was assigned based on the 1990 census population.
[4]Insufficient data to compute a stable rate for races other than white or black.

Year	Total Rate (Count)	White Rate (Count)	Black Rate (Count)
1990	66.1 (4,712)	51.8 (2,944)	133.2 (1,711)
1991	56.8 (4,106)	43.9 (2,503)	115.2 (1,565)
1992	63.7 (4,638)	48.6 (2,768)	127.9 (1,811)
1993	59.1 (4,291)	42.4 (2,402)	125.6 (1,815)
1994	52.4 (3,783)	35.4 (1,985)	118.5 (1,719)
1995	63.1 (4,457)	39.1 (2,151)	158.2 (2,214)
1996	59.0 (4,092)	37.9 (2,063)	145.4 (1,945)
1997	58.7 (4,019)	38.1 (2,055)	148.6 (1,905)
1998	40.4 (2,734)	28.1 (1,506)	95.1 (1,178)
1999	40.5 (2,725)	29.2 (1,556)	92.8 (1,120)
2000	48.4 (3,257)	33.4 (1,781)	117.4 (1,416)
2001	49.7 (3,341)	33.4 (1,780)	121.4 (1,464)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2001, there was a significant overall decline in asthma hospitalization rates in Michigan for children ages 0 to 4 years in general and whites specifically, (Total: ρ=-0.75, p<0.01; White: ρ=-0.88, p<0.01).

Figure 6.4: Rates[1, 2] of Asthma[3] Hospitalization (per 10,000) by Year and Race[4, 5], Compared to *Healthy People 2010* Target for Objective 24-2, Age 5 to 64 Years, Michigan, 1990 to 2001.



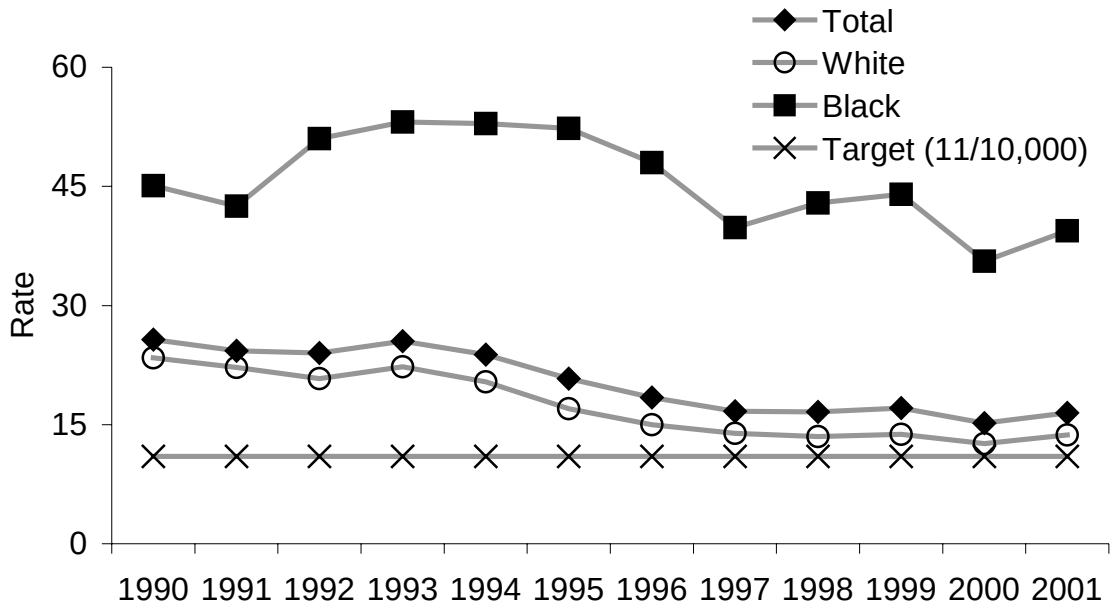
[1]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data on race, race was assigned based on the 1990 census population.
[5]Insufficient data to compute a stable rate for races other than white or black.

Year	Total Rate (Count)	White Rate (Count)	Black Rate (Count)
1990	14.0 (10,229)	10.6 (6,543)	34.9 (3,576)
1991	13.8 (10,132)	10.4 (6,408)	35.1 (3,650)
1992	13.7 (10,205)	10.1 (6,275)	36.5 (3,796)
1993	15.6 (11,693)	11.2 (7,043)	42.5 (4,476)
1994	14.6 (11,008)	10.1 (6,363)	42.3 (4,489)
1995	15.6 (11,986)	10.3 (6,623)	46.2 (5,160)
1996	15.1 (11,734)	10.0 (6,466)	44.6 (5,059)
1997	14.4 (11,268)	9.7 (6,288)	41.7 (4,835)
1998	13.3 (10,521)	8.5 (5,557)	42.3 (4,874)
1999	13.3 (10,570)	8.6 (5,660)	41.2 (4,775)
2000	13.6 (10,776)	8.6 (5,636)	42.3 (5,013)
2001	12.6 (9,999)	8.0 (5,270)	39.2 (4,550)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Between 1990 and 2001, there was a significant overall decline in asthma hospitalization rates in Michigan for whites 5 to 64 years, (ρ=-0.90, p<0.01). No significant trend is observed for blacks 5 to 64 years during this time period.
- ✧ The difference between asthma hospitalization rates for whites and blacks, ages 5 to 64 years, demonstrates an overall increase between 1990 and 2001.

Figure 6.5: Rates[1, 2] of Asthma[3] Hospitalization (per 10,000) by Year and Race[4, 5], Compared to *Healthy People 2010* Target for Objective 24-2, Age 65 Years and Older, Michigan, 1990 to 2001.



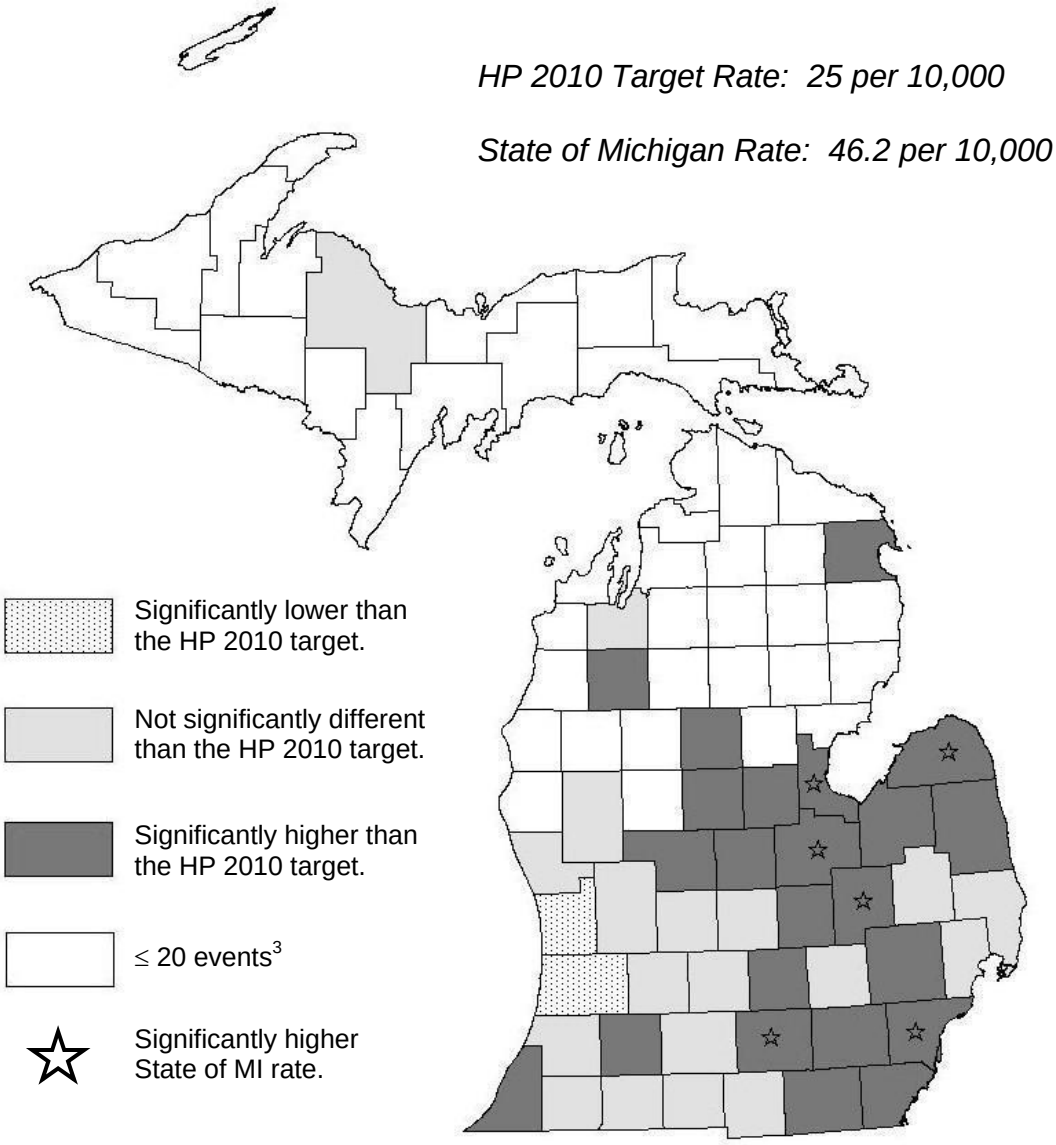
[1]Population estimates are taken from the Michigan annual population estimates, 1990-1999.
[2]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data on race, race was assigned based on the 1990 census population.
[5]Insufficient data to compute a stable rate for races other than white or black.

Year	Total Rate (Count)	White Rate (Count)	Black Rate (Count)
1990	25.7 (2,849)	23.4 (2,304)	45.1 (513)
1991	24.3 (2,757)	22.2 (2,237)	42.5 (500)
1992	24.0 (2,754)	20.8 (2,122)	51.0 (602)
1993	25.5 (2,991)	22.3 (2,312)	53.1 (657)
1994	23.8 (2,818)	20.4 (2,140)	52.9 (650)
1995	20.8 (2,502)	17.0 (1,812)	52.3 (657)
1996	18.4 (2,232)	15.0 (1,611)	48.0 (599)
1997	16.7 (2,033)	13.9 (1,506)	39.8 (506)
1998	16.6 (2,034)	13.5 (1,459)	42.9 (555)
1999	17.1 (2,090)	13.8 (1,500)	44.0 (564)
2000	15.2 (1,853)	12.6 (1,364)	35.6 (459)
2001	16.5 (2,023)	13.7 (1,491)	39.4 (504)

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

✧ Between 1990 and 2001, there was a significant overall decline in asthma hospitalization rates in Michigan adults 65 years and older in general and whites specifically, (Total: ρ=-0.95, p<0.01; White: ρ=-0.94, p<0.01).

