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*The Burden*

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*of*

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# DIABETES

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*in South Dakota*

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South Dakota Department of Health  
Diabetes Prevention and Control Program  
615 East Fourth Street, Pierre, SD 57501  
Phone: (800) 738-2301  
Fax: (605) 773-5942  
<http://diabetes.sd.gov>



## OFFICE OF THE SECRETARY

600 East Capitol Avenue  
Pierre, South Dakota 57501-2536  
605/773-3361 FAX: 605/773-5683

July 31, 2008

Dear South Dakotans:

On behalf of the South Dakota Department of Health Diabetes Prevention & Control Program, I am pleased to present *The Burden of Diabetes in South Dakota*.

This report quantifies the epidemic of diabetes in the state of South Dakota. It presents information on the number of people with diabetes, their characteristics, the treatment they receive and the consequences of the disease. It also describes the risk factors that increase the occurrence of diabetes and its complications.

The report indicates that diabetes is **common, costly, and serious**:

**Diabetes is common** – 2007 surveillance showed that approximately 40,000 South Dakota adults had been diagnosed with diabetes, more than 13,000 have the disease but do not know it, and almost 150,000 South Dakota adults have pre-diabetes. Pre-diabetes places people at an increased risk of developing type 2 diabetes, heart disease, and stroke.

**Diabetes is costly** – the per capita annual cost of health care for people with diabetes is calculated at \$11,744 a year, of which \$6,649 (57%) is attributed to diabetes.

**Diabetes is serious** – uncontrolled diabetes can lead to serious complications such as lower extremity amputations, blindness, end-stage renal disease, and significantly increased rates of heart disease and cardiovascular events. In 2007 there were 246 deaths directly attributed to diabetes. From 2003-2007 a total of 1,174 deaths were directly attributed to diabetes in South Dakota residents.

*The Burden of Diabetes in South Dakota* is part of a statewide initiative to improve the health care of people either at risk for or already with diabetes and is consistent with the *South Dakota Diabetes State Plan 2007-2009*, available at <http://diabetes.sd.gov>.

We hope that you will find this report useful in your diabetes prevention and control efforts.

Sincerely,

A handwritten signature in black ink that reads "Doneen B. Hollingsworth". The signature is fluid and cursive.

Doneen B. Hollingsworth  
Secretary of Health

# **The Burden of Diabetes in South Dakota**

**Published July 2008**

**For additional information or copies of this report,  
contact:**

**South Dakota Department of Health  
615 East 4<sup>th</sup> Street  
Pierre, South Dakota 57501-1700  
(800) 738-2301  
<http://diabetes.sd.gov>**

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## Executive Summary

Diabetes is a serious disease, requiring extensive medical monitoring, lifelong treatment and is a common cause of disability and death in South Dakota. In 2007:

- Approximately 6.7%-39,344 of South Dakota adults have been diagnosed with diabetes and the prevalence of diabetes has more than doubled since 1998.
- Another estimated 13,115 South Dakotans are likely to not know they have diabetes.
- A significant racial disparity exists as the prevalence of diagnosed diabetes in Native Americans was 11.0 % compared to 6.4% in whites.
- There are about 973 South Dakotans under 18 with diabetes. Because type 2 diabetes rarely develops in those under 18, the vast majority of these 973 kids have type 1 diabetes.
- South Dakotans aged 65 years or older were almost twice as likely to have been diagnosed with diabetes as persons aged 45 to 64 years.
- Analysis by the Centers for Disease Prevention & Control shows 25.9% of adults aged 20 years or older had pre-diabetes. Extrapolating this analysis to South Dakota shows about 149,250 adult had pre-diabetes.
- Of South Dakota women who gave birth between August 2006 and January 2007, 1.1% had pre-existing diabetes and 7.1% developed gestational diabetes during the pregnancy.
- Being overweight or obese places South Dakotans at an increased risk for type 2 diabetes and other chronic diseases. Among South Dakota adults, 38.3% were overweight and an additional 27.2% were obese.
- Quality of life indicators among South Dakotans show people with diabetes were more likely to report poor physical and mental health as well as significant limitations to their usual activities. They also reported rates of disability with equipment needs three times higher than those without diabetes. Dissatisfaction with life was higher for people with diabetes when compared to those without diabetes, 5.7% versus 3.4%.
- 66.4% of people with diabetes had taken a course to learn about diabetes self-care.
- 66.6% of people with diabetes had been told by a health professional that they had high blood pressure.
- 58.6% of people with diabetes had been told they had high cholesterol.
- 14.1% of people with diabetes had heart disease. Adults with diabetes were five times more likely to have suffered a stroke than those without diabetes, 10.3% versus 2.0%.
- While South Dakota adults with diabetes are less likely than those without diabetes to be current smokers, 17.5% versus 20.0% respectively, the incidence is still quite high. The rate of adults with diabetes who use spit tobacco is 2.5%.

## The Burden of Diabetes in South Dakota

- 90.6% of adults with diabetes reported their A1c had been checked one or more times in the previous year.
- 73.4% of adults with diabetes stated a health professional had checked their feet at least once in the previous year.
- 74.4% of adults with diabetes stated they'd had a dilated eye exam in the previous 12 months and 19.4% had been told that diabetes had affected their eyes or they had retinopathy.
- 80.2% of adults aged 65 and older with diabetes reported receiving a flu shot within the previous 12 months and 78.4% reported ever receiving a pneumococcal shot.
- 72.7% of adults aged 18-64 with diabetes reported receiving a flu shot within the previous 12 months and 59.4% reported ever receiving a pneumococcal shot.
- 5.7% of South Dakota adults with diabetes had no health insurance.
- The per capita annual cost of health care for people with diabetes is calculated at \$11,744 a year, of which \$6,649 (57%) is attributed to diabetes.
- Outpatient training to help people self-manage their diabetes prevents hospitalizations. Every \$1 invested in such training can cut health care costs by up to \$8.76.
- Preconception care for women with diabetes leads to healthier mothers and babies. Every \$1 invested in such care can reduce health costs by up to \$5.19 by preventing costly complications.
- There were 246 deaths directly attributed to diabetes in 2007 compared to 201 in 2003. That is a 22.4% increase. There have been a total of 1,174 deaths attributed to diabetes in South Dakota residents from 2003-2007.
- Native Americans were more likely to die from diabetes as the primary cause than whites in 2007 (8.6% versus 3.2%). Also, there was a greater rate of potential life lost before the age of 75 per 100,000 for Native Americans than whites, 1,246 years versus 143 years.
- Native Americans have a lower average age at death than whites, 66 years versus 80 years.

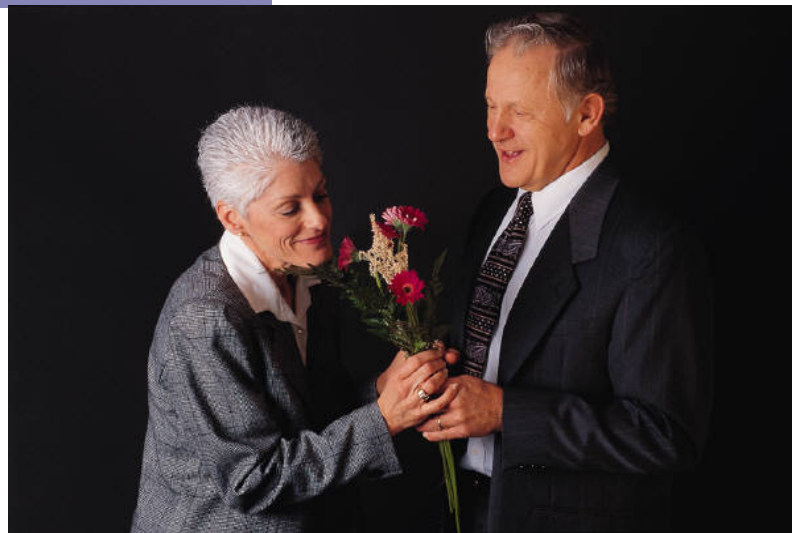
The *Burden of Diabetes in South Dakota* was developed as part of a statewide initiative to improve the health care of people at risk for and with diabetes and is consistent with the *South Dakota Diabetes State Plan 2007-2009*, available at <http://diabetes.sd.gov>.

