

Health and Hospital Corporation of Marion County,
Marion County Public Health Department

Catching Your Breath: Asthma in Marion County

Asthma Risk Factors, Rates of Disease, Hospitalizations and Deaths, 2011

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December 2011

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Executive Summary

Asthma is a chronic lung disease, characterized by obstruction of the lung's airways due to inflammation and a tightening of the muscles. Some airway obstruction is punctuated by episodes of increased inflammation (attacks), generally in response to specific triggers, which may constitute a medical emergency.

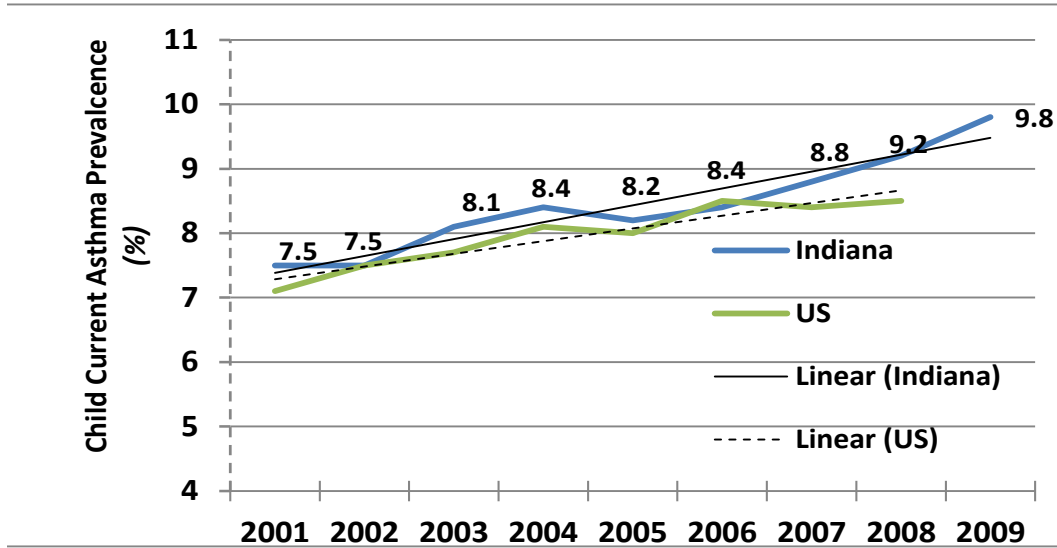
Development of New Asthma Cases:

Large national studies following children from birth find 14-18% develop asthma before the age of six. Asthma incidence has been increasing in the U.S. at more than 4% per year since the 1980s, and continues to increase among both children and adults. Long-term studies of childhood asthma incidence in pre-school children established risk factors such as:

- A family history of asthma or allergy increases asthma risk in childhood by 90%.
- Early and severe respiratory infections triple the risk of asthma onset.
 - Boys are at greater risk of asthma incidence than girls, and
 - Maternal pre-natal smoking, and a child's exposure to environmental tobacco smoke are independent risk factors for asthma incidence in children.
- One-in-four of all Marion County White births (233 per 1,000 births) are exposed to maternal smoking during pregnancy, including 35% of births among White mothers aged 18-24. Overall Marion County maternal smoking rates have not changed between 2005 and 2009 in all ethnicities.
- 22.2% of Marion County children under age 5 (or nearly 29,000) are exposed to someone who smokes in their home. Eliminating or reducing tobacco smoke exposure could prevent a considerable fraction of asthma in both children and adults.

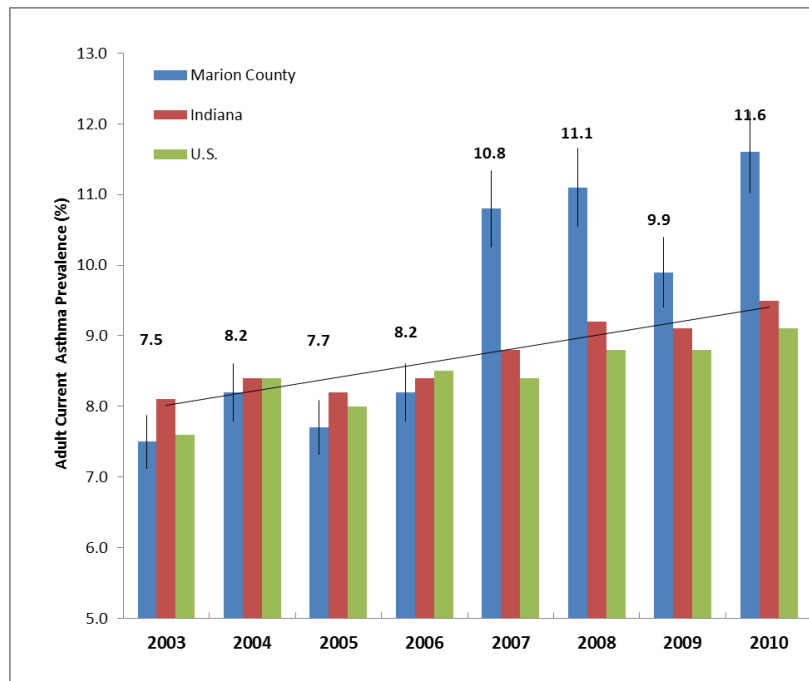
Asthma Prevalence (Burden of Disease):

- 9.5% of Indiana children aged 0-10, and 11.8% of 11-17 year olds currently have asthma (2010). National and Indiana child asthma prevalence for ages 5-17 is gradually increasing (2001 -2009).
- Applying state rates to Marion County children ages 5-17 indicate that more than 15,000 local children currently have asthma.
- Estimates for one county school district finds elementary students with asthma may miss up to 20 days of school per year. National studies estimate that a child with asthma loses 75% more School Absence Days, (or about 2.5 more days) than children without asthma.²⁵
- Marion County Head-Start children under age 6 had a 12.8% current asthma prevalence (2011).



Indiana and U.S. asthma prevalence in 5-17 year olds (BRFSS data)

- National, Indiana and Marion County current asthma prevalence in adults over age 18 also has increased (2003 to 2010). County asthma prevalence increased from 7.5% to 11.6%, with women’s prevalence being twice that of men (12.7% versus 4-6%), but ethnic differences are not statistically significant (2010).



Adult current asthma prevalence 2003-2010: Marion County, Indiana and U.S. (BRFSS data)

Emergency Department (ED) Use: Marion County ranks among the highest Indiana counties in asthma ED visits per 10,000 population (83.6 visits per 10,000; or 7567 visits, 2009) – or 68% higher than the overall state rate (59 per 10,000 population). Asthma-related ED visit rates increased 64% from 2005 to 2009.

- Children under 18 have the highest rates of asthma ED visits, which peak in Fall-early Winter, and are lowest in mid-Summer. Adults, however, do not show this seasonal pattern.
- Three major age groups' asthma-related ED rates for the county are comparable to state rates and Healthy People 2020 Objectives. Four populous zip codes in the northwest area of the county, however, exceed the county average ED rates for children ages 0-4 by two-to-three fold.

Hospitalizations Due to Asthma are generally considered potentially preventable events if asthma is controlled through proper disease management, reduced trigger exposure, and regular preventive visits.

Indiana asthma hospitalization rates grew 30% (2000 to 2009) and Marion County's rate grew by 20% (15.5 to 18.6 per 10,000, 2005 to 2008), unlike U.S. declining trends. The county's asthma hospitalization rate was 51% higher than the state's (13.9 per 10,000, 2009)¹.

- Marion County's asthma hospitalization rate for under-5 year olds is 2.5 times greater than the HP2020 Objective (46.8, versus 18.1 per 10,000 population) and is double that of the state (23.5). The county rate for 5-64 year olds is 60% higher than the HP2020 Objective (13.8 versus 8.6 discharges per 10,000 population).
- Marion County direct charges for asthma-related care in acute care hospitals totaled \$30.5 million dollars (2009), a 73% increase from 2006. More than 60% of these charges were incurred by public programs (\$18.8 million).

Disparities: Non-Hispanic Blacks have nearly three times the rate of asthma hospitalizations than non-Hispanic Whites of any age (33 versus 12 discharges per 10,000 population), including a four-fold greater chance among children under age 15. As there is no significant ethnicity difference in asthma prevalence, this disparity likely reflects differences in severity of disease and/or access to primary care and disease management in ethnic groups.

- Women have twice the likelihood of asthma-related hospitalizations than men.

Asthma Deaths: Indiana's asthma mortality fell 38% between 1999 and 2007. Indiana non-Hispanic Blacks, however, had three times the rate of asthma deaths compared to Whites². County deaths were too few to gain accurate estimates by race or gender.

- Marion County asthma deaths for 1997 to 2007 (total: 152 deaths) yields an annual asthma mortality rate of 2.0 deaths per 100,000 population. Rates for ages 35-64, however, are twice that of the state, and 30% higher among persons 65 and older.

Introduction:

Asthma is a chronic lung disease, characterized by reversible airway obstruction due to inflammation of the lung's airways and a tightening of the muscles around them. Some degree of airway obstruction is punctuated by episodes of increased inflammation (attacks), generally in response to specific triggers, which may constitute a medical emergency. Asthma symptoms include coughing, wheezing and shortness of breath which worsen during an acute attack³. Half of persons (52%) with current asthma (8.7 million adults and 4 million children, 2009) reported an asthma attack in the prior year⁴.

Between 1980 and 1996, U.S. adult asthma prevalence increased by an average of 3.8% per year, but from 2001-2009 current asthma prevalence slowed its rate of increase to 1.2% per year⁵. Asthma mortality⁶ and hospitalizations have declined, however⁷. Asthma triggers vary in each case and local environment, but leading triggers include cigarette and other smoke, mold, pollen, dust, animal dander, exercise, cold air, household and industrial products, air pollutants, and respiratory infections⁸. In the U.S. asthma led to 1.75 million emergency department (ED) visits, 456,000 asthma hospitalizations (2007)⁹. There were also 3,447 U.S. deaths due to asthma in 2007¹⁰.

Asthma Incidence in Children:

Asthma is the most common chronic condition found in childhood¹¹, and 9.1% of all U.S. children under age 18 currently have asthma, or more than 7 million¹². Asthma onset is most common in a child's first year and is difficult to distinguish from other causes of wheezing. Those who have consistent wheezing up to age three are at greater risk for developing chronic asthma by the time they start school.

One of the few studies to document asthma development in children is the European Community Respiratory Health Survey, which studied asthma onset from birth to 10 years, 10-20 years and later in life among 18,156 subjects. Authors noted the following as independent causal factors for incident (previously undiagnosed) cases of asthma¹³:

- A family history of asthma or allergy increased asthma risk in childhood by 90% (HR, 1.89; [CI: 1.67-2.13]) and later in life.
- Males are more likely to develop asthma in childhood, but by puberty females have the greater risk.
- Early, acute and severe *respiratory* infections triples the risk of asthma onset in early childhood (pooled HR, 3.19; [CI: 2.75-3.69]), regardless of a patient's family history (genetic predisposition).¹⁴
- Early contact with older children, an indicator of exposure to various infectious agents, reduces the risk of asthma development in both children and adults by about 15% (HR, 0.84; [CI: 0.74-0.96]).

- Early pet exposure in the home may not lead to asthma development in children¹⁵.