Figure 6.6: County Level Attainment of the Healthy People 2010 Target for Rate[1] of Asthma Hospitalization[2] for Objective 24-2, Age 0 to 4 Years, Michigan, 1999 to 2001.



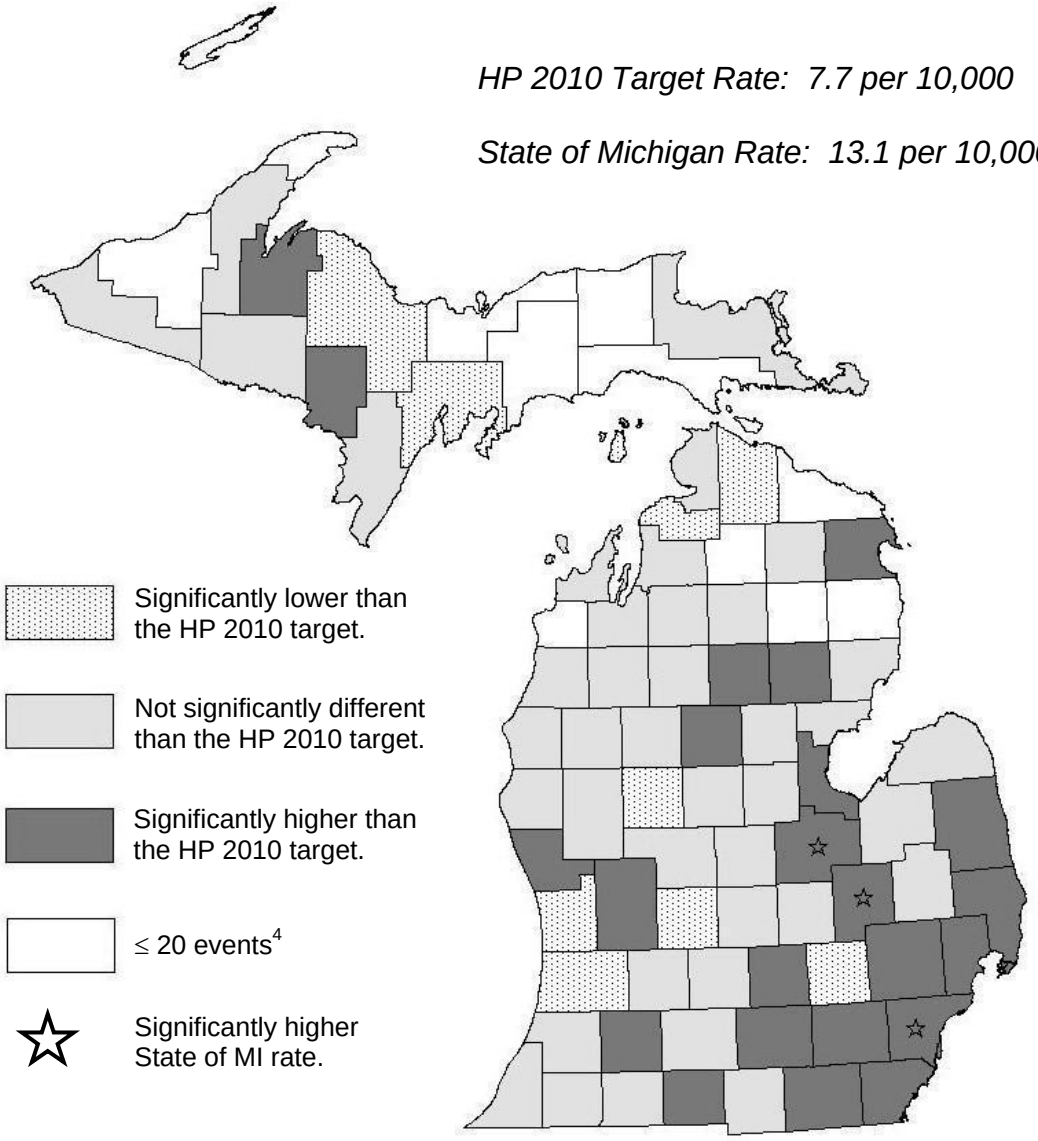
[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[3]Insufficient data to compute a stable rate, (Number of events ≤ 20).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Allegan and Ottawa counties have met the *Healthy People 2010* target rate for asthma hospitalizations among children 0 to 4 years.
- ✧ 23 counties have asthma hospitalization rates significantly higher than the Healthy People 2010 target for children 0 to 4 years.
- ✧ 6 counties have asthma hospitalization rates significantly higher than the state rate.

See Table 7 in Appendix for supporting data.

Figure 6.7: County Level Attainment of the Healthy People 2010 Target for Rate[1, 2] of Asthma Hospitalization[3] for Objective 24-2, Age 5 to 64 Years, Michigan, 1999 to 2001.



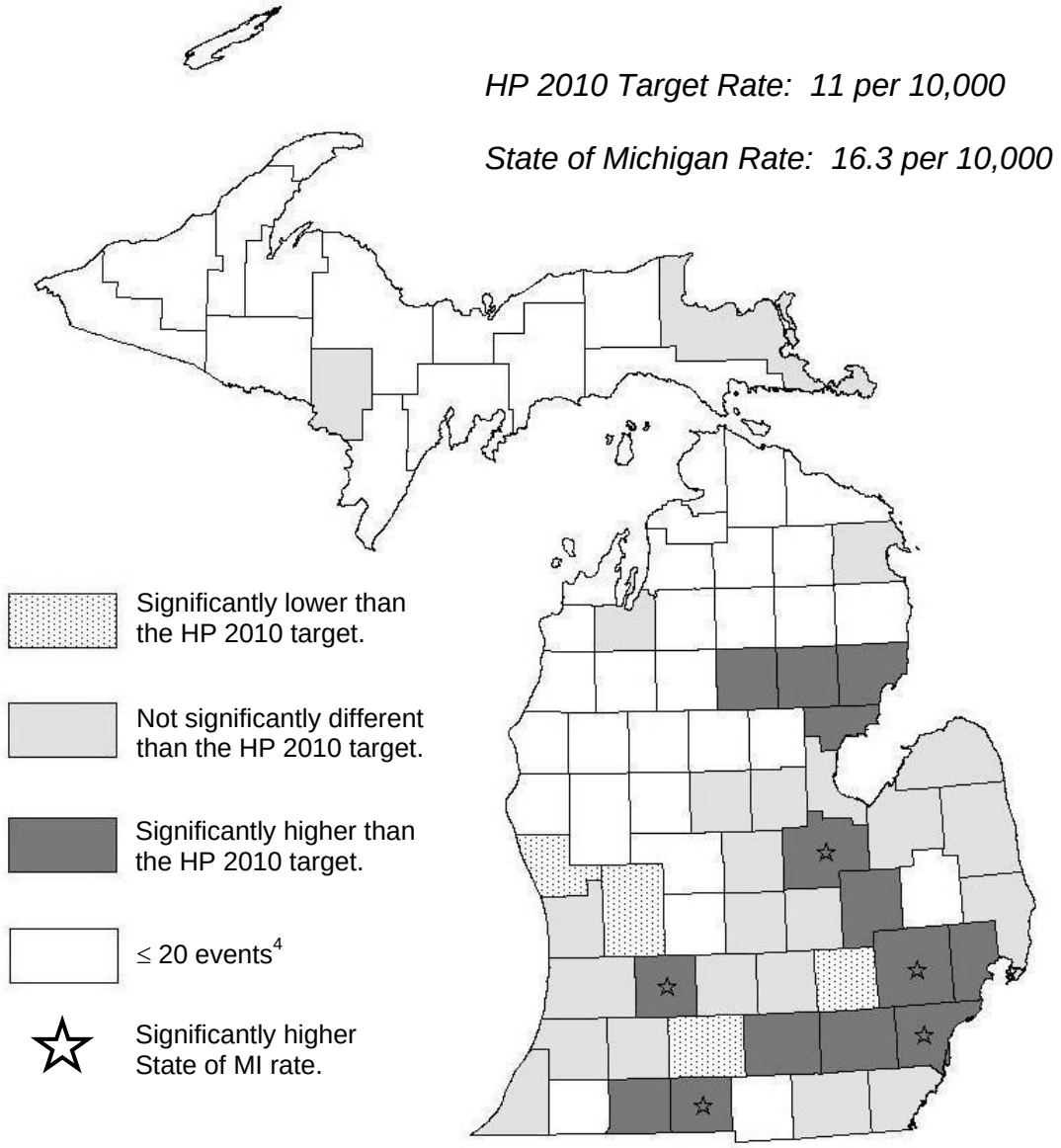
[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]Insufficient data to compute a stable rate, (Number of events ≤ 20).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Allegan, Charlevoix, Cheboygan, Delta, Ionia, Livingston, Marquette, Mecosta, and Ottawa counties have met the *Healthy People 2010* target rate for asthma hospitalizations among those 5 to 64 years.
- ✧ 23 counties have asthma hospitalization rates significantly higher than the *Healthy People 2010* target for children 5 to 64 years.
- ✧ 3 counties have asthma hospitalization rates significantly higher than the state rate.

See Table 8 in Appendix for supporting data.

Figure 6.8: County Level Attainment of the Healthy People 2010 Target for Rate[1, 2] of Asthma Hospitalization[3] for Objective 24-2, Age 65 Years and Older, Michigan, 1999 to 2001.



[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]Insufficient data to compute a stable rate, (Number of events ≤ 20).

Data Source: Michigan Inpatient Database, Bureau of Epidemiology, MDCH.

- ✧ Calhoun, Kent, Livingston, and Muskegon counties have met the *Healthy People 2010* target rate for asthma hospitalizations among adults 65 years and older.
- ✧ 14 counties have asthma hospitalization rates significantly higher than the *Healthy People 2010* target for adults 65 years and older.
- ✧ 5 counties have asthma hospitalization rates significantly higher than the state rate.

See Table 9 in Appendix for supporting data.

Recommendations

Asthma presents a significant burden to the residents of Michigan. Despite improvements in asthma management, preventable asthma events (such as hospitalizations and deaths) still occur. Although there are many positive aspects to asthma management in Michigan, there are clear areas for improvement, as evidenced by disparities in asthma rates between racial groups and by income level. In some cases, these disparities are increasing over time; management and outcomes improve for some subpopulations and geographic areas, but not others. The report's findings suggest recommendations for improvements in asthma surveillance and management, including reductions in preventable asthma events and health disparities.

Recommendations for improving the asthma surveillance system:

- ✧ Michigan needs to improve its ability to collect information on the number of people with asthma in all Michigan populations. Data on the number of people with asthma are not available for all age groups (particularly young children) or subpopulations (for example, Arab/Chaldean or Hispanic populations). Data are also not available at the level of geographic detail that would aid in planning and conducting asthma interventions (e.g., county, city or school district levels).