We hope this document will be of benefit to you, your associates, and persons with diabetes. The South Dakota Diabetes Prevention & Control Program welcomes your comments and questions regarding the contents of this report. Please contact Colette Hesla, DPCP coordinator at (605) 773-7046 or [Colette.hesla@state.sd.us](mailto:Colette.hesla@state.sd.us) with your comments.

## Introduction

Diabetes is a serious disease requiring extensive medical monitoring and lifelong treatment. It is a common cause of disability and death in South Dakota. The purpose of this report is to quantify the epidemic of diabetes in the state of South Dakota. It presents information on the number of people with diabetes, their characteristics, the treatment they receive and the consequences of the disease. It also describes the risk factors that increase the occurrence of diabetes and its complications.

The *Burden of Diabetes in South Dakota* was developed as part of a statewide initiative to improve the health care of people at risk for and with diabetes and is consistent with the *South Dakota Diabetes State Plan 2007-2009*, available at <http://diabetes.sd.gov>.



## What is Diabetes?

Diabetes is a disease in which the body does not produce or properly use insulin. Insulin is a hormone that is needed to convert sugar, starches and other food into energy needed for daily life. The cause of diabetes continues to be a mystery, although both genetics and environmental factors such as obesity and lack of exercise appear to play roles (1). Diabetes has 3 main categories:

### **Type 1 Diabetes Mellitus**

Type 1 diabetes results from the body's failure to produce insulin, the hormone that "unlocks" the cells of the body, allowing glucose to enter cells and fuel them. It is estimated that 5-10% of Americans who are diagnosed with diabetes have type 1 diabetes (1). Type 1 diabetes is usually diagnosed in children and young adults, and was previously known as juvenile diabetes (36).

### **Type 2 Diabetes Mellitus**

Type 2 diabetes results from insulin resistance (a condition in which the body fails to properly use insulin), usually combined with the body not producing enough insulin (1). Insulin is necessary for the body to be able to use glucose for energy. When glucose is not able to enter the cells and builds up in the blood it can cause two problems. First, the cells may be starved for energy, and second, high blood glucose levels can damage the blood vessels, nerves, and other soft tissues. Ninety to ninety-five percent of people with diabetes have type 2. While diabetes occurs in people of all ages and races, some groups have a higher risk for developing type 2 diabetes than others. Type 2 diabetes is more common in Native Americans, Latinos, African Americans, and Asian Americans/Pacific Islanders, as well as the aged population (37).

### **Gestational Diabetes Mellitus (GDM)**

GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (10). Although this form of diabetes usually disappears after the baby's birth, women who have had GDM have a 40 to 60 % chance of developing type 2 diabetes within 5 to 10 years (17). GDM affects maternal-child health and is associated with a potential for preeclampsia, cesarean delivery for the mother, and with higher rates of perinatal mortality, macrosomia, birth trauma, hyperbilirubinemia, and neonatal hypoglycemia in the infant (11).

### **Pre-diabetes**

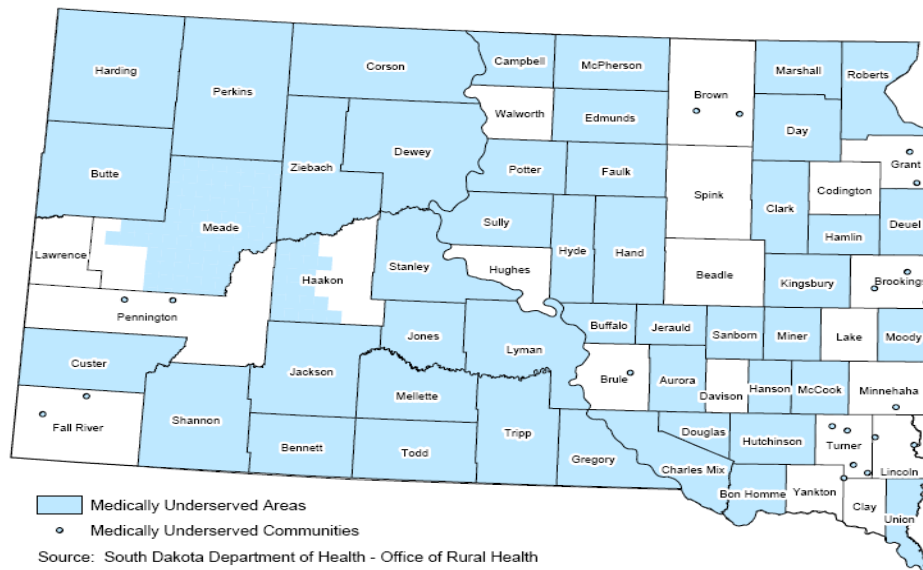
Pre-diabetes is a general term for impaired fasting glucose (IFG) or impaired glucose tolerance (IGT). It occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of type 2 diabetes (1). Progression to diabetes among those with pre-diabetes is not inevitable. Studies have shown that people with pre-diabetes who lose weight and increase their physical activity can prevent or delay diabetes and return their blood glucose levels to normal. In the Diabetes Prevention Program, a nationwide prevention study of people at high risk for diabetes, showed that lifestyle intervention reduced developing diabetes by 58% over 3 years. The reduction was even greater, 71%, among adults aged 60 years or older (16).

## Demographics of South Dakota

South Dakota is one of the least densely populated states in the nation with 781,919 people living within its 75,955 square miles for an average population density of 10.3 people per square mile. Nearly 60% of South Dakota's total population lives in small, rural communities of 5,000 or fewer people, with communities of less than 500 people comprising a large portion of this population group. The population of South Dakota is predominantly non-Hispanic White with Native American being the largest minority, 88.4 % and 8.5%, respectively. The remaining 3.1% are classified as another race. Adults age 65 and older comprise 14.2 % of the population which is higher than the national average of 12.4 %. A total of 12.9% of South Dakotans live below 100% of the federal poverty level (31) and five of the 10 counties in the United States with the lowest per capita income are on South Dakota Indian reservations (32). Access to primary care providers, diabetes educators and specialists is limited in the state with over two-thirds of the state designated by the federal government as Medically Underserved (Figure 1) (27).

**Figure 1**

### SOUTH DAKOTA MEDICALLY UNDERSERVED AREAS May 12, 2008



As of July 2008, there are 1,675 physicians practicing in South Dakota. Over half (55.3%) currently practice in an urban community (defined as having a population center of 50,000 or more). Of the remaining physicians, 4.1% practice in frontier communities (defined as having a population density of six or less persons per square mile) and 40.6% practice in a rural community (defined as a population density of more than six persons per square mile but no population centers of 50,000 or more) (23).

