

An Issue Brief



Childhood Asthma: A Public Health Problem in Missouri and the Nation

by
Heidi Monroe, RN, BSN, Sherri G. Homan, RN, PhD
and Peggy Gaddy, RRT, MBA



An Issue Brief

Childhood Asthma: A Public Health Problem in Missouri and the Nation

by

Heidi Monroe, RN, BSN, Sherri G. Homan, RN, PhD and Peggy Gaddy, RRT, MBA

REPORT INFORMATION

Title: Childhood Asthma: A Public Health Problem in Missouri and the Nation

Description: This report provides information about the prevalence of childhood asthma and health care utilization in Missouri and the United States. The report also focuses on national recommendations and what is being done to address childhood asthma in Missouri. The report provides insight into childhood asthma and illustrates the need for increased education and awareness to address this problem.

Audience: This report is intended for use by the general public as well as state and local policy makers, researchers, local public health agencies, school nurses, school health personnel and others interested in childhood asthma.

Permission to copy, disseminate, or otherwise use information from this report is granted as long as appropriate acknowledgment is given.

Layout: Missouri Department of Health and Senior Services, Office of Community Health Information.

Special Thanks: Special thanks to Marjorie Cole, RN, MSN, State School Nurse Consultant and School Health Services Program Manager; Kathy Penfold, MSN, RN, Public Health Nurse Consultant and Child Care Health Consultation Program; and Ben Francisco, PhD, PNP-BC, AE-C, Director, Asthma Ready Communities.

Suggested Citation: Monroe, H, Homan, SG, & Gaddy, P. (2010). *Childhood Asthma: A Public Health Problem in Missouri and the Nation*. Jefferson City, Mo: Missouri Department of Health and Senior Services, Division of Community and Public Health.

Contact Information:

Sherri Homan, RN, PhD
Section of Epidemiology for Public Health Practice
Missouri Department of Health and Senior Services
PO Box 570, Jefferson City, Mo 65102
Ph: 573-522-2810
Email: Sherri.Homan@dhss.mo.gov

The Issue Brief, *Childhood Asthma: A Public Health Problem in Missouri and the Nation*, was in part supported by Cooperative Agreement U59/EH000510-01 from the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent official views of the Centers for Disease Control and Prevention.

Asthma:

Asthma is defined as a chronic respiratory condition that involves airway obstruction that may or may not be reversible, airway inflammation due to many cellular components, increased airway hyper-responsiveness, and in some cases airway remodeling, which may lead to irreversible structural changes (Akinbami, 2006; Subbarao, Mandhane, & Sears, 2009). The symptoms may include shortness of breath, coughing, wheezing or chest tightness. Asthma is often worse during the night, early in the morning, during physical exertion and when respiratory viruses occur (Francisco & Klein, 2005; Markus, Lyon, & Rosenbaum, 2010). While the cause of asthma is largely unknown, many things can trigger an asthma episode, including environmental factors such as pollen, tobacco smoke or changes in weather. Other common triggers include pet dander, mold, dust mites and cockroach allergens. Triggers may also include things such as exercise and some foods.

Disabling asthma occurs when there is a “long term reduction in the ability to participate in children’s usual activities, such as attending school or engaging in play, due to a chronic condition” (Newacheck & Halfon, 2000). Newacheck & Halfon (2000) reported children with disabling asthma experienced almost 3 weeks per year (19.9 days) of activity-restricted days, significantly more than children with other chronic conditions (11.8 days), based on data from the 1994-1995 National Health Interview Survey. Children with disabling asthma also missed significantly more school days per year (9.7 days) compared with children with other chronic diseases (5.3 days). Approximately 50 percent of children living with asthma do not receive quality care for their condition (Markus, Lyon, & Rosenbaum, 2010). Asthma impairment can be reduced when individuals: 1) learn about asthma; 2) take action after they recognize their symptoms or measure changes in airflow; 3) reduce exposure to triggers and treat contributing conditions such as acid reflux disease; and 4) correctly inhale asthma medications (Francisco & Klein, 2005). Factors associated with poor control of asthma include: increased number of exacerbations or episodes during the previous year; low adherence to treatment; inadequate knowledge of the disease; increasing body mass index; male gender in childhood, but female gender in adulthood; exposure to tobacco smoke; and low number of scheduled visits to a physician for routine asthma care (Butz, Tsoukleris, Donithan, Hsu, Mudd, Zuckerman, & Bollinger, 2006; McGhan, MacDonald, James, Naidau, Wong, Shape, et al., 2006; Hermosa, Sanchez, Rubio, Minguez, & Walther, 2010).