Studies following populations of children from birth find between 14-18% develop asthma before the age of six¹⁶. The rate of new (incident) childhood cases doubled between the 1980s and 1990s, increasing about 4% per year between 1985 and 1996^{17, 18} and U.S. incidence rates in children and adults continues to rise.⁽¹⁷⁾

Pre-natal exposure to tobacco smoke:

Maternal smoking in pregnancy is a preventable risk factor for many adverse birth outcomes, including low birth weights, prematurity, congenital defects and fetal lung development. Each of these factors directly influences a child's immediate risk of respiratory infections and development of asthma. Mothers who smoked during pregnancy or who were exposed to environmental tobacco smoke (ETS) are more likely to have infants with poor lung growth and increased risk of developing asthma and respiratory tract infections¹⁹.

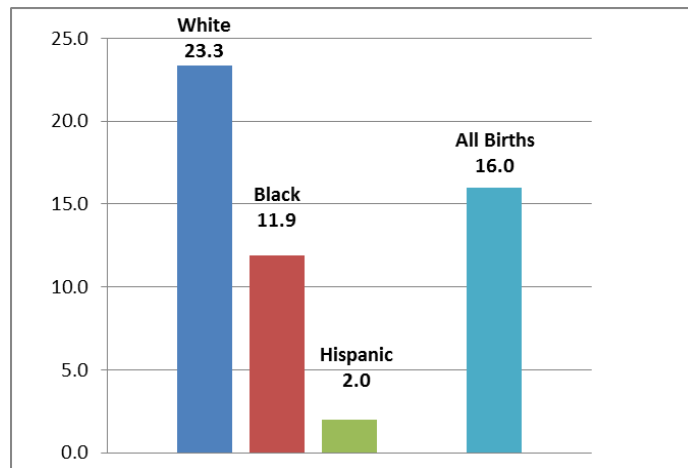
Nearly one in four American women smoke during pregnancy(23.8% prevalence). Fetal hypoxia and ischemia are the major smoking contributors to defects in fetal lung development while nicotine has a direct effect in impairing fetal lung maturation²⁰. Maternal smoking during pregnancy predisposes newborns to a 40% increased risk of wheezing, asthma²¹, airway hyper-responsiveness²² and increased upper and lower respiratory tract infections²³. Several studies have indicated higher risk for asthma incidence among premature and low birth weight infants²⁴.

In utero exposure to tobacco smoke is associated with a significant decrease in lung function during early childhood²⁵. Prenatal tobacco exposure can increase asthma risk at least until adolescence²⁶, and may triple the risk of asthma development before the age of six, even when other risk factors are considered²⁷.

Marion County Maternal Pregnancy Smoking:

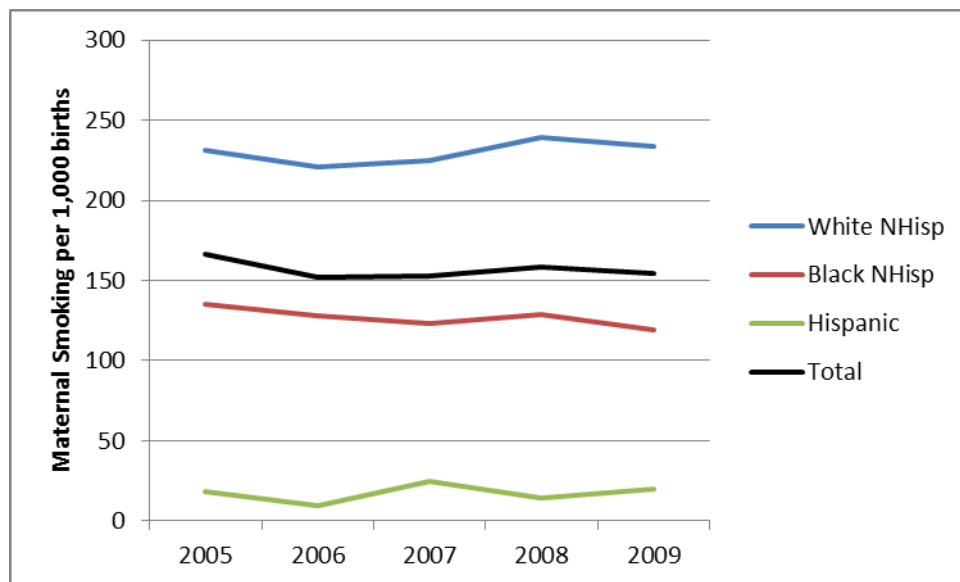
In 2009, 16% of all pregnant Marion County women smoked (a rate of 154.4 per 1000 births, as indicated by birth certificate data). This includes nearly one-fourth of White births (or 233 per 1,000 births), more than twice the exposure among Black expectant mothers and 10 times that seen in Hispanic mothers (Figure 1). Unfortunately, pregnancy smoking rates in the county have been relatively stable in all ethnic groups in the previous 5 years (Figure 2).

Figure 1 Percent of maternal smoking in pregnancy, Marion County 2009



Source: 2009 Birth certificates DR1306 Epidemiology.

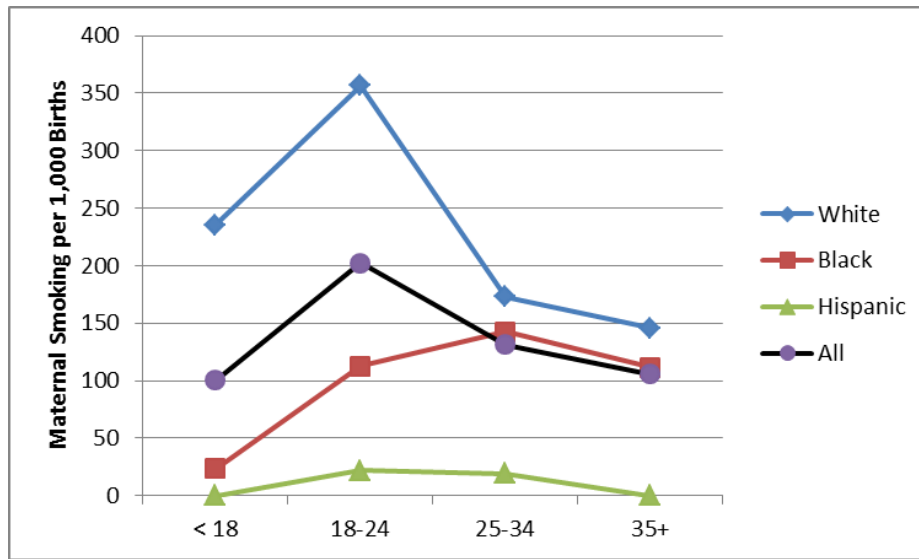
Figure 2 Pregnancy smoking rates per 1,000 births by ethnicity, Marion County 2005-2009



Source: 2009 Birth certificates DR1306 Epidemiology

Pregnancy smoking rates are highest among 18- to 24- year old White mothers (350 births per 1,000) while Black rates peak among 25-to 34- year old expectant mothers (Figure 3). Interventions to reduce all adolescent and prenatal smoking rates would have multiple effects to improve low birth weight infants, infant mortality rates (IMR), as well as child asthma incidence.

Figure 3 Smoking rates in pregnancy by age, Marion County 2009



Source: 2009 Birth certificates DR1306 Epidemiology

A summary of studies regarding pre- and post-natal environmental and maternal tobacco exposure concludes the strength and validity of these studies strongly demonstrate:²⁸

- a) Maternal smoking in pregnancy increases the risk of asthma development in children;
- b) Post-natal exposure to tobacco smoke causes the development of asthma in childhood; and doubles emergency department use by exposed children with asthma²⁹.
- c) Fetal exposure in utero to tobacco use by the mother also is related to an increased risk of adolescent and adult-onset asthma³⁰.

As of 2009, 22.2% of Marion County children under age 5 (or nearly 29,000) were exposed to someone who smokes in their home³¹. A 2011 survey of over 400 Marion County residents found that of the 45% of households with children, 30% had a resident smoker. Of these latter homes, 59% of the smokers regularly smoked indoors, even though 95% of survey respondents recognized the health dangers posed by environmental tobacco smoke (ETS) exposure³².

Parents are the major sources of ETS for children and exposure increases the risk of hospitalization for respiratory disease among infants³³. Eliminating or reducing ETS exposure could prevent up to 13.3% of asthma hospitalizations in children and 9.8% in adults³⁴.

Asthma Prevalence: Children and Youth

Overall, U.S. current asthma prevalence rates among persons under 18 (94.1 per 1,000), is significantly greater than for all adults (71.8 per 1,000)³⁵ and is highest among the school-aged population or 5-17 year olds (107 per 1,000 population or 10.7%). Prevalence indicates the number of medically recognized cases or conditions existing in a defined population, usually expressed as a proportion or rate per thousand(s)³⁶. Boys' current asthma prevalence rate (114.3 per 1,000) was 54% higher than among girls (74.0 per 1,000). This pattern is reversed in adults when asthma is more prevalent in women than men.

The American Lung Association (2010) estimated Marion County had approximately 22,257 diagnosed pediatric cases aged 0-18 and about 58,985 adult cases of asthma³⁷.

Pre-School Asthma:

Asthma can be diagnosed in very young children. Marion County's Head Start Program reported a 12.8% prevalence of diagnosed asthma in children under age 6 from low-income families (Table 1). This ranged from 10.3% in the youngest (ages 2-3) to 13% among older enrollees (ages 3-5)³⁸.

The program has worked closely with MCPHD to evaluate cases, to maintain an Asthma Action Plan (AAP) for each one, and train staff to care for specific asthma needs³⁹. Of the 3-5 year olds with asthma, 28% had had an acute asthma episode within the past year, and 26% had a record of current use of an inhaler or other regular asthma medication. Both characteristics indicate a need for asthma symptom monitoring and asthma planning and education for staff and parents of this pre-school population.

Table 1 Marion County Head Start Children and Asthma Prevalence, 2001

Marion County Head-Start Program	2011 Enrollees	Asthma Prevalence (%)
Early Head Start (Ages 2-3)	203	10.3%
Head Start (Ages 3-5)	1926	13%
Total	2129	12.8%

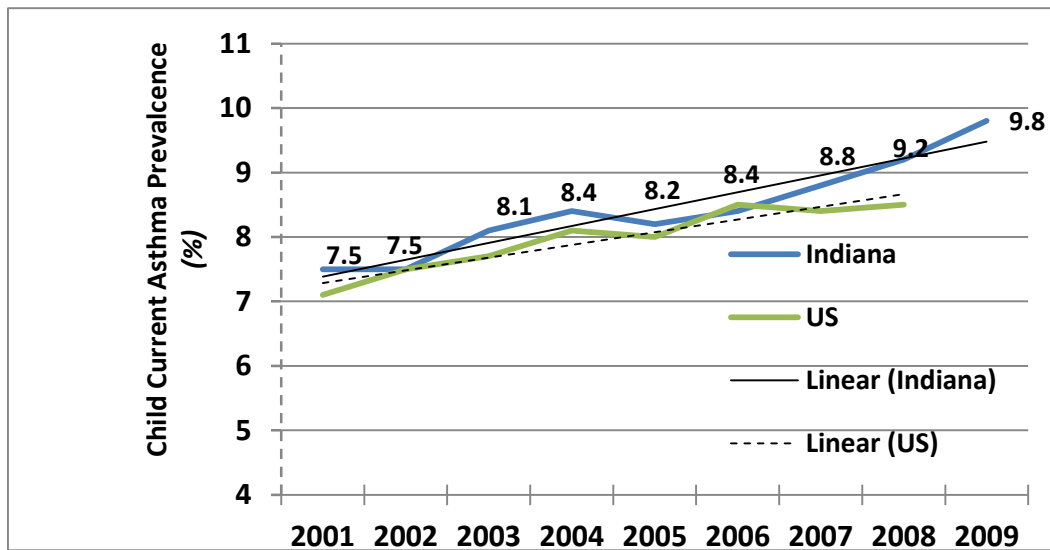
Source: Marion County Head Start Program, April 2011, FSSA Head Start Office.