South Dakota has 49 general community hospitals, of which 37 are critical access hospitals, and three Veteran's Administration hospitals. There are also 39 federally qualified health center (FQHC) sites, 60 licensed rural health clinics (24), a multitude of clinics associated with the Avera McKennan, Rapid City Regional, and Sanford health systems as well as some private clinics. There are four Indian Health Service hospitals, seven Service Units (35), and

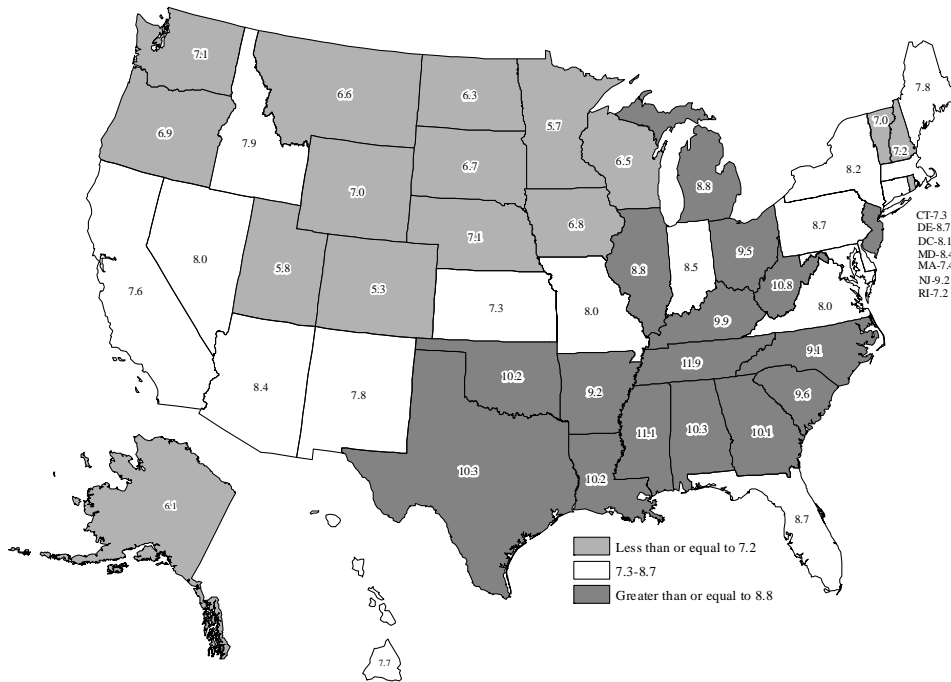
three Urban Indian Health Clinics. There are 25 Diabetes Self-Management Education (DSME) programs recognized by the American Diabetes Association, the Indian Health Service or the South Dakota Department of Health (26).

**Prevalence of Diagnosed Diabetes**

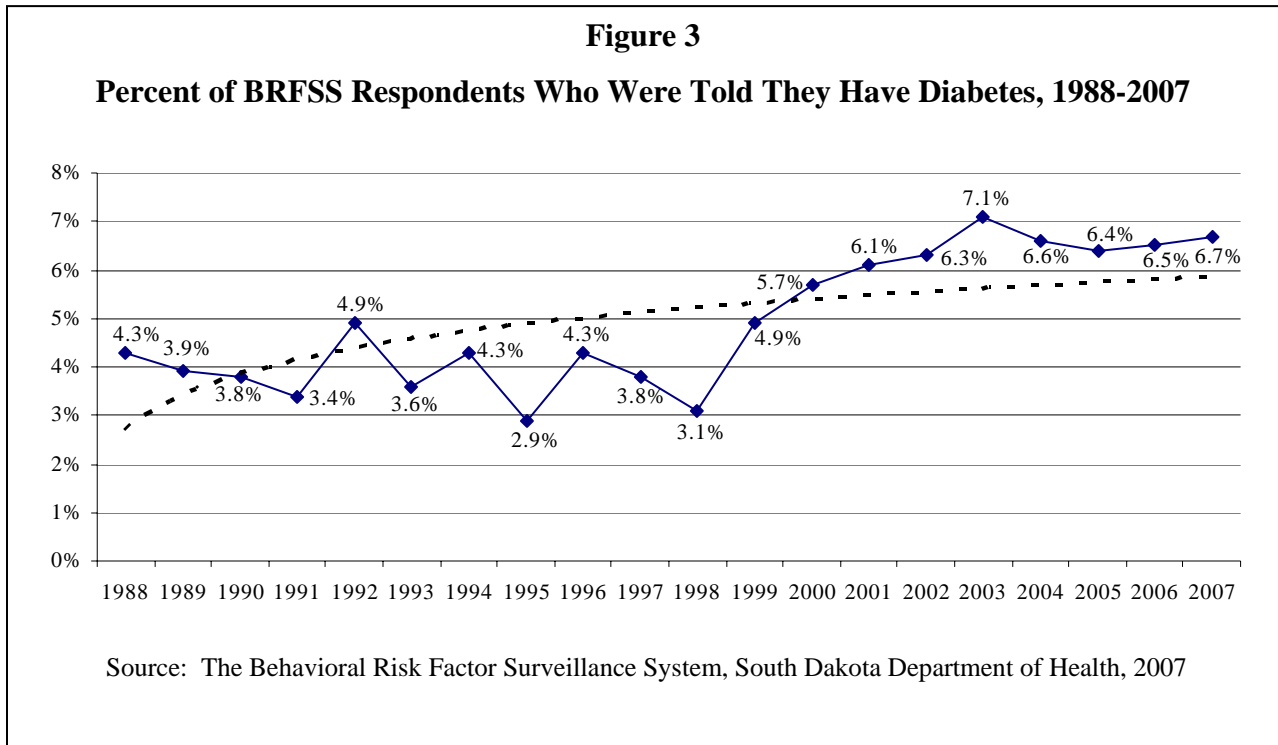
According to the Centers for Disease Control and Prevention (CDC), nearly 8% of the population in the United States (24 million people) has diabetes. Of this number, about 17.9 million have been diagnosed and another 25%-5.7 million people have not been diagnosed and are unaware that they have the disease (18). The 2007 Behavioral Risk Factor Surveillance System (BRFSS) shows that 6.7% of South Dakotans 18 and older have been diagnosed with diabetes, about 39,344 adults. Using the national estimate that about 25% of people with diabetes are undiagnosed, an additional 13,115 South Dakotans are likely to not know they have diabetes (18). Nationally, Colorado had the lowest prevalence rate at 5.3% while Tennessee had the highest rate at 11.9%. The national median was 8.0% (2) (Figure 2).

**Figure 2**

**Nationally, BRFSS Respondents Who Were Told They Have Diabetes, 2007**

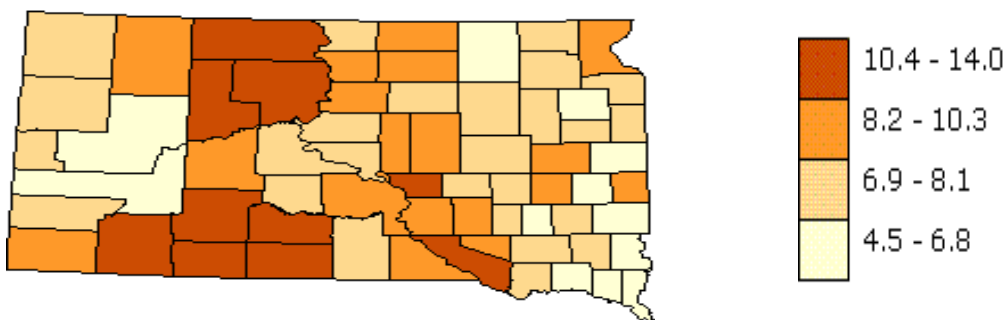


Diabetes prevalence rates in South Dakota, as in the United States, have increased gradually since the late 1980's. The number of people with diagnosed diabetes in South Dakota has increased 2.4 percentage points since 1988; however, the prevalence has more than doubled since 1998. (Figure 3).