National Statistics

In 2007, 9.0 percent of children nationally had current asthma, but 13.5 percent had been diagnosed with asthma at some point in their lifetime (Child and Adolescent Health Measurement Initiative). However, in 2008, 9.4 percent of children had current asthma, with 13.8 percent of children having an asthma diagnosis sometime during their life (Bloom, Cohen, & Freeman, 2009). Only childhood obesity is higher in prevalence than childhood asthma (Markus, Lyon, and Rosenbaum, 2010). In the United States, approximately 37 percent of all children are considered low income; however, these children account for 58 percent of children with asthma. Sixty percent of children living with asthma have a family income that is below 200 percent of the federally poverty level (Markus, Lyon, & Rosenbaum, 2010).

According to Akinbami (2006), in 2005 about two of every three children with current asthma had an attack during the past 12 months. The prevalence of asthma attacks or episodes in the previous year provides an indication of symptomatic children with poorly controlled asthma who are at risk of adverse outcomes such as activity limitations, missed school days, emergency room (ER) visits and hospitalizations. Based on 2003 data, children who had at least one asthma episode during the previous year (4 million children) missed a total of 12.8 million school days (Akinbami, 2006). In 2004, there were 6.5 million physician office visits nationally, 750,000 ER visits, and 198,000 hospitalizations for children (age birth to 17 years of age) with asthma. Sadly, there were also 186 deaths among children due to asthma. The National Institute of Nursing Research (NINR, 2006) found that 75 percent of children with asthma had recently visited an ER, although they had medications to manage their asthma. Of the children with asthma who lived in rural areas, 40 percent required a visit to an ER. Minority children and children who live in low-income areas and inner cities have increased hospitalizations and deaths due to asthma (Akinbami, 2006). These data indicate the need for improved asthma management and care.

Schools offer an ideal setting for connecting with children who have asthma, with school nurses serving as primary external caregivers during the day. The School Health Profile by Brener, McManus, Foti, Shanklin, Hawkins, Kann, et al., (2009) assessed secondary schools throughout the United States on their asthma management activities. It found that states varied widely in their handling of students with asthma. The percentage of schools within each state that allowed inhalers to be carried and self-administered by the students ranged from a low of 26 percent to a high of 71 percent. Additionally, the percentage of schools that had a full-time registered nurse ranged from 4 percent to 99 percent; 27 percent to 77 percent of schools administered individualized health plans or action plans for students with asthma; 26 percent to 76 percent included asthma awareness in their health education classes, and 9 percent to 49 percent of the schools specifically trained their lead health education teacher on asthma awareness. Although, slightly more than one-half of the children with asthma had been taught by a health care provider how to improve their asthma management, only 39 percent received a management plan (Akinbami, 2006).

In 2000, it was estimated that it cost an average of \$3.2 billion a year for the treatment of children younger than age 18 with asthma (Weiss, Sullivan, Lytle, 2000). However, in 2006, the treatment of childhood asthma was estimated to cost nearly \$8 billion. The money spent on medications alone for children with asthma is four times higher than for those without asthma (Markus, Lyon, & Rosenbaum, 2010). Nationally, asthma adds 50 cents to each health care dollar spent on children (Markus, Lyon, & Rosenbaum, 2010). Yet, with training for care providers on asthma management, trigger reduction, early recognition of asthma signs and symptoms, proper inhalation technique and the daily use of control medication, many costly treatment encounters could be avoided.