Asthma in School-Aged Children:

An estimated 150,780 Indiana school aged children (9.8%) currently have asthma (2009)⁴⁰.

Indiana's current asthma rate for children aged 5-17 is not significantly different than national rates, where child prevalence has been gradually increasing (2001 to 2009, Figure 4). In 2010 of Indiana children ever diagnosed with asthma, 9.5% of those aged 0-10 years and 11.8% of those aged 11-17 were reported to still have asthma⁴¹.

Figure 4 US and Indiana Child Current Asthma Prevalence, ages 5-17 years.



Source: Adults reporting a child 5-17 years with current-asthma in the respondent's household. Indiana BRFSS 2001-2010, ISDH BRFSS Annual Reports.

Current asthma is also self-reported biennially by Indiana high school students (grades 9-12) in the Youth Risk Behavior Survey⁴². The prevalence among these adolescents, 12.2%, is similar to the 11.8 % reported for 11-17 year olds in the Indiana Behavioral Risk Factor Surveillance Survey (BRFSS). As in adults, differences in asthma prevalence by race are not statistically significant.

Asthma is one of the leading causes of school absenteeism nationwide⁴³. An estimated 14.4 million lost school days occurred among U.S. children who had an asthma attack in the previous year. HP2020's Objective is that the 58% of children with asthma who miss school due to this condition will be reduced to 49% or less⁴⁴.

Applying Indiana's BRFSS reported child prevalence rate (9.8%) to the County population of 5-17 year olds results in an estimate that 15,103 Marion County school-aged children currently have asthma⁴⁵.

Asthma Friendly School Initiative:

Marion County Public Health Department (MCPHD) has joined the American Lung Association’s (ALA) “Asthma Friendly School Initiative” which promotes asthma care and prevention education for school staff, parents and students, healthy indoor air quality, and reduced exposure to tobacco smoke and other harmful environmental asthma triggers. The prevention program addresses potential triggers in school settings, such as poor ventilation, dust, pets, chemicals, mold/moisture, insect and other irritants which can pose asthma risks for staff and students⁴⁶.

Work in the Metropolitan School District of Perry Township (MSDPT) included a baseline assessment of asthma prevalence among MSDPT elementary (K-5) students, coverage of asthma-students with standing Asthma Action Plans (AAP), evaluation of school Indoor Air Quality (IAQ), and collaboration on an anti-idling policy for school buses.

Asthma prevalence in the District’s elementary school settings averaged about 4% of all grade K-5 students (total 281 cases identified by school nurses; averaging 28 per school), but prevalence varied widely by setting (2.4% to 15.8%,⁴⁷ Table 2). The asthma cases missed an average of 2.5 days (range: 0.9-2.7 days), for a total of 704 absent days during November-December, 2009⁴⁸. If this rate of absences held constant during the 10 month school year, MSDPT elementary students with asthma may miss up to 20 days of school⁴⁹. A national estimate noted that a child with asthma loses 75% more School Absence Days, or on average an excess of 2.5 more days than children without asthma⁵⁰.

Table 2 Perry District Elementary Student Asthma Prevalence, Grades K-5: Nov-Dec. 2009

MSD Perry Elementary Schools (12 settings)	Total K-5 Population	Total Asthma Cases	Asthma Prevalence (%)	Absent days per case (Nov.-Dec. 2009)	Projected 2009-2010 Asthma case absent days	% Asthma cases with Action Plan
All-District (Range)	6814	281 (6-40 per school)	4.1% (2.4-15.8%)	2.5 (0.9-2.7)	12.5 days per case	52.3% (5.1-100%)

Sources: Metropolitan School District of Perry Township nursing staff, Indianapolis Asthma Healthy School Initiative. Projected annual absences per case are based on a 10 month school year.

Overall, 52.3% of MSDPT elementary asthma cases had an AAP on-file⁵¹, with several schools achieving between 80% to 100% plan-coverage of these students⁵². While neither asthma prevalence nor percent of cases with a completed action plans correlated with school size or percentage of low-income students⁵³ it appears that schools with better Asthma Action Plan coverage tended to have fewer absent days among their asthma students than schools with less complete AAP coverage.

During the Asthma Friendly School Intervention, Perry elementary schools were surveyed by MCPHD staff for indoor air quality (adequate heating/ventilation and carbon monoxide/dioxide levels, etc.), and common asthma triggers (mold/moisture, dust-catchers, classroom pets, chemical triggers, etc.) in all instructional rooms⁵⁴.

Several potential hazards for allergies/asthma were common, such as carpeting or rugs (ranging from 17-91% of all rooms per school) and stuffed toys (in 52-82% of all classrooms), while others were relatively rare (furry or feathered class pets, signs of pest infestation, or mold/moisture). Carbon dioxide (CO₂) levels were relatively high in classrooms throughout the district, ranging from 25-75% of rooms, with elevated levels found in each school. Although a few rooms had HVAC units that were not in operation or had vents that were blocked, the more apparent issue was the operation and/or design of the mechanical units' outside air intakes. Many of these classrooms were designed for fewer students than they are now must accommodate. Planned renovations include upgrading the mechanical systems. There was also no apparent relationship between any single asthma trigger prevalence in the two schools with the highest student asthma prevalence (over 9% each). Air quality results are being shared with principals, school nurses and custodial staff to further school asthma control training.

Currently school indoor air quality (IAQ) environments are not subject to routine IAQ inspections. In May 2011 the agency promulgated new rules ([410 IAC 33-2-1](#)) which adopted language from the Environmental Protection Agency (EPA) and Asthma-Friendly School programs. Language was added to define CO₂, humidity and temperature ranges for school rooms, targeted asthma triggers such as chemical, mold, dust and animal exposures, and reduced exposure to vehicle exhaust fumes⁵⁵. The new rules encourage schools/Districts to appoint an air-quality coordinator to review these conditions and plan needed maintenance and remediation. For example, an Indoor Air Quality (IAQ) Team will be formed for the Perry District. Likewise the Indiana State Department of Health (ISDH) created a similar position to receive air-quality complaints, authority to enter and inspect schools, and to assist schools in this monitoring.

School Clinic Use Related to Asthma:

A local network of school based clinics, Learning Well Inc., is accessible to nearly 1-in-3 students in the county's schools (Table 3) in 10 of the 11 public school districts. Clinic patient visit data provides some insight as to asthma health care use among students during school hours.

Like primary care settings, most school-based care focused on ear-nose-throat complaints, headaches, accidents/first aid and muscular strains and gastro intestinal symptoms. Less than 4% (4519) of all visits were coded as asthma-related acute care, and fewer than 2% of Learning Well 2010 patients were seen to receive their prescribed asthma therapies or medications⁵⁶. On-site care may have prevented more extended absences for students with asthma, and provided monitoring for poorly controlled cases, however.

Table 3 Marion County Learning Well, Inc. School Clinic Asthma Visits, 2010

Districts ⁵⁷ with Learning Well Clinics (Plus Charter and Parochial schools)	10	90%
Total LW Clinics	87	
County students w/ available LW clinic	78,548	33.2% (of county school pop'l)
Percent of students in covered population using LW clinic	14,268	44%
Diagnosed asthma patients with medication care at LW clinic sites	212	1.5%
Total 2010 LW Asthma Visits	4519	3.7%

Source: Learning Well, Inc., database, accessed 2/11/2011, Epidemiology.

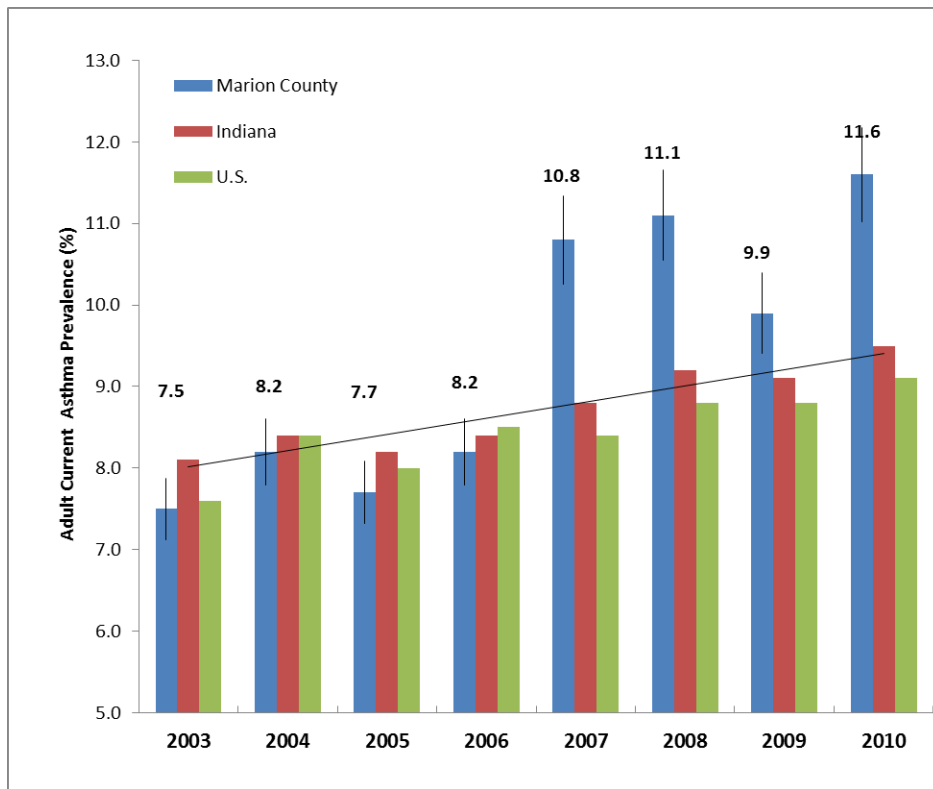
Adult Asthma Prevalence:

In 2008, BRFSS data estimated 19.6 million U.S. adults currently had asthma⁵⁸.

State and County residents participate each year in CDC's Behavioral Risk Factor Surveillance System (BRFSS) phone survey which asks about current asthma status among adults. Indiana and Marion County (11.6%) rates in 2009-2010 were not statistically different than national BRFSS population estimates (at 8.8% and 9.1%)⁵⁹. Like the nation, however, state asthma prevalence has been increasing during the past 6 years (Figure 5, see Indiana linear trend). It is not clear why asthma rates in Marion County appear to exceed state and national rates during 2007-2008, as survey methods remained unchanged during this period.

Gender differences: American women over age 18 have current asthma prevalence that is 56% greater than among American men (8.8% versus 5.6%, respectively). Indiana gender patterns are similar, but rates are somewhat higher than the nation (11.5% women: 6.6% men). Gender disparities also appear in Marion County, where women's prevalence, as in Indiana, is generally twice that of men (10%-12.7%) versus 4%-6%, respectively). Prevalence rates for both genders (Figure 6), however, are not significantly different from those seen in the state.

