

Impact of Heart Disease and Stroke in Michigan: 2008 Report on Surveillance



*Michigan Department
of Community Health*



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Heart Disease and
Stroke in Michigan:
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Executive Summary

Cardiovascular Disease (CVD) has been the leading cause of death in the United States for a century, except for the year 1918 due to pandemic flu. Heart disease and stroke, the most prevalent cardiovascular diseases, are the first and third leading causes of death in Michigan and the nation.

The burden of CVD is higher in Michigan than in the United States.

- Michigan's CVD mortality rate was 297.2 deaths per 100,000 people in 2005 compared to 277.3 per 100,000 for the United States.
- Nationally, Michigan was ranked as the 13th worst state for CVD mortality, 8th worst for coronary heart disease mortality and 28th worst for stroke mortality.
- CVD was responsible for more than one-third (36.1%) of Michigan deaths in 2006: 78.0% of these were due to heart disease and 15.3% were caused by stroke.
- CVD burden in Michigan may be higher than the United States but both have seen a steady decline in mortality rates over the past several years. From 2000 to 2006 Michigan had a 21.5% decrease in CVD mortality rates.

Racial disparities with CVD burden are apparent in Michigan.

- Black males have the highest hospitalization rate for four of the five diseases discussed in this report (cardiovascular disease, heart disease, heart failure and stroke).
- The highest CVD mortality rates occur in black males (499.4 per 100,000), more than twice the rate for white females (231.3 per 100,000), who have the lowest CVD mortality rate.
- Coronary heart disease hospitalization rates have been highest among white males.

Certain geographic regions in Michigan have a higher CVD burden.

- Arenac, Bay, Gladwin, Clare and Ogemaw counties had the highest hospitalization rates for CVD, heart disease, coronary heart disease and heart failure. These five counties are contiguous.
- Sanilac County had one of the highest county mortality rates for each of the five diseases.
- Ogemaw had one of the highest county mortality rates for all of the diseases except stroke.

The burden of CVD on Michigan will increase.

- The average age of Michigan's population is expected to increase appreciably in the next decade. The proportion of population over 65 years is expected to increase from 12.5% in 2006 to 16.8% in 2020. This age group experiences the highest rates of CVD hospitalization and mortality.
- The prevalence of risk factors (poor nutrition, physical inactivity, high blood pressure, high blood cholesterol, diabetes, and obesity) for developing CVD is increasing in Michigan. Prevalence of smoking in Michigan is the only risk factor for CVD that has shown a decline.
- Michigan ranks as one of the worst in the nation for many CVD risk factors, including 16th worst in smoking, 17th worst in high blood pressure, 13th worst in obesity and 11th worst in diabetes.
- In 2007, only four percent of Michigan's population was classified as having all four healthy lifestyles (healthy weight, adequate fruit and vegetable intake, not smoking and engaging in adequate physical activity).

Impact of Heart Disease and Stroke in Michigan will discuss the major cardiovascular diseases: heart disease, coronary heart disease, heart failure and stroke, and the risk factors contributing to these diseases. This will be the foundation for strategic planning related to CVD in the state.



Table of Contents

Executive Summary	iv
Introduction	1
Overview of Michigan	
Demographics	4
Insurance	5
Geography	7
Medical Resources	8
Cardiovascular Disease	
Hospitalizations	16
Mortality	20
Heart Disease	
Hospitalizations	24
Quality Improvement	27
Mortality	28
Coronary Heart Disease	
Prevalence	32
Hospitalizations	33
Quality Improvement	36
Mortality	37
Heart Failure	
Hospitalizations	41
Quality Improvement	45
Mortality	46
Stroke	
Prevalence	50
Hospitalizations	52
Quality Improvement	55
Mortality	59
Risk Factors	
Cigarette Smoking	63
High Blood Pressure	67
High Blood Cholesterol	72
Overweight and Obesity	76
Physical Inactivity	81
Dietary Behavior	84
Diabetes Mellitus	90
Risk Factor Clustering	92
Summary	100
Appendix	A-1



List of Figures

Figure 1.	A diagram of the major components of cardiovascular disease and the corresponding ICD codes.....	1
Figure 2.	Cardiovascular disease surveillance model.....	2
Figure 3.	Number and percent of Michigan residents by race, 2006.....	4
Figure 4.	Age distribution of Michigan residents, 2006.....	4
Figure 5.	Prevalence of insurance status among adults, 18 and over, 2003 to 2007.....	5
Figure 6.	Leading causes of death in Michigan, 2006.....	14
Figure 7.	Leading causes of death in the United States, 2005.....	15
Figure 8.	Age-adjusted hospitalization rate by race and gender for cardiovascular disease for Michigan, 2000 to 2006.....	17
Figure 9.	Age-adjusted hospitalization rate by age for cardiovascular disease for Michigan, 2000 to 2006.....	18
Figure 10.	Age-adjusted mortality rates for cardiovascular disease for Michigan and United States, 2000 to 2006.....	20
Figure 11.	Age-adjusted mortality rates by race and gender for cardiovascular disease for Michigan, 2000 to 2006.....	21
Figure 12.	Age-adjusted mortality rates by age for cardiovascular disease for Michigan, 2000 to 2006.....	22
Figure 13.	Age-adjusted hospitalization rates by race and gender for heart disease for Michigan, 2000 to 2006.....	25
Figure 14.	Age-adjusted hospitalization rates by age for heart disease for Michigan, 2000 to 2006.....	26
Figure 15.	Age-adjusted mortality rates for heart disease for Michigan, 2000 to 2006.....	28
Figure 16.	Age-adjusted mortality rates by race and gender for heart disease for Michigan, 2000 to 2006.....	29
Figure 17.	Age-adjusted mortality rates by age for heart disease for Michigan, 2000 to 2006.....	30
Figure 18.	Age-adjusted hospitalization rates by race and gender for coronary heart disease for Michigan, 2000 to 2006.....	33
Figure 19.	Age-adjusted hospitalization rates by age for coronary heart disease for Michigan, 2000 to 2006.....	34
Figure 20.	Age-adjusted mortality rates for coronary heart disease for Michigan compared with <i>Healthy People 2010</i> goals, 2000 to 2006.....	37
Figure 21.	Age-adjusted mortality rates by race and gender for coronary heart disease for Michigan, 2000 to 2006.....	38
Figure 22.	Age-adjusted mortality rates by age for coronary heart disease for Michigan, 2000 to 2006.....	39
Figure 23.	Age-adjusted hospitalization rates by race and gender for heart failure for Michigan, 2000 to 2006.....	42
Figure 24.	Age-adjusted hospitalization rates by age for heart failure for Michigan, 2000 to 2006.....	43
Figure 25.	Get with the Guidelines (GWTG) SM heart failure performance indicators for the United States, 2006.....	45
Figure 26.	Age-adjusted mortality rates for heart failure for Michigan and United States, 2000 to 2006.....	46

Impact of Heart Disease and Stroke in Michigan



Figure 27. Age-adjusted mortality rates by race and gender for heart failure for Michigan, 2000 to 2006.....	47
Figure 28. Age-adjusted mortality rates by age for heart failure for Michigan, 2000 to 2006.....	48
Figure 29. Prevalence of correct and incorrect responses to stroke warning signs by adults, 18 and over, in Michigan, 2007.....	51
Figure 30. Age-adjusted hospitalization rates by race and gender for stroke for Michigan, 2000 to 2006.....	52
Figure 31. Age-adjusted hospitalization rates by age for stroke for Michigan, 2000 to 2006.....	53
Figure 32. Get with the Guidelines (GWTG) SM -Stroke performance indicators for the United States, 2006.....	58
Figure 33. Age-adjusted mortality rates for stroke for Michigan and United States compared to <i>Healthy People 2010</i> , 2000 to 2006.....	59
Figure 34. Age-adjusted mortality rates by race and gender for stroke for Michigan, 2000 to 2006.....	60
Figure 35. Age-adjusted mortality rates by age for stroke for Michigan, 2000 to 2006.....	61
Figure 36. Prevalence of current cigarette smoking among adults, 18 and over, in Michigan and United States compared to the <i>Healthy People 2010</i> target, 2001 to 2007.....	65
Figure 37. Prevalence of current cigarette smoking and ever smoked among youth, grades 9 through 12, in Michigan and United States, 1997 to 2007.....	66
Figure 38. Prevalence of having high blood pressure among adults, 18 and over, in Michigan and United States, 2001 to 2007.....	69
Figure 39. Percent of hypertensive patients, 18 to 85, whose blood pressure was under control, by commercial health plan in Michigan, 2006.....	70
Figure 40. Percent of hypertensive patients whose blood pressure was under control, by Medicaid health plan in Michigan, 2006.....	71
Figure 41. Prevalence of having high cholesterol among adults, 18 and over, who ever had their cholesterol tested in Michigan and United States, 2001 to 2007.....	74
Figure 42. Percent of patients that had prior cardiovascular conditions and had their cholesterol screened in the past year by commercial health plan in Michigan, 2006.....	75
Figure 43. Body mass index chart for adults, age 20 and over.....	76
Figure 44. Body mass index chart for children, ages 2 to 18 years.....	76
Figure 45. Prevalence of overweight and obese adults, 18 and over, in Michigan and United States, 2001 to 2007.....	78
Figure 46. Prevalence of obesity among low-income children, two to four-years-old, in Michigan by race and ethnicity, 2000 to 2006.....	79
Figure 47. Prevalence of obese youth, grades 9 through 12, in Michigan, 1999 to 2007.....	80
Figure 48. Prevalence of inadequate physically active adults, 18 and over, in Michigan and United States, 2001 to 2007.....	82
Figure 49. Prevalence of physically inactive youth, grades 9 through 12, in Michigan and United States, 2001 to 2005.....	83
Figure 50. Prevalence of adults, 18 and over, who consumed fewer than five fruits and vegetables in a day in Michigan and United States, 2002 to 2007.....	86

Impact of Heart Disease and Stroke in Michigan



Figure 51.	Frequency of fast food consumption among adults, 18 and over, in Michigan, 2005	87
Figure 52.	Prevalence of obesity by frequency of fast food consumption among adults, 18 and over, in Michigan, 2005.....	88
Figure 53.	Prevalence of youth, grades 9 through 12, who consumed fewer than five fruits and vegetables in a day in Michigan and United States, 1999 to 2007.....	89
Figure 54.	Prevalence of diabetes among adults, 18 and over, in Michigan and United States, 2001 to 2007.....	91
Figure 55.	Metabolic syndrome definition, having three or more of the following criteria.....	92
Figure 56.	Prevalence of cardiovascular disease risk factors over time, Michigan and United States, 1990 to 2007	93
Figure 57.	Age-adjusted prevalence of having up to seven risk factors among adults, 18 and over, in Michigan, 2007.....	94
Figure 58.	The number of risk factors the population with cardiovascular disease and without cardiovascular disease have among adults, 18 and over, in Michigan, 2007.....	95
Figure 59.	Number of risk factors reported among Michigan adults, 18 and over, that also reported poor health, 2007	96
Figure 60.	Average number of days adults reported poor physical health by number of risk factors in Michigan, 2007	97
Figure 61.	Average number of days adults reported poor mental health by number of risk factors in Michigan, 2007	98
Figure 62.	Average number of days adults reported activity limitations due to physical and mental health by number of risk factors in Michigan, 2007.....	99



List of Maps

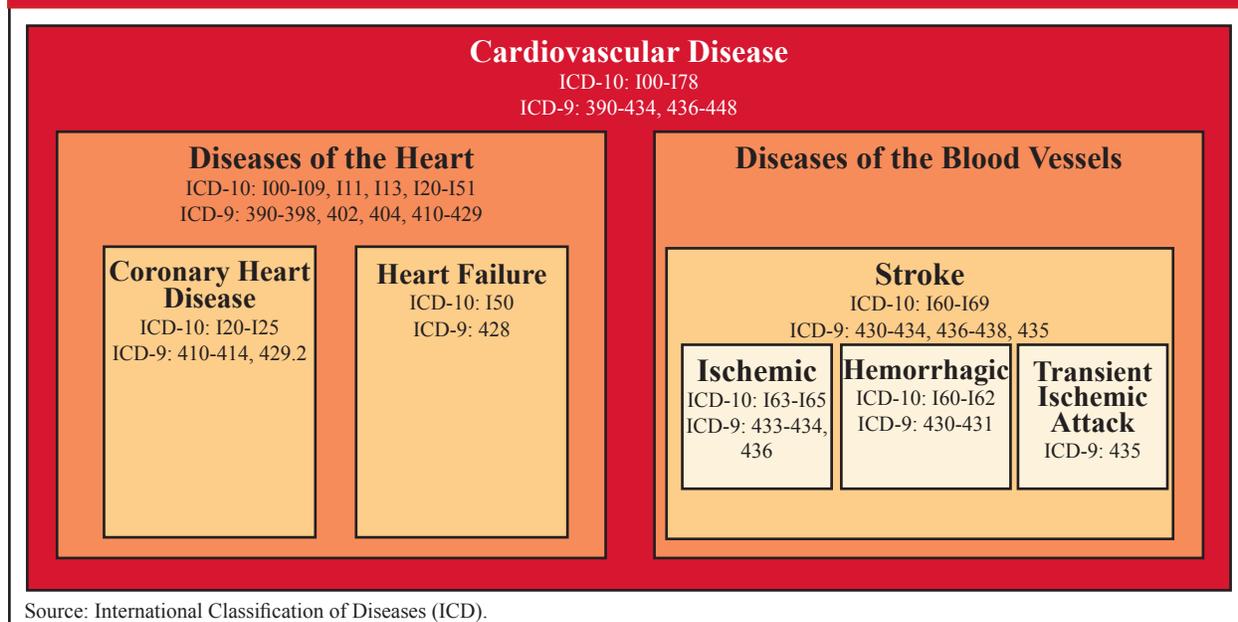
Map 1.	Population density map of Michigan, 2000 census tract population per square mile.....	7
Map 2.	Medically underserved area and medically underserved population designations in Michigan, 2007.....	9
Map 3.	Michigan medical control authorities.....	10
Map 4.	The location of hospitals and multi-hospital systems that are members of the Michigan Health and Hospital Association, 2008.....	11
Map 5.	Primary stroke center hospitals in Michigan, 2008.....	12
Map 6.	Stroke network hospitals in Michigan. 2008.....	13
Map 7.	Age-adjusted five-year hospitalization rates for cardiovascular disease by county, 2002 to 2006.....	19
Map 8.	Age-adjusted five-year mortality rates for cardiovascular disease by county, 2002 to 2006.....	23
Map 9.	Age-adjusted five-year hospitalization rates for heart disease by county, 2002 to 2006.....	27
Map 10.	Age-adjusted five-year mortality rates for heart disease by county, 2002 to 2006.....	31
Map 11.	Age-adjusted five-year hospitalization rates for coronary heart disease by county, 2002 to 2006.....	35
Map 12.	Age-adjusted five-year mortality rates for coronary heart disease by county, 2002 to 2006.....	40
Map 13.	Age-adjusted five-year hospitalization rates for heart failure by county, 2002 to 2006.....	44
Map 14.	Age-adjusted five-year mortality rates for heart failure by county, 2002 to 2006.....	49
Map 15.	Age-adjusted five-year hospitalization rates for stroke by county, 2000 to 2006.....	54
Map 16.	The hospitals participating in year one of MiSRQIP, 2007 to 2008.....	57
Map 17.	Age-adjusted five-year mortality rates for stroke by county, 2002 to 2006.....	62



Introduction

Cardiovascular disease (CVD) refers to diseases that affect the heart and blood vessels. Diseases of the heart include coronary heart disease, heart failure, sudden cardiac death and hypertensive heart disease, whereas stroke, atherosclerosis and hypertension are diseases of the blood vessels, Figure 1. Heart disease is the leading cause of death and stroke is the third leading cause in Michigan and the United States. Cardiovascular disease is very prevalent with one in three Americans reporting that they have one or more types of the disease. In 2008, cardiovascular disease will cost the United States an estimated \$448.5 billion due to health expenditures and lost productivity from morbidity and mortality.¹ Monitoring the burden of heart disease and stroke is crucial to address this problem.

Figure 1. A diagram of the major components of cardiovascular disease and the corresponding ICD codes



Due to public health efforts, as well as advances in medical/surgical interventions and pharmacologic treatment, significant progress has been made in reducing both heart disease and stroke mortality. Over the past 35 years, age-adjusted mortality from CVD declined 50%. Awareness of CVD risk factors has increased and average blood pressure and cholesterol have been reduced in the United States. Although CVD is becoming less lethal, disease prevalence continues to increase. In fact, we may be losing ground on these advancements in the United States and Michigan because of increasing risk factors in the population, continued challenges in providing access to care to vulnerable populations, under-use of prevention strategies, the aging population and suboptimal adherence to clinical guidelines.²

Impact of Heart Disease and Stroke in Michigan

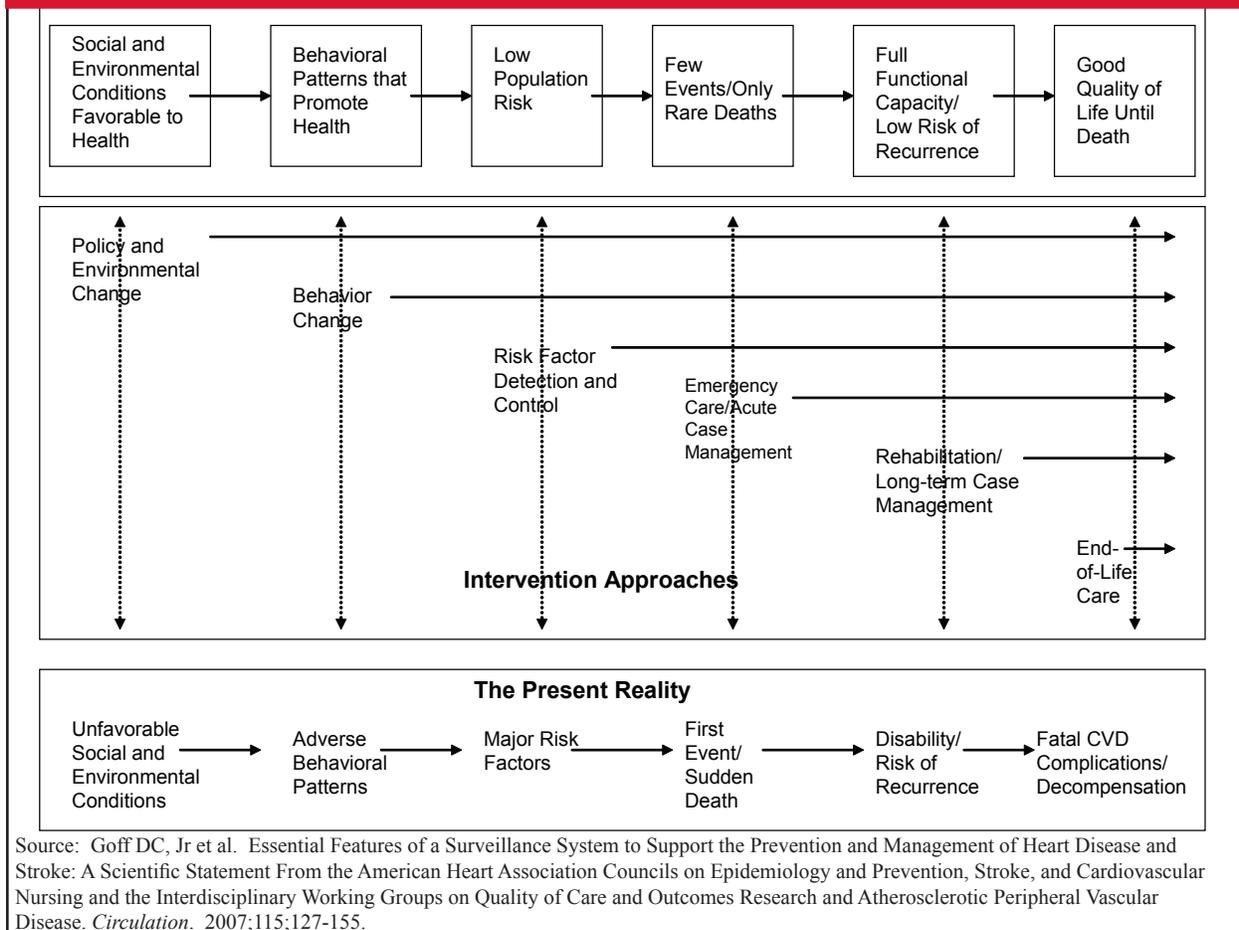


The purpose of this surveillance report is to guide and inform the development of the state heart disease and stroke plans, partnerships and interventions. Available data for Michigan and the United States are presented to identify populations of concern and emerging trends. This data will be used to update and/or modify program objectives for the Michigan Department of Community Health (MDCH) Heart Disease and Stroke Prevention program and its partners.

Heart disease and stroke are complex diseases with multiple risk factors at environmental, population and individual levels. The cardiovascular disease surveillance model, Figure 2, illustrates what risk factors and outcomes need to be monitored, to identify gaps in data, and to guide program development and evaluation. This model demonstrates many points of intervention, including prevention, rehabilitation and end-of-life care.

The model shows that unfavorable environmental and social conditions can give rise to the adoption of adverse behavior patterns that may lead to the development of risk factors and eventually to cardiovascular disease.³ The model also contrasts an ideal with present reality. Documenting and tracking progress across the model is crucial to Michigan's success in reducing CVD burden.

Figure 2. Cardiovascular disease surveillance model



Impact of Heart Disease and Stroke in Michigan



In 2007, the Centers for Disease Control and Prevention identified six priority areas of focus for State Heart Disease and Stroke Programs. Those areas are as follows:

- Increase the number of people who have their high blood pressure under control.
- Increase the number of people who have total blood cholesterol less than 200 mg/dL.
- Increase the number of people who know the risk factors and signs and symptoms for heart disease and stroke and the importance of calling 9-1-1.
- Improve emergency responses to CVD.
- Improve quality of heart disease and stroke care.
- Eliminate CVD disparities in terms of race, ethnicity, gender, geography, and socioeconomic status.

This report provides data to support planning and interventions in these areas. *The Impact of Heart Disease and Stroke in Michigan* will reflect these priority areas and will cover the major cardiovascular diseases: heart disease, coronary heart disease, heart failure and stroke. This document will also discuss risk factors contributing to these diseases and identify economic costs associated with the diseases. Health care systems and resources relevant to cardiovascular disease will also be described and mapped geographically.



Overview of Michigan

Demographics

In 2006, Michigan was the eighth most populous state, with a total population of 10,095,643 people.⁴ Females comprised more than half (50.8%) of the population and 77.6% of the population was white, Figure 3.

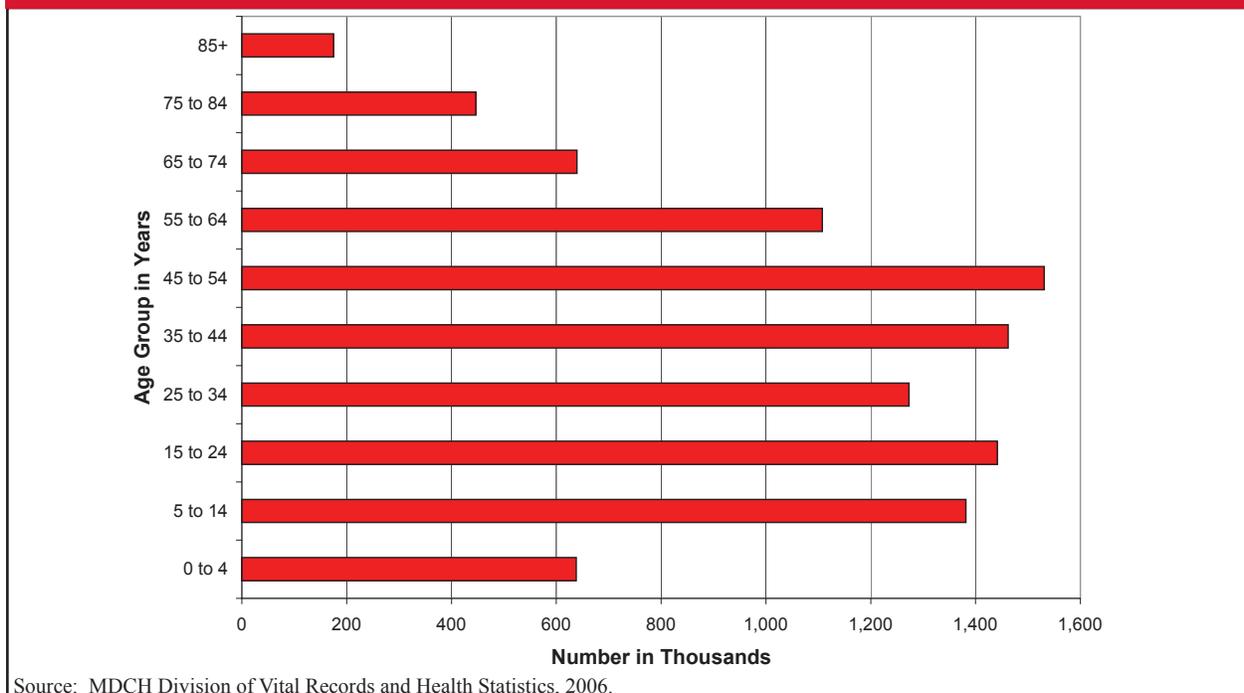
Figure 3. Number and percent of Michigan residents by race, 2006

Race	Number	Percent (%)
White, non-Hispanic	7,836,885	77.6
African American/Black, non-Hispanic	1,417,505	14.0
American Indian or Alaska Native	46,259	0.5
Asian	236,565	2.3
Native Hawaiian and Other Pacific Islander	1,237	0.0
Hispanic	392,770	3.9
Multiracial	149,739	1.5

Source: American Community Survey, 2006.

The median age in Michigan (37.3) was above the national median (36.4), Figure 4. In 2006, 12.5% of the population was 65 years of age or older but this is expected to increase to 16.8% by 2020. The median household income in 2006 was \$47,182 and 13.5% of individuals lived below the poverty level. As of 2006, 87.2% of Michigan residents (25 years of age and above) had a high school diploma and 24.5% held a bachelor's degree or higher.⁴

Figure 4. Age distribution of Michigan residents, 2006



Source: MDCH Division of Vital Records and Health Statistics, 2006.

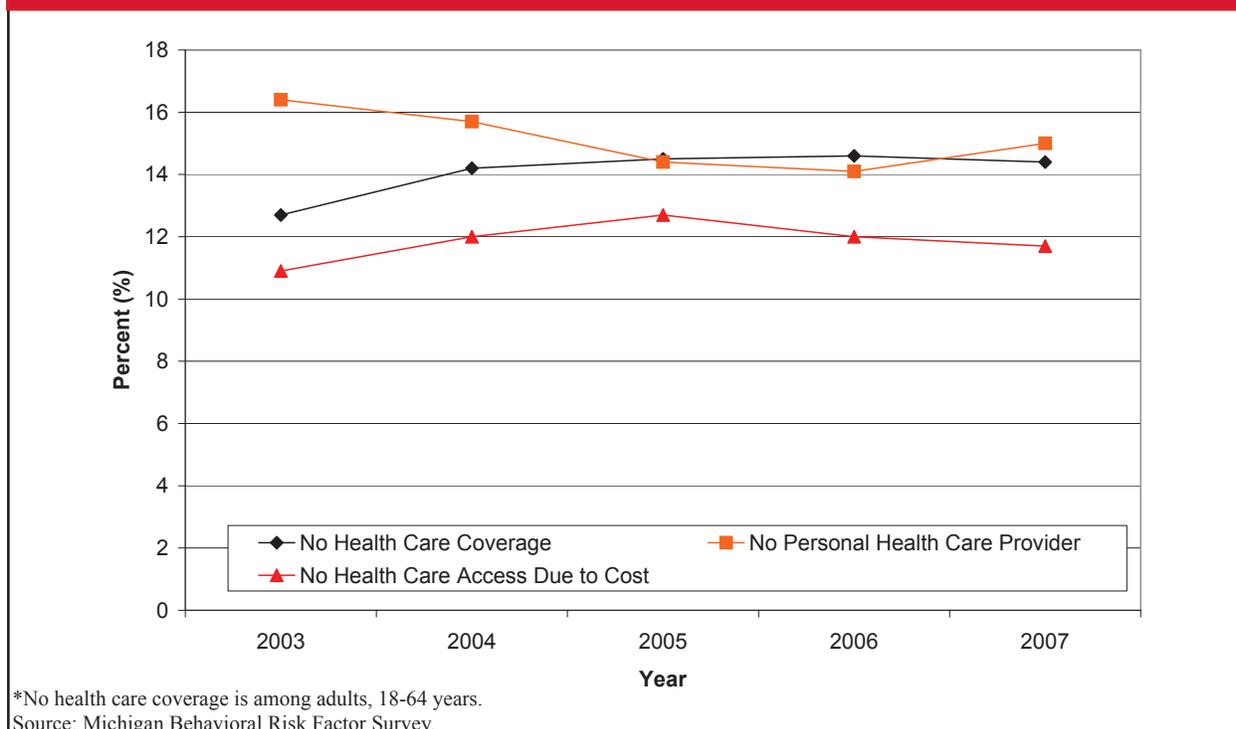
Impact of Heart Disease and Stroke in Michigan



Insurance

Health care access is a key determinant of health. It is important not only to have health insurance but to have a personal health care provider to help maintain one's health. There is evidence that having a consistent source of health care results in better outcomes, reduced disparities and cost.^{5,6} However in Michigan, more than 14% of adults aged 18 to 64 reported having no health care coverage in 2007, Figure 5. Blacks, 18 to 64 years, were more likely to have no insurance (18.7%) than whites (13.7%) and Hispanics (11.3%).

Figure 5. Prevalence of insurance status among adults, 18 and over*, 2003 to 2007



Fifteen percent of Michigan adults reported that they did not have a personal health care provider, dropping to 4.8% in ages 65 and above. Gender differences were present: 19.3% of males compared to 10.9% of females reported having no health care provider. People with lower educational attainment (20.0%) and living in low income households (24.7%) were less likely to have a regular provider than those with a college degree (11.2%) and living in higher income households (8.6%).

A similar pattern was seen for inability to get care. Thirteen percent of Michigan adults aged 18 to 64 and 3.7% aged 65+ were unable to receive care in the last 12 months due to cost. Blacks, 18 to 64 years, (17.3%) had a higher prevalence of inability to receive care than Hispanics (14.7%) and whites (10.2%). Adults whose household had an income of more than \$75,000 (3.1%) were less likely to report this barrier than adults in a household with an income of less than \$20,000 (26.6%). Females (12.8%) were more likely than males (10.4%) to report cost as a barrier to receiving care.

Impact of Heart Disease and Stroke in Michigan



Eleven percent of Michigan adults reported that they currently have Medicaid health care coverage in 2007. This prevalence varied by race; 8.1% of whites reported the lowest use of Medicaid, whereas 24.8% and 12.3% of blacks and Hispanics, respectively, reported enrollment. Reported Medicaid coverage decreased with increasing education and household income, similar to overall insurance status.

During the most recent five-year period, the percentage of adults without health insurance increased from 12.7% in 2003 to 14.4% in 2007, Figure 5. Prevalence of not being able to receive health care due to cost also rose, from 10.9% in 2003 to 11.7% in 2007. However, the percentage of adults reporting that they did not have a personal health care provider decreased during this period. In 2003, 16.4% reported not having a regular health care provider; in 2007 the prevalence dropped to 15.0%.

Impact of Heart Disease and Stroke in Michigan

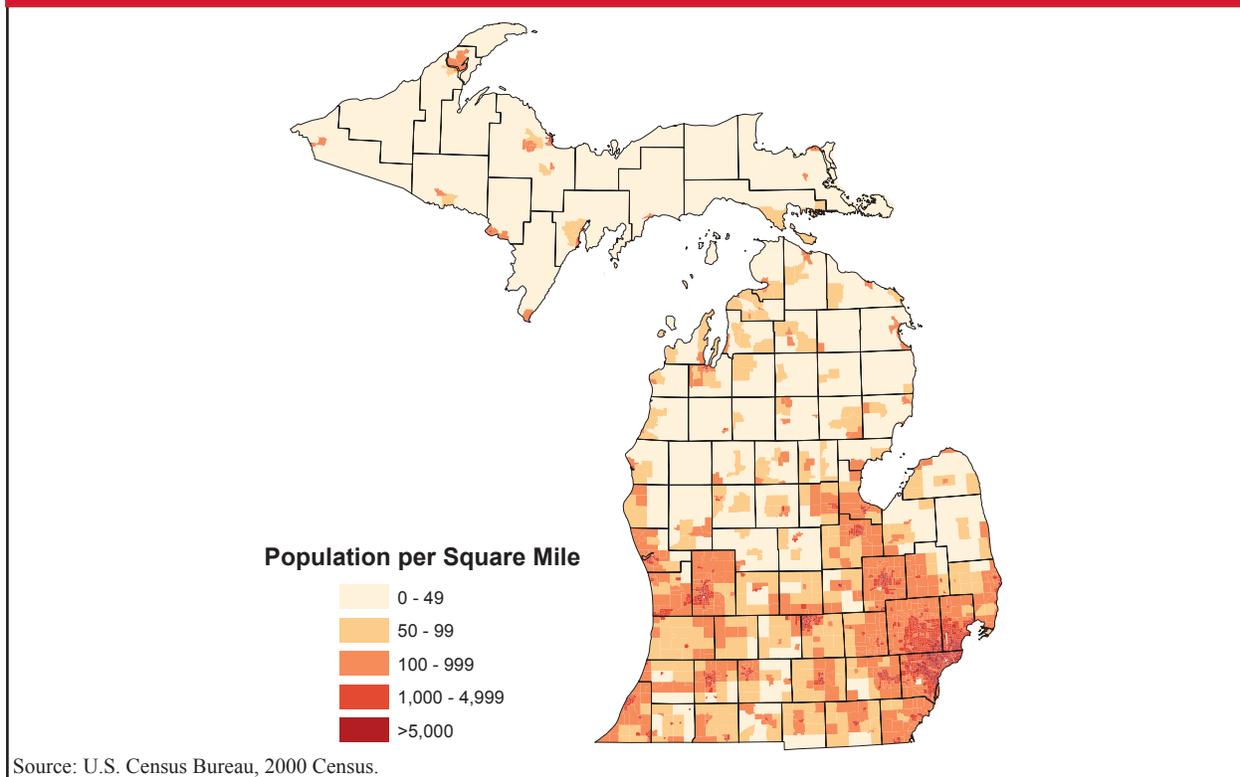


Geography

Each region of Michigan has its own geographic opportunities and challenges. Michigan consists of two peninsulas and covers 58,110 square miles.⁷ The Upper Peninsula is sparsely populated, with one-third of the total land and only 3.09% of Michigan's total population (312,153 people), Map 1.⁴ In 2006, Marquette was the largest city in the Upper Peninsula with a population of 20,488. The racial makeup of Northern Michigan and the Upper Peninsula is predominately white.

The population in the Lower Peninsula has two distinct areas as well, the northern and southern Lower Peninsula. The northern half of the Lower Peninsula is also sparsely populated. It is home to several national parks and inland lakes. The southern part of the Lower Peninsula is the most populous part of the state. The largest city in Michigan is Detroit, with 871,121 residents. Almost half (44.3%) of Michigan residents reside in the Detroit-Warren-Livonia metropolitan statistical area in the southeast side of the state. This same area houses 71.5% of the black population and 40.0% of the Hispanic population of Michigan.⁴

Map 1. Population density map of Michigan, 2000 census tract population per square mile





Medical Resources

The provision of services to populations needing prevention and treatment for heart disease, stroke and their precursors requires a broad range of health care resources. These resources include, but are not limited to, hospitals, emergency medical systems, local health departments, and clinics. Some of these resources are mentioned in this section to highlight their importance to heart disease and stroke prevention and control efforts.

Local Health Departments

Local public health departments play a critical role in the prevention and control of diseases and risk factors. They often are recognized as leaders in infectious disease control and protection of community members from environmental hazards. Local public health also focuses on promoting health and preventing disease. They provide health information and often serve the most vulnerable populations. They continue to be strong partners in applying service to practice, policy and environmental changes to enhance healthy lifestyle options. Many local health departments perform community assessments to identify priority health issues that drive local program interventions.

Michigan has 83 counties that are served either through a city, county or a multi-county district health department. The 45 Michigan local health departments are listed in Appendix B. Currently there are eight local health departments that are participating in the WISEWOMAN initiative to screen women for CVD risk factors (see box at right).

WISEWOMAN

Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN) is a cardiovascular disease risk factor screening program funded by CDC. There are 15 state and tribal programs providing low-income, under insured or uninsured women ages 40 to 64 years with cardiovascular screening and lifestyle counseling services. The Michigan program is housed in the MDCH Cancer Section and recruits women to participate when they come in for Breast and Cervical Cancer screening. The WISEWOMAN program provides women with knowledge, skills and opportunities to improve diet, physical activity, and other lifestyle behaviors to prevent, delay and control cardiovascular disease and other chronic diseases.

The Michigan program includes clinical screening for cholesterol, blood pressure, body mass index and diabetes. Medical history and lifestyle questions are also asked, such as smoking history and family history of heart disease and stroke. The latter family history question is unique to Michigan and has yielded important findings. Over one-third (34.5%) of the participants reported having a first-degree relative who had a premature heart attack and/or stroke. This information is incorporated into counseling and follow-up. The Michigan program began screening in 2001 and currently provides WISEWOMAN services in 27 counties, Appendix C. There are approximately 3,600 women screened and counseled each year in the WISEWOMAN program.

Source: Emeott A, Roberts R, Theisen V, Duquette D, Teachout M. Family History of Premature Heart Attack or Stroke, Michigan WISEWOMAN Program 2001-2006. Michigan Department of Community Health. Presented January 2008.

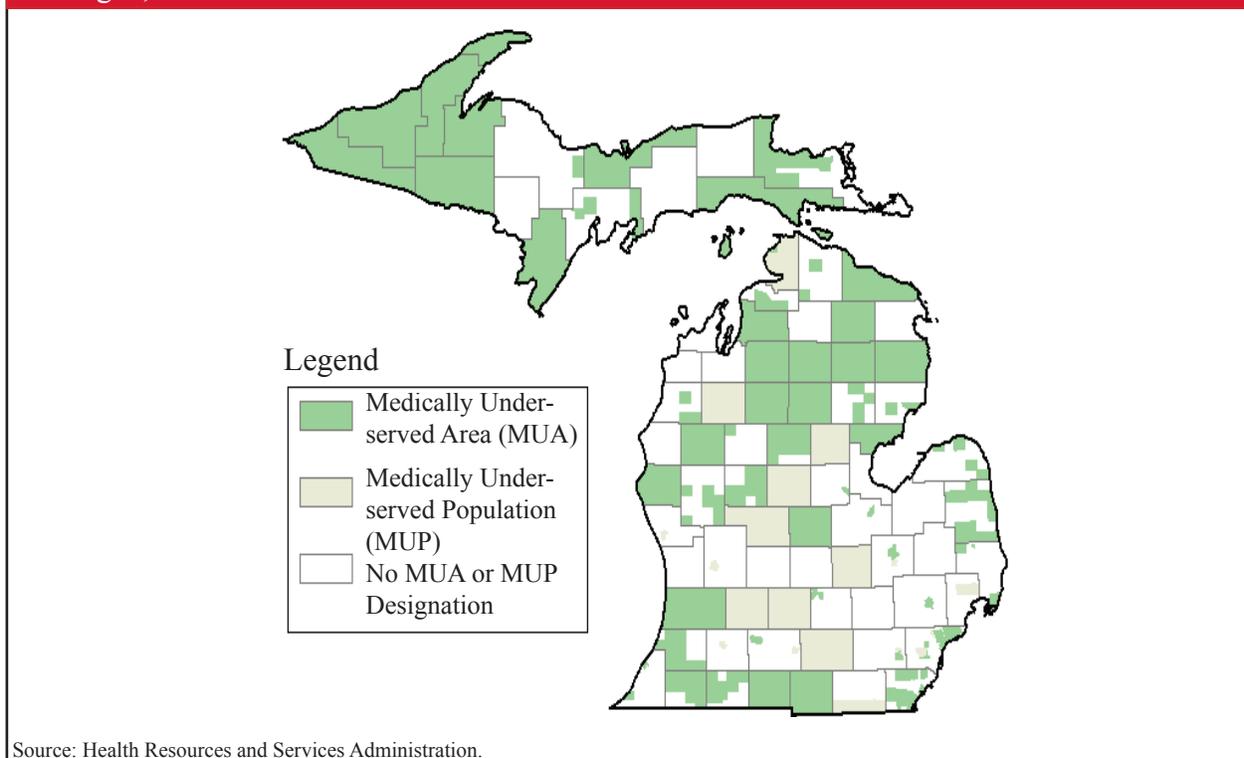
Impact of Heart Disease and Stroke in Michigan



Medically Underserved Areas and Populations

Medically Underserved Areas (MUA) have demonstrated a need for more primary health care resources given the shortage of personal health services in the area. A Medically Underserved Population (MUP) is a group of people who have greater barriers to health care access and have a demonstrated shortage of primary health care resources relative to the population. Michigan has more MUAs than MUPs, the majority of which are in the northern part of the Lower Peninsula and the Upper Peninsula, Map 2.

Map 2. Medically underserved area and medically underserved population designations in Michigan, 2007



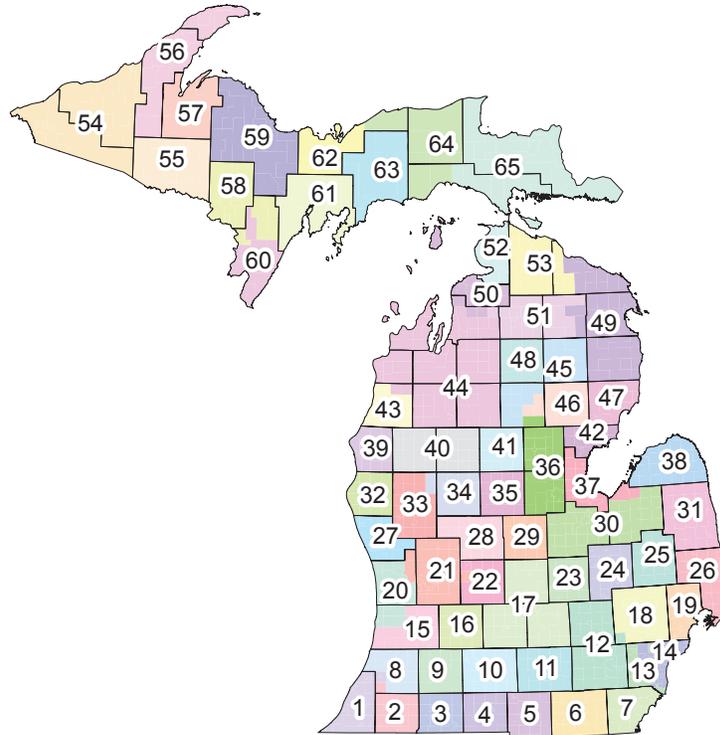
Emergency Medical Services

In 2006, there were over 82,000 emergency medical service (EMS) responses in Michigan alone. Michigan's system of EMS is complicated, being composed of multiple components working together to provide emergency care for residents. Sixty percent of unexpected cardiac deaths are treated by EMS.⁸ Emergencies require that EMS Systems have the training, personnel, and resources to provide the necessary care to people. Acute heart attack and stroke are both reliant on timely and appropriate EMS care.

Michigan's EMS system includes 65 Medical Control Authorities (MCAs) who are responsible for the medical care given in the field.⁹ MCAs are found throughout the state often, Map 3. See Appendix D for a listing of the MCA names.



Map 3. Michigan medical control authorities



Source: State of Michigan Medical Control Authorities Directory, MDCH EMS & Trauma Services Section.

Michigan's EMS System also includes 400 Life Support Agencies (LSAs).¹⁰ These are licensed, usually privately owned, agencies providing care and transport for emergencies. A third major component of the EMS System is the 110 Public Safety Answering Points (PSAPs) who take emergency calls. Some PSAPs handle medical emergency calls and others transfer them. PSAPs may use nationally-recognized protocols to respond to medical calls and some PSAPs use their own protocols.

EMS personnel comprise another level of this system and they are licensed to provide a specific level of care. EMS in Michigan is grappling with a shortage of personnel. The 2006 Rural EMS Report stated that an additional 1,922 staff were needed, which was almost equal to their current workforce. Over 60% of the EMS personnel were volunteers. For the first time, Michigan had three areas of the state not covered by EMS for a period of time. The average EMS run time in rural Michigan was 94.8 minutes.⁸

Michigan is one of four states in the country without a Trauma System¹⁰, meaning there is not a system in place that designates that a trauma victim be delivered to a trauma hospital. There is not a formal system to follow up on emergency care given so EMS can implement quality improvement activities. This will begin to be addressed when a statewide EMS Information System is implemented in 2008-09, and data on every patient care record and ambulance run will be collected.

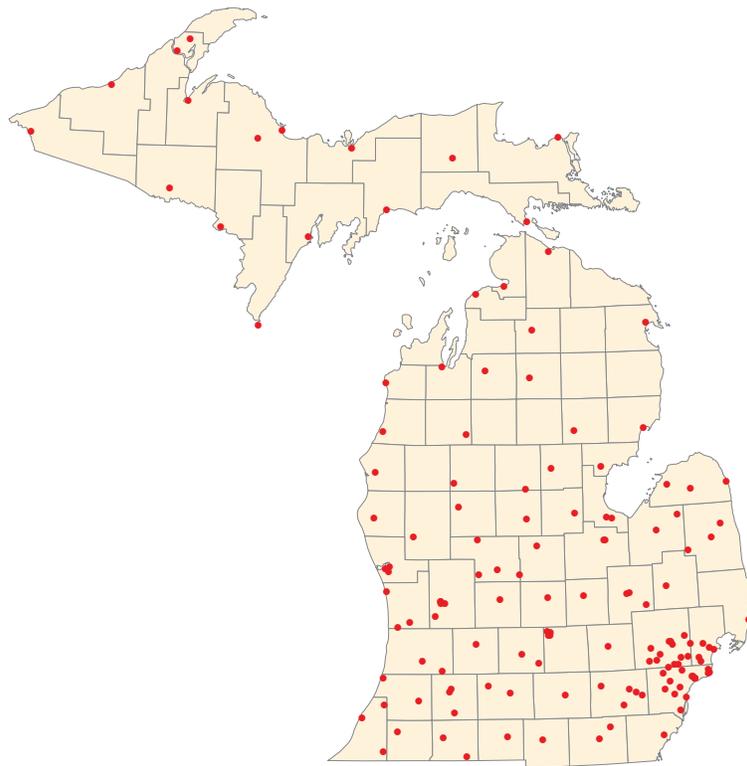
Impact of Heart Disease and Stroke in Michigan



Hospitals

Michigan hospitals are non-profit organizations that serve the community 24 hours a day, seven days a week. They are also a last resort option for care to all individuals regardless of their ability to pay. Michigan hospitals operate as an economic engine by contributing to the health care sector which is the largest employer in the state. In Michigan, there are a total of 147 acute care hospitals, Map 4 and Appendix E.

Map 4. The location of hospitals and multi-hospital systems that are members of the Michigan Health and Hospital Association, 2008



Source: Michigan Health and Hospital Association, 2008.

Critical Access Hospitals

The Critical Access Hospitals (CAH) program was designed to strengthen and sustain the rural health safety net by improving access to rural health services through the nation's small (25 beds or less) rural hospitals. CAHs provide basic and essential acute care hospital services in their communities and are required to have functional referral agreements with area tertiary care facilities.

Michigan's 34 CAHs are scattered across Michigan's rural communities and are all members of the Michigan Critical Access Hospital Quality Network (MICAH). This Network has developed quality standards appropriate to measure low volume hospitals and to track performance improvement. Among these indicators are measures for acute myocardial infarction.

Impact of Heart Disease and Stroke in Michigan



Primary Stroke Centers

The Joint Commission, a national organization leading quality health care, offers certification for hospitals demonstrating a high level of stroke care called Primary Stroke Centers (PSC). Hospitals' attainment of PSC signifies that the services provided at that organization have the critical elements needed to achieve long-term success in improving outcomes in stroke care. A hospital designated as a PSC has demonstrated compliance with national standards and performance measurement expectations. The Joint Commission's PSC certification program was developed in collaboration with the American Stroke Association. In Michigan, as of July 2008, there were 22 Primary Stroke Centers, Map 5.

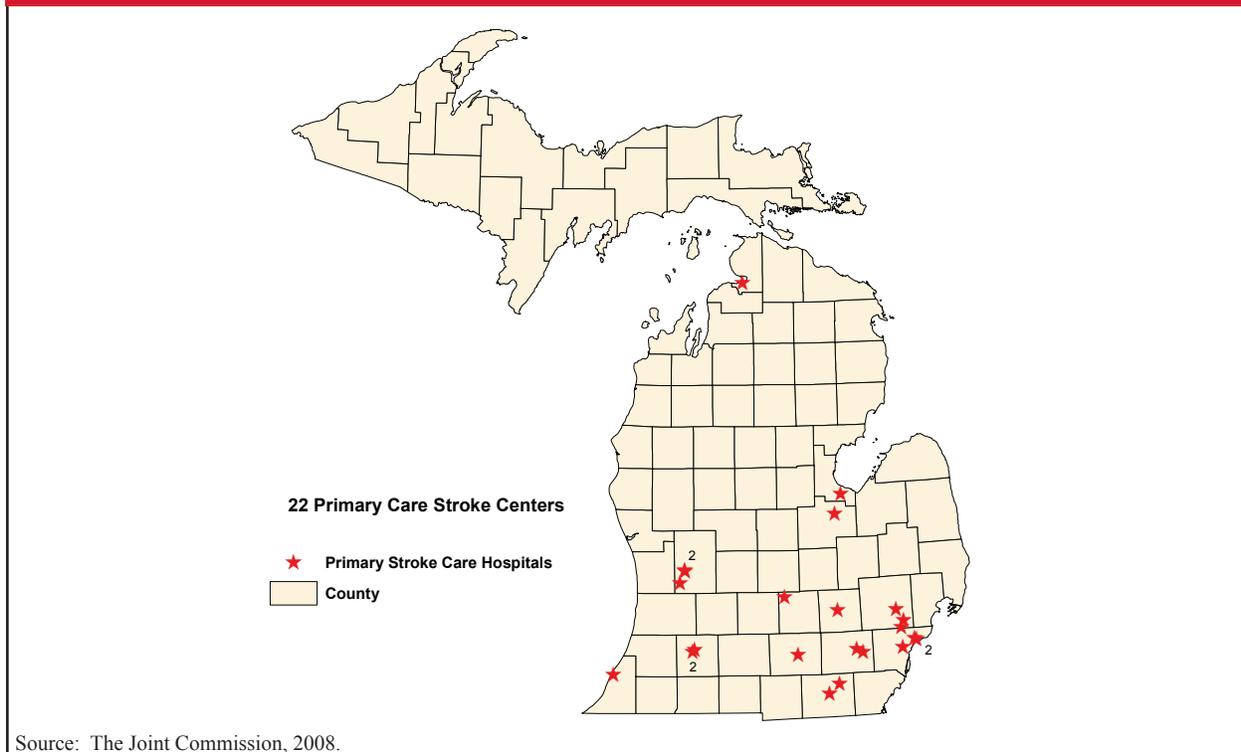
Modeling Stroke Center Development

Tissue Plasminogen Activator, or tPA, was approved by the FDA in 1996, but treatment rates remain relatively low, particularly among populations most at risk for stroke. As of the early 2000s, the treatment rate was approximately 2%, and tPA was more likely to be administered to white patients, younger patients, and in suburban or rural hospitals.

Treatment of tPA must be administered within three hours of stroke onset, and it is imperative that vulnerable populations are located near hospitals equipped to treat with tPA. Therefore, identifying hospitals for stroke center designation is necessary to expand treatment rates. A model was developed to select hospitals for primary stroke center designation in Michigan using the existing hospital infrastructure network in conjunction with census demographic data and the estimation of travel times to hospitals for stroke care. Based on the demographic data, communities at high risk for stroke incidence were identified and the adequacy of the model was assessed. The model can be seen in Appendix F.

Source: J Am Heart Association, Jan 11 2006; Demaerschalk B, Yip T. Economic Benefit of Increasing Utilization of Intravenous Tissue Plasminogen Activator for Acute Ischemic Stroke in the United States. Stroke 2005; 36.10.2500-2503.

Map 5. Primary stroke center hospitals in Michigan, 2008



Source: The Joint Commission, 2008.