Missouri Statistics

In Missouri, about 13.8 percent of all families that have children with asthma have been greatly or moderately affected by asthma in some way. It was found that 7.9 percent of all children in Missouri have been affected by asthma (Child and Adolescent Health Measurement Initiative, 2003). According to Akinbami (2006), the average asthma prevalence in Missouri

between 2001 and 2005 was 8.6 percent for children, which includes those up to 17 years of age. In 2007, the prevalence of current asthma among Missouri children remained at 8.6 percent while 13.1 percent had been given a diagnosis of asthma at some point in their lifetimes (Missouri Department of Health and Senior Services [DHSS], 2008). The current asthma prevalence by age groups was: 0 to 4 (4.8%), 5 to 9 (10.2%) and 10 to 17 (9.9%). Although the prevalence is low among children age 0 to 4, this is most likely due to reluctance on the part of care providers to make a diagnosis of these children. However, respiratory distress can quickly become life-threatening and for this reason utilization of the ER and inpatient hospitalizations are high among this group (Table 1).

Table 1. Asthma emergency room and inpatient hospitalizations among children by age group, gender and race, Missouri, 2007

Age and Gender	Emergency Room Visits Per 1,000*			Hospitalizations Per 10,000*		
	White	African American	Total	White	African American	Total
Less than 1	3.8	22.9	7.1	14.2	43.4	19.4
Male	5.1	29.9	9.3	18.0	61.3	25.6
Female	2.4	15.9	4.7	10.2	25.4	13.0
1 to 4	7.0	45.8	13.9	27.1	83.1	38.3
Male	9.1	55.2	17.3	33.0	102.9	47.6
Female	4.9	35.9	10.4	20.9	62.5	28.5
5 to 9	5.6	32.4	10.1	11.9	65.5	20.8
Male	6.7	41.1	12.5	13.3	81.8	24.5
Female	4.4	23.5	7.6	10.4	48.6	17.0
10 to 14	3.4	21.0	6.4	5.2	38.1	10.6
Male	3.8	24.0	7.1	5.5	43.9	11.7
Female	3.0	17.9	5.5	4.9	32.2	9.4
15 to 17	3.3	18.0	5.7	2.7	20.2	5.7
Male	2.7	17.2	5.1	2.0	22.1	5.3
Female	4.0	18.9	6.4	3.5	18.4	6.1

*Age group specific rates.

Source: Missouri Department of Health and Senior Services, Missouri Information for Community Assessment (MICA).

For children younger than age 15, Medicaid was the expected payment source for 62.7 percent of the 11,280 asthma ER visits followed by commercial insurance (29.6%) and self-pay or no charge (5.8%) in 2007. Similarly in 2007, Medicaid was also the number one expected payment source for the 2,565 asthma inpatient hospitalizations for children less than age 15 with 60.7 percent followed by commercial insurance (32.4%) and self-pay or no charge (4.2%). There were almost 5,000 days of care and total hospital charges for these children exceeded \$15.6 million dollars in 2007.

Over the past 10 years (1999 thru 2008), there have been 48 deaths among Missouri children age 0 to 17 with asthma as the underlying cause. According to Akinbami (2006), children at greatest risk of dying from asthma are those with severe, uncontrolled disease, children who have experienced a near-fatal attack of asthma, or have a history of recurrent

hospitalization or intubation for asthma. Often modifiable barriers to asthma control contribute to these adverse outcomes. These barriers include: lack of a daily control medication, improper inhalation technique, infrequent monitoring of children with asthma, such as airflow measurements, no plans for asthma exacerbations, no plans for avoidance of triggers, exposure to secondhand tobacco smoke, lack of education and support and limited access to health care during crises. Interventions that effectively address these barriers and increase family, clinician and caregiver involvement have the most potential in the control of childhood asthma.

The National Plan of Action

The goal of the National Asthma Education and Prevention Program's (NAEPP) Expert Panel Report 3 (EPR-3) is "to help people with asthma control their asthma so that they can be active all day and sleep well at night". The NAEPP lists four main components of asthma care. The first component is to assess asthma severity and monitor asthma control. This includes assessing impairment (level of symptoms, quick relief medicine use, limitations to activity, and lung function) and risk (likelihood of another exacerbation and medication side effects). The next component is education for a partnership for care between those with asthma and clinicians. This includes a written asthma action plan (AAP) created by the clinician and the person with asthma to guide treatment and care. The third component is control of environmental factors, as well as other conditions that might affect one with asthma (e.g., gastroesophageal reflux, sinusitis, and being overweight). Identification of asthma triggers and co-morbid conditions can minimize or prevent future asthma attacks. The final component is medications. The NAEPP recommends a stepwise approach to medicines, assessing adherence, inhalation technique, medication side effects, and taking a step down in therapy for asthma that is well controlled for at least three months. The NAEPP recommends that children 5 to 11 years of age have a written action plan, engage in physical activity and continuously monitor their asthma progression. It is important that children be able to identify environmental factors that can trigger their asthma, that they are taught medication administration techniques and the importance of daily use of a control medication and that they have their concerns addressed by care providers.

There are several key elements for effective comprehensive asthma treatment for children. These include stable and continuous health insurance; high quality clinical care with case management; asthma education, including reaching children who remain ineligible for insurance coverage; the ability to continuously exchange information and monitor progress using health information technology; reduction of asthma triggers in homes and communities; and learning what works and increasing asthma knowledge (Markus, Lyon, & Rosenbaum, 2010).

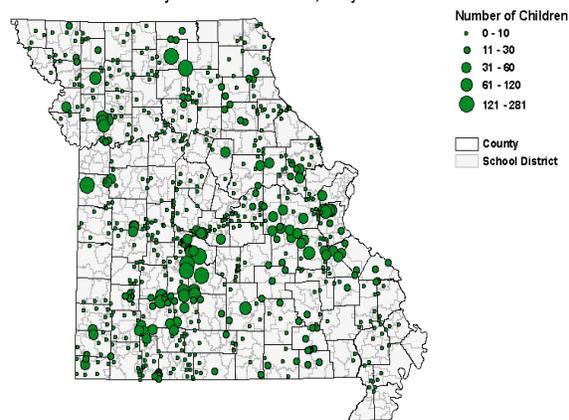
The Missouri Plan of Action

In 2000, DHSS convened a State Asthma Task Force to assess the burden of asthma in Missouri and made recommendations for a coordinated public health response (Kelsey & Gaddy, 2005). In 2001, the Missouri Asthma Prevention and Control Program (MAPCP) was launched with a grant from the Centers for Disease Control and Prevention to develop state capacity to address asthma from a public health perspective. MAPCP currently is funded as an Enhanced Intervention Program with three programmatic areas – partnerships, surveillance, and interventions (DHSS, 2009). The Missouri Asthma Coalition (MAC) was established in 2002 and now includes 750 participants in its network. Partners include schools, school nurses and

school-board members; child care health consultants; universities; physicians; hospitals; clinics; Federally Qualified Health Centers; rural and urban asthma coalitions; and organizations such as the American Lung Association and the Asthma and Allergy Foundation. As part of the surveillance programmatic area, the MAPCP collects and utilizes data to better describe the burden of asthma in Missouri, including prevalence, severity, morbidity (ER visits and hospitalizations, health status, control and management, and deaths). These data are also used in program and policy planning and evaluation. Asthma data are collected through the Behavioral Risk Factor Surveillance System (BRFSS), asthma adult and child call-back surveys, patient abstract system, county-level study, Vital Statistics and others. These data are then benchmarked to national data to assess surveillance systems and determine progress toward meeting national objectives.