Figure 5 U.S., Indiana and Marion County Adult Current Asthma Prevalence: 2003-2009.



Source: DR1399 BRFSS-SMART data website. Confidence Intervals for annual estimates indicated by vertical lines⁶⁰; Indiana linear trend for 2003-2010 also indicated by line.

Figure 6 Marion County Current Asthma Prevalence by Gender: 2003-2008

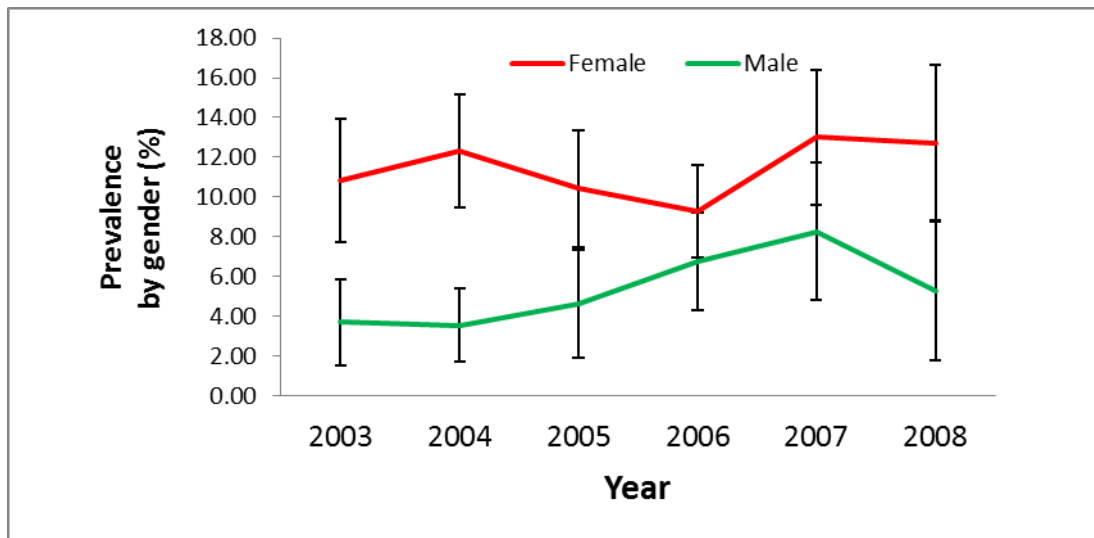
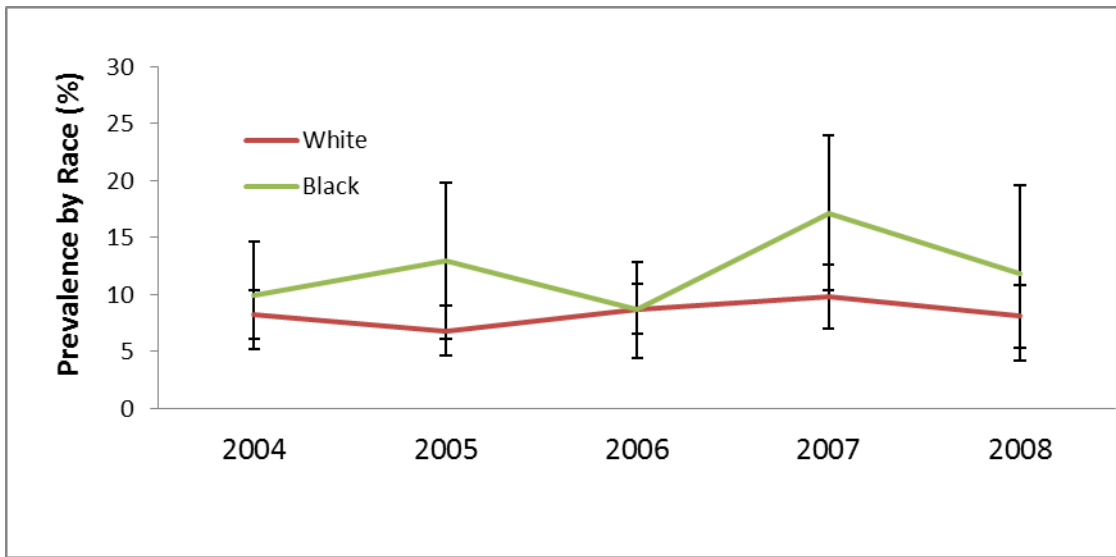


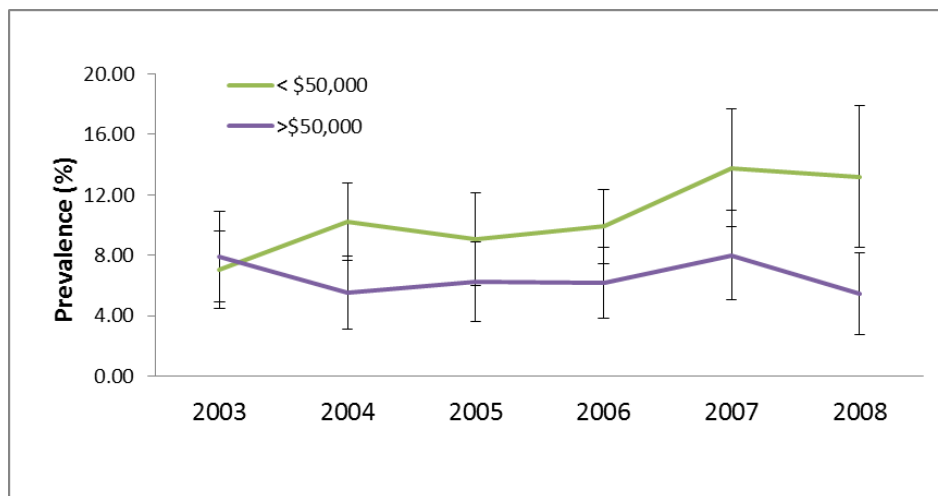
Figure 7 Marion County Asthma Prevalence by Ethnicity: 2004-2008



Ethnicity and Income Differences: In 2009 disparities in current asthma prevalence rates among U.S. African Americans and Whites closed to 15% versus 13%. Similarly Indiana prevalence rates between Blacks and Whites (12% versus 9.2%), and among Marion County Blacks and Whites (11.9%, [CI: 4.2-19.6] and 8.1%, [CI: 5.4-10.9], respectively, Figure 7⁶¹), are not significantly different.

Asthma prevalence rates also tend to be higher in adults from Marion County households earning under \$50,000/year (approximately the County median income) versus those with household incomes over \$50,000 (statistically significant only in 2008) (Figure 8). Other characteristics such as normal versus overweight/obese status, education level, having health insurance and a regular physician were not significant factors in describing county adults with asthma.

Figure 8 Marion County Adult Asthma Rates by Income: 2003-2008



Health Care Use:

Emergency Department Visits:

Asthma is among the top 10 reasons in the U.S. for an emergency department visit⁶². In the past decade, asthma attack rates among American youth under age 18 has been nearly twice that of adults (54.8 versus 28.8 per 1,000 respectively, 2009). Persons with an attack are at risk of requiring an ED visit or hospital admission. The 34.1 million Americans ever-diagnosed with asthma generate some 217,000 Emergency Department (ED) visits/ year due to poorly controlled asthma⁶³, and/or inadequate access to primary health care⁶⁴. Patients with high ED use for asthma (six or more visits/year) contribute two-thirds (67%) of all asthma ED visits each year, and are characterized by minority status, being uninsured or having a public insurance source, and having clinical markers for chronic asthma severity⁶⁵.

For the period 2006-2008, the U.S. asthma ED visit rate was 59.2 per 10,000 population. Highest rates occurred among non-Hispanic Blacks (171.6 visits per 10,000) versus non-Hispanic Whites (41.3), and persons under age 18 (90.1 ED visits per 10,000) versus adults aged 18-64 (47.8)⁶⁶.

More than 31,000 asthma-related ED visits occurred in Indiana, or 49.8 visits per 10,000 population (2009),⁶⁷ up 10% from 2008, and costing approximately \$46 million. Marion County is the 3rd highest in asthma ED use rates among Indiana counties, or 83.6 visits per 10,000 population (7567 visits, 2009). The county's all-age ED use rate is 68% higher than the state⁶⁸, and has increased 64% between 2005 and 2009⁶⁹.

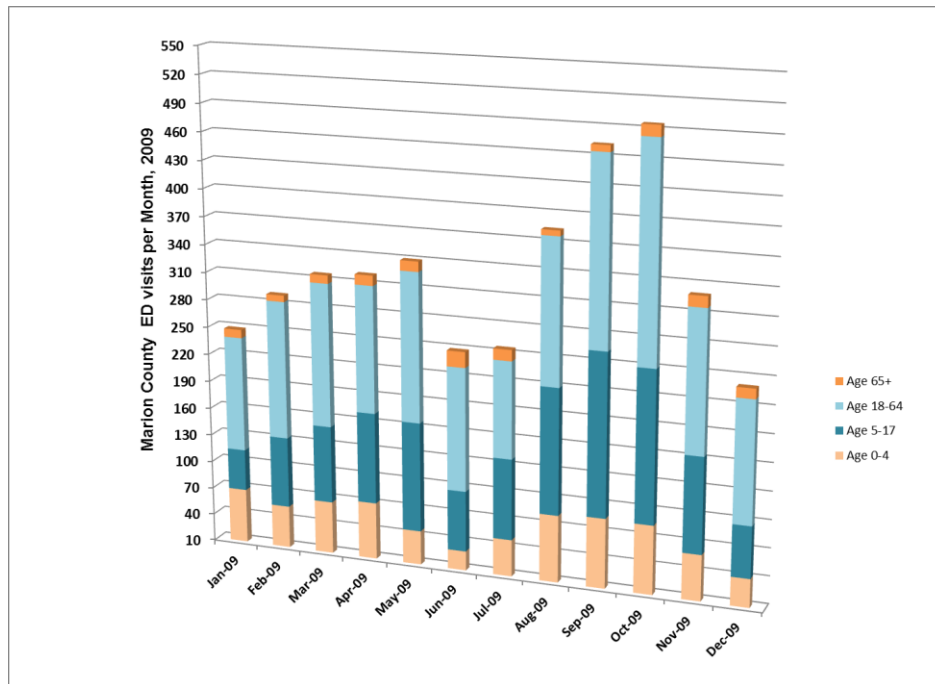
Marion County Seasonal ED Visits:

Asthma ED use peaks in early Fall for most age groups. Marion County asthma-related ED visits of 400-500 visits per month peak in August-October, with lower averages of 250 visits/month in June-July and December-January, for a total of nearly 4,000 ED visits among county residents⁷⁰ (Figure 9). Boys aged 0-4 years have an ED use rate that is double that of young girls, but from adolescence onward, females use ED services more than males (data not shown).

Seasonal patterns are easily seen in rates of ED use by age group. Children's asthma ED use rates among those under age 17 closely follow the Fall-Winter peaks, and Summer lows of the traditional school year (Figure 10), while adults exhibit relatively small seasonal variation.

This may be due in part to children's risks from indoor exposures, and acquired respiratory infections in school settings which can trigger pediatric asthma attacks. Adults on the other hand, may be more consistent than youth in using asthma management and emergency medications, and minimizing their exposure to allergens and respiratory infections⁷¹.