- ✧ With exception of some information on smoking in adults with asthma from the BRFSS and information on work place exposures, the prevalence of asthma triggers in Michigan is unknown. The prevalence of other triggers in homes and schools is useful to both patients and health care providers, as well as for the development of interventions to reduce those exposures. Real time information on outdoor air triggers (e.g., pollen, ozone, and other air pollutants) would be an important addition to help people with asthma better manage their disease.

- ✧ Our knowledge of asthma management is limited to self-reported survey data for adults and about asthma management in schools. MDCH has little or no information on:
    - o asthma management in children,
    - o access to care for people with asthma,
    - o impact of asthma on quality of life for people with asthma and their caretakers, and
    - o pharmacy usage among people with asthma.

  The MDCH Asthma Program should work with organizations that have administrative data sources (Medicaid, Medicare, and data from commercial insurers) and performance measurement initiatives (e.g., Michigan Quality Improvement Consortium) to develop an administrative data system that would provide a better understanding of asthma management in children and adults.

- ✧ Michigan does not have statewide data on scheduled or unscheduled office visits nor emergency department visits for asthma. MDCH needs to develop a system for

monitoring routine and urgent outpatient visits for asthma. The Asthma Epidemiology and Surveillance Work Group of the Michigan Asthma Advisory Committee has suggested that MDCH add asthma to its list of reportable diseases to aid in developing this system.

- MDCH needs to develop Michigan-specific estimates of asthma costs, including local level estimates. These estimates are important for justifying the need for asthma programs and for documenting the cost effectiveness of local and state level asthma programs.

- The Michigan Asthma Advisory Committee unanimously voted that the Michigan Department of Community Health adopt the *US Healthy People 2010* objectives for asthma. Furthermore, they recommended that MDCH establish systems to gather data for those objectives that the State cannot currently measure. It is important to acquire new sources of data, particularly emergency department information, to measure Michigan's progress toward meeting all the *US Healthy People 2010* targets.

Recommendations for improving asthma management:

- Patient and provider awareness of the goals of therapy and basic aspects of asthma management should be increased.

- The use of smoking cessation classes for people with asthma, as well as their family members, should be encouraged. Family members of people with asthma should be encouraged not to smoke around them (in the house, in the car, etc).

- Although the majority of Michigan Medicaid enrollees with persistent asthma have filled at least one prescription for appropriate asthma medication in 2002, 35% have not. Michigan's Medicaid program and its managed care plans should continue their efforts to increase the use of inhaled corticosteroids and other long term control medications among people with persistent asthma.

- The Michigan Asthma Advisory Committee should act to raise awareness of the importance of inhaled corticosteroids and other long-term control medications among people with asthma and health care providers.

- MDCH and the Michigan Department of Education should continue to work to improve asthma management in schools. In particular, these agencies should:

    - Raise awareness of asthma as a serious disease in schools among school staff.

    - Support local asthma coalition initiatives to raise awareness of the state law allowing children to carry and use their inhaler in school[7].

- Encourage the use of case management activities and education for children with diagnosed asthma that is affecting their school performance.

Recommendations for reducing preventable events

The workplace is currently one of the only settings where primary prevention of asthma is possible:

- ✧ MDCH should ensure that healthcare providers are aware on how to diagnose and manage work-related asthma.

- ✧ The MDCH asthma program should continue to fund work-related outreach and education activities to employers and employees.

- ✧ Michigan occupational health standards should be set at levels to prevent work-related asthma.

Another avenue for primary prevention of asthma is to prevent smoking around children:

- ✧ MDCH and other asthma stakeholders should continue to educate parents (particularly in families with a history of asthma), day care providers, and others who frequently deal with young children on importance of not exposing children to second hand smoke.

Asthma hospitalizations are considered preventable with appropriate asthma management. Despite this, asthma causes an average of 15,545 hospitalizations each year. To prevent hospitalizations:

- ✧ Health care provider education and quality of care activities should be targeted to areas and populations with the highest hospitalization rates.

- ✧ More information is needed regarding the reasons why rates are higher in some areas and among some demographic groups. This information could be used to develop programs that effectively address racial and geographic disparities in asthma hospitalization rates.

Fortunately asthma mortality is a relatively infrequent event. However, the majority of asthma deaths, particularly in children and young adults, should be preventable with good asthma management.

MDCH is currently conducting a review of asthma deaths occurring in people 2-34 years of age. The purpose of this review is to identify risk factors that could be changed or addressed to prevent future asthma deaths in young people. Based on the review of 2002 asthma deaths, those risk factors are:

- ✧ Inadequate prescription of inhaled corticosteroids by health care providers.

- ✧ Patient noncompliance with asthma management, (i.e. failure to use steroids, follow up with medical care, eliminate or avoid triggers).

- ✧ Lack of health insurance and regular medical care with a primary care physician.

- ✧ Need for specialist referral and pulmonary function testing for high-risk asthma patients.

Based on reviews of the 2002 asthma deaths, an expert panel developed a series of recommendations for preventing future deaths. Highlights of these recommendations include:

- ✧ Education programs for health care providers are needed to raise awareness of:
    - o The severity of asthma as a fatal disease.
    - o The dangers of overuse of short term rescue medications.
    - o The importance of using inhaled corticosteroids for long-term management.
    - o The need to refer high-risk patients to specialists.
    - o The need for pulmonary function testing as a routine part of asthma management.

- ✧ Asthma education programs for patients need to focus on the importance of the use of inhaled steroids, even when the patient is “feeling well”.

- ✧ System level changes are also recommended to prevent future deaths:
    - o Case management is needed for high-risk asthma patients.
    - o Insurance coverage for people with asthma needs to be improved.
    - o A system to limit the number of rescue medication refills that can be obtained without active physician approval should be developed.

For more information on the Asthma Mortality Review, please see *2002 Annual Report on Asthma Deaths Among Individuals Aged 2-34 Years in Michigan* on the Asthma Initiative Website, (http://www.getasthmahelp.org/02AsthmaMortalityAnnRpt.pdf).

Recommendations for reducing health disparities

Despite some encouraging results, there remains a dramatic racial disparity in asthma hospitalization and mortality rates of Michigan. Efforts to reduce the burden of asthma in Michigan must address this issue.

MDCH must target resources, including programs and activities, to areas and populations that are experiencing the highest burden of adverse asthma events. Coalitions and other asthma stakeholders should rely on local level data for targeting and evaluating programs and their effectiveness for different populations in their community.

Asthma Data Sources in Alphabetical Order

Name: Healthcare Cost and Utilization Project
Acronym: HCUP
Basic Purpose and History: The HCUP family of administrative longitudinal databases currently provides data for 1988-2001. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcome of treatment at the national, state, and local market levels.
Data Collection Process: HCUP databases contain discharge-level information compiled in a uniform format with privacy protections in place. The databases included in HCUP are the Nationwide Inpatient Sample (NIS), some State Inpatient Databases (SID), some State Ambulatory Surgery Databases (SASD), and a Kids' Inpatient Database (KID) comprised of records from the State Inpatient Databases.
Population Included: Each database included in HCUP is comprised of data from a particular population. NIS contains all discharge data from a sample of hospitals located in 33 States, approximating a 20-percent stratified sample of U.S. community hospitals. SID and SASD contain data for the universe of these events for participating states. Currently, the KID contains data drawn from participating State Inpatient Databases on children 20 years of age and younger.
Asthma Data: HCUP records include information on discharge diagnoses, which in the case of asthma includes the International Classification of Disease, Version 9, Clinical Modification (ICD-9-CM) codes 493.00-493.99.
Additional Information: For more information about HCUP and additional data for comparison, visit the website for the Agency for Healthcare Research and Quality at HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/data/hcup/hcupnet.htm.

Name: Health Plan and Employer Data and Information Set from the National Committee for Quality Assurance
Acronym: HEDIS®, NCQA

Basic Purpose and History: HEDIS® is a set of performance measures for assessing, reporting on, and improving the quality of care provided by the managed care industry.
Population Included: Managed care plan members who are 5 to 56 years and were continuously enrolled in a Medicaid managed care plan during 2001 and 2002 were selected for analysis.
Asthma Data: HEDIS® includes a quality of care measure for asthma called "Use of Appropriate Medications for People with Asthma." This measure evaluates whether people with persistent asthma are filling medications that are acceptable as primary therapy for long-term control of asthma (for an inhaled corticosteroid, nedocromil, cromolyn sodium, leukotriene modifiers, or methylxanthines). It is calculated as the percentage of people with persistent asthma who had at least one prescription for appropriate long-term asthma therapy in 2002. People with "persistent asthma" are identified in this group by having any of the following events during 2001:

- At least four asthma medication-dispensing events; or
- At least one emergency department visit with a principal diagnosis of asthma; or
- At least one hospitalization with an principal diagnosis of asthma; or
- At least four outpatient visits with a corresponding diagnosis of asthma and at least two asthma medication-dispensing events.

A medication-dispensing event is defined by NCQA as one prescription of an amount lasting 30 days or less. Therefore to meet the HEDIS® criteria for use of appropriate asthma medications, a managed care enrollee with persistent asthma would only need to have filled one prescription for an inhaled corticosteroid, nedocromil, cromolyn sodium, leukotriene modifiers, or methylxanthines in the measurement year.
Additional Information: Data presented in this report have been reproduced from the Michigan Medicaid HEDIS® 2002 Statewide Aggregate Report, Health Services Advisory Group, Inc., December 2002, (http://www.mahp.org/HMOinMI/qualityitems/Aggregate%20Report%20-%20Final.pdf). For more information about HEDIS®, visit http://www.ncqa.org/Programs/HEDIS/index.htm.

Name: Michigan Behavioral Risk Factor Surveillance System
Acronym: BRFSS
Basic Purpose and History: The BRFSS is a source of estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Michigan has conducted the BRFSS survey since 1987. Asthma related questions were added to the survey in 2000.
Data Collection Process: Annual estimates are based on data collected from a random-digit dial telephone survey of a sample of Michigan households. It is a population-based representative sample of non-institutionalized Michigan residents. The data are weighted to represent estimates for the general adult population. BRFSS interviewers use a Computer Assisted Telephone Interviewing (CATI) system, which provides the interviewer with prompts. The interviewer types the respondent's responses directly onto the computer screen, providing quality control and minimizing interviewer error.

Population Included: A record is a completed telephone interview. The selected respondent must be a Michigan resident, 18 years of age or older who lives in a private residence and has a telephone. One randomly selected adult from a household is interviewed.

Asthma Data: There are two core questions dedicated to estimating asthma prevalence for the general population of adults. Michigan has opted to include the asthma module questions that include information about child prevalence and disease management/control. Finally, Michigan has also developed questions regarding work-related asthma. The following are the questions included on the Michigan BRFSS survey in 2001 regarding asthma:

Asthma Prevalence Questions for Adults:

- Have you ever been told by a doctor, nurse, or other health professional that you had asthma?
- Do you still have asthma?