In June 2008, the CDC released estimates of diagnosed diabetes for all counties in the United States. Derived from BRFSS and census data, the estimates provide a clearer picture of areas within the state that have higher diabetes rates (5). See Figure 4.

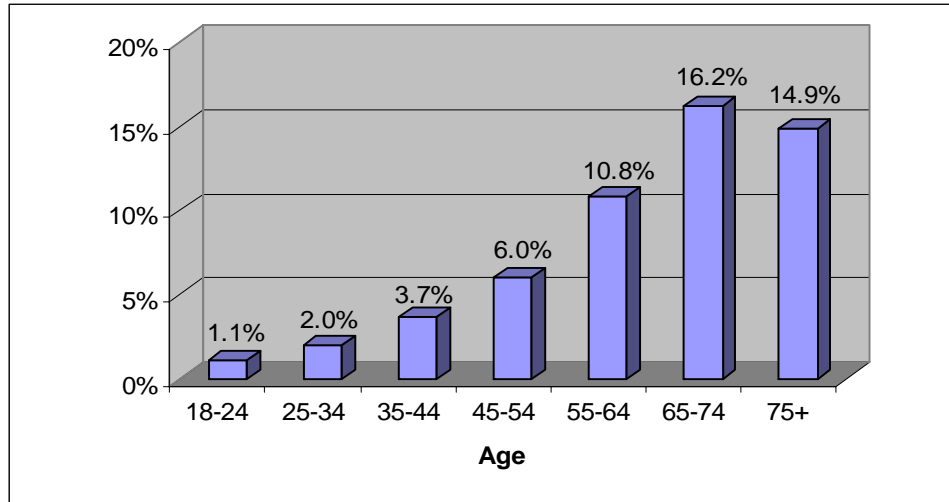
**Figure 4**  
**County Level Estimates of Diagnosed Diabetes - Percentage of Adults in SD, 2005**



Diabetes incidence generally increases with age. Data from the 2007 BRFSS indicate that South Dakotans aged 65 years or older were almost twice as likely to have been diagnosed with diabetes as persons aged 45 to 64 years. See Figure 5. In recent years, the incidence is occurring at a younger age (22).

**Figure 5**

**Percent of SD BRFSS Respondents Who Were Told They Have Diabetes, By Age, 2007**

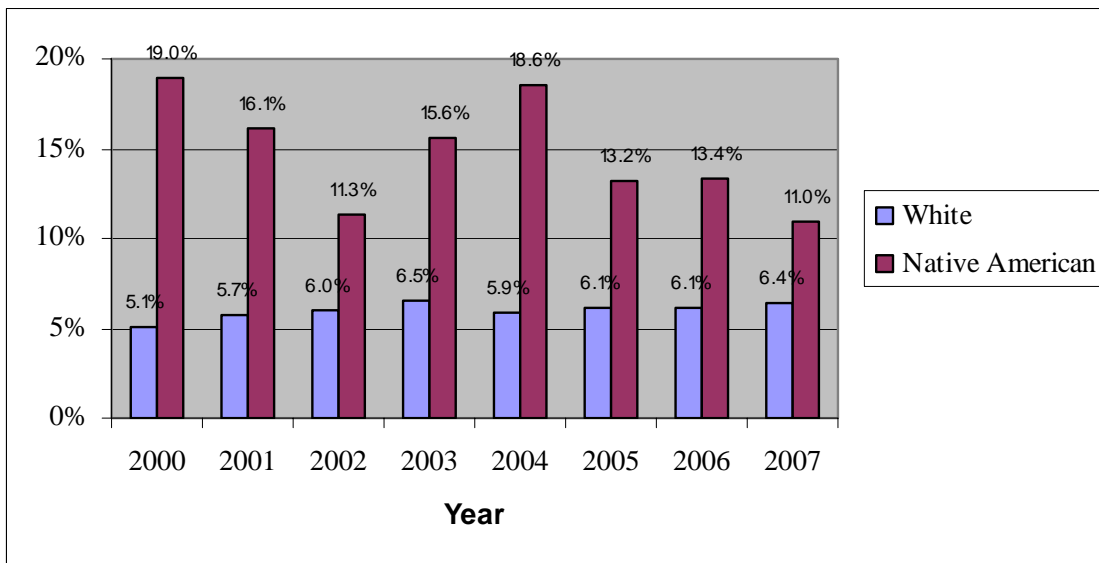


The prevalence of diabetes is significantly higher among persons of lower income levels. In 2007, of those earning less than \$25,000, 10.9% had diabetes versus 4.8% of those earning more than \$50,000 per year (22).

Racial and ethnic sub-populations in the United States suffer from diabetes at disproportionately higher rates than the majority population. South Dakota's 2007 BRFSS data reflects this racial disparity. The prevalence of diagnosed diabetes among Whites was 6.4 % compared to Native Americans at 11.0 % – nearly twice the prevalence among Whites (22). See Figure 6. Native American females have a significantly higher prevalence of diabetes than those of White females, 11.4% versus 6.2% in 2007 (22).

**Figure 6**

**Percent of Race with Diagnosed Diabetes, South Dakota, 1999-2007**



Additional consideration needs to be given to overweight women of childbearing age as excess weight increases the risk of gestational diabetes mellitus (GDM). Approximately 7% of all pregnancies (ranging from 1 to 14% depending on the population studied and the diagnostic tests used) are complicated by GDM (30). According to a survey of South Dakota women who gave birth between August 2006 and January 2007, 1.1% had pre-existing diabetes and 7.1% developed diabetes during the pregnancy (28).

The CDC calculates about 186,300 people younger than 20 years have diabetes (type 1 or type 2) in the United States. In South Dakota in 2007, the prevalence of type 1 and type 2 diabetes in South Dakotans 17 years and younger was 0.5% (22). In 2006 the prevalence rate was 0.3% (7) and in 2005 it was 0.5% (33). The US Census 2006 population estimate indicates there were 194,698 South Dakotans under 18 (31). Therefore, there are approximately 973 South Dakota youth with diabetes. Because type 2 diabetes rarely develops in those under 18, the vast majority of these 973 kids have type 1 diabetes.

### **Prevalence of Pre-diabetes**

Pre-diabetes is a condition in which individuals have blood glucose levels higher than normal but not high enough to be classified as diabetes. According to analysis by CDC, 25.9% of U.S. adults aged 20 years or older, 57 million Americans, had pre-diabetes in 2007 (16). Extrapolating this analysis to South Dakota suggests about 149,250 South Dakotans had pre-diabetes in 2007. People with pre-diabetes have an increased risk of developing type 2 diabetes, heart disease, and stroke.