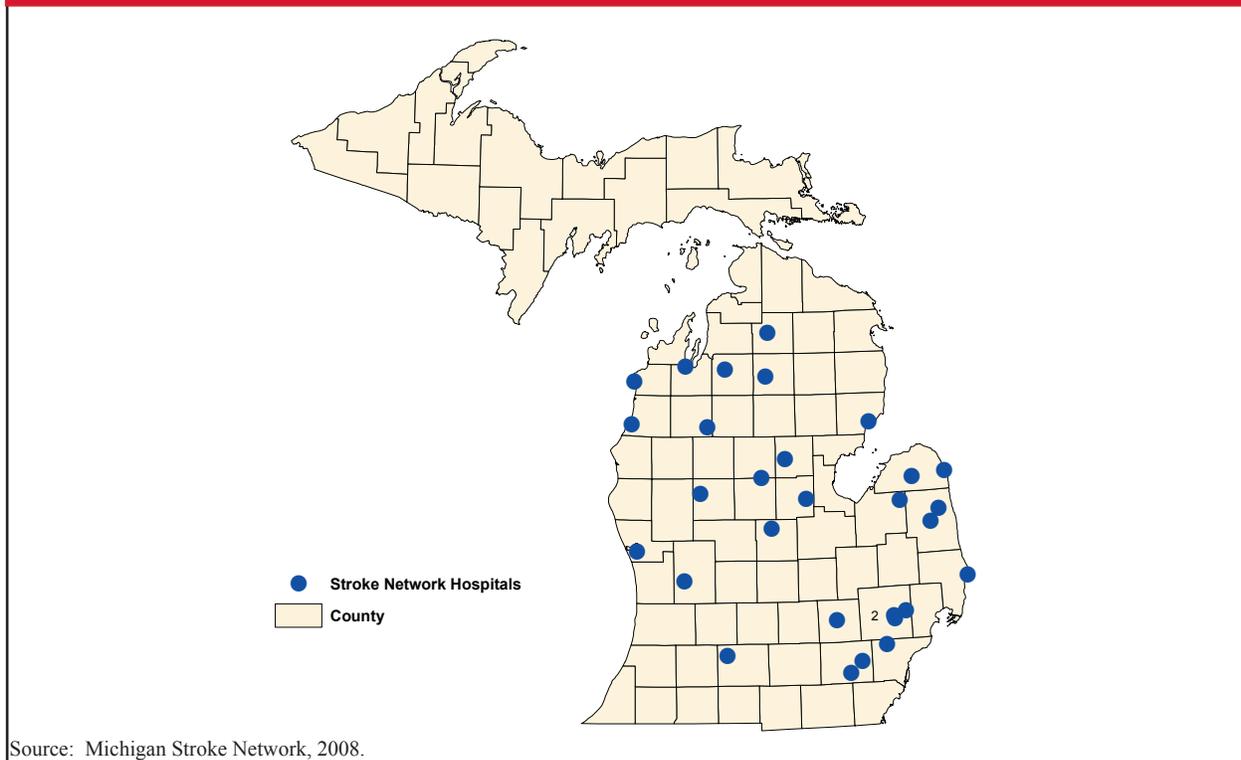
Impact of Heart Disease and Stroke in Michigan



Michigan Stroke Network

The Michigan Stroke Network (MSN), founded by Trinity Health, is a collaborative network of hospitals working together to deliver comprehensive stroke care in Michigan. By using telemedicine physicians, participating hospitals will have 24-hour access to consultation with neuroendovascular specialists, therefore allowing stroke patients to get quality medical care when they need it. Member hospitals within the MSN have 24-hour a day access to highly specialized neuroendovascular technology that can mean the difference between life and death for many stroke victims. Member hospitals also receive around the clock access to neuroendovascular specialists, access to rapid transport (helicopter or ambulance) and cutting-edge technology. Using bedside video conferencing, telemedicine medical teams in hospital emergency centers can consult with neuro specialists. This consultative approach improves access to speciality care and reduces the need for exhausting travel and unnecessary patient transports. As of July 2008 there were 29 hospitals in MSN, Map 6.

Map 6. Stroke network hospitals in Michigan, 2008

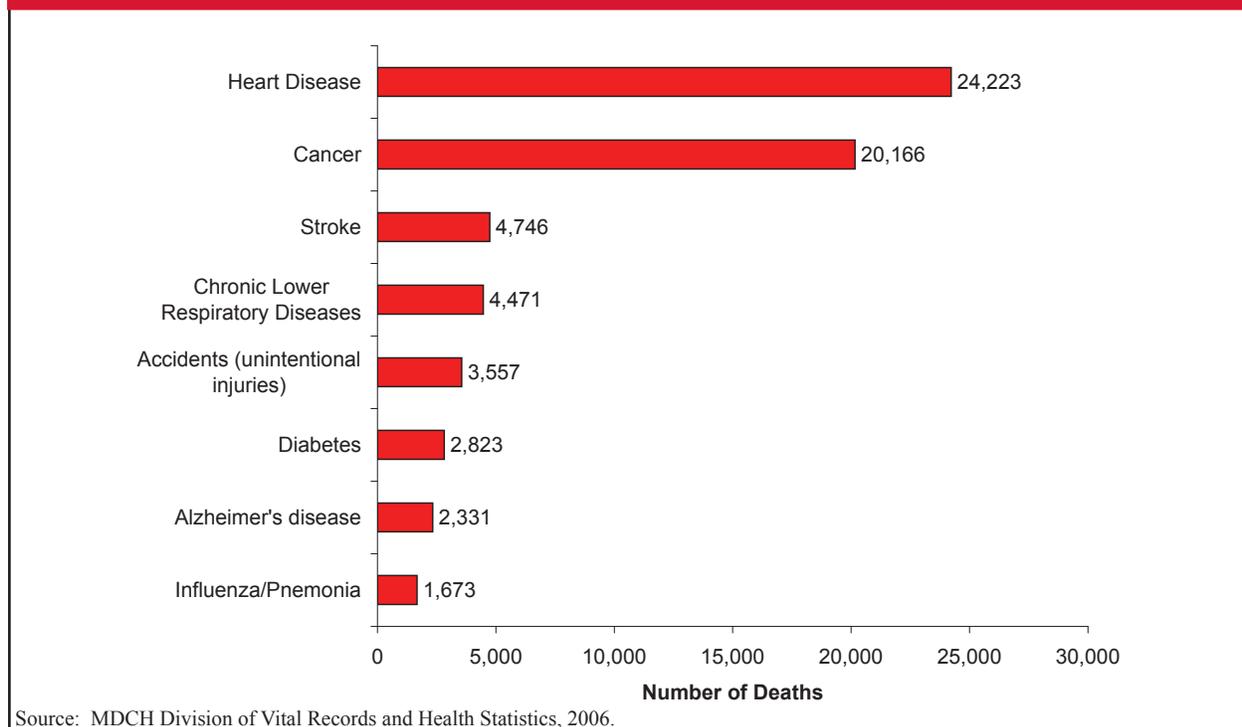




Leading Causes of Death

Cardiovascular disease (CVD) is the leading cause of death in Michigan. In 2006, CVD was responsible for 36.1% of Michigan deaths; of that, 78.0% were due to heart disease and 15.3% were caused by stroke. Heart disease and stroke are the first and third causes of death in Michigan, with cancer the second leading cause of death, Figure 6.

Figure 6. Leading causes of death in Michigan, 2006

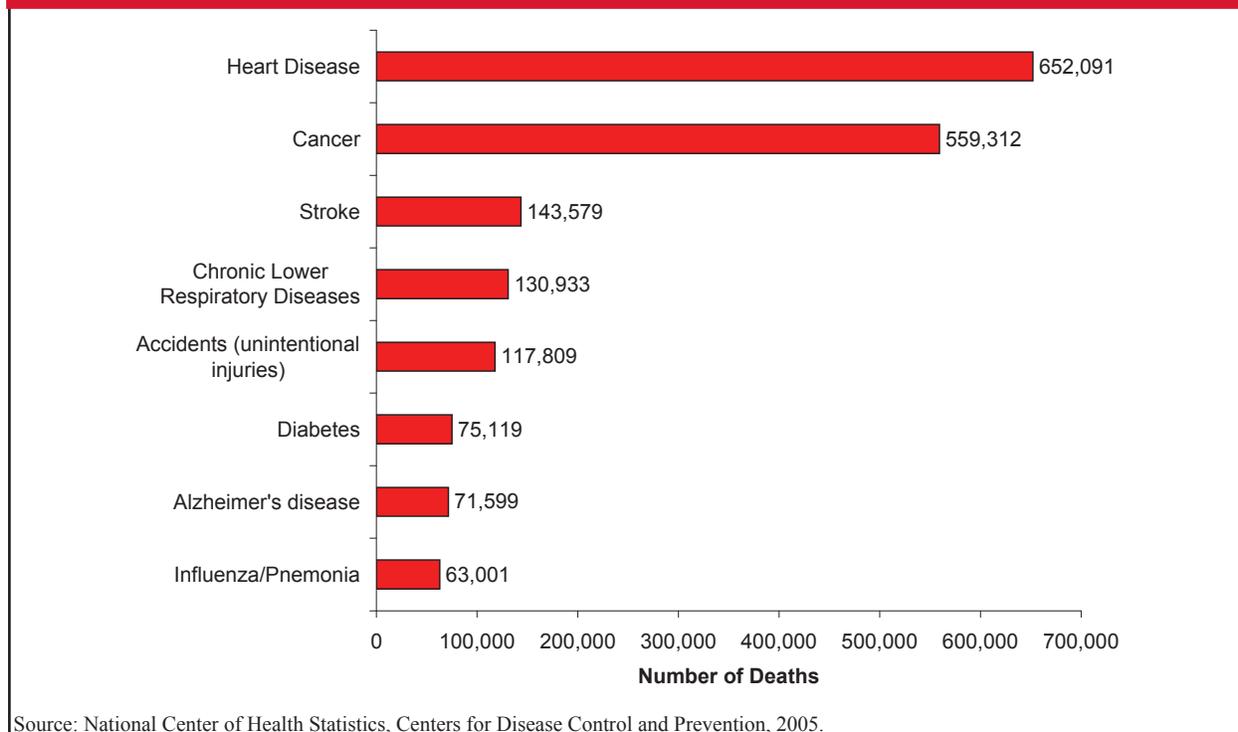


Impact of Heart Disease and Stroke in Michigan



Nationally, cardiovascular disease is also the number one cause of death and has been every year since 1900, except in 1918 during the influenza pandemic.¹ Similar to Michigan, the leading causes of death were heart disease, cancer and stroke, the top three causes, Figure 7.

Figure 7. Leading causes of death in the United States, 2005





Cardiovascular Disease

What is cardiovascular disease and why is it important?

Cardiovascular disease is a term that describes many different diseases that affect the heart and blood vessels, such as heart disease, coronary heart disease, stroke, heart failure and peripheral arterial disease.

One in three American adults, or an estimated 80.7 million people, have one or more types of cardiovascular disease. In 2008, the estimated total direct and indirect cost due to CVD in the United States will total \$448.5 billion.¹

What is the scope of the problem?

Hospitalizations

The hospitalization rate for cardiovascular disease has decreased over the past seven years from 217.5 per 10,000 in 2000 to 202.5 per 10,000 in 2006. However, in 2006 there were still over 200,000 hospital discharges for CVD in Michigan and over five million throughout the United States in 2005.

In 2006, the majority of CVD hospitalizations were discharged to their home or self-care (64.3%). The other 35.7% were discharged to the following locations: a home that was under home health services (14.7%), nursing facilities (8.5%), another short-term hospital (3.9%) and other locations (5.7%). Almost three percent died in-hospital, equivalent to over 6,000 deaths.

Cardiovascular Disease and Pregnancy

Peripartum cardiomyopathy (PPCM) is a comorbid condition diagnosed in the third trimester of pregnancy or during the postpartum period. PPCM is poorly understood but has a devastating influence on the long-term health and mortality risk of a woman. The etiology remains unclear but it is thought to be secondary to the development of myocarditis arising from an autoimmune, infectious, viral or idiopathic process unmasked by the increased cardiac demands of pregnancy. The risk factors for PPCM classically identified in the literature include multiparity, advanced maternal age, multifetal pregnancy, preeclampsia, and hypertension. Black women have been shown to have a significantly higher mortality risk from PPCM. However, it is unclear whether race represents an independent risk factor or whether it is interacting with other factors such as hypertension during pregnancy.

Population-based estimates are not available and thus the true prevalence of PPCM is unknown. The accepted incidence for the United States is approximately 1 per 3,000 to 4,000 live births, which would translate to between 1,000 and 1,300 women annually. We don't know the true incidence and/or prevalence in Michigan but we have information from Maternal Mortality Surveillance. Among the pregnancy-related maternal deaths (99 cases) reviewed in Michigan between 1999 and 2004, cardiomyopathy in puerperium (13 cases, 13.1%) was the second most prevalent along with hypertension during pregnancy.

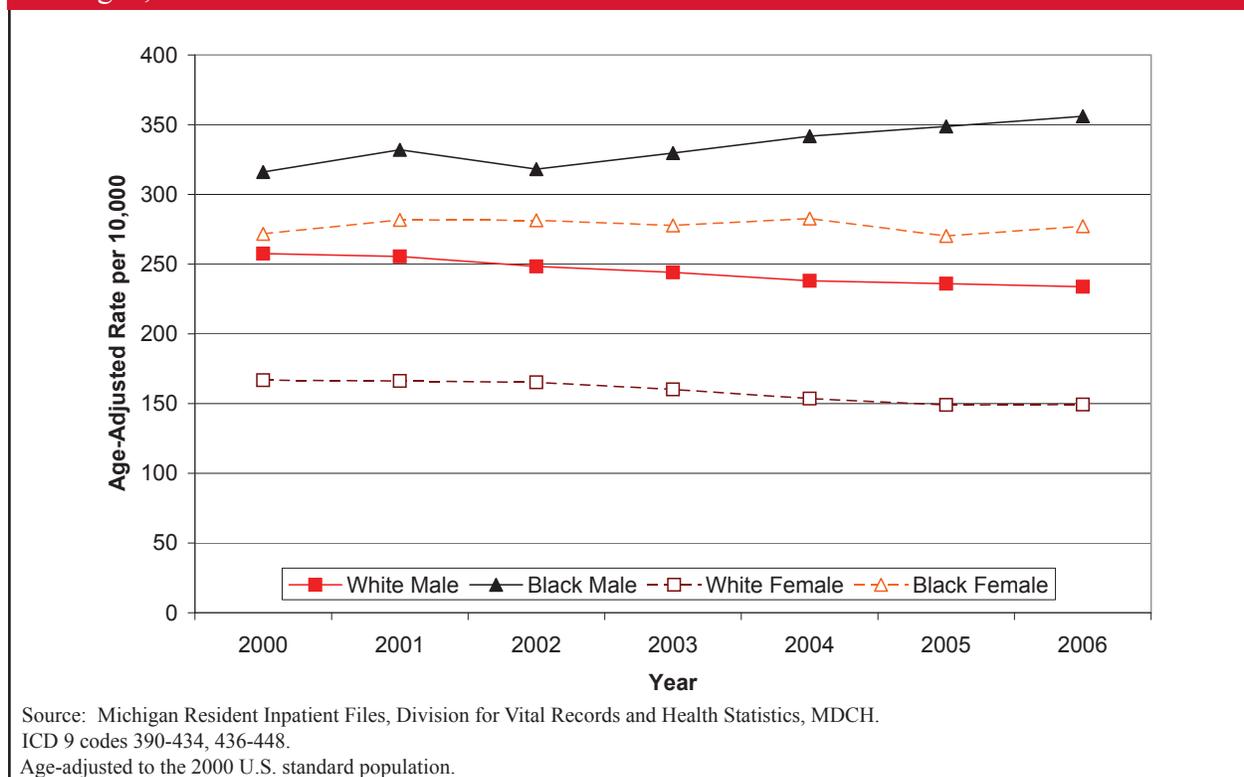
Sources: Pearson Gail et al. Peripartum cardiomyopathy: National Heart, Lung, and Blood Institute and Office of Rare Diseases (National Institutes of Health) workshop recommendations and review. JAMA.2000; 283:1183-1188, Maternal Mortality Report and Maternal Morbidity Study.

Impact of Heart Disease and Stroke in Michigan



Black males and females have had an increase in cardiovascular hospitalization rates since 2000, Figure 8. The rate for black males increased by 12.7% in the seven year period, at a time when rates for whites were dropping. In 2006, black males had the highest age-adjusted CVD hospitalization rate (356.1 per 10,000) while white females had the lowest (149.3 per 10,000). This disparity has grown in the last seven years as hospitalization rates for white females are falling and rates for black males are increasing.

Figure 8. Age-adjusted hospitalization rate by race and gender for cardiovascular disease for Michigan, 2000 to 2006

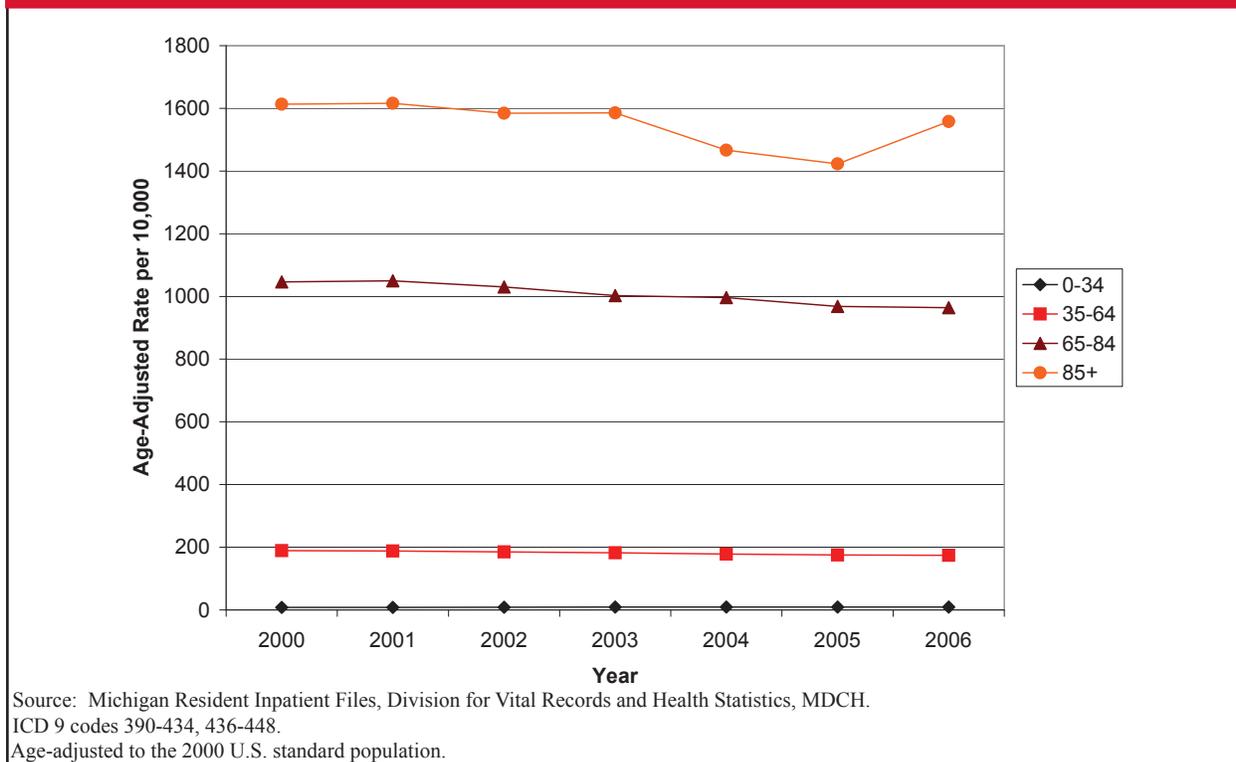


Impact of Heart Disease and Stroke in Michigan



From 2000 to 2006, CVD hospitalization rates decreased in each of the age groups, except those ages 0 to 34, Figure 9. The age group 0 to 34 increased slightly from 2000, 7.8 per 10,000, to 2006, 9.2 per 10,000. This age group had the lowest age-adjusted hospitalization rate and the group 85 years and above had the highest (1,558.0 per 10,000).

Figure 9. Age-adjusted hospitalization rate by age for cardiovascular disease for Michigan, 2000 to 2006

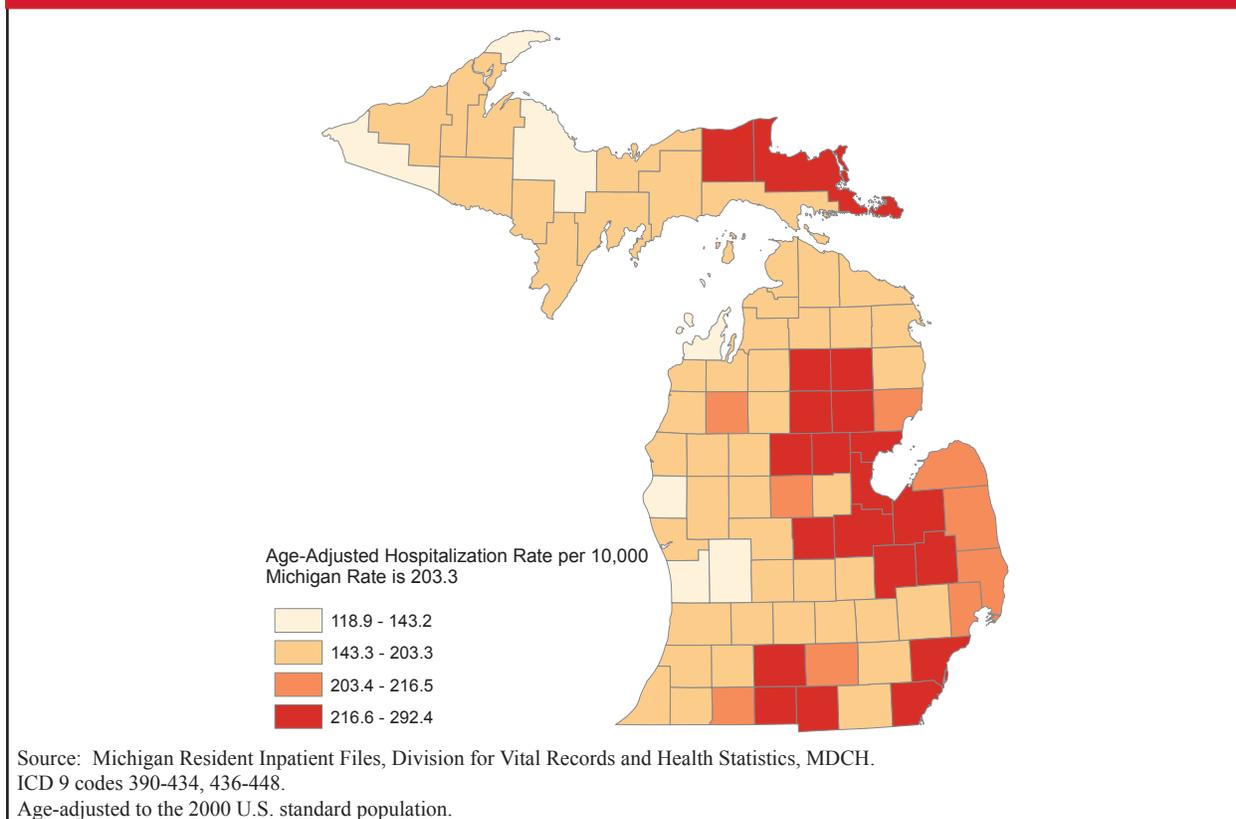


Impact of Heart Disease and Stroke in Michigan



The 2002 to 2006 five-year age-adjusted hospitalization rate for CVD in Michigan was 203.3 per 10,000. There were 29 counties above this rate with Arenac (292.4 per 10,000) and Bay (266.2 per 10,000) counties having the highest rates, Map 7. The counties with the lowest CVD age-adjusted hospitalization rates were Keweenaw and Ottawa with rates of 118.9 per 10,000 and 129.0 per 10,000 respectively. See Appendix G for a complete listing by county of age-adjusted hospital rates and number of hospital visits.

Map 7. Age-adjusted five-year hospitalization rates for cardiovascular disease by county, 2002 to 2006



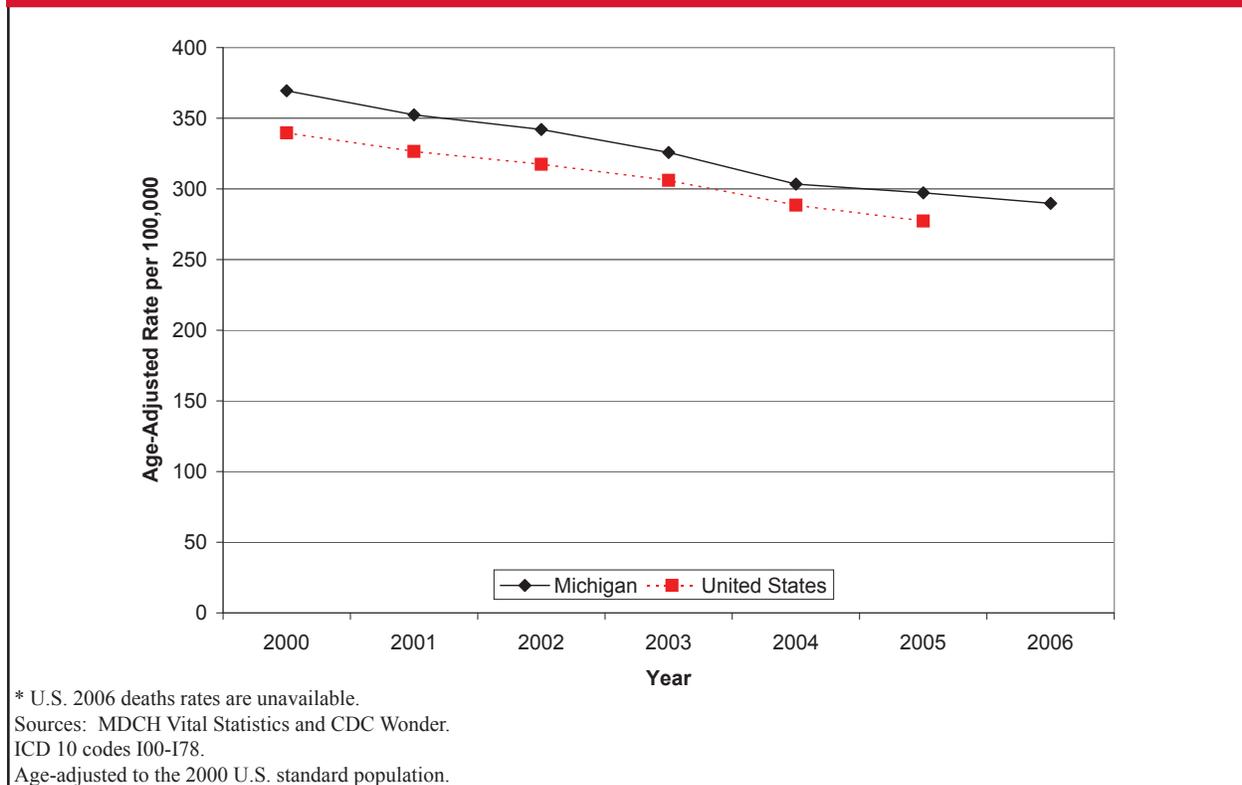
Impact of Heart Disease and Stroke in Michigan



Mortality

Death rates due to CVD have been declining for a number of years. The 2000 rate in Michigan was 369.4 per 100,000, declining by 21.5% to 289.8 per 100,000 in 2006, Figure 10. However, the death rate for CVD for Michigan is still above the national rate. In 2005, the Michigan CVD age-adjusted mortality rate was 297.2 per 100,000, 6.7% higher than the rate for the United States (277.3 per 100,000), Figure 10. In 2004, Michigan had the 13th worst age-adjusted mortality rate for cardiovascular disease in the United States.¹

Figure 10. Age-adjusted mortality rates for cardiovascular disease for Michigan and United States, 2000 to 2006*

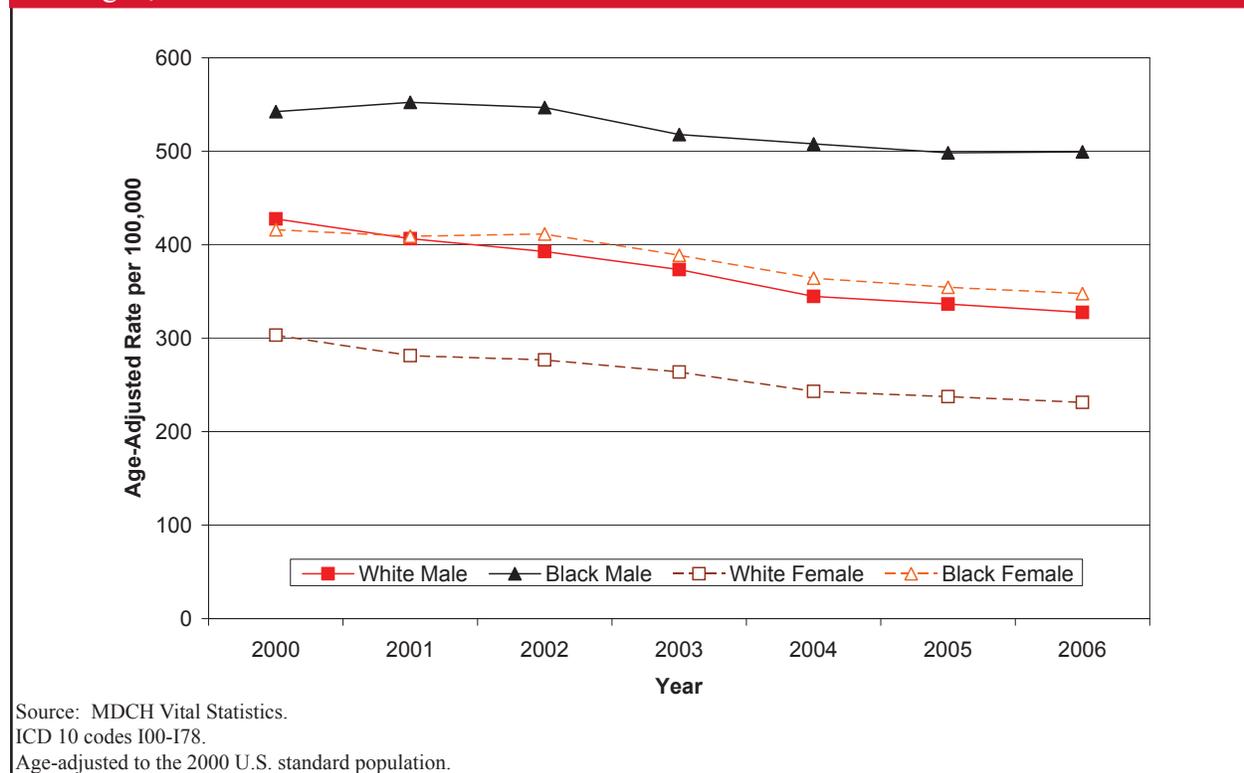


Impact of Heart Disease and Stroke in Michigan



Black males have the highest CVD age-adjusted mortality rate (499.4 per 100,000) when compared to other races and genders. The lowest rate is found in white females (231.3 per 100,000) Figure 11. All racial and gender groups have seen a decrease in CVD mortality in the last seven years, with white males and females having the largest decreases, 23.4% and 23.7% respectively.

Figure 11. Age-adjusted mortality rates by race and gender for cardiovascular disease for Michigan, 2000 to 2006

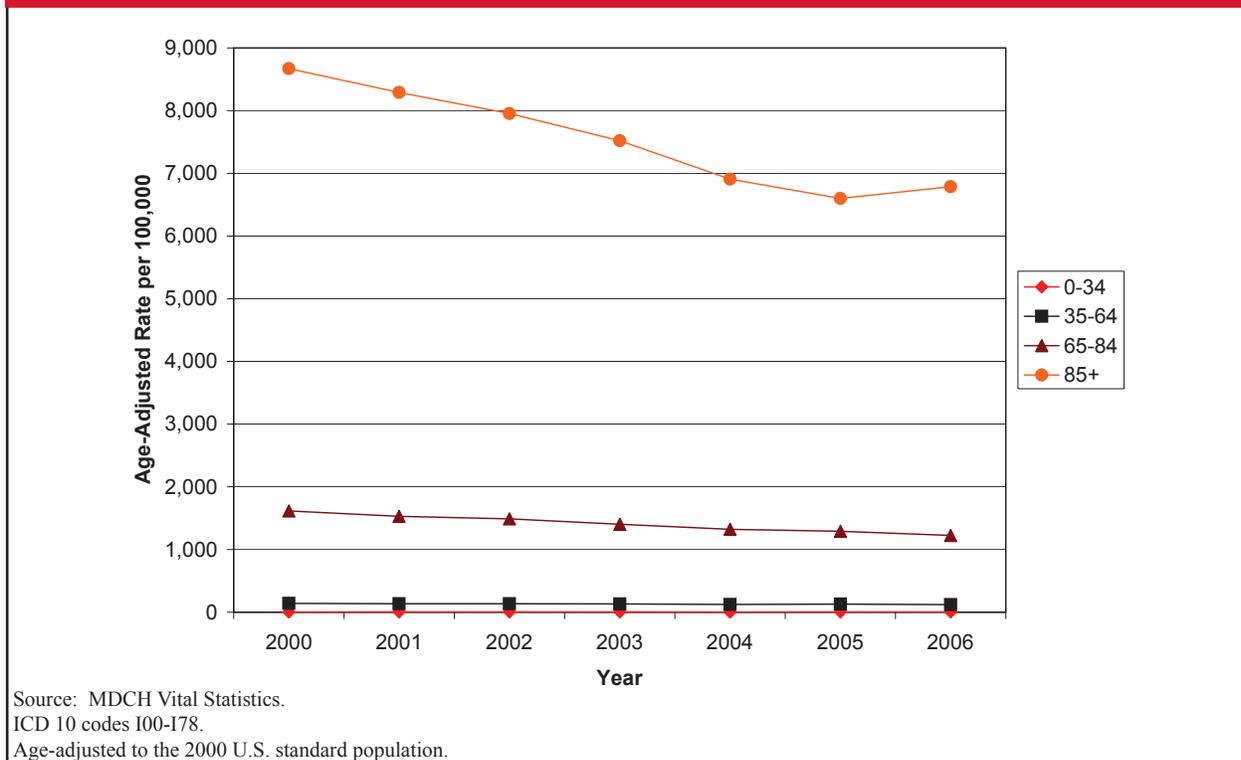


Impact of Heart Disease and Stroke in Michigan



Each age group has seen a decline in mortality rates with the exception of the 0 to 34-year-old group. There has been a 21.7% decrease in age-adjusted mortality rates for the 85 and above age group from 2000 to 2006, Figure 12.

Figure 12. Age-adjusted mortality rates by age for cardiovascular disease for Michigan, 2000 to 2006

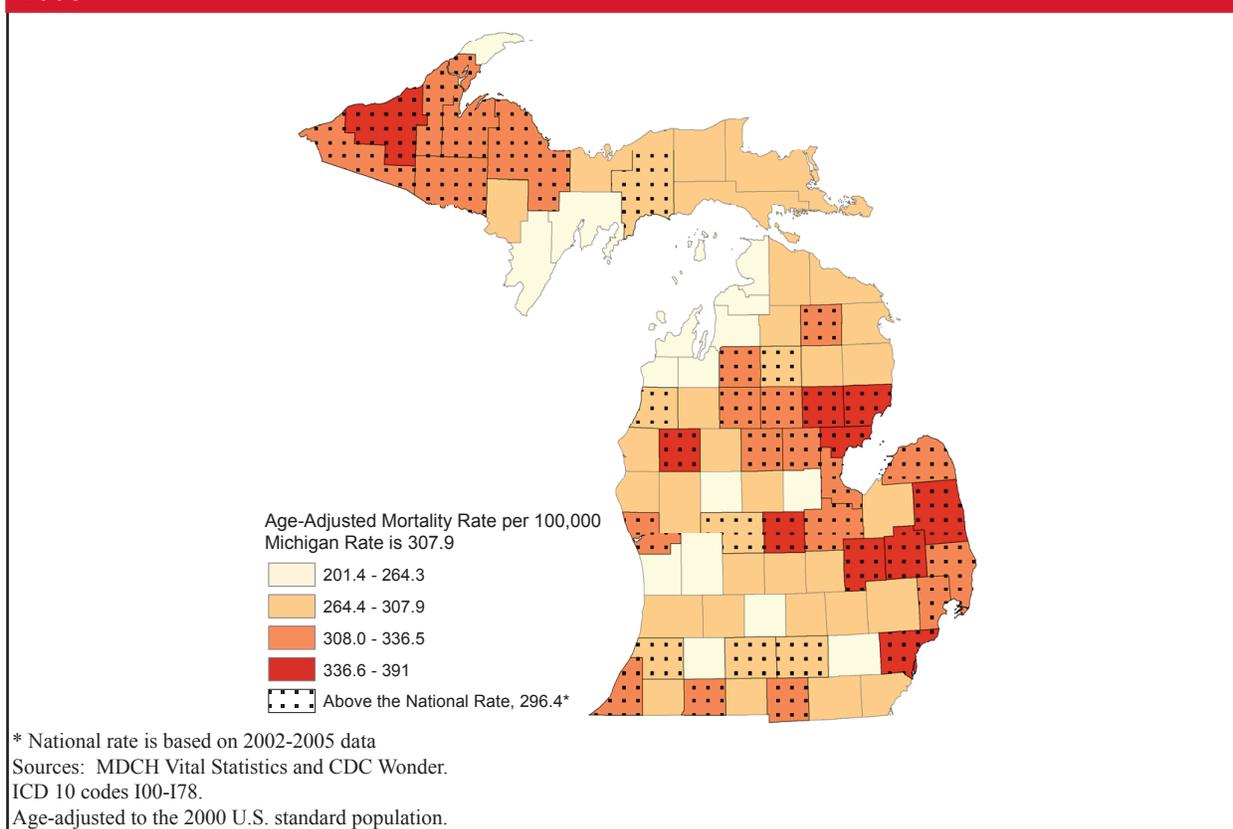


Impact of Heart Disease and Stroke in Michigan



The five-year age-adjusted CVD mortality rate in Michigan, from 2002 to 2006, was 307.9 per 100,000 people. There are 30 counties that have rates above the Michigan rate with Wayne (376.0 per 100,000), Ogemaw (383.0 per 100,000) and Sanilac (390.2 per 100,000) having the highest five-year age-adjusted rates, Map 8. The national rate for this period was 296.4 per 100,000 people and there were 37 counties above this. Seven of the 37 counties were below the state rate. The lowest rates were found in Leelanau (201.4 per 100,000) and Ottawa (227.5 per 100,000). See Appendix H for a listing of all county age-adjusted mortality rates and number of deaths.

Map 8. Age-adjusted five-year mortality rates for cardiovascular disease by county, 2002 to 2006





Heart Disease

What is heart disease and why is it important?

Heart disease is a subset of cardiovascular disease that includes all forms of diseases affecting the heart and blood vessels in the heart. The wide range of diseases covered under heart disease include rheumatic heart disease, hypertensive heart disease, pulmonary heart disease, atherosclerotic heart disease, heart failure, and coronary heart disease. Heart disease has been a classification reported in health statistics for many years and has been the leading cause of death in Michigan and the United States for decades. As the largest and most preventable type of heart disease, coronary heart disease is a category of particular importance and will be discussed in its own section later in the report.^{12,13}

What is the scope of the problem?

Hospitalizations

In 2006, Michigan hospitals saw 164,696 heart disease discharges; nationally there were over four million. Over half occurred in males both in Michigan (54.7%) and in the United States (54.8%). Two-thirds of the discharges were sent home, while an additional 2.4% resulted in in-hospital deaths. Fifteen percent were transferred to a home with home health care and 7.4% were transferred to a skilled nursing facility.

Sudden Cardiac Death of the Young

Sudden Cardiac Death of the Young (SCDY) is the unexpected death of a young person, (usually defined as 1 to 39 years of age) due to cardiac or ill-defined causes. Many of the conditions that lead to SCDY are genetic but can often be treated. In 2007, the Michigan Department of Community Health became the first state health department in the nation to implement a SCDY Mortality Review System. The objectives are to gain an understanding of the factors that contribute to SCDY and identify opportunities for prevention.

About six percent of Michigan residents report having a family history of SCDY, and approximately 280 people in the state between the ages of 1 and 39 die suddenly each year. Analysis of mortality data suggests significant health disparities. SCDY disproportionately affects both blacks (nearly 38% of cases) and males (about 74% of cases). The most common underlying conditions vary by age at death and include cardiomyopathies, cardiac arrhythmias, congenital heart defects and ill-defined causes. Factors contributing to the deaths appear to include a lack of: health insurance, available defibrillators, awareness of cardiac symptoms, when to seek medical care, and screening for family members.

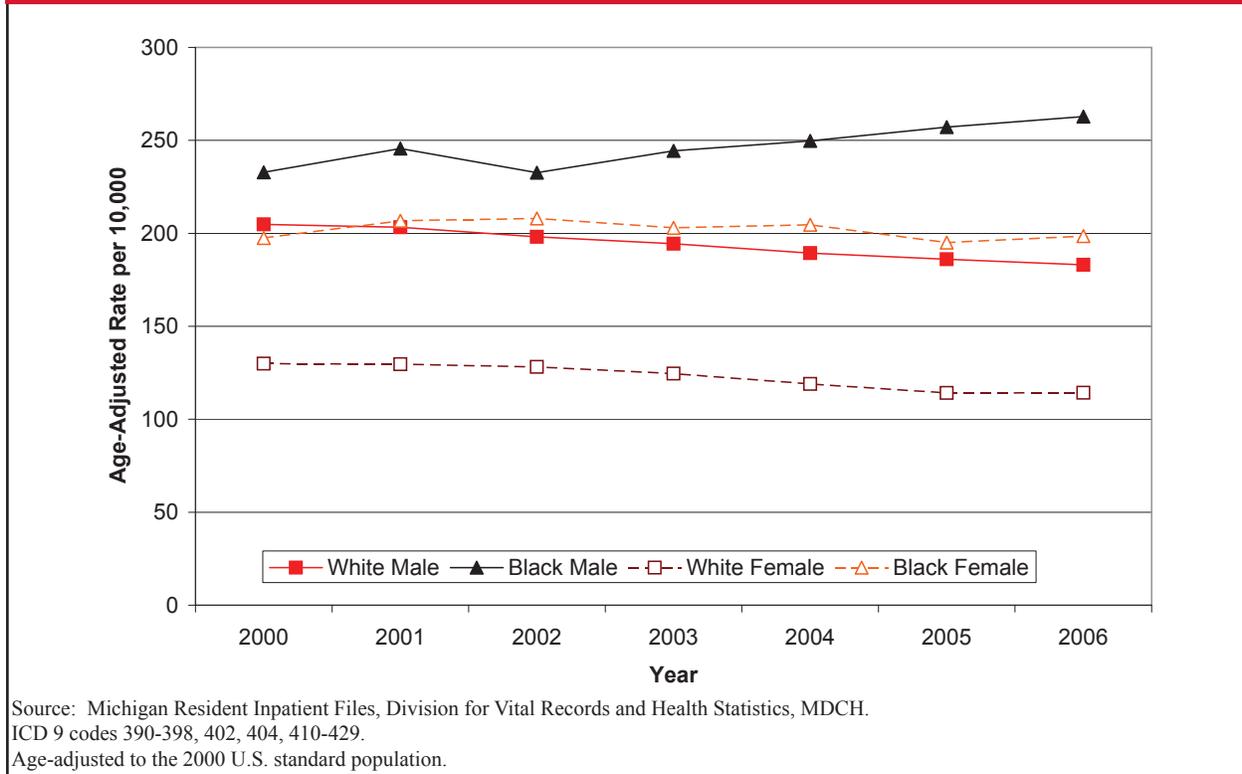
Source: Preliminary 2007 BRFSS data.

Impact of Heart Disease and Stroke in Michigan



The 2006 age-adjusted hospitalization rate for heart disease for Michigan was 155.3 per 10,000 people. This has decreased 8.5% in the past seven years. White males and white females have both experienced a decrease. However, black males and black females have seen an increase in age-adjusted hospitalization rates in the same seven year period, Figure 13. Black males had an age-adjusted rate in 2000 of 232.8 per 10,000, which increased to 262.8 per 10,000 in 2006, a 12.9% increase.

Figure 13. Age-adjusted hospitalization rates by race and gender for heart disease for Michigan, 2000 to 2006

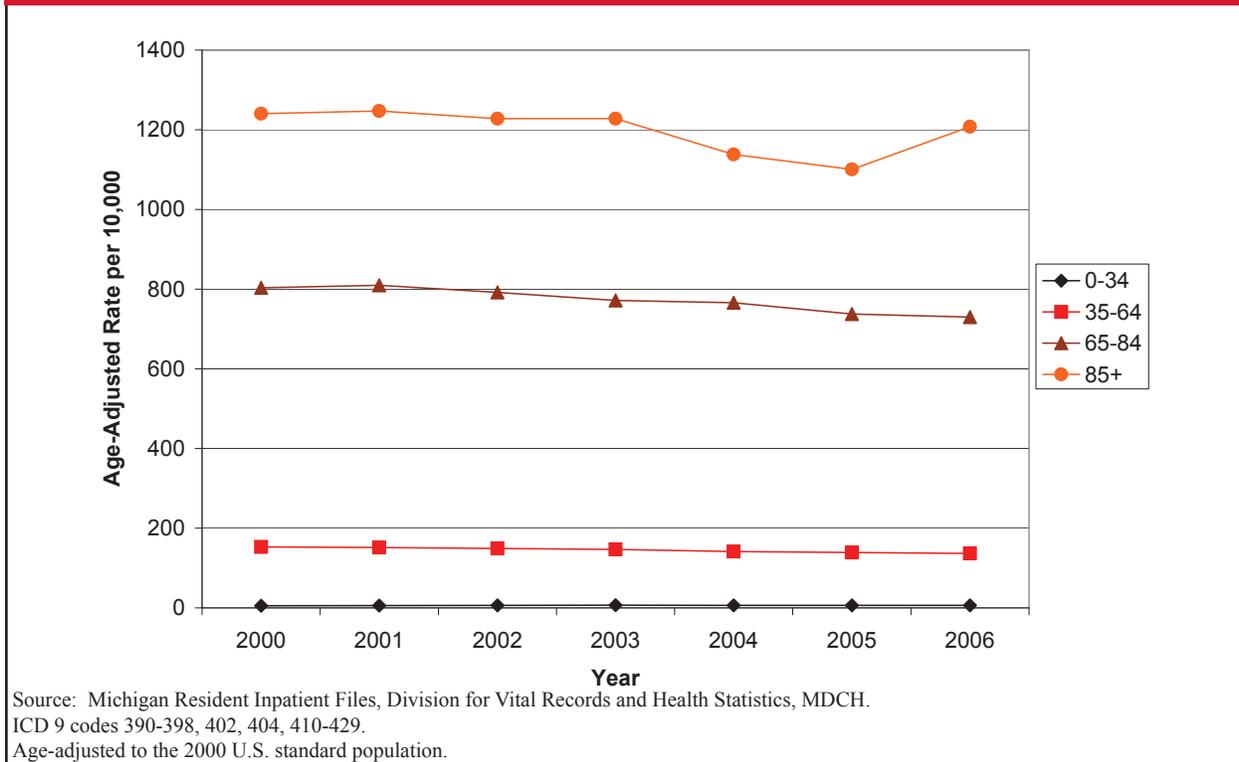


Impact of Heart Disease and Stroke in Michigan



Starting in 2003, the age group 85 years and above had a decline in age-adjusted hospitalization rates until 2005. In the period 2005 to 2006, the 85 and older group saw a 9.8% increase from 1,100.5 per 10,000 to 1,207.8 per 10,000, Figure 14. The rest of the groups had a decrease from 2000 to 2006. The largest decrease came from the 35 to 64 age group, with a 10.8% decline.

Figure 14. Age-adjusted hospitalization rates by age for heart disease for Michigan, 2000 to 2006

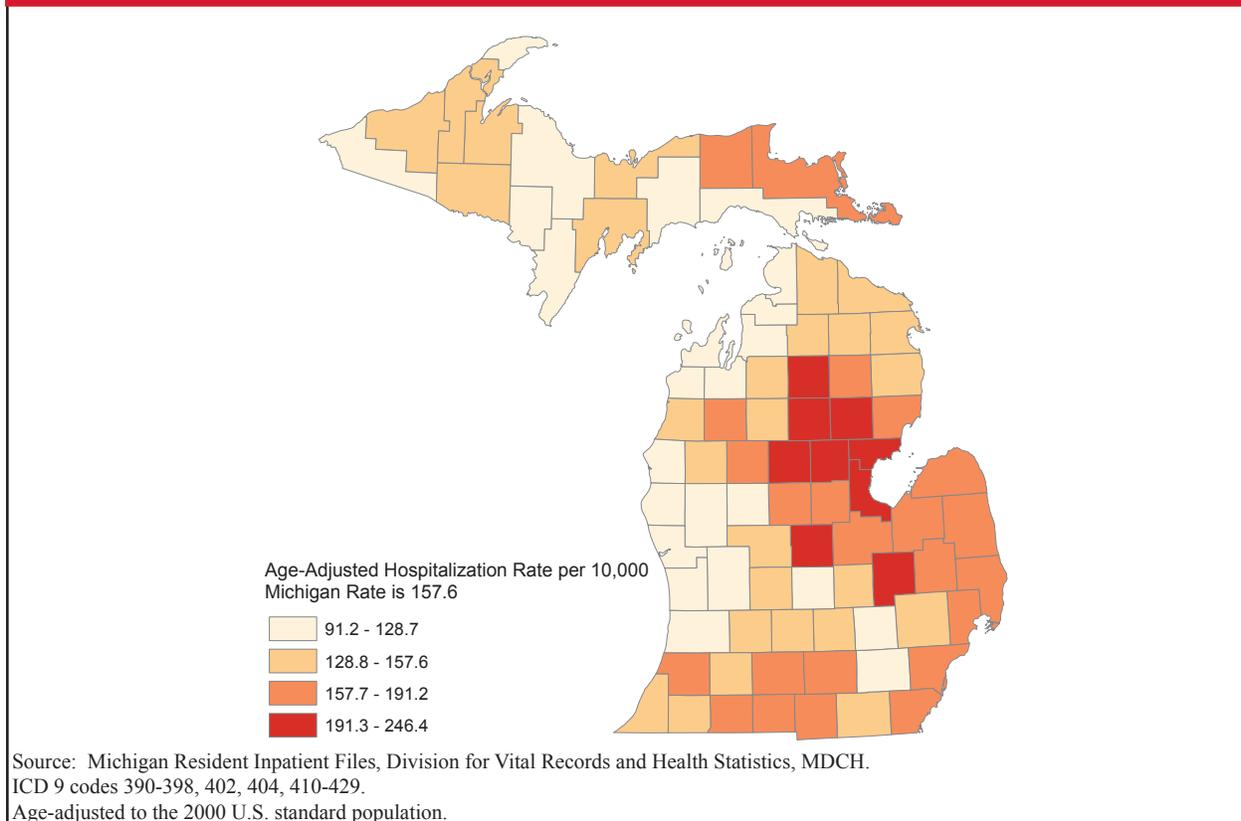


Impact of Heart Disease and Stroke in Michigan



The five-year age-adjusted rate for Michigan for heart disease was 157.6 from 2002 to 2006. The county with the highest age-adjusted rate was Arenac with 246.4 per 10,000 people being discharged from a hospital with a heart disease ICD code (see Figure 1). The lowest county rate was 91.2 per 10,000 in Keweenaw and 98.5 per 10,000 in Ottawa. There were 51 counties that were below the state rate, Map 9. See Appendix I for a complete listing of age-adjusted rates by county.