Asthma Prevalence Questions for Children in the Household:

- Earlier you said there were <number> children, age 17 or younger, living in your household. How many of these children have ever been diagnosed with asthma?
- How many of these children/does this child still have asthma?

Asthma Management and Control Questions:

- How old were you when you were first told by a doctor, nurse, or other health professional that you had asthma?
- During the past 12 months, have you had an episode of asthma or an asthma attack?
- During the past 12 months, how many times did you visit an emergency room or urgent care center because of your asthma?
- During the past 12 months, how many times did you see a doctor, nurse, or other health professional for urgent treatment of worsening asthma symptoms?
- During the past 12 months, how many times did you see a doctor, nurse, or other health professional for a routine checkup for your asthma?
- During the past 12 months, how many days were you unable to work or carry out your usual activities because of your asthma?
- Symptoms of asthma include cough, wheezing, shortness of breath, chest tightness, and phlegm production when you don't have a cold or respiratory infection. During the past 30 days, how often did you have any symptoms of asthma?
- During the past 30 days, how many days did symptoms of asthma make it difficult for you to stay asleep?
- During the past 30 days, how often did you take asthma medication that was prescribed or given to you by a doctor? This includes an inhaler.

State Added Questions on Work-Related Asthma:

- Were you ever told by a doctor or other medical person that your asthma was related to any job you ever had?
- Did you ever tell a doctor or other medical person that your asthma was related to any job you ever had?
- When you first developed symptoms of asthma, what kind of work were you doing? For example, RN, supervisor of order department, auto mechanic, or accountant.
- What kind of business or industry was that job in? For example, hospital, newspaper publishing, mail order house, auto repair shop, or bank.

Additional Information: For more information about the BRFSS and national data for comparison, visit http://www.cdc.gov/brfss/index.htm. For a complete report of the Michigan BRFSS Survey, visit http://www.michigan.gov/mdch/0,1607,7-132--12702--,00.html.

Name: Michigan Inpatient Database
Acronym: MIDB
Basic Purpose and History: These data help support the State of Michigan health planning activities and are used by facilities themselves for internal evaluation. The Michigan Department of Community Health (MDCH) has purchased data since 1982.
Data Collection Process: Data are collected throughout a patient hospital stay by clinical and administrative staff and filed within a medical record. Hospital medical record personnel ascertain and keypunch information from these records. Some small hospitals complete data collection forms and send these directly to Michigan Health and Hospital Association (MHHA) for processing. Depending on the facility, data are submitted on a voluntary basis monthly, quarterly, or annually to MHHA. Because data formats often differ by hospital, all coding is converted into standard formats at MHHA. The public use file provided to MDCH is stripped of all patient, provider, and hospital identifiers.
Population Included: Records include all hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from acute care hospitals in contiguous states. It includes virtually all hospitalizations in Michigan and for Michigan residents.
Asthma Data: The MIDB includes information on discharge diagnoses, which in the case of asthma includes the International Classification of Disease, Version 9, Clinical Modification (ICD-9-CM) codes 493.00-493.99. Procedure codes for treatments administered during the inpatient stay are also maintained in the dataset.
Additional Information: For the 2003 report on the *Michigan Hospital Profiles Project* published by MHHA, visit http://www.michiganhospitalprofiles.org/. For the latest data regarding preventable hospitalizations in Michigan, visit http://www.mdch.state.mi.us/pha/osr/chi/hosp/frame.html. The National Hospital Discharge Survey (NHDS) collects national data comparable to the MIDB. For more information about the NHDS and data for comparison, visit http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm.

Name: Michigan Resident Death Files
Acronym: MRDF
Basic Purpose and History: The death certificate database is a high quality computerized data set containing demographic and cause of death information for all Michigan residents (out of state deaths included) and non-Michigan residents dying in Michigan. Death certificates are one of public health's vital records for monitoring the health of citizens. Death certificates have been collected in Michigan since 1897.
Data Collection Process: A funeral director, or another individual responsible for disposing of the body, completes the demographic and disposition components of the death certificate. When applicable, an attending physician or other hospital medical staff completes the portion of the death certificate describing the death (time, date, place, and immediate/underlying cause). A county medical examiner completes this section in all unexpected deaths including fatal injuries. The death certificate is then sent to the local registrar who verifies that the document has been properly filled out. If not, it is returned to the appropriate person for revision. Certificates for Michigan residents dying out-of-state are provided by those states (primarily Indiana, Ohio, and Wisconsin). Instructional materials to complete the death certificate are available at the state and local level for doctors, hospitals, medical examiners, and funeral directors. Michigan funeral director training also includes an annual seminar on death certificate completion.
Population Included: All instate occurrences regardless of the state of residence and all Michigan residents regardless of location of death are included.
Asthma Data: The MRDF includes information on causes of death, which in the case of asthma includes the International Classification of Disease (ICD), Version 9 codes 493 (1990-1998) and Version 10 codes J45 and J46 (1999-present).
Additional Information: For more data regarding Michigan mortality, visit http://www.mdch.state.mi.us/pha/osr/index.asp?Id=4. The National Center for Health Statistics maintains the National Vital Statistics System that provides a natural comparison to the MRDF. For more information, visit http://www.cdc.gov/nchs/about/major/dvs/mortdata.htm.

Name: School Health Education Profiles
Acronym: SHEP
Basic Purpose and History: The School Health Education Profiles monitor characteristics of health education in middle/junior high schools and senior high schools. Michigan has administered the survey since 1996. In 2002, questions regarding school-based asthma management activities were added to the principal's questionnaire.
Data Collection Process: A systematic equal-probability sampling strategy is used to produce a representative sample of schools. A questionnaire is self-administered by both the school principal and the lead health education teacher during the spring semester every other year. Completion of the survey is confidential and voluntary. Follow-up telephone calls and written reminders are used to encourage participation.
Population Included: Michigan public schools serving students in grades six through 12.

Asthma Data: The following are the questions included on the Michigan SHEP school principal survey in 2002 regarding school-based asthma management activities:
Does your school implement each of the following school-based asthma management activities?

- Provide a full-time registered nurse, all day every day.
- Identify and track all students with asthma.
- Obtain and use an Asthma Action Plan for all students with asthma.
- Assure immediate access to medications as prescribed by a physician and approved by parents.
- Provide intensive case management for students with asthma who are absent 10 days or more per year.
- Educate school staff about asthma.
- Educate students with asthma about asthma management.
- Teach asthma awareness to all students in at least one grade.
- Encourage full participation in physical education and physical activity when students with asthma are doing well.
- Provide modified physical education and physical activities as indicated by the student's Asthma Action Plan.

Additional Information: For more information about the SHEP and national data for comparison, visit http://www.cdc.gov/nccdphp/dash/profiles/. For the latest report of the Michigan SHEP, visit http://www.michigan.gov/mde/1,1607,7-140-6525_6530_6568-19495--,00.html.

Name: Sentinel Event Notification System of Occupational Risk
Acronym: SENSOR
Basic Purpose and History: Project SENSOR is a federally funded grant to assist the state in conducting patient and work place follow up of occupational disease reports received by the Michigan Department of Consumer and Industry Services (MDCIS). Interviews of patients with noise-induced hearing loss, occupational asthma, and silicosis are routinely conducted to determine the patient's work place conditions and exposures. SENSOR began investigating work-related disease in 1988.
Data Collection Process: Persons with work-related asthma are identified by the following means: report from physician, reports for hospitals (since 1989), and claims filed with the Bureau of Worker's Compensation. Once an individual is identified to have work-related asthma within one of these systems, he/she is interviewed to determine the work-relatedness of their condition. An industrial hygiene investigation may be conducted at the patient's workplace, where co-workers are interviewed to determine if other individuals are experiencing similar breathing problems from exposure to the suspected allergen. An industrial hygienist conducts air monitoring for any suspected allergens and reviews the company's health and safety program.
Population Included: All Michigan workers.
Asthma Data: The work-relatedness of each patient's condition is determined and classified as: occupational asthma, possible occupational asthma, work-aggravated

asthma, and Reactive Airways Dysfunction Syndrome (RADS). Patients are further described as to their industry of employment, primary workplace exposures, smoking status, personal/family history of allergy, and asthma symptoms.
Additional Information: For the latest *Annual Report on Work-Related Asthma in Michigan*, visit http://web2.chm.msu.edu/oem/Reports.htm.

Name: Youth Tobacco Survey
Acronym: YTS
Basic Purpose and History: The YTS was created to support the design, implementation, and evaluation of state level tobacco control programs. Its core questions ask about a variety of tobacco issues, including tobacco use, secondhand smoke exposure, ability to purchase, and attitudes about tobacco. Michigan first administered the YTS in 2001 and featured asthma prevalence questions that same year.
Data Collection Process: A two-stage sampling scheme is implemented, where public middle and high schools are first selected, followed by classes within those schools. The questionnaire is self-administered by students who volunteer to participate in the selected classes, (Sample size approximately 3,000 students). The survey is conducted every two years.
Population Included: Public school students in grades 6 through 12 are eligible to participate.
Asthma Data: The following are the questions included on the Michigan YTS survey in 2001 regarding asthma prevalence:

- Have you ever been told by a doctor or other health care provider that you have/had asthma?
- Do you have asthma now?
- How old were you when you were first told by a doctor or other health care provider that you had asthma?

Additional Information: For more information about the YTS and national data for comparison, visit http://www.cdc.gov/tobacco/global/GYTS.htm.

Methods

Topic 1: Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population.

Prevalence is computed by dividing the number of existing cases at a particular point or period in time by the total population from which the cases came. It is often multiplied by 100 and expressed as a percent.

$$\text{Prevalence} = \frac{\text{number of existing cases of disease}}{\text{total population}}$$

In this report, prevalence estimates are generated in the analysis of data from the Behavioral Risk Factor Surveillance System, School Health Education Profiles, Youth Tobacco Survey, Sentinel Event Notification System of Occupational Risk, and Health Plan and Employer Data and Information Set from the National Committee for Quality Assurance.

Topic 2: *t*-test

The *t*-test can be used to compare prevalence measures between two groups. The null hypothesis of this statistical test is that the prevalence for group 1 is equal to the prevalence for group 2; the alternative hypothesis is that the prevalence for group 1 is not equal to the prevalence for group 2.

The resulting p-value of the *t*-test ranges from 0.0 to 1.0 and gives the probability of finding a significant difference between the two groups when, in reality, no significant difference exists. The standard used to assess the significance of a statistical test is p-value = 0.05. A p value less than or equal to 0.05 indicates that there is at most a 5% chance of observing a difference between the groups by chance alone, given that in reality the prevalence in the groups is similar. In this case, the null hypothesis is

rejected and the result is considered statistically significant. If the p value is greater than 0.05, chance cannot be excluded as a likely explanation for the observed difference, so the null hypothesis is not rejected and the result is not considered statistically significant.

The binomial test is very similar to the *t*-test for comparing prevalence measures between two groups and is interpreted the same way.

Topic 3: Average

The average estimates a "typical" value for a given continuous variable in a specific population. It is calculated by adding all the observed values of the variable and dividing by the total number of values.

$$\text{Average} = \frac{\text{sum of observed values}}{\text{total number of values}}$$

In this report, average estimates are generated in the analysis of data from the Behavioral Risk Factor Surveillance System, Sentinel Event Notification System of Occupational Risk, and Healthcare Cost and Utilization Project.

Topic 4: Incidence Rate

The incidence rate expresses the rate at which events occur in a population at risk at any given point in time during a defined time period. Rates presented in this report are used to estimate annual incidence for aggregates of individuals, defined by geographic area and demographic characteristics, over a given time period.

The numerator of the incidence rate is the number of new events in the population during a given time period. The denominator is the average population estimated for that same time period multiplied by the number of years in the interval. The use of this denominator assumes that the population and its demographic composition are relatively stable.

The population at the midpoint of a given time interval is used to estimate the average population over the entire interval. This is then multiplied by the number of years in the interval so that an *annual* rate is generated. For example, to compute a rate of asthma hospitalizations for 1998 through 2000, the population in 1999 (midpoint) multiplied by 3 is used as the denominator. Rates for single years are calculated using the estimated population for that year.

$$\text{Annual Incidence Rate} = \frac{\text{number of new events during given time period}}{\text{average population X number of years in time period}}$$

Incidence rates are generally multiplied by a factor of 10 so that they can be better understood in terms of a population. For asthma hospitalizations, rates are multiplied by 10,000, whereas for asthma deaths, rates are multiplied by 1,000,000.

In this report, incidence rates are generated in the analysis of data from the Michigan Inpatient Database, Michigan Resident Death File, and Sentinel Event Notification System of Occupational Risk.

Topic 5: Age Adjustment by Direct Standardization

Populations often differ in their distribution of age, which may in turn affect the overall rate of events in that population. For example, if one population has a larger number of young children than another, it could demonstrate a higher asthma hospitalization rate simply due to its age structure. Therefore, when comparing rates of events in populations of different age distributions, it is important to account for those differences. In this report, age structure differences are accounted for in overall rates using direct standardization methodology to compute age-adjusted rates. Rates that are not age adjusted are referred to as crude rates.

An age-adjusted rate is a weighted average of age group specific rates in the population under study. The age group specific rates are weighted by the number of people in each age group of a selected *standard* population. When two or more age-adjusted rates are computed using the same *standard* population, they may be compared. Age-adjusted rates are presented in this report so that comparisons can be made between geographic subgroups (ex. County vs. County) and demographic subgroups (ex. White vs. Black). The *standard* population used in the calculation of age-adjusted rates in this report is the 2000 United States Standard Population.

To compute an age-adjusted incidence rate, the first step is to compute the comprising age specific rates. These are then multiplied by the corresponding age specific weight, i.e. the proportion of people in a particular age strata in the *standard* population. The products of these calculations are then summed and divided by the sum of all the age specific weights.

$$\text{Age-Adjusted Incidence Rate} = \frac{\text{Sum of (age specific rate X age specific weight)}}{\text{Sum of age specific weights}}$$

In this report, age-adjusted rates are generated in the analysis of data from the Michigan Inpatient Database and the Michigan Resident Death File.

Topic 6: Confidence Interval

The purpose of a confidence interval (CI) is to estimate the statistical uncertainty around a particular measure. For example, the *estimated* prevalence of asthma among

Michigan adults is 8.8%, with a 95% confidence interval of 7.8% to 9.8%; we are 95% confident that the *true* prevalence in the population is no less than 7.8% and no greater than 9.8%.

In this report, 95% confidence intervals are provided for estimates of prevalence and average annual incidence rates.

The confidence interval formula for an estimate of prevalence is based on the binomial distribution. The upper and lower limits are often multiplied by 100 and expressed as percents.

$$\text{Prevalence CI} = p \pm 1.96 \times \left(\frac{p \times (1 - p)}{n} \right)^{1/2}$$

Where p = prevalence proportion
n = sample size

The confidence interval formula for a crude incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10: 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Crude Incidence Rate CI} = IR_c \pm 1.96 \times \left(\frac{IR_c}{n} \right)^{1/2}$$

Where IR_c = crude incidence rate
n = denominator of the rate

The confidence interval formula for an age-adjusted incidence rate is based on the Poisson distribution. The upper and lower limits are often multiplied by an appropriate factor of 10 – 10,000 for asthma hospitalization rates and 1,000,000 for asthma mortality rates.

$$\text{Age-Adjusted Incidence Rate CI} = IR_a \pm 1.96 \times \left(\frac{\text{Sum } (W^2 \times I)}{(\text{Sum } W)^2} \right)^{1/2}$$

Where IR_a = age-adjusted incidence rate
W = age specific weights from the *standard* population
I = variance of crude age specific rates

Confidence intervals can be used as a method to test whether a specific measure is statistically different between groups. For example, in comparing a county specific asthma hospitalization rate with that of the State of Michigan, they are considered statistically different if their confidence intervals do not overlap.

Topic 7: Data Suppression

Incidence rate estimates calculated with a small number of events or population sizes are statistically unstable. They exhibit wide confidence intervals indicative of great variability. In this report, data suppression rules are enforced so that the data presented are reliable. For demographic or geographic subgroups where there is less than or equal to 20 hospitalizations or less than 5000 population, asthma hospitalization rates are not presented. Mortality rates are suppressed when there is less than 5 deaths or less than 5000 population. In addition, to protect the identity of persons who have been hospitalized or died, counts less than 5 are not presented in this report.

Topic 8: Trend Analysis

To determine if Michigan has experienced an overall trend in asthma hospitalization and mortality rates over the 12-year period 1990-2001, the Spearman Correlation Coefficient and its accompanying statistical Rank Correlation Test were utilized. This test assesses whether there is a statistically significant monotonic relationship between 2 variables, in this case year and rate.

The Spearman Correlation Coefficient (rho, ρ) ranges from –1.0 to 1.0. If the coefficient equals –1.0, it indicates a perfect negative correlation, where each year has a lower hospitalization rate than the previous year. If the coefficient equals 1.0, it indicates a perfect positive correlation, where each year has a higher hospitalization rate than the previous year. As the correlation coefficient approaches 0.0, from either direction, the relationship between the 2 variables weakens. For example, a correlation coefficient of 0.90 indicates a stronger positive relationship between 2 variables than a coefficient of 0.50.

The p-value of the Rank Correlation test ranges from 0.0 to 1.0 and gives the probability of finding a significant overall monotonic trend in the asthma hospitalization rate data when, in reality, no trend exists. Again, the standard used to assess the significance of a statistical test is p-value = 0.05. A p value less than or equal to 0.05 indicates that there is at most a 5% chance of observing a trend, given that, in reality, rates are stable. In this case, the result is considered statistically significant. If the p value is greater than 0.05, chance cannot be excluded as a likely explanation for the observed trend, so the result is not considered statistically significant.
From this, it follows that:

- If there is a statistically significant **increase** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **positive** and the p-value for the test will be **less** than 0.05.

- If there is a statistically significant **decrease** in asthma hospitalization rates over time, the Spearman Correlation Coefficient will be **negative** and the p-value for the test will be **less** than 0.05.

IMPORTANT: This is a crude analysis that simply identifies whether there is an **overall** increase or decrease in the asthma hospitalization or mortality rates. This statistical test does cannot determine the significance of more complex trend patterns. There is no way to know from these statistics if a specific event or series of events caused an observed change in rates.

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Appendix

Supporting Data Tables for County Level Asthma Surveillance

Table 1. Rates (per 10,000) of Hospitalization due to Asthma by County of Residence, Michigan, All Ages, 1999-2001.

Table 2. Rates (per 10,000) of Hospitalization due to Asthma for Children < 18 Years by County of Residence, Michigan, 1999-2001.

Table 3. Rates (per 10,000) of Hospitalization due to Asthma for Adults ≥ 18 Years of Age by County of Residence, Michigan, All Ages, 1999-2001.

Table 4. Rates (per 10,000) of Hospitalization due to Asthma for White Persons by County of Residence, Michigan, All Ages, 1999-2001.

Table 5. Rates (per 10,000) of Hospitalization due to Asthma for Black Persons by County of Residence, Michigan, All Ages, 1999-2001.

Table 6. Total Number of Deaths and Average per Year due to Asthma by County of Residence, Michigan, All Ages, 1990-2001.

Table 7. Rates (per 10,000) of Hospitalization due to Asthma for Children 0 to 4 Years by County of Residence, Michigan, 1999-2001.

Table 8. Rates (per 10,000) of Hospitalization due to Asthma for Children and Adults, 5 to 64 Years by County of Residence, Michigan, 1999-2001.

Table 9. Rates (per 10,000) of Hospitalization due to Asthma for Adults Age 65 Years and Older by County of Residence, Michigan, 1999-2001.