## Risk Factors for Development of Diabetes

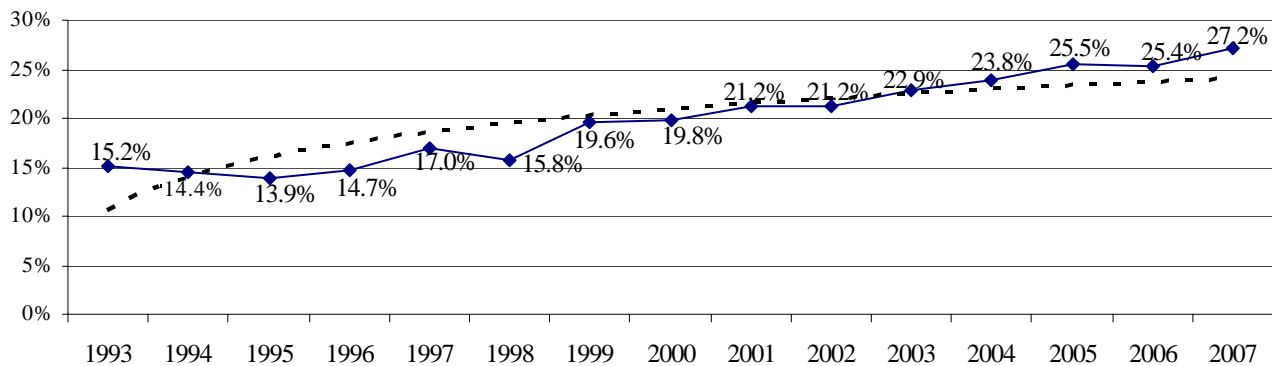
For type 1 diabetes, there are no known modifiable risk factors that can lower a person’s probability of developing the disease. For type 2 diabetes however, both obesity and lack of physical activity are significant risk factors, making lifestyle changes such as improved nutrition, weight control, and regular physical activity highly advisable. The Diabetes Prevention Program, a study which was ended and the results released a year early because of the profound findings, proved that type 2 diabetes can be prevented or delayed with modest weight loss and increased physical activity for many people at risk for the disease (8).

### Overweight and Obesity Rates

For the past few decades, the prevalence of overweight and obesity has steadily increased which puts South Dakotans at an increased risk for type 2 diabetes. South Dakota’s percentage of overweight but not obese (defined as a body mass index of 25.0 to 29.9) has increased from 37.8% in 1993 to 38.3% in 2007. The percent of obese adults (defined as a body mass index of 30.0 and over) has increased from 15.2% in 1993 to 27.2% in 2007 (22). See Figure 7. Overweight and obese adults were most prevalent among the 55-64 year old age group. In 2007, 84.8% of South Dakotans with diabetes were overweight or obese (22).

Figure 7

Percent of Obese Adult South Dakotans, 1993-2007



Overweight and obese children are at risk for developing type 2 diabetes later on in life (15). The 2006-2007 School Height and Weight Report shows that 32.9% of South Dakota children and adolescents aged 5-19 are overweight or obese. Native American students have a higher rate of overweight and obese than Whites, 46.8% and 30.7% respectively (20).

### Physical Activity Rates

To achieve and maintain good health and reduce the risk for chronic disease, able adults are recommended to get moderate-intensity aerobic physical activity, at least 30 minutes a day, five days a week and/or vigorous-intensity aerobic physical activity for at least 20 minutes on three days a week. Physical activity can be acquired in 10 minute bouts throughout the day to achieve the recommended amounts of physical activity (14).

- In 2007, 32.1% of persons with diabetes engaged in moderate physical activity compared to 49.0% of persons without diabetes.
- Also In 2007, 12.9% of persons with diabetes engaged in vigorous physical activity compared to 26.3% of persons without diabetes.

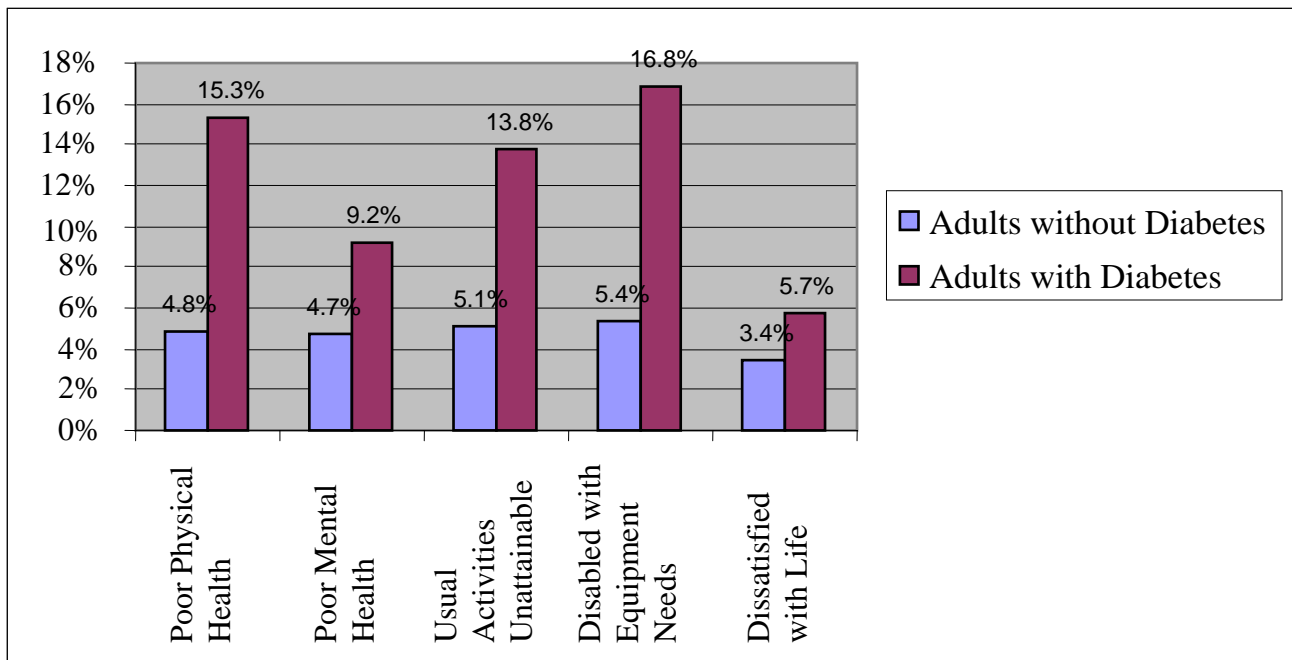
### Quality of Life

Diabetes can cause emotional distress and impair self-care. It is not uncommon for persons with diabetes to feel overwhelmed from their care regimens. Depression, anxiety, and other psychological disorders are more prevalent among persons with diabetes.

Quality of life indicators among South Dakotans as reported in the 2007 BRFSS show people with diabetes were more likely to report poor physical and mental health as well as significant limitations to their usual activities. South Dakotans with diabetes also reported rates of disability with equipment needs three times higher than those without diabetes. Dissatisfaction with life was higher for people with diabetes when compared to those without diabetes, 5.7% versus 3.4% (22). See Figure 8.

**Figure 8**

**South Dakota Adult Quality of Life Indicators**



## Risk Reduction

People who have diabetes suffer an increased risk of developing a number of disabling and life-threatening complications including heart disease, stroke, kidney failure, blindness, and lower-limb amputations. Working together, people with diabetes, their support network, and their health care providers can reduce the occurrence of these and other diabetes complications by controlling the levels of blood glucose, blood pressure, and blood lipids, by receiving other preventive care practices in a timely manner (16).

### Glucose control

- Studies in the United States and abroad have found that improved glycemic control benefits people with either type 1 or type 2 diabetes. In general, every percentage point drop in A1c blood test results (e.g., from 8.0% to 7.0%) can reduce the risk of microvascular complications (eye, kidney, and nerve diseases) by 40%.
- In patients with type 1 diabetes, intensive insulin therapy has long-term beneficial effects on the risk of cardiovascular disease (16).