Map 9. Age-adjusted five-year hospitalization rates for heart disease by county, 2002 to 2006



Quality Improvement

Percutaneous coronary intervention (PCI), previously called angioplasty or balloon angioplasty, is a procedure used to treat people with diseased arteries of the heart. During this procedure, a catheter is passed through an artery in the groin to the troubled area in the heart. A balloon is then inflated, compressing the plaque and widening the narrowed coronary artery so that blood can flow more easily.¹⁴

In January 2006, the American College of Cardiology (ACC) recognized the urgent need to reduce door-to-balloon times for patients experiencing ST-segment elevation myocardial infarction (STEMI). The ACC identified the following goal for their Door To Balloon (D2B) Initiative: “To achieve a door-to-balloon time of 90 minutes or less for at least 75% of non-transfer primary PCI patients with ST-segment elevation myocardial infarction in all participating hospitals performing primary PCI.¹⁵”

Impact of Heart Disease and Stroke in Michigan

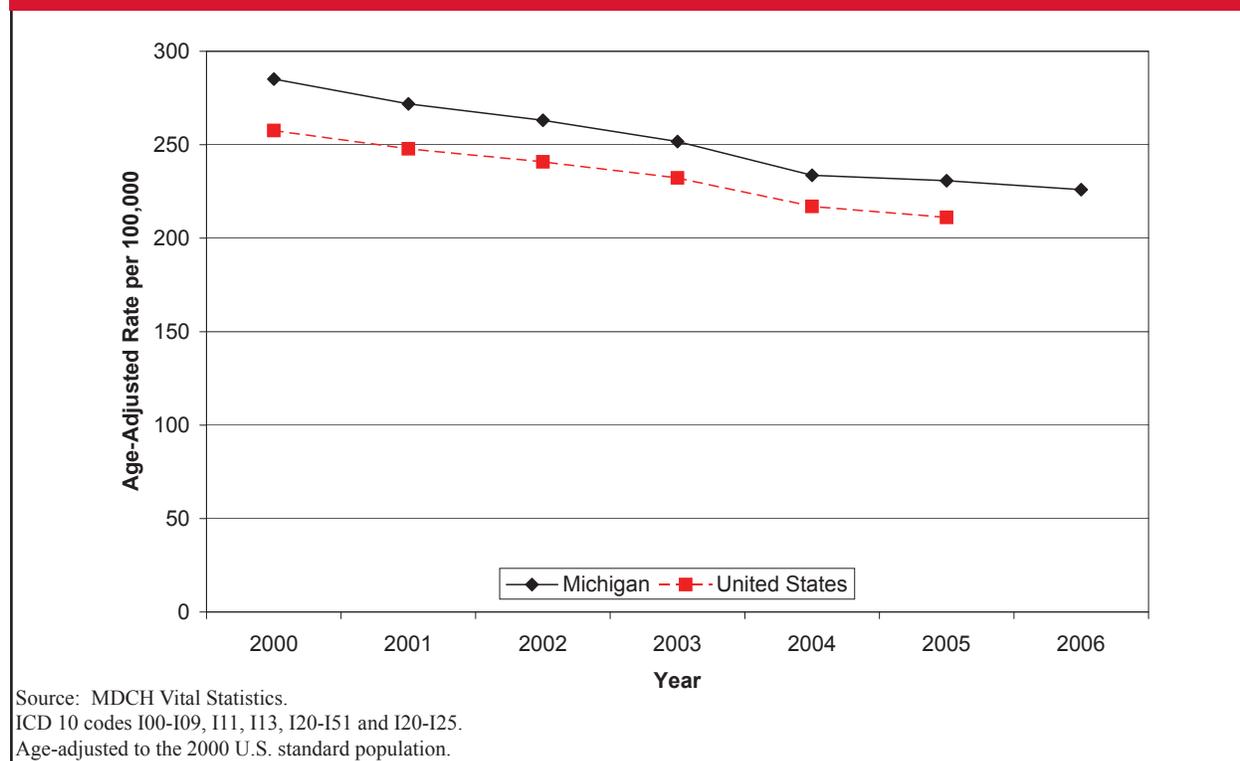


Although measures have been in place for some time that define ideal care for patients with a STEMI, only 40% of hospitals have been able to consistently perform primary PCI in less than 90 minutes. In June 2006, the ACC began building the D2B Alliance™, a nationwide network of hospitals, physician champions and strategic partners committed to addressing the D2B™ challenge. This Alliance is committed to working together to provide the tools, information and support necessary to help hospitals achieve their goals and improve outcomes in this critical area. Michigan has 43 D2B hospitals that became a part of the Alliance, led by the Michigan Chapter of the ACC, Appendix E. Through sharing best practices, these hospitals continue to strive for excellence in care of patients experiencing STEMIs in Michigan.¹⁵

Mortality

Heart disease is the number one cause of death in Michigan and the United States. In Michigan, the age-adjusted mortality rate in 2006 was 226.0 per 100,000 people. Michigan has consistently been above the national rate which was 211.1 per 100,000 in 2005. Heart disease mortality rates have declined for a number of years but the decline has been steady since 1998. In 2000, Michigan had a rate of 285.1 per 100,000 which decreased to its current rate of 226.0 per 100,000, Figure 15.

Figure 15. Age-adjusted mortality rates for heart disease for Michigan, 2000 to 2006

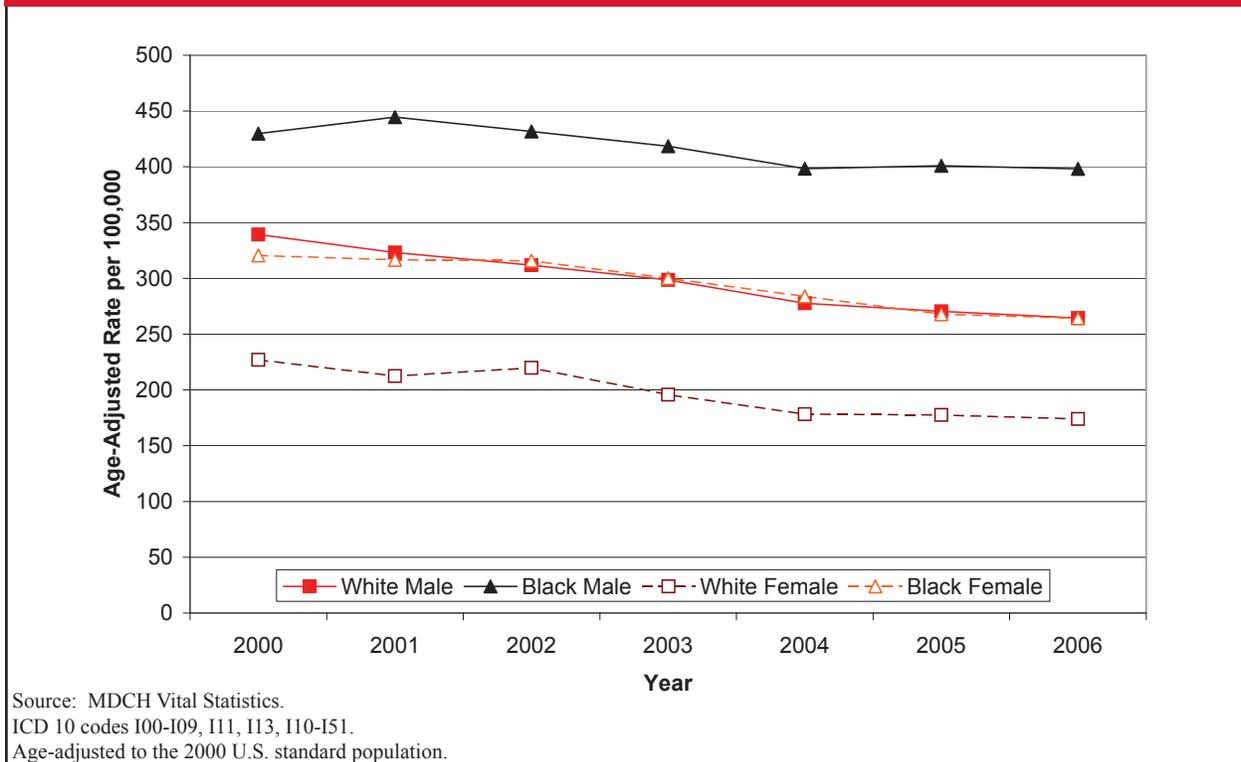


Impact of Heart Disease and Stroke in Michigan



Black females and white males have similar age-adjusted rates for heart disease, (264.2 per 100,000) and (264.4 per 100,000), 2006. Black males had the highest age-adjusted rate (398.1 per 100,000) and white females had the lowest, (173.9 per 100,000). All of the groups have seen a decrease in age-adjusted mortality rates since 2000, Figure 16. However, black males have not seen as large a decrease as the other groups.

Figure 16. Age-adjusted mortality rates by race and gender for heart disease for Michigan, 2000 to 2006

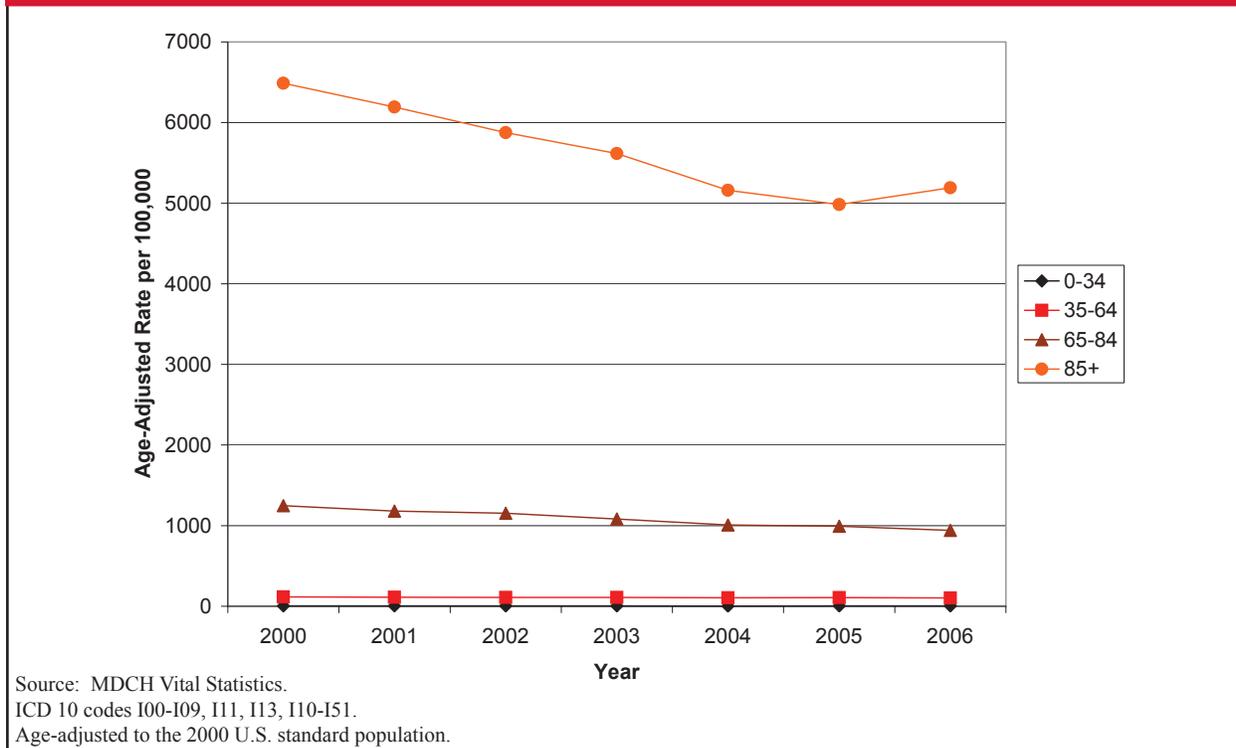


Impact of Heart Disease and Stroke in Michigan



The age group 85 years of age and above had the highest age-adjusted mortality rate for heart disease, Figure 17. The rates have declined since 2000 (6,487.9 per 100,000) except for a slight increase from 2005 to 2006, to where it is now 5,191.8 per 100,000 people. The lowest age-adjusted heart disease mortality rate came from the 0 to 35-year-old group (3.84 per 100,000).

Figure 17. Age-adjusted mortality rates by age for heart disease for Michigan, 2000 to 2006

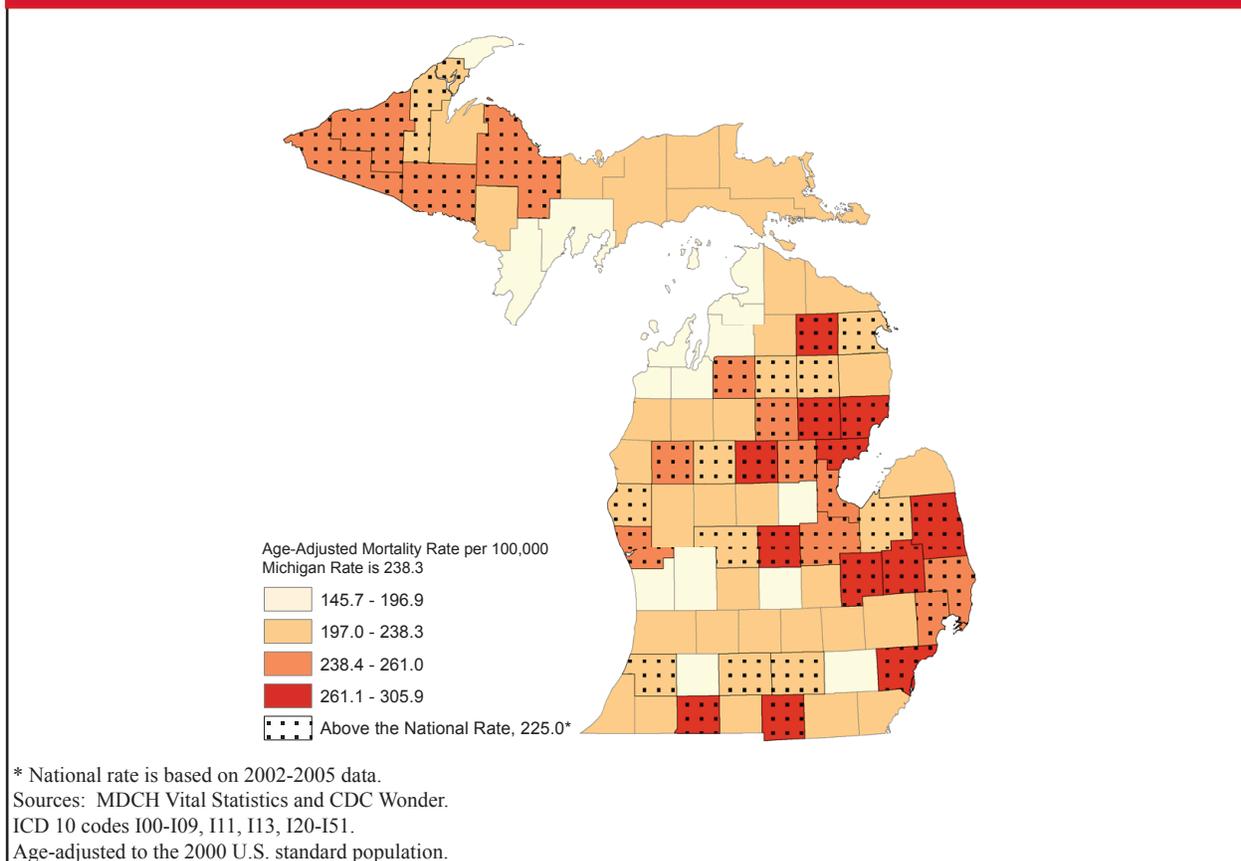


Impact of Heart Disease and Stroke in Michigan



The five-year age-adjusted state rate for heart disease mortality (238.3 per 100,000) was above the national rate (225.0 per 100,000). Twenty-six Michigan counties exceeded the state rate and an additional eleven exceeded the national rate, Map 10. The county with the highest age-adjusted heart disease mortality rate was Wayne, 305.9 per 100,000, followed by Ogemaw, 303.4 per 100,000. Leelanau had the lowest rate, 145.7 per 100,000. See Appendix J for a complete listing of age-adjusted rates and number of deaths by county.

Map 10. Age-adjusted five-year mortality rates for heart disease by county, 2002 to 2006





Coronary Heart Disease

What is coronary heart disease and why is it important?

Coronary heart disease (CHD), also called coronary artery disease and ischemic heart disease, is a condition in which the flow of blood to the heart muscle is reduced. Like any muscle, the heart needs a constant supply of oxygen and nutrients that are carried by the blood in the coronary arteries. When the coronary arteries become narrowed or clogged, they cannot supply enough blood to the heart. The reduced oxygen supply weakens the heart muscle, and it may not work as effectively. The heart may respond to the lack of oxygen with pain, called angina. The pain is usually felt in the left arm or shoulder. When the blood supply is cut off completely, the result is a heart attack. The part of the heart muscle that does not receive oxygen begins to die, and some of the heart muscle is permanently damaged. The damaged heart is less effective at pumping blood, and over time it decompensates, leading to heart failure. CHD can be prevented by controlling risk factors and identifying and treating them early.^{12,13}

In 2005, the prevalence of CHD in the United States was estimated at 16 million (8.7 million men and 7.3 million women). CHD is the largest major killer of males and females. Fifty percent of men and 64% of women who died suddenly of CHD had no previous symptoms of disease. An additional 770,000 people are projected to have a new coronary event this year. CHD caused one of every five deaths in the U.S. in 2004. About 38% of people who experience a coronary attack in a given year will die from it. In 2008, the cost of CHD is projected to be \$156.4 billion.¹

What is the scope of the problem?

Prevalence

In 2007, 6.8% of adults 35 years and older reported they had been told by a physician that they had a heart attack. The lifetime prevalence of heart attack increased with age, from 3.9% of those aged 35 to 64 to 16.0% of those age 65 and older. A higher percentage of males (8.8%) than females (4.9%) reported the event. Whites (6.3%) and blacks (7.7%) reported the lowest prevalence of heart attack followed by other races (12.6%).

Almost seven percent of adults 35 or older had ever been told by a physician that they had angina or coronary heart disease in 2007. Prevalence increased with age from 4.1% of adults 35 to 64 years to 16.2% of adults 65 and older. Prevalence was also higher in males (8.5%) than females (5.5%).

Awareness of Risk Factors and Warning Signs

Questions regarding public awareness of heart attack risk factors and warning signs were asked on the 2004 Michigan Behavioral Risk Factor Survey. Most commonly reported risk factors were overweight/obesity (38.8%), diet (37.3%), smoking (35.4%), physical inactivity (31.3%), high cholesterol (25.1%) and hypertension (22.6%). Most commonly reported warning signs were pain or discomfort in the chest (78.0%), shortness of breath (39.3%), pain or discomfort in other upper body areas (38.6%), and other signs such as light-headedness, sweating, or nausea (23.2%).

Impact of Heart Disease and Stroke in Michigan



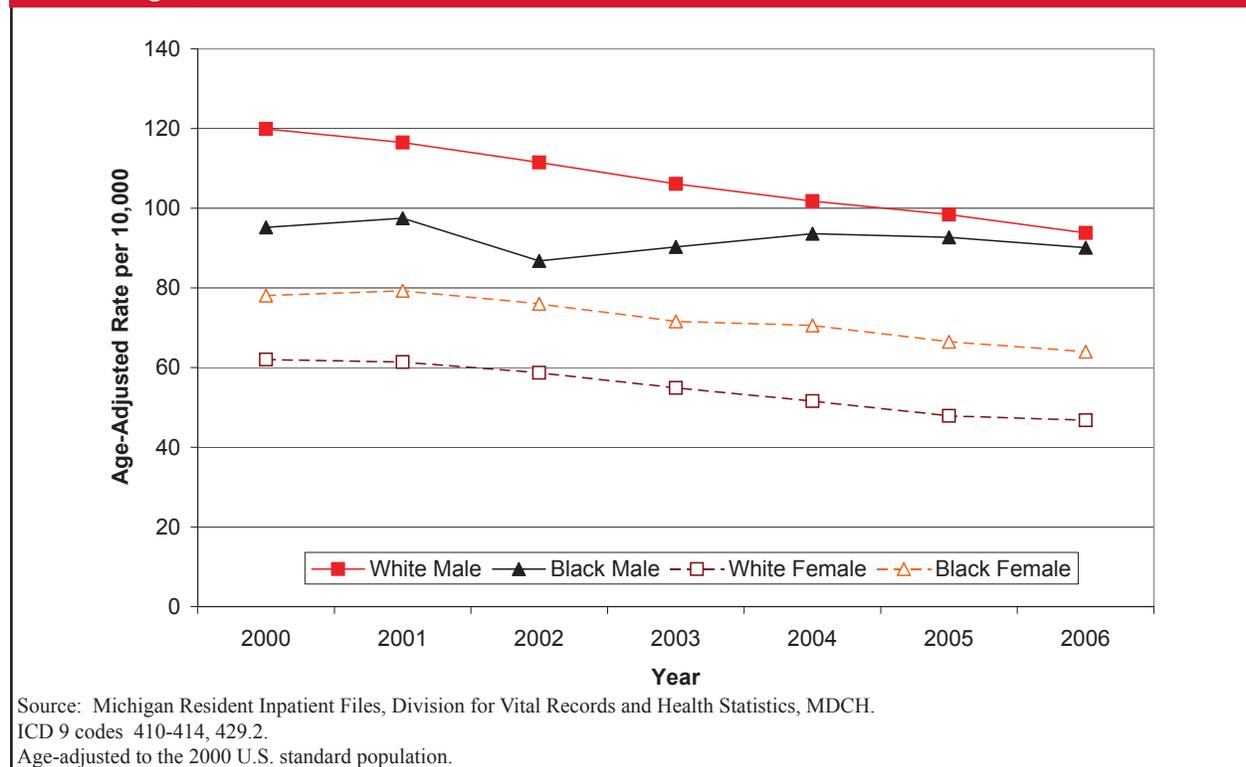
Nearly half (48.4%) of Michigan adults were aware of at least three correct risk factors for heart attack and 26.6% were aware of at least three warning signs. Less than 10% were not able to recall any heart attack risk factors (9.5%) or warning signs (8.4%). There were significant disparities in knowledge of heart attack risk factors and warning signs by race, with lower proportions of blacks compared with whites reporting three correct risk factors (24.3% vs. 52.6%) or three correct warning signs (13.8% vs. 29.3%).

Hospitalizations

Almost half of the heart disease hospitalizations in Michigan in 2006 were due to coronary heart disease, approximately 74,000 of the 164,696 heart disease hospitalizations. The United States saw the same coronary heart disease to heart disease ratio in 2006, causing almost two million hospital discharges from coronary heart disease.

Age-adjusted hospitalization rates for coronary heart disease in Michigan have declined, from 88.5 per 10,000 in 2000 to 69.4 per 10,000 in 2006. All of the race and gender groups experienced this decline except for rates among black males which began to increase in 2003, Figure 18. White females experienced the largest decline, 24.5%, and black males had the least change, a 5.4% decrease.

Figure 18. Age-adjusted hospitalization rates by race and gender for coronary heart disease for Michigan, 2000 to 2006

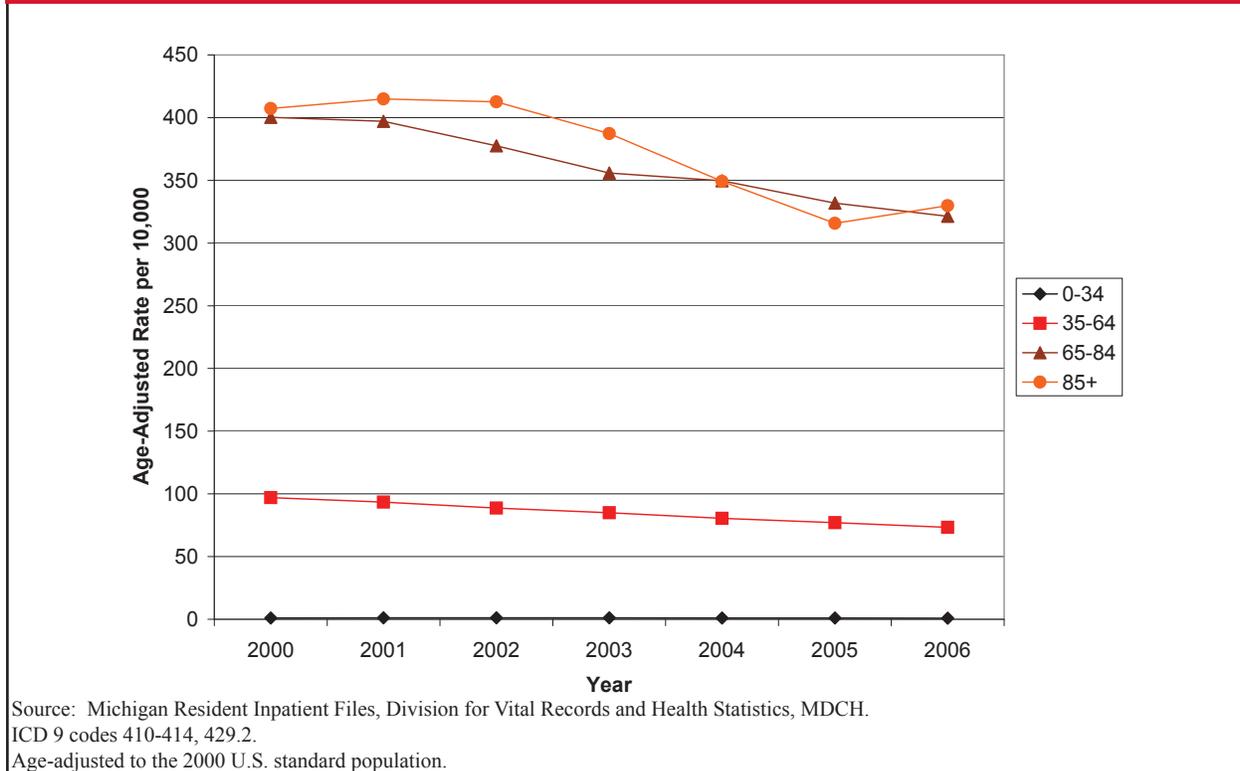


Impact of Heart Disease and Stroke in Michigan



Unlike the other disease age-adjusted hospitalization rates, the two oldest groups, 65 to 84 years and 85 years and above have similar rates. In 2004 and 2005, the 65 to 84 age group actually had a higher age-adjusted rate than the 85 and older group, Figure 19. Each of the age groups did see a decrease in the seven year period from 2000 to 2006.

Figure 19. Age-adjusted hospitalization rates by age for coronary heart disease for Michigan, 2000 to 2006

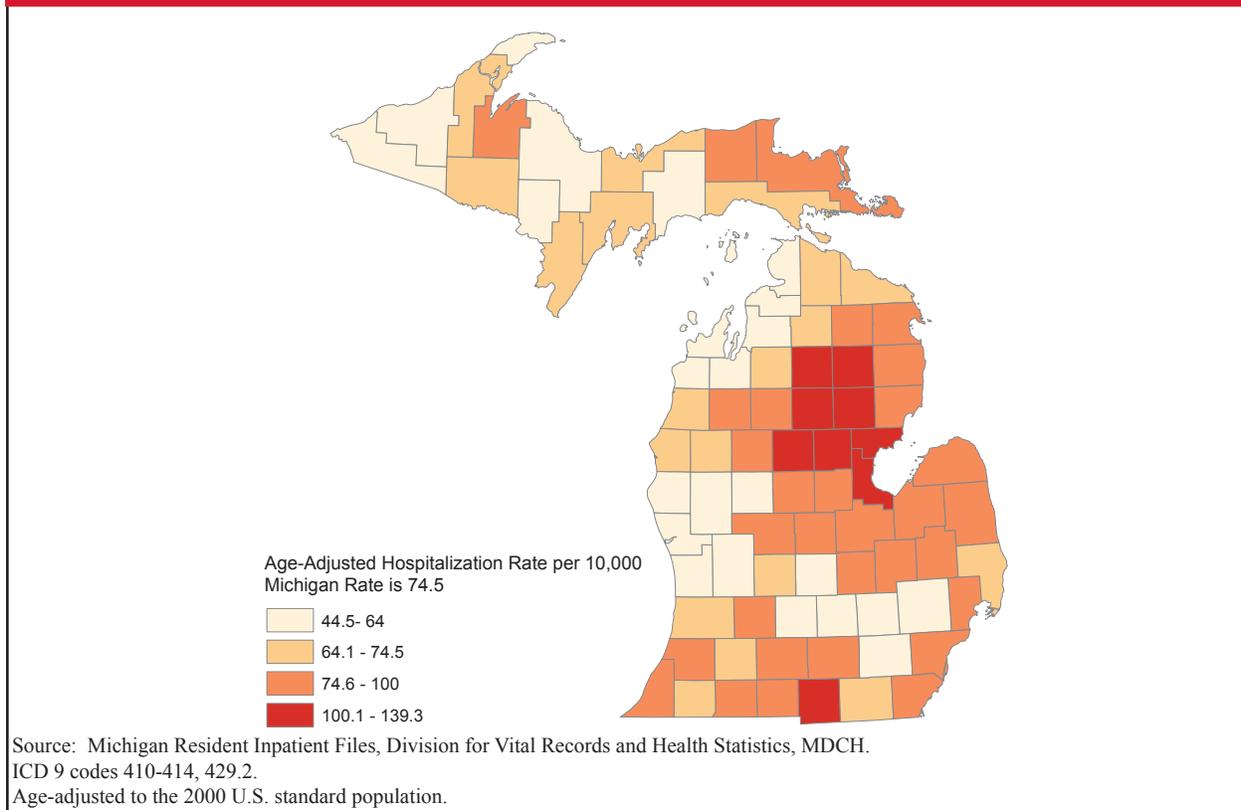


Impact of Heart Disease and Stroke in Michigan



The five-year age-adjusted hospitalization rate for Michigan for coronary heart disease was 74.5 per 10,000. There were 40 counties in Michigan that had higher rates than the state rate, Map 11. The highest rate was 139.3 per 10,000 in Arenac county. Eight of the nine counties with the highest rate were clustered in the same area. The lowest rate was 44.5 per 10,000 in Leelanau. See Appendix K for a complete listing of age-adjusted rates by county.

Map 11. Age-adjusted five-year hospitalization rates for coronary heart disease by county, 2002 to 2006



Impact of Heart Disease and Stroke in Michigan



Quality Improvement

In 2006, Michigan was ranked as the top state to provide beta-blocker treatment to its Medicaid recipients. Almost 97% of Medicaid members, 35 years of age and older, that were hospitalized and discharged after surviving a heart attack, received a prescription for beta-blockers upon discharge.¹⁶

Michigan was an early leader in the application of quality improvement strategies in the area of myocardial infarction. Three projects conducted between the years 2000 and 2003 in the American College of Cardiology's (ACC) Acute Myocardial Infarction Guidelines Applied in Practice (GAP) project compared the care given to 1,892 heart attack patients treated at the 33 hospitals before the studies began, and 2,065 heart attack patients treated while the system was in place. The study measured use of aspirin, beta blockers and ACE inhibitors early and late in a patient's care, cholesterol tests and cholesterol-lowering drugs, and counseling on diet and smoking cessation.¹⁷ All hospitals were offered a toolkit of reminders, checklists, stickers, standard orders, reference cards and educational materials that made it easier for doctors, nurses and patients to follow the ACC's guidelines.

Results showed that hospitals consistently using the standardized order set and discharge document demonstrated larger gains. Use of aspirin and beta blockers early in a patient's hospital stay increased 6.6% and 5.6%, respectively. Pre-discharge prescriptions for the same drugs rose 12.4% and 6.3%, respectively. There was also a 7.7% increase in prescriptions for ACE inhibitor drugs given before patients went home. A nine percent jump in cholesterol tests was also seen, and prescriptions for cholesterol-lowering drugs increased by 14.3%. Next, the biggest gains were in the area of diet and smoking cessation counseling. The proportion of patients who got advice about stopping smoking increased 34.8% and the percentage who saw a dietitian or nutritionist before they went home increased 21.6%.¹⁷ These improvements are commendable, but demonstrate challenges in informing patients of lifestyle changes.

None of the therapies were used in 100 percent of patients. The highest percentage achieved was 94%, for pre-discharge aspirin. Statistically significant increases were seen in all of the indicators when the standardized order set and discharge document were used.¹⁷

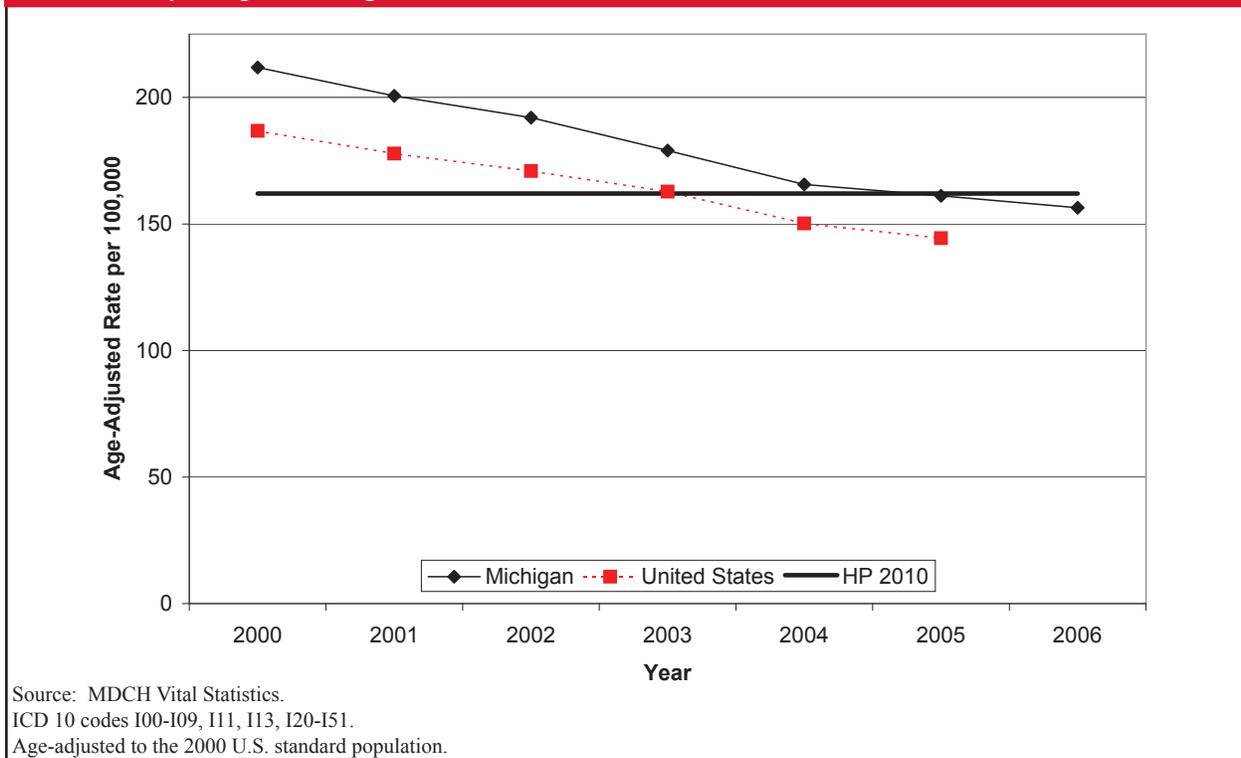
Impact of Heart Disease and Stroke in Michigan



Mortality

Michigan is above the national age-adjusted mortality rate for coronary heart disease. Michigan has seen a 26.2% decrease in the age-adjusted rate from 2000. However, as of 2004 Michigan had the 8th worst age-adjusted mortality rate for coronary heart disease in the United States.¹ A *Healthy People 2010* (HP 2010) target was set for age-adjusted mortality rates for coronary heart disease (162 per 100,000). Michigan reached the goal in 2005 and has continued to surpass it, Figure 20. The United States passed the HP 2010 target a year before Michigan.¹⁸

Figure 20. Age-adjusted mortality rates for coronary heart disease for Michigan compared with *Healthy People 2010* goals, 2000 to 2006

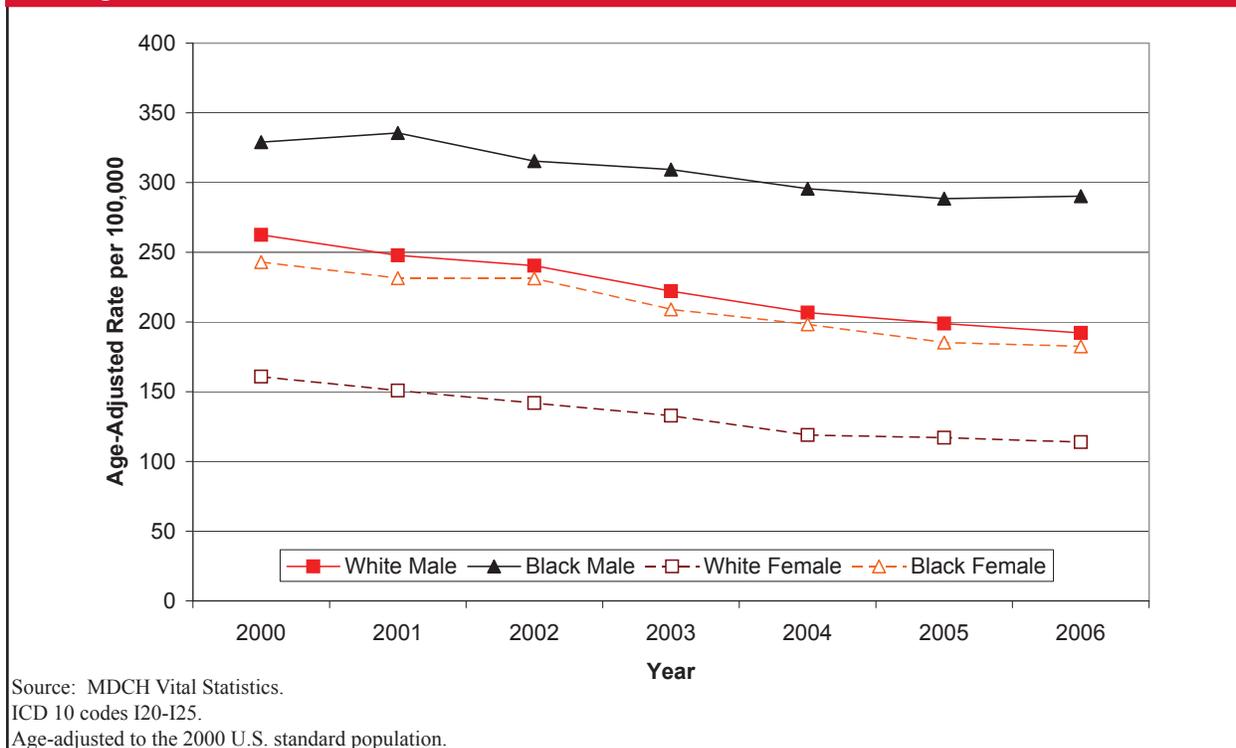


Impact of Heart Disease and Stroke in Michigan



White males have a slightly higher age-adjusted mortality rate than black females for coronary heart disease. Black males (398.1 per 100,000) had the highest rate and white females the lowest (173.9 per 100,000). These groups also saw a decrease in rates from 2000 to 2006 for coronary heart disease, Figure 21.

Figure 21. Age-adjusted mortality rates by race and gender for coronary heart disease for Michigan, 2000 to 2006

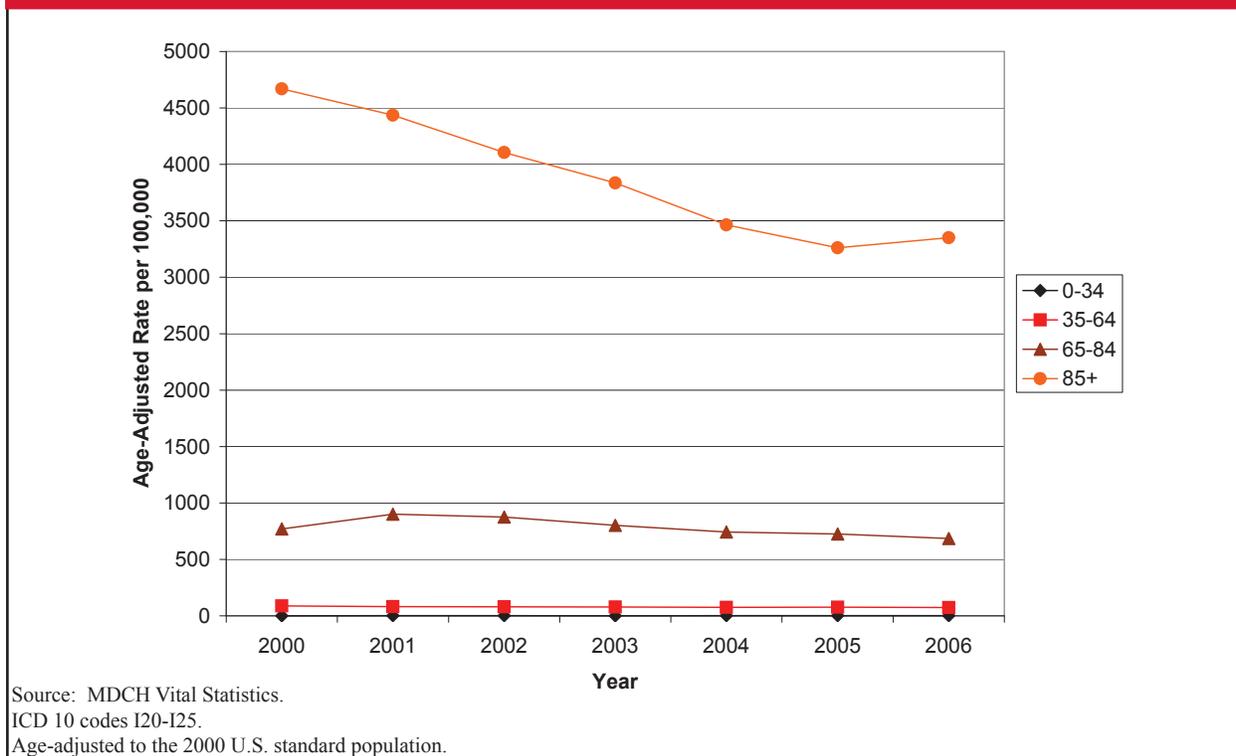


Impact of Heart Disease and Stroke in Michigan



The age group of 85 years and higher had the largest decrease in age-adjusted coronary heart disease mortality rates, a 28.3% decrease, Figure 22. In 2000, they had a rate of 4,670 per 100,000 which decreased to 3,350 per 100,000 in 2006. From 2005 to 2006 they began to see a slight increase. The second largest decrease in mortality rates came from the 35 to 64 year group, a 16.8% decrease.

Figure 22. Age-adjusted mortality rates by age for coronary heart disease for Michigan, 2000 to 2006

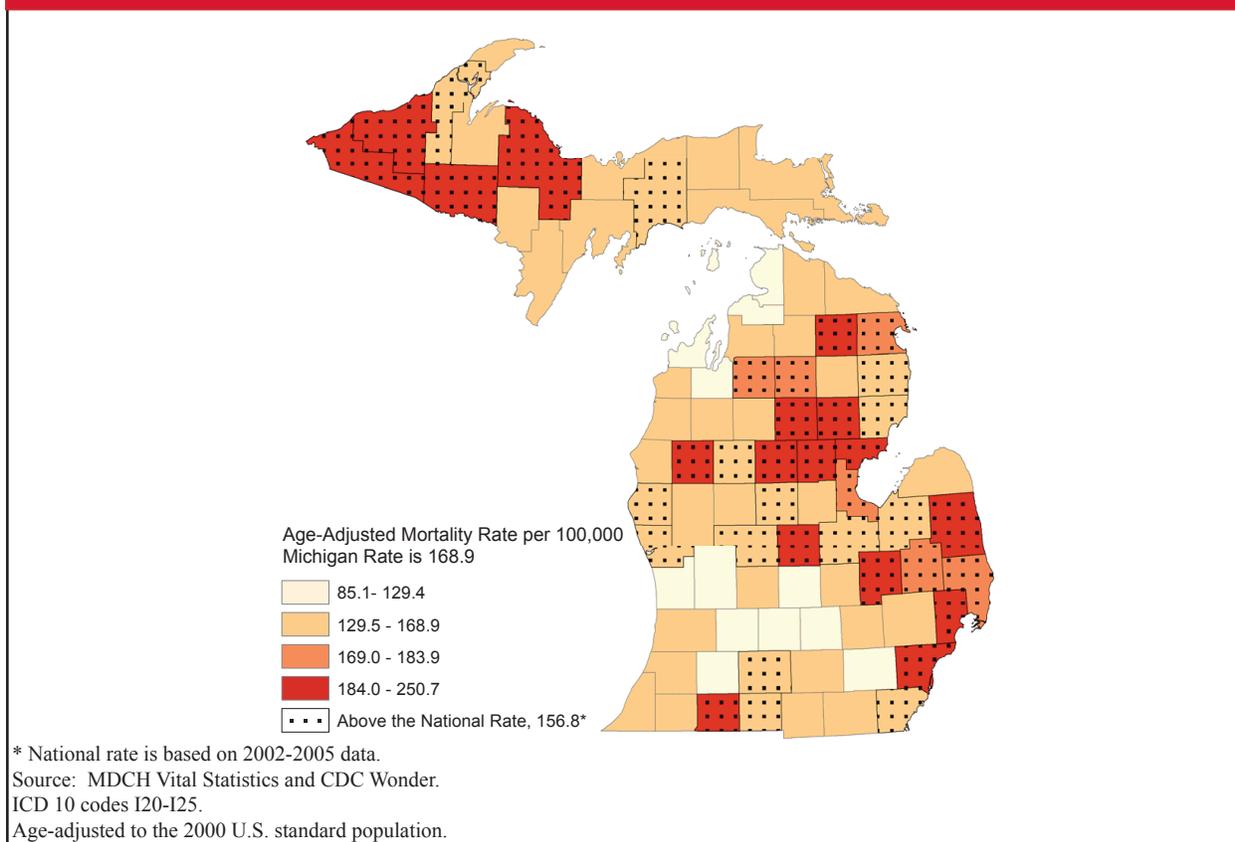


Impact of Heart Disease and Stroke in Michigan



The five-year age-adjusted mortality rate for coronary heart disease in Michigan is 168.9 per 100,000. This is above the national rate of 156.8 per 100,000 for 2002 to 2005. Leelanau (85.1 per 100,000), Ottawa (104.4 per 100,000) and Emmet counties (118.5 per 100,000) had the lowest age-adjusted rates. There were 24 counties above the Michigan rate and an additional 14 below the state rate but above the national rate, Map 12. The county with the highest age-adjusted mortality rate in Michigan was Baraga with a rate of 250.7 per 100,000. The Upper Peninsula had four counties that were among the highest in Michigan. A list of the county rates can be seen in Appendix L.

Map 12. Age-adjusted five-year mortality rates for coronary heart disease by county, 2002 to 2006





Heart Failure

What is heart failure and why is it important?

Heart failure, also called congestive heart failure or chronic heart failure, is a life-threatening condition in which the heart can no longer pump enough blood to the rest of the body. Heart failure does not mean that the heart has stopped, but that it cannot pump blood the way it should.¹²

Heart failure can result from narrowed arteries that supply blood to the heart muscle and from other factors. As the flow of blood out of the heart slows, blood returning to the heart through the veins backs up, causing congestion in the tissues. Often swelling results, most commonly in the legs and ankles. Sometimes fluid collects in the lungs and interferes with breathing, causing shortness of breath, especially when a person is lying down.¹²

The prevalence of heart failure in 2005 was 5.4 million in the United States (2.7 million males and 2.7 million females). It is estimated that 75% of heart failure cases have a history of hypertension. The lifetime risk for heart failure of a person with blood pressure greater than 160/90 mmHg is double compared to a person with blood pressure less than 140/90 mmHg. In 2004, heart failure was listed as the underlying cause of death for 57,120 Americans. The cost of heart failure in the United States is estimated to total \$34.8 billion in 2008.¹

What is the scope of the problem?

Hospitalization

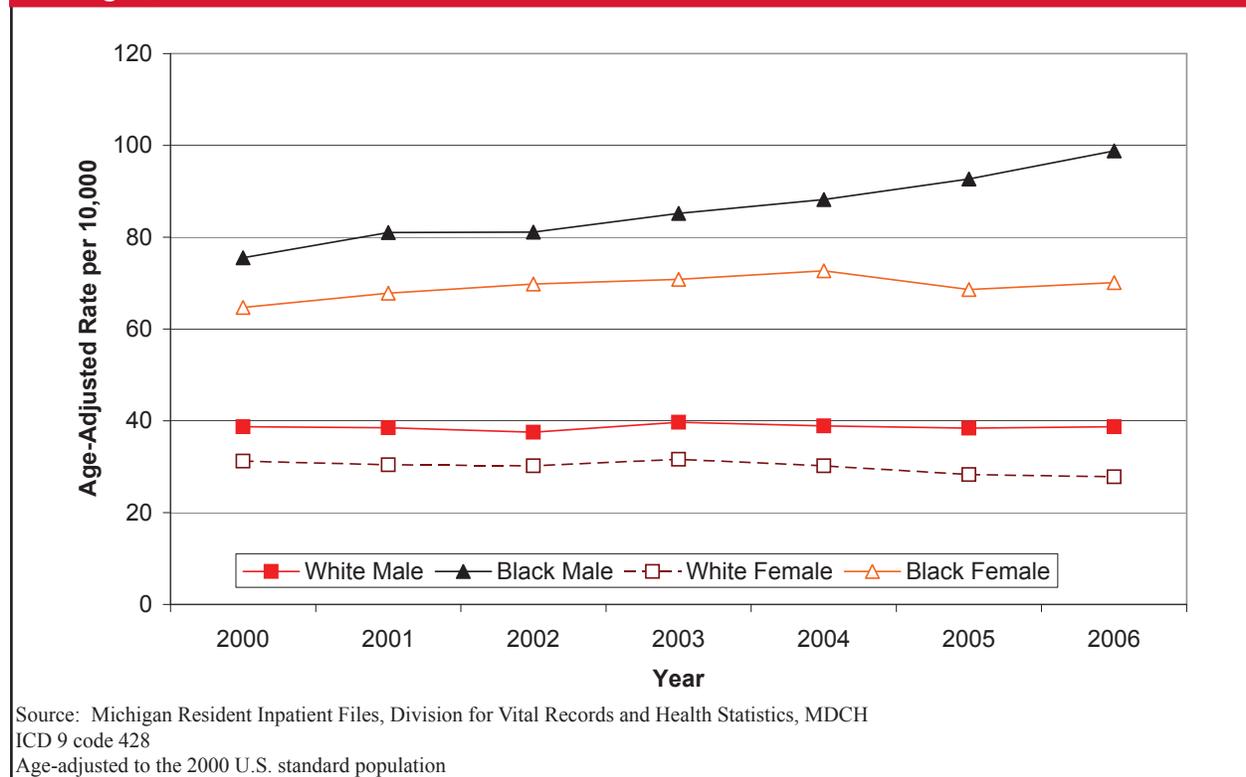
Michigan had 40,603 hospital discharges due to heart failure in 2006, while the United States had over one million. The majority of heart failure hospitalizations were among females (50.5%) (males 49.5%) in Michigan. This was the same for the United States (51.0% and 49.0%, respectively). Over 53% of the discharged were sent home, 22.6% were transferred to a home under health care services and 13.1% were released to a skilled nursing facility. An additional 2.8% or 1,154 discharges were in-hospital deaths.

Impact of Heart Disease and Stroke in Michigan



Black males (98.8 per 10,000), followed by black females (70.1 per 10,000), had the highest age-adjusted hospitalization rate for heart failure. White females (27.8 per 10,000) and white males (38.7 per 10,000) had the lowest rates. White females were the only group to experience a decrease in the seven year period, Figure 23. Black males and black females increased from 2000 to 2006 and white males started in 2000 and ended in 2006 with the same rate.

Figure 23. Age-adjusted hospitalization rates by race and gender for heart failure for Michigan, 2000 to 2006

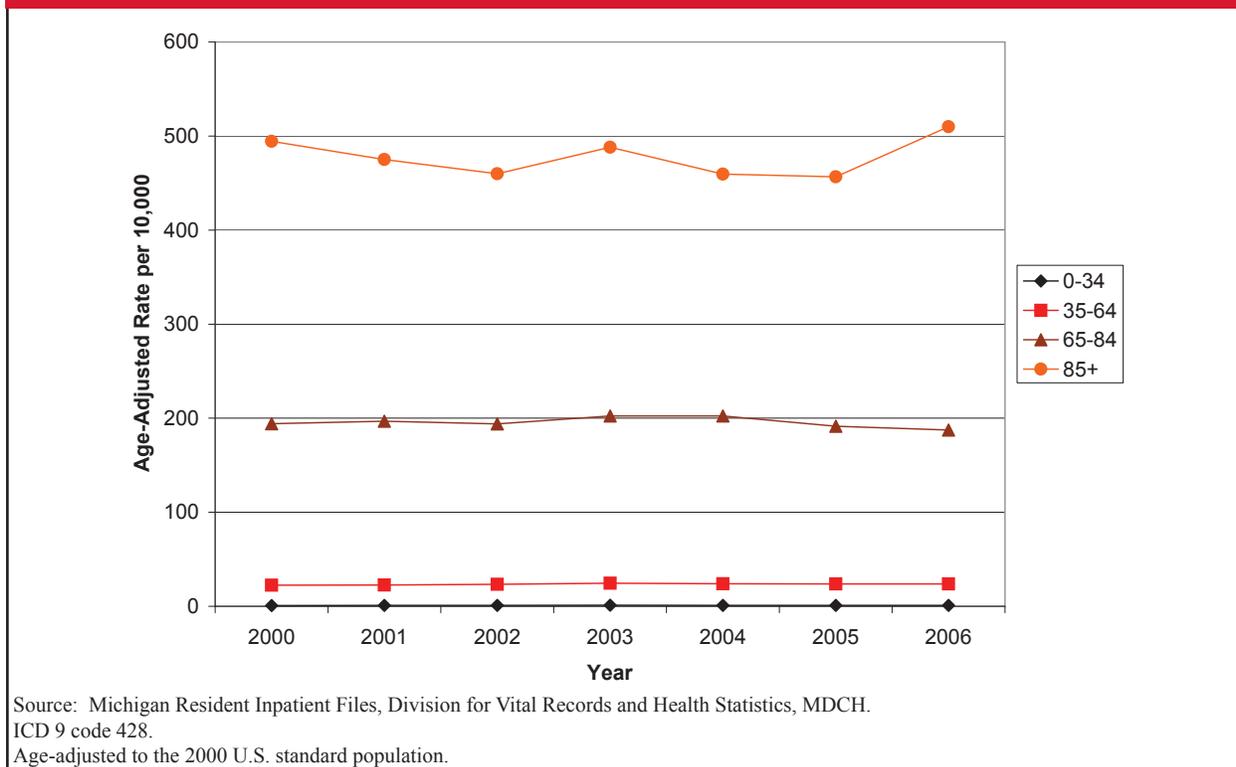


Impact of Heart Disease and Stroke in Michigan



The age group 0 to 34 years had the lowest age-adjusted hospitalization rate (1.0 per 10,000) and the age group 85 years of age and above had the highest (509.9 per 10,000). Rates for adults 65-84 years of age did not increase; all other age groups had very modest increases in rates from 2000 to 2006, Figure 24.

Figure 24. Age-adjusted hospitalization rates by age for heart failure for Michigan, 2000 to 2006

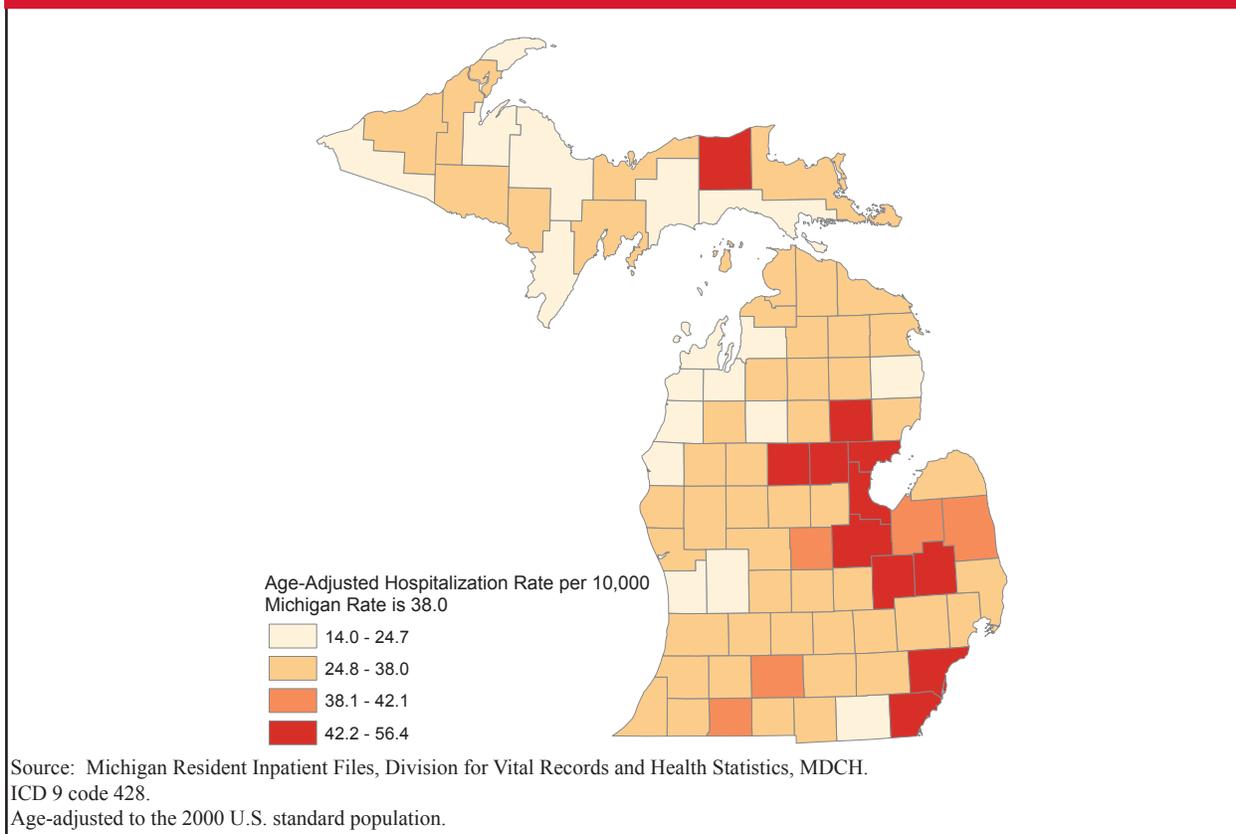


Impact of Heart Disease and Stroke in Michigan



Heart failure in Michigan had an age-adjusted rate of 38.0 per 10,000 for 2002 to 2006. There were 16 counties that had rates that were above this, including Wayne (56.4 per 10,000), Arenac (53.8 per 10,000) and Gladwin (53.7 per 10,000) that had the highest rates in Michigan, Map 13. The lowest rates were found in Leelanau (14.0 per 10,000) and Keweenaw (16.2 per 10,000). See Appendix M for a listing of the county rates.

Map 13. Age-adjusted five-year hospitalization rates for heart failure by county, 2002 to 2006



Impact of Heart Disease and Stroke in Michigan



Quality Improvement

Get With the Guidelines (GWTG)SM is a hospital data reporting and quality improvement program developed by the American Heart Association (AHA) in 2000. AHA has three different GWTGSM modules: Stroke, Heart Failure and Coronary Heart Disease. Each module emphasizes data reporting and use of a team approach to implement evidence-based treatment and discharge guidelines in acute care hospitals.¹⁹ Nationally, more than 1,400 hospitals have participated, reaching over one million patients.¹ The Michigan Department of Community Health started supporting hospital involvement in GWTGSM-Heart Failure in 2006, and in 2008 eleven GWTGSM-Heart Failure mini-grants were awarded in Michigan to reduce readmissions and improve the management of heart failure risk factors post-discharge.

In 2006, 35,576 patients were admitted to 231 GWTGSM-Heart Failure hospitals nationally. The GWTGSM-Heart Failure program has six performance indicators for quality care and 2006 national data are presented in Figure 25.¹

Figure 25. Get with the Guidelines (GWTG)SM-Heart Failure performance indicators for the United States, 2006

Performance indicator	Percent of inpatients
Complete set of discharge instructions*	79
Measure of LV function*	94
ACE or ARB at discharge for patients with LVSD, no contraindications*	86
Smoking cessation counseling, current smokers*	91
Beta blockers at discharge for patients with LVSD, no contraindications	89
Anticoagulation for atrial fibrillation or atrial flutter, no contraindications	67
Composite quality-of-care measure	88

* Indicates one of the five key performance measures targeted in GWTGSM-HF. Mechanical ventilation was required in 1.8 percent of patients. In-hospital mortality was 3.2 percent, and mean length of hospital stay was 6.6 days (median 5.0 days).
 LVSD: left ventricular systolic dysfunction.
 ACE: angiotensin-converting enzyme.
 ARB: angiotensin receptor blocker.

Source: American Heart Association, Heart Disease and Stroke Statistics, 2008.

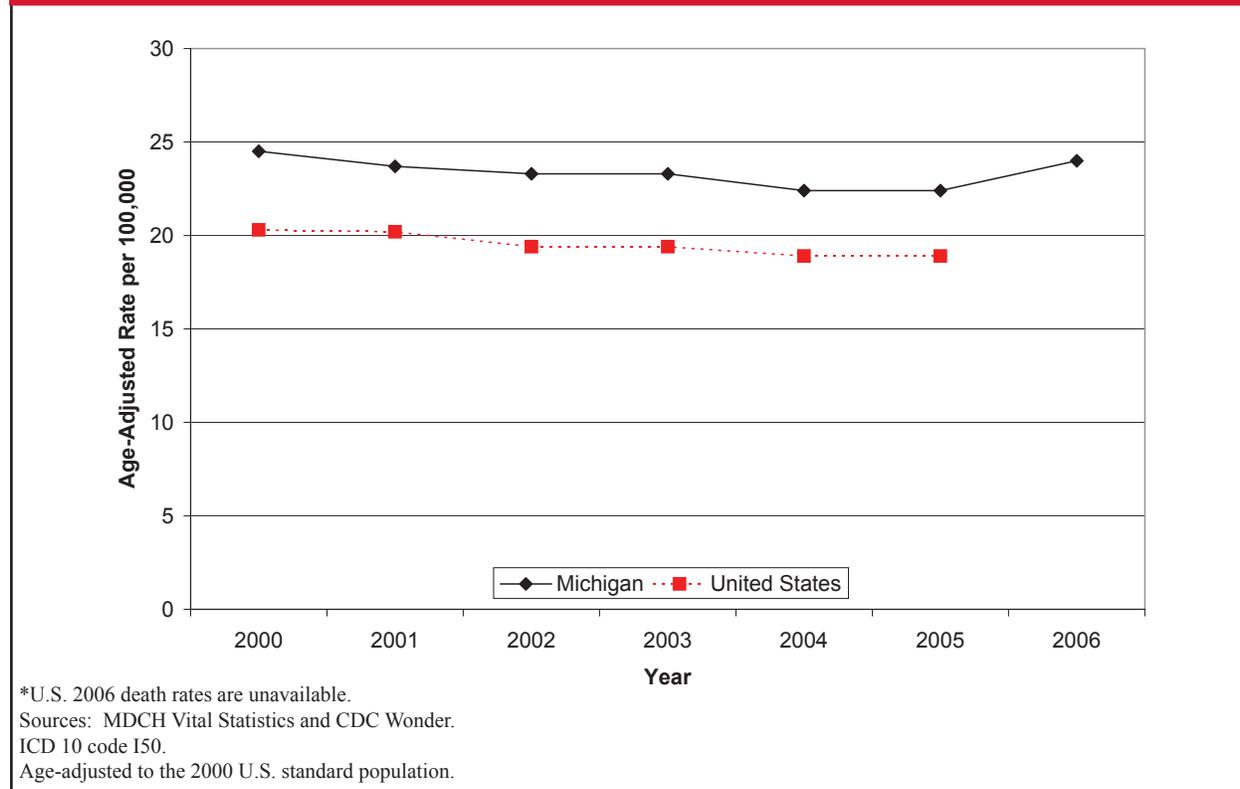
Impact of Heart Disease and Stroke in Michigan



Mortality

The state rate for age-adjusted mortality for heart failure was consistently above the national rate from 2000 to 2006. The rate for Michigan decreased slightly from 24.5 per 100,000 in 2000 to 2004. In 2005, it started to increase again from 22.4 per 100,000 in 2005 to 24.0 per 100,000 in 2006. The United States rate was at 18.9 per 100,000 in 2005, Figure 26.

Figure 26. Age-adjusted mortality rates for heart failure for Michigan and United States,* 2000 to 2006

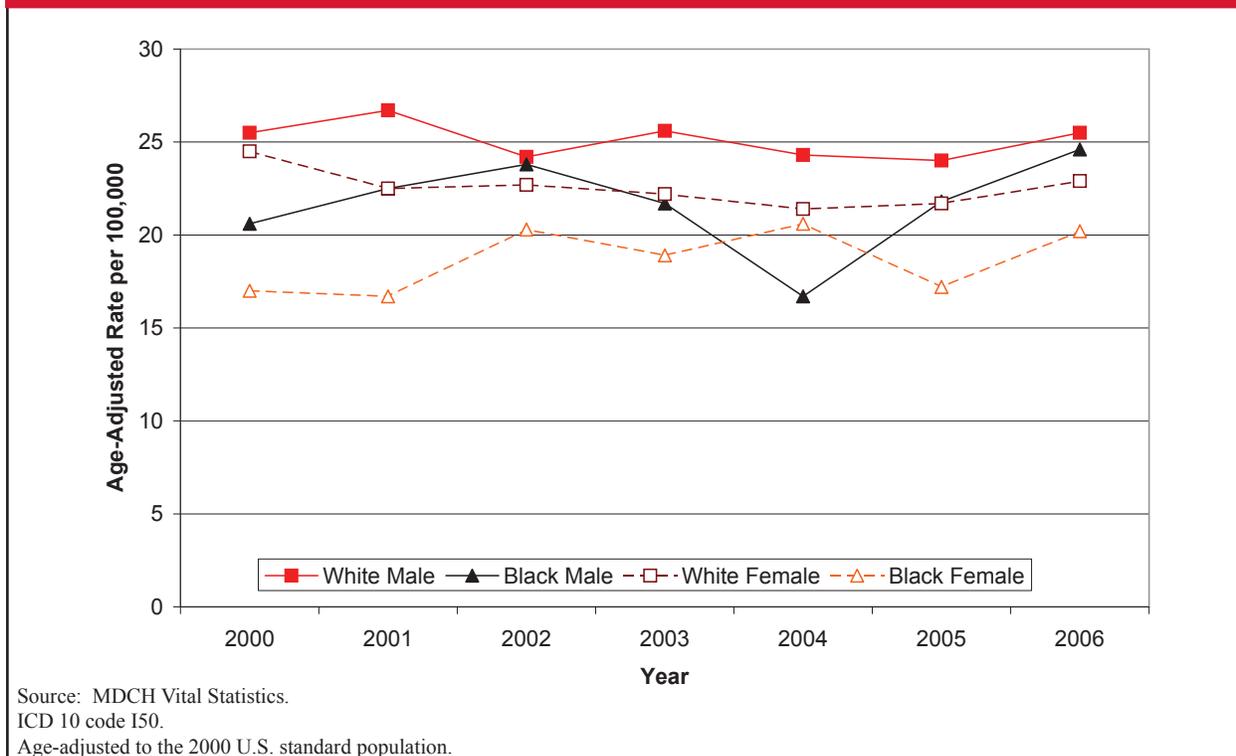


Impact of Heart Disease and Stroke in Michigan



White males have the highest age-adjusted mortality rates for heart failure (25.5 per 100,000). Black males experienced a downward trend from 20.6 per 100,000 in 2000 to a low of 16.7 per 100,000 in 2004. However, this rate rose to 24.6 per 100,000 by 2006, Figure 27.

Figure 27. Age-adjusted mortality rates by race and gender for heart failure for Michigan, 2000 to 2006

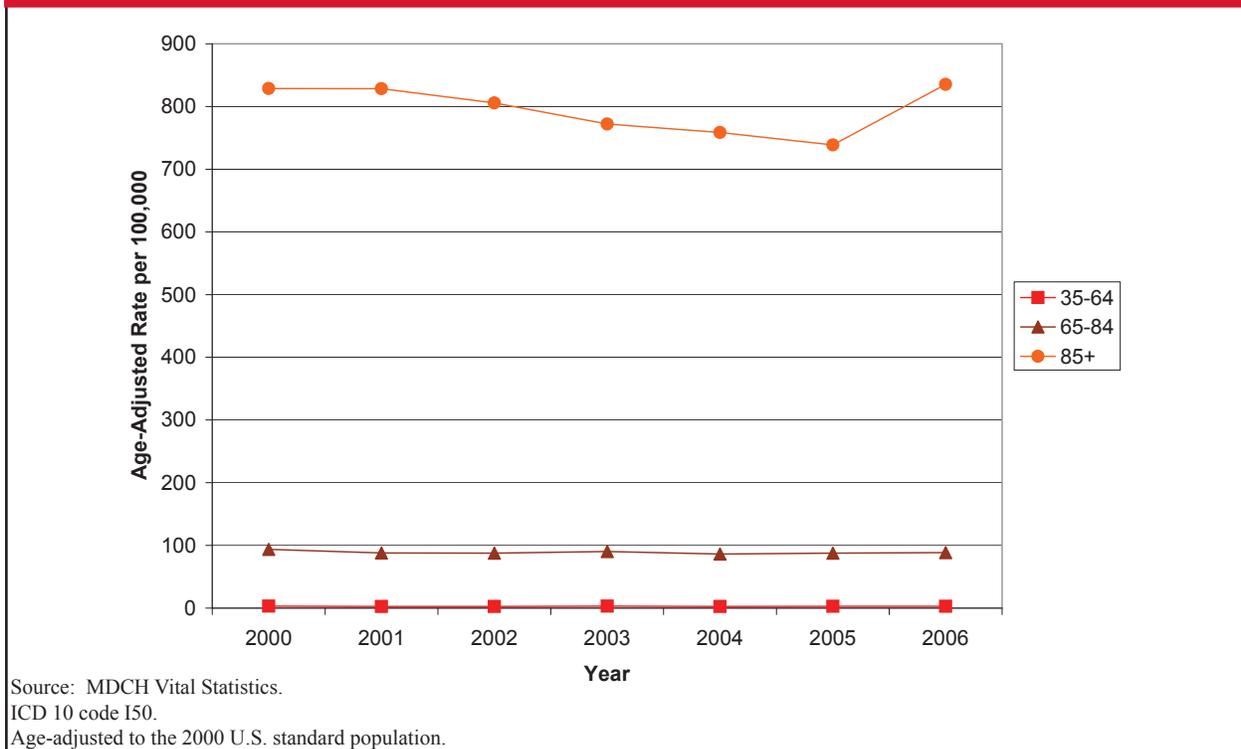


Impact of Heart Disease and Stroke in Michigan



The age group 0 to 34 years had insufficient data (less than 20 deaths) to calculate a rate. The age group 85 years and above declined from 828.7 per 100,000 in 2000 to 738.8 per 100,000 in 2005. However, their mortality rate jumped 13.1% to 835.4 per 100,000 in 2006, above what the rate was in 2000. The lowest rate was 3.0 per 100,000 for 35 to 64 year age group, Figure 28.

Figure 28. Age-adjusted mortality rates by age for heart failure for Michigan, 2000 to 2006

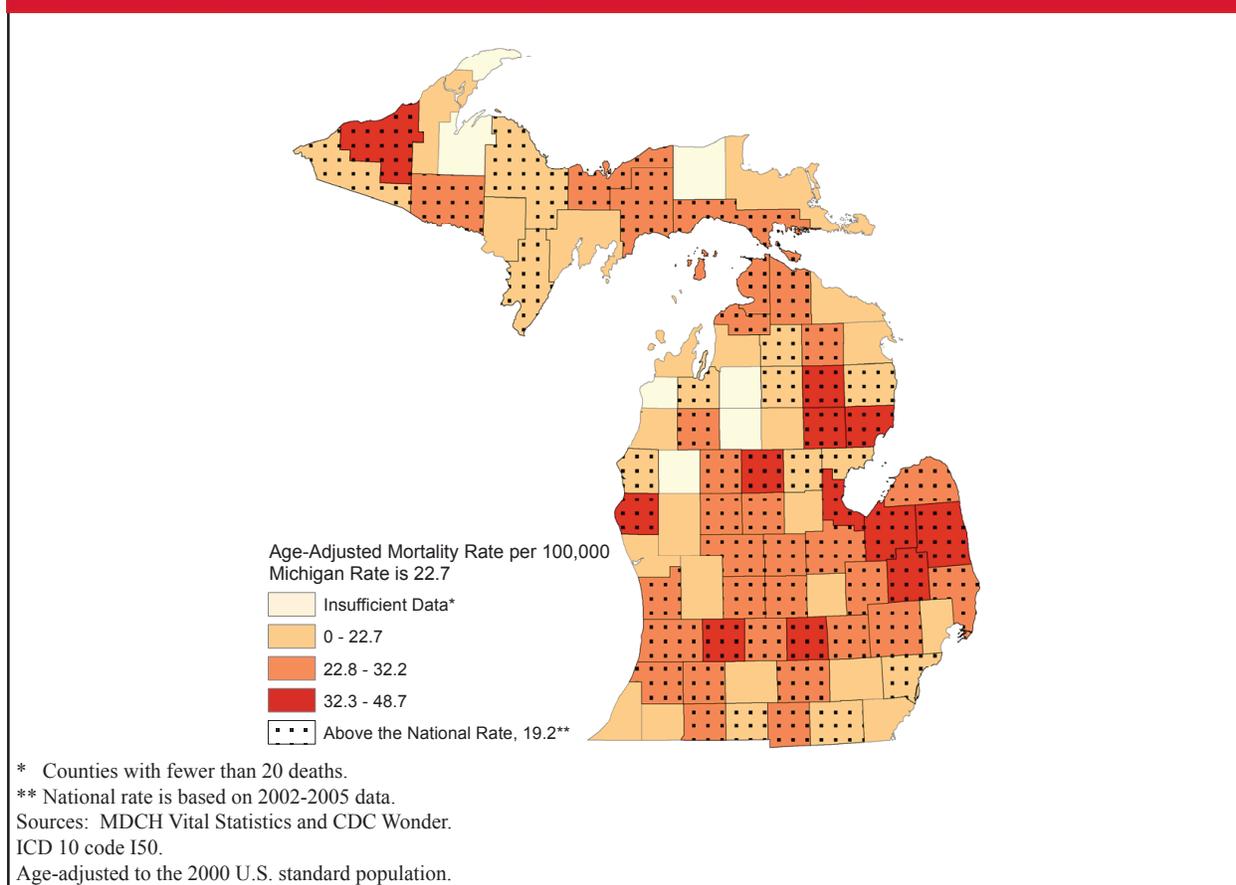


Impact of Heart Disease and Stroke in Michigan



Seven counties had fewer than 20 heart failure deaths during 2002 to 2006; consequently, rates were not calculated for them. Over 72% of the counties in Michigan (55 counties) were above the national age-adjusted heart failure mortality rate (19.2 per 100,000). Of those 55 counties, 42 of them were also above the state rate (22.7 per 100,000). Houghton (9.4 per 100,000) had the lowest rate and Midland and Muskegon were tied for the second lowest rate (12.6 per 100,000), Map 14. Sanilac had the highest county rate in Michigan, 48.7 per 100,000. Appendix N has a listing of all the counties and their corresponding rates.

Map 14. Age-adjusted five-year mortality rates for heart failure by county, 2002 to 2006





Stroke

What is stroke and why is it important?

Stroke is a form of cerebrovascular disease that affects the arteries of the central nervous system. The main types of stroke are ischemic and hemorrhagic. *Ischemic stroke* accounts for 83% of all cases. It occurs as a result of an obstruction within a blood vessel supplying blood to the brain. The underlying condition for this type of obstruction is the development of fatty deposits lining the vessel walls (in brain or elsewhere in the body) that results in a blood clot forming in the brain or a clot breaking off from elsewhere lodging in a brain vessel. *Hemorrhagic stroke* accounts for approximately 17% of stroke cases. It results from a weakened vessel that ruptures and bleeds into the surrounding brain. The blood accumulates and compresses the surrounding brain tissue. As a result of these ruptures or blockages, part of the brain does not get the flow of blood it needs. Deprived of oxygen, nerve cells in the affected area of the brain cannot function and die within minutes.²⁰ The typical patient loses 1.9 million neurons each minute stroke is left untreated.²¹ When nerve cells cannot function, the part of the body controlled by these cells cannot function either.

Transient ischemic attacks, commonly referred to as TIAs, are characterized by a short duration of stroke symptoms that resolve within 24 hours. Even though the symptoms disappear after a short time, TIAs are a strong indicator of a possible future stroke, especially over the short-term (days to weeks).²⁰ Fifteen percent of strokes are preceded by a TIA. After the occurrence of a TIA the 90-day risk of stroke increases from three to 17.3 percent and within a year up to one-quarter of the TIA patients will die.¹

Each year in the United States, approximately 700,000 people experience a new or recurrent stroke. More women (approximately 46,000 more) have strokes each year compared to men. In 2004, women accounted for 61% of stroke deaths. In 2004, stroke accounted for one in every 16 deaths in the United States. It is currently the third leading cause of death in the United States and Michigan. In 2007, stroke cost the United States \$62.7 billion from direct and indirect costs. Stroke is the leading cause of serious and long-term disability in the United States.¹

What is the scope of the problem?

Prevalence

Over three percent of Michigan adults age 35 years and older reported that a physician told them they had a stroke. This is equivalent to over 180,000 adults in Michigan. The prevalence of stroke increased with age from 1.81% among adults 35 to 64 years of age to 8.7% in those 65 and older. Stroke is more prevalent in blacks (6.8%) than whites (2.9%) or other races (3.9%). A higher percentage of females reported having had a stroke than males, 3.8% and 3.1% respectively.

Impact of Heart Disease and Stroke in Michigan



Awareness of Risk Factors and Warning Signs

It is important to recognize symptoms of a stroke quickly since the ischemic brain ages 3.6 years each hour without treatment.²¹ To gain an understanding of the public's awareness of stroke risk factors and warning signs, open-ended questions were included in the 2004 Michigan Behavioral Risk Factor Survey (BRFS). Respondents were asked to list up to three risk factors and three warning signs. The risk factors most commonly reported were hypertension (32.8%), diet (27.0%), smoking (26.8%), overweight/obesity (19.4%), and physical inactivity (18.5%). The most commonly reported stroke warning signs were weakness or numbness (65.6%), confusion, trouble speaking or understanding speech (46.5%), and trouble seeing (23.3%). Only 15.2% and 10.2%, respectively, reported trouble with walking, dizziness or balance or severe headache as warning signs of a stroke. Twenty-nine percent of Michigan adults were able to name at least three correct risk factors for stroke and 27.6% were able to name at least three warning signs. However, 21.5% were not able to recall any stroke risk factors and 17.7% could not recall any warning signs. There were significant disparities in knowledge of stroke risk factors and warning signs by race, with lower proportions of blacks compared with whites reporting three correct risk factors (13.8% vs. 31.6%) and three correct warning signs (17.2% vs. 30.0%).

In 2007, adults were asked the CDC closed-ended version of stroke knowledge questions. The adults were told six warning signs and asked if they were or were not correct warning signs for stroke. Figure 29 lists the warning signs asked and the percentage correctly answered. Five of the six warning signs were correct. The latter was a warning sign for heart attack.

Figure 29. Prevalence of correct and incorrect responses to stroke warning signs by adults, 18 and over, in Michigan, 2007

Warning Sign	% correct	% incorrect
Sudden confusion or trouble speaking	89.8	10.2
Sudden numbness or weakness of face, arm, or leg, especially on one side	95.4	4.6
Sudden trouble seeing in one or both eyes	72.7	27.3
Sudden trouble walking, dizziness, or loss of balance	87.5	12.5
Severe headache with no known cause	56.7	43.3
Sudden chest pain or discomfort (incorrect warning sign)	57.7	42.3

Source: Behavioral Risk Factor Survey, 2007.

Numbness or weakness of the face, arm or leg was the warning sign most frequently identified correctly (95.4%) and the warning sign of a severe headache with no known cause was the least correctly identified (56.7%). Almost half (44.9%) of the adults correctly identified all five warning signs. More college graduates (54.4%) identified all signs correctly compared to adults with less than a high school education (22.7%).

Impact of Heart Disease and Stroke in Michigan

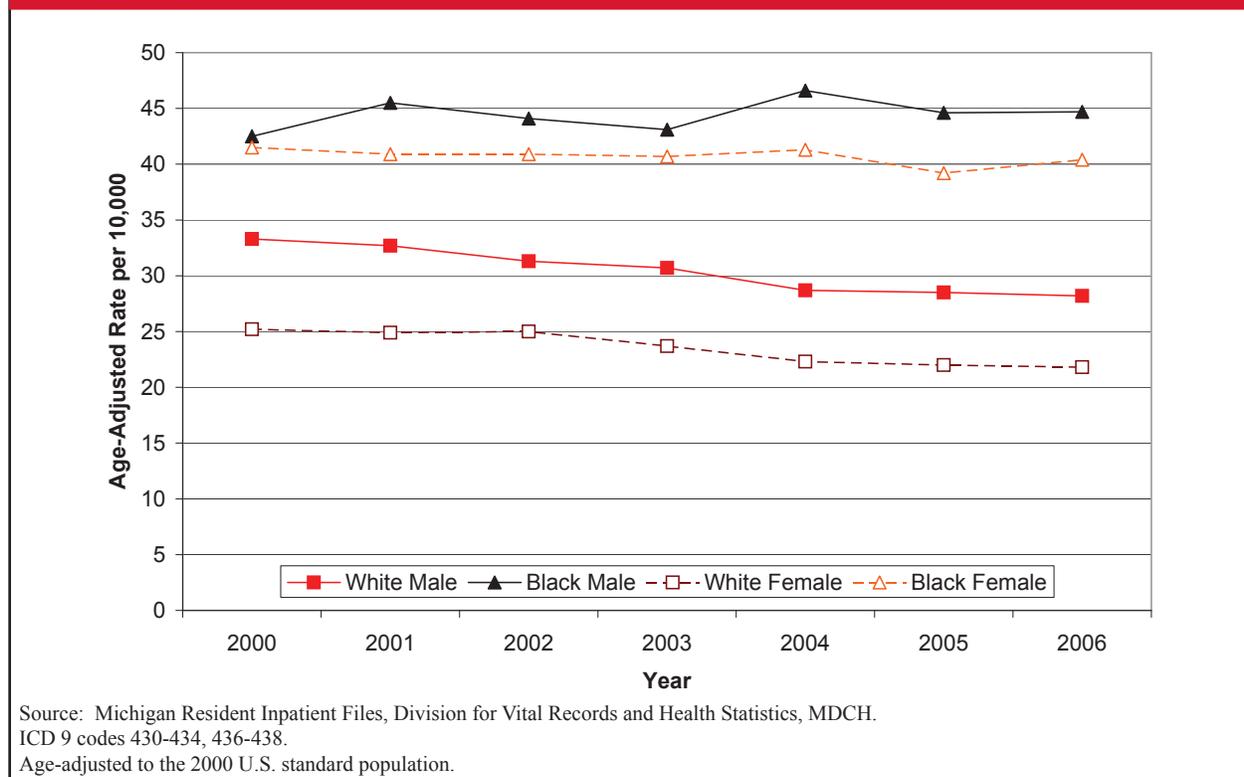


Hospitalizations

Since 2000, stroke hospitalization rates have decreased 11.8%, from 30.3 per 10,000 to 26.7 per 10,000 in 2006. In 2006, there were 28,207 stroke-related hospital discharges; over 1,500 of those discharges were deaths. Almost half of the discharges were to their home or to self-care (49.4%) and 9.7% were discharged to an inpatient rehabilitation facility. In 2006, 5.8% of stroke hospitalizations resulted in in-hospital deaths.

Black males (44.7 per 10,000) and black females (40.4 per 10,000) have the highest age-adjusted hospitalization rates, followed by white males (28.2 per 10,000) and white females (21.8 per 10,000), Figure 30. Black males were the only group whose age-adjusted rate increased from 2000 to 2006.

Figure 30. Age-adjusted hospitalization rates by race and gender for stroke for Michigan, 2000 to 2006

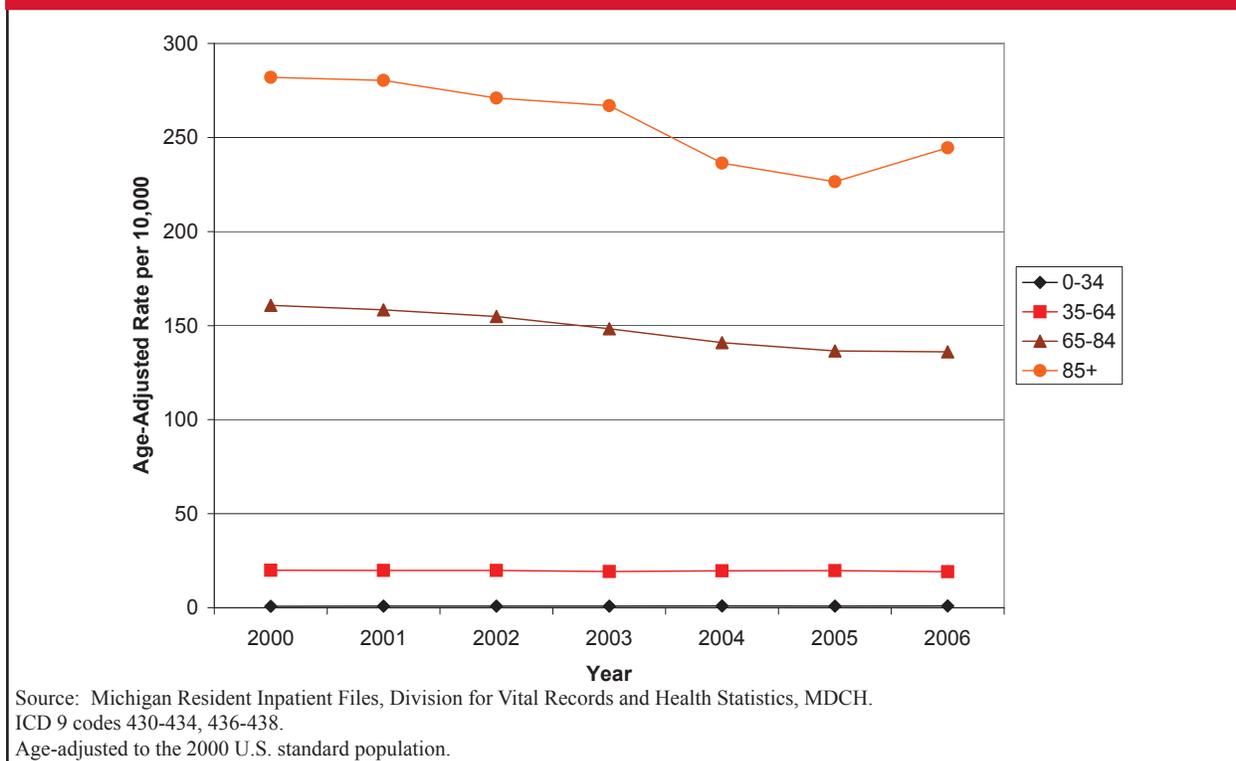


Impact of Heart Disease and Stroke in Michigan



Similar to prevalence, age-adjusted stroke hospitalization rates increase with age. In 2006, the rates ranged from 0.9 per 10,000 for those aged 0 to 34 years to 244.5 per 10,000 for those 85 years and older, Figure 31. The group 85 years and older was steadily declining from 2001 to 2005, but then started to rise again in 2006.

Figure 31. Age-adjusted hospitalization rates by age for stroke for Michigan, 2000 to 2006

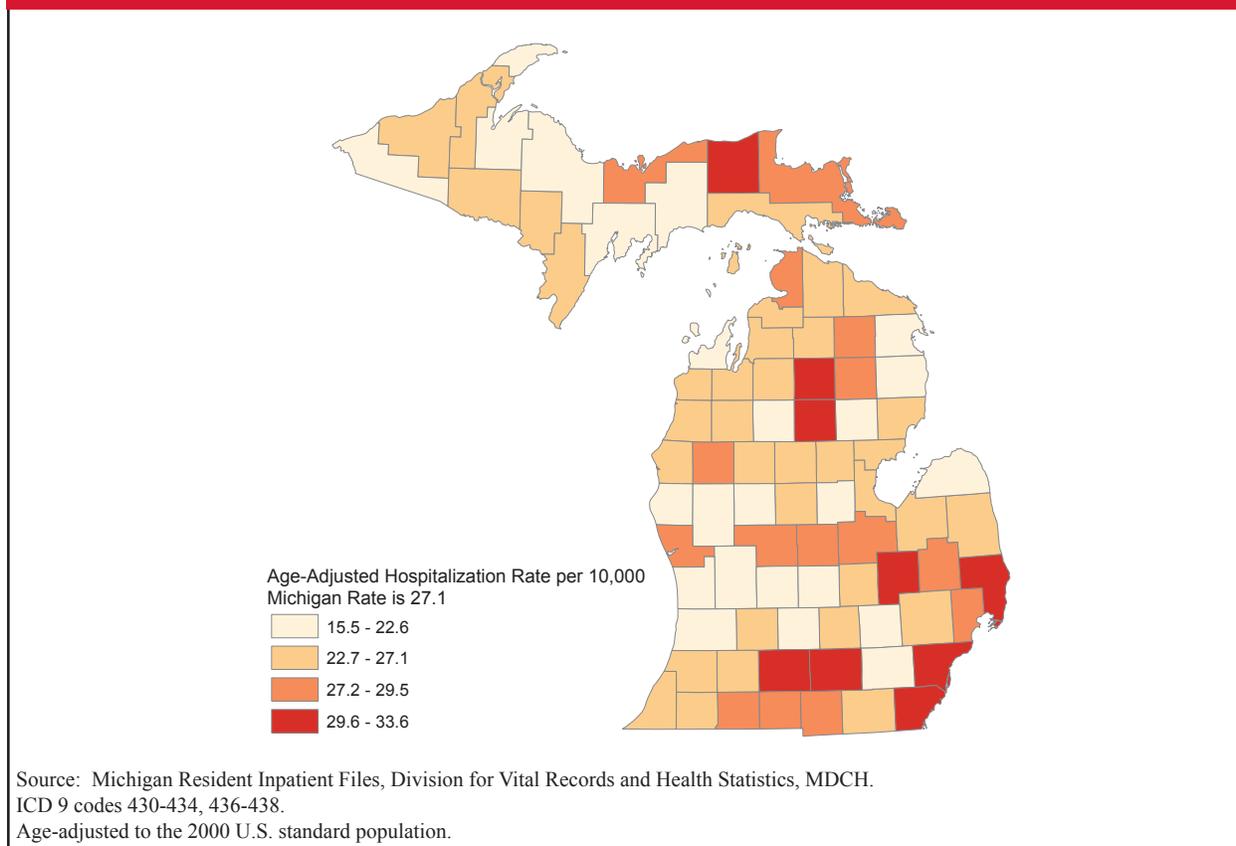


Impact of Heart Disease and Stroke in Michigan



Michigan's five-year age-adjusted hospitalization rate was 27.1 per 10,000 for 2002 to 2006. Keweenaw (15.5 per 10,000) had the lowest county rate in Michigan. The three counties with the highest age-adjusted rates were Luce (33.1 per 10,000), Monroe (33.2 per 10,000) and Wayne (33.6 per 10,000). A total of 24 counties were above the state rate, Map 15. Appendix O contains a list of all the counties and their age-adjusted stroke hospitalization rates.

Map 15. Age-adjusted five-year hospitalization rates for stroke by county, 2000 to 2006



Transient Ischemic Attack

In 2006, there were 7,348 TIA hospital discharges in Michigan. Over 75% of these discharges were released home. TIA age-adjusted hospitalization rates decreased from 8.1 per 10,000 in 2000 to 6.9 per 10,000 in 2006.



Quality Improvement for Hospital-Based Care

Many national organizations are working to improve the quality of care for acute stroke across the continuum of care. For example, The Joint Commission certifies stroke centers (see Medical Resources Section) while the American Stroke Association has implemented its Get With The GuidelinesSM-Stroke program, a hospital-based data reporting and quality improvement program for acute stroke care. Finally, the Centers for Disease Control and Prevention (CDC) funds the Paul Coverdell National Acute Stroke Registry (PCNASR), a hospital-based acute stroke registry designed to improve acute stroke care in the United States. The PCNASR strives to:

- Measure, track, and improve the quality of care for acute stroke patients.
- Increase public awareness of stroke treatment and prevention.
- Through secondary prevention, decrease the rate of premature death and disability from acute stroke.
- Reduce disparities in acute stroke care by providing underserved populations with better access to high quality care.²²

These three organizations developed ten consensus stroke performance measures as a foundation of improving quality of care in hospitals.

Consensus Performance Measures for Stroke:

For hemorrhagic and ischemic stroke patients

- Deep vein thrombosis prophylaxis by end of the second hospital day
- Dysphagia screening
- Assessment for rehabilitation
- Smoking cessation counseling (patients with TIA as well)
- Stroke education (patients with TIA as well)

For ischemic stroke and TIA patients

- Antithrombotic therapy by end of day two and prescribed at discharge
- Lipid-lowering therapy for patients with strokes of atherosclerotic origin with LDL ≥ 100
- Anticoagulation for atrial fibrillation
- Use of tPA intravenous thrombolytic therapy

Source: CDC Paul Coverdell National Acute Stroke Registry

Impact of Heart Disease and Stroke in Michigan



Michigan was fortunate to have been selected by CDC as a pilot prototype Coverdell registry. In August 2001, Michigan State University (MSU) was one of the first four prototype sites chosen to develop and pilot test PCNASR. The PCNASR prototype in Michigan is referred to as the Michigan Acute Stroke Care and Overview Treatment Surveillance System (MASCOTS). MASCOTS developed measures, data collection procedures, and quality improvement activities. The MASCOTS investigators used findings from the case registry data to identify target areas for improvement, and worked with hospitals to improve care on those areas.

After examining MASCOTS registry data, 16 targeted performance measures for improvement were identified including: time from emergency department arrival to evaluation and treatment; dysphagia screening; smoking cessation counseling; anti-thrombotic and anti-coagulant treatments at discharge; documentation of reasons for non-treatment with tPA; documentation of the National Institute of Health (NIH) stroke scale and documentation of stroke risk factors in the past medical history (PMH). During the six-month active intervention period, three learning sessions were conducted with representatives of the 13 participating hospitals. The impact of the intervention was quantified by comparing pre-intervention data with post-intervention data. Clinically and statistically significant improvements were observed for five measures: smoking cessation counseling (31% improvement), dysphagia screening (19% improvement), documentation of the NIH stroke scale (19% improvement), documentation of the reasons for not using tPA (13% improvement), and documentation of PMH of dyslipidemia (9% improvement). This collaboration resulted in improving five of the 16 targeted measures over a relatively brief intervention period.²³

INSTINCT Trial

Only one to three percent of stroke patients in community settings are receiving tPA therapy seven years after FDA approval. Data suggest substantially higher treatment rates are possible. The development and implementation of educational interventions to motivate physicians and other health care providers to learn the principles of acute stroke care has been declared a high-priority objective. Limited prior work found a combination of community and professional education increased thrombolytic use in stroke from a pre-intervention rate of 2.2% to a post-intervention rate of 11.3%, with the data suggesting the professional education component was the critical element in increasing use.

The INcreasing Stroke Treatment through INteractive behavioral Change Tactics, The INSTINCT trial, is a multi-center, randomized, controlled study designed to evaluate a standardized, system-based, barrier assessment and interactive educational intervention in increasing appropriate tPA use in stroke. The intervention targets emergency departments. It is based on adult education and behavior change theory and is designed for replication in community health initiatives. The primary endpoint will be an increase in appropriate use of tPA in stroke with evaluations of change in emergency physician knowledge on tPA use.

Impact of Heart Disease and Stroke in Michigan

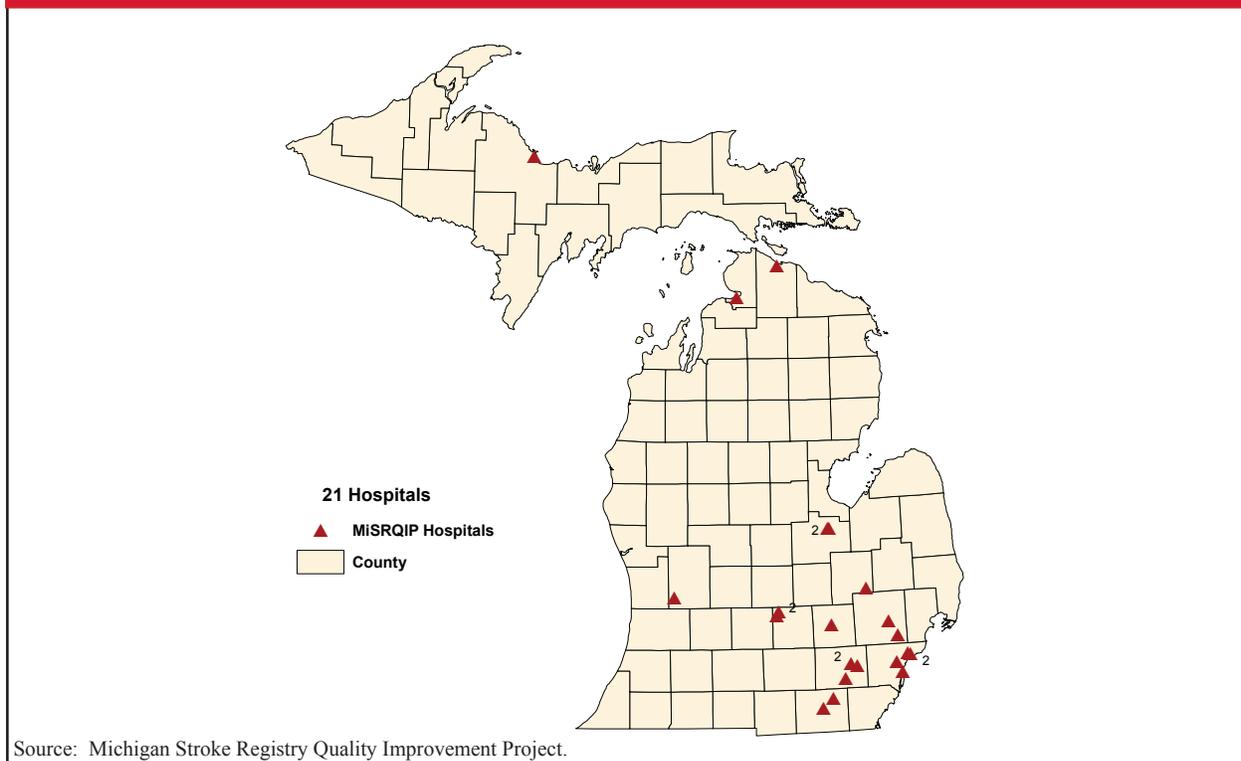


The success of MASCOTS and the quality improvement projects in Michigan provided the stimulus and partnerships to successfully compete for PCNASR. Michigan is currently one of six states funded by CDC to implement this next phase of the PCNASR. The Michigan registry, now under the direction of the Michigan Department of Community Health, is called the Michigan Coverdell Stroke Registry and Quality Improvement Project or MiSRQIP. As of Summer 2008, 21 hospitals were participating in MiSRQIP (Map 16) with plans to add 19 additional hospitals in the Fall. MiSRQIP hospitals will represent a wide spectrum of hospital type and size across the state. When fully implemented, MiSRQIP will:

- Assess stroke care across the state, among African Americans and in rural areas.
- Provide quality improvement resources, national and state expertise, and peer-to-peer sharing to stroke teams in participating hospitals.
- Share findings and lessons learned with additional hospitals.
- Provide findings and best practices to inform policy makers across the continuum of stroke care.

Data from MiSRQIP will be available in Spring 2009.

Map 16. The hospitals participating in year one of MiSRQIP, 2007 to 2008



Impact of Heart Disease and Stroke in Michigan



The American Heart Association's Get With the Guidelines (GWTG)SM includes a module on stroke.¹⁹ In 2007, 23 hospitals in Michigan received funding for GWTGSM-Stroke and in 2008, an additional 19 hospitals will receive funding through MiSRQIP. Nationally in 2006, there were 141,449 clinically identified patients that were admitted to 778 GWTGSM-Stroke hospitals. Over 60% of the patients that arrived to the GWTGSM-Stroke hospitals within two hours of symptom onset were administered tPA, Figure 32.¹

Figure 32. Get with the Guidelines (GWTG)SM-Stroke performance indicators for the United States, 2006

Performance indicator	Percent of inpatients
IV tPA in patients who arrived <2 hr after symptom onset *	63
IV tPA in patients who arrived <3 hr after symptom onset	51
Documentation of ineligibility (why no tPA)	93
Rate of symptomatic brain hemorrhage after tPA	4.4
Antithrombotics <48 hr after admission*	95
DVT prophylaxis by second hospital day*	83
Antithrombotics at discharge*	98
Anticoagulation for atrial fibrillation at discharge*	98
Therapy at discharge if LDL>100 mg/dL or on therapy at admit*	82
Counseling for smoking cessation*	84
Lifestyle changes recommended for BMI≥ kg/m ²	42
Composite quality-of-care measure	99

* Indicates one of the seven key performance measures targeted in GWTGSM-Stroke. In-hospital mortality was 7.1 percent, and mean length of hospital stay was 6.5 days (median 5.0 days). tPA: tissue plasminogen activator. DVT: deep vein thrombosis.

Source: American Heart Association, Heart Disease and Stroke Statistics, 2008.

Keystone Center for Patient Safety and Quality

The Michigan Health and Hospital Association's (MHA) Keystone Center for Patient Safety and Quality was created in March 2003 to address patient safety and quality of health care delivery. Since then, Michigan hospitals have improved patient safety and quality, and enhanced the value of health care delivery through the application of science and implementation of evidence-based best practices to improve health care, save lives and reduce costs. The Keystone Center has contributed to this progress.

MHA Keystone Center is positioned to bring large numbers of hospitals together in a single improvement initiative by providing a non-competitive environment. One collaborative example is Keystone Stroke, which began with support from MDCH in 2003 to focus on improving hospital awareness and practices of best stroke care in Michigan hospitals. Keystone Stroke was funded by MDCH until 2005 to lead educational programs and quality improvement projects.

Source: Michigan Health and Hospital Association.

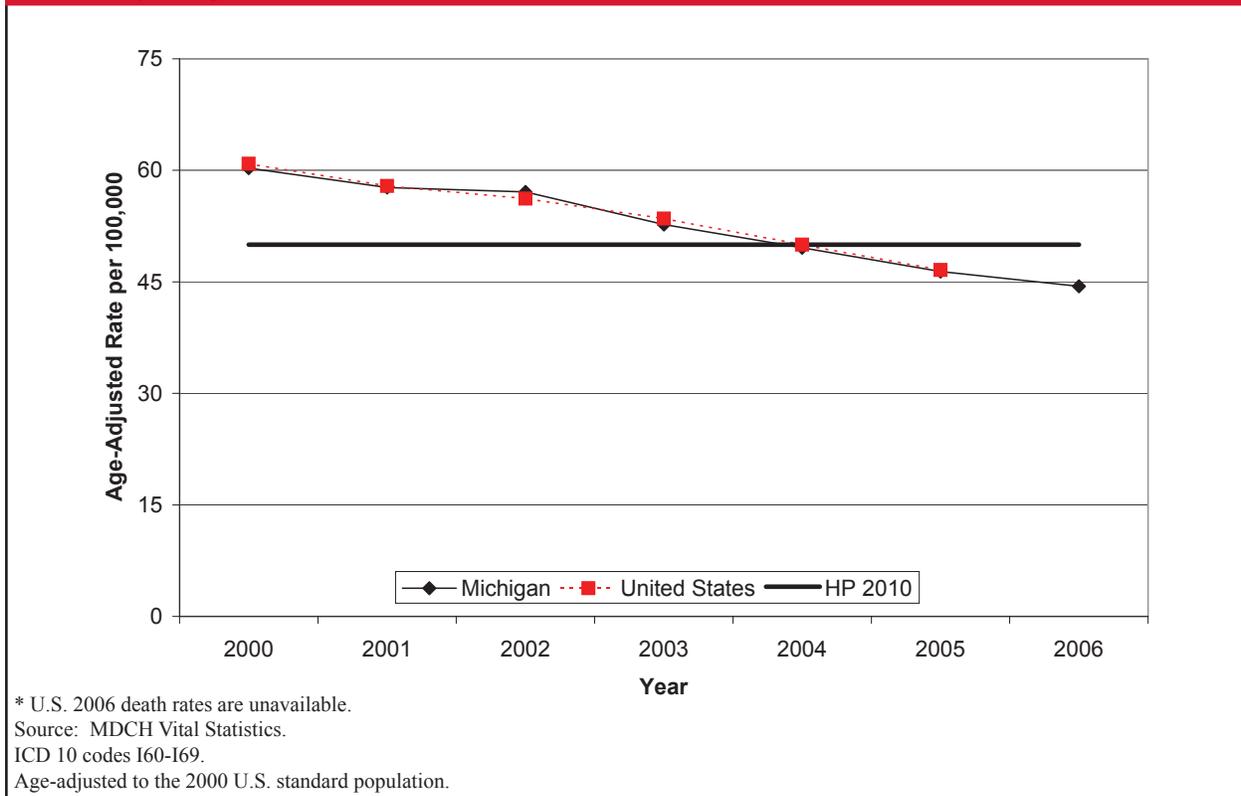
Impact of Heart Disease and Stroke in Michigan



Mortality

In 2006, Michigan's age-adjusted mortality rate for stroke was 44.4 per 100,000 persons. Michigan's rate has steadily decreased since 2000 and is now below the *Healthy People 2010* (HP 2010) target, 50 per 100,000, Figure 33. The United States also surpassed the HP 2010 target in 2005 (46.6 per 100,000). In 2004, Michigan was ranked as the 28th worst state for age-adjusted stroke mortality rates in the United States.

Figure 33. Age-adjusted mortality rates for stroke for Michigan and United States* compared to *Healthy People 2010*, 2000 to 2006

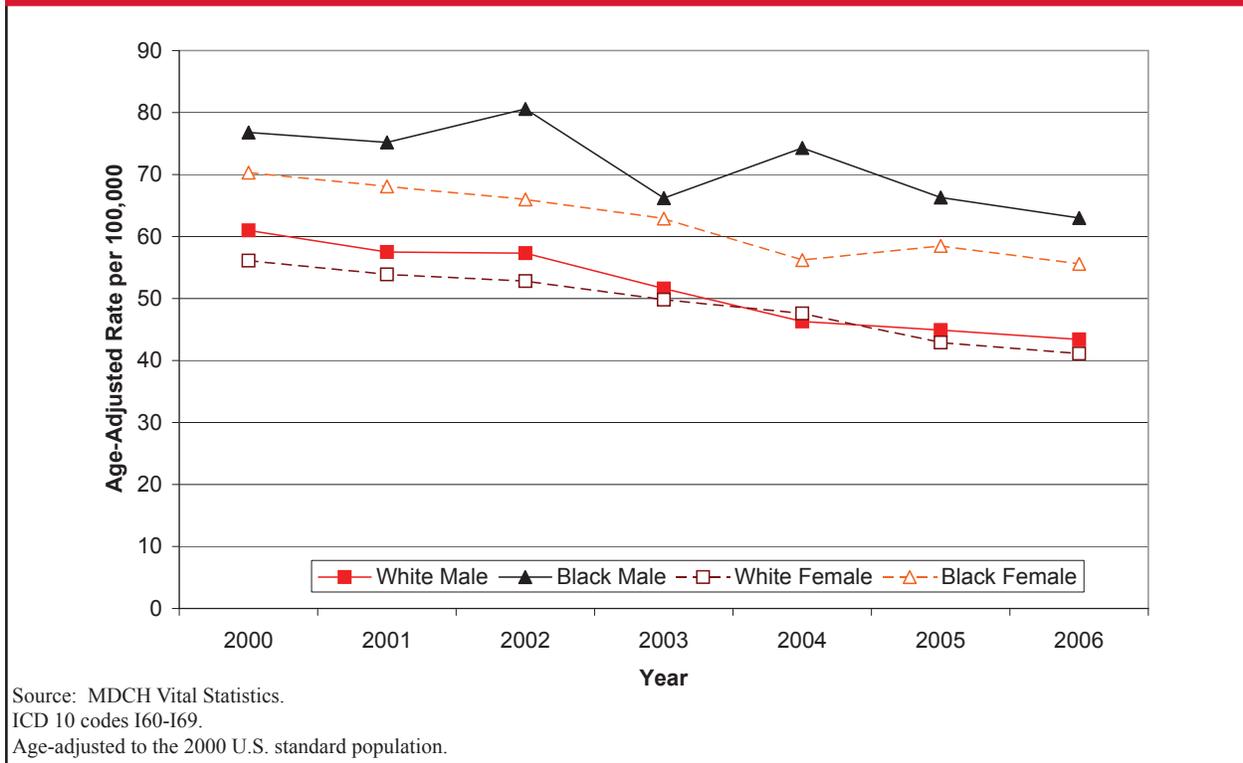


Impact of Heart Disease and Stroke in Michigan



Black males (63.0 per 100,000) followed by black females (55.6 per 100,000) have the highest age-adjusted mortality rates, Figure 34. Each of the gender and race groups have seen a decline in the age-adjusted mortality rate, averaging over 15 fewer deaths per 100,000 in 2006 than in 2000 within each group. White males (43.4 per 100,000) and white females (41.1 per 100,000) had lower age-adjusted rates than the Michigan rate, in 2006.

Figure 34. Age-adjusted mortality rates by race and gender for stroke for Michigan, 2000 to 2006

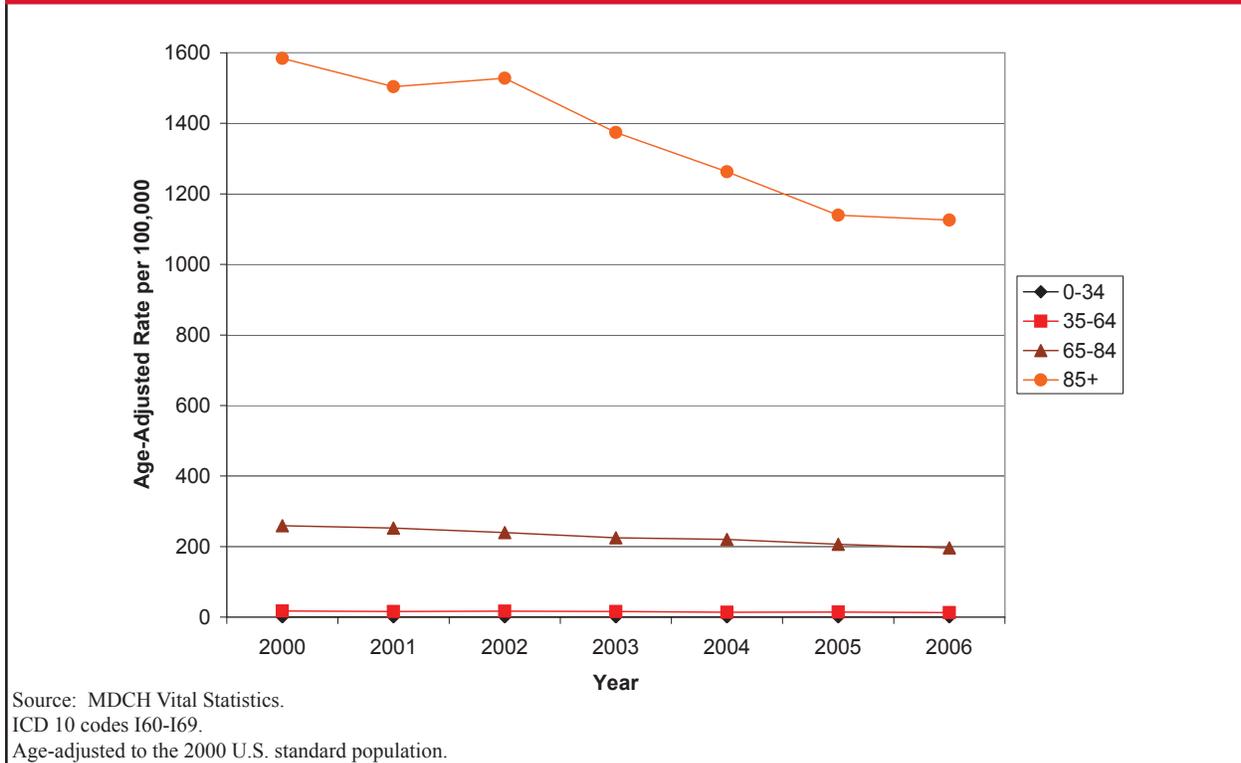


Impact of Heart Disease and Stroke in Michigan



Each age group's age-adjusted rate in Michigan has decreased from 2000, Figure 35. The largest decreases come from the 85 and older group. In 2000, the rate was 1,584.1 per 100,000; in 2006, it was 1,125.6 per 100,000, a 28.9% decrease. The 35 to 64-year-old group decreased 27.0% and the 65 to 84-year-old group decreased 24.3% from 2000 to 2006.

Figure 35. Age-adjusted mortality rates by age for stroke for Michigan, 2000 to 2006

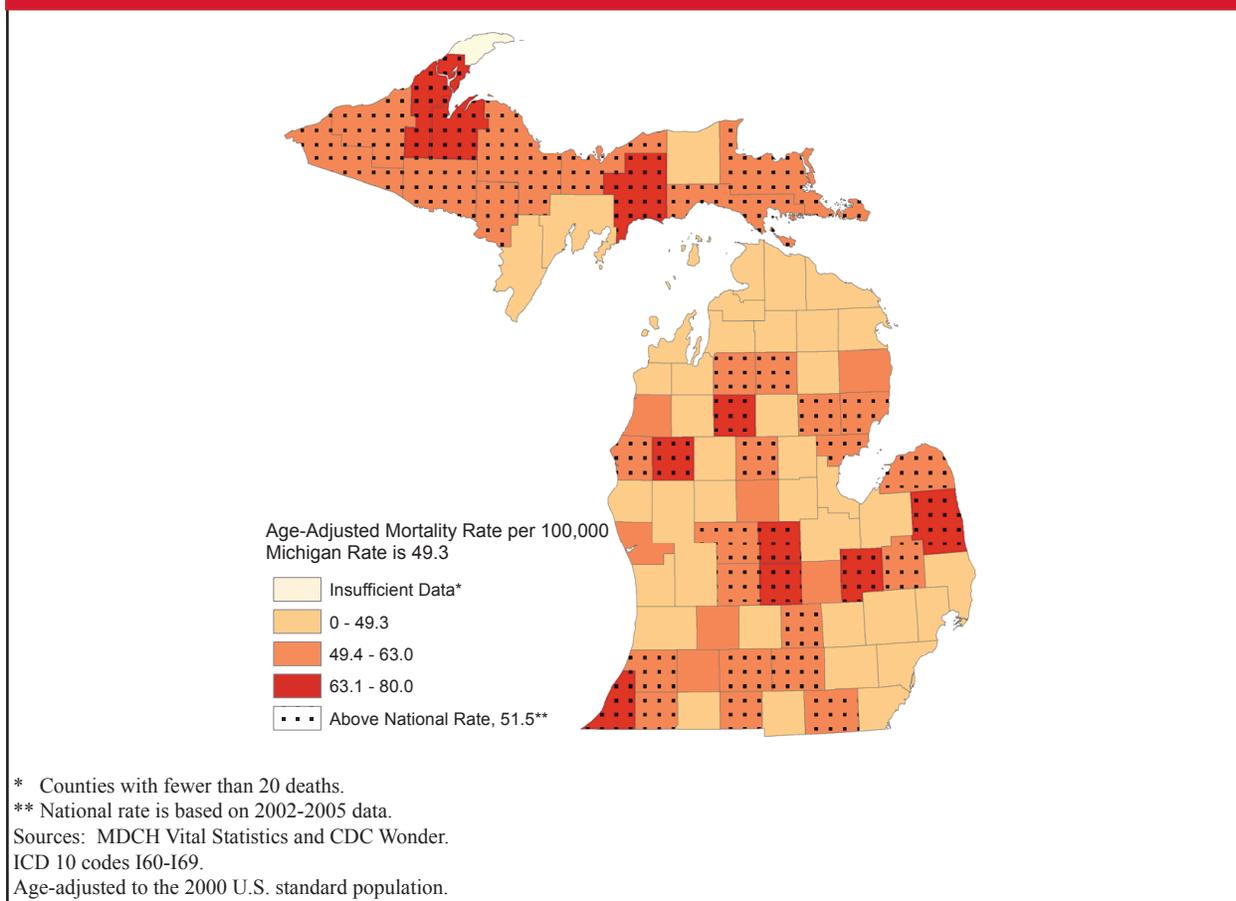


Impact of Heart Disease and Stroke in Michigan



From 2002 to 2006, Michigan's age-adjusted mortality rate was 49.3 per 100,000, lower than the rate (51.5 per 100,000) for the United States. Alpena County had the lowest rate, 34.6 per 100,000. Sanilac (77.9 per 100,000), Clinton (78.2 per 100,000) and Gratiot (78.8 per 100,000) Counties had the highest rates. Over half of the counties in Michigan were above the state rate (49.3 per 100,000) and 36 were above the state and national rate (51.5 per 100,000), Map 17. A table with the number and age-adjusted stroke mortality rates for each county can be found in Appendix P.

Map 17. Age-adjusted five-year mortality rates for stroke by county, 2002 to 2006





Risk Factors

The American Heart Association has identified six modifiable risk factors for heart disease and stroke: cigarette smoking, physical inactivity, high blood pressure, high blood cholesterol, obesity and overweight, and diabetes mellitus. Each of these risk factors can be prevented, treated or controlled through medication and/or lifestyle changes. Along with the modifiable risk factors, there are also several risk factors for heart disease and stroke that cannot be modified, such as age, race, sex and family history.¹²

In 2000, a report was released that included a set of indicators and goals for the United States to measure and improve the health of the country over the next decade. *Healthy People 2010* has two overarching goals: 1) to increase quality and years of healthy life, and 2) to eliminate health disparities.¹⁸ The document also includes indicators and targets on diseases, risk factors and other health topics. These indicators will be used to compare Michigan and the United States to the *Healthy People 2010 (HP 2010)* targets where appropriate.

Cigarette Smoking

Why is it important?

Cigarette smoking is the most preventable cause of premature death in the United States, accounting for more than 400,000 deaths a year or approximately one in five deaths.²⁴ Cigarette smoking has a strong effect on the circulatory system causing a narrowing of the blood vessels.¹² People who smoke are two to four times more likely to develop coronary heart disease and have twice the risk for stroke.²⁵

Cigarette smoking causes immediate increases in both blood pressure and heart rate and, as a result, reduces cardiac output and coronary blood flow.²⁶ Carbon monoxide binds to the hemoglobin, which normally carries oxygen from the lungs via the bloodstream, and therefore reduces the amount of oxygen reaching body tissues.²⁷ Toxins in the blood from smoking cigarettes also contribute to the development of atherosclerosis. Atherosclerosis is a progressive hardening of the arteries caused by the deposit of fatty plaques and the scarring and thickening of the artery walls. Smoking makes blood vessels and blood cells sticky, allowing cholesterol and other dangerous fatty material to build up inside them. Inflammation of the artery walls and the development of blood clots can obstruct blood flow and cause heart attacks and strokes.²⁸

Impact of Heart Disease and Stroke in Michigan



Each year it is estimated that smoking costs \$167 billion in the United States, including \$75 billion dollars in direct medical costs and \$92 billion in lost productivity. It is estimated that smoking costs Michigan over \$7.2 billion each year, including \$3.4 billion in direct medical costs and \$3.8 billion in lost productivity.¹

Eliminating smoking not only reduces the risk of coronary heart disease, but also reduces the risk of repeat heart attacks and death by heart disease by 50%.¹ Research also indicates that smoking cessation is crucial in the management of many contributors to heart attack, including atherosclerosis, thrombosis, coronary artery disease, and cardiac arrhythmias.²⁶

Secondhand Smoke and Heart Disease

Secondhand smoke is estimated to cause from 750 to 2,300 premature deaths from heart disease each year in Michigan among nonsmokers. Nonsmokers who are exposed to secondhand smoke regularly at home or at work increase their risk of developing heart disease by 25% to 30%. Secondhand smoke interferes with the normal functioning of the heart, blood and vascular systems. Even a short time in a smoky room can cause the blood platelets to become stickier, damage the lining of blood vessels, decrease coronary flow velocity reserves and reduce heart rate variability, potentially increasing the risk of heart attack.

The current Surgeon General's Report concluded that there is no risk-free level of exposure to secondhand smoke, and the Centers for Disease Control and Prevention advise individuals with heart disease to avoid indoor settings with exposure to secondhand smoke. The implementation of comprehensive smoke-free policies helps to protect the health of non-smokers, and it also helps to encourage current smokers to quit smoking. Current smoke-free work site counties in Michigan can be seen in Appendix Q.

Sources: http://www.cdc.gov/tobacco/data_statistics/Factsheets/HeartDisease.htm
U.S. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006.

What is the scope of the problem?

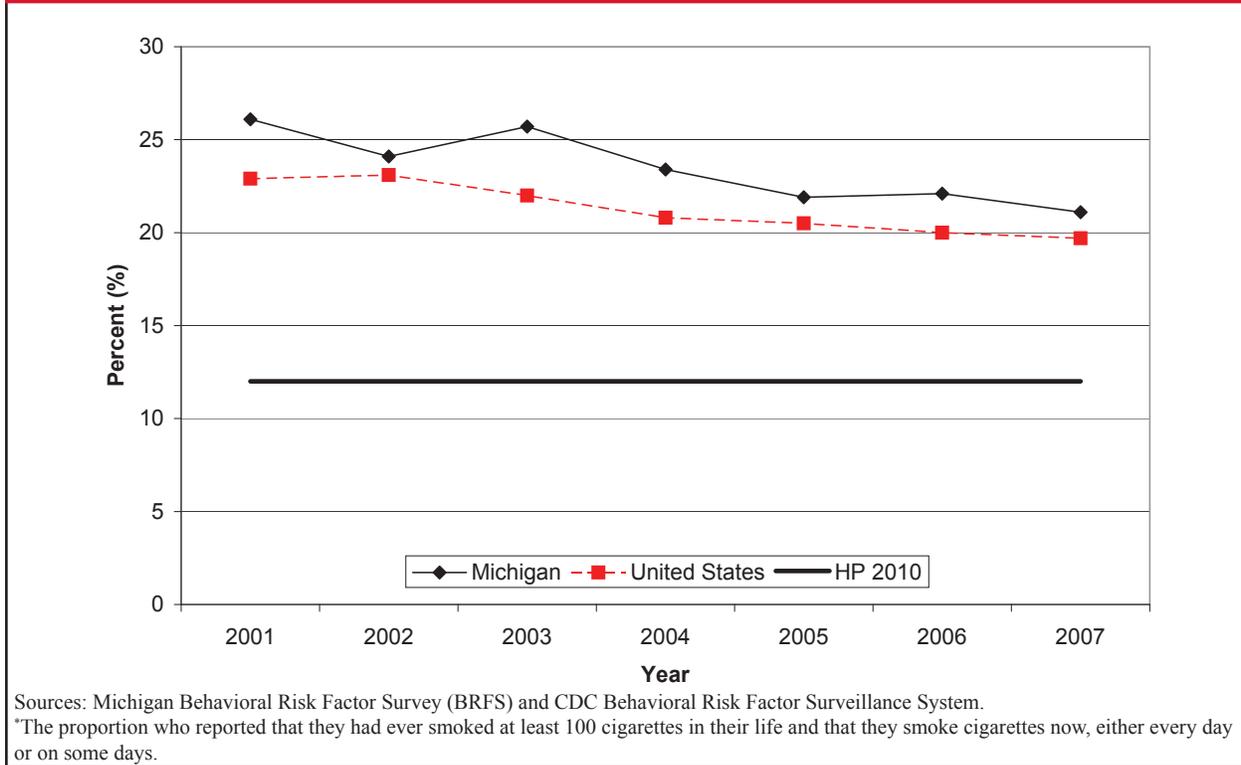
Twenty-one percent of adults in Michigan are current smokers. There was a slight decline in the prevalence of smoking from 2001 to 2007 in Michigan and the United States. In Michigan, there was a 19.2% decrease in smoking rates during this period and a 14.0% decline in the United States, Figure 34. The *HP 2010* target is to reduce the proportion of adults who smoke to 12% by 2010.¹⁸ As of 2007, neither Michigan (21.1%) nor the United States (19.7%) had reached the target. Michigan had the 16th highest smoking rate in the United States in 2007. In 2007, 54.0% of Michigan adults reported that they had never smoked. An additional 24.9% reported that they were former smokers. Among the 21.1% of Michigan adults estimated to smoke in 2007, 61.6% had attempted to quit smoking for at least one day in the past year.

Among Michigan adults, smoking rates were higher among men (23.5%) compared to women, Hispanics (24.5%) compared to other races and 18 to 34-year-olds (28.8%) compared to older age groups. Prevalence of smoking was higher among adults without a high school diploma (34.4%) compared with adults with a college degree (9.2%). The same trend was seen with income; the highest prevalence was those with less than \$20,000 in household income (33.7%) and decreased to 13.2% among households with an income of \$75,000 or more. Current smokers were much more likely to report not having health care coverage (25.0%) than non-smokers (8.6%).

Impact of Heart Disease and Stroke in Michigan



Figure 36. Prevalence of current cigarette smoking* among adults, 18 and over, in Michigan and United States compared to the *Healthy People 2010* target, 2001 to 2007



In 2001, there were over 14,500 smoking attributable deaths in Michigan. Over one-third of these smoking attributable deaths were categorized as being cardiovascular-related. Over 3,000 of these were from ischemic heart disease.

Smoke-free work site regulations have been passed and implemented in 19 counties and two cities in Michigan, Appendix Q. These regulations currently protect over 46.0% of Michigan workers from secondhand smoke exposure within their work site. However, in 2007, 12.9% of adults were exposed to secondhand smoke in their place of work and 26.2% were exposed in a vehicle.

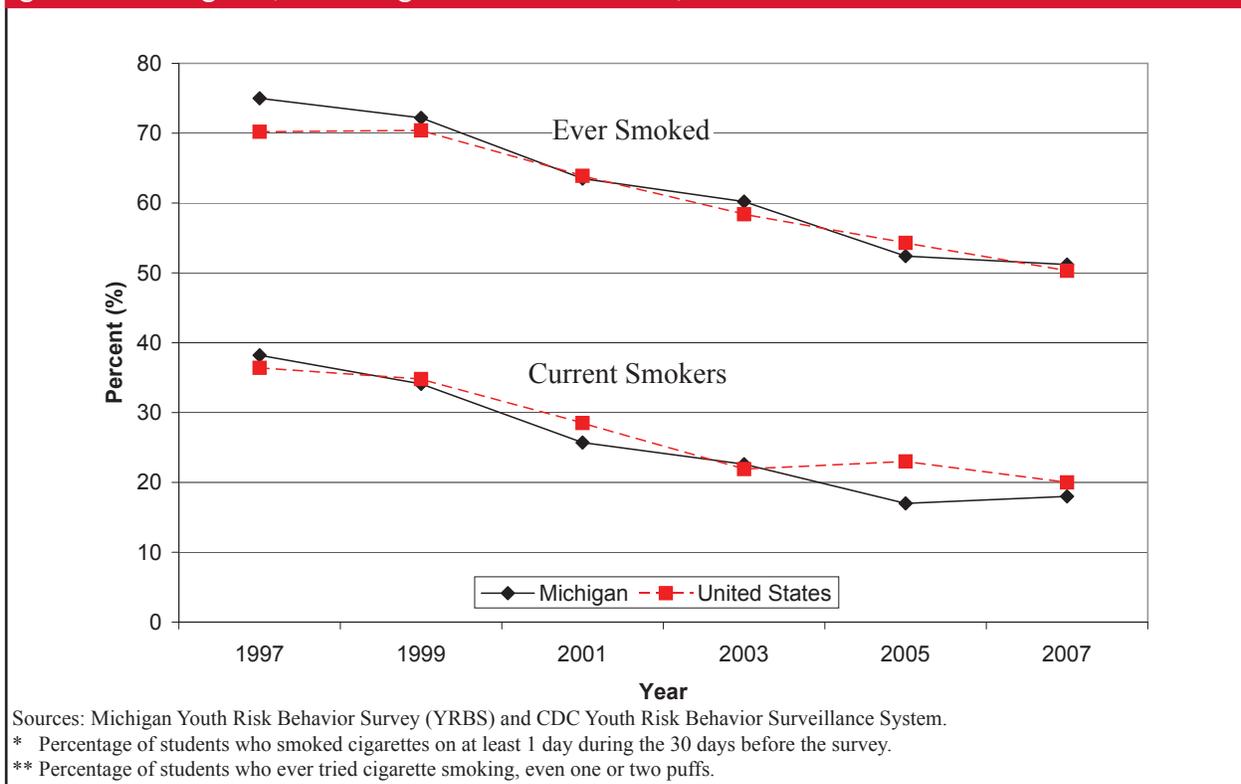
Impact of Heart Disease and Stroke in Michigan



Youth

In 1997, three out of four high school youth (grades 9 through 12) reported having tried smoking a cigarette. This decreased to just over half (51.2%) in 2007. The prevalence of current smoking among youth also decreased, from 38.2% in 1997 to 18.0% in 2007. Between 1997 and 2007, there was a statistically significant decrease in both the percentage of youth who had ever smoked and the percentage of current youth smokers. Both of these measures have followed a similar trend with the youth in the United States, Figure 37.

Figure 37. Prevalence of current cigarette smoking use* and ever smoked** among youth, grades 9 through 12, in Michigan and United States, 1997 to 2007



Over 60% of high school youth were exposed to secondhand smoke in their home at least one day in the past week according to the 2007 Michigan High School Youth Tobacco Survey. Youth were much more likely to report secondhand smoke exposure at work (48.5%) than adults (13.5%). Additionally, 45.6% of youth were exposed at least once to smoke while in a vehicle.



High Blood Pressure

Why is it important?

High blood pressure, or hypertension, is often referred to as the “silent killer” due to its lack of symptoms and warning signs. Blood pressure is the force of blood pushing against the artery walls. Blood pressure is measured by two numbers: a top number (called the systolic pressure) which is the maximum measure of the blood in the arteries during contraction of the heart during a heartbeat, and a bottom number (called diastolic pressure) which is the minimum pressure of the blood in the arteries between heartbeats. When blood pressure is too high, the heart works harder to pump blood, thus leading to serious cardiovascular disease complications. High blood pressure is defined as a systolic blood pressure of 140 mmHg or higher, or diastolic blood pressure of 90 mmHg or higher, or taking high blood pressure medication, see Appendix R and box on page 69. The diagnosis of high blood pressure is made when the blood pressure is elevated on at least two different occasions.²⁹

High blood pressure is the number one modifiable risk factor for stroke. The higher one’s blood pressure, the greater the risk of heart attack, heart failure, stroke and kidney disease. High blood pressure results in the hardening of arteries that supply the body’s organs with oxygen and nutrient-rich blood. If the body’s organs do not get enough blood they will not work properly. If the heart cannot get enough oxygen, chest pain, also known as “angina,” can occur. If the flow of blood is blocked, a heart attack results. High blood pressure is the number one risk factor for congestive heart failure. Congestive heart failure is a serious condition in which the heart is unable to pump enough blood to supply the body’s needs.²⁹

In 2004, high blood pressure was listed as a primary or contributing cause of death for 300,000 people in the United States. It is estimated that the cost of high blood pressure will be \$69.4 billion in the United States in 2008.¹

One of the *Healthy People 2010* goals for blood pressure is to reduce the proportion of adults, 20 and older, with high blood pressure. The target set for this goal is 16%.¹⁸ According to the 2005-2006 National Health and Nutrition Examination Survey, 29% of adults in the United States were hypertensive and an additional 37% were pre-hypertensive (their blood pressure was higher than normal but below a hypertensive classification).³⁰



High Blood Pressure Clinical Guidelines

The National High Blood Pressure Education Program of the National Institutes of Health has convened with national experts to establish clinical guidelines for the prevention, detection, evaluation and treatment of high blood pressure since 1973. There have been seven different published consensus reports with changes to guidelines and recommendations based on current science. Early guidelines identified 160 mmHg systolic or 96 mmHg diastolic and above as the cutoff for diagnosing high blood pressure. For a period of time, there was a strong emphasis on diastolic as the most important clinical reading but, in the past decade, emphasis has been placed on using both systolic and diastolic in the clinical assessment of risk. In the most recent guidelines published by the Joint National Committee on the Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) identifies high blood pressure as consistent readings above 140 mmHg systolic and 90 mmHg diastolic. For those who have diabetes or renal disease, the guidelines recommend blood pressure should be below 130 mmHg systolic and 85 mmHg diastolic. A normal blood pressure is identified as below 120 mmHg systolic and 80 mmHg diastolic. See Appendix R for complete blood pressure classifications.

Source: Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jr. et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003; 42(6):1206-1252.

What is the scope of the problem?

Twenty-nine percent of adults in Michigan reported having ever been told by a physician they have high blood pressure in 2007, Figure 38. Michigan was ranked the 17th worst state for prevalence of high blood pressure in 2007. Lifetime prevalence of high blood pressure increased between 2001 and 2007 in the United States and Michigan. The increase in high blood pressure prevalence is partially due to the changing definitions of high blood pressure, described above.

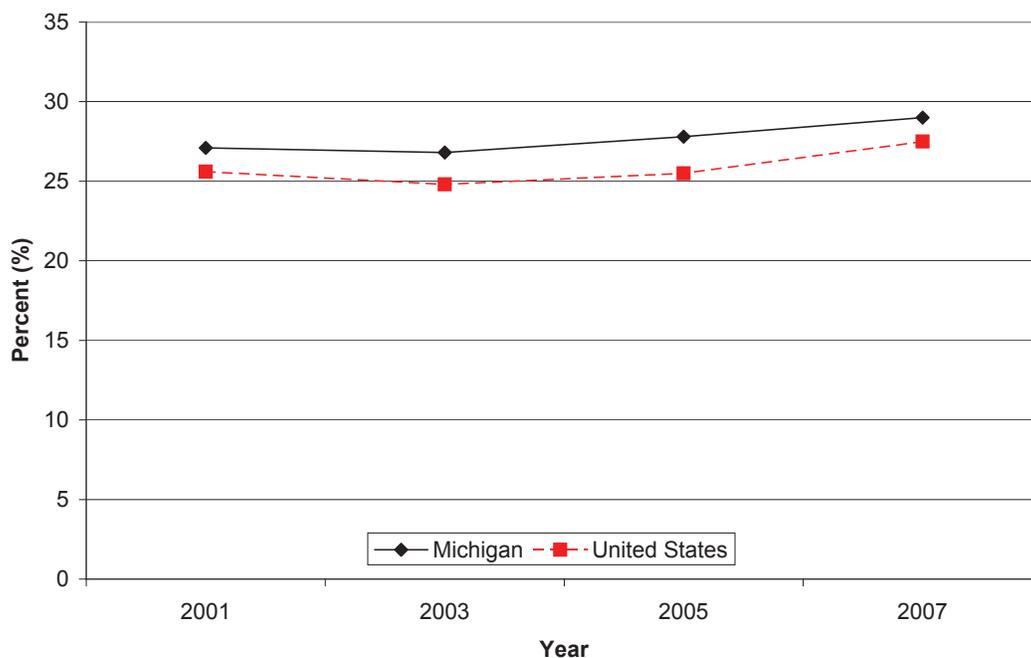
The prevalence of high blood pressure increased with age, from 9.8% among adults 18 to 34-years-old to 59.1% among adults 65 and older. Blacks (37.2%) had the highest prevalence compared with other race-ethnic groups as did males (30.8%) compared with females. The proportion of adults reporting high blood pressure decreased with education and household income. Adults with less than a high school diploma had a prevalence of 33.6% whereas college graduates reported a 22.8% prevalence of high blood pressure. Adults in households with an income of less than \$20,000 had the highest prevalence (37.3%) while adults in households with an income of \$75,000 or more had the lowest (21.2%).

Adults with high blood pressure were less likely to report (8.2%) that they did not have health care coverage than those without high blood pressure (13.8%). In other words, adults with high blood pressure are more likely to be insured.

Of the adults who reported having high blood pressure, 79.4% reported also taking medication to control their blood pressure. This has increased by 15.0% since 2001 when the prevalence was 69.0%. Ninety-five percent of those taking medication have health insurance, where as 78.0% of those not currently taking blood pressure medicine have health coverage.



Figure 38. Prevalence of having high blood* pressure among adults, 18 and over, in Michigan and United States, 2001 to 2007



Sources: Michigan Behavioral Risk Factor Survey (BRFS) and CDC Behavioral Risk Factor Surveillance System.

*Among all respondents, the proportion who reported that they were ever told by a doctor that they have high blood pressure. Women who had high blood pressure only during pregnancy and adults who were borderline hypertensive were considered to not have been diagnosed.

Hypertension and Renal Disease Connection

Uncontrolled high blood pressure is the second leading cause of kidney failure in the United States and Michigan, accounting for 27% of kidney failure cases nationwide in 2005 and 29% of Michigan cases in 2006. Most of these cases could have been prevented with good medical care and prescription medication for high blood pressure. One in eight Michigan residents, ages 20 and above, have kidney disease and most are unaware of their disease status. This rate is similar to the national rate.

Blacks have a higher risk of renal disease, partly due to their higher prevalence of high blood pressure and diabetes. Blacks are 6.5 times more likely to develop end stage renal disease (ESRD) because of hypertension than whites. In 2006, blacks in Michigan made up 14% of the general population yet they made up 47% of the population receiving dialysis.

Sources: ESRD Network 11 ADR 2006, USRDS ADR 2005, Feldman HI, Klag MJ, Chiapella AP, Whelton PK. End stage renal disease in U.S. Minority Groups. Am J Kidney Dis. 1992;19:397-410. National Kidney Foundation of Michigan.

Impact of Heart Disease and Stroke in Michigan

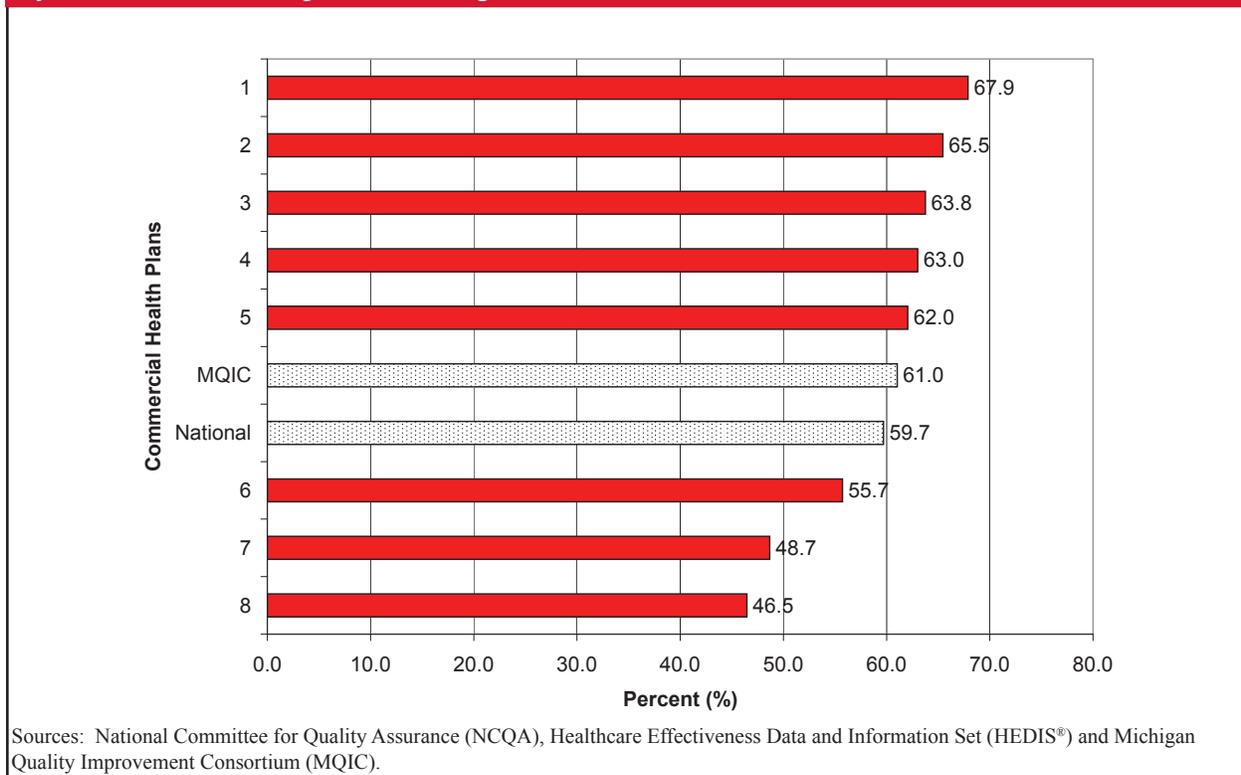


Quality Improvement

High blood pressure is a significant risk factor for cardiovascular disease. Studies have shown that antihypertensive therapies have been associated with a 35 to 40 percent reduction in stroke incidence, 20 to 25 percent reduction in heart attack and more than 50% reduction in heart failure.³¹ Health plan performance on this measure is shown in the figure below for publicly reporting health plans that provide services in Michigan. Each commercial plan was assigned a number that is consistent through the report; each Medicaid plan was assigned a letter. One of the HEDIS[®] measures reports the percentage of adults, age 18 to 85, who are hypertensive and their blood pressure is under control. See the boxes on pages 71 and 75 for more information on the Michigan Quality Improvement Consortium (MQIC) and Healthcare Effectiveness Data and Information System (HEDIS[®]) data sources.

In 2006, 59.7% of hypertensive adults in commercial health plans nationally have their blood pressure under control. The rate for adults enrolled in MQIC commercial plans was 61.0%. There were five commercial health plans in Michigan whose prevalence was higher and three whose prevalence was lower than the national average, Figure 39.

Figure 39. Percent of hypertensive patients, 18 to 85, whose blood pressure was under control, by commercial health plan in Michigan, 2006

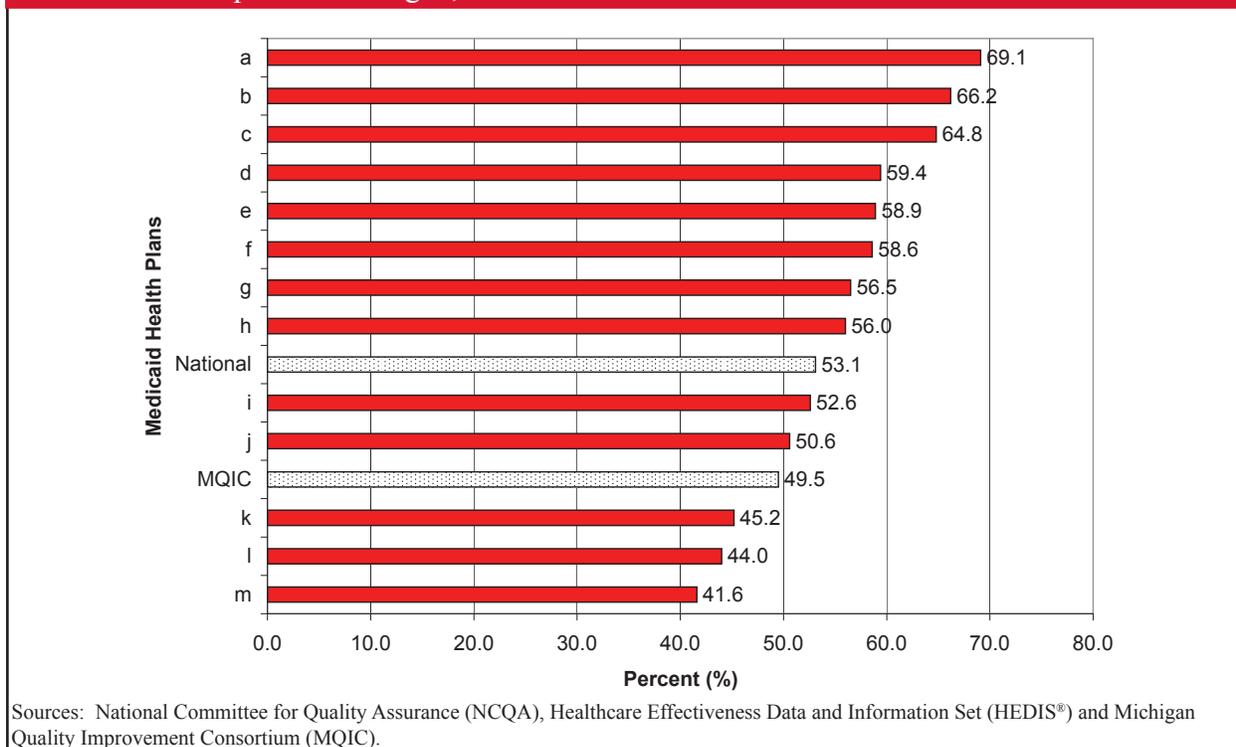


Impact of Heart Disease and Stroke in Michigan



Thirteen Medicaid health plans reported HEDIS® performance measures for control of hypertension. Two Michigan plans were between the national (53.1%) and Michigan rate (49.5%). Eight of the Medicaid plans were above the national rate (53.1%) and three were below the MQIC rate (49.5%).

Figure 40. Percent of hypertensive patients whose blood pressure was under control by Medicaid health plan in Michigan, 2006



Michigan Quality Improvement Consortium (MQIC)

The Michigan Quality Improvement Consortium is a collaborative effort of physicians and other personnel representing 12 Michigan health management organizations, Michigan State Medical Society, Michigan Osteopathic Association, Michigan Association of Health Plans, Michigan Peer Review Organization and Blue Cross Blue Shield of Michigan. MQIC can reach over 11,000 physicians statewide. MQIC establishes and implements clinical practice guidelines and standardized performance measures. Quality improvement interventions are at the discretion of individual plans, but care guidelines, performance goals, measurement methodology, and performance reporting are standardized. This collaborative approach is meant to achieve consistent delivery of evidence-based services and better health outcomes and reduce the administrative burden on practices due to diverse health plan guidelines and associated reporting.

Many of MQIC's 25 guidelines address cardiovascular health, including guidelines for preventive services for adults and children, childhood overweight prevention and treatment, obesity treatment, outpatient management of uncomplicated deep vein thrombosis, management of chronic heart failure, screening and management of hyperlipidemia, and medical management of adults with hypertension. MQIC publishes an annual report of performance measures.

Source: MQIC web site www.mqic.org



High Blood Cholesterol

Why is it important?

Cholesterol is a waxy, fat-like substance that is found in the blood. To travel in the bloodstream, cholesterol is carried in small packages called lipoproteins. The small packages are made of fat (lipid) on the inside and proteins on the outside. Two kinds of lipoproteins carry cholesterol throughout the body. Low density lipoprotein (LDL) cholesterol is sometimes called bad cholesterol. Elevated levels of LDL cholesterol lead to a buildup of cholesterol in arteries. The higher the level in a person's blood, the greater chance they have of developing heart disease. High density lipoprotein (HDL) cholesterol carries cholesterol from parts of the body back to the liver so that it can be removed. HDL is sometimes called good cholesterol because the higher the level, the lower the chance of getting heart disease.³²

The body uses cholesterol to make hormones and build cell membranes; however, if too much cholesterol circulates in the bloodstream, it can build up in the inner walls of the arteries and lead to fatty deposits of plaque, called atherosclerosis. Sometimes plaque leads to blockages that reduce blood flow. If a blockage is in the heart, the result is a heart attack. It can also lead to stroke from blockages of blood vessels to and in the brain.³²

High blood cholesterol is diagnosed by checking levels of cholesterol in the blood. The preferable method is a blood test called a lipoprotein profile. The National Heart, Lung and Blood Institute recommends that everyone age 20 and older get their cholesterol checked at least once every five-years. Total blood cholesterol levels should be under 200 mg/dL, however it is not labeled as high until it is 240 mg/dL or above (see Appendix R for more cholesterol levels).³²

Approximately 17% of the adult population in the United States has high blood cholesterol-over 17 million males and nearly 20 million females.³³ High blood cholesterol is a condition that is also being seen in adolescents 12 to 19 years of age. About 10% of adolescents had a blood cholesterol level above 200 mg/dL.¹

The National Health and Nutrition Examination Survey has been used as the data source for two of the *Healthy People 2010 (HP 2010)* goals on blood cholesterol. The first is to reduce the mean total blood cholesterol levels among adults and a target was set for 199 mg/dL. As of the 2005/2006 survey year, the mean serum cholesterol level was exactly at the target. A second goal is to reduce the proportion of adults with high total blood cholesterol levels to 17%. In 2005/2006, 15.7% of adults had high blood cholesterol. Not all age group rates passed the *HP 2010* goal; the group 40 to 59 had a prevalence of approximately 19%.³⁴

Impact of Heart Disease and Stroke in Michigan



What is the scope of the problem?

In 2007, 82.5% of Michigan adults reported ever having their blood cholesterol level checked. Adults aged 18 to 34 are much less likely to have had their blood cholesterol checked (57.1%) than the 35 to 64-year-old group (91.0%) or those 65 and older (97.5%). Hispanics had the lowest reported blood cholesterol checks (67.6%) compared with blacks (84.8%) and whites (82.6%). The prevalence of blood cholesterol screening decreased when the adults were questioned whether they had their blood cholesterol checked in the past five years (78.5%) compared to ever having it checked (82.5%).

Lack of health care coverage may keep people from being screened. Almost 29% of Michigan adults who had never been screened for blood cholesterol did not have insurance. Unscreened adults were more than three times as likely not to have insurance than adults whose cholesterol had been tested. Only 8.6% of adults who were tested did not have insurance, indicating the importance of insurance access for screening.

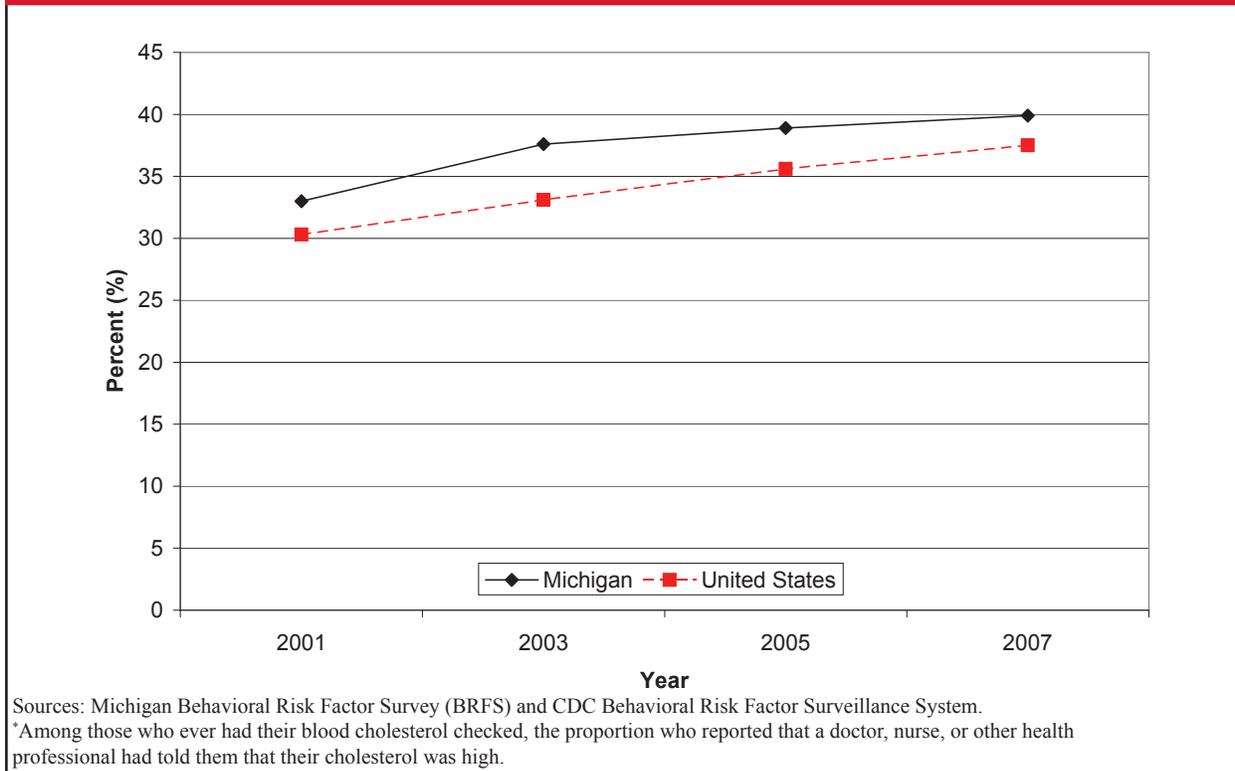
In Michigan, an estimated 32.9% of all adults had ever been diagnosed with high blood cholesterol. Males (42.8%) were more likely to report having high blood cholesterol.

Prevalence of high blood cholesterol decreased with increasing household income. The highest prevalence was among adults from households that have an income of less than \$20,000 (44.1%). The lowest was among adults from households that have an income of \$75,000 or more (36.8%).

The prevalence of adults in both Michigan and the United States who have high blood cholesterol has slowly increased over the years. Michigan is slightly higher than the United States median for high blood cholesterol, among those tested, 39.9% and 37.5%, respectively, in 2007, Figure 41.



Figure 41. Prevalence of having high cholesterol* among adults, 18 and over, who ever had their cholesterol tested in Michigan and United States, 2001 to 2007



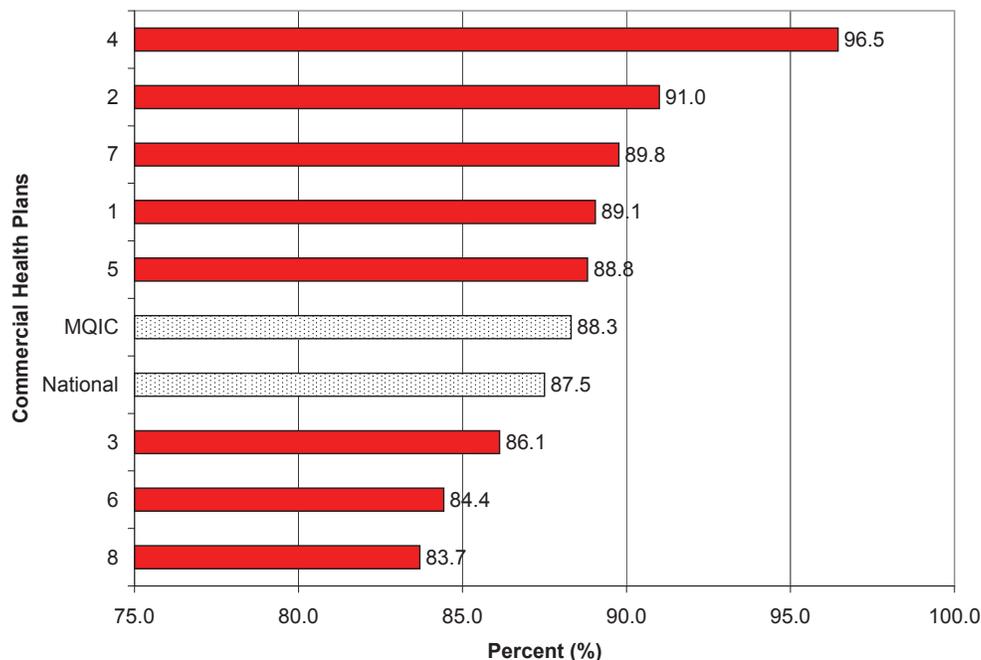
Quality Improvement

Although high blood cholesterol is a risk factor for developing cardiovascular disease, especially coronary heart disease, it is also important to manage cholesterol levels among patients with existing cardiovascular conditions. Screening and management of cholesterol can be very effective in reducing cardiovascular disease.¹² Quality improvement efforts include monitoring performance measures by health plans. This is important in ensuring patients with cardiovascular conditions are screened for cholesterol and other risk factors. One HEDIS[®] measure assesses the percentage of members hospitalized for acute myocardial infarction, coronary artery bypass graft or percutaneous transluminal coronary angioplasty who received an LDL-C screening between 60 and 365 days after discharge. The health plans, listed below, are publicly reporting plans that provide services in Michigan. The plans have been assigned a number and the same number is used in the blood pressure section for comparability of health plan performance between performance measures. See the boxes on page 71 and 75 for more information on MQIC and HEDIS[®].

In 2006, the national prevalence for cholesterol screening among patients with cardiovascular conditions was 87.5%. The MQIC rate was 88.3%. There were five Michigan commercial plans that were above the national rate and the MQIC rate and three that were below, Figure 42.



Figure 42. Percent of patients that had prior cardiovascular conditions and had their cholesterol screened in the past year by commercial health plan in Michigan, 2006



Sources: National Committee for Quality Assurance (NCQA), Healthcare Effectiveness Data and Information Set (HEDIS®) and Michigan Quality Improvement Consortium (MQIC).

Healthcare Effectiveness Data and Information Set (HEDIS)®

The Healthcare Effectiveness Data and Information Set (HEDIS®) is a set of performance data developed and maintained by the National Committee for Quality Assurance (NCQA), and is the most widely used standardized performance measure in the managed care industry. HEDIS is part of an integrated system to establish accountability in managed care. It is designed to assure that employers, regulators, public purchasers, and consumers have the information they need to compare the performance of managed care plans. According to NCQA, 90% of America's health plans measure performance using HEDIS®.

The NCQA receives reports on these measures from health plans and insurers and presents these measures separately for different types of plans (commercial, Medicaid) and compared to national and regional benchmarks. Only state rankings and data from publicly reporting plans are presented in this report. Commercial plans are assigned a consistent number throughout the report to demonstrate that a plan's ranking and performance may vary between measures.

Sources: <http://www.ncqa.org/tabid/59/Default.aspx> and http://www.michigan.gov/mdch/0,1607,7-132-2943_4860-39268--,00.html



Overweight and Obesity

Why is it important?

Overweight and obesity are terms for weight that is above what is generally considered healthy. According to the National Heart, Lung and Blood Institute, clinical assessment of overweight and obesity involves using three key measures: body mass index (BMI), waist circumference, and risk factors for diseases and conditions associated with obesity.³⁵

BMI is computed by dividing an individual's body weight by the square of their height, see Appendix S. For adults, BMI is interpreted using standard weight status categories that are the same for all ages and gender, see Figure 43.³⁶

Figure 43. Body mass index chart for adults, age 20 and over

BMI	Weight Status
<18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
≥30.0	Obese

Source: CDC, Department of Health and Human Services.

For children and teens, BMI age- and sex-specific percentiles are used because the amount of body fat changes with age and the amount of body fat differs between girls and boys, Figure 44.

Figure 44. Body mass index chart for children, ages 2 to 18 years

Percentile of Age/Sex	Weight Status
<5th	Underweight
5th - 85th	Normal
85th - 94th	Overweight
≥95th	Obese

Source: 2007 Expert Committee Recommendations.

Impact of Heart Disease and Stroke in Michigan



Overweight people are more likely to have high blood pressure, a major risk factor for heart disease and stroke. Being overweight is associated with angina and sudden death from heart disease or stroke. Overweight people are twice as likely to develop type 2 diabetes as people who are not overweight.¹⁸ Obesity is a major risk factor for coronary heart disease, which can lead to a heart attack. Obesity raises blood cholesterol and triglyceride levels and lowers HDL “good” cholesterol.¹²

In 2005, an estimated 142 million United States adults were overweight (66% of all adults) and 67.3 million of the 142 million were obese (31%). In 2002 dollars, the direct cost of overweight and obesity was \$92 billion and \$40 billion, respectively, in indirect costs, with a combined total of \$132 billion.¹

The *Healthy People 2010* goal for obesity is to reduce the proportion of adults, 20 years and older, who are obese to 15%. In 2005 to 2006, 34.6% of adults were obese, more than double the goal. This includes 33.3% of men and 35.3% of women.³⁷

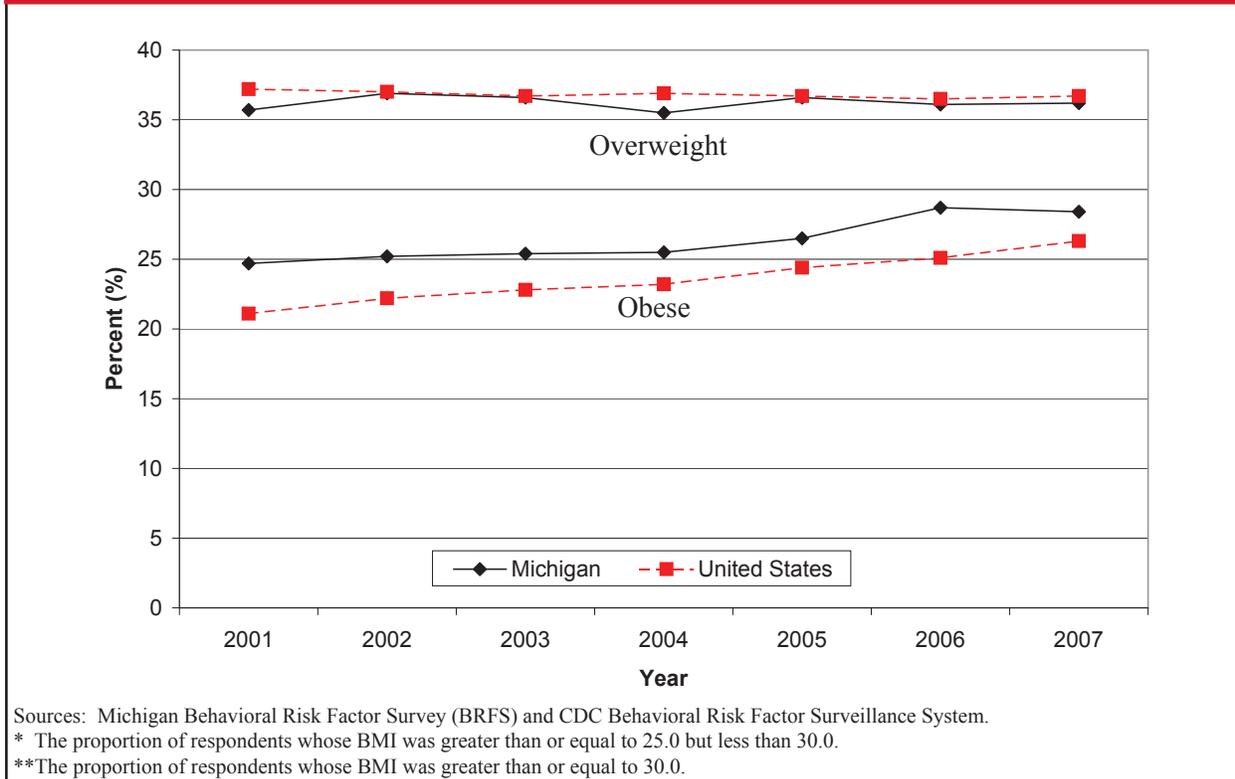
What is the scope of the problem?

In 2007, 36.2% of the Michigan adult population was overweight and an additional 28.4% were obese. This means that only 35.4% of Michigan adults had a BMI below 25. Overweight and obesity prevalence is increasing in Michigan. Since 2001 there has been a 1.5% increase in overweight adults and a 15% increase in obese adults. Michigan’s rate of obesity is above the United States median (26.3% in 2007), Figure 45. Although the rates for the United States and Michigan have risen since 2001, the United States rate has risen faster (24.6%) than Michigan’s rate. In 2007, Michigan was ranked the 16th best for prevalence of overweight adults, however, we were ranked 13th worst for prevalence of obese adults.

In Michigan, males (41.5%) were more likely than females (30.9%) to be overweight. When obesity and overweight prevalences are combined, black non-Hispanics have a higher prevalence (73.0%) than white non-Hispanics (67.6%) and other non-Hispanics (57.7%). Almost 11% of those who are overweight or obese do not have health care coverage. This is lower than the 13.4% of those in the normal weight range who do not have health insurance.



Figure 45. Prevalence of overweight* and obese adults, 18 and over, in Michigan and United States, 2001 to 2007**



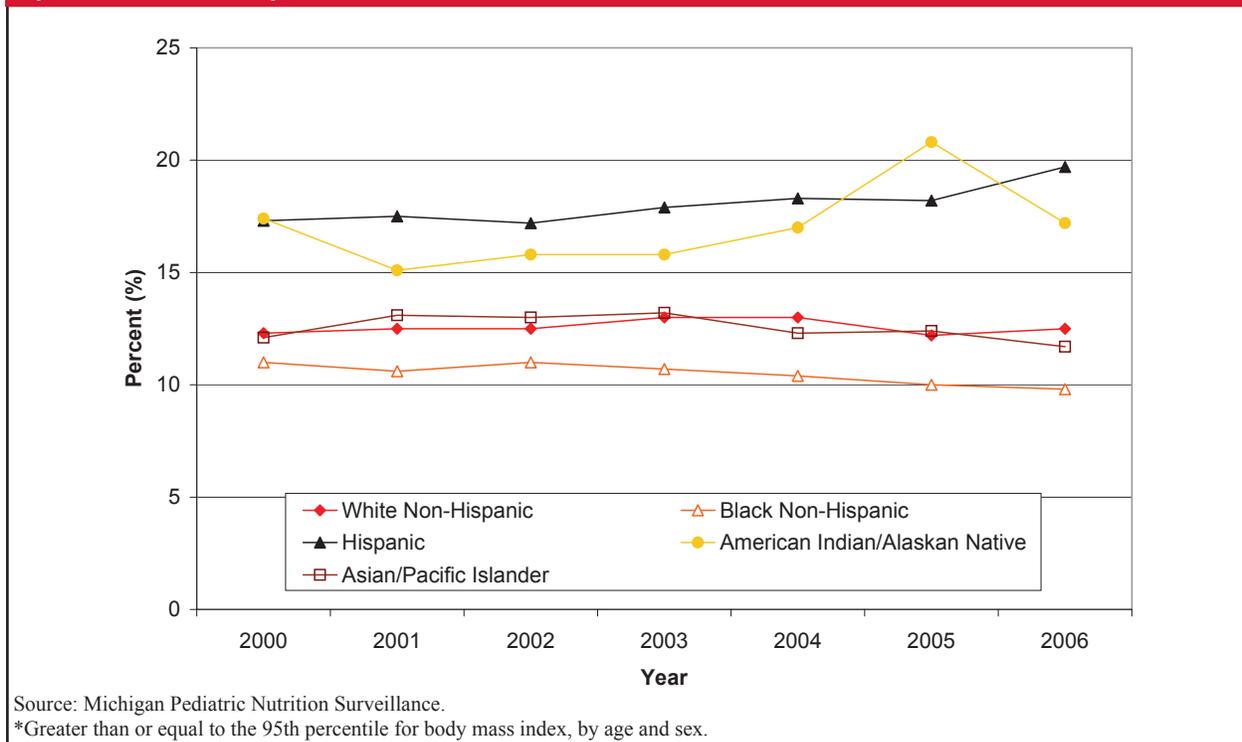
Impact of Heart Disease and Stroke in Michigan



Children

Michigan and the United States are also seeing high BMI in children. The Women, Infants and Children (WIC) program provides food, education and referrals to health and social services to participants. These services are available to low income families and children, up to five-years of age, determined to be nutritionally at risk.³⁸ In Michigan in 2006, 13.3% of these low-income children, two to four-years-old, were at or above the 95th percentile or obese. There were another 16.2% that were overweight. Hispanics and American Indian/Alaskan Natives had the highest percent of children that were obese and black non-Hispanics had the lowest from 2000 to 2006, Figure 46.

Figure 46. Prevalence of obesity* among low-income children, 2 to 4-years-old, in Michigan by race and ethnicity, 2000 to 2006



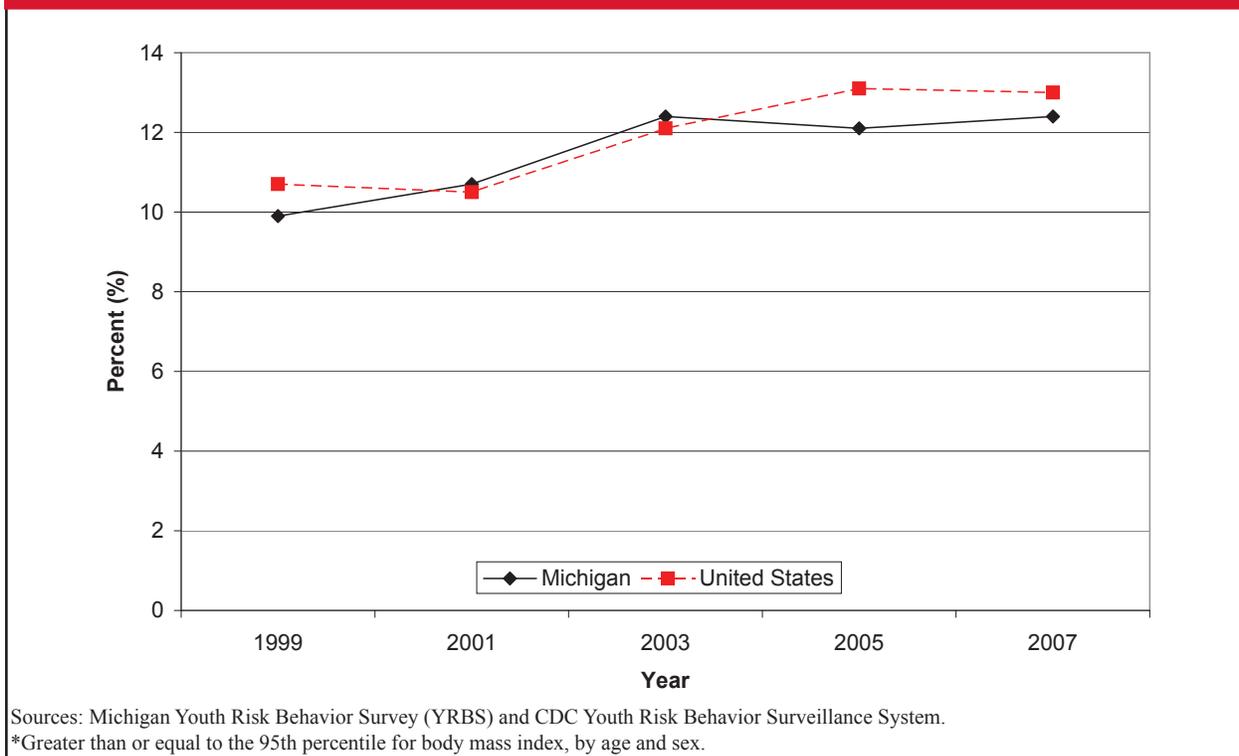
Impact of Heart Disease and Stroke in Michigan



Youth

Although Michigan adults have a higher prevalence of obesity than the United States, this changes when we compare Michigan youth to United States youth. Figure 47 shows the trend of Michigan and United States youth, grades 9 through 12, whose body mass index is greater than or equal to the 95th percentile (i.e., obese). Michigan is at the same level as the United States if not below. The prevalence of obese youth in Michigan has increased from 10.9% in 1999 to 12.4% in 2007, however, this is not a statistically significant change. In 2007, there were an additional 16.5% of youth who reported weight that is overweight. Black youth (18.5%) also had the highest prevalence of obesity compared to whites (11.2%).

Figure 47. Prevalence of obesity* youth, grades 9 through 12, in Michigan, 1999 to 2007





Physical Inactivity

Why is it important?

The United States Department of Health and Human Services (DHHS) and the United States Department of Agriculture (USDA) recommend that Americans engage in at least 30 minutes of moderate-intensity physical activity, above usual activity at work or home, on five or more days of the week or 20 minutes of vigorous physical activity three or more days a week to reduce the risk of chronic disease. Recommendations published by the American Heart Association (AHA) and the American College of Sports Medicine (ACSM) and the DHHS also state that it is necessary to engage in approximately 60 minutes of moderate-to-vigorous-intensity activity on most days of the week to manage body weight and prevent gradual, unhealthy body weight gain in adulthood. Leading authorities also stress that greater benefit is achieved by activity of greater duration and/or intensity, and that resistance exercise should be performed to enhance skeletal muscle strength and endurance and stretching exercises for improved flexibility.³⁹

Physical inactivity is a major risk factor for developing coronary heart disease. The relative risk of coronary heart disease with physical inactivity is between 1.5 and 2.5. Regular physical activity decreases the risk of developing other chronic diseases including stroke, hypertension, type 2 diabetes, colon cancer and osteoporosis. Physical inactivity is also strongly correlated to increasing most of the cardiovascular risk factors such as obesity, high blood pressure, high triglycerides, high cholesterol and diabetes. Physical activity helps to achieve and maintain a healthy weight while contributing to the health of bones, joints, and muscles. It can also reduce feelings of anxiety and depression.⁴⁰ Even though the benefits of physical activity are apparent, less than half of adults in the United States engage in physical activity regularly.⁴¹

The cost of physical inactivity in 2000 was \$76.6 billion in the United States.¹ In 2002, the cost in direct and indirect costs was \$8.9 billion in Michigan alone.⁴²

Healthy People 2010 aims to reduce the proportion of adults who engage in no leisure-time physical activity to 20%. As of 2005, adults in the United States reported through the National Health Interview Survey that 40% are still not getting any physical activity.

What is the scope of the problem?

In 2007, almost half (49.4%) of the adult population in Michigan were estimated to not meet the minimum physical activity in a week (30 minutes of moderate physical activity five or more days a week or 20 minutes of vigorous physical activity three or more days a week). This percentage increased with age group, topping off with 57.4% of those aged 65 and older not meeting the requirement. Blacks (59.0%) had the highest prevalence of inadequate physical activity compared with whites (48.1%) and Hispanics (33.4%). The prevalence of inadequate physical activity decreased with increasing household income. The highest prevalence coming from households with an income of less than \$20,000 (56.6%) and the lowest inadequate physical activity prevalence from the households with \$75,000 or more in income (43.8%).

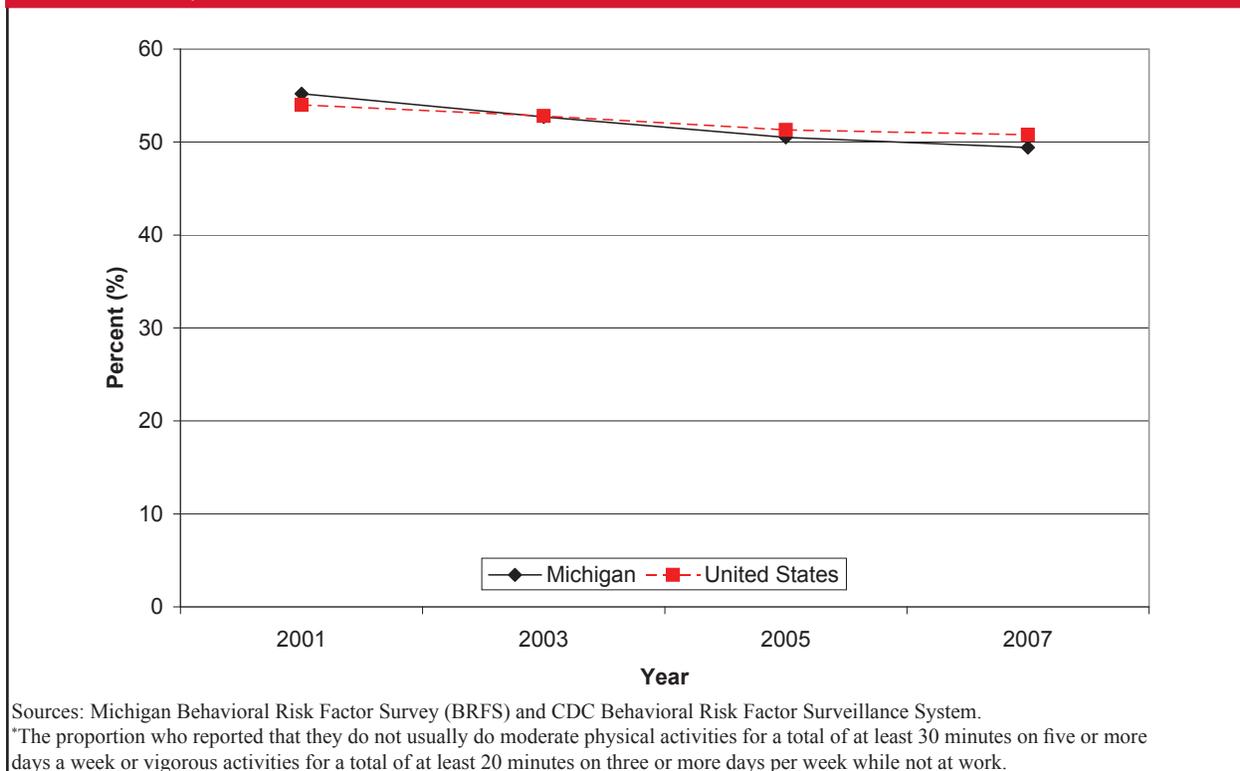
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Michigan's prevalence of inadequate physical activity has been slightly lower than the United States median since 2003, Figure 48. Lack of health care coverage was very similar between the group that achieved adequate physical activity (12.9%) and the group that did not (11.1%).

Almost 21% reported that they had not done any leisure time physical activity in the past month. Females (23.3%) compared to males (18.3%) and blacks (29.8%) compared to whites (18.5%) had the highest prevalence. No leisure time physical activity also appears to change with income, decreasing from 34.9% of those with a household income of less than \$20,000 to 10.9% of those with an income of more than \$75,000. College graduates (12.5%) reported the lowest prevalence of no leisure-time activity and less than high school graduates (35.5%) reported the highest.

Figure 48. Prevalence of inadequate physically active* adults, 18 and over, in Michigan and United States, 2001 to 2007



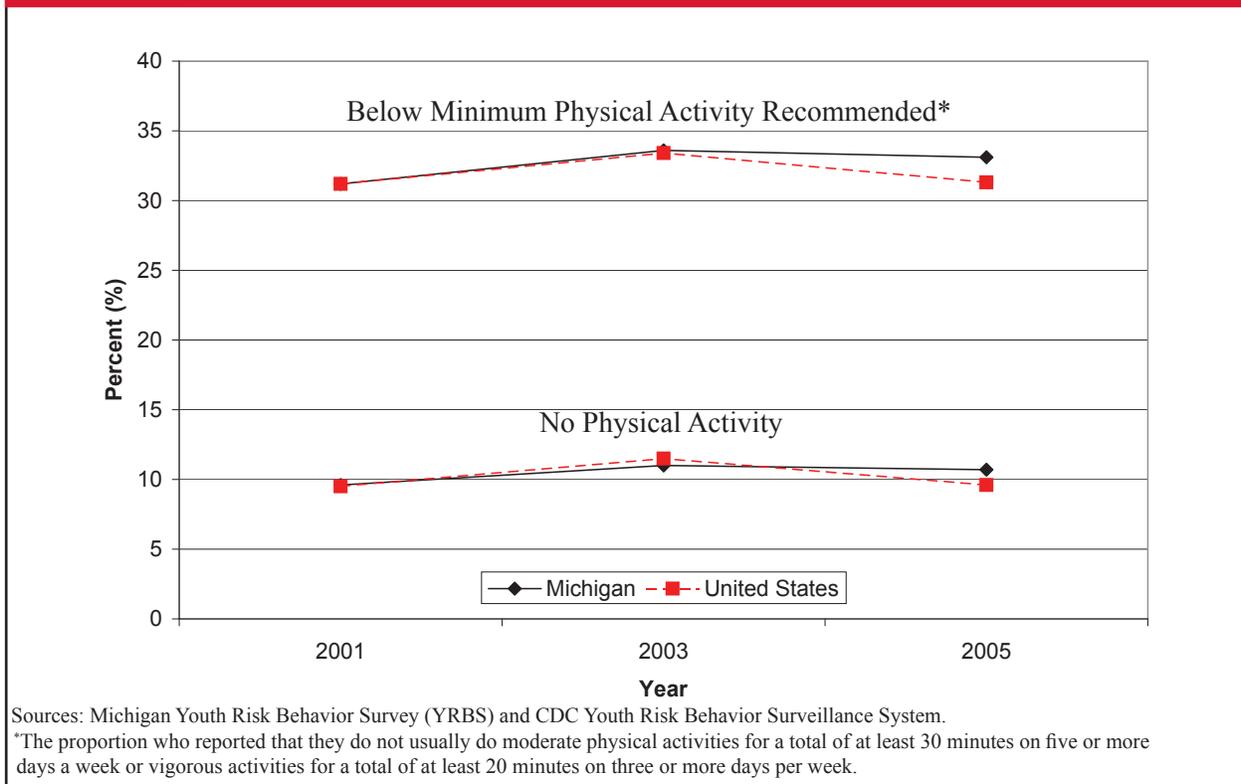
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Youth

In 2005, 33.1% of Michigan youth in grades 9 through 12 did not meet the recommended amount of physical activity, this was higher than the United States rate (31.3%). Included in the 33.1% of Michigan youth not meeting the recommendations were 10.7% who reported no physical activity in the past seven days. Almost 37% of females did not meet the recommendations compared to 29.3% of males.

Figure 49. Prevalence of physically inactive youth, grades 9 through 12, in Michigan and United States, 2001 to 2005



In 2007, the Youth Risk Behavior Survey changed their measure of recommended physical activity to prevalence of students who were physically active for 60 minutes or more on five or more of the last seven days. In Michigan, 44% of the youth reported that they met this new recommendation, meaning 56% did not. Males (52.7%) more frequently met the recommendation than females (35.5%), as did whites (45.8%) compared to blacks (41.0%).



Dietary Behavior

Why is it important?

Research shows that good nutrition can help to lower people's risk for many chronic diseases, including heart disease, stroke, some cancers, diabetes, and osteoporosis. However, a large gap remains between healthy dietary patterns and what Americans actually eat.⁴³

The *2005 Dietary Guidelines for Americans* published by the U.S. Department of Health and Human Services (DHHS) and the U.S. Department of Agriculture (USDA) recommend that adults consume a variety of nutrient-dense foods and beverages within and among the basic food groups while choosing foods that limit the intake of saturated and *trans* fats, cholesterol, added sugars, salt, and alcohol. The guidelines urge the consumption of two cups of fruit and two-and-one-half cups of vegetables per day (see box), three or more ounce-equivalents of whole-grain products per day, and three cups per day of fat-free or low-fat milk or equivalent milk products. Adults should also aim for less than 10% of calories from saturated fatty acids and less than 300 mg/day of cholesterol.

More Matters

In March 2007, the Five-A-Day program became the National Fruit and Vegetable Program and launched a new public health initiative, Fruits & Veggies-More Matters, in order to reflect the new dietary guidelines, which recommend *more* than five servings of fruits and vegetables for some Americans.

The Dietary Guidelines for Americans, released in January 2005, changed fruit and vegetable recommendations for all Americans. Previous dietary guidelines recommended a range of five to nine servings of fruits and vegetables a day. The new guidelines recommend 2 to 6 1/2 cups of fruits and vegetables a day or the equivalent of 4 to 13 servings. Through consumer research, it was found that a cup measurement is a more understandable and a more motivating tool for helping consumers visualize the amount of fruits and vegetables they should eat. See Appendix T for fruit and vegetable guidelines by age and activity level.

Sources: Dietary Guidelines for Americans and CDC More Matters

Total fat intake should remain between 20% to 35% of calories, with most fats coming from sources of polyunsaturated and monounsaturated fatty acids, such as fish, nuts and vegetable oils. When selecting and preparing meat, poultry, dry beans, and milk or milk products, it is recommended that consumers make choices that are lean, low-fat, or fat-free.⁴⁴

Impact of Heart Disease and Stroke in Michigan



Controlling total fat intake is important because fats have more than twice as many calories as protein and carbohydrates. Unhealthy eating contributes largely to obesity. Too much fat, not enough fiber, and too many simple carbohydrates all contribute to a diagnosis of diabetes. Ninety percent of people who have been diagnosed with type 2 diabetes are overweight. Eating too much saturated fat can raise blood cholesterol levels, which increases the risk of coronary artery disease and heart attack. In some people, too much sodium causes blood pressure to rise. High blood pressure constricts the arterioles, making them resistant to blood flow. This makes the heart work progressively harder to pump enough blood to the body's tissues and organs. High sodium levels also cause the body to retain fluid, which increases the heart's workload. People with heart failure and other heart conditions need to be especially careful not to put this extra strain on their heart.¹²

Medical expenditures and lost productivity due to heart disease, cancer, stroke and diabetes associated with poor nutrition cost the United States \$42 billion each year.¹

Nutrition and Physical Activity Survey

The 2002 Michigan Nutrition and Physical Activity Survey was conducted using a BRFSS-like protocol. Results indicate that one-third of Michigan adults thought that their eating habits were excellent to very good, while 42% thought their eating habits were good and 25% fair to poor. One-in-four consumed fruits and vegetables \geq five times/day, and Michigan adults were estimated to eat about three different types of fruit and 3.6 different vegetables per week. Sixty-five percent were trying to decrease or limit the fat in their diet and 41% the salt or sodium. Forty-five percent reported that they read nutrition labels on foods they eat at least most of the time. The majority (69%) ate restaurant or take-out food \geq one time/week, and 14% \geq five times/week.

The majority (92%) reported that there was a grocery store near them that had a good variety of foods, and 88% reported there were safe and convenient places in their community to bicycle or walk for exercise. Among employed adults, 37% reported that their workplace encouraged employees to be more physically active.

Impact of Heart Disease and Stroke in Michigan

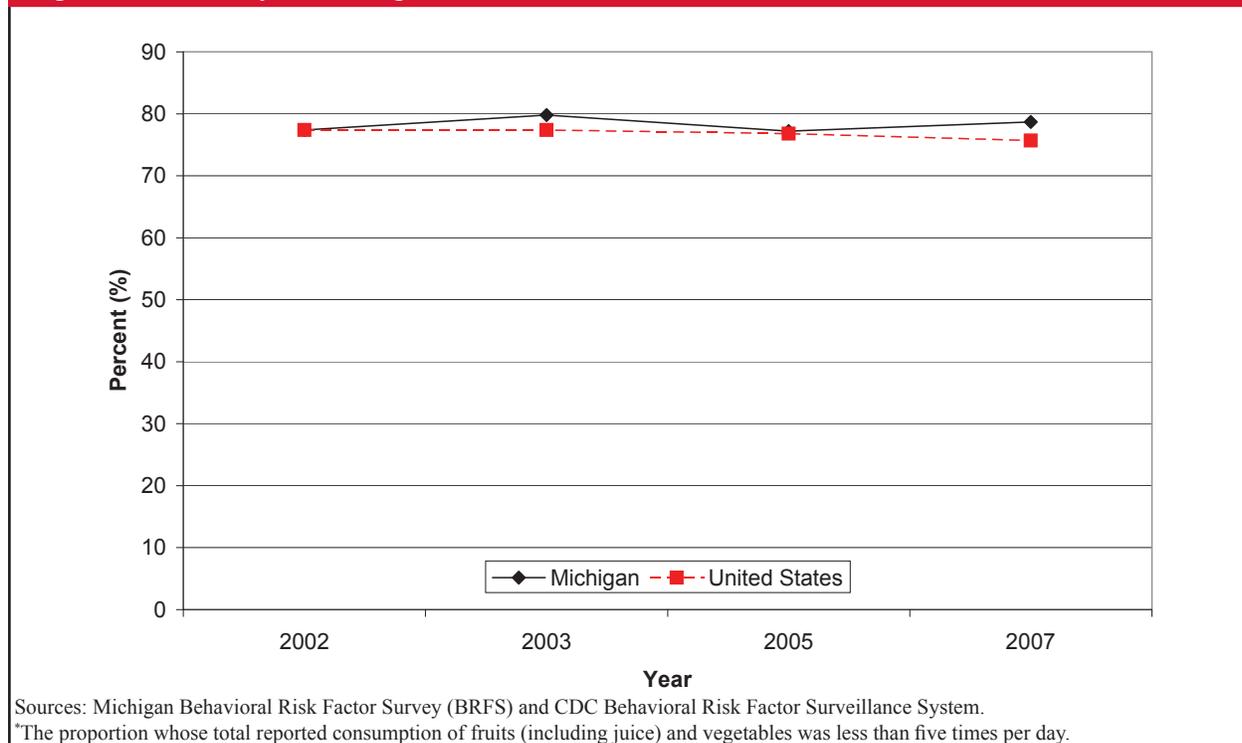


What is the scope of the problem?

The DHHS and USDA recommend that each person eat at least five servings of fruits and vegetables a day. In 2007, only 21.3% of Michigan residents reported that they met this goal. Michigan females were more likely to meet the fruit and vegetable recommendations than Michigan males (25.7% and 16.4% respectively). Fruit and vegetable consumption did not vary by race but did vary by age with those 65 years and older having the highest percentage reporting getting the recommended five servings (16.0%) and 35 to 64-year-olds having the lowest (20.2%).

The United States five-a-day attainment rate has slightly decreased from 77.4% in 2002 to 75.7% in 2007. Michigan's rate remained relatively constant across the same period, Figure 50. In Michigan, people who met the guidelines were less likely to be without insurance (9.4%) than those who did not get adequate fruit and vegetable consumption (13.0%).

Figure 50. Prevalence of adults, 18 and over, who consumed fewer than five fruits and vegetables* in a day in Michigan and United States, 2002 to 2007

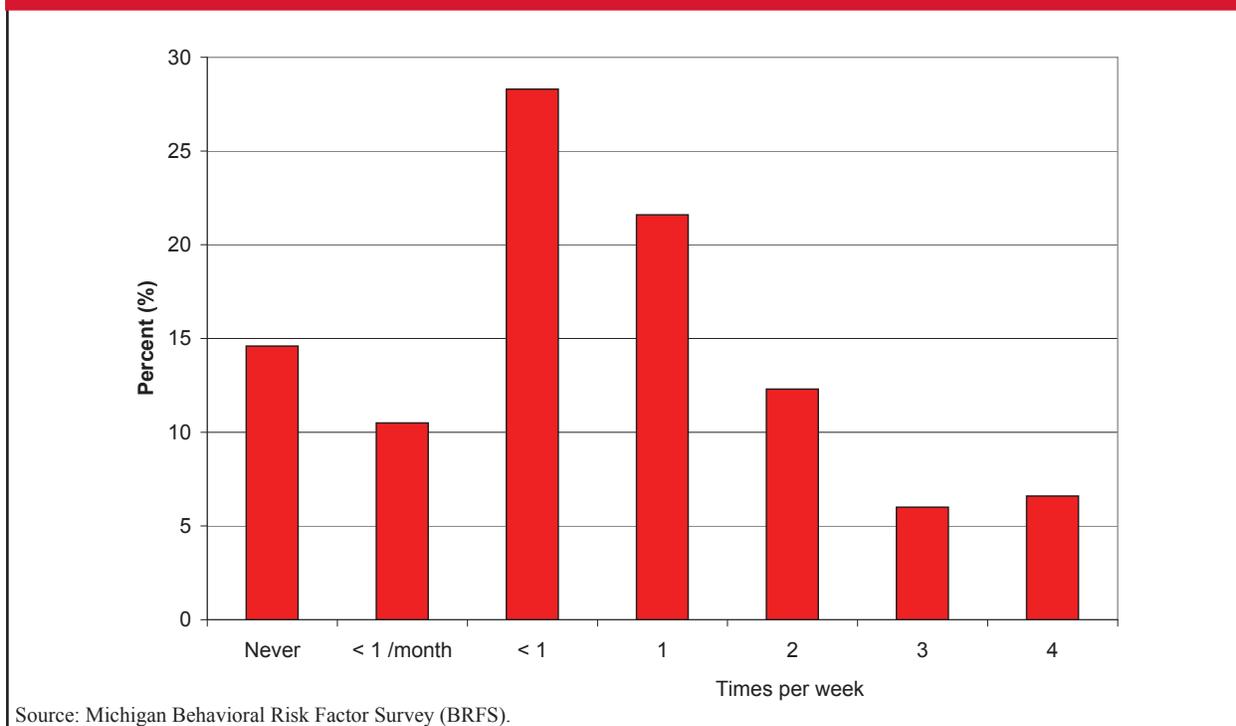


Impact of Heart Disease and Stroke in Michigan



Fast food consumption is also related to poor nutrition. In 2005, nearly 15% of Michigan adults never went to a fast food restaurant, Figure 51. Whereas one in four (24.9%) did so regularly, defined as two or more times per week. The prevalence of regular fast food consumption decreases steadily from 36.5% of the group 18 to 24 years to 11.3% of those age 65 and older. More males (30.4%) than females (20.0%) were regular fast food consumers. Also, blacks (30.3%) had a higher prevalence of regular fast food consumption than whites (23.9%). The main reasons people reported going to fast food restaurants were speed and convenience (62.7%), taste of the food (17.1%), sociability (8.1%), cost (6.1%) and convenient location (3.3%).

Figure 51. Frequency of fast food consumption among adults, 18 and over, in Michigan, 2005

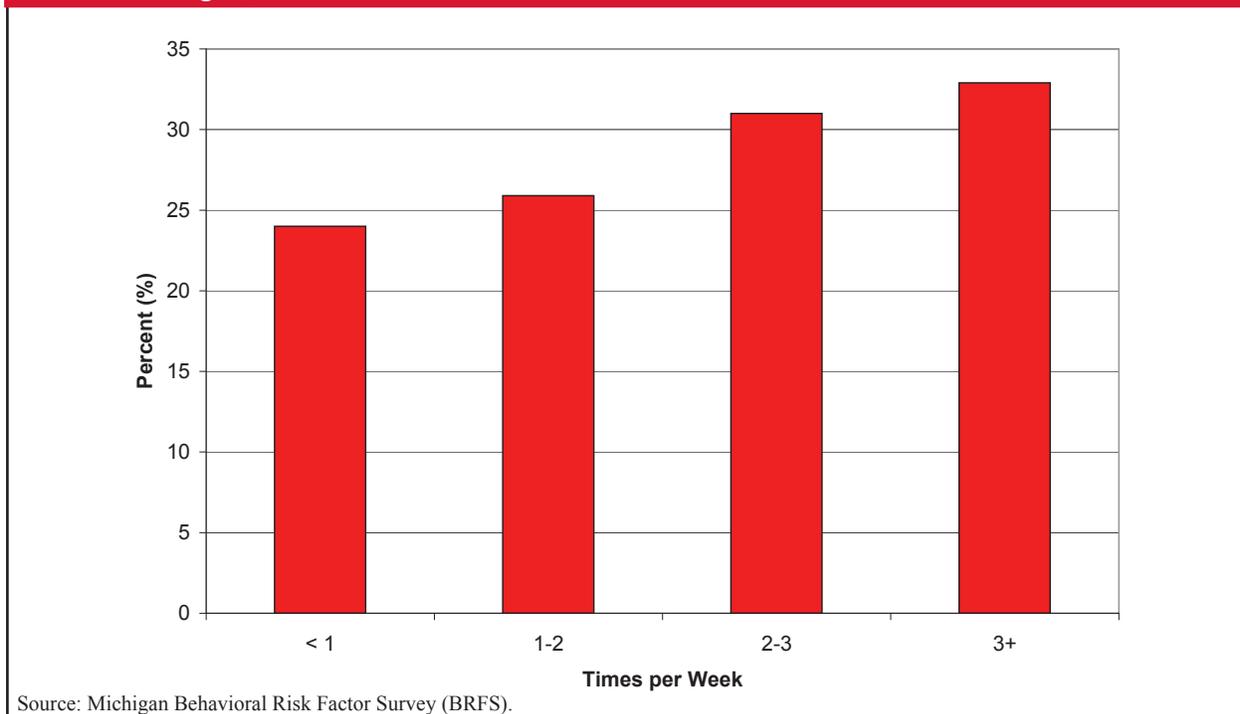


Impact of Heart Disease and Stroke in Michigan



Fast food consumption was also associated with higher body mass index. The prevalence of obesity increased with increased number of visits to fast food restaurants in a week. It rose from 24.0% of those who ate fast food less than once a week to 32.9% of those who went more than three times a week, Figure 52. The odds of being obese were about 60% greater for those eating fast food two or more times a week compared with those consuming it less frequently.

Figure 52. Prevalence of obesity by frequency of fast food consumption among adults, 18 and over, in Michigan, 2005



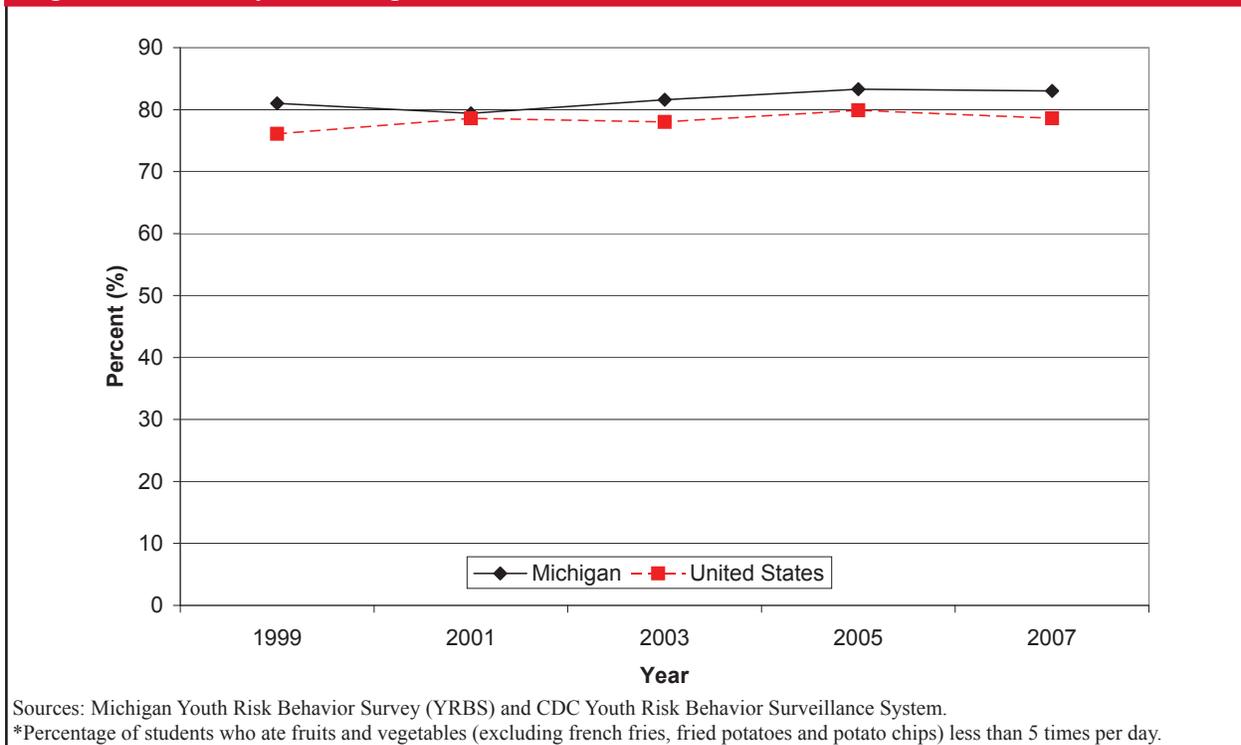
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Youth

In 2007, Michigan students reported that they ate the following one or more times in the past seven days: fruit (84.3%), green salad (64.7%), potatoes (71.4%), carrots (48.3%) and other vegetables (82.2%). However, when asked if they get the recommended five or more servings of fruits and vegetables every day in the past week, only 17.0% reported that they did. Over nine years, the percentage of students who reported meeting the recommendation fluctuated between 19.0% in 1999 to 17.0% in 2007, Figure 53.

Figure 53. Prevalence of youth, grades 9 through 12, who consumed fewer than five fruits and vegetables* in a day in Michigan and United States, 1999 to 2007





Diabetes Mellitus

Why is it important?

Diabetes is a disease in which the body does not produce or properly use insulin. Insulin is necessary for the body to be able to utilize glucose for energy. When you eat food, the body breaks down all of the sugars and starches into glucose, which is the basic fuel for the cells in the body. Insulin takes the sugar from the blood into the cells. When glucose builds up in the blood instead of going into cells, the cells may be starved for energy and over time, the high blood glucose levels may damage the eyes, kidneys, nerves or heart.⁴⁵

There are three types of diabetes: type 1, type 2, and gestational diabetes. Type 1 diabetes is usually diagnosed in children and young adults, previously known as juvenile diabetes. In type 1 diabetes, the body does not produce insulin. In type 2 diabetes, the most common form of diabetes, either the body does not produce enough insulin or the cells ignore the insulin. Gestational diabetes is when women who have never had diabetes before have high glucose levels during pregnancy. Babies with excess insulin exposure *in utero* become children who are at risk for obesity and adults who are at risk for type 2 diabetes.⁴⁵

Approximately 17.5 million people in the United States have been diagnosed with diabetes and another 8.6 million are estimated to have diabetes but are undiagnosed, totaling 26.1 million people that have diabetes in the United States. Diabetes is a significant comorbid condition and an independent risk factor for cardiovascular disease (CVD). CVD is the leading cause of death among people with diabetes, accounting for at least two out of three diabetes-related deaths.⁴⁵ Those with diabetes have a two to four times greater risk of CVD and stroke versus people without diabetes.⁴⁶ People with diabetes that have had an acute coronary event have a higher risk of death despite modern therapies.⁴⁷ Diabetes affects cholesterol levels - lowering HDL “good” cholesterol and raising triglyceride and LDL “bad” cholesterol levels - which increase the risk for heart disease and stroke.¹²

The cost of diabetes in 2007 totaled \$174 billion in the United States, which included \$116 billion in direct medical cost and \$58 billion in lost productivity. The cost of diabetes in Michigan, in 2006 dollars, was \$4.1 billion direct and \$2.1 billion indirect.⁴⁸

What is the scope of the problem?

In 2007, 9.0% of the Michigan population reported ever having diabetes, type 1 or type 2. This rate has been rising for several years, Figure 54. Since 2001, there has been a twenty-five percent increase in reported diabetes in Michigan and a 22.7% increase in the United States. This continues a trend that started in 1990. Michigan is ranked as having the 11th highest rate in the United States. A higher proportion of blacks (14.8%) compared to whites (7.8%) had been told they have diabetes.

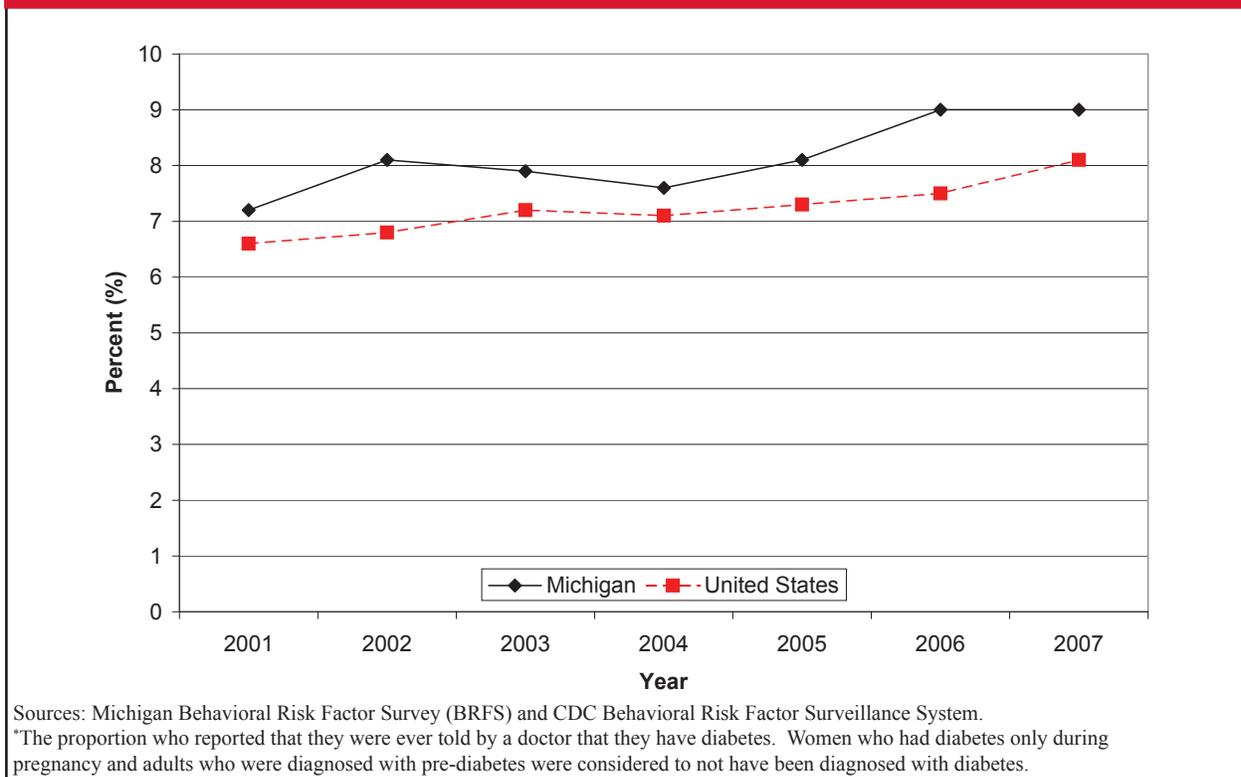
Impact of Heart Disease and Stroke in Michigan



Prevalence of diabetes decreases with increasing education and income. Adults with less than high school education (12.6%) were more likely than college graduates (5.8%) to have diabetes as were adults with a household income less than \$20,000 (16.3%) compared to adults with a household income of \$75,000 and higher (4.6%). Diabetes prevalence also increased with age, from 1.4% among adults 18 to 34 years of age to 21.1% among adults 65 years and above.

Adults with diabetes are less likely to be without health care (6.6%) than adults without diabetes (12.7%).

Figure 54. Prevalence of diabetes* among adults, 18 and over, in Michigan and United States, 2001 to 2007



Youth

Almost five percent of students reported that they have been told by a doctor or nurse that they had diabetes in 2007. More males (6.7%) than females (2.9%) reported the condition. Differences were also seen by race and ethnicity; whites reported the lowest prevalence (4.1%), followed by blacks (6.8%) and Hispanics (11.5%).



Risk Factor Clustering

Why is it important?

Metabolic syndrome is the name for a group of risk factors linked to overweight and obesity that increase a person’s chance for heart disease, diabetes and stroke. The term “metabolic” refers to the biochemical processes involved in the body’s normal functioning.

The diagnosis of metabolic syndrome is made if a person has any three out of the following five heart disease risk factors: a large waistline, a higher than normal triglyceride level, a lower than normal level of HDL cholesterol (high-density lipoprotein cholesterol), higher than normal blood pressure, or higher than normal fasting blood sugar (glucose), Figure 55.

Figure 55. Metabolic syndrome definition, having three or more of the following criteria

	Men	Women
Abdominal obesity	waist circumference >102 cm	waist circumference >88 cm
Triglycerides	>150 mg/dL	
HDL cholesterol	<40 mg/dL	<50 mg/dL
Blood pressure	>130/85 mmHg	
Fasting glucose	>110 mg/dL	

Source: National Institutes of Health, National Cholesterol Education Program.

Impact of Heart Disease and Stroke in Michigan



The more CVD risk factors you have, the greater your chance of developing heart disease, diabetes or a stroke. In general, a person with metabolic syndrome is twice as likely to develop heart disease and five times as likely to develop diabetes as someone without metabolic syndrome.³² Risk factor clustering is very similar to metabolic syndrome but without the measurements. The risk factor clustering in this chapter is based on self-reported risk factors from the Michigan Behavioral Risk Factor Survey. The seven risk factors that are used in this analysis are:

- Cigarette smoking
- High blood pressure
- High blood cholesterol
- Overweight and obesity
- Physical inactivity
- Dietary behavior
- Diabetes mellitus

What is the scope of the problem?

The Michigan Behavioral Risk Factor Survey asks adults questions about most of the cardiovascular disease (CVD) risk factors including smoking, high blood pressure, high blood cholesterol, diabetes, BMI, physical inactivity and nutrition. It is important to look at these risk factors over time because of how long it takes to develop CVD, Figure 56. Smoking prevalence was the only risk factor to show a decline in Michigan since 1990. In 2007, only 4.0% of Michigan's adult population engaged in all four healthy lifestyles (healthy weight, adequate fruit and vegetable intake, not smoking and engaging in adequate physical activity).

Figure 56. Prevalence of cardiovascular disease risk factors over time, Michigan and United States, 1990 to 2007

Risk Factor	1990	1994	1998	2001	2005	2007	US 2007
Smoking	29.2	25.4	27.5	26.1	21.9	21.1	19.7
Blood Pressure: Ever told high	23.3	NA	NA	27.1	27.8	28.6	27.5
Cholesterol: Ever told high (of tested)	27.0	NA	NA	33.0	38.9	39.9	37.5
Overweight (BMI \geq 25, includes obesity)	47.4	54.0	57.8	60.4	63.1	64.3	63.0
Obese	14.1	17.1	21.5	24.7	26.5	28.2	26.3
Fruits and Vegetables: Less than 5 servings/day	NA	70.2	73.6	NA	77.2	78.7	75.7
No Leisure Time Physical Activity	NA	23.4	21.7	23.5	22.6	20.8	23.0
Diabetes	4.9	4.6	7.0	7.2	8.1	8.8	8.1

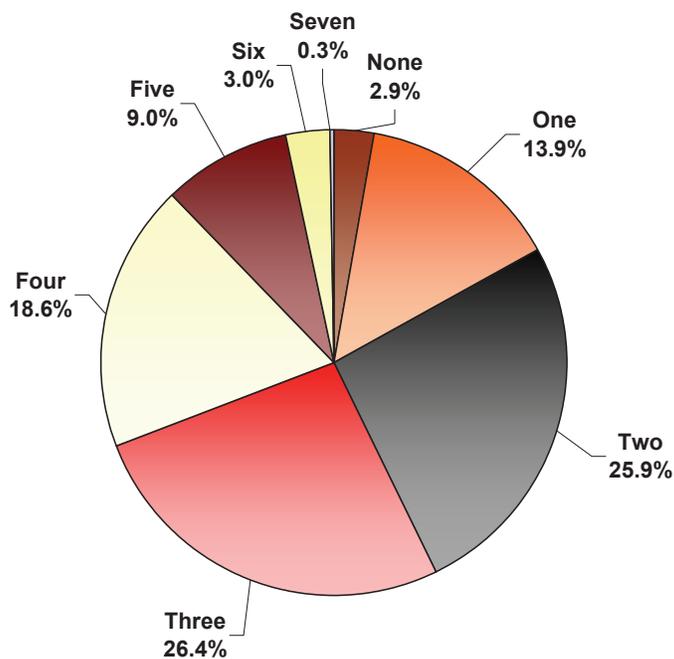
Sources: Michigan Behavioral Risk Factor Survey (BRFS) and CDC Behavioral Risk Factor Surveillance System.

Impact of Heart Disease and Stroke in Michigan



In addition to looking at each risk factor, it is also important to look at their synergistic effects. An age standardized analysis was performed to identify the number of risk factors out of the seven each adult reported in Michigan in 2007. Only 2.9% reported having no CVD risk factors. Over 57% reported three or more risk factors. Michigan adults most commonly reported three risk factors (26.4%), Figure 57.