Figure 9 Total Monthly ED Visits by Marion County Age Groups: 2009



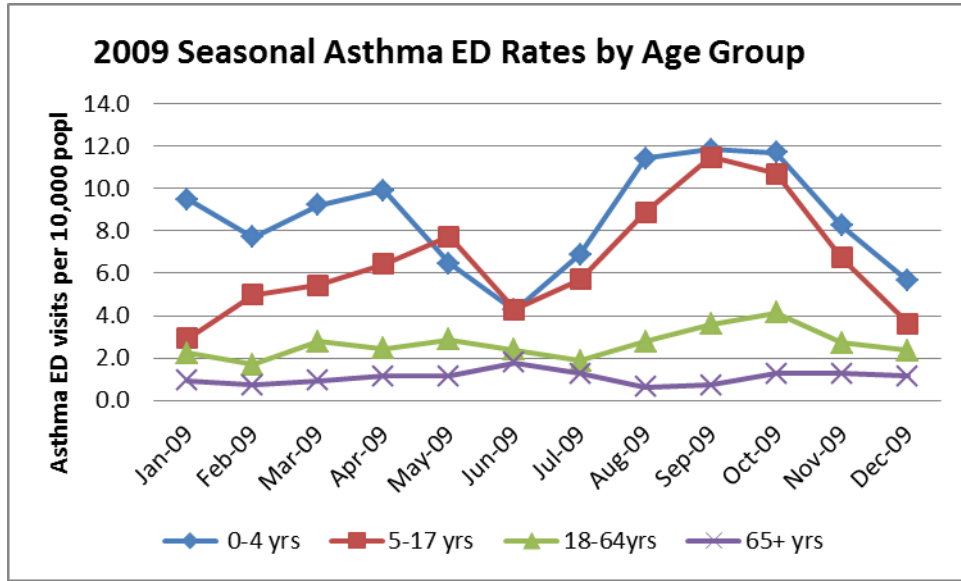
Source: MCPHD Epidemiology ESSENCE data DR1609

Healthy People 2020 Objectives (RD3.1-3.3) to reduce asthma-related ED visits set distinct targets for 0-4 year olds (95.5 per 10,000), 5-64 year olds (49.1) and adults over age 65 (13.2 per 10,000). Overall Marion County’s age-group rates for ED visits by primary complaint⁷² are comparable to state rates⁷³ and HP2020 Objectives⁷⁴ (Figure 11).

As young children exhibit both greater acute event rates and higher seasonality of ED use, ED visit rates were mapped for county children aged 0-4 (Figure 12). Four major northwest zip code areas (46218, 46226, 46250 and 46235, Figure 12) have ED use rates for children 0-4 which exceed the county average rate by two-to-three fold. Other zip codes meet or fall below the average county rate or the HP 2020 Objective for this age group.

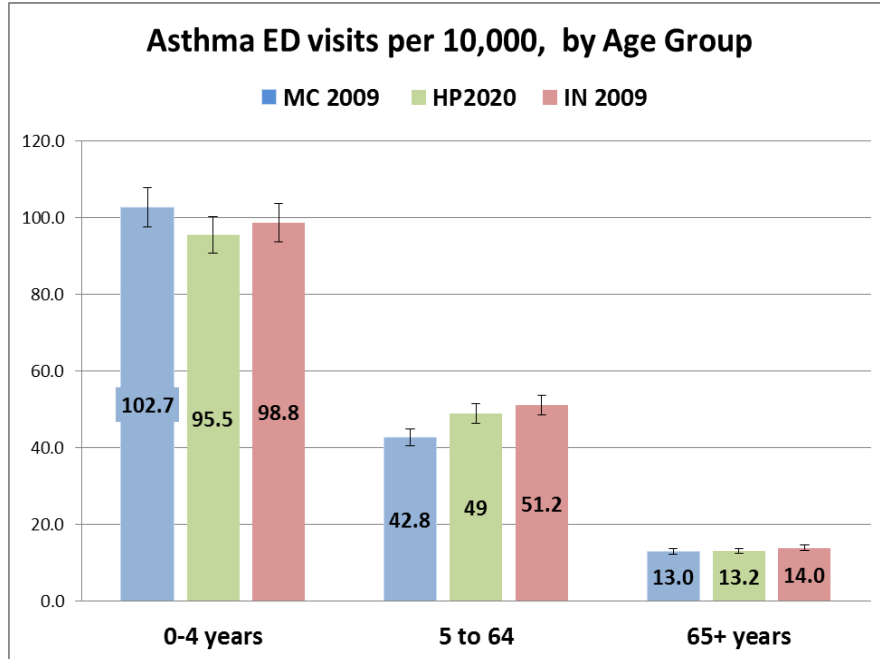
While several of the zip codes with high 0-4 year olds’ asthma-related ED use are high poverty areas, other contiguous areas with substantially lower rates are equally impoverished and densely populated. The four zip code areas also overlap with higher-than-average ED use by other age groups (Figure 13). They are also in the prevailing southwest-to-northeast wind patterns⁷⁵ of small-particulate (2.5 ppm) pollution from local point-pollution sources (Figure 13, blue circles) which may adversely affect respiratory health⁷⁶. While mapped ED use cannot address other potential triggers (such as dust, ETS or other indoor exposures) or differential in access to care in these areas, high asthma ED use areas may highlight potential focus areas for environmental and primary care asthma interventions.

Figure 10 Marion County Seasonal Asthma ED rates by Age: 2009



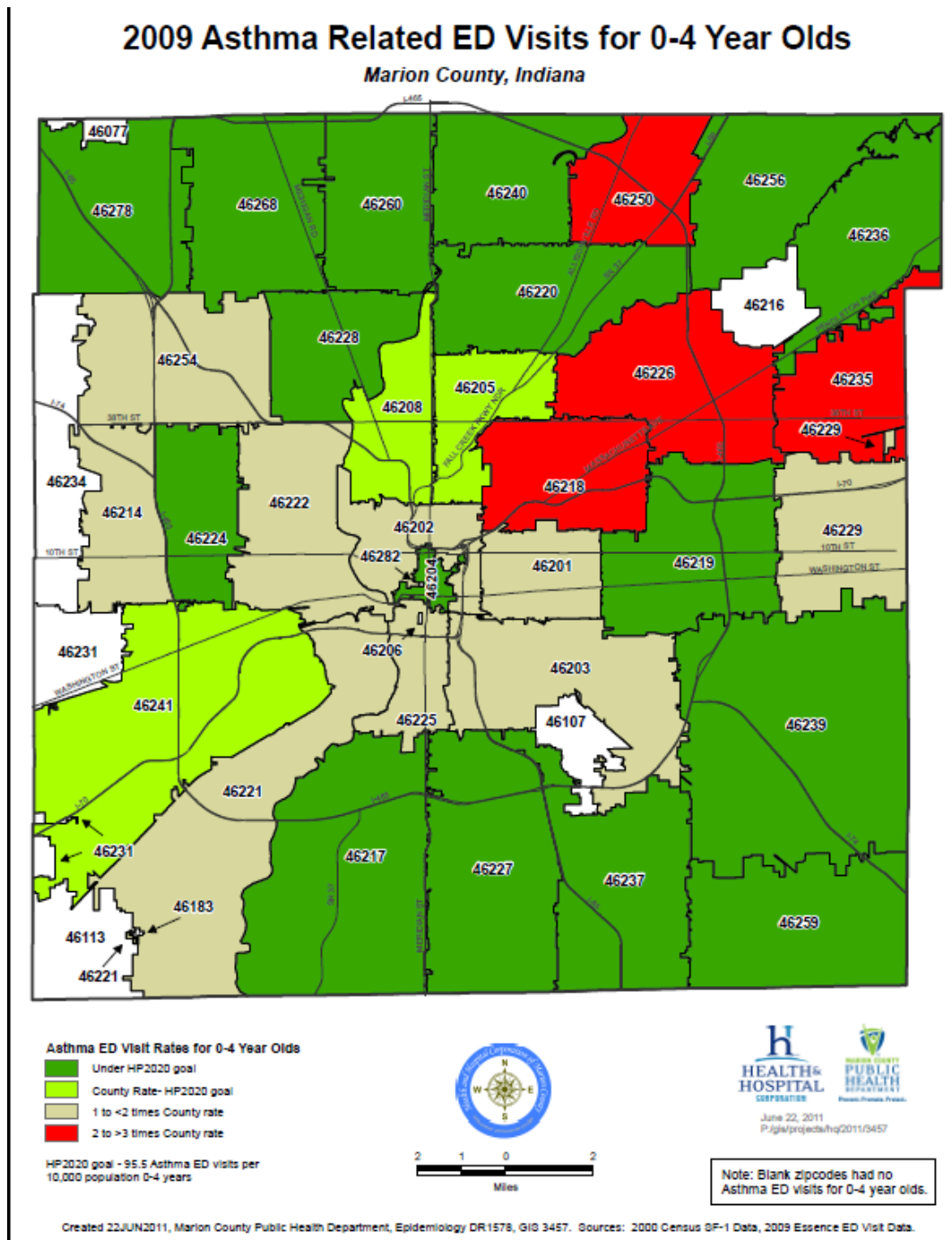
Source: MCPHD Epidemiology ESSENCE data DR1609

Figure 11 Asthma ED visit Rates by Age Group, 2009: County, Indiana and HP2020 Objectives



Source: MCPHD Epidemiology ESSENCE data DR1609, ISDH 2011 Burden of Asthma, and HP2020

Figure 12 Asthma ED Rates per 10,000 0-4 year olds, 2009



Source: MCPHD Epidemiology ESSENCE data DR1609

Asthma-related Hospital Discharges:

Asthma hospitalization data are used to indicate the severity of asthma in a population and are targeted in Healthy People 2020 Objectives⁷⁷ as an indicator of both limited access to, and/or low-quality of primary care in a community. Hospitalizations due to asthma are generally considered an “ambulatory-care-sensitive” or potentially preventable event if asthma is controlled through proper disease management, reduced trigger exposure, and regular preventive visits to providers⁷⁸.

National Trends:

U.S. asthma-related hospital discharge rates remained stable in the early 1990s, peaking at 19.5 per 10,000 population (1995), then declining to 15.1 per 10,000 population in 2007 (or 456,000 discharges)⁷⁹. During the decade of 1995-2006, the rate of hospital discharges decreased 13% overall, with a 25% decrease between 2003 and 2006 alone⁸⁰. Unlike other chronic lung diseases, asthma discharges are very common among children, with some 33% occurring in patients under 15 years of age.

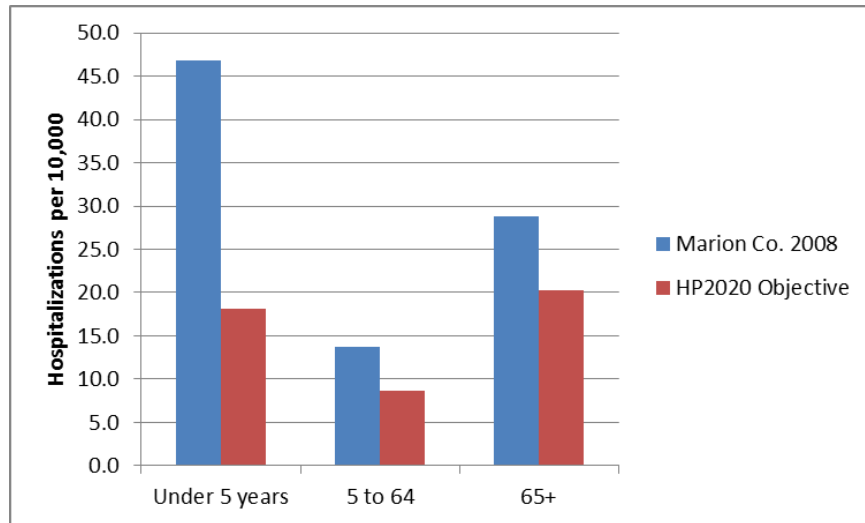
Marion County Asthma Discharges:

Unlike U.S. trends, asthma hospitalization rates in Indiana increased 30% (2000 to 2009), from 13.0 to 16.9 per 10,000 population⁸¹. Marion County’s asthma discharge rates also increased by 20% from 15.5 to 18.6 per 10,000, just for the period 2005 to 2008 (to 1599 discharges).