### Blood pressure control

- Blood pressure control reduces the risk of cardiovascular disease (heart disease or stroke) among persons with diabetes by 33% to 50%, and the risk of microvascular complications (eye, kidney, and nerve diseases) by approximately 33%.
- In general, for every 10 mm Hg reduction in systolic blood pressure, the risk for any complication related to diabetes is reduced by 12% (16).

### Control of blood lipids

- Improved control of LDL cholesterol can reduce cardiovascular complications by 20% to 50% (16).

### Preventive care practices for eyes, feet, and kidneys

- Detecting and treating diabetic eye disease with laser therapy can reduce the development of severe vision loss by an estimated 50% to 60%.
- Comprehensive foot care programs can reduce amputation rates by 45% to 85%.
- Detecting and treating early diabetic kidney disease by lowering blood pressure can reduce the decline in kidney function by 30% to 70%. Treatment with angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) are more effective in reducing the decline in kidney function than other blood pressure lowering drugs.
- In addition to lowering blood pressure, ARBs reduce proteinuria, a risk factor for developing kidney disease, by 35%, similar to the reduction achieved by ACE inhibitors (16).

## Preventive Services

Self-management of diabetes, combined with medical treatment for metabolic abnormalities, and early detection and treatment of complications, can alleviate the problems and lessen the severity of complications arising from the condition. Data from the BRFSS provide an indication of the level of self-care and medical care attained by South Dakotans with diabetes.

### Diabetes Self-Management Education

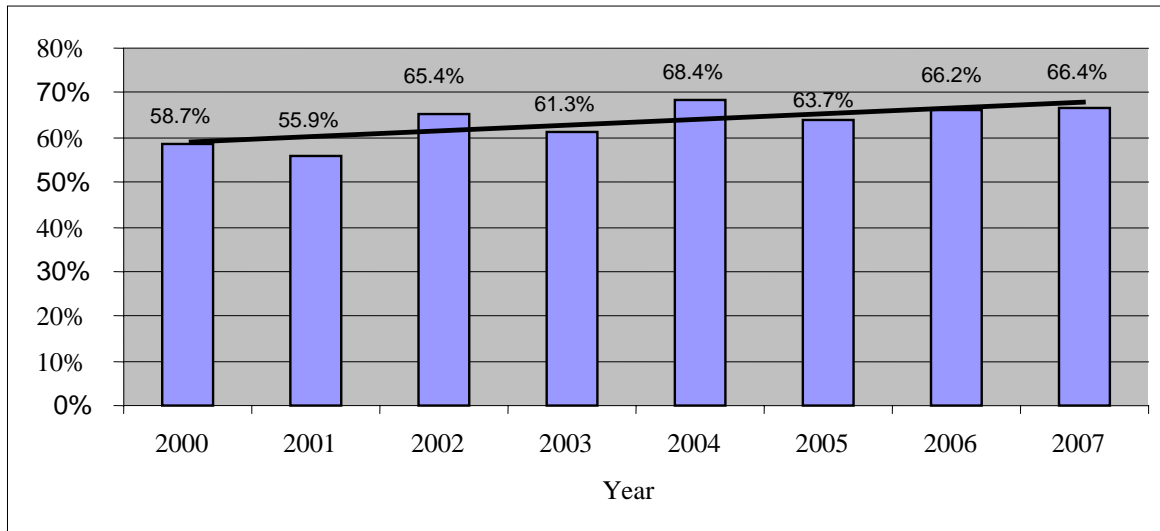
Diabetes Self-Management Education (DSME) is a key step in improving health outcomes and quality of life for people with diabetes. DSME focuses on self-care behaviors such as healthy eating, being active, and monitoring blood sugar. It is a collaborative process in which diabetes educators help people with diabetes gain the knowledge and problem-solving and coping skills needed to successfully self-manage the disease and its related conditions. (16). DSME prevents complications and hospitalizations. Every \$1 invested in such training can cut health care costs by up to \$8.76 (19).

- In 2007, 66.4% of BRFSS respondents stated they had taken a course to learn about diabetes self care (22). Participation in a course is up from 2000, when 58.7% had done so. See Figure 9.

**Healthy People 2010 objective:** *Increase the proportion of persons with diabetes who receive formal diabetes education (13).*

**Figure 9**

**BRFSS Respondents Who Had Taken a DSME Course, 2000-2007**



### **Self-Monitored Blood Glucose Testing (SMBG)**

Self-monitoring of blood glucose allows people with diabetes to achieve specific glycemic goals. Maintenance of normal or near-normal blood glucose levels has major health benefits for persons with diabetes. Results of major studies indicate that there is a direct relationship between blood glucose level and the risk of future diabetes related complications (diabetic retinopathy, nephropathy, and neuropathy). Both the development and the progression of microvascular complications are slowed with improved glucose control (21). Self-monitoring of blood glucose can also be used as a proxy measure for overall diabetes self-care.

- Data from the 2007 BRFSS indicates that 67.3% of South Dakotans with diabetes check their blood glucose one or more times per day. This percentage is 9 percentage points higher than in 2000. However, those reporting never checking their blood glucose increased 3.5 percentage points from 2004 to 2007 (22).



### **Blood Pressure**

High blood pressure contributes to the development and progression of diabetes complications. Control of high blood pressure reduces the rate of progression of diabetes nephropathy and reduces complications of hypertensive nephropathy, cerebrovascular and cardiovascular disease (3). Awareness of the existence of high blood pressure is the base upon which treatment and control can be built.

- In 2007, 66.6% of BRFSS respondents with diagnosed diabetes had been told by a health professional that they had high blood pressure (22).

### **Blood Lipids**

In type 2 diabetes there is an increased risk for obesity and lipid abnormalities that is independent of blood glucose control. Because of the two to four fold increase in the prevalence of blood vessel disease in persons with diabetes, it is important to identify and manage all modifiable cardiovascular risk factors (25). Awareness of abnormalities in blood lipids such as LDL (low-density lipoprotein) and HDL (high-density lipoprotein) cholesterols is the base upon which treatment and control can be built.

- In 2007, 58.6% of BRFSS respondents with diabetes had been told that they had high cholesterol (22).

### **Heart Disease & Stroke**

Adults with diabetes have heart disease death rates 2 to 4 times higher than adults without diabetes and death records note that more than 65% of people with diabetes die from heart disease (16).

- In 2007, 14.1% of BRFSS respondents with diabetes had heart disease as compared to

3.3% of respondents without diabetes (22). Adults with diabetes were five times more likely to have suffered a stroke than those without diabetes, 10.3% versus 2.0% (22).

- People with diabetes were nearly three times more likely to report having high blood pressure than those without diabetes-66.6% compared to 22.6% (22).

### **Tobacco Use**

Tobacco use is the leading cause of preventable death in the United States and is responsible for the deaths of more than 1,000 South Dakotans each year including many with diabetes (25). People with diabetes who use tobacco are at increased risk of complications to blood vessels (34).

- While South Dakota adults with diabetes are less likely than those without diabetes to be current smokers, 17.5% versus 20.0%, the incidence is still quite high.
- The rate of adults with diabetes who use spit tobacco is 2.5% while 5.2% of adults without diabetes use spit tobacco (22).

### **A1c**

A1c, also known as Hemoglobin A1c and HbA1c, is a blood test that measures the amount of glycosylated hemoglobin in blood. Glycosylated hemoglobin is a molecule in red blood cells that attaches to glucose (blood sugar). The more glucose in blood, the more glycosylated hemoglobin is present. The test gives an estimated average blood glucose level over the previous 2 to 3 months and is reported as a percentage with less than 7% generally considered to be good control. A1c has a strong predictive value for diabetes complications and is used to assess therapy efficacy (12).