Figure 57. Age-adjusted prevalence of having up to seven risk factors among adults, 18 and over, in Michigan, 2007



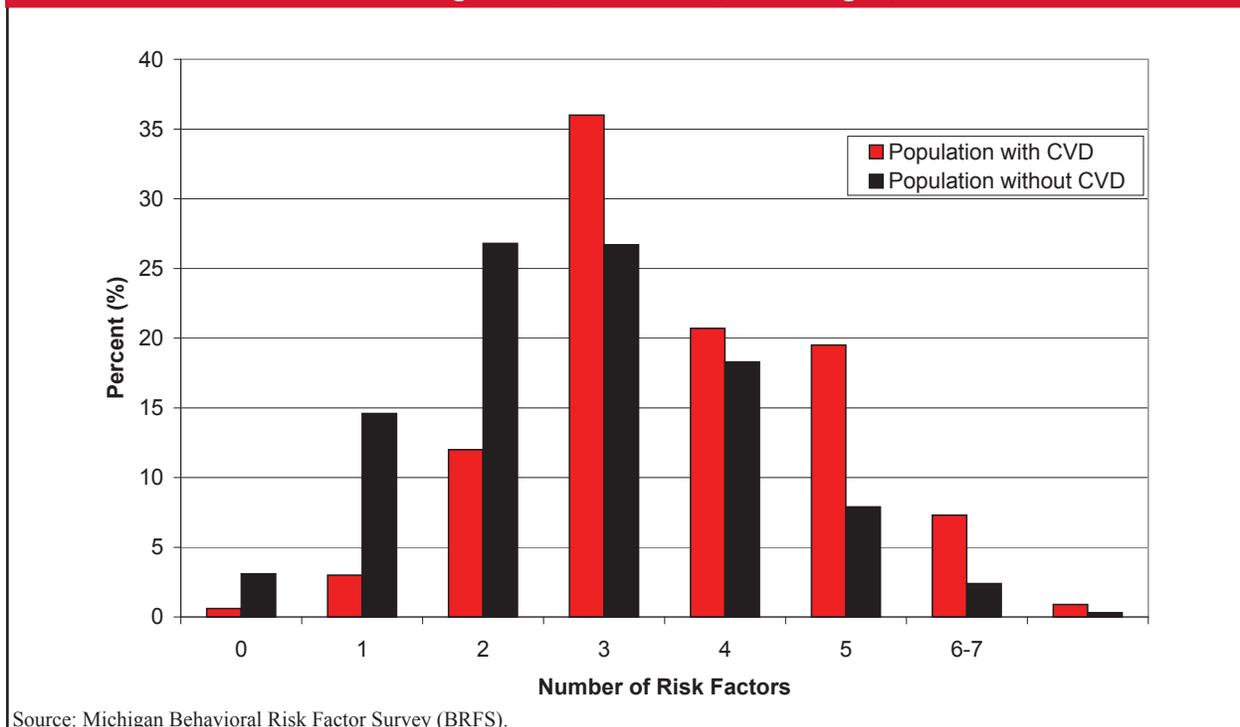
Source: Michigan Behavioral Risk Factor Survey (BRFS).

Impact of Heart Disease and Stroke in Michigan



In the same analysis, the population was broken into adults who reported CVD and those who did not. The population with the highest age-adjusted prevalence in each risk factor group shifts when it reaches three risk factors, Figure 58. Almost half (44.5%) of the population without CVD had two or fewer risk factors, compared to 15.6% of the population with CVD. In other words, the population with CVD is more likely to report having three risk factors or more than the population without CVD.

Figure 58. The number of risk factors the population with cardiovascular disease and without cardiovascular disease have among adults, 18 and over, in Michigan, 2007

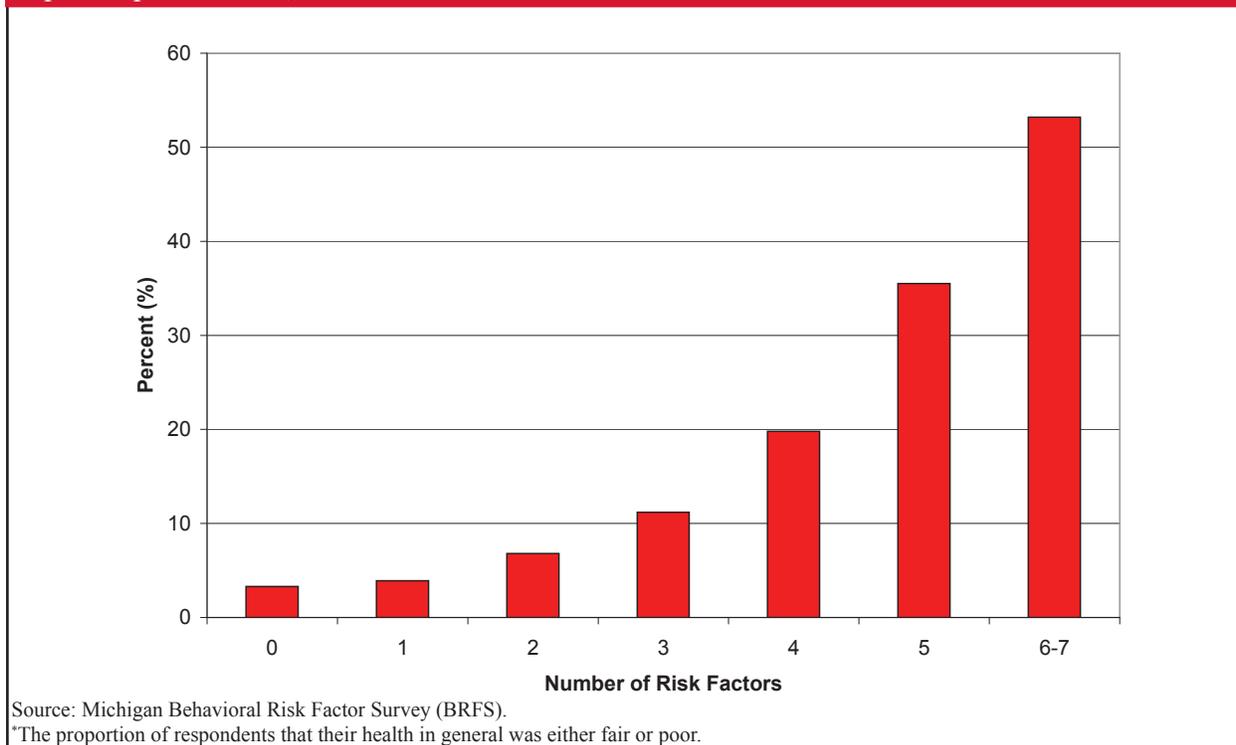


Impact of Heart Disease and Stroke in Michigan



The number of risk factors was also compared to several health status questions. The comparison was to the self-reported answer of health status: excellent, very good, good, fair or poor. For this analysis responses to fair or poor were used. As the number of risk factors reported increases so does the prevalence of a fair or poor health response, Figure 59. It increases from 3.3% of adults with no risk factors reporting a fair or poor health response to 53.2% with six to seven risk factors.

Figure 59. Number of risk factors reported among Michigan adults, 18 and over, that also reported poor health*, 2007

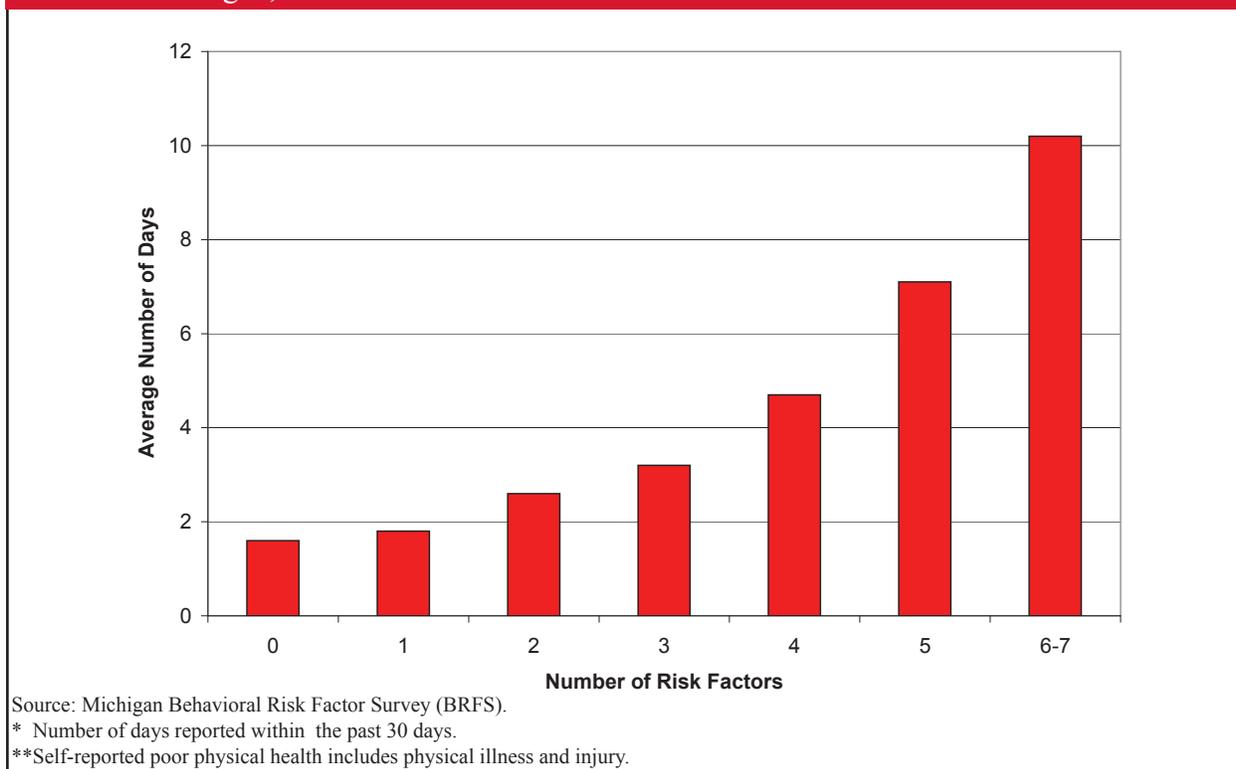


Impact of Heart Disease and Stroke in Michigan



This next comparison was to the number of days the respondent felt they had poor physical health in the past 30 days. Again, the number of poor physical health days increased with the number of risk factors. On average, an adult with no risk factors reported 1.6 days of poor health, whereas an adult with six to seven risk factors reported over ten days (10.2) of poor physical health—at least one out of three days during the month of poor physical health, Figure 60.

Figure 60. Average number of days* adults reported poor physical health** by number of risk factors in Michigan, 2007

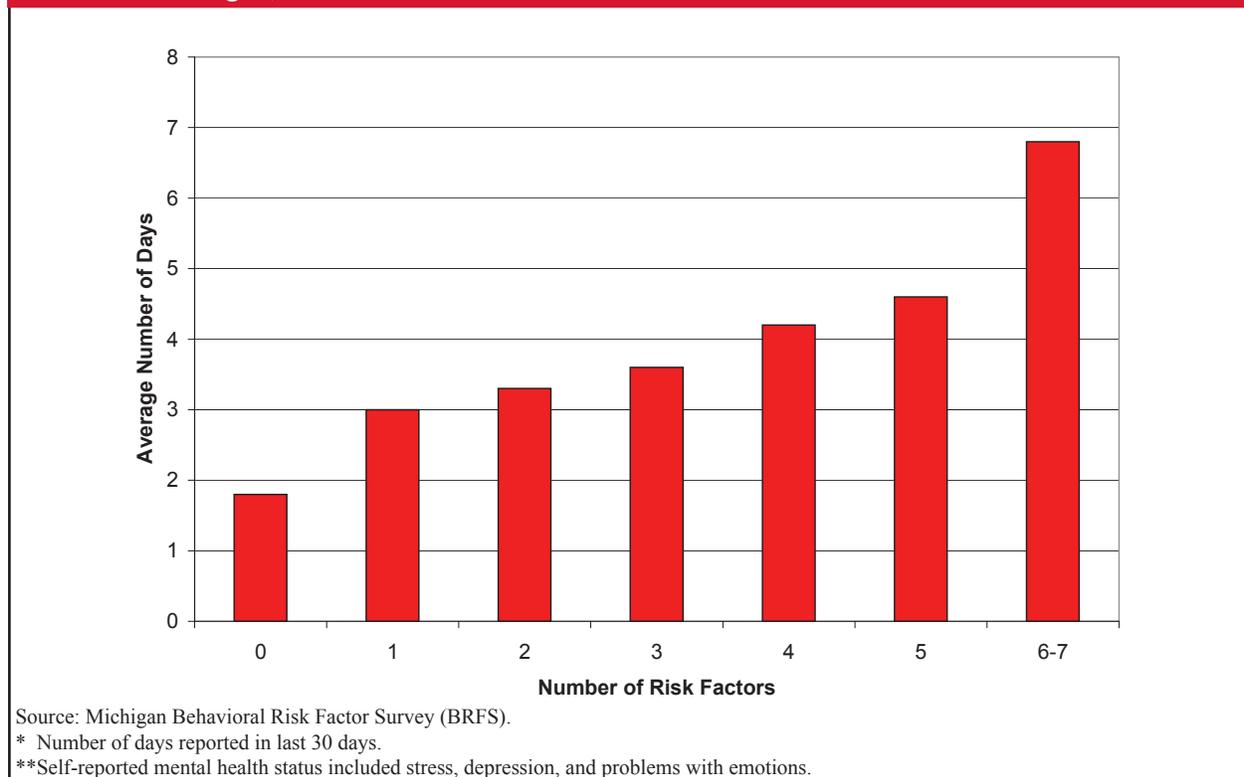


Impact of Heart Disease and Stroke in Michigan



Mental health questions were also asked in the Michigan BRFs. The respondents were asked the number of days in the past month that they had poor mental health, including stress, depression and problems with emotions. Figure 61 displays the data from comparing number of risk factors by number of days with poor mental health that was reported. The number of days ranged from 1.8, no risk factors, to 6.8, six/seven risk factors.

Figure 61. Average number of days* adults reported poor mental health** by number of risk factors in Michigan, 2007

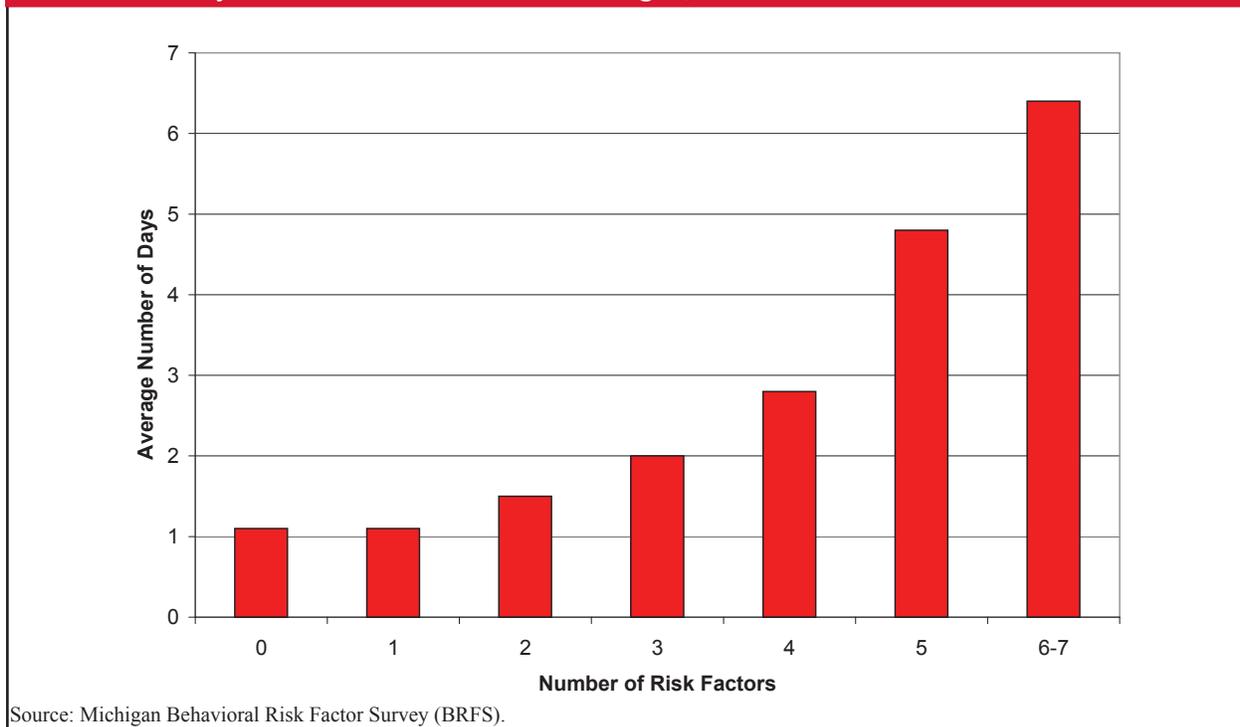


Impact of Heart Disease and Stroke in Michigan



Finally, the number of risk factors were compared with the number of days in the past month that physical or mental health kept respondents from doing their usual activities. As the number of reported risk factors increases so does the number of days that activity was limited, Figure 62. The lowest mean reported number of days was 1.1 for adults with either zero or one risk factor and goes up to 6.4 days for those with six/seven risk factors.

Figure 62. Average number of days adults reported activity limitations due to physical and mental health by number of risk factors in Michigan, 2007





Summary

Cardiovascular disease (CVD) continues to be the leading cause of death in Michigan and the United States. Although rates of CVD hospitalization and mortality have decreased, these diseases are still a serious burden in Michigan. The state's mortality rate continuously has been above the national rate between 2000 and 2005. For example, Michigan's rate was 297.2 per 100,000 compared to 277.3 per 100,000 (United States) in 2005.

The burden of CVD is not evenly distributed across racial groups in Michigan. While CVD hospitalization rates are decreasing for most racial/gender groups, rates among black males continue to rise. This is in part due to the rise in heart failure hospitalizations among black males. Black males have the highest hospitalization rates for four of the five diseases discussed in this report (cardiovascular disease, heart disease, heart failure and stroke), followed by rates among black females. Coronary heart disease hospitalization rates are highest among white males.

Geographic disparities in CVD also exist in Michigan. Five contiguous counties (Arenac, Bay, Gladwin, Clare and Ogemaw) had the highest hospitalization rates of all counties for all the cardiovascular diseases except for stroke. Sanilac County had one of the highest mortality rates for each of the five diseases, including stroke. Ogemaw County also had one of the highest mortality rates for all the diseases but stroke.

The burden of CVD on Michigan is expected to increase, in part as the population ages appreciably over the next decade. The proportion of population over 65 years of age is expected to increase from 12.5% in 2006 to 16.8% by 2020. This age group experiences the highest rates of CVD hospitalization and mortality. Consequently, this demographic shift will lead to a higher CVD burden and a concurrent increased demand on the medical community. The age group 85 years and older consistently has the highest hospitalization rates with cardiovascular diseases, except coronary heart disease where the two oldest groups, 65 to 84 years and 85 years and older have similar rates.

Aging will not be the only reason for increasing burden. Although smoking rates in Michigan and the United States have declined, prevalence of other risk factors for CVD have either remained constant or increased. In fact, Michigan's prevalence of risk factors is one of the worst in the nation: 16th worst in smoking, 17th worst in high blood pressure, 13th worst in obesity and 11th worst in diabetes. In 2007, only 4.0% of Michigan adults had all four of the healthy lifestyle characteristics (healthy weight, adequate fruit and vegetable intake, not smoking and engaging in adequate physical activity). In 2007, 2.9% of adults reported having no CVD risk factors and over 57% reported having three or more risk factors.

Youth in Michigan are also experiencing risk factors associated with CVD. Over twelve percent of the youth, grades 9 through 12, in Michigan were obese and an additional 12.4% were

Impact of Heart Disease and Stroke in Michigan



overweight in 2007. There is continuing work to reduce and prevent smoking among youth. The prevalence of youth that use cigarettes has declined for a number of years, from 38.2% in 1997 to 18.0% in 2007. One-third of youth are not getting adequate physical activity and less than one-fifth meet nutritional recommendations. These are behaviors that they could carry with them for the rest of their lives.

Although not modifiable, another important risk factor is family history - an estimated 6% of Michigan residents have a family history of sudden cardiac death of the young. Two-hundred and eighty people in Michigan between the ages of 1 and 39 die suddenly each year due to this disease. Understanding family history of cardiovascular disease and its risk factors can inform actions people take to keep healthy.

Insurance status is another factor related to the prevention of CVD burden in Michigan. Lack of health care coverage may keep people from being screened for certain risk factors. Almost 29% of Michigan adults that had never been screened for blood cholesterol did not have insurance. However, missed opportunities for preventive behavior is not limited to issues of insurance. In 2007, 78.0% of Michigan adults not currently taking medicine for their high blood pressure had health coverage. This statistic points out a missed opportunity for risk factor treatment and control.

Michigan has data challenges and limitations that have prohibited a complete analysis of CVD burden. For example, data are available to track hospitalizations, but information or data on recurrent events or type of care received after an event are extremely limited.

Recommendations for future analysis:

- Examine data for additional subpopulations. For example, Michigan has a growing Hispanic population and two geographic areas with a high concentration of people of Arab ancestry.
- Map and analyze risk factor data through small area analysis to assess overlap with geographic disparities in cardiovascular disease events.
- Examine comorbidities between CVD and other diseases, such as diabetes and kidney disease.
- Work with partners to examine rehabilitation data.
- Perform a geographic analysis of out-of-hospital deaths for stroke, in particular observing the proximity of death to hospitals and distribution in rural and urban areas.



Table of Appendices

Appendix A:	A map of Michigan showing the location and name of each county.....	A-2
Appendix B:	A map of Michigan showing the local health departments.....	A-3
Appendix C:	The WISEWOMAN program locations and counties served in Michigan.....	A-4
Appendix D:	The medical control authorities and their corresponding map numbers.....	A-5
Appendix E:	The names and cities of the hospitals or hospital systems in Michigan.....	A-6
Appendix F:	Selected hospitals and hospital service area for stroke center development in Michigan.....	A-10
Appendix G:	Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for cardiovascular disease (CVD).....	A-11
Appendix H:	Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for cardiovascular disease (CVD).....	A-12
Appendix I:	Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for heart disease.....	A-13
Appendix J:	Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for heart disease (HD).....	A-14
Appendix K:	Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for coronary heart disease.....	A-15
Appendix L:	Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for coronary heart disease (CHD).....	A-16
Appendix M:	Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for heart failure.....	A-17
Appendix N:	Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for heart failure (HF).....	A-18
Appendix O:	Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for stroke.....	A-19
Appendix P:	Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for stroke.....	A-20
Appendix Q:	Smoke-free worksite regulations in Michigan.....	A-21
Appendix R:	The classification of blood pressure, LDL, HDL and total blood cholesterol.....	A-22
Appendix S:	The formula to calculate body mass index and the classification scale for adults and children.....	A-23
Appendix T:	Fruit and vegetable recommendations by age, gender and activity level.....	A-24
Appendix U:	The <i>Healthy People 2010</i> goals related to heart disease and stroke.....	A-25
Appendix V:	Resources.....	A-26
Appendix W:	List of abbreviations.....	A-29
Appendix X:	Glossary.....	A-31
Appendix Y:	Methods.....	A-37
Appendix Z:	Data sources.....	A-40

Impact of Heart Disease and Stroke in Michigan



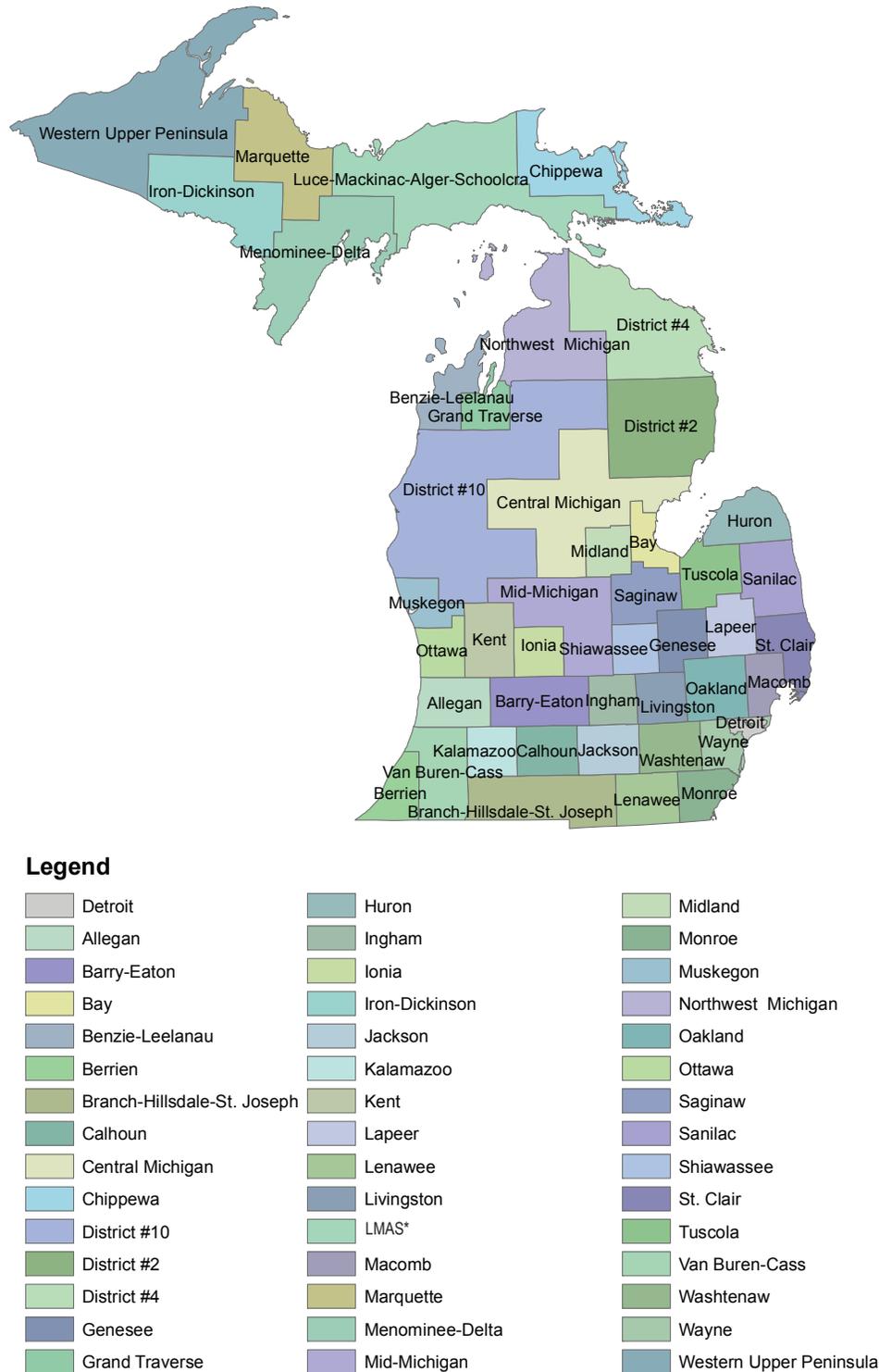
Appendix A: A map of Michigan showing the location and name of each county.



Impact of Heart Disease and Stroke in Michigan



Appendix B: A map of Michigan showing the local health departments.

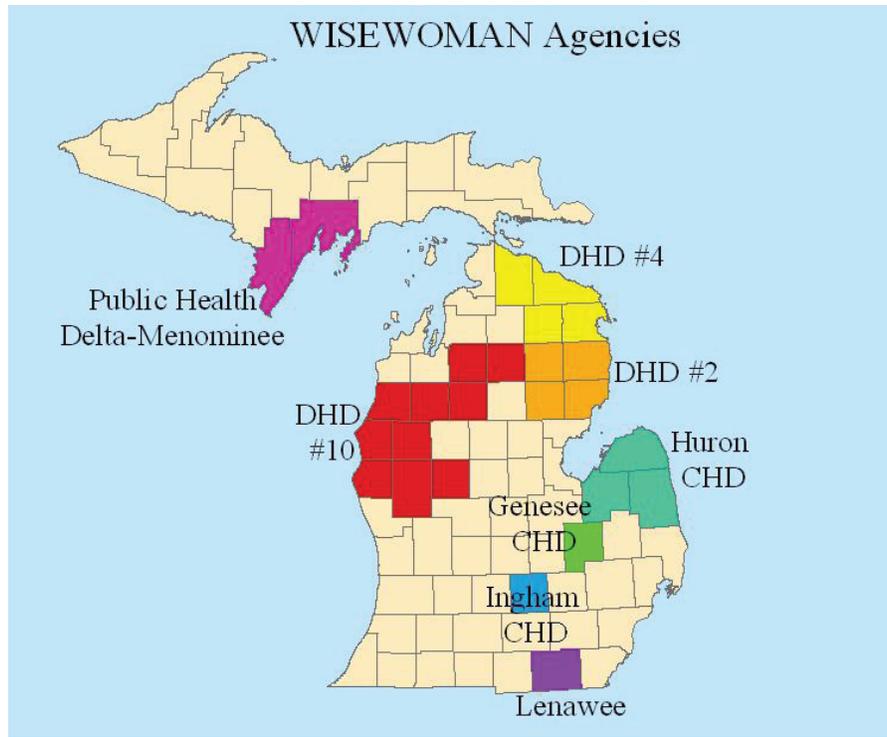


*Luce-Mackinac-Alger-Schoolcraft

Impact of Heart Disease and Stroke in Michigan



Appendix C: The WISEWOMAN program locations and counties served in Michigan.



Health Department	Counties Served
District Health Department #2:	Alcona
	Iosco
	Ogemaw
	Oscoda
District Health Department #4:	Alpena
	Cheboygan
	Montmorency
	Presque Isle
District Health Department #10:	Crawford
	Kalkaska
	Lake
	Manistee
	Mason
	Mecosta
	Missaukee
	Newaygo
	Oceana
	Wexford

Health Department	Counties Served
Genesee County Health Department:	Genesee
Huron County Health Department:	Huron
	Sanilac
	Tuscola
Ingham County Health Department:	Ingham
Lenawee County Health Department:	Lenawee
Public Health Delta & Menominee Counties:	Delta
	Menominee

Source: <http://www.cdc.gov/wisewoman/index.htm>

Impact of Heart Disease and Stroke in Michigan



Appendix D: The medical control authorities and their corresponding numbers in Map 3.

Number	Medical Control Authority
1	Berrien County
2	Cass County
3	St. Joseph County
4	Branch County
5	Hillsdale County
6	Lenawee County
7	Monroe County
8	Van Buren County
9	Kalamazoo County
10	Calhoun County
11	Jackson County
12	Washtenaw/Livingston
13	Wayne County
14	Detroit East
15	Allegan County
16	Barry County
17	Tri-County
18	Oakland County
19	Macomb County
20	Ottawa County
21	Kent County
22	Ionia County
23	Shiawassee County
24	Genesee County
25	Lapeer
26	St. Clair County
27	Muskegon County
28	Montcalm County
29	Gratiot County
30	Saginaw Valley
31	Sanilac County
32	Oceana County

Number	Medical Control Authority
33	Newaygo County
34	Mecosta County
35	Isabella County
36	Midland-Gladwin
37	Bay County
38	Huron County
39	Mason County
40	Lakola
41	Clare County
42	Arenac County
43	Manistee County
44	Northwest Region
45	North Central
46	Ogemaw County
47	Iosco County
48	Crawford County
49	Northeast Michigan
50	Charlevoix County
51	Otsego County
52	Northern Michigan
53	Cheboygan County
54	Gogebic/Ontonagon
55	Iron County
56	Keweenaw
57	Baraga County
58	Dickinson County
59	Marquette County
60	Bay Area
61	Delta County
62	Alger County
63	Schoolcraft County
64	Luce County
65	Eastern UP

Source: State of Michigan Medical Control Authorities Directory, Department of Community Emergency Medical Services

Impact of Heart Disease and Stroke in Michigan



Appendix E: The names and cities of the hospitals or hospital systems in Michigan.

Name	City	PSC	MSN	D2B	CAH	MiSRQIP
Allegan General Hospital	Allegan				x	
Allegiance Health (Foote Health System)	Jackson			x		
Alpena Regional Medical Center	Alpena					
Aspirus Keweenaw Hospital	Laurium					
Aspirus Ontonagon Hospital	Ontonagon				x	
Baraga County Memorial Hospital	L'Anse				x	
Battle Creek Health System	Battle Creek		x	x		
Bay Area Medical Center	Marinette					
Bay Regional Medical Center	Bay City	x		x		
Bay Special Care Hospital	Bay City					
Beaumont Hospital-Grosse Pointe	Grosse Pointe					
Beaumont Hospital-Royal Oak	Royal Oak	x		x		x
Beaumont Hospital-Troy	Troy			x		
Bell Hospital	Ishpeming				x	
Borgess Medical Center	Kalamazoo	x		x		
Borgess-Lee Memorial Hospital	Dowagiac				x	
Borgess-Pipp Hospital	Plainwell					
Botsford Hospital	Farmington Hills			x		
Bronson LakeView Hospital	Paw Paw				x	
Bronson Methodist Hospital	Kalamazoo	x		x		
Bronson Vicksburg Hospital	Vicksburg					
Caro Community Hospital	Caro				x	
Carson City Hospital	Carson City					
Central Michigan Community Hospital	Mt. Pleasant					
Charlevoix Area Hospital	Charlevoix				x	
Cheboygan Memorial Hospital	Cheboygan					x
Chelsea Community Hospital	Chelsea					
Children's Hospital of Michigan	Detroit					
Clinton Memorial Hospital	St. Johns				x	
Community Health Center of Branch County	Coldwater					
Community Hospital	Watervliet					
Covenant Medical Center Inc.	Saginaw			x		x
Crittenton Hospital Medical Center	Rochester Hills		x	x		
Deckerville Community Hospital	Deckerville		x		x	
Detroit Receiving Hospital & University Health Center	Detroit	x				x
Dickinson County Healthcare System	Iron Mountain					
Eaton Rapids Medical Center	Eaton Rapids				x	
Forest Health Medical Center	Ypsilanti					

Abbreviations:

PSC: Primary Stroke Center

CAH: Critical Access Hospital

MSN: Michigan Stroke Network

MiSRQIP: Michigan Stroke Registry Quality Improvement Project

D2B: Door to Balloon

Impact of Heart Disease and Stroke in Michigan



Name	City	PSC	MSN	D2B	CAH	MiSRQIP
Garden City Hospital	Garden City			x		
Genesys Regional Medical Center	Grand Blanc			x		x
Gerber Memorial Health Services	Fremont					
Grand View Health System	Ironwood				x	
Gratiot Medical Center	Alma		x			
Harbor Beach Community Hospital Inc.	Harbor Beach		x		x	
Harper/Hutzel Hospital	Detroit			x		
Hayes Green Beach Memorial Hospital	Charlotte				x	
Helen DeVos Children's Hospital	Grand Rapids					
Helen Newberry Joy Hospital	Newberry				x	
Henry Ford Cottage Hospital	Grosse Pointe Farms					
Henry Ford Health System	Detroit	x				
Henry Ford Hospital	Detroit			x		x
Henry Ford Macomb Hospitals	Clinton Township			x		
Henry Ford Macomb Hospital-Warren Campus	Warren					
Henry Ford West Bloomfield Hospital	West Bloomfield					
Henry Ford Wyandotte Hospital	Wyandotte			x		x
Hills & Dales General Hospital	Cass City		x		x	
Hillsdale Community Health Center	Hillsdale					
Holland Hospital	Holland			x		
Hurley Medical Center	Flint			x		
Huron Medical Center	Bad Axe		x			
Huron Valley-Sinai Hospital	Commerce Township					
Ingham Regional Medical Center	Lansing			x		x
Ingham Regional Orthopedic Hospital	Lansing					
Ionia County Memorial Hospital Corporation	Ionia				x	
Iron County Community Hospital	Iron River				x	
Kalkaska Memorial Health Center	Kalkaska		x		x	
Lakeland Community Hospital-Niles	Niles					
Lakeland Regional Medical Center-St. Joseph	St. Joseph	x		x		
Lapeer Regional Medical Center	Lapeer					
Mackinac Straits Hospital & Health Center	St. Ignace				x	
Marlette Regional Hospital	Marlette				x	
Marquette General Health System	Marquette			x		x
McKenzie Memorial Hospital	Sandusky		x		x	
McLaren Regional Medical Center	Flint			x		
Mecosta County Medical Center	Big Rapids		x			
Memorial Healthcare	Owosso					
Memorial Medical Center of West Michigan	Ludington					
Mercy General Health Partners-Mercy Campus	Muskegon		x			

Abbreviations:

PSC: Primary Stroke Center

CAH: Critical Access Hospital

MSN: Michigan Stroke Network

MiSRQIP: Michigan Stroke Registry Quality Improvement Project

D2B: Door to Balloon

Impact of Heart Disease and Stroke in Michigan



Name	City	PSC	MSN	D2B	CAH	MiSRQIP
Mercy General Health Partners-Muskegon General Campus	Muskegon		x			
Mercy Health Partners Hackley Campus	Muskegon					
Mercy Health Partners Lakeshore Campus	Shelby				x	
Mercy Hospital	Port Huron		x			
Mercy Hospital Cadillac	Cadillac		x			
Mercy Hospital Grayling	Grayling		x			
Mercy Memorial Hospital System	Monroe					
Metro Health Hospital	Wyoming	x		x		x
Michigan Orthopaedic Specialty Hospital	Madison Heights					
MidMichigan Medical Center-Clare	Clare		x			
MidMichigan Medical Center-Gladwin	Gladwin		x		x	
MidMichigan Medical Center-Midland	Midland		x	x		
Mount Clemens Regional Medical Center	Mt. Clemens			x		
Munising Memorial Hospital	Munising				x	
Munson Medical Center	Traverse City		x	x		
North Oakland Medical Centers	Pontiac					
North Ottawa Community Hospital	Grand Haven					
Northern Michigan Regional Hospital	Petoskey			x		x
O.S.F. St. Francis Hospital and Medical Group	Escanaba					
Oaklawn Hospital	Marshall					
Oakwood Annapolis Hospital	Wayne			x		
Oakwood Heritage Hospital	Taylor					
Oakwood Hospital & Medical Center-Dearborn	Dearborn			x		x
Oakwood Southshore Medical Center	Trenton					
Otsego Memorial Hospital	Gaylord		x			
Paul Oliver Memorial Hospital	Frankfort		x		x	
Pennock Health Services	Hastings					
POH Regional Medical Center	Pontiac		x			x
Port Huron Hospital	Port Huron			x		
Portage Health	Hancock					
ProMedica North Region-Bixby Campus	Adrian	x				x
ProMedica North Region-Herrick Campus	Tecumseh	x			x	x
Providence Hospital & Medical Centers	Southfield	x		x		
Providence Park Hospital	Novi					
Saint Joseph Mercy Livingston Hospital	Howell		x			x
Saint Joseph Mercy Saline Hospital	Saline		x			x
Saint Mary's Health Care	Grand Rapids	x	x	x		
Scheurer Hospital	Pigeon				x	
Schoolcraft Memorial Hospital	Manistique				x	
Sheridan Community Hospital	Sheridan				x	

Abbreviations:

PSC: Primary Stroke Center

CAH: Critical Access Hospital

MSN: Michigan Stroke Network

MiSRQIP: Michigan Stroke Registry Quality Improvement Project

D2B: Door to Balloon

Impact of Heart Disease and Stroke in Michigan



Name	City	PSC	MSN	D2B	CAH	MiSRQIP
Sinai-Grace Hospital	Detroit			X		
South Haven Community Hospital	South Haven					
Sparrow Hospital-Main Campus	Lansing	X		X		X
Sparrow Hospital-St. Lawrence Campus	Lansing	X				
Spectrum Health Blodgett Hospital	Grand Rapids	X				
Spectrum Health Butterworth Hospital	Grand Rapids	X		X		
Spectrum Health Reed City Hospital	Reed City				X	
Spectrum Health United Memorial Kelsey Hospital	Lakeview				X	
Spectrum Health United Memorial United Hospital	Greenville					
St. John Hospital & Medical Center	Detroit			X		
St. John Macomb-Oakland Hospital	Warren			X		
St. John North Shores Hospital	Harrison Township					
St. John River District Hospital	East China					
St. Joseph Health System	Tawas City					
St. Joseph Mercy Hospital	Ann Arbor	X	X	X		X
St. Joseph Mercy Oakland	Pontiac	X	X	X		
St. Mary Mercy Hospital	Livonia		X	X		
St. Mary's of Michigan	Saginaw	X		X		X
St. Mary's of Michigan Standish Hospital	Standish				X	
Straith Hospital for Special Surgery	Southfield					
Sturgis Hospital	Sturgis					
Three Rivers Health	Three Rivers					
Trinity Health	Novi					
University of Michigan Hospitals & Health Centers	Ann Arbor	X		X		X
War Memorial Hospital	Sault Ste Marie					
West Branch Regional Medical Center	West Branch					
West Shore Medical Center	Manistee		X			
Zeeland Community Hospital	Zeeland					

Abbreviations:

PSC: Primary Stroke Center

CAH: Critical Access Hospital

MSN: Michigan Stroke Network

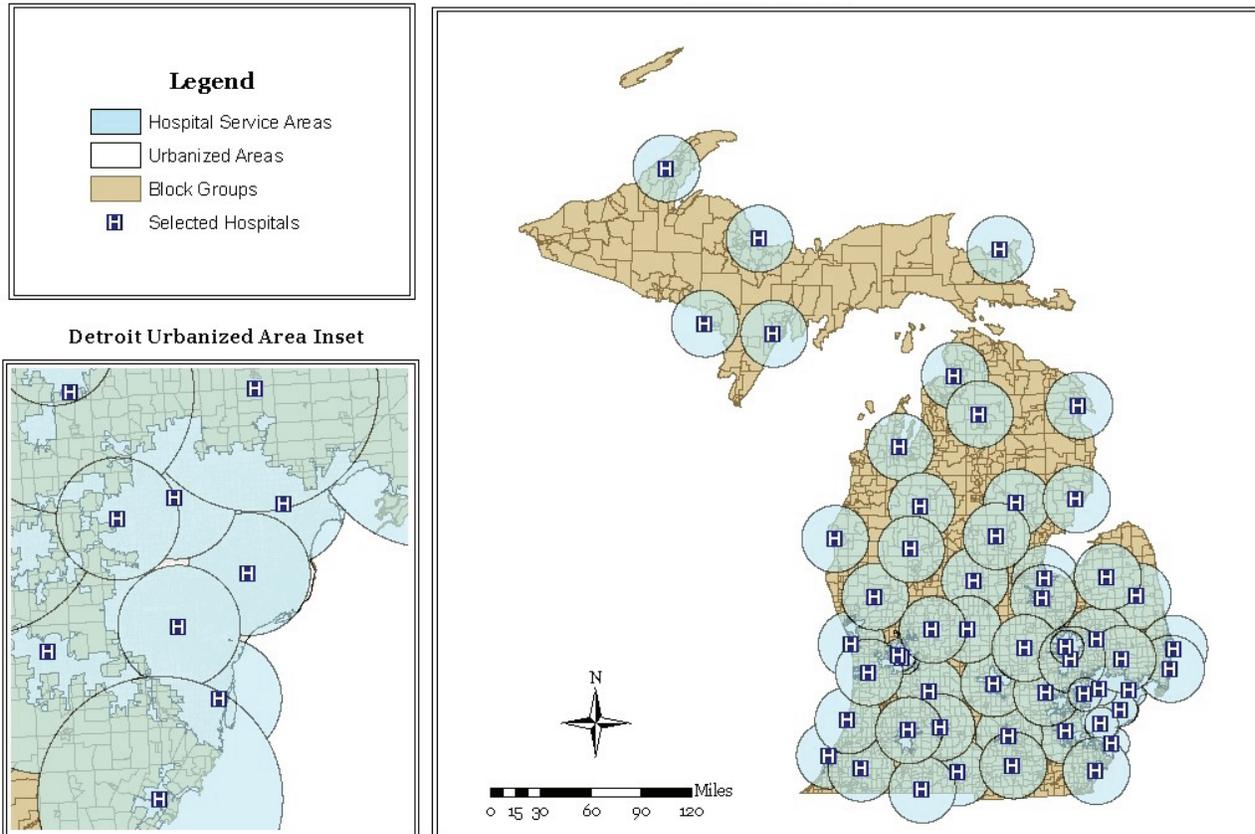
MiSRQIP: Michigan Stroke Registry Quality Improvement Project

D2B: Door to Balloon

Impact of Heart Disease and Stroke in Michigan



Appendix F: Selected hospitals and hospital service area for stroke center development in Michigan.



Source: US Census Bureau 2000, ESRI 2000, Michigan Hospital Association 2003-2005, University of Michigan SAVi Lab 2005.

* Ten mile buffer for hospitals in urbanized areas greater than or equal to 150 square miles, 20 mile buffers for all other hospitals, 54 total selected hospitals

Impact of Heart Disease and Stroke in Michigan



Appendix G: Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for cardiovascular disease (CVD).

County	Age-Adjusted Rate	Number of Hospitalizations
Alcona	167.3	1,771
Alger	182.2	1,180
Allegan	164.1	8,803
Alpena	189.9	3,912
Antrim	163.4	2,705
Arenac	292.4	3,313
Baraga	189.4	1,064
Barry	189.4	5,726
Bay	266.2	17,499
Benzie	161.0	1,868
Berrien	193.2	18,341
Branch	223.5	5,598
Calhoun	235.6	17,895
Cass	183.3	5,474
Charlevoix	158.4	2,582
Cheboygan	185.8	3,442
Chippewa	224.4	4,590
Clare	261.7	5,562
Clinton	162.2	5,385
Crawford	249.0	2,341
Delta	171.6	4,440
Dickinson	165.6	3,076
Eaton	173.1	9,541
Emmet	162.3	3,167
Genesee	254.6	56,040
Gladwin	263.2	4,952
Gogebic	134.6	1,774
Grand Traverse	165.2	7,547
Gratiot	242.3	5,526
Hillsdale	233.5	6,051
Houghton	188.6	3,901
Huron	206.9	5,262
Ingham	187.6	22,337
Ionia	187.5	5,175
Iosco	204.0	4,434
Iron	196.2	2,129
Isabella	208.1	5,240
Jackson	211.4	18,125
Kalamazoo	186.3	21,573
Kalkaska	177.3	1,708
Kent	138.8	36,574
Keweenaw	118.9	201

County	Age-Adjusted Rate	Number of Hospitalizations
Lake	192.8	1,562
Lapeer	225.2	9,395
Leelanau	132.7	2,073
Lenawee	171.5	9,308
Livingston	153.3	11,301
Luce	234.3	950
Mackinac	169.1	1,424
Macomb	216.5	97,454
Manistee	174.0	2,997
Marquette	143.2	5,210
Mason	165.4	3,199
Mecosta	156.9	3,478
Menominee	165.6	2,785
Midland	195.2	8,724
Missaukee	185.8	1,641
Monroe	239.4	17,923
Montcalm	197.3	6,340
Montmorency	194.8	1,721
Muskegon	157.8	14,216
Newaygo	163.2	4,311
Oakland	181.9	111,515
Oceana	142.4	2,251
Ogemaw	250.0	3,853
Ontonagon	181.8	1,160
Osceola	200.9	2,754
Oscoda	232.6	1,630
Otsego	172.7	2,378
Ottawa	129.0	14,576
Presque Isle	176.2	2,041
Roscommon	249.7	5,269
Saginaw	228.1	26,216
Sanilac	207.0	18,282
Schoolcraft	150.6	7,085
Shiawassee	193.0	5,693
St. Clair	207.5	938
St. Joseph	211.2	7,302
Tuscola	229.7	7,507
Van Buren	203.0	8,188
Washtenaw	157.8	20,801
Wayne	250.6	248,252
Wexford	207.7	3,697

Source: MDCH Vital Statistics
 ICD-9 codes 390-434, 436-448
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix H: Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for cardiovascular disease (CVD).

County	Age-Adjusted Rate	CVD Deaths
Alcona	273.0	297
Alger	288.2	206
Allegan	281.6	1,487
Alpena	283.6	652
Antrim	256.2	424
Arenac	340.7	383
Baraga	366.3	238
Barry	280.0	814
Bay	310.7	2,245
Benzie	262.4	326
Berrien	310.7	3,142
Branch	288.3	736
Calhoun	307.1	2,438
Cass	281.1	831
Charlevoix	258.6	428
Cheboygan	276.0	526
Chippewa	290.9	607
Clare	336.5	713
Clinton	282.3	887
Crawford	299.1	283
Delta	245.3	703
Dickinson	284.9	645
Eaton	264.3	1,455
Emmet	233.9	494
Genesee	357.9	7,600
Gladwin	308.9	568
Gogebic	311.7	537
Grand Traverse	245.9	1,196
Gratiot	374.9	914
Hillsdale	329.6	851
Houghton	323.6	811
Huron	332.6	967
Ingham	285.9	3,439
Ionia	274.8	747
Iosco	349.4	804
Iron	332.4	457
Isabella	293.4	750
Jackson	302.7	2,697
Kalamazoo	259.3	3,107
Kalkaska	330.2	285
Kent	258.2	7,003
Keweenaw	229.1	38

County	Age-Adjusted Rate	CVD Deaths
Lake	359.8	295
Lapeer	347.9	1,270
Leelanau	201.4	312
Lenawee	288.1	1,607
Livingston	270.7	1,758
Luce	275.2	115
Mackinac	280.1	239
Macomb	315.7	14,934
Manistee	301.6	556
Marquette	315.8	1,223
Mason	277.2	590
Mecosta	260.6	580
Menominee	252.3	475
Midland	258.1	1,190
Missaukee	319.8	278
Monroe	288.0	2,085
Montcalm	307.2	993
Montmorency	324.2	298
Muskegon	313.6	2,975
Newaygo	275.4	709
Oakland	279.5	17,116
Oceana	291.7	472
Ogemaw	383.0	594
Ontonagon	342.9	249
Osceola	285.3	396
Oscoda	289.6	208
Otsego	274.2	365
Ottawa	227.5	2,662
Presque Isle	271.4	346
Roscommon	318.1	727
Saginaw	309.2	3,781
St. Clair	319.0	2,896
St. Joseph	327.0	1,150
Sanilac	390.2	857
Schoolcraft	303.9	207
Shiawassee	296.3	1,112
Tuscola	291.4	985
Van Buren	303.4	1,236
Washtenaw	255.9	3,158
Wayne	376.0	38,135
Wexford	285.9	532

Source: MDCH Vital Statistics
ICD-10 codes I00-178

Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix I: Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for heart disease.

County	Age-Adjusted Rate	Number of Hospitalizations
Alcona	132.6	1,396
Alger	134.0	868
Allegan	126.9	6,823
Alpena	151.4	3,104
Antrim	123.7	2,049
Arenac	246.4	2,783
Baraga	149.3	838
Barry	149.8	4,547
Bay	223.4	14,694
Benzie	121.1	1,402
Berrien	144.4	13,713
Branch	178.7	4,477
Calhoun	175.5	13,334
Cass	140.5	4,205
Charlevoix	119.4	1,951
Cheboygan	139.0	2,567
Chippewa	176.7	3,619
Clare	217.7	4,620
Clinton	128.7	4,290
Crawford	200.0	1,877
Delta	132.7	3,426
Dickinson	126.6	2,335
Eaton	137.3	7,579
Emmet	117.7	2,299
Genesee	199.6	44,004
Gladwin	221.0	4,148
Gogebic	105.9	1,382
Grand Traverse	125.1	5,726
Gratiot	195.3	4,452
Hillsdale	184.5	4,786
Houghton	144.5	2,988
Huron	168.0	4,247
Ingham	145.6	17,360
Ionia	149.5	4,142
Iosco	160.8	3,477
Iron	154.5	1,656
Isabella	170.4	4,301
Jackson	162.2	13,922
Kalamazoo	143.0	16,575
Kalkaska	135.1	1,298
Kent	102.3	27,054
Keweenaw	91.2	157

County	Age-Adjusted Rate	Number of Hospitalizations
Lake	141.1	1,135
Lapeer	180.6	7,572
Leelanau	99.6	1,558
Lenawee	132.2	7,181
Livingston	122.2	9,048
Luce	180.0	730
Mackinac	125.9	1,056
Macomb	169.3	76,263
Manistee	131.1	2,253
Marquette	106.6	3,886
Mason	124.7	2,399
Mecosta	122.7	2,715
Menominee	126.1	2,113
Midland	161.8	7,241
Missaukee	152.6	1,347
Monroe	186.1	13,972
Montcalm	152.7	4,907
Montmorency	146.2	1,280
Muskegon	111.9	10,101
Newaygo	122.5	3,244
Oakland	142.2	87,431
Oceana	108.5	1,716
Ogemaw	210.1	3,229
Ontonagon	142.1	907
Osceola	159.0	2,175
Oscoda	182.7	1,275
Otsego	131.1	1,799
Ottawa	98.5	11,150
Presque Isle	134.7	1,542
Roscommon	201.7	4,218
Saginaw	182.7	21,035
St. Clair	159.0	14,026
St. Joseph	164.9	5,534
Sanilac	161.6	4,448
Schoolcraft	114.7	706
Shiawassee	155.8	5,909
Tuscola	188.6	6,172
Van Buren	157.8	6,382
Washtenaw	122.6	16,181
Wayne	191.2	189,652
Wexford	166.7	2,969

Source: MDCH Vital Statistics
 ICD-9 codes 390-398, 402, 404, 410-429
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix J: Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for heart disease (HD).

County	Age-Adjusted Rate	HD Deaths
Alcona	210.5	226
Alger	216.5	154
Allegan	215.5	1,138
Alpena	231.2	528
Antrim	196.9	325
Arenac	264.6	297
Baraga	285.0	187
Barry	208.0	606
Bay	256.2	1,852
Benzie	196.0	244
Berrien	205.6	2,066
Branch	210.9	538
Calhoun	227.7	1,807
Cass	207.5	616
Charlevoix	193.6	320
Cheboygan	217.8	413
Chippewa	212.7	443
Clare	269.2	571
Clinton	188.4	596
Crawford	232.0	218
Delta	188.1	534
Dickinson	202.9	452
Eaton	204.1	1,124
Emmet	171.2	360
Genesee	267.3	5,700
Gladwin	248.5	458
Gogebic	247.4	418
Grand Traverse	186.0	904
Gratiot	277.6	672
Hillsdale	265.0	686
Houghton	227.9	561
Huron	221.2	639
Ingham	215.0	2,591
Ionia	205.1	559
Iosco	267.8	614
Iron	248.6	331
Isabella	225.0	576
Jackson	226.2	2,009
Kalamazoo	186.0	2,227
Kalkaska	239.5	207
Kent	196.3	5,314
Keweenaw	178.8	29

County	Age-Adjusted Rate	HD Deaths
Lake	260.5	212
Lapeer	271.0	993
Leelanau	145.7	225
Lenawee	212.3	1,186
Livingston	212.7	1,388
Luce	203.0	85
Mackinac	205.3	174
Macomb	246.1	11,614
Manistee	208.4	383
Marquette	241.2	933
Mason	204.7	431
Mecosta	202.2	449
Menominee	196.9	372
Midland	196.0	900
Missaukee	217.0	189
Monroe	221.6	1,610
Montcalm	233.2	754
Montmorency	265.9	243
Muskegon	242.3	2,295
Newaygo	212.2	549
Oakland	217.3	13,321
Oceana	225.3	364
Ogemaw	303.4	472
Ontonagon	256.6	183
Osceola	231.8	321
Oscoda	234.1	168
Otsego	208.0	277
Ottawa	171.1	1,999
Presque Isle	211.3	270
Roscommon	255.2	583
Saginaw	238.9	2,920
St. Clair	258.7	2,352
St. Joseph	264.0	927
Sanilac	293.7	650
Schoolcraft	222.8	150
Shiawassee	223.1	838
Tuscola	235.5	798
Van Buren	230.1	936
Washtenaw	191.2	2,367
Wayne	305.9	31,013
Wexford	217.5	403

Source: MDCH Vital Statistics
 ICD-10 codes I00-I09, I11, I13, I20-I51
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix K: Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for coronary heart disease.

County	Age-Adjusted Rate	Number of Hospitalizations
Alcona	75.6	769
Alger	70.9	455
Allegan	66.9	3,648
Alpena	79.8	1,585
Antrim	60.9	1,005
Arenac	139.3	1,576
Baraga	83.5	455
Barry	77.0	2,387
Bay	120.5	7,839
Benzie	60.5	690
Berrien	76.2	7,191
Branch	100.0	2,506
Calhoun	95.4	7,245
Cass	69.4	2,100
Charlevoix	56.8	930
Cheboygan	70.4	1,284
Chippewa	98.8	2,024
Clare	124.9	2,629
Clinton	57.9	1,975
Crawford	112.3	1,060
Delta	71.1	1,811
Dickinson	62.2	1,104
Eaton	63.1	3,532
Emmet	54.9	1,060
Genesee	99.0	22,148
Gladwin	121.0	2,249
Gogebic	56.5	695
Grand Traverse	54.3	2,475
Gratiot	99.1	2,232
Hillsdale	107.7	2,805
Houghton	74.2	1,486
Huron	85.5	2,097
Ingham	63.1	7,524
Ionia	74.0	2,081
Iosco	85.0	1,803
Iron	74.1	730
Isabella	89.1	2,234
Jackson	90.5	7,759
Kalamazoo	67.2	7,760
Kalkaska	65.7	642
Kent	48.9	12,861
Keweenaw	53.9	91

County	Age-Adjusted Rate	Number of Hospitalizations
Lake	69.3	560
Lapeer	85.4	3,778
Leelanau	44.5	700
Lenawee	72.0	3,926
Livingston	58.5	4,510
Luce	77.6	313
Mackinac	68.5	575
Macomb	82.0	36,639
Manistee	67.4	1,141
Marquette	53.7	1,962
Mason	67.0	1,264
Mecosta	64.0	1,407
Menominee	67.6	1,113
Midland	87.1	3,915
Missaukee	86.4	764
Monroe	93.2	7,164
Montcalm	85.4	2,759
Montmorency	84.8	706
Muskegon	50.7	4,553
Newaygo	63.5	1,704
Oakland	63.9	39,781
Oceana	53.1	837
Ogemaw	117.6	1,809
Ontonagon	63.3	394
Osceola	86.9	1,192
Oscoda	106.2	729
Otsego	65.8	917
Ottawa	50.0	5,633
Presque Isle	69.8	767
Roscommon	117.1	2,385
Saginaw	79.8	9,188
Sanilac	77.1	6,510
Schoolcraft	58.8	2,913
Shiawassee	79.8	2,211
St. Clair	73.4	354
St. Joseph	87.5	3,069
Tuscola	97.1	3,194
Van Buren	84.6	3,449
Washtenaw	50.8	6,819
Wayne	78.8	77,878
Wexford	91.9	1,638

Source: MDCH Vital Statistics
 ICD-9 codes 410-414, 429.2
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix L: Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for coronary heart disease (CHD).

County	Age-Adjusted Rate	CHD Deaths
Alcona	159.5	167
Alger	156.0	112
Allegan	137.2	727
Alpena	181.5	409
Antrim	143.2	238
Arenac	198.6	223
Baraga	250.7	165
Barry	125.6	366
Bay	182.7	1,308
Benzie	148.4	185
Berrien	134.1	1,352
Branch	159.3	407
Calhoun	163.4	1,296
Cass	152.3	454
Charlevoix	125.1	207
Cheboygan	156.4	297
Chippewa	143.8	300
Clare	202.3	430
Clinton	125.8	399
Crawford	175.6	165
Delta	138.4	390
Dickinson	141.0	306
Eaton	122.5	672
Emmet	118.5	245
Genesee	188.6	4,039
Gladwin	184.6	341
Gogebic	199.6	334
Grand Traverse	127.5	615
Gratiot	216.2	520
Hillsdale	153.7	396
Houghton	165.8	406
Huron	148.9	427
Ingham	123.6	1,472
Ionia	138.2	376
Iosco	161.4	372
Iron	190.8	250
Isabella	162.4	414
Jackson	153.6	1,356
Kalamazoo	120.1	1,432
Kalkaska	178.7	155
Kent	128.7	3,454
Keweenaw	136.8	23

County	Age-Adjusted Rate	CHD Deaths
Lake	192.2	158
Lapeer	182.2	671
Leelanau	85.1	131
Lenawee	151.9	848
Livingston	147.8	967
Luce	144.2	60
Mackinac	153.5	130
Macomb	185.1	8,742
Manistee	145.3	266
Marquette	187.3	724
Mason	140.6	292
Mecosta	147.8	329
Menominee	135.2	260
Midland	151.0	694
Missaukee	152.5	134
Monroe	166.9	1,214
Montcalm	167.1	541
Montmorency	198.3	179
Muskegon	160.9	1,528
Newaygo	150.9	391
Oakland	156.1	9,560
Oceana	157.9	255
Ogemaw	222.4	347
Ontonagon	190.5	136
Osceola	161.5	223
Oscoda	148.8	108
Otsego	143.0	192
Ottawa	104.4	1,207
Presque Isle	149.2	191
Roscommon	200.5	460
Saginaw	161.9	1,964
St. Clair	182.7	1,658
St. Joseph	195.6	687
Sanilac	200.2	455
Schoolcraft	165.3	111
Shiawassee	145.6	547
Tuscola	162.7	550
Van Buren	147.5	595
Washtenaw	129.4	1,593
Wayne	225.7	22,850
Wexford	154.3	283

Source: MDCH Vital Statistics
ICD-10 codes I20-I25
Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix M: Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for heart failure.

County	Age-Adjusted Rate	Number of Hospitalizations
Alcona	24.7	281
Alger	35.1	232
Allegan	26.7	1,404
Alpena	31.1	688
Antrim	24.3	414
Arenac	53.8	614
Baraga	31.4	192
Barry	36.8	1,077
Bay	46.6	3,208
Benzie	19.3	233
Berrien	31.8	3,102
Branch	34.7	874
Calhoun	39.5	3,036
Cass	33.6	995
Charlevoix	30.3	501
Cheboygan	31.4	604
Chippewa	35.5	725
Clare	45.6	994
Clinton	27.8	886
Crawford	34.4	330
Delta	27.3	738
Dickinson	27.1	550
Eaton	29.5	1,598
Emmet	26.4	531
Genesee	49.7	10,771
Gladwin	53.7	1,030
Gogebic	17.7	263
Grand Traverse	22.8	1,056
Gratiot	42.1	992
Hillsdale	36.8	954
Houghton	28.0	628
Huron	33.2	916
Ingham	33.7	3,971
Ionia	35.5	951
Iosco	33.0	768
Iron	31.6	401
Isabella	37.3	942
Jackson	29.3	2,524
Kalamazoo	35.8	4,170
Kalkaska	27.9	260
Kent	23.7	6,260
Keweenaw	16.2	30

County	Age-Adjusted Rate	Number of Hospitalizations
Lake	33.8	277
Lapeer	44.6	1,682
Leelanau	14.0	222
Lenawee	23.8	1,295
Livingston	25.7	1,713
Luce	49.8	204
Mackinac	23.7	204
Macomb	37.7	17,308
Manistee	24.6	446
Marquette	19.7	731
Mason	24.2	495
Mecosta	27.8	621
Menominee	24.7	443
Midland	27.5	1,234
Missaukee	20.2	178
Monroe	47.0	3,410
Montcalm	34.5	1,096
Montmorency	29.3	285
Muskegon	28.2	2,578
Newaygo	27.5	714
Oakland	35.2	21,318
Oceana	27.1	437
Ogemaw	46.2	717
Ontonagon	37.5	262
Osceola	27.2	375
Oscoda	32.3	236
Otsego	32.4	436
Ottawa	20.8	2,370
Presque Isle	27.3	337
Roscommon	33.1	741
Saginaw	44.7	5,225
St. Clair	35.4	3,111
St. Joseph	39.0	1,334
Sanilac	41.6	1,043
Schoolcraft	20.1	136
Shiawassee	29.3	1,096
Tuscola	39.4	1,302
Van Buren	35.3	1,422
Washtenaw	29.2	3,690
Wayne	56.4	56,188
Wexford	26.3	477

Source: MDCH Vital Statistics
 ICD-9 code 428
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix N: Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for heart failure (HF).

County	Age-Adjusted Rate	HF Deaths
Alcona	19.5	23
Alger	28.7	22
Allegan	28.9	150
Alpena	15.9	40
Antrim	15.6	26
Arenac	22.0	25
Baraga	-	-
Barry	39.4	112
Bay	34.1	261
Benzie	-	-
Berrien	17.7	182
Branch	20.8	53
Calhoun	17.1	138
Cass	18.1	54
Charlevoix	32.0	54
Cheboygan	25.3	49
Chippewa	17.4	36
Clare	33.3	71
Clinton	25.7	79
Crawford	22.0	21
Delta	14.4	42
Dickinson	19.2	49
Eaton	30.8	172
Emmet	25.4	58
Genesee	31.3	652
Gladwin	20.1	37
Gogebic	20.0	41
Grand Traverse	19.4	99
Gratiot	25.5	64
Hillsdale	30.9	80
Houghton	9.4	27
Huron	32.2	99
Ingham	36.7	448
Ionia	29.2	80
Iosco	34.3	81
Iron	25.5	39
Isabella	27.0	70
Jackson	25.8	238
Kalamazoo	23.2	282
Kalkaska	-	-
Kent	17.6	494
Keweenaw	-	-

County	Age-Adjusted Rate	HF Deaths
Lake	-	-
Lapeer	41.6	144
Leelanau	17.4	27
Lenawee	22.4	127
Livingston	26.7	164
Luce	-	-
Mackinac	24.8	22
Macomb	18.4	887
Manistee	13.9	27
Marquette	20.2	82
Mason	19.5	46
Mecosta	29.1	65
Menominee	20.1	39
Midland	12.6	59
Missaukee	-	-
Monroe	15.9	112
Montcalm	27.5	89
Montmorency	29.4	27
Muskegon	12.6	125
Newaygo	17.0	43
Oakland	23.2	1,416
Oceana	34.8	57
Ogemaw	35.9	56
Ontonagon	36.1	28
Osceola	29.3	41
Oscoda	33.3	23
Otsego	21.7	28
Ottawa	23.0	280
Presque Isle	15.6	20
Roscommon	19.1	45
Saginaw	26.6	340
St. Clair	27.2	248
St. Joseph	22.9	83
Sanilac	48.7	94
Schoolcraft	31.2	22
Shiawassee	18.7	71
Tuscola	39.0	133
Van Buren	22.9	94
Washtenaw	18.8	225
Wayne	20.8	2,148
Wexford	31.0	60

Source: MDCH Vital Statistics
 ICD-10 codes I50. Age-Adjusted to the 2000 U.S. standard population
 -Insufficient data, less than 20 deaths in the county

Impact of Heart Disease and Stroke in Michigan



Appendix O: Five-year age-adjusted hospitalization rates per 10,000 by county in Michigan, 2002 to 2006 for stroke.

County	Age-Adjusted Rate	Number of Hospitalizations
Alcona	20.2	223
Alger	28.1	186
Allegan	22.4	1,188
Alpena	22.1	476
Antrim	24.0	401
Arenac	26.6	307
Baraga	24.4	141
Barry	25.0	743
Bay	25.9	1,721
Benzie	23.8	281
Berrien	26.8	2,577
Branch	27.2	685
Calhoun	31.0	2,367
Cass	26.5	787
Charlevoix	24.1	391
Cheboygan	25.5	480
Chippewa	27.8	567
Clare	26.6	567
Clinton	22.0	715
Crawford	31.2	298
Delta	22.5	594
Dickinson	24.5	477
Eaton	21.9	1,189
Emmet	27.3	537
Genesee	32.9	7,148
Gladwin	26.8	514
Gogebic	18.3	257
Grand Traverse	25.8	1,182
Gratiot	29.5	680
Hillsdale	29.3	761
Houghton	27.0	571
Huron	22.3	596
Ingham	25.3	2,992
Ionia	22.6	610
Iosco	26.3	586
Iron	24.0	282
Isabella	26.2	654
Jackson	31.0	2,659
Kalamazoo	25.7	2,974
Kalkaska	26.7	257
Kent	21.2	5,539
Keweenaw	15.5	26

County	Age-Adjusted Rate	Number of Hospitalizations
Lake	28.4	239
Lapeer	29.1	1,177
Leelanau	20.8	326
Lenawee	24.2	1,314
Livingston	19.7	1,410
Luce	33.1	135
Mackinac	25.1	213
Macomb	28.5	12,894
Manistee	24.9	436
Marquette	21.7	791
Mason	23.9	477
Mecosta	20.6	459
Menominee	27.0	465
Midland	22.6	1,010
Missaukee	20.8	184
Monroe	33.2	2,461
Montcalm	27.9	894
Montmorency	27.9	257
Muskegon	28.5	2,578
Newaygo	22.5	590
Oakland	23.8	14,419
Oceana	22.1	350
Ogemaw	21.9	353
Ontonagon	23.6	157
Osceola	24.8	346
Oscoda	28.3	201
Otsego	24.1	334
Ottawa	18.5	2,086
Presque Isle	24.6	294
Roscommon	30.1	658
Saginaw	27.2	3,146
St. Clair	31.0	2,725
St. Joseph	27.3	918
Sanilac	26.5	719
Schoolcraft	20.1	132
Shiawassee	24.4	913
Tuscola	25.5	832
Van Buren	25.2	1,010
Washtenaw	21.5	2,753
Wayne	33.6	33,203
Wexford	23.8	426

Source: MDCH Vital Statistics
 ICD-9 codes 430-434, 436-438
 Age-Adjusted to the 2000 U.S. standard population

Impact of Heart Disease and Stroke in Michigan



Appendix P: Five-year age-adjusted mortality rates per 100,000 by county in Michigan, 2002 to 2006 for stroke.

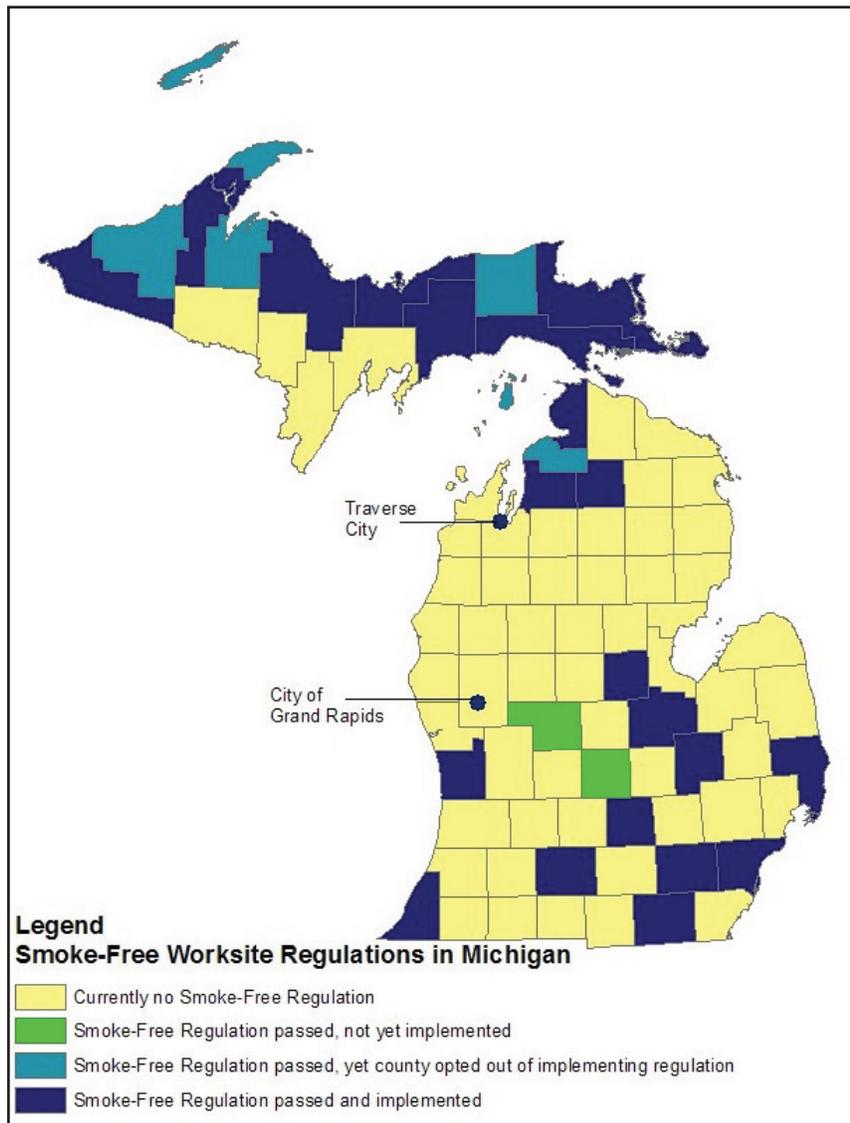
County	Age-Adjusted Rate	Stroke Deaths
Alcona	50.8	57
Alger	54.4	40
Allegan	49.1	260
Alpena	34.6	82
Antrim	48.9	81
Arenac	57.0	64
Baraga	56.5	36
Barry	50.5	146
Bay	39.4	287
Benzie	48.0	60
Berrien	70.0	723
Branch	52.5	135
Calhoun	56.4	449
Cass	58.5	171
Charlevoix	44.3	74
Cheboygan	42.8	84
Chippewa	55.1	116
Clare	53.5	111
Clinton	78.2	242
Crawford	54.1	52
Delta	37.4	109
Dickinson	60.1	142
Eaton	47.0	258
Emmet	42.8	92
Genesee	70.8	1,483
Gladwin	42.6	77
Gogebic	51.9	97
Grand Traverse	45.7	224
Gratiot	78.8	196
Hillsdale	44.5	115
Houghton	67.8	175
Huron	53.2	156
Ingham	53.8	646
Ionia	55.2	150
Iosco	53.6	123
Iron	60.5	96
Isabella	51.0	130
Jackson	55.6	501
Kalamazoo	50.1	603
Kalkaska	52.9	47
Kent	45.2	1,235
Keweenaw	-	-

County	Age-Adjusted Rate	Stroke Deaths
Lake	65.4	53
Lapeer	58.0	208
Leelanau	41.0	64
Lenawee	52.8	294
Livingston	40.8	260
Luce	48.4	20
Mackinac	61.3	53
Macomb	46.0	2,192
Manistee	49.7	92
Marquette	52.4	204
Mason	53.7	119
Mecosta	42.3	95
Menominee	35.5	66
Midland	46.0	215
Missaukee	67.1	58
Monroe	45.1	321
Montcalm	58.9	190
Montmorency	45.5	43
Muskegon	50.0	477
Newaygo	45.8	115
Oakland	45.1	2,749
Oceana	47.4	77
Ogemaw	54.4	83
Ontonagon	56.5	42
Osceola	40.0	56
Oscoda	36.2	26
Otsego	44.6	59
Ottawa	42.7	503
Presque Isle	35.6	44
Roscommon	48.0	110
Saginaw	47.2	581
St. Clair	42.1	381
St. Joseph	42.7	151
Sanilac	77.9	167
Schoolcraft	63.3	45
Shiawassee	49.9	186
Tuscola	42.7	142
Van Buren	55.4	227
Washtenaw	47.7	583
Wayne	47.8	4,856
Wexford	47.8	90

Source: MDCH Vital Statistics
ICD-10 codes I60-I69. Age-Adjusted to the 2000 U.S. standard population
-Insufficient data, less than 20 deaths in the county



Appendix Q: Smoke-free worksite regulations in Michigan.



Impact of Heart Disease and Stroke in Michigan



Appendix R: The classification of blood pressure, LDL, HDL and total blood cholesterol.

Category	Systolic Blood Pressure (mmHg)		Diastolic Blood Pressure (mmHg)
Normal	<120	and	<80
Prehypertension	120-139	or	80-89
Hypertension, Stage 1	140-159	or	90-99
Hypertension, Stage 2	≥160	or	≥100

Source: U.S. Department of Health and Human Services, Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7)

Category	LDL Cholesterol (mg/dL)
Optimal	<100
Near optimal/above optimal	100-129
Borderline high	130-159
High	160-189
Very high	≥190

Category	HDL Cholesterol (mg/dL)
Low	<40
High	≥60

Category	Total Cholesterol (mg/dL)
Desirable	<200
Borderline high	200-239
High	≥240

Source: National Institutes of Health, National Cholesterol Education Program



Appendix S: The formula to calculate body mass index and the classification scale for adults and children.

$$\text{BMI} = \left(\frac{\text{Weight in Pounds}}{(\text{Height in Inches})^2} \right) \times 706$$

Body mass index chart for adults, age 20 and over.

BMI	Weight Status
<18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
≥30.0	Obese

Source: Centers for Disease Control and Prevention

Body mass index chart for children, age 19 and younger.

Percentile of Age/Sex	Weight Status
> 85th	Normal
85th-94th	Risk of Overweight
≥95th	Overweight

Source: Centers for Disease Control and Prevention

Online calculator for children and teens based on age and sex can be found at:
<http://apps.nccd.cdc.gov/dnpabmi/Calculator.aspx>

Impact of Heart Disease and Stroke in Michigan



Appendix T: Fruit and vegetable recommendations by age, gender and activity level.

Females	Age	Fruits	Vegetables	Males	Age	Fruits	Vegetables
Less Active	2-3	1 cup	1 cup	Less Active	2-3	1 cup	1 cup
	4-8	1 cup	1.5 cups		4-8	1.5 cups	1.5 cups
	9-13	1.5 cups	2 cups		9-13	1.5 cups	2.5 cups
	14-18	1.5 cups	2.5 cups		14-18	2 cups	3 cups
	19-30	2 cups	2.5 cups		19-30	2 cups	3 cups
	31-50	1.5 cups	2.5 cups		31-50	2 cups	3 cups
	51+	1.5 cups	2 cups		51+	2 cups	2.5 cups
Moderately Active	2-3	1 cup	1 cup	Moderately Active	2-3	1 cup	1 cup
	4-8	1.5 cups	1.5 cups		4-8	1.5 cups	1.5 cups
	9-13	1.5 cups	2 cups		9-13	1.5 cups	2.5 cups
	14-18	2 cups	2.5 cups		14-18	2 cups	3 cups
	19-30	2 cups	2.5 cups		19-30	2 cups	3 cups
	31-50	2 cups	2.5 cups		31-50	2 cups	3 cups
	51+	1.5 cups	2.5 cups		51+	2 cups	2.5 cups
Active	2-3	1 cup	1 cup	Active	2-3	1 cup	1 cup
	4-8	1.5 cups	1.5 cups		4-8	1.5 cups	2 cups
	9-13	1.5 cups	2.5 cups		9-13	2 cups	2.5 cups
	14-18	2 cups	3 cups		14-18	2.5 cups	3.5 cups
	19-30	2 cups	3 cups		19-30	2.5 cups	4 cups
	31-50	2 cups	3 cups		31-50	2.5 cups	3.5 cups
	51+	2 cups	2.5 cups		51+	2 cups	3 cups

Source: Created using CDC More Matters and Dietary Guidelines for Americans

Impact of Heart Disease and Stroke in Michigan



Appendix U: The *Healthy People 2010* goals related to heart disease and stroke.

(Objective 12-1) Reduce coronary heart disease deaths to 166 deaths per 100,000 population.
(Objective 12-2) Increase the proportion of adults aged 20 years and older who are aware of the early warning symptoms and signs of a heart attack and the importance of accessing rapid emergency care by calling 911.
(Objective 12-3) Increase the proportion of eligible patients with heart attacks who receive timely artery-opening therapy from symptom onset.
(Objective 12-4) Increase the proportion of persons trained in cardiopulmonary resuscitation (CPR) in the past year.
(Objective 12-5) Increase the proportion of eligible persons with witnessed out-of-hospital cardiac arrest who receive their first therapeutic electrical shock within 6 minutes after collapse recognition.
(Objective 12-6) Reduce hospitalizations of older adults with congestive heart failure as the principal diagnosis.
(Objective 12-7) Reduce stroke deaths to 50 per 100,000 population.
(Objective 12-8) Increase the proportion of adults who are aware of the early warning symptoms and signs of a stroke and the importance of accessing rapid emergency care by calling 911.
(Objective 12-9) Reduce the proportion of adults with high blood pressure to 14%.
(Objective 12-10) Increase the proportion of adults with high blood pressure whose blood pressure is under control to 50%.
(Objective 12-11) Increase the proportion of adults with high blood pressure who are taking action to help control their blood pressure to 95%.
(Objective 12-12) Increase the proportion of adults who have had their blood pressure measured within the preceding 2 years and can state whether their blood pressure was normal or high to 95%.
(Objective 12-13) Reduce the mean total blood cholesterol levels among adults to 199mg/dL.
(Objective 12-14) Reduce the proportion of adults with high total blood cholesterol levels to 17%.
(Objective 12-15) Increase the proportion of adults who have had their blood cholesterol checked within the preceding 5 years to 80%.

Source: *Healthy People 2010*, Chapter 12 Heart Disease and Stroke
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Appendix W: List of abbreviations.

ACC	American College of Cardiology
ACE	Angiotensin Converting Enzyme
ACSM	American College of Sports Medicine
AHA	American Heart Association
BMI	Body Mass Index
BRFS	Behavioral Risk Factor Survey
CAH	Critical Access Hospital
CDC	Centers for Disease Control and Prevention
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
DHHS	Department of Health and Human Services
D2B	Door To Balloon
EMS	Emergency Medical Services
ESRD	End Stage Renal Disease
FDA	Food and Drug Administration
HD	Heart Disease
HDL	High Density Lipoprotein
HEDIS	Healthcare Effectiveness Data and Information System
HF	Heart Failure
<i>HP 2010</i>	<i>Healthy People 2010</i>
GWTG	Get with the Guidelines
ICD	International Classification of Diseases
INSTINCT	Increasing Stroke Treatment through Interactive behavioral Change Tactics
JNC7	The seventh edition of the guidelines published by the Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure
LDL	Low Density Lipoprotein
LSA	Life Support Agencies
MASCOTS	Michigan Acute Stroke Care and Overview Treatment Surveillance System
MCA	Medical Control Authorities
MDCH	Michigan Department of Community Health
MDE	Michigan Department of Education
mg/dL	Milligrams per deciliter
MHA	Michigan Health and Hospital Association
MICAH	Michigan Critical Access Hospital Quality Network
MiSRQIP	Michigan Stroke Registry and Quality Improvement Project
mmHg	millimeters of mercury
MQIC	Michigan Quality Improvement Consortium
MSN	Michigan Stroke Network
MSU	Michigan State University
MUA	Medically Underserved Areas
MUP	Medically Underserved Population

Impact of Heart Disease and Stroke in Michigan



NCQA	National Committee for Quality Assurance
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung and Blood Institute
NIH	National Institutes of Health
PA	Physical Activity
PCI	Percutaneous Coronary Intervention
PCNASR	Paul Coverdell National Acute Stroke Registry
PPCM	Peripartum Cardiomyopathy
PRAMS	Pregnancy Risk Assessment Monitoring System
PSAP	Public Safety Answering Points
PSC	Primary Stroke Center
TIA	Transient Ischemic Attack
tPA	Tissue Plasminogen Activator
STEMI	ST-segment Elevation Myocardial Infarction
SCDY	Sudden Cardiac Death of the Young
USDA	United States Department of Agriculture
WIC	Women, Infants and Children
WISEWOMAN	Well Integrated Screening and Evaluation for Women Across the Nation
YRBS	Youth Risk Behavior Survey
YTS	Youth Tobacco Survey



Appendix X: Glossary

Age-adjusted rates – A statistical process applied to rates of disease, death, injuries or other health outcomes that allows communities with different age structures to be compared. The potential confounding effect of age is reduced when comparing age-adjusted rates computed using the same standard population.

Angina – Chest pain due to an inadequate supply of oxygen to the heart muscle.

Atherosclerosis – A type of hardening of the arteries in which cholesterol and other substances in the blood are deposited in the walls of arteries, including the coronary arteries that supply blood to the heart. In time, narrowing of the coronary arteries by atherosclerosis may reduce the flow of oxygen-rich blood to the heart.

Blood pressure – The force of the blood pushing against the walls of arteries. Blood pressure is measured as two numbers, the systolic pressure (the first number, which measures the pressure while the heart is contracting) and the diastolic pressure (the second number, which measures the pressure when the heart is resting between beats). Normal blood pressure is defined as less than 120/80 mmHg.

Body mass index (BMI) – A statistical measure of the weight of a person scaled according to height. An adult's body mass index is computed by dividing an individual's body weight by the square of their height.

Cardiac arrhythmias – A term for any of a large and heterogeneous group of conditions in which there is abnormal electrical activity in the heart. The heart beat may be too fast or too slow, and may be regular or irregular.

Cardiomyopathy – A disease in which the heart muscle becomes inflamed and doesn't work as well as it should. Classified as primary or secondary. Primary cardiomyopathy can't be attributed to a specific cause. Secondary cardiomyopathy is due to specific causes, such as high blood pressure, heart valve disease, artery diseases or congenital heart defects. It's often associated with diseases involving other organs as well as the heart. There are three main types of cardiomyopathy: dilated, hypertrophic and restrictive.

Cardiovascular disease (CVD) – Includes: rheumatic fever/rheumatic heart disease; hypertensive diseases; ischemic (coronary) heart disease; pulmonary heart disease and diseases of pulmonary circulation; other forms of heart disease; cerebrovascular disease (stroke); atherosclerosis; other diseases of arteries, arterioles and capillaries; diseases of veins, lymphatics and lymph nodes not classified elsewhere; and other and unspecified disorders of the circulatory system. ICD-9 Codes: 390-434, 436-448 ICD-10 Codes: 100-199

Cerebrovascular – Pertaining to the blood vessels and, especially, the arteries that supply the brain.

Impact of Heart Disease and Stroke in Michigan



Cholesterol – A waxy substance that circulates in the bloodstream. When the level of cholesterol in the blood is too high, some of the cholesterol is deposited in the walls of the blood vessels. Over time, these deposits can build up until they narrow the blood vessels, causing atherosclerosis, which reduces the blood flow. The higher the blood cholesterol level, the greater the risk of getting heart disease. Blood cholesterol levels of less than 200 mg/dl are considered desirable.

Chronic disease – Diseases and illnesses of long duration, generally slow progression, that do not resolve spontaneously and may not be cured completely.

Chronic lower respiratory disease – General term that refers to chronic diseases that affect the lower respiratory tract (including the lungs) including chronic obstructed pulmonary disease (COPD), cystic fibrosis, emphysema and chronic bronchitis.

Coronary heart disease (CHD) – A narrowing of the blood vessels that provide oxygen and nutrients to the heart. The narrowing is usually caused by fatty material called plaque or a clot that attaches to the blood vessel walls. ICD-9 Codes: 410-414, 429.2 ICD-10 Codes: 100-109, 111, 113, 120-151.

Defibrillator – An electronic device used to give an electric shock to the heart. This helps reestablish normal contraction rhythms in a heart having dangerous arrhythmia or in cardiac arrest. In recent years small portable defibrillators have become available. These are called automated external defibrillators or AEDs.

Diabetes Mellitus – A disease in which the body does not produce or properly use insulin. There are three types of diabetes; type 1, type 2, and gestational diabetes. Type 1 diabetes, usually diagnosed in children and young adults, and was previously known as juvenile diabetes, is characterized by the body not producing insulin. In type 2 diabetes, the most common form of diabetes, either the body does not produce enough insulin or the cells ignore the insulin. Gestational diabetes is when women, who have never had diabetes before, have high glucose levels during pregnancy.

Dialysis – A medical process that removes waste, salt and extra water to prevent them from building up in the body keeps a safe level of certain chemicals in blood, such as potassium, sodium and bicarbonate and helps to control blood pressure. There are two main types of dialysis: hemodialysis and peritoneal dialysis. Both types filter blood to rid the body of harmful wastes, extra salt and water. Hemodialysis does that with a machine. Peritoneal dialysis uses the lining of your abdomen, called the peritoneal membrane, to filter the blood.

Diastolic – Referring to the time when the heart is in a period of relaxation and dilation (expansion). The diastolic pressure is specifically the minimum arterial pressure during relaxation and dilatation of the ventricles of the heart when the ventricles fill with blood.

Direct costs – Costs associated with an illness that can be attributed to a medical service, procedure, medication, etc. Examples include payment for an x-ray; pharmaceutical drugs, insulin; surgery; or a physician visit.



Impact of Heart Disease and Stroke in Michigan

Disparity - Inequality or difference in some respect.

Dysphagia – A problem with chewing and swallowing food occurring when muscles around the mouth are weak as a result of a stroke.

End stage renal disease (ESRD) – A complete or near complete failure of the kidneys to function to excrete wastes, concentrate urine, and regulate electrolytes. Fatal unless treated with dialysis or transplantation.

Gestational diabetes – High blood sugar (diabetes) that starts or is first diagnosed during pregnancy.

Glucose – The simple sugar (monosaccharide) that serves as the chief source of energy in the body. The principal sugar the body makes from proteins, fats and, in largest part, carbohydrates.

Heart attack – Also called acute myocardial infarction, occurs when a coronary artery becomes completely blocked, usually by a blood clot (thrombus), resulting in lack of blood flow to the heart muscle and therefore loss of needed oxygen. As a result, part of the heart muscle dies (infarcts). The blood clot usually forms over the side of a cholesterol rich narrowing (or plaque) that has burst or ruptured.

Heart disease – Any disorder that affects the heart. The most common form of heart disease is coronary heart disease but heart failure and sudden cardiac death is also included as a disease of the heart.

Heart failure – The inability of the heart to pump with normal efficiency. This results in a lack of blood flow to the body's tissues and organs. ICD-9 Code: 428. ICD-10 Code: 150.

High blood pressure (Hypertension) – A medical condition in which the blood pressure is chronically elevated. A systolic blood pressure of 140 mmHg or greater or a diastolic pressure of 90 mmHg or greater. With high blood pressure the heart has to work harder, resulting in an increased risk of a heart attack, stroke, heart failure, kidney and eye problems, and a peripheral vascular disease. For those who have high blood pressure, they are considered to be under control if their blood pressure is less than 140/90 mmHg, or less than 130/80 mmHg for those with diabetes or chronic kidney disease.

High density lipoprotein (HDL) – Sometimes called good cholesterol. HDL carries cholesterol from other parts of your body back to your liver. The liver removes the cholesterol from your body. The higher your HDL cholesterol level, the lower your chance of getting heart disease.

Healthy People 2010 (HP2010) – A set of health objectives for the United States to achieve over the first decade of the new century designed to help individuals of all ages increase life expectancy and improve their quality of life and eliminate health disparities among different segments of the population.

Impact of Heart Disease and Stroke in Michigan



Incidence – The number of new cases of disease that develops in a population during a specified period of time, such as a year.

Indirect costs – Those costs associated with an illness that occur because an individual cannot work at his or her usual job due to premature death, sickness, or disability (for example, amputation).

Influenza (A flu) – A contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness, and at times can lead to death.

Ischemic heart disease – Includes heart attack and related heart problems caused by narrowing of the coronary arteries and therefore a decreased supply of blood and oxygen to the heart. Also called coronary artery disease and coronary heart disease.

Kidney disease – Kidney disease results from damage to the nephrons, the tiny structures inside your kidneys that filter blood resulting in waste build up in blood. May result in high blood pressure, anemia (low blood count), weak bones, poor nutritional health, nerve damage, and heart and blood vessel disease. May be caused by diabetes, high blood pressure and other disorders.

Low density lipoprotein (LDL) – Sometimes called bad cholesterol. High LDL cholesterol leads to a buildup of cholesterol in arteries. The higher the LDL level in your blood, the greater chance you have of getting heart disease.

Metabolic syndrome – A group of risk factors linked to overweight and obesity that increase a person’s chance for heart disease, diabetes and stroke. The term “metabolic” refers to the biochemical processes involved in the body’s normal functioning.

The diagnosis is made if a person has any three out of these five heart disease risk factors: a large waistline, a higher than normal triglyceride level, a lower than normal level of HDL cholesterol (high-density lipoprotein cholesterol), higher than normal blood pressure, and higher than normal fasting blood sugar (glucose).

mg/dl – A measure of concentration (mass per unit volume) using milligrams per deciliter.

Morbidity – A measure used to address the prevalence or incidence of a disease, the degree or severity of a disease, disability or the state of being of someone with a disease.

Mortality – The total number of deaths from a given disease in a population during a specific interval of time, usually a year.

Neuroendovascular therapy– Clinical practice that focuses on endovascular therapies for cerebrovascular disorders; such as brain aneurysms, atherosclerotic diseases, vascular malformations and fistulas, and vascular-rich tumors.

Impact of Heart Disease and Stroke in Michigan



Obese – Label for ranges of weight that are greater than what is generally considered healthy for a given height. An adult who has a Body Mass Index (BMI) of 30 or higher.

Osteoporosis – A disease in which bones become fragile and more likely to break. If not prevented or if left untreated, osteoporosis can progress painlessly until a bone breaks. These broken bones, also known as fractures, occur typically in the hip, spine, and wrist.

Overweight – Label for ranges of weight that are greater than what is generally considered healthy for a given height. An adult who has a Body Mass Index (BMI) between 25 and 29.9.

Pandemic – An epidemic of infectious disease that spreads through human populations across a large region (for example a continent), or even worldwide.

Prevalence – The total number of cases of disease existing in a population during a specific point in time.

Puerperium – The time immediately after the delivery of the placenta through the first few weeks after the delivery. This period is usually considered to be 6 weeks in duration.

Rate – The basic measure of disease occurrence that expresses probability or risk of disease in a defined population over a specified period of time.

Risk factor – A variable associated with an increased risk of disease or infection. Risk factors are not necessarily causal.

Stroke – A form of cerebrovascular disease that affects the arteries of the central nervous system. A stroke occurs when blood vessels bringing oxygen and nutrients to the brain burst (hemorrhagic stroke) or become clogged by a blood clot or some other particle (ischemic stroke). Because this rupture or blockage, part of the brain does not get the flow of blood it needs. Deprived of oxygen, nerve cells in the affected area of the brain cannot function and die within minutes. When nerve cells cannot function, the part of the body controlled by these cells cannot function either. This category includes: subarachnoid hemorrhage; intracerebral hemorrhage; other nontraumatic intracranial hemorrhage; cerebral infarction; stroke, not specified as hemorrhage or infarction; occlusion and stenosis of precerebral arteries not resulting in cerebral infarction; other cerebrovascular diseases; cerebrovascular disorders in diseases classified elsewhere, and sequelae of cerebrovascular disease. ICD-9 Codes: 430-434, 436-438. ICD-10 Codes: 160-169.

Systolic – The blood pressure when the heart is contracting. It is specifically the maximum arterial pressure during contraction of the left ventricle of the heart. The time at which ventricular contraction occurs is called systole.

Impact of Heart Disease and Stroke in Michigan



Tissue plasminogen activator (tPA) – A thrombolytic agent (clot-busting drug) administered through an intravenous (IV) line in the arm by hospital personnel approved for use in certain patients having a heart attack or stroke. The drug can dissolve blood clots, which cause most heart attacks and strokes. tPA is the only drug approved by the U.S. Food and Drug Administration for the acute (urgent) treatment of ischemic stroke.

Transfat – An unhealthy substance, also known as trans fatty acid, made through the chemical process of hydrogenation of oils. Hydrogenation solidifies liquid oils and increases the shelf life and the flavor stability of oils and foods that contain them.

Transient ischemic attack (TIA) – A “warning stroke” or “mini-stroke” that produces stroke-like symptoms but no lasting damage. They can occur days, weeks or even months before a major stroke when a blood clot temporarily clogs an artery, and part of the brain doesn’t get the blood it needs. The symptoms occur rapidly and last a relatively short time. ICD-9 Code: 435.

Triglyceride – The chemical form in which most fat exists in food as well as in the body. They are also present in blood plasma and, along with cholesterol, form the plasma lipids. Triglycerides in plasma are derived from fats eaten in foods or made in the body from other energy sources like carbohydrates. Calories ingested in a meal and not used immediately by tissues are converted to triglycerides and transported to fat cells to be stored. Hormones regulate the release of triglycerides from fat tissue so they meet the body’s needs for energy between meals.



Appendix Y: Methods

Coding for hospitalization and mortality data

The International Classification of Diseases (ICD) Ninth Revision Clinical Modification (ICD-9-CM) was used to classify hospitalization data and the ICD Tenth Revision (ICD-10) was used for the mortality data. The following principal diagnosis codes in the hospitalization data and the underlying cause of death codes in the mortality data were used.

Disease	ICD-9	ICD-10
Cardiovascular Disease	390-434, 436-448	I00-I78
Diseases of the Heart	390-398, 402, 404, 410-429	I00-I09, I11, I13, I20-I51
Coronary Heart Disease	410-414, 429.2	I20-I25
Stroke	430-434, 436-438	I60-I69
TIA	435	
Heart Failure	428	I50

A hospitalization is defined as an inpatient stay with a primary discharge diagnosis listed above. Data represent the number of hospitalization stays, not the number of people hospitalized.

Prevalence

Prevalence is the proportion of individuals in a population who have the disease at a point in time or during a given time period. It is often used to describe the health burden on a given population. Prevalence is computed by dividing the number of existing cases at a particular point or period in time by the total population from which the cases came. It is often multiplied by 100 and expressed as a percent. In this report, prevalence estimates are generated in the analysis of data from the Behavioral Risk Factor Surveillance System, Youth Risk Behavior Survey, Youth Tobacco Survey, and Health Plan and Employer Data and Information Set from the National Committee for Quality Assurance.

$$\text{Prevalence} = \frac{\text{Number of existing cases of disease}}{\text{Total population}}$$

For example, 21% of people in Michigan smoke. This is the prevalence of smoking. The number of people who reported being a smoker was divided by the total number of people that were asked.



Hospitalization Rate/Incidence Rate

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

The denominator is the average population estimated for that same time period multiplied by the number of years in the interval. The population at the midpoint of a given time interval is used to estimate the average population over the entire interval. This is then multiplied by the number of years in the interval so that an annual rate is generated. The use of this denominator assumes that the population and its demographic composition are relatively stable.

For example, hospitalization rate for CVD in 2006 was 202.5 per 10,000, meaning that for every 10,000 people in Michigan there were 202.5 hospitalizations due to CVD.

Incidence rates are generally multiplied by some factor of 10 so that they can be better understood in terms of a population. For cardiovascular disease hospitalizations, rates are multiplied by 10,000, whereas for cardiovascular disease deaths, rates are multiplied by 100,000.

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

$$\text{Annual Incidence Rate} = \frac{\text{Number of new events during a given time period}}{\text{Average population} \times \text{Number of years in time period}}$$

Geographical Information System Mapping

Environmental Systems Research Institute's (ESRI) ArcGIS Map was used to create the maps seen in the report. Data used in the maps were from varying data sources such as Michigan Resident Inpatient File and Michigan Resident Death File. Analyses of the data used in the maps were performed externally from the ArcGIS program.



Age-Adjustment by Direct Standardization

Populations often differ in their distribution of age, which may in turn affect the overall rate of events in that population. For example, if one population has a larger number of young children (0 to 4 years) than another, it could exhibit a higher hospitalization rate simply due to its age structure. Therefore, when comparing rates of events in populations of different age distributions, it is important to account for those differences.

In this report, age structure differences are accounted for in overall rates using direct standardization methodology to compute age-adjusted rates. Rates that are not age-adjusted are referred to as crude rates. An age-adjusted rate is a weighted average of age group-specific rates in the population under study. The age group-specific rates are weighted by the number of people in each age group of a selected standard population. When two or more age-adjusted rates are computed using the same standard population, they may be compared. Age-adjusted rates are presented in this report so that comparisons can be made between geographic subgroups (ex. County vs. County) and demographic subgroups (ex. white vs. black).

The standard population used in the calculation of age-adjusted rates in this report is the 2000 United States Standard Population. To compute an age-adjusted incidence rate, the first step is to compute the comprising age-specific rates. These are then multiplied by the corresponding age specific weight, i.e. the proportion of people in a particular age strata in the standard population. The products of these calculations are then summed and divided by the sum of all the age-specific weights. In this report, age-adjusted rates are generated in the analysis of data from the Michigan Resident Inpatient File and the Michigan Resident Death File.

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

Data Suppression

Incidence rate estimates calculated with a small number of events or population sizes are statistically unstable. They exhibit wide confidence intervals indicative of great variability. In this report, data suppression rules are enforced so that the data presented are reliable. For demographic or geographic subgroups where there is less than or equal to 20 deaths mortality rates are suppressed. In addition, this is done to protect the identity of persons who have been hospitalized or died.



Appendix Z: Data sources

Name: Healthcare Cost and Utilization Project

Acronym: HCUP

Basic Purpose and History: The HCUP family of administrative longitudinal databases currently provides data for 1988-2006. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcome of treatment at the national, state, and local market levels.

Data Collection Process: HCUP databases contain discharge-level information compiled in a uniform format with privacy protections in place. The databases included in HCUP are the Nationwide Inpatient Sample (NIS). The National Inpatient Sample is comprised of records from all participating state's inpatient databases.

Population Included: Each database included in HCUP is comprised of data from a particular population. NIS contains all discharge data from a sample of hospitals located in 33 States, approximating a 20-percent stratified sample of U.S. community hospitals.

Additional Information: For more information about HCUP and additional data for comparison, visit the website for the Agency for Healthcare Research and Quality at HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/data/hcup/hcupnet.htm>.

Name: Health Plan and Employer Data and Information Set from the National Committee for Quality Assurance

Acronym: HEDIS®, NCQA

Basic Purpose and History: HEDIS® is a set of performance measures for assessing, reporting on, and improving the quality of care provided by the managed care industry.

Population Included: Managed care plan members who are 5 to 56 years and were continuously enrolled in a managed care plan during 2005 and 2006 were selected for analysis.

Additional Information: Data presented in this report have been reproduced from the Michigan Medicaid HEDIS® 2007 Results Statewide Aggregate Report, Health Services Advisory Group, Inc., December 2007 and from the NCQA Health Plan Report Card

For more information about HEDIS®, visit

<http://www.ncqa.org/Programs/HEDIS/index.htm>.

For more information about NCQA Health Plan Report Card visit

<http://hprc.ncqa.org/frameset.asp>

Impact of Heart Disease and Stroke in Michigan



Name: Michigan Behavioral Risk Factor Surveillance System

Acronym: BRFSS

Basic Purpose and History: The BRFSS is a source of estimates of the prevalence of certain health behaviors, conditions, and practices associated with leading causes of death. Michigan has conducted the BRFSS survey since 1987.

Data Collection Process: Annual estimates are based on data collected by telephone from a sample of Michigan adults selected using random-digit dial methods. It is a population-based representative sample of non-institutionalized Michigan residents. The data are weighted to represent estimates for the general adult population. BRFSS interviewers use a Computer Assisted Telephone Interviewing (CATI) system, which provides the interviewer with prompts. The interviewer types the respondent's responses directly onto the computer screen, providing quality control and minimizing interviewer error.

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

Additional Information: For more information about the BRFSS and national data for comparison, visit <http://www.cdc.gov/brfss/index.htm>. For a complete report of the Michigan BRFSS Survey, visit <http://www.michigan.gov/brfs>.

Name: Michigan Inpatient Database

Acronym: MIDB

Basic Purpose and History: These data help support the State of Michigan health planning activities and are used by facilities themselves for internal evaluation. The Michigan Department of Community Health (MDCH) has purchased data from the Michigan Health and Hospital Association (MHA) since 1982.

Data Collection Process: Data are collected throughout a patient hospital stay by clinical and administrative staff and filed within a medical record. Hospital medical record personnel ascertain and keypunch information from these records. Some small hospitals complete data collection forms and send these directly to MHA for processing. Depending on the facility, data are submitted on a voluntary basis monthly, quarterly, or annually to MHA. Because data formats often differ by hospital, all coding is converted into standard formats at MHA. The public use file provided to MDCH is stripped of all patient, provider, and hospital identifiers.

Population Included: Records include all hospital discharges from any of Michigan's reporting acute care hospitals or Michigan residents discharged from acute care hospitals in contiguous states. It includes virtually all hospitalizations in Michigan and for Michigan residents.

Additional Information: For the latest data regarding preventable hospitalizations in Michigan, visit <http://www.mdch.state.mi.us/pha/osr/chi/hosp/frame.html>.

Impact of Heart Disease and Stroke in Michigan



Name: Michigan Resident Death Files

Acronym: MRDF

Basic Purpose and History: The death certificate database is a high quality computerized data set containing demographic and cause of death information for all Michigan residents (out of state deaths included) and non-Michigan residents dying in Michigan. Death certificates are one of public health's vital records for monitoring the health of citizens. Death certificates have been collected in Michigan since 1897.

Data Collection Process: A funeral director, or another individual responsible for disposing of the body, completes the demographic and disposition components of the death certificate. When applicable, an attending physician or other hospital medical staff completes the portion of the death certificate describing the death (time, date, place, and immediate/underlying cause). A county medical examiner completes this section in all unexpected deaths including fatal injuries. The death certificate is then sent to the local registrar who verifies that the document has been properly filled out. If not, it is returned to the appropriate person for revision. Certificates for Michigan residents dying out-of-state are provided by those states (primarily Indiana, Ohio, and Wisconsin). Instructional materials to complete the death certificate are available at the state and local level for doctors, hospitals, medical examiners, and funeral directors. Michigan funeral director training also includes an annual seminar on death certificate completion.

Population Included: All in-state occurrences regardless of the state of residence and all Michigan residents regardless of location of death are included.

Additional Information: For more data regarding Michigan mortality, visit <http://www.mdch.state.mi.us/pha/osr/index.asp?Id=4>.

Name: Youth Risk Behavior Survey

Acronym: YRBS

Basic Purpose and History: YRBS was designed to determine the prevalence of health-risk behaviors among high school students. It was also designed to monitor trends and progress toward achieving national health objectives. Michigan first administered the survey in 1997.

Data Collection Process: A two-stage cluster sampling scheme is implemented, where public schools with grades 9 through 12 are first selected, followed by classes within those schools. The questionnaire is self-administered by students who volunteer to participate in the selected classes. The survey is conducted every odd year at the national, state and local levels.

Population Included: Public and private school students in grades 9 through 12 are eligible to participate.

Additional Information: For more information about the YRBS and national data for comparison, visit <http://www.cdc.gov/HealthyYouth/yrbs/index.htm>.

Impact of Heart Disease and Stroke in Michigan



Name: Youth Tobacco Survey

Acronym: YTS

Basic Purpose and History: The YTS was created to support the design implementation, and evaluation of state level tobacco control programs. Its core questions ask about a variety of tobacco issues, including tobacco use, secondhand smoke exposure, ability to purchase, and attitudes about tobacco. Michigan first administered the YTS in 2001.

Data Collection Process: A two-stage sampling scheme is implemented, where public middle and high schools are first selected, followed by classes within those schools. The questionnaire is self-administered by students who volunteer to participate in the selected classes, (Sample size approximately 3,000 students). The survey is conducted every two years.

Population Included: Public school students in grades 6 through 12 are eligible to participate.

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



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