As part of the interventions component of MAPCP, children are a priority population, as they bear a disproportionate burden of asthma ER visits and hospitalizations in Missouri. In 2002, the MAPCP and the Division of Maternal Child and Family Health conducted a survey of school nurses in Missouri. The survey evaluated: 1) documentation as well as school policies on asthma; 2) barriers in obtaining information on children with asthma and 3) school resources for children with asthma. The results indicated that school nurses were interested in asthma and needed educational material and training. In a separate study (Bullock, Libbus, Lewis & Gayer, 2002), a statistically significant difference was found between groups of school nurses who participated in a continuing education program and those that did not participate. The participating group reported a higher self-perceived competence in every area, including asthma. In addition to assessing the needs and the effectiveness of a continuing education program among school nurses, there was a need to assess the level of disability among school aged children in Missouri. The *Disabling Asthma Survey* was conducted in early 2005. The results of this survey highlighted the degree of disabling asthma in school children throughout the state (Figure 1) and the need to develop a competent workforce to address impairment in these children.

Figure 1.
Numbers of Rural School Children in Missouri with Disabling Asthma
by School ZIP Code, May 2005



Source: Francisco, B. and König, P., 2005. School Nurse Survey of Disabling Asthma in Missouri, Unpublished Data, University of Missouri, Columbia.

In 1993, one-half of all school districts in Missouri did not have a school health program. However, by 2005, only seven school districts in Missouri did not have a school nurse. According to the School Health Profile, 93 percent of schools in Missouri can track their students with asthma and 91 percent ensure immediate access to medications (Miller & Bihr, 2003). Missouri currently has 2,300 school nurses in the workforce (DHSS, 2009) and 79 percent of the schools have a registered nurse who works full-time (National Center for Chronic Disease Prevention and Health Promotion, 2008). Missouri has surpassed the National Association of School Nurses recommendation of 750 students to 1 school nurse with a school nurse for every 593 students (DHSS, 2006). These nurses monitor children with asthma, aid the children in

taking their medications and provide education to children and their families (Francisco & Klein, 2005).

In 2004, MAPCP developed and disseminated the *Missouri School Asthma Manual* and in-service DVDs to approximately 1,200 school nurses. Following its release, an evaluation survey was conducted and found that 66 percent of Missouri school nurses used the School Asthma Manual and 40 percent of Missouri schools had sent a student home based on asthma symptoms. The MAPCP also developed face-to-face training programs for school nurses and other health professionals. In 2005, the Missouri School Board Association made it a requirement that all newly elected school board members have asthma as a component of their training. MAPCP established the School Nursing Award in 2006 to recognize the contributions of school nurses in community-based efforts to improve asthma care. Since its inception, there have been 147 recipients that have implemented more than 200 evidenced-based interventions covering 60 percent of Missouri counties.

MAPCP has formed important partnerships with the Missouri School Health Services Program (MSHSP) and the Child Care Health Consultation Program (CCHCP). The MSHSP awards contracts to public school districts and local public health departments for school nursing services. This contract includes approximately 280 schools and covers nearly 275,000 children of which more than 21,400 report asthma. During the 2008-2009 school year, approximately 39 percent of the students with asthma required their medications at school and the number of students with AAPs exceeded those who required asthma medication at school (DHSS, 2009). CCHCP provides health and safety consultation and training to childcare providers and parents. During the past two years the Missouri Childcare Health Consultants have provided a total of 570 hours of asthma management training to 3,175 child care providers and 103 parents (DHSS, 2009). As a result, AAPs have been completed for 210 children related to 36 hours of on-site consultation to 152 childcare providers.

Asthma control can be improved and asthma attacks could be minimized by increasing asthma knowledge and asthma literacy among caregivers. This includes educating caregivers on the most effective inhalation techniques for administering medications to children. It also involves teaching caregivers how to recognize early signs and symptoms before an asthma attack occurs, such as when the child is coughing, which can be the first sign of an asthma attack. Caregivers should be instructed to assess their children's breathing problems by monitoring asthma symptoms or using a peak flow meter (NINR, 2006). Either symptom or peak flow monitoring is appropriate for some patients; evidence suggests the benefits are similar (National Asthma Education and Prevention Program, 2007). Due to the wide natural variation in the results of peak flow measurements, more sensitive measures of lung function are being used. School nurses, along with other health care providers, are being encouraged to monitor the Forced Expiratory Volume in one second (FEV1). Low FEV1 indicates current obstruction (impairment) and risk for future exacerbations (risk). For children, FEV1/forced vital capacity (FVC) appears to be a more sensitive measure of severity and control in the impairment domain. FEV1 is a useful measure of risk for exacerbations. FEV1 is a more sensitive measurement of airflow that often identifies airflow obstruction in children who have normal peak flows. The MAPCP, the University of Missouri-Columbia School of Medicine and the Association of Asthma Educators (AAE) joined in partnership to provide a six-hour training course, *Becoming*

an Asthma Educator and Care Manager (BAECM), in 2006. There have been more than 550 health professionals that have attended this training, including; school nurses, clinic nurses, respiratory therapists, and physicians. Attendees of this training receive In-Check Dials™ for objective assessment of inhalation technique and electronic flow meters to obtain objective measures of airflow (FEV1 and peak flow).

In 2006, two Missouri counties (Washington and Dunklin) were identified as having populations, particularly children, disproportionately affected by asthma. These counties have established systems-based asthma programs that addressed asthma through linking schools, hospitals, clinics and child care settings. As more communities, local public health agencies, and other organizations make asthma control a priority, easy access to planning resources and interventions will be needed. In recognition of this, asthma has been included as a topic in the internet-based Community Health Improvement Resources (www.dhss.mo.gov/CHIR) which uses an evidence-based public health process to guide community intervention planning and evaluation.

The MAPCP partnered with the University of Missouri-Columbia to develop the *Asthma Ready™* program in Missouri. The *Asthma Ready™* program is designed to be used in schools, child care facilities, hospitals and clinics. The goals of this program are to aid health care providers in their management of asthma, increase communication between the children and their families with trained health care providers and promote asthma friendly communities (Francisco & Klein, 2005). The program criteria are based on the EPR-3 asthma guidelines and include on-line training for health professionals (ARCT I and ARCT II) that provides continuing education credits. Missouri is taking great strides to increase asthma control, education and awareness to reduce asthma preventable ER visits, hospitalizations and deaths and to improve the quality of life for children with asthma and their families.

For additional information:

<http://www.dhss.mo.gov/asthma/Publications.html> (Missouri Asthma Manual)

<http://www.asthmahere.org> (Department of Health and Senior Service/Missouri Asthma Coalition)

<http://www.asthmaready.org> (Find “AsthmaReady” resources/Become an “AsthmaReady” School)

<http://www.cdc.gov/asthma/> (Centers for Disease Control and Prevention)

References

- Akinbami, LJ. (2006). The state of childhood asthma, United States, 1980-2005. *Advanced data from vital and health statistics*; No. 381, Hyattsville, MD: National Center for Health Statistics.
- Brener ND, McManus T, Foti K, Shanklin SL, Hawkins J, Kann L, & Speicher N. (2009). *School Health Profiles 2008: Characteristics of Health Programs Among Secondary Schools*. Atlanta: Centers for Disease Control and Prevention.
- Bloom, B, Cohen, RA, & Freeman, G. (2009). Summary health statistics for U.S. children: National Health Interview Survey, 2008, National Center for Health Statistics. *Vital Health Statistics*, 10(244).
- Bullock, L., Libbus, M., Lewis, S., & Gayer, D (2002). Continuing education: Improving Perceived competence in school nurses. *Journal of School Nursing*, 18(6), 360-363.
- Butz,AM, Tsoukleris, M, Donithan, M, Hsu, VD, Mudd, K, Zuckerman, IH, & Bollinger, ME. (2006). Patterns of inhaled antiinflammatory medication use in young underserved children with asthma. *Pediatric*, 118(6), 2504-2513.
- Child and Adolescent Health Measurement Initiative. 2003 *National Survey of Children's Health*. Data Resource Center for Child and Adolescent Health. Retrieved June 30, 2009 from www.nschdata.org
- Child and Adolescent Health Measurement Initiative. 2007 *National Survey of Children's Health*, Data Resource Center for Child and Adolescent Health. Retrieved January 27, 2010 from www.nschdata.org
- Francisco, B, & Klein, T. (2005). Childhood Asthma: Understanding and addressing the public health problem. *Missouri Youth Initiative*, 15 (5).
- Hermosa, JL, Sanchez, CB, Rubio, MC, Minguez, MM, & Walther, JL. (2010). Factors associated with the control of severe asthma. *Journal of Asthma*, 47, 124-130.
- Kelsey, A, & Gaddy, P. (2005). *Addressing asthma in Missouri*. Jefferson City, MO: Missouri Department of Health and Senior Services, Section for Chronic Disease Prevention and Nutrition Services, Missouri Asthma Prevention and Control Program.
- McGhan, SL, MacDonald, C, James, DE, Naidu, P, Wong, E, Sharpe, H, Hessel, PA, & Befus, AD. (2006). Factors associated with poor asthma control in children aged five to 13 years. *Canadian Respiratory Journal*, 13(1), 23-29.
- Markus, Lyon & Rosenbaum. (2010) Changing pO₂licy: The elements for improving childhood asthma outcomes. The George Washington University School of Public Health and Health Services, The Department of health Policy. Retrieved March 4, 2010 from www.mcanonline.org/policy_issues/