Table 1. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] by County of Residence, Michigan, All Ages, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	35	10.2	6.6	13.9
Alger	17	~	~	~
Allegan	248	7.9	6.9	8.9
Alpena	132	15.1	12.5	17.7
Antrim	46	6.3	4.4	8.1
Arenac	65	12.3	9.3	15.4
Baraga	47	16.9	11.9	21.8
Barry	178	10.9	9.3	12.5
Bay	453	14.0	12.7	15.3
Benzie	42	9.1	6.3	11.9
Berrien	481	10.1	9.2	11.0
Branch	172	12.8	10.9	14.7
Calhoun	370	8.7	7.8	9.6
Cass	159	10.6	8.9	12.2
Charlevoix	48	6.4	4.5	8.2
Cheboygan	64	8.6	6.4	10.7
Chippewa	92	8.1	6.5	9.8
Clare	116	12.1	9.9	14.3
Clinton	182	9.7	8.3	11.1
Crawford	40	9.8	6.7	12.8
Delta	73	6.1	4.6	7.5
Dickinson	126	16.2	13.3	19.1
Eaton	297	10.1	9.0	11.3
Emmet	68	8.1	6.1	10.0
Genesee	2,341	17.9	17.2	18.6
Gladwin	57	6.8	5.0	8.6
Gogebic	39	8.2	5.5	10.8
G Traverse	206	9.1	7.8	10.3
Gratiot	151	12.9	10.8	14.9
Hillsdale	119	8.5	7.0	10.0
Houghton	91	9.5	7.5	11.6
Huron	149	13.8	11.6	16.1
Ingham	1,069	13.1	12.3	13.9
Ionia	131	6.6	5.5	7.8
Iosco	86	10.7	8.4	13.1
Iron	38	12.0	8.0	16.1
Isabella	203	12.9	11.1	14.8
Jackson	689	14.7	13.6	15.8
Kalamazoo	677	10.1	9.4	10.9

Table 1. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kalkaska	37	7.7	5.2	10.2
Kent	1,695	10.1	9.7	10.6
Keweenaw	11	~	~	~
Lake	28	9.7	6.0	13.3
Lapeer	252	9.4	8.3	10.6
Leelanau	48	8.2	5.8	10.5
Lenawee	393	13.3	12.0	14.6
Livingston	312	7.0	6.2	7.8
Luce	19	~	~	~
Mackinac	21	~	~	~
Macomb	2,790	11.9	11.5	12.4
Manistee	58	8.3	6.1	10.5
Marquette	120	6.6	5.4	7.8
Mason	81	9.9	7.7	12.1
Mecosta	64	5.9	4.4	7.3
Menominee	58	8.4	6.2	10.6
Midland	267	11.1	9.8	12.4
Missaukee	41	9.4	6.5	12.3
Monroe	651	15.0	13.8	16.1
Montcalm	171	9.2	7.8	10.6
Montmorency	33	11.3	7.2	15.3
Muskegon	540	10.6	9.7	11.5
Newaygo	117	8.5	6.9	10.0
Oakland	4,234	12.2	11.8	12.5
Oceana	80	10.5	8.2	12.8
Ogemaw	99	14.6	11.6	17.6
Ontonagon	34	15.2	9.9	20.6
Osceola	63	10.1	7.6	12.7
Oscoda	25	9.9	5.9	14.0
Otsego	37	5.6	3.8	7.4
Ottawa	516	7.6	6.9	8.2
Presque Isle	27	6.0	3.6	8.4
Roscommon	88	14.2	11.1	17.4
Saginaw	1,599	25.4	24.1	26.6
St Clair	589	12.1	11.1	13.1
St Joseph	147	7.8	6.5	9.1
Sanilac	172	13.2	11.2	15.2
Schoolcraft	8	~	~	~
Shiawassee	242	11.5	10.1	13.0
Tuscola	196	11.3	9.7	12.8
Van Buren	221	9.7	8.4	11.0
Washtenaw	1,362	16.4	15.5	17.2
Wayne	18,847	29.7	29.3	30.2
Wexford	92	10.2	8.1	12.3
Michigan	**46,634**	**15.8**	**15.7**	**16.0**

Table 2. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Children < 18 Years by County of Residence, Michigan, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
* Number of hospitalizations < 5 and > 0.
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	9	~	~	~
Alger	*	~	~	~
Allegan	80	9.0	7.0	11.0
Alpena	57	26.0	19.2	32.8
Antrim	13	~	~	~
Arenac	14	~	~	~
Baraga	9	~	~	~
Barry	43	10.2	7.2	13.3
Bay	187	23.4	20.0	26.7
Benzie	20	~	~	~
Berrien	225	18.7	16.3	21.2
Branch	59	17.3	12.9	21.7
Calhoun	117	10.9	8.9	12.8
Cass	53	14.3	10.4	18.1
Charlevoix	17	~	~	~
Cheboygan	22	12.7	7.4	18.0
Chippewa	20	~	~	~
Clare	31	13.7	8.9	18.6
Clinton	69	13.7	10.5	17.0
Crawford	11	~	~	~
Delta	26	8.7	5.3	12.0
Dickinson	57	30.0	22.2	37.8
Eaton	116	15.3	12.5	18.1
Emmet	30	13.3	8.5	18.0
Genesee	955	27.6	25.8	29.3
Gladwin	17	~	~	~
Gogebic	7	~	~	~
Grand Traverse	76	12.8	10.0	15.7
Gratiot	82	27.8	21.8	33.9
Hillsdale	45	12.1	8.6	15.7
Houghton	21	9.4	5.4	13.4
Huron	65	25.6	19.3	31.8
Ingham	459	21.7	19.7	23.7
Ionia	55	10.2	7.5	12.9
Iosco	21	11.6	6.6	16.6
Iron	9	~	~	~
Isabella	94	22.7	18.1	27.3
Jackson	275	23.6	20.9	26.4

Table 2. Continued.

County	Count	Rate	95 % Confidence Interval	
			Lower Limit	Upper Limit
Kalamazoo	272	16.2	14.3	18.1
Kalkaska	14	~	~	~
Kent	658	14.0	12.9	15.1
Keweenaw	*	~	~	~
Lake	17	~	~	~
Lapeer	120	16.8	13.8	19.8
Leelanau	29	19.2	12.2	26.2
Lenawee	148	19.5	16.4	22.7
Livingston	152	12.7	10.7	14.8
Luce	*	~	~	~
Mackinac	7	~	~	~
Macomb	882	16.2	15.1	17.2
Manistee	19	~	~	~
Marquette	39	9.0	6.1	11.8
Mason	18	~	~	~
Mecosta	33	12.0	7.9	16.1
Menominee	31	18.0	11.6	24.3
Midland	88	13.8	10.9	16.7
Missaukee	23	19.6	11.6	27.6
Monroe	280	24.3	21.4	27.1
Montcalm	85	17.3	13.6	21.0
Montmorency	11	~	~	~
Muskegon	235	17.2	15.0	19.4
Newaygo	30	7.7	4.9	10.4
Oakland	1,474	17.3	16.4	18.1
Oceana	29	13.9	8.8	19.0
Ogemaw	10	~	~	~
Ontonagon	10	~	~	~
Osceola	22	12.5	7.3	17.7
Oscoda	*	~	~	~
Otsego	7	~	~	~
Ottawa	192	9.7	8.3	11.1
Presque Isle	7	~	~	~
Roscommon	16	~	~	~
Saginaw	606	36.6	33.6	39.5
Saint Clair	181	14.2	12.1	16.3
Saint Joseph	49	9.8	7.1	12.6
Sanilac	58	17.3	12.8	21.7
Schoolcraft	*	~	~	~
Shiawassee	103	18.6	15.0	22.2
Tuscola	85	18.8	14.8	22.8
Van Buren	93	15.1	12.0	18.2
Washtenaw	559	26.5	24.3	28.7
Wayne	7,930	47.1	46.0	48.1
Wexford	56	23.2	17.1	29.3
Michigan	**18,328**	**24.2**	**23.9**	**24.6**

Table 3. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Adults ≥ 18 Years of Age by County of Residence, Michigan, All Ages, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	26	8.7	5.1	12.4
Alger	13	~	~	~
Allegan	168	7.6	6.4	8.7
Alpena	75	11.3	8.7	13.9
Antrim	33	5.6	3.6	7.5
Arenac	51	12.6	9.1	16.2
Baraga	38	18.0	12.1	23.9
Barry	135	11.1	9.2	13.0
Bay	266	10.7	9.4	12.0
Benzie	22	5.8	3.3	8.2
Berrien	256	7.1	6.2	8.0
Branch	113	11.2	9.1	13.3
Calhoun	253	8.0	7.0	9.0
Cass	106	9.3	7.6	11.1
Charlevoix	31	5.5	3.5	7.4
Cheboygan	42	7.2	5.0	9.4
Chippewa	72	8.4	6.4	10.3
Clare	85	11.5	9.0	14.0
Clinton	113	8.3	6.8	9.9
Crawford	29	9.6	6.1	13.1
Delta	47	5.1	3.6	6.6
Dickinson	69	11.6	8.7	14.4
Eaton	181	8.4	7.1	9.6
Emmet	38	6.3	4.2	8.3
Genesee	1,386	14.6	13.8	15.3
Gladwin	40	6.0	4.1	8.0
Gogebic	32	8.8	5.6	11.9
G Traverse	130	7.8	6.4	9.1
Gratiot	69	7.7	5.9	9.5
Hillsdale	74	7.2	5.6	8.9
Houghton	70	9.8	7.4	12.1
Huron	84	9.8	7.6	11.9
Ingham	610	10.4	9.5	11.2
Ionia	76	5.4	4.2	6.6
Iosco	65	10.5	7.8	13.1
Iron	29	11.8	7.2	16.3
Isabella	109	9.6	7.7	11.5
Jackson	414	11.6	10.5	12.8
Kalamazoo	405	8.1	7.3	8.9

Table 3. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kalkaska	23	6.6	3.8	9.3
Kent	1,037	8.8	8.3	9.3
Keweenaw	9	~	~	~
Lake	11	~	~	~
Lapeer	132	6.9	5.7	8.0
Leelanau	19	~	~	~
Lenawee	245	11.1	9.7	12.5
Livingston	160	5.0	4.2	5.8
Luce	18	~	~	~
Mackinac	14	~	~	~
Macomb	1,908	10.5	10.0	10.9
Manistee	39	6.7	4.5	8.8
Marquette	81	5.8	4.5	7.1
Mason	63	10.3	7.7	12.9
Mecosta	31	3.8	2.5	5.2
Menominee	27	5.1	3.1	7.0
Midland	179	10.2	8.7	11.7
Missaukee	18	~	~	~
Monroe	371	11.8	10.6	13.0
Montcalm	86	6.4	5.0	7.7
Montmorency	22	9.3	5.1	13.5
Muskegon	305	8.4	7.4	9.3
Newaygo	87	8.8	6.9	10.6
Oakland	2,760	10.4	10.0	10.8
Oceana	51	9.3	6.7	11.8
Ogemaw	89	17.5	13.7	21.3
Ontonagon	24	13.2	7.6	18.8
Osceola	41	9.3	6.4	12.2
Oscoda	22	11.6	6.5	16.7
Otsego	30	6.3	4.0	8.5
Ottawa	324	6.8	6.1	7.6
Presque Isle	20	~	~	~
Roscommon	72	15.1	11.3	18.9
Saginaw	993	21.5	20.1	22.8
St Clair	408	11.4	10.3	12.5
St Joseph	98	7.1	5.7	8.5
Sanilac	114	11.9	9.7	14.1
Schoolcraft	5	~	~	~
Shiawassee	139	9.0	7.5	10.5
Tuscola	111	8.6	7.0	10.2
Van Buren	128	7.9	6.5	9.2
Washtenaw	803	12.9	12.0	13.9
Wayne	10,917	23.7	23.3	24.1
Wexford	36	5.6	3.8	7.5
Michigan	**28,306**	**12.9**	**12.8**	**13.1**

Table 4. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for White[4] Persons by County of Residence, Michigan, All Ages, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 Census population.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	35	10.3	6.6	14.0
Alger	16	~	~	~
Allegan	234	7.7	6.7	8.7
Alpena	121	14.0	11.5	16.5
Antrim	44	6.0	4.2	7.9
Arenac	62	12.0	9.0	15.1
Baraga	43	17.5	12.1	23.0
Barry	174	10.8	9.1	12.4
Bay	423	13.3	12.1	14.6
Benzie	42	9.4	6.5	12.3
Berrien	259	6.8	5.9	7.6
Branch	163	12.5	10.6	14.5
Calhoun	274	7.4	6.5	8.3
Cass	135	10.0	8.3	11.7
Charlevoix	48	6.6	4.7	8.4
Cheboygan	62	8.6	6.4	10.8
Chippewa	77	8.2	6.3	10.0
Clare	114	12.0	9.7	14.2
Clinton	165	9.0	7.6	10.3
Crawford	39	9.8	6.7	13.0
Delta	72	6.2	4.8	7.7
Dickinson	125	16.4	13.5	19.3
Eaton	255	9.2	8.1	10.4
Emmet	68	8.4	6.4	10.4
Genesee	1,302	13.0	12.2	13.7
Gladwin	57	6.8	5.0	8.6
Gogebic	37	8.1	5.4	10.7
Grand Traverse	203	9.2	7.9	10.4
Gratiot	149	12.9	10.8	14.9
Hillsdale	116	8.3	6.8	9.9
Houghton	88	9.7	7.6	11.8
Huron	148	13.8	11.5	16.1
Ingham	707	10.6	9.8	11.4
Ionia	123	6.5	5.3	7.6
Iosco	84	11.0	8.6	13.5
Iron	38	12.5	8.3	16.7
Isabella	186	12.7	10.8	14.6
Jackson	546	12.9	11.8	14.0

Table 4. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kalamazoo	460	8.0	7.3	8.7
Kalkaska	37	7.8	5.2	10.3
Kent	1,338	9.0	8.5	9.5
Keweenaw	9	~	~	~
Lake	24	9.5	5.6	13.4
Lapeer	251	9.5	8.3	10.7
Leelanau	42	8.1	5.6	10.7
Lenawee	366	12.9	11.6	14.2
Livingston	305	7.0	6.2	7.8
Luce	17	~	~	~
Mackinac	19	~	~	~
Macomb	2,571	11.4	10.9	11.8
Manistee	54	7.9	5.7	10.1
Marquette	116	6.6	5.4	7.8
Mason	81	10.2	8.0	12.5
Mecosta	60	5.9	4.4	7.4
Menominee	57	8.6	6.3	10.9
Midland	261	11.1	9.8	12.5
Missaukee	41	9.5	6.6	12.5
Monroe	612	14.5	13.3	15.6
Montcalm	167	9.4	7.9	10.8
Montmorency	33	11.4	7.3	15.4
Muskegon	297	7.3	6.5	8.1
Newaygo	113	8.4	6.8	9.9
Oakland	3,079	10.3	9.9	10.6
Oceana	76	10.2	7.9	12.6
Ogemaw	99	14.8	11.7	17.8
Ontonagon	31	14.1	8.9	19.3
Osceola	63	10.3	7.7	12.8
Oscoda	25	10.0	5.9	14.1
Otsego	37	5.6	3.8	7.5
Ottawa	476	7.2	6.5	7.8
Presque Isle	25	5.6	3.3	8.0
Roscommon	88	14.4	11.2	17.6
Saginaw	810	16.1	14.9	17.2
Saint Clair	546	11.5	10.5	12.5
Saint Joseph	128	7.1	5.9	8.3
Sanilac	170	13.3	11.2	15.3
Schoolcraft	7	~	~	~
Shiawassee	236	11.4	9.9	12.8
Tuscola	195	11.5	9.8	13.1
Van Buren	184	8.6	7.4	9.9
Washtenaw	825	12.4	11.5	13.2
Wayne	4,334	12.3	11.9	12.6
Wexford	92	10.4	8.3	12.5
Michigan	**26,038**	**10.6**	**10.5**	**10.8**

Table 5. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Black[4] Persons by County of Residence, Michigan, All Ages, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
[4]For records that are missing data for race, race was assigned based on the 1990 Census population.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
* Number of hospitalizations < 5 and > 0.
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	0	~	~	~
Alger	*	~	~	~
Allegan	8	~	~	~
Alpena	5	~	~	~
Antrim	0	~	~	~
Arenac	*	~	~	~
Baraga	0	~	~	~
Barry	*	~	~	~
Bay	15	~	~	~
Benzie	0	~	~	~
Berrien	217	24.0	20.6	27.4
Branch	*	~	~	~
Calhoun	92	18.4	14.5	22.3
Cass	23	18.3	10.5	26.2
Charlevoix	0	~	~	~
Cheboygan	*	~	~	~
Chippewa	*	~	~	~
Clare	*	~	~	~
Clinton	14	~	~	~
Crawford	*	~	~	~
Delta	0	~	~	~
Dickinson	0	~	~	~
Eaton	36	26.0	16.2	35.7
Emmet	0	~	~	~
Genesee	1,024	36.5	34.2	38.9
Gladwin	0	~	~	~
Gogebic	*	~	~	~
Grand Traverse	*	~	~	~
Gratiot	*	~	~	~
Hillsdale	*	~	~	~
Houghton	0	~	~	~
Huron	0	~	~	~
Ingham	326	33.0	29.1	37.0
Ionia	5	~	~	~
Iosco	*	~	~	~
Iron	0	~	~	~
Isabella	5	~	~	~

Table 5. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Jackson	134	35.4	28.9	42.0
Kalamazoo	206	31.1	26.4	35.7
Kalkaska	0	~	~	~
Kent	302	20.3	17.7	22.8
Keweenaw	0	~	~	~
Lake	*	~	~	~
Lapeer	0	~	~	~
Leelanau	0	~	~	~
Lenawee	11	~	~	~
Livingston	*	~	~	~
Luce	0	~	~	~
Mackinac	0	~	~	~
Macomb	190	44.1	37.5	50.6
Manistee	0	~	~	~
Marquette	*	~	~	~
Mason	0	~	~	~
Mecosta	*	~	~	~
Menominee	0	~	~	~
Midland	*	~	~	~
Missaukee	0	~	~	~
Monroe	25	44.8	27.0	62.6
Montcalm	*	~	~	~
Montmorency	0	~	~	~
Muskegon	239	25.5	22.1	29.0
Newaygo	*	~	~	~
Oakland	1,070	29.0	27.1	30.8
Oceana	0	~	~	~
Ogemaw	0	~	~	~
Ontonagon	0	~	~	~
Osceola	0	~	~	~
Oscoda	0	~	~	~
Otsego	0	~	~	~
Ottawa	21	~	~	~
Presque Isle	*	~	~	~
Roscommon	0	~	~	~
Saginaw	750	62.7	57.9	67.4
Saint Clair	42	58.2	40.1	76.3
Saint Joseph	5	~	~	~
Sanilac	*	~	~	~
Schoolcraft	0	~	~	~
Shiawassee	*	~	~	~
Tuscola	0	~	~	~
Van Buren	31	27.6	17.6	37.6
Washtenaw	522	50.8	46.2	55.5
Wayne	14,386	53.5	52.6	54.4
Wexford	0	~	~	~
Michigan	19,865	45.5	44.9	46.2

Table 6. Total Number of Deaths and Average per Year due to Asthma[1, 2] by County of Residence, Michigan, All Ages, 1990-2001

[1]Asthma death defined as a primary cause of death as asthma, ICD-10=J45 or J46.
[2]1990-1998 deaths adjusted for the ICD-9 to ICD-10 comparability ratio.
* Number of deaths < 5 and > 0.
~ Average less than 1 death per year.

County	Count	Average per Year
Alcona	*	~
Alger	*	~
Allegan	14	1
Alpena	6	~
Antrim	*	~
Arenac	*	~
Baraga	6	~
Barry	13	1
Bay	17	1
Benzie	*	~
Berrien	33	3
Branch	7	~
Calhoun	22	2
Cass	6	~
Charlevoix	5	~
Cheboygan	5	~
Chippewa	14	1
Clare	5	~
Clinton	9	~
Crawford	*	~
Delta	10	~
Dickinson	8	~
Eaton	14	1
Emmet	*	~
Genesee	96	8
Gladwin	*	~
Gogebic	7	~
Grand Traverse	6	~
Gratiot	5	~
Hillsdale	8	~
Houghton	*	~
Huron	7	~
Ingham	53	4
Ionia	13	1
Iosco	15	1
Iron	6	~
Isabella	7	~
Jackson	29	2
Kalamazoo	37	3
Kalkaska	*	~

Table 6. Continued.

County	Count	Average per Year
Kent	102	9
Keweenaw	0	~
Lake	*	~
Lapeer	13	1
Leelanau	*	~
Lenawee	20	2
Livingston	19	2
Luce	*	~
Mackinac	*	~
Macomb	131	11
Manistee	6	~
Marquette	21	2
Mason	9	~
Mecosta	6	~
Menominee	*	~
Midland	12	1
Missaukee	*	~
Monroe	16	1
Montcalm	10	~
Montmorency	*	~
Muskegon	32	3
Newaygo	11	~
Oakland	202	17
Oceana	7	~
Ogemaw	9	~
Ontonagon	*	~
Osceola	*	~
Oscoda	*	~
Otsego	*	~
Ottawa	31	3
Presque Isle	5	~
Roscommon	6	~
Saginaw	50	4
Saint Clair	23	2
Saint Joseph	13	1
Sanilac	8	~
Schoolcraft	*	~
Shiawassee	8	~
Tuscola	14	1
Van Buren	13	1
Washtenaw	44	4
Wayne	633	53
Wexford	8	~
Michigan	1,986	166

Table 7. Rates[1] (per 10,000) of Hospitalization due to Asthma[2] for Children 0 to 4 Years by County of Residence, Michigan, 1999-2001

[1]Population estimates are taken from the Michigan population estimates for 1999.
[2]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
* Number of hospitalizations < 5 and > 0.
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	5	~	~	~
Alger	*	~	~	~
Allegan	39	16.5	11.3	21.7
Alpena	30	55.4	35.6	75.2
Antrim	8	~	~	~
Arenac	*	~	~	~
Baraga	*	~	~	~
Barry	25	22.8	13.8	31.7
Bay	137	64.7	53.8	75.5
Benzie	15	~	~	~
Berrien	140	45.0	37.6	52.5
Branch	27	30.0	18.7	41.4
Calhoun	57	20.2	15.0	25.5
Cass	32	33.6	22.0	45.3
Charlevoix	10	~	~	~
Cheboygan	17	~	~	~
Chippewa	8	~	~	~
Clare	17	~	~	~
Clinton	42	32.2	22.5	41.9
Crawford	7	~	~	~
Delta	9	~	~	~
Dickinson	43	~	~	~
Eaton	73	37.6	29.0	46.2
Emmet	18	~	~	~
Genesee	539	60.1	55.1	65.2
Gladwin	8	~	~	~
Gogebic	*	~	~	~
Grand Traverse	43	27.1	19.0	35.2
Gratiot	46	61.6	43.8	79.4
Hillsdale	26	26.5	16.3	36.7
Houghton	12	~	~	~
Huron	49	73.9	53.2	94.6
Ingham	230	38.6	33.6	43.6
Ionia	33	23.2	15.3	31.1
Iosco	10	~	~	~
Iron	8	~	~	~
Isabella	67	59.9	45.5	74.2
Jackson	177	56.9	48.5	65.3
Kalamazoo	144	31.0	25.9	36.0
Kalkaska	11	~	~	~