- In 2007, 90.6% of BRFSS respondents with diabetes stated their A1c had been checked one or more times in the previous year. This percentage is up from 2000, when 88.4% reported it had been checked one or more times in the past year (22).

**Healthy People 2010 objective:** *Increase the proportion of adults with diabetes who have an A1c measurement at least once a year (13).*

### **Feet**

Due to the caustic nature of high blood glucose on nerves and blood vessels, especially on the lower extremities, diabetes is the leading cause lower limb amputations.

- In 2007, 73.4% of BRFSS respondents with diabetes stated a health professional had checked their feet at least once in the previous year. The rate was 73.8% in 2000 (22).

**Healthy People 2010 objective:** *Increase the proportion of adults with diabetes who have at least one annual foot examination each year (13).*

## Eyes

High blood glucose is caustic to the nerves and blood vessels of the eye and can lead to development of diabetic retinopathy. Diabetes is the leading cause of new cases of blindness in adults 20-74 years of age (4). If retinopathy is untreated, it can lead to blindness. If diagnosed and treated promptly blindness is usually preventable. A dilated eye exam completed by an optometrist or ophthalmologist can detect the signs of retinopathy.

- In 2007, 74.4% of BRFSS respondents with diabetes stated they'd had a dilated eye exam in the previous 12 months, compared to 77.1% in 2000 (22).
- Also in 2007, 19.4% of BRFSS respondents with diabetes had been told that diabetes had affected their eyes or they had retinopathy, compared to 23.7% in 2000 (22).

**Healthy People 2010 objective:** *Increase the proportion of adults with diabetes who have an annual dilated eye examination (13).*

## Vaccinations

Influenza (“flu”) and pneumococcal (“pneumonia”) vaccinations can prevent flu and pneumonia in people with diabetes, who are at greater risk of hospitalizations and death than those without diabetes. The flu shot is recommended annually and a pneumonia shot is generally given once in a lifetime. South Dakotans with diabetes historically have had higher rates for flu and pneumonia shots than the general population of South Dakota.

- In 2007, 80.2% of adults aged 65 and older with diabetes reported receiving a flu shot within the past 12 months and 78.4% reported ever receiving a pneumococcal shot (22).

**Healthy People 2010 objective:** *Increase the proportion of adults with diabetes aged 65 and older who are vaccinated annually against influenza and ever vaccination against pneumococcal disease to 90% (13).*

- Also in 2007, 72.7% of adults aged 18-64 with diabetes reported receiving a flu shot within the past 12 months and 59.4% reported ever receiving a pneumococcal shot (22).

**Healthy People 2010 objective:** *Increase the proportion of adults with diabetes aged 18-64 who are vaccinated annually against influenza and ever vaccinated against pneumococcal disease to 60% (13).*

## Oral Health

People with diabetes get periodontal disease more often than people who do not have the disease. Gum infections can make it hard to control blood sugar and once an infection starts, it can take longer to heal. Good blood sugar control and regular dental exams are the best defense against periodontal disease (6).

- South Dakota BRFSS data indicate that in 2006, adults with diabetes are less likely to go to the dentist than those without diabetes, 60.9% versus 70.1% (7).

### **Insurance Status**

Access to health care is necessary for successful treatment of diabetes. People without health insurance are less likely than others to have a usual source of care and to receive preventive health care services and appropriate medical management of diabetes.

- 5.7% of South Dakota adults with diabetes had no health insurance in 2007 (22) compared to almost 15% of adults nationwide.

### **Costs**

Costs for the preventive services detailed above plus treatment of complications if they arise the “direct cost of diabetes” combined with the indirect costs of decreased productivity, contribute to diabetes’ staggering cost, which was estimated in 2007 by the American Diabetes Association (ADA) to be \$174 billion.

- Medical expenditures totaled \$116 billion and were comprised of \$27 billion for diabetes care, \$58 billion for chronic diabetes-related complications, and \$31 billion for excess general medical costs.
- Indirect costs resulting from increased absenteeism, reduced productivity, disease-related unemployment disability, and loss of productive capacity due to early mortality totaled 58 billion.

The actual national burden of diabetes likely exceeds the \$174 billion estimate because it omits the social cost of intangibles such as pain and suffering, care provided by non-paid caregivers, excess medical costs associated with undiagnosed diabetes, and diabetes-attributed costs for health care expenditures categories not studied.

The 2007 per capita annual cost of health care for people with diabetes is \$11,744 a year, of which \$6,649 (57%) is attributed to diabetes. One out of every five health care dollars is spent caring for someone with diagnosed diabetes, while one in 10 health care dollars is attributed to diabetes (9).

### **Preventive Services as Cost-Saving Tools**

- Outpatient training to help people self-manage their diabetes prevents hospitalizations. Every \$1 invested in such training can cut health care costs by up to \$8.76 (19).
- Preconception care for women with diabetes leads to healthier mothers and babies. Every \$1 invested in such care can reduce health costs by up to \$5.19 by preventing costly complications (19).
- Intensified blood pressure control can cut health care costs by \$900 (2000 US dollars) over the lifetime of a person with type 2 diabetes. It can also extend life by 6 months (19).
- In just 5 years, a foot care program can save \$900 (2000 U.S. dollars) in health care costs for a person with diabetes who has had foot ulcers. Such care prevents amputations (19).

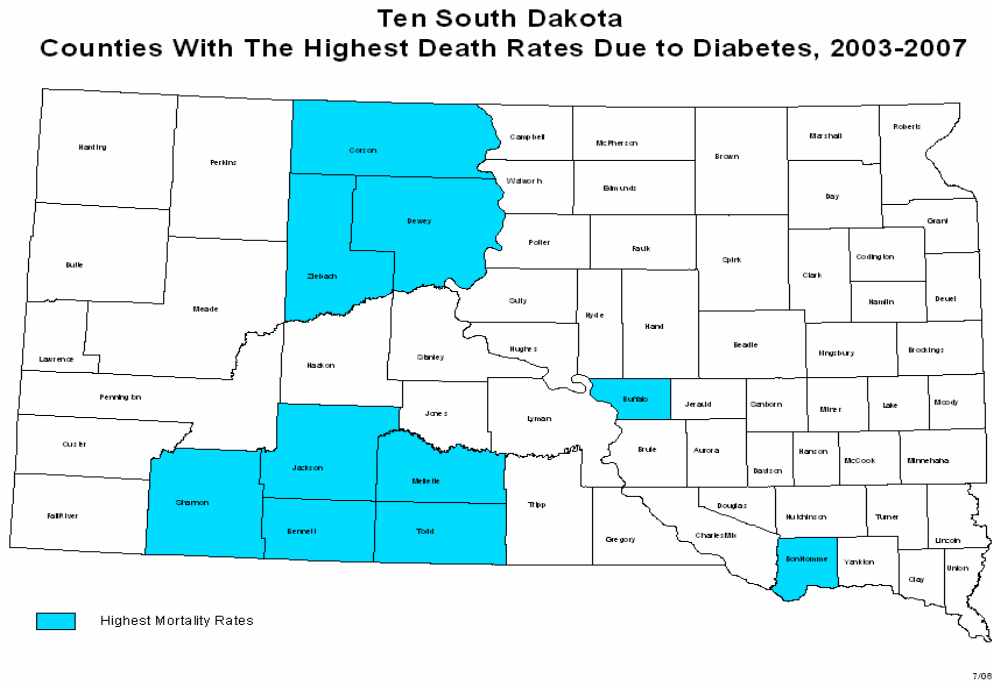
## Mortality

Diabetes is widely recognized as one of the leading causes of death. In South Dakota, diabetes is currently the seventh leading cause of death by disease (23). The number of deaths directly caused by diabetes continues to increase. Unpublished data from the SD Office of Data, Statistics and Vital Records show that in 2003 there were 201 deaths from diabetes and in 2007 there were 246. That is a 22.4% increase. There have been a total of 1,174 deaths attributed to diabetes in South Dakota residents from 2003-2007 (23). Overall, the risk for death among people with diabetes is about twice that of people without diabetes of similar age (16).