In 2009, Marion County had one of the highest asthma hospitalization rates among Indiana counties of 20.9 per 10,000, for 1906 total discharges (Highest: Lake, 22.2/10,000; Lowest: Monroe, 3.4 per 10,000)⁸². The county’s asthma hospitalization rate was 51% higher than the state’s (13.9 per 10,000, 2009)⁸³. Both the county and state asthma-related discharge rates have been increasing since 2007.

In 2008, children under age 18 made up 40% of all asthma discharges in Marion County hospitals⁸⁴. Marion County’s hospitalization rate for under-5 year olds is 2.5 times greater than the HP2020 Objective (46.8 versus 18.1 discharges per 10,000 population) and is nearly double the state’s rate (Indiana, 23.5) (Table 4). Its rate for 5-64 year olds is 60% higher than the HP2020 objective (13.8 versus 8.6 per 10,000). It is closest to national rates for asthma-related hospitalizations and HP2020 objectives⁸⁵ only for persons over age 65 (Figure 14).

Figure 14 Marion County Asthma Discharge Rates and HP2020 Objectives



Source: DR1604 and HP2020 Asthma Objective RD-2

Table 4 Marion County, U.S. asthma hospitalization rates and HP2020 objectives

2008 Asthma Hospitalization Rates ⁸⁶	Age Group (population) ⁸⁷	Asthma Hospitalizations	MC Rate per 10,000, per Age Group	U.S. Rates (AHCQ 2006) ⁸⁸	HP 2020 Objectives (Rate per 10,000)
Children	0-4 (73,498)	344	46.8	--	18.1
	0 to <15 (pop=187,144)	613	32		
	0-17 (233,006)	632	27	14.4	17.3
Children-Adults	5-64 (710,830)	979	13.8	--	8.6
Adults	18-64 (pop=543,171)	691	10	12.4	
	65+ (96,052)	276	28.7	22.2	20.3
All Ages	Total (880,380)	1599	18.2		

Source: 2008 Hospital discharge data,, DR1604 Department of Epidemiology., HP2020 Asthma Objective RD-2 . AHCQ 2009 National Healthcare Quality & Disparities Reports, Preventable Health Care Use-Asthma admissions., Marion age-specific populations: US Census 2008 Population Estimates and Projections, Table DP-1, and T3-Race (2008) Marion County IN .

Disparities in Asthma Hospitalizations:

While Marion County asthma prevalence rates by ethnicity are not statistically different, disparities in asthma severity/ control may be seen in comparing Black and White (non-Hispanic) hospitalization rates (Figure 15). Overall, county Blacks have nearly three times the rate of asthma hospitalization compared to Whites (33 versus 12 discharges per 10,000 population), and four times the hospitalization rate among children under age 5, (Table 5). This is similar to state discharge rates comparing Blacks to Whites⁸⁹.

Disparities in preventable hospital admissions among ethnic groups and low-income populations have been well documented, particularly among the poor and uninsured. Coordinated community preventive services, public health interventions, and primary care can reduce levels of acute asthma events and costly health care.

As the proportion of the population with current asthma (prevalence) is similar for Blacks and Whites, disparities in hospitalization rates are more likely due to greater severity or poorer control of chronic asthma, or differential access to asthma monitoring and primary care services.

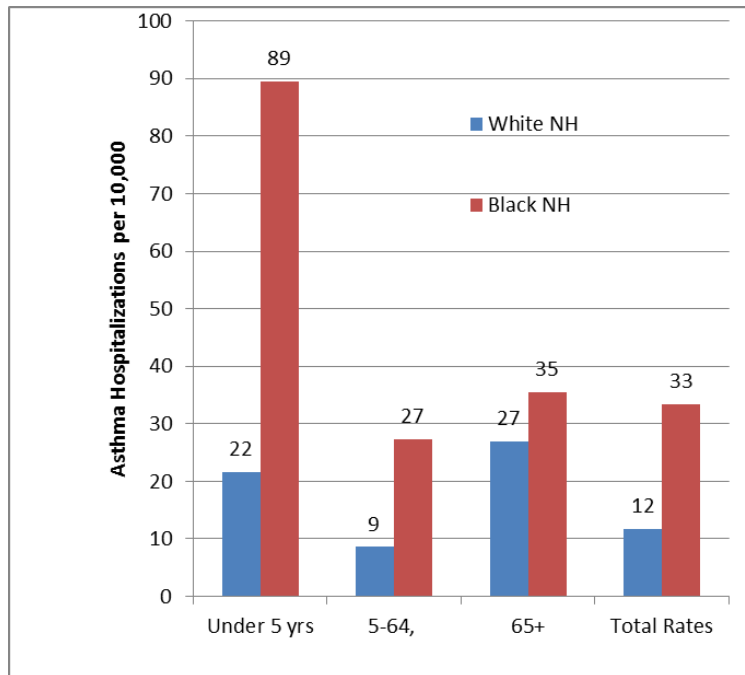
In addition, Marion County women over age 18 are twice as likely to be hospitalized for asthma as men, but in ages 25-64, women are hospitalized three times more frequently as men (2008)⁹⁰.

Table 5 Asthma discharges by Age group and Race per 10,000 population: 2008

Marion Co. 2008 Asthma Discharges	Age groups			
	<5 years	5-64	65+	Total (2008)
Whites	22	9	27	12.0
Blacks	89	27	35	33.0
Total	46.8	13.8	28.7	

Source: 2008 Marion County Hospital Discharge Data, Epidemiology, DR1604. Marion County age-specific populations: US Census 2008 Population Estimates and Projections, Table DP-1, and T3-Race (2008) Marion County IN.

Figure 15 Marion County Asthma Hospitalization Rates by Age Group and Race, 2008



Source: DR1604, Dept. of Epidemiology, 2008 Marion County Hospital Discharge Data

Asthma severity HP2020 Objectives targets reduction in asthma hospitalization rates for age groups 0-4, 5-64 and over 65 years⁹¹. The Agency for Health Quality and Research (AHQR) similarly monitors asthma admissions for patients 0-17 years, and adults 18-64 and 65 years and older as “preventable hospitalizations”. These are used as state and program Prevention Quality Indicators (PQIs), e.g. those ambulatory care sensitive conditions that evidence suggests could have been avoided, in part, through high-quality outpatient care⁹².

Children who have asthma management plans are less likely to have severe asthma attacks, and Black or Hispanic children are less likely to have such plans than Whites⁹³. Language barriers are associated with under-diagnosis among non-English speaking urban Hispanics⁹⁴. Wide disparities between Blacks and Whites in access to health care and proper treatment have been shown to be associated with greater asthma control problems and emergency hospital visits among non-Hispanic Blacks⁹⁵.

Proper use of a common asthma medication, inhaled corticosteroids (ICS), also may prevent acute asthma health care events. Studies find adherence to ICS is low overall and depends on financial access to primary care and good patient-provider communication, ICS use is lower among Black than White patients⁹⁶. Even when controlling for access to care, use of controller medications, asthma education, and specialist care, researchers find Blacks are still twice as likely to be hospitalized for asthma than Whites (HR 2.01, [CI:1.33-3.02])⁹⁷.

Economic Cost of Asthma:

National estimates of medical expenditures attributed to asthma include direct health care annual cost of \$15.6 billion (including 5.6 billion in prescription drugs, the largest direct medical cost⁹⁸); and indirect costs of \$5.1 billion (lost productivity), totaling \$20.7 billion (2010 dollars).

In 2008, asthma accounted for 14.4 million lost school days among U.S. children and 14.2 million lost work days in employed adults⁹⁹. Additionally, asthma is a leading cause of disability in adults¹⁰⁰.

In Marion County, direct hospitalization charges for asthma patients cared for in local acute care hospitals totaled \$30.5 million dollars (2009), a 73% increase from \$17.6 million in 2006, and a 35% increase in discharges (Table 6)¹⁰¹. County average length of stay (LOS) of 2.92 days for all ages of asthma patients is less than that in the nation (3.4 days, 2007)¹⁰².

Table 6 Marion County Asthma Hospitalizations, Length of Stay and Charges: 2006 and 2009

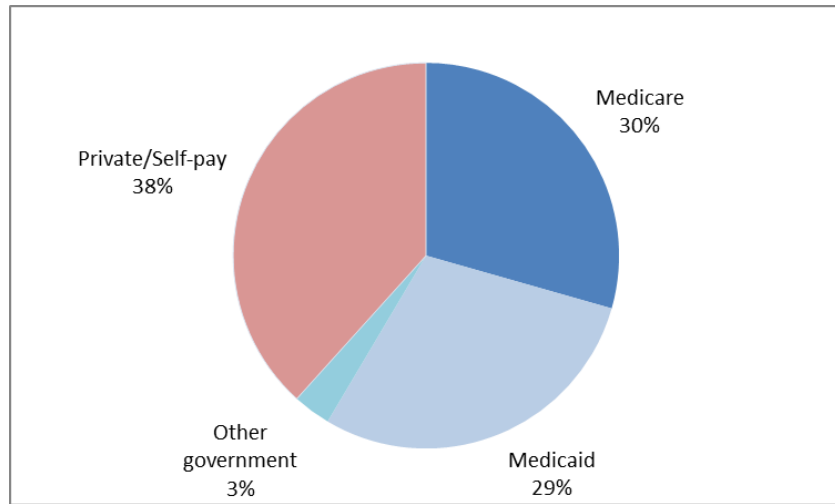
Marion County Asthma Hospitalizations	Patients % increase	Total days	Average Days / Patient	Total Charges (\$M)	% increase	Average charge/ Patient
2006		6081	3.65 ¹⁰³ ,	\$17.55		\$10,539.95
2009	+ 35%	6583	2.92	\$30.50	+73%	\$13,597.77

Source: ISDH 2009 Aggregated Hospital Discharge files, Marion County Acute Care Hospitals. Discharges for patients admitted with asthma (ICD-9 codes 493.0 - 493.9) as first listed diagnosis.

More than 62% of total charges and 58.6% of all 2009 asthma hospital stays were paid for by public programs (Medicare, Medicaid and other local government) (Figure 16), for a total of \$18.8 Million. The relative contributions of Medicaid and Medicare were nearly equal for county asthma patients (29% and 30%, respectively). Children and youth make up 40% of county Medicaid asthma discharges.

Conversely, given the older age structure of the state population than the county, Medicare is the leading payer in all state asthma hospitalizations (at about 33%) and Medicaid contributes just over 20%¹⁰⁴ for asthma hospital care. Medicare patients' greater age and multiple co-morbidities lead to longer average length of stay (LOS) and higher patient charges (\$17,983/case, which are the highest among all payers¹⁰⁵).