Table 7. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kent	328	24.8	22.1	27.5
Keweenaw	*	~	~	~
Lake	8	~	~	~
Lapeer	64	36.1	27.2	44.9
Leelanau	15	~	~	~
Lenawee	95	48.3	38.6	58.0
Livingston	92	29.6	23.5	35.6
Luce	0	~	~	~
Mackinac	*	~	~	~
Macomb	432	29.0	26.3	31.8
Manistee	13	~	~	~
Marquette	23	20.7	12.2	29.1
Mason	11	~	~	~
Mecosta	18	~	~	~
Menominee	20	~	~	~
Midland	53	31.4	22.9	39.8
Missaukee	14	~	~	~
Monroe	161	52.9	44.7	61.0
Montcalm	50	38.6	27.9	49.3
Montmorency	*	~	~	~
Muskegon	104	29.0	23.5	34.6
Newaygo	21	20.0	11.4	28.5
Oakland	870	37.4	34.9	39.9
Oceana	16	~	~	~
Ogemaw	*	~	~	~
Ontonagon	*	~	~	~
Osceola	15	~	~	~
Oscoda	*	~	~	~
Otsego	5	~	~	~
Ottawa	93	17.0	13.6	20.5
Presque Isle	*	~	~	~
Roscommon	14	~	~	~
Saginaw	240	57.0	49.8	64.2
Saint Clair	79	23.6	18.4	28.8
Saint Joseph	37	28.0	19.0	37.1
Sanilac	38	43.1	29.4	56.8
Schoolcraft	*	~	~	~
Shiawassee	70	48.8	37.4	60.2
Tuscola	40	35.2	24.3	46.1
Van Buren	59	36.7	27.3	46.1
Washtenaw	291	46.8	41.5	52.2
Wayne	3,622	81.2	78.6	83.9
Wexford	40	62.3	43.0	81.7
Michigan	**9,323**	**46.2**	**45.2**	**47.1**

Table 8. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Children and Adults, 5 to 64 Years by County of Residence, Michigan, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	23	8.6	4.9	12.4
Alger	14	~	~	~
Allegan	151	6.0	5.1	7.0
Alpena	82	11.9	9.3	14.4
Antrim	18	~	~	~
Arenac	45	11.5	8.1	14.8
Baraga	27	13.9	8.7	19.2
Barry	98	7.3	5.8	8.7
Bay	252	9.6	8.4	10.8
Benzie	19	~	~	~
Berrien	288	7.5	6.6	8.4
Branch	98	9.2	7.4	11.0
Calhoun	260	7.7	6.8	8.6
Cass	97	7.9	6.3	9.5
Charlevoix	35	5.8	3.9	7.8
Cheboygan	35	6.0	4.0	8.1
Chippewa	65	7.2	5.5	9.0
Clare	83	11.1	8.7	13.6
Clinton	119	7.5	6.2	8.9
Crawford	29	9.0	5.7	12.4
Delta	49	5.2	3.8	6.7
Dickinson	62	10.7	8.0	13.4
Eaton	182	7.3	6.2	8.4
Emmet	45	6.9	4.9	9.0
Genesee	1,570	14.5	13.8	15.2
Gladwin	40	6.1	4.1	8.0
Gogebic	32	8.8	5.7	11.8
Grand Traverse	125	7.0	5.7	8.2
Gratiot	84	8.8	6.9	10.7
Hillsdale	81	7.3	5.7	8.9
Houghton	64	8.9	6.7	11.1
Huron	73	8.9	6.8	10.9
Ingham	735	11.0	10.2	11.8
Ionia	79	4.9	3.8	6.0
Iosco	56	9.4	6.9	11.9
Iron	24	10.3	6.1	14.5
Isabella	117	9.1	7.4	10.8
Jackson	418	11.0	10.0	12.1
Kalamazoo	439	8.1	7.3	8.8

Table 8. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kalkaska	18	~	~	~
Kent	1172	8.9	8.3	9.4
Keweenaw	9	~	~	~
Lake	18	~	~	~
Lapeer	169	7.4	6.3	8.5
Leelanau	23	5.4	3.1	7.7
Lenawee	261	10.9	9.5	12.2
Livingston	190	5.0	4.3	5.7
Luce	11	~	~	~
Mackinac	15	~	~	~
Macomb	1,878	9.8	9.4	10.3
Manistee	32	5.8	3.8	7.9
Marquette	73	4.9	3.8	6.1
Mason	57	9.2	6.8	11.6
Mecosta	38	4.4	3.0	5.8
Menominee	34	6.0	4.0	8.0
Midland	170	8.4	7.1	9.6
Missaukee	23	6.8	4.0	9.6
Monroe	432	12.2	11.0	13.3
Montcalm	110	7.4	6.0	8.8
Montmorency	22	10.5	6.0	15.0
Muskegon	386	9.6	8.6	10.6
Newaygo	84	7.9	6.2	9.6
Oakland	2,599	8.9	8.6	9.3
Oceana	53	8.9	6.5	11.3
Ogemaw	68	13.9	10.5	17.3
Ontonagon	23	14.0	8.2	19.9
Osceola	42	8.8	6.1	11.5
Oscoda	16	~	~	~
Otsego	28	5.3	3.4	7.3
Ottawa	336	6.0	5.4	6.7
Presque Isle	16	~	~	~
Roscommon	55	12.7	9.2	16.1
Saginaw	1,130	22.1	20.8	23.4
Saint Clair	440	11.3	10.2	12.3
Saint Joseph	72	4.9	3.8	6.1
Sanilac	110	11.0	8.9	13.1
Schoolcraft	0	~	~	~
Shiawassee	136	7.9	6.5	9.2
Tuscola	123	8.7	7.2	10.3
Van Buren	143	7.9	6.6	9.2
Washtenaw	934	13.3	12.5	14.2
Wayne	13,270	26.1	25.7	26.6
Wexford	44	6.4	4.5	8.2
Michigan	**31,345**	**13.1**	**13.0**	**13.3**

Table 9. Rates[1, 2] (per 10,000) of Hospitalization due to Asthma[3] for Adults Age 65 Years and Older by County of Residence, Michigan, 1999-2001

[1]Rates are age adjusted to the 2000 US standard population by the direct standardization method. Hospitalization records with missing age are excluded.
[2]Population estimates are taken from the Michigan population estimates for 1999.
[3]Asthma hospitalization defined as a primary discharge diagnosis of asthma, ICD-9-CM=493.XX.
~Insufficient data to compute a stable rate, (Number of events ≤ 20 or Population < 5000).
* Number of hospitalizations < 5 and > 0.
Gray shading indicates a county rate significantly higher than the rate for the State of Michigan.

			95 % Confidence Interval	
County	Count	Rate	Lower Limit	Upper Limit
Alcona	7	~	~	~
Alger	*	~	~	~
Allegan	58	15.2	11.3	19.1
Alpena	20	~	~	~
Antrim	20	~	~	~
Arenac	19	~	~	~
Baraga	16	~	~	~
Barry	55	27.2	20.0	34.4
Bay	64	13.9	10.5	17.3
Benzie	8	~	~	~
Berrien	53	7.6	5.5	9.6
Branch	47	26.0	18.6	33.4
Calhoun	53	8.9	6.5	11.4
Cass	30	15.2	9.8	20.7
Charlevoix	*	~	~	~
Cheboygan	12	~	~	~
Chippewa	19	~	~	~
Clare	16	~	~	~
Clinton	21	11.1	6.3	15.8
Crawford	*	~	~	~
Delta	15	~	~	~
Dickinson	21	13.2	7.5	18.9
Eaton	42	13.1	9.2	17.1
Emmet	5	~	~	~
Genesee	232	16.7	14.6	18.9
Gladwin	9	~	~	~
Gogebic	5	~	~	~
Grand Traverse	38	12.7	8.6	16.7
Gratiot	21	12.4	7.1	17.7
Hillsdale	12	~	~	~
Houghton	15	~	~	~
Huron	27	12.9	8.0	17.7
Ingham	104	13.1	10.6	15.6
Ionia	19	~	~	~
Iosco	20	~	~	~
Iron	6	~	~	~
Isabella	19	~	~	~
Jackson	94	15.1	12.0	18.1

Table 9. Continued.

			95 % Confidence Interval	
County	**Count**	**Rate**	**Lower Limit**	**Upper Limit**
Kalamazoo	94	11.9	9.5	14.4
Kalkaska	8	~	~	~
Kent	195	10.3	8.9	11.8
Keweenaw	0	~	~	~
Lake	*	~	~	~
Lapeer	19	~	~	~
Leelanau	10	~	~	~
Lenawee	37	9.8	6.6	13.0
Livingston	30	7.8	5.0	10.6
Luce	8	~	~	~
Mackinac	*	~	~	~
Macomb	480	16.0	14.6	17.5
Manistee	13	~	~	~
Marquette	24	9.5	5.7	13.4
Mason	13	~	~	~
Mecosta	8	~	~	~
Menominee	*	~	~	~
Midland	44	17.4	12.3	22.6
Missaukee	*	~	~	~
Monroe	58	12.3	9.1	15.5
Montcalm	11	~	~	~
Montmorency	8	~	~	~
Muskegon	50	7.3	5.3	9.3
Newaygo	12	~	~	~
Oakland	765	19.0	17.7	20.3
Oceana	11	~	~	~
Ogemaw	28	23.0	14.5	31.6
Ontonagon	7	~	~	~
Osceola	6	~	~	~
Oscoda	6	~	~	~
Otsego	*	~	~	~
Ottawa	87	12.3	9.7	14.8
Presque Isle	9	~	~	~
Roscommon	19	~	~	~
Saginaw	229	28.8	25.1	32.5
Saint Clair	70	11.1	8.5	13.7
Saint Joseph	38	15.1	10.3	19.9
Sanilac	24	11.1	6.7	15.5
Schoolcraft	5	~	~	~
Shiawassee	36	14.1	9.5	18.7
Tuscola	33	14.5	9.5	19.4
Van Buren	19	~	~	~
Washtenaw	137	18.8	15.6	21.9
Wayne	1,955	24.5	23.4	25.5
Wexford	8	~	~	~
Michigan	**5,966**	**16.3**	**15.8**	**16.7**

Jennifer M. Granholm, Governor
Janet Olszewski, Director

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