Although diabetes is listed as the underlying cause of 1,174 deaths (3.6% of all deaths) reported in 2007 (23), diabetes is likely to be underreported as a cause of death. Studies have found that only about 35% to 40% of decedents with diabetes have it listed anywhere on the death certificate and only about 10% to 15% have it listed as the underlying cause of death (16). Because diabetes is not mentioned at all on the death certificate of many people whose death is diabetes-related, mortality statistics alone underestimate the impact of the disease. The statistics reflect the fact that people with diabetes are more likely to die from the complications of the disease rather than the disease itself and die at an earlier age than their non-diabetic counterparts.

The disparity noted in the prevalence of diabetes between Native Americans and Whites is also present in the death rates. South Dakota death records indicate that Native Americans were more likely to die from diabetes as the primary cause than Whites in 2007 (8.6% vs. 3.2%) (23). Also, there was a greater rate of potential life lost before the age of 75 per 100,000 for Native Americans than Whites, 1,246 years versus 143 years. Native Americans also have a lower average age at death than Whites, 66 years versus 80 years respectively (23). The 10 South Dakota counties with the highest death rates due to diabetes, 2003-2007 are plotted on the map in Figure 10 (29).

Figure 10



Age-adjusted mortality rates (per 100,000 population) for counties noted above (18):

- Shannon - 205.4
- Buffalo - 130.8
- Ziebach - 129.7
- Todd - 105.4
- Dewey - 98.9
- Corson - 73.0
- Bennett - 72.5
- Jackson - 60.3
- Mellette - 48.9
- Bon Homme - 47.7



## **Appendix A:** *Glossary and Resources*

**A1c:** (Hemoglobin A1c or HbA1c) A blood test that measures a person's average blood glucose (sugar) level for the 2-3 month period before the test. Because it provides an indication of blood glucose management over time, this test is very valuable in determining overall diabetes management effectiveness.

**Age-adjusted rate:** Adjusted rate with allowances made for the age distribution of the population such that rates of two or more populations can be compared to each other as though the populations had the same age distributions.

**Body Mass Index (BMI):** BMI is a tool for measuring weight status in both youth and adults. BMI is the commonly accepted index for the classification of overweight and obesity in adults and is recommended to identify children and adolescents who are underweight, overweight, or obese when compared to the same age and gender.

**BMI formula:**  $BMI = \text{Weight in Pounds} \times 703 \div (\text{Height in inches})^2$   
Stated another way, BMI = body weight in pounds divided by height in inches squared multiplied by 703.

**Behavioral Risk Factor Surveillance System (BRFSS):** The BRFSS is a random digit-dialed telephone survey of a sample of non-institutionalized adults (age 18 years and older) conducted annually in all 50 states, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands, in collaboration with the Centers for Disease Control and Prevention (CDC). In South Dakota, the 2007 BRFSS survey was administered to 6,871 adults between January 1, 2007 and December 31, 2007. The BRFSS survey includes questions on a wide variety of health-related topics, including diabetes, tobacco and alcohol use, physical activity, diet, weight control, health insurance, and the use of preventive and other health care services. For this report, a person was assumed to have diabetes if they answered “yes” to the question: “Have you ever been told by a doctor that you have diabetes?” Responses to this question were used to develop the state and county specific estimates of the prevalence of diabetes presented elsewhere in this report. Responses of “don’t know”, “not sure” or refusals were excluded from the analysis of all BRFSS questions included in this report.

**Cholesterol:** A fat-like substance found in the body. The body makes and needs some cholesterol. Too much cholesterol, however, may cause fat to build up in the artery walls and cause disease that slows or stops the flow of blood.

**Death Certificates:** The diabetes mortality data presented in this report were obtained from death certificates on file with Data, Statistics, and Vital Records within the Department of Health. Mortality data are available for every deceased South Dakota resident, whether death occurs in South Dakota or out of state. Information collected on the death certificate include personal identifiers, demographics (age at death, gender, race), date and place of death, and the underlying (i.e., primary) and contributing causes of death. For deaths occurring in or before 1998, causes of death are coded according to the Ninth Edition of the World Health Organization’s International Classification of Disease (ICD-9). For deaths occurring in 1999

or later, causes of death are coded according to the Tenth Edition of the World Health Organization's International Classification of Disease (ICD-10).

**Diabetic retinopathy :** Progressive weakening and leaking of blood vessels in the eye's retina, caused by long-term uncontrolled diabetes. Diabetic retinopathy can result in loss of vision.

**Dilated eye (pupil) exam :** An eye examination in which eye drops are administered to enlarge the pupils enabling the doctor to examine the retina, located at the back of the eye, for signs of deterioration.

**End stage renal disease (ESRD):** The final stage of kidney disease treated by dialysis or kidney transplantation.

**Incidence:** The number of newly diagnosed cases over a certain period of time.

**Insulin:** A hormone produced by the pancreas that helps the body use glucose (sugar) for energy.

**Morbidity:** A descriptive measurement of sickness. Morbidity rates are generally given in one of two ways (see corresponding definitions): incidence or prevalence.

**Mortality:** A descriptive measurement of death. A mortality rate is the number of deaths per unit of population over a specified period of time.

**Nephropathy:** A disease or abnormality of the kidney. In diabetes, high glucose (sugar) concentrations damage the blood vessels in the kidney that remove wastes from the blood. If uncontrolled, leads to progressive weakening of the kidneys and end stage renal disease (see corresponding definition).

**Neuropathy:** Damage to nerves. In diabetes it is caused by high glucose (sugar) concentrations in the blood. Usually seen in the peripheral nerves and results in pain, numbness, and sometimes muscle weakness.

**Obesity:** In Body Mass Index measurements, obesity is defined as a BMI equal to or greater than 30.0 in adults and equal to or greater than 95<sup>th</sup> percentile in children and adolescents.

**Overweight:** In Body Mass Index measurements, overweight is defined as a BMI between 25.0 and 29.9 in adults. For children two to twenty years, overweight is defined as BMI-for-age equal to or greater than the 85<sup>th</sup> percentile and less than the 95<sup>th</sup> percentile.

**Prevalence:** The number of known cases at any given time. Diabetes prevalence is expressed as a percentage.

**Rate:** A proportion of the number of specific events per a stated number in the population. The persons or events represented in the numerator must be from the population in the denominator. Prevalence rates are sometimes written as percentages since they represent the number of cases per 100 population. Mortality rates are calculated per 100,000 population.

**Risk Factor:** A habit, characteristic, or finding on clinical examination that is consistently associated with increased probability of a disease or complication from that disease.

**South Dakota School Height and Weight Report:** A summary of South Dakota student height and weight data collected by the South Dakota Department of Health in cooperation with the South Dakota Department of Education. More information is available online at <http://www.state.sd.us/doh/SchoolWeight/>.

**Years of Potential Life Lost (YPLL):** A widely-used estimate of premature mortality, defined as the number of years of life lost among persons who die before age 75. YPLL is the sum of the differences between age 75 and the age at death for everyone who died before age 75.

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