- Miller, K, & Bihr, M.A. (2003). *Missouri School Health Profiles 1994-2002*. Jefferson City, Missouri: Missouri Department of Elementary and Secondary Education.
- Missouri Department of Health and Senior Services. (2008). *2007 Missouri Behavioral Risk Factor Surveillance System Data Report*. Jefferson City, MO: Division of Community and Public Health, Office of Epidemiology. Retrieved February 2, 2010 from <http://www.dhss.mo.gov/brfss/Data.html>
- Missouri Department of Health and Senior Services. (2009). *School Health Services End of Year Data Report for the 2008-2009 School Year*. Jefferson City, MO: Division of Community and Public Health.
- Missouri Department of Health and Senior Services. *Emergency Room Missouri Information for Community Assessment (MICA)*. Retrieved January 30, 2010 from <http://www.dhss.mo.gov/EmergencyRoomMICA/index.html>
- Missouri Department of Health and Senior Services. *Hospital Discharges, Charges and Days of Care MICA*. Accessed February 2, 2010 from http://www.dhss.mo.gov/D_C_DofCMICA/
- Missouri Department of Health and Senior Services. *Inpatient Hospitalization MICA*. Retrieved January 30, 2010, from <http://www.dhss.mo.gov/InpatientHospitalizationMICA>
- Missouri Department of Health and Senior Services. (2006). *Missouri Asthma Prevention and Control Program. Asthma in Missouri Schools*. Retrieved on June 30, 2009, from <http://www.dhss.mo.gov/asthma/Publications.html>
- Missouri Department of Health and Senior Services. (2009). *Addressing asthma from a public health perspective*. Jefferson City, MO: Section for Chronic Disease Prevention and Nutrition Services, Missouri Asthma Prevention and Control Program.
- National Asthma Education and Prevention Program Expert Panel Report 3 (2007). *Guidelines for the diagnosis and management of asthma*. U.S. Department of Health and Human Services, National Institutes of Health.
- National Center for Chronic Disease Prevention and Health Promotion. (2008). *Missouri – selected topics fact sheet, School Health Profiles*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Division of Adolescent and School Health.
- National Institute of Nursing Research (2006). *NINR Focus: managing Asthma*. Retrieved on June 30, 2009, from www.ninr.nih.gov/NR/rdonlyres/ECCE8007-2BC7-430E-963435BCDC84DE6C/0/FocusonAsthma2006Final.pdf - 09-26-2009
- Newacheck, PW, & Halfon, N. (2000). Prevalence, impact, and trends in childhood disability

due to asthma. *Archives of Pediatrics & Adolescent Medicine*, 154, 287-293.

Subbarao, P, Mandhane, PJ, & Sears, MR. (2009). Asthma: epidemiology, etiology and risk factors. *Canadian Medical Association Journal*, 181, E181-E190.

Weiss KB, Sullivan SD, & Lytle CS. (2000). Trends in the Cost of Illness for Asthma in the United States, 1985-1994. *Journal of Allergy Clinical Immunology*, 106, 493-499.