Figure 16 Marion County Asthma Hospitalization Charges, by Payer, 2009



Source: ISDH 2009 Aggregated Hospital Discharge files: Marion County Acute Care Hospitals.

Table 7 Marion County Asthma Hospitalizations 2009: Charges and Length of Stay

2009 Marion Co. Asthma Hospitalizations	Total Asthma Charges	Average Charge/Case	Average LOS
Medicare	\$8,973,824	\$17,983	3.87
Medicaid	\$8,884,580	\$11,925	2.51
Other Government	\$964,672	\$12,211	2.58
Commercial	\$8,794,366.	\$13,264	2.89
Managed care	\$2,611,167.00	\$11,158	2.43
Self-Pay	\$284,798	\$11,866	2.67
Total	\$30.5M	\$13,597	2.92

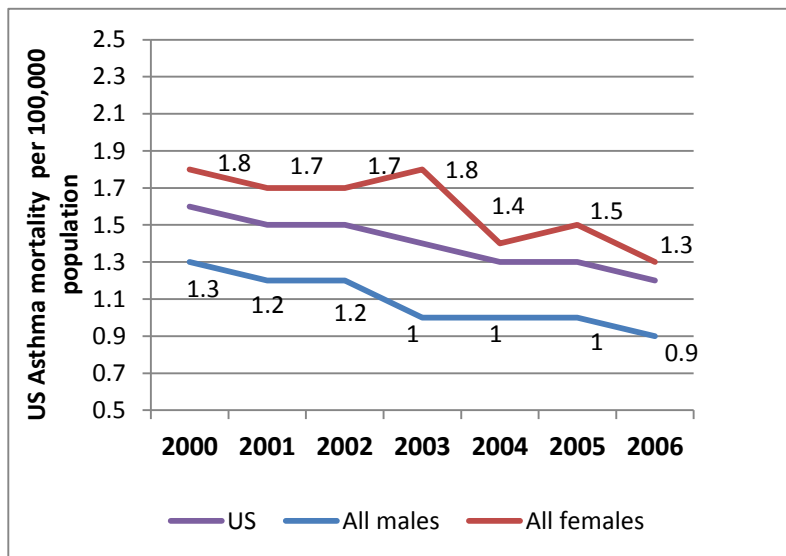
Source: ISDH 2009 Aggregated Hospital Discharge files: Marion County Acute Care Hospitals.

Asthma Deaths:

Deaths due to asthma are rare, especially among children under age 15 (0.22 per 100,000, 2006) but risk of death increases with age¹⁰⁶. The U.S. asthma death rate for ages 18-64 was 1.5 per 100,000, while adults over age 65 had nearly a 3 fold greater risk of asthma death (4.4 per 100,000, 2005-07)¹⁰⁷. Indiana asthma death rates for all age groups were not significantly different than the nation¹⁰⁸. The state's asthma mortality fell 38% between 1999 and 2007¹⁰⁹, and U.S. asthma death rate has declined by 22% since 1999¹¹⁰.

Gender disparities in asthma mortality continue in the U.S. American women over age 18 experienced 29% greater risk of asthma death than men (Figure 17).

Figure 17 U.S. Gender Trends in Asthma Deaths 2000-2006



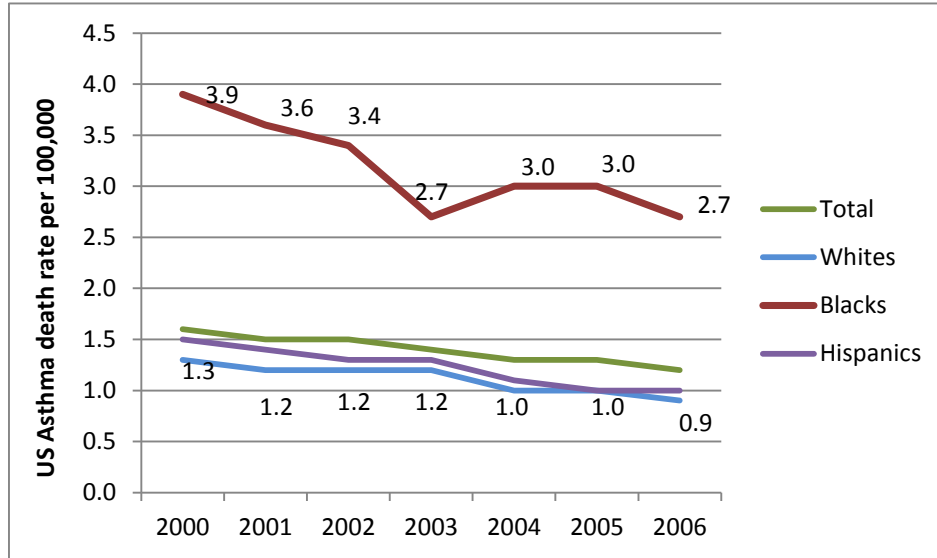
Source: Centers for Disease Control and Prevention. NCHS. National Vital Statistics Reports. Table 2: Asthma - Age-Adjusted Death Rate per 100,000 population, by Race and Sex, Final Data for 1979-2006.

Similarly, U.S. ethnic disparities in asthma death rates, especially among non-Hispanic Blacks also persist unchanged over time (Figure 18). Blacks are at three times the risk of death due to asthma (2.8 per 100,000) than are Whites (0.9 per 100,000), and Black women had the highest asthma mortality rate of any gender/ethnic group. Asthma mortality rates for Hispanics, at 1 per 100,000, was similar to that for Whites, but 64% lower than among Blacks¹¹¹.

Indiana reported 68 deaths attributed to asthma in 2007 or a rate of 1.2 asthma deaths per 100,000 population¹¹². Indiana has not met the HP2020 targets for asthma deaths in persons ages 35-64 (0.6 per 100,000) or over age 65 (2.3 per 100,000) through 2007. Indiana Blacks also have nearly a three-fold risk of dying due to asthma, compared to Whites (3.9 versus 1.1 per 100,000 population, respectively, 2003-05).

Marion County asthma deaths for the period 1997-2007 (total: 152 deaths) yields an estimated annual asthma mortality rate of 2.0 deaths per 100,000 adult population, or 20 per million [CI: 1.7-2.3] . County asthma death rates for ages 35-64 are twice that of the U.S. and state, and 30% higher among persons 65 and older (Table 8). Numbers of county asthma deaths for minority cases are too small to calculate ethnicity-specific asthma death rates, but we assume patterns are similar to that seen in the state.

Figure 18 U.S. Asthma Death Rates by Ethnicity: 2000 to 2006.



Source: CDC Health Data Interactive, Age-Adjusted rates per 100,000 population.

Table 8 Marion County, Indiana and U.S. Asthma Mortality Rates per 100,000 and HP 2020 Objectives

	Adults 18+	35-64 years	45-64 years	65+
Marion Co. 1997-2007	2.0	2.2	2.9	5.2
Indiana 2005-2007	1.2	1.08	1.5	4
US 2005- 2007	1.5	1	1.5	4.0
HP2020	---	.6		2.3

Source: CDC, NCHS. Compressed Mortality File 1999-2007 Series 20 No. 2M, 2010. CDC WONDER On-line Database, compiled from Compressed Mortality File 1999-2007

Decreasing Asthma’s Impact:

Asthma triggers vary from case to case, but established indoor triggers include cigarette and other smoke, mold, dust mites, animal dander, industrial and household chemicals, and exposure to respiratory infections¹¹³. Outdoor triggers include pollen and dust, extreme temperatures especially

cold air, industrial and other sources of air pollutants. Many of these triggers can be controlled or avoided.

Asthma prevalence and the consequent health care use are increasing among county residents, especially the young. Public awareness of ways to reduce risk exposure is a first step in lowering rates of new cases, asthma events and emergency care. The MCPHD works with the Indiana Lung Association and Smoke Free Indy's policy initiatives to reduce second-hand tobacco smoke exposure, and increase smoking cessation efforts, following the clear evidence that reduced exposure lowers both incidence and exacerbation of asthma¹¹⁴. Other initiatives to educate school officials and families include the evaluation of healthy air conditions in schools through the (Asthma Friendly-Schools)¹¹⁵, daycare settings, and multi-family housing through the American Lung Association, Indiana Joint Asthma Coalition (InJAC) and U.S. HUD-EPA funded Healthy Homes programs¹¹⁶. MCPHD's Healthy Homes program follows The Prevention Task Force's Community Guide "strong-evidence" based in-home assessments, low-cost education and remediation interventions to reduce asthma triggers¹¹⁷. Behavioral interventions for smoking prevention and cessation occur in MCPHD's many programs for high-risk current and expectant mothers and their children. Other partners such as the Hoosier Environmental Council, Improving Kids' Environment (IKE) and the Indiana Department of Environmental Management (IDEM) lead in evaluating and addressing outdoor environmental triggers and pollutants¹¹⁸ that may exacerbate asthma¹¹⁹.

Timely access to medical evaluation and management of asthma can increase asthma free days and lower costly medical complications. MCPHD immunizes high risk youth and adults for respiratory infections such as influenza and pneumonia¹²⁰. MCPHD's Asthma Program and the Asthma Alliance of Indianapolis work to lower ED visits and hospitalizations for children with asthma. They encourage use of Asthma Action Plans to decrease school absenteeism and to ensure the use of the National Institutes of Health Asthma Management guidelines. The Asthma program works closely with the MCPHD Indoor Air Quality program to refer asthma patients to tailored assessments of their homes. These in-home assessments provide the missing link to an asthma management plan outlined by patients' health care providers.

Access to primary care, and capacity to maintain long-term, complex and costly therapies may help decrease the excess asthma severity and poor health outcomes among low income and low health literacy segments of the population¹²¹. Education of families, patients and providers supports routine management of asthma, appropriate use of therapies, and lowering allergen/trigger risk where possible at home and work.

Two-thirds of asthma-related ED and hospitalization care are paid for by public payers like Medicare and Medicaid¹²². Improvements in linking public health and primary care approaches to chronic disease surveillance, referrals, management and community-level changes are being supported in both federal funding and health reform policies. Medicare and Medicaid, for example, seek clinical interventions to reduce repeated asthma hospitalizations and improve outcomes for patients¹²³. This includes reducing the disparities in asthma deaths, which while declining, are still more common in minority adults.

Improved targeting of high-risk asthma patients with advancing age, previous life-threatening asthma episodes, asthma-related hospital admission(s) in the past year, poor asthma management, lack of access to health care and current tobacco smoke exposure¹²⁴ may help avert needless loss of life¹²⁵.

Acknowledgements

We wish to acknowledge the help of Cindy Xue, MPH in preparing the Marion County BRFSS graphs for this report and assisting with the literature review. We also thank MCPHD's Jessica Craig, Epidemiology division for maternal smoking data, Indoor Air Quality's Lisa Cauldwell in providing school environment data, Learning Well, Inc., for its school clinical data, and the Metropolitan School District of Perry Township for its assistance in data collection among Perry elementary students. We also thank the members Dr. Juanita Brand, Jo Rhodes, and Jason Ravenscroft of the MCPHD Healthy Homes group for initial data on asthma in its sample of enrolled homes.

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44. Healthy People 2020 Objective RD-5.1 Reduce the proportion of children aged 5 to 17 years with asthma who miss school days Reduce the proportion of children aged 5 to 17 years with asthma who miss school days <http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=36>
45. The American Lung Association uses county-level projections of child current asthma prevalence from state estimates from the 2008 National Health Interview Survey (NHIS) or 11.1% among children under the age of 18 in

Indiana (2008). This current asthma prevalence applied to the 2008 county population of children ages under 18 years would indicate 22,257 children under 18 currently have asthma, American Lung Association, Epidemiological and Statistics Unit, 2010, Estimated Prevalence and Incidence of Lung Disease by Lung Association Territory. Page 47.

46. American Lung Association <http://www.lungusa.org/lung-disease/asthma/in-schools/asthma-friendly-schools/about-afsi/maintain-healthy-indoor-air.pdf>

47. The highest prevalence setting in the District had a very small student population of special needs students.

48. Source: Constance Zickler, RN, MSD Perry Township, April 2011, reporting identified asthma cases, total all-cause absent days per case, and cases with asthma-care plans.

49. County-wide data on school absentee days on the county's student population is not available. MCPHD does not have access to school absentee trends except when voluntarily released by Districts during communicable disease outbreaks, such as the 2009 H1N1 influenza event.

50. Wang LY, Zhong Y, Wheeler L. Direct and indirect costs of asthma in school-age children. *Prev Chronic Dis* [serial online] 2005 Jan. Available from: URL: http://www.cdc.gov/pcd/issues/2005/jan/04_0053.htm.

51. A median of 46% of secondary schools in the U.S. (2008) had Action Plans available for all asthma-case students. <http://www.cdc.gov/healthyyouth/asthma/index.htm>. See Brener ND, McManus T, Foti K, Shanklin SL, Hawkins J, Kann L, Speicher N. School Health Profiles: Characteristics of Health Programs Among Secondary Schools 2008. Atlanta: Centers for Disease Control and Prevention; 2009.

52. American Lung Association, Asthma Friendly Schools Initiative, Asthma Action Plans <http://www.lungusa.org/lung-disease/asthma/in-schools/asthma-friendly-schools/about-afsi/asthma-action-plan.pdf>

53 Each school's percentage of students eligible for the USDA's free or reduced lunch program was used as a proxy for low income status.

54 Salam, MT, Yu-Fen Li, Langholz, B, and Gilliland FD, Early-Life Environmental Risk Factors for Asthma: Findings from the Children's Health Study *Environ Health Perspect* 2004;112:760–765.

55 MEETING NOTES FROM THE INDOOR AIR QUALITY PANEL, INDIANA STATE DEPARTMENT OF HEALTH MAY 6, 2011, Final Rule LSA Document #09-682, May 2011. Adds 410 IAC 33 to establish an indoor air quality (IAQ) inspection, evaluation, and parent and employee notification program to assist schools and state agencies in improving indoor air quality and establish best practices and necessary minimum standards for IAQ in schools and state agencies, regulate items that affect the IAQ, specify when the department will inspect for IAQ, and establish requirements for parent or employee, or both, notification of IAQ evaluation findings. Sec. 1. (a) The state inspector is authorized to enter a school or state agency building, either rented or owned by the state, at reasonable times upon presentation of credentials to do any of the following:

(1) Inspect facilities, equipment, or records.

(2) Investigate complaints.

(3) Conduct tests.

(4) Collect samples to obtain information required under this rule.

(5) Determine whether any school or state agency is in violation of this rule.

(b) The state inspector shall investigate a complaint even if the school or state agency subject to the complaint has addressed or resolved the issues in the complaint.

(c) The state inspector may investigate any condition that it reasonably believes is contributing or could contribute to poor IAQ regardless of whether a complaint has been filed.

(Indiana State Department of Health; 410 IAC 33-2-1)

56. Data for Jan 1-Dec 31, 2010 Learning Well Clinic, Inc., for diagnosis code ICD9 438. 429 East Vermont Suite 300 Indianapolis IN 46202.

57. Learning Well Inc. clinics are found in Beech Grove, Decatur, Franklin IPS, Lawrence, Perry, Speedway and Warren school districts in Marion County, including several county charter schools, and 2 parochial school systems. Rates of asthma visits were greatest in Perry, IPS, and Beech Grove Districts.

58. The 2008 National Health Interview Survey (NHIS) estimates some 23.3 million adults (7.8%) currently had asthma. The BRFSS is a state-based telephone survey of the non-institutionalized U.S. population aged 18 and over that collects information about modifiable risk factors for chronic diseases and other leading causes of death. The National Health Interview Survey for adults tends to produce larger point-in time estimates. The BRFSS Questions on lifetime and current asthma prevalence are comparable to the National Health Interview Survey, but estimates vary due to sampling design. According to the 2008 BRFSS, an estimated 19.6 million adults (8.5%) currently had asthma in 2008, compared to 7.8% with current asthma in the 2008 National Health Interview Survey (NHIS). Estimates of these prevalence rates both surveys were statistically different.

59. U.S. and Indiana Adult Current Asthma Prevalence, BRFSS websites,

<http://apps.nccd.cdc.gov/BRFSS/display.asp?state=IN&cat=AS&yr=0&qkey=4416&grp=0&SUBMIT4=Go>

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60. 95% confidence intervals (CIs) are calculated for each sample estimate to indicate the precision (reliability) of the estimate. The interpretation is that the “true” prevalence estimate is likely to fall within the numeric range of the CI, as indicated by the vertical bar (or CI range listed in brackets[CI] in text).
61. Insufficient Marion County sample sizes preclude analysis for Hispanics or other groups by year. See Dwivedi, PK and Lahsae, H. (2011). The Burden of Asthma in Indiana. Indiana State Department of Health, Indianapolis, IN. 2011. http://www.in.gov/isdh/files/BR_Asthma_5-11-11gw.pdf page 21.
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69. Indiana State Department of Health. (March 2008). The Burden of Asthma in Indiana: Second Edition. http://www.in.gov/isdh/files/Final_3-13-08.pdf
70. Total ED visits for Marion County (2009) reported here differ from that reported in Dwivedi, PK and Lahsae, H (2011). The Burden of Asthma in Indiana, for two major reasons. First, this report’s ED visit counts are based on the first presenting complaint of the patient from the ESSENCE reporting system, not final ED diagnosis. Secondly, we present ED visits for patients whose residence was Marion County.
71. Busse, WW.; Gern, JE. and Dick, EC. The role of respiratory viruses in asthma. Ciba Foundation Symposium, 1997;206:208-213.
69. Marion County rates are visits where asthma was the primary presenting complaint, not visits which were finally coded as asthma-related in ED discharge files.
73. Dwivedi, PK and Lahsae, H. (2011). The Burden of Asthma in Indiana. Indiana State Department of Health, Indianapolis, IN. 2011 http://www.in.gov/isdh/files/BR_Asthma_5-11-11gw.pdf page 16.
74. Healthy People 2020 Objective RD3.1-RD3.3 Reduce emergency room use for asthma, for ages under 5, 5-64 years and over age 65. <http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=36>
75. USDA, National Water and Climate Center, Wind Rose plots for states and counties <http://www.wcc.nrcs.usda.gov/climate/wind-data.html>
76. Dockery D. Health effects of particulate pollution. *Ann Epidemiol* 2009;19:257-263, cited in Yip, FY, Unhealthy Air Quality --- United States, 2006—2009, - *MMWR* Vol 60, No 1;28 2011-01-14 http://www.cdc.gov/mmwr/preview/mmwrhtml/su6001a5.htm?s_cid=su6001a5_w
A total of 53 (23.3%) of 227 counties were nonattainment counties for the EPA’s 2006 24-hour PM2.5 standard representing 13.6% of the U.S population in 2007. Twenty-six (49.1%) of these counties were classified as large central metropolitan counties or large fringe metropolitan counties (i.e., MSA counties with a population of ≥1 million. *MMWR* Unhealthy Air Quality --- United States, 2006—2009. The EPA lists Indianapolis as meeting NAAQS small particle standards in 2011. <http://www.epa.gov/airtrends/pdfs/PM2520072009dvupdate.pdf>
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78. Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the Seventh (2009) National Healthcare Quality Report <http://statesnapshots.ahrq.gov/snaps09/Methods.jsp?menuId=68&state=IN#asthmaQualityOfCare>
79. CDC Health Data Interactive website Hospitalizations, U.S., first listed diagnosis asthma, 2007 <http://205.207.175.93/HDI/TableViewer/tableView.aspx>
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81. Dwivedi, PK and Lahsae, H (2011). ISDH, Burden of Asthma 2011 page 32. http://www.in.gov/isdh/files/BR_Asthma_5-11-11gw.pdf
82. Dwivedi, PK and Lahsae, H (2011). ISDH, Burden of Asthma 2011 page 24 http://www.in.gov/isdh/files/BR_Asthma_5-11-11gw.pdf
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84. Indiana Hospital and Health Association (IHHA) hospital discharge data from all community acute care facilities in Marion County have been compiled and include all inpatient stays in these facilities. Marion County statistics only reflect discharges from short-stay hospitals, and not long-term institutions, or federal facilities such as Veterans Administration hospitals, and discharges of newly born infants were excluded from the analysis to be comparable to NHDS data for the U.S. discharges. Discharge diagnoses are coded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD–9–CM). The data are based on the principal diagnosis (if so identified) or first-listed diagnosis in a patient’s medical record. These data are counts of hospital visits and may include multiple visits per patient. State data indicate some 10% of asthma hospitalizations are re-admissions. See ISDH, The Burden of Asthma in Indiana (Second Edition): Supplement One. Released: September 2008
85. Healthy People 2020 Objective RD-2 Reduce hospitalizations for asthma, <http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=36>
86. IHHA: 2008 Hospital discharge data, DR1433, Department of Epidemiology.
87. Totals for Marion County populations by age group: American Fact Finder, 2008 Population estimates and Projections, Table DP-1, Marion County IN. DR1604.
88. Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample and AHRQ Quality Indicators, version 3.1, Hospitalization data for 2006 Tables http://www.ahrq.gov/qual/qrd09/8_respiratorydiseases/T8_3_2-1.htm
89. Dwivedi, PK and Lahsae, H (2011). ISDH. The Burden of Asthma in Indiana, page 22 http://www.in.gov/isdh/files/BR_Asthma_5-11-11gw.pdf Additionally, Indiana Blacks are over four times as likely to visit an ED for asthma, compared to non-Hispanic Whites.
90. Marion County hospitalization data, 2005. MCPHD Epidemiology, DR1351
91. Healthy People 2020 Objective RD-2. Reduce hospitalizations for asthma. 0 to 4 Years: 18.1 per 10,000; 5 to 64 Years: 8.6 per 10,000, and ≥ 65 Years: 20.3 per 10,000. Healthy People 2020: <http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=36>
92. Methods Applying AHRQ Quality Indicators to Healthcare Cost and Utilization Project (HCUP) Data for the Seventh (2009) National Healthcare Quality Report <http://statesnapshots.ahrq.gov/snaps09/Methods.jsp?menuId=68&state=IN#asthmaQualityOfCare>
The three asthma outcome measures are from AHRQ’s Healthcare Cost and Utilization Project (HCUP). These are measures of avoidable hospital admissions for asthma for children ages 2-17, adults ages 18-64, and adults ages 65 and over. Asthma admissions (excluding patients with cystic fibrosis or anomalies of the respiratory system, obstetric admissions, and transfers from other institutions) per 100,000 population.
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