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State Level Differences in Diabetes Care Behaviors

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An abstract of

State Level Differences in Diabetes Care Behaviors

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University

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Abstract

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Diabetes is a major problem in the United States but engaging in specific diabetes care behaviors can lessen the disease's complications. Healthy People 2020 is a set of national health goals which include targets for diabetes care behaviors such as self-monitoring of blood glucose (SMBG), biannual HbA1c tests, diabetes education, and annual foot examinations. These preventative and self-management behaviors have determinants at multiple levels, including the state level. Therefore, the purpose of this study was to determine if there were state-level differences in the proportion meeting the recommendations for the diabetes care behaviors, whether these differences changed over time, and what their state-level determinants are. Data from 2000-2010 Behavioral Risk Factor Surveillance System (BRFSS) were used to generate age-adjusted prevalences for each behavior across all years and in two time points: 2000-2005 and 2006-2010. Results indicated that there were disparities by state, but no large changes occurred over time. Few states are currently on track to meet the Healthy People 2020 objectives. Only HbA1c had one significant state-level predictor, proportion on Medicaid, and SMBG had two significant state-level predictors, proportion female and proportion on Medicaid. Implications and directions for future research are discussed.

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Chapter 1

Diabetes is one of the most serious medical problems facing America today. In 2010, diabetes was the 7th leading cause of death in the United States, due to its associations with microvascular and macrovascular conditions such as peripheral neuropathy, limb amputation, stroke, myocardial infarction, and retinopathy.[1,2] In 2007, $27 billion was spent to directly treat diabetes, $58 billion was spent to treat diabetes-related chronic complications, $31 billion was spent in excess general medical costs, and $58 billion was lost due to reduced national productivity.[3] The epidemic of diabetes is only expected to worsen as the prevalence is projected to increase to 21-33% by 2050.[4] Because diabetes is associated with serious health conditions and its burdens are expected to increase, it is important to find ways to prevent or delay the disease's hazardous outcomes. Therefore, the purpose of this study is to examine how one method of preventing diabetes complications, diabetes care behaviors, varies by state and over time.

Diabetes Epidemiology

As of 2011, 25.8 million people in the United States had diabetes, which represents 8.3% of the population. This estimate includes 7 million people with undiagnosed diabetes.[5] The prevalence is much higher in older age groups, where 26.9% of people aged 65 years or older have diabetes. In contrast, only 3.7% of people aged 20-44 have diabetes and 13.7% of people aged 45-64 have diabetes. Nationally representative data also indicated that there are racial disparities in diagnosed diabetes. Estimates show that 7.1% of non-Hispanic Whites, 12.6% of non-Hispanic Blacks, 11.8% of Hispanics, 8.4% of Asian Americans, and 14.2% of American Indians/Alaska Natives have been diagnosed with diabetes.[5] The risk of diagnosed diabetes in a nationally representative sample was 77% higher among non-Hispanic Blacks, 66% higher among Hispanics, and 18% higher among Asian Americans, compared to non-Hispanic Whites.[5] In 2010, there were no major sex differences, with 11.8% of men and 10.8% of women having diagnosed diabetes.[5] Although the data are less recent, studies have indicated that the prevalence of diabetes is higher for those in the lowest income quartiles.[6] Additionally, the same studies have indicated that the prevalence of diabetes has increased more from the 1970s to the 2000s for those in lower socioeconomic groups compared to the higher groups.[6]

Diabetes Care Behaviors

Although diabetes affects people from a variety of demographic groups, some of its worst complications like peripheral neuropathy, amputations, stroke, and other conditions can be prevented or decreased when people with diabetes engage in key health behaviors.[7] Some of these behaviors include self-monitoring blood glucose levels daily, getting HbA1c levels tested twice a year, annual foot examinations, and attending diabetes education classes.[8,9] According to the American Diabetes Association, the primary purpose of self-monitoring blood glucose levels (SMBG) is to help manage and evaluate people with diabetes.[10] Specifically, the practice can be used to maintain glycemic control and prevent hypoglycemia.[11] By collecting information about blood glucose levels at many time points, people with diabetes can learn how to maintain a more constant glucose level. Using this information, they can adjust their diet, physical activity, and insulin to improve daily glycemic control.

Obtaining an HbA1c measurement twice a year can also help maintain glycemic control by measuring the amount of glycosylated hemoglobin in the blood. This test differs from the daily monitoring of blood glucose because it measures glycemic control over a period of months rather than days. As a result, it gives people with diabetes and their health care providers important information about their long term control over their glycemic levels. Since it gives information about long-term control, the HbA1c test does not provide useful information on glycemic variability in the short term.[12]

Annual foot examinations are another important behavior because 30% of people with diabetes have reduced sensation in their feet. In this population, the lifetime risk of developing a foot ulcer is 15% and severe neuropathy can lead to amputation of the lower limbs.[5] A regular foot exam can prevent many of these serious factors. During a foot examination, people with diabetes have their history and symptoms taken and their feet examined for dermatological, musculoskeletal, neurological, and vascular problems.[13] A trained physician or podiatrist can screen for sensory loss, vibratory sensation, pinprick sensation, ankle reflexes, and vibration perception threshold during this exam. After the examination, an individual is assigned to one of four foot risk categories, which determine appropriate treatment and follow-up.

The final diabetes care behavior examined in this study is diabetes education. The purpose of diabetes education is to facilitate self-care by focusing on the needs, goals, and experiences of people with diabetes.[14] Its main objectives are to promote problem solving, informed decision making, self-care behaviors, and collaboration with the greater health care team to improve health and quality of life. Although there is no best approach to diabetes education, successful programs use behavioral and psychosocial methods and are tailored to appropriate age and cultural groups.[14] The diabetes education curriculum teaches about the disease and its treatment, incorporating good nutrition and physical activity into daily life, using medication safely, monitoring blood glucose, developing personal strategies for psychosocial issues and behavior change, and preventing, detecting, and treating both acute and chronic complications of diabetes.[14]

Despite the importance of these four health behaviors, many people with diabetes engage in them at suboptimal levels.[15-18] Increasing the prevalence of these behaviors is one of the goals of Healthy People 2020, a series of national objectives designed to improve American health. For these four health behaviors, the HP2020 goals are to increase the proportion of adults getting an annual foot examination to 74.8%, to increase the biannual percentage of glycosylated hemoglobin measurements to 71.1%, to increase the proportion of people with diagnosed diabetes who receive formal education to 62.5%, and to increase proportion of adults who take daily self-measurements of their blood glucose to 70.4%.[19]

Rationale for State-level Analysis

Although Healthy People 2020 is a series of national level goals, the states have some influence on health outcomes, particularly in terms of insurance. In 2010, 83.7% of the US population had some sort of health insurance. Most adults under the age of 65 receive employer-based health insurance but the percentage varies by state. This variation results from the effect that demographics, employment characteristics, state policy, and local health system characteristics have on the likelihood of being covered by an employer plan and the difference in the distribution of these factors across the states.[20] Additionally, individual states determine the eligibility for public programs such as

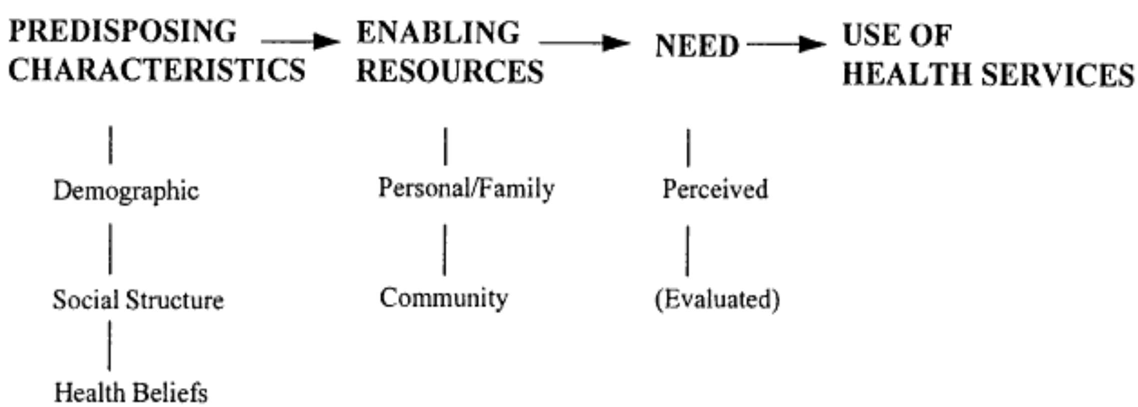
Medicaid through income limits, which can further exacerbate already existing insurance disparities.[21] Although 20% of the total US population was enrolled in Medicaid in 2009, state level participation ranged from 11% in Utah to 30% in California.[22] Through these two factors, eligibility for certain insurance programs can vary based upon an individual's state of residence. This difference in insurance coverage creates the potential for geographic disparities in diabetes care behaviors.

In addition to state level differences in health insurance, there are also state level differences in diabetes care programs. The Centers for Disease Control and Prevention (CDC)'s Division of Diabetes Translation provides funding for diabetes prevention and control programs for each of the 50 states and Washington D.C.[23] This funding goes to the state health departments but sixteen departments received expanded funding, which creates the possibility of disparities. This funding addresses various aspects of diabetes in different states. For instance, the Georgia Diabetes Prevention and Control Program focuses on diabetes data surveillance and evaluation, access to diabetes self-management education and preventive care resources, quality of care, health equity, public policy, and health communication.[24] In contrast, the Minnesota Diabetes Program focuses on leadership and coordination; prevention, health promotion, and community engagement; clinical care improvement; monitoring and evaluation; and health communications.[25] Because state health departments may have different priorities, it creates the potential for state-level disparities in diabetes care behaviors and outcomes.

Additionally, some states have enacted legislation that targets diabetes research, education, prevention, and management. In the 2011-2012 legislative sessions, 18 states passed 41 bills related to diabetes. In older sessions, bills were proposed and/or passed addressing a diabetes month or day, disparities, prevention, reporting of self-identification, and research, among others.[26] Overall, 46 states have some type of law that requires health insurance to cover diabetes treatment. Specifically, Mississippi, Missouri, and Washington require insurers to offer coverage for diabetes treatment but do not require this coverage to be included in all active policies. The states of Alabama, Idaho, North Dakota and Ohio also have no diabetes treatment insurance requirement or mandate.[27] Because the states have different policies and legislation, it creates the potential for state level disparities in diabetes care.

Andersen's Behavioral Model of Health Services Use

Figure 1



Besides state-level factors, individual level factors can also influence uptake of diabetes care behaviors. Andersen's Behavioral Model of Health Services Use is one model that can explain quality of care behaviors in people with diabetes, including potential disparities (Figure 1).[28] This model suggests that the use of health services is based on predisposing, enabling, and need components. Although the family was the unit of analysis in the original model, the focus was changed to the individual because it is easier to measure.[29] The predisposing component posits that some individuals are more prone to use health services than others, based on their demographics, social structure, and health beliefs. Demographics include factors like age, sex, and marital status. Although these factors may not be direct reasons for engaging in diabetes care behaviors, there are specific health problems that only affect people of certain ages and genders, so they may seek health services in varying amounts. For example, a healthy young man will probably seek medical care less than a woman who is just entering menopause. The second part of the predisposing component, social structure, refers to an individual's status in society, ability to cope with problems, ability to find resources to deal with problems, and the healthiness of the physical environment.[29] Typically, this construct has been operationalized through income, education, and ethnicity. Social networks and interactions can also be considered part of this section of the component. The third portion of the predisposing component, health beliefs, refer to attitudes, knowledge, and values that people may have about health and health services.[29]

The second component, enabling resources, makes health resources available to individuals.[28] This availability can occur on two levels. Individuals must have health services and personnel in close proximity to where they live and work, but they also need a means to access and use these services. Because enabling resources can refer to means and geographic proximity, this component can occur on both the individual and community levels. Measures for this component may include income, health insurance status, region, physician-population ratio, and regular access to care.

The final component of Anderson's model is need, which represents the most immediate determinant of health service use.[28] This component can be broken down into perceived and evaluated aspects. Perceived need reflects how individuals view their own health and well-being, so it has many social determinants. It includes how individuals experience the illness state and whether they judge their health state to be serious enough to seek medical attention.[29] Although evaluated need can also have social determinants, it is more objective because it reflects a professional's opinion on the need for medical care. This type of need is related to the type of treatment an individual will receive when they eventually go to a health care provider.

These three components all contribute to the utilization of health services. This utilization behavior can be divided into a discretionary component, which involves individual choice, and a non-discretionary component, which reflects the individual's physical condition.[28] The use of services can relate to a specific disease or illness, including diabetes care and behaviors. For this study, Anderson's model helps illuminate predictors of diabetes care behaviors.

Research questions

Because a variety of factors can contribute to disparities at the state level, it is important to investigate differences in diabetes care behaviors. Based on this information, this study has three research questions.

1. How does the proportion of people with diabetes meeting the recommendations for daily blood glucose self-monitoring, biannual HbA1C measurements, annual foot examination, and diabetes education vary by state? Based on previous research, we hypothesize that there will be state-level differences in these diabetes care behaviors.
2. Has the percentage of people with diabetes who meet the recommendations for these behaviors changed over time? Although the

research is limited, we hypothesize that the prevalence of the four diabetes care behaviors has increased over time.

3. What are the state-level predictors of the change in the prevalence of diabetes care behaviors? Using Anderson's Model, we hypothesize that many predisposing and enabling factors will be significant predictors of the change over time in the four diabetes care behaviors.

Chapter 2 – Literature Review

Diabetes is a major health problem in the United States.[1,2,5] Diabetes care behaviors play an important role in preventing complications related to diabetes, including myocardial infarction, microvascular complications, and amputations.[8,9] These behaviors have a variety of determinants, including intentions,[30] self-efficacy,[31,32] location,[33] and age,[34,35] among others. Disparities in diabetes care behaviors were also found between the different racial/ethnic and income groups.[36,37] Several studies have described the surveillance of these behaviors on the national level,[16-18,38] but few have examined them by state or have looked at state level determinants.[39]

Daily Blood Glucose Self-Monitoring and HbA1C Measurement

The earliest studies on glycemic levels found that individuals with type II diabetes who maintained tight glycemic control had a reduced risk of microvascular complications, myocardial infarction, and cataract extraction, while those with higher glycemic levels had an increased risk of diabetic complications.[9,40] Additionally, continuous improvements in glycemic control among people with diabetes have been associated with reduced health care costs and utilization.[41] In a recent meta-analysis of randomized control trials, increased glycemic control was associated with lower incidence rates of peripheral vascular disease and stroke.[42] This research demonstrates the importance of improving and maintaining glycemic control in patients with diabetes, and subsequently the importance of HbA1c tests and daily self-monitoring of blood glucose.

Annual Foot Examination

Several studies have been conducted on the importance of foot examinations for people with diabetes. Individuals with diabetes and a history of foot ulcers who had regular foot care were less likely to have a recurrence of ulcerations compared to those who had no care.[43] In another study, participants who were randomly assigned to a foot screening program had significantly fewer amputations compared to those participants in a non-treatment control group, which resulted in cost-effectiveness due to amputations prevented.[44] Additionally, individuals with diabetes who received a foot care intervention were less likely to have serious lesions and more like to engage in self-monitoring foot care behaviors than those who did not receive the program.[8] Overall, these studies indicate the important health benefits and cost savings that come when people with diabetes receive annual foot examinations.

Diabetes Education

Many studies have found that diabetes education programs have several beneficial effects. One review study found that people with type 2 diabetes who took part in self-management education classes experienced significantly greater decreases in glycosylated hemoglobin compared to those in the control group.[7] Another review of the literature demonstrated that 18 of 26 studies found diabetes education programs to be associated with cost effectiveness, cost savings, return on investment, or decreased cost.[45] Additionally, people who had received diabetes education used more preventive services, fewer acute services, lower claims costs, and higher rates of compliance.[46] Together, these studies indicate the important effect that diabetes education has on health outcomes and costs.

Determinants of and Disparities in Diabetes Care Behaviors

Because each of the diabetes care behaviors involves a different aspect of the health care system, each has different factors which determine whether individuals with diabetes engage in them on a regular basis. For self-monitoring of blood glucose, research has shown that implementation desire and implementation intentions mediate the relationship between diabetes goal intentions and daily blood glucose monitoring.[30] Additionally, self-efficacy was associated with self-monitoring of blood glucose levels in a variety of populations, including diverse and European samples.[31,32] Another cross-sectional study of managed care patients in eastern Massachusetts used objective measures of self-monitoring and found that low neighborhood socioeconomic status, old age, fewer A1c tests and fewer doctors' visits were associated with decreased rates of SMBG. [34]

Studies have also examined disparities in self-monitoring of blood glucose. One study found that among those with incomes over $20,000, Blacks and Hispanics engaged in SMBG at lower rates than Whites. However, among those with incomes under $20,000, Hispanics engaged in significantly less SMBG than Blacks and Whites.[37] Additionally, Hispanics of low-income who were proficient at English engaged in SMBG at higher rates than those Hispanics who were not. Other research has also found that Hispanics are significantly more likely to never monitor their blood glucose levels compared to other racial and ethnic groups.[36]

Research has also examined determinants of attending a diabetes education class. In an older study on determinants of attending a diabetes education class, a larger percentage of individuals with diabetes who received insulin treatment attended diabetes education classes compared to those who did not received insulin treatment.[35] For those not treated with insulin, higher education, diabetes complications, young age were associated with attending a diabetes education class. In an older predominantly African American population in Philadelphia, women, those on insulin, and the more obese were more likely to have attended a diabetes education program. Barriers to attendance included a lack of awareness that the programs existed, misperceptions about insurance coverage, structural barriers such as time and transportation, and health beliefs, like lack of motivation and denial of the seriousness of diabetes.[47] More recently, shorter diabetes duration, regular primary care, regular diabetes specialist care, and being single were all predictors of attending a diabetes education class.[48]

Other studies have examined disparities in diabetes education. One recent nationally representative study found that non-Hispanic Blacks in urban areas were the most frequent recipients of diabetes education. In this study, people in the south received little diabetes education and those with no insurance received less diabetes education than those with insurance.[33] Additionally, among those making less than $20,000 a year, Blacks and Whites engaged in similar rates of diabetes education, while Hispanics participated at lower rates. Low-income Hispanics who were proficient at English engaged in diabetes education at higher rates than those who were not proficient at English. There were no racial disparities among those making more than $20,000.[37]

Fewer studies have examined determinants of annual foot examinations or HbA1C tests, but several studies have examined disparities with differing results. One study examined racial differences in the proportion of diabetics who get an annual foot exam and found that blacks were less likely than whites to have this procedure completed.[49] Another nationally representative study found that Asians were less likely than Whites to meet the recommendations for HbA1c tests and annual foot examinations, Hispanics were less likely than Whites to receive an annual foot examination, but Blacks were more likely than Whites to have received a foot examination.[50] However, another study of

Veterans Affairs facilities found no racial disparities in receiving either foot examinations or HbA1c tests.[51]

Although few studies examined determinants, both procedures involve visiting a health care professional and submitting payment for a medical procedure, which suggests that insurance policies can affect whether individuals with diabetes receive necessary care. Previous nationally representative research has indicated that uninsured individuals under 65 are less likely to receive annual foot examinations and HbA1c tests, as well as report self-monitoring of blood glucose and attendance at diabetes education classes.[52] Additionally, in a sample of patients at Federally Qualified Health Centers in Oregon, those with consistent health insurance are more likely to receive diabetes preventive health care compared to those with no insurance or partial insurance.[53]

Surveillance of Diabetes Care Behaviors

Because daily blood glucose self-monitoring, twice yearly A1c measurements, annual foot examinations, and diabetes education classes are so crucial, it is important to determine how many people with diabetes engage in these behaviors. The first cross-sectional studies only examined the diabetes care behaviors at one time point. An early study from the 1994 BRFSS found that 78% of people with diabetes had ever self-monitored their blood glucose levels, and that 61% of people with diabetes had a foot examination in the last year.[17] People not on insulin, those of younger age, those with less education, and those without health insurance were less likely to receive these services. In 1995, 38% of individuals with diabetes self-monitored their blood glucose at least once a day, 28.8% had at least one A1C test in the past year, and 54.8% had an annual foot examination.[15] In this sample, people with diabetes that used insulin were more likely to have an annual foot exam and poor glycemic control compared to those diabetics that did not use insulin.

Later studies examined the behaviors at two time points. One of these studies used BRFSS data from 1995 and 2001 and found that the proportion of people with diabetes who engaged in daily self-monitoring of blood glucose increased from 38.1% to 54.1% and the proportion who had an annual foot exam increased from 56.6% to 64.5%.[16] Another study that also used two time points found small increases. In 2000 and 2003, the age adjusted percentage of people engaging in annual foot exams significantly increased from 63.7% to 69.3%, while the percentage of people receiving the biannual HbA1C test experienced a non-significant increase from 68.3% to 69.5%.[39] A third study that used BRFSS data from 1995 and 2002 also found increases between these two time points. Annual foot examinations increased from 64.5% to 68.3% and self-monitoring of blood glucose increased from 38.5% to 55.1%. Diabetes education was only measured in 2002 and was 54.9%.[18] Only one study examined trends in Medicare beneficiaries and found that from 1992 to 2001 the rate of HbA1C testing rose by 44.7 percentage points while the self-monitoring of blood glucose levels rose 37.7 points during the same time period.[54]

Very few studies have compared diabetes care behaviors among states. One study that examined the national prevalence of obesity and diabetes also produced state level maps and tables, which indicated that Alabama had the highest prevalence of diabetes and Minnesota the lowest.[55] Another study that examined state disparities at two time points found that in 2000 the percentage meeting the Healthy People 2010 target for annual foot examinations ranged from 42.1% to 85.1%, while in 2003 the range was

47.0% to 82.4%.[39] For the biannual HbA1C test, the range was 40.5% to 80.5% in 2000 and 53.6% to 85.5% in 2003. In this sample, states with low baseline rates in 2000 were more likely to show an increase or maintain baseline, while high baseline rates in 2000 were more likely to decrease in 2003.

Theory applications

Several studies have used Anderson's Behavioral Model of Health Service Use to examine diabetes in national datasets. In one relevant study, researchers used the model to determine characteristics that affect adherence to diabetes care behaviors among sub-populations in the 2005 BRFSS. [56] This study found that in groups with the lowest levels of adherence to diabetes care behaviors, need and predisposing characteristics were the best predictors, as operationalized by factors like fewer years with diabetes, no diabetes education, high self-rated health, younger age, male gender, employment, and a high school education or less. In contrast, for the groups with the most adherence to the behaviors, need components were the most important, which the researchers defined as having more than 9 years of diabetes, some diabetes education, older age, yearly household income over $20,000, poor self-rated health, no eye disease, non-smoking status, and adequate consumption of fruits and vegetables.[56]

Another study used the Medical Expenditure Panel Survey to examine racial differences in diabetes preventive care. The study chose to only examine the predisposing and enabling components of the model because all individuals with diabetes are encouraged to have preventive care. Specifically, they chose to focus on race, age, gender, rurality, income, and insurance as determinants of diabetes care behaviors. They found that African Americans and Whites were less likely to engage in diabetes care behaviors than whites, and that the enabling factors, especially health insurance status, mediated the relationship between race and diabetes care.[57] Combined, the results of these studies demonstrate that Anderson's model can be successfully applied to diabetes care behaviors in population datasets.

Summary

This review has made several gaps in the literature clear. Few studies have examined the proportion of individuals that are meeting the recommendations for diabetes care behaviors on a national level. In the studies that have examined these behaviors, most analyzed them in only one or two years, so the long term change in these behaviors over time is not clear.[16,17] It is important to examine these behaviors over time to determine whether diabetes care is improving in the United States and where diabetes policy and programs need to be directed. Even fewer national level studies have examined inter-state variations in diabetes care behaviors. Because state legislatures influence health insurance and policy, there is the potential for geographic disparities, so it is important to examine differences among the states. Additionally, few studies have examined predictors of the diabetes care behaviors, especially at the state level, but many studies have found racial and ethnic disparities. In order to properly tailor diabetes programs, it is important to determine what factors best predict meeting the recommendations for the behaviors. To fill these gaps, we will examine whether disparities in diabetes care exist at the state level, how these disparities have changed over time, and what factors best predict the behaviors at the state level.

Chapter Three - Methods

Participants. The participants for this study were respondents to eleven years of data from the Behavioral Risk Factor Surveillance Survey (BRFSS) from 2000 to 2010. Funded by the Centers for Disease Control & Prevention (CDC), BRFSS is the world's largest telephone-based survey system and has been run by state health departments since 1984. The purpose of BRFSS is to provide state specific estimates of behaviors that explain many of the leading causes of death in the United States, and when pooled can provide representative national-level estimates. It consists of a core question set that all states complete and optional modules that individuals states may elect to complete. Previous research has found that most of the questions on BRFSS have at least moderate reliability and validity.[58] The total number of participants per year has ranged from 184,450 in 2000 to 451,075 in 2010. Starting in 2004, the question assessing diabetes status was "Have you ever been told by a doctor that you have diabetes?" Possible responses are *Yes*, *Yes during pregnancy*, *No*, *No prediabetes or borderline diabetes*, *Don't Know/Not Sure* and *Refused*. In 2003 and earlier, the question was "Have you ever been told by a doctor that you have diabetes?" with possible responses of *Yes*, *Yes but female told only during pregnancy*, *No*, *Don't Know/Not Sure* and *Refused.* Previous research has demonstrated that self-reported diabetes status has adequate sensitivity and high specificity when compared with objective measures of fasting glucose.[59-61] To combine questions, anyone responding with prediabetes or borderline diabetes was coded as not having diabetes. For this study, all analyses were restricted to individuals who reported having diabetes. People with gestational diabetes, prediabetes or borderline diabetes, or no diabetes were dropped from the dataset.

Procedure. Because households are the main sampling unit in the BRFSS, state health departments use multi-stage sampling to select a probability sample of participants by phone through random digit dialing. Residential telephone numbers are drawn from two lists, a high density list and a medium density list, and numbers in the high density stratum are sampled at the highest rate.[62] Cell phones were not fully incorporated until 2011. Ineligible households include vacation homes, group homes, and institutions. All household members 18 years and older were considered eligible, even if they are not home at the time of the call. People who do not live in the home on a permanent basis are not included in the study. Any eligible person who refuses to be interviewed is contacted one additional time by another interviewer. For all questions, participants are assured of confidentiality. States conduct the survey on a monthly basis and send their results back to the Centers for Disease Control and Prevention for editing, weighting, and analysis. Through 2010, results were weighed using post-stratification method, which weighted the results according to the population proportions of age, race and ethnicity, sex, and geographic region. Further information can be found on the BRFSS website.[63]

Outcome Measures. For this study, the outcome measures were the four Healthy People 2020 diabetes objectives present in BRFSS optional diabetes module. All states did not complete this module every year during the eleven year period, which resulted in a large number of missing values. Once these missing values were dropped, 234,776 observations remained. If the module was completed, states had several hundred to a couple thousand responses each year.

For **diabetes education**, the question used was: 'Have you ever taken a course or class in how to manage your diabetes yourself?' Possible answers to this question were *Yes*, *No*, *Don't Know/Not Sure*, and *Refused*. Participants who answered yes to this question were considered to meet the goal. Because only a small percentage of respondents (<1% combined) answered *Don't Know/Not Sure* or *Refused*, they were dropped from the dataset.

For **A1c levels**, the question changed one time between 2000 and 2010. Since 2004, the question was "About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for "A one C"?" Possible answers to this question allowed the participant to fill in the number of times in the past year, or to answer *None*, *Never heard of "A one C" test*, *Don't know/Not Sure*, or *Refused*. From 2000-2003, the question was "A test for hemoglobin "A one C" measures the average level of blood sugar over the past three months. About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for hemoglobin "A one C"? with the same response options as the previous question. This variable was dichotomized into two categories: those that met the recommendation and those who did not. Respondents who had received two or more tests in the past 12 months were considered to meet the recommendation, while respondents who stated that they had never heard of the A1c test, or responded with one or none were coded as not meeting the recommendation. Because only a small percentage of respondents answered *Don't Know/Not Sure* or *Refused*, they were dropped from the dataset. Previous research has compared self-reported HbA1c with administrative records and found that the self-report measure had high sensitivity, positive predictive value, and negative predictive value.[64]

For **annual foot examinations**, the question used was, "About how many times in the past 12 months has a health professional checked your feet for any sores or irritations?" Possible responses to this question allow the participant to state the number of times, *None*, *Don't know/Not Sure*, or *Refused*. Participants who report at least one foot exam in the past year were considered to meet the recommendations. This variable was dichotomized into two categories: those that met the recommendation and those who did not. Because only a small percentage of respondents answered *Don't Know/Not Sure* or *Refused* (<2%), they were dropped from the dataset.

For **daily blood glucose monitoring**, the question used was "About how often do you check your blood for glucose or sugar?" Possible responses allow the respondent to fill in how many times they engaged in the behavior per day, week, month or year. Participants can also answer *Don't Know/Not Sure, Never,* or *Refused*. Participants who reported engaging in this behavior at least once daily were considered to meet the recommendations. This variable was dichotomized into two categories: those that met the recommendation and those who did not. Because only about 1% percentage of respondents answered *Don't Know/Not Sure* or *Refused*, they were dropped from the dataset. Previous research has found that self-reported measures of daily blood glucose monitoring frequency are correlated with actual frequency as measured by glucometer memory meters.[65]

Demographic Measures from BRFSS. To operationalize the predisposing component of Andersen's model, age, sex, race, and education variables were used.[28,29] To indicate **state** status, the state variable was used, which included all 50 US states, the District of Columbia, Guam, Puerto Rico, and the Virgin Islands. **Age** was used either as a continuous variable or as a categorical variable with 4 groups, 18-44, 45-64, 65-74, and 75 and older, depending on the analysis. **Sex** was treated as a dichotomous variable. For

race/ethnicity, a new variable was calculated with the following categories: Non-Hispanic White, Non-Hispanic Black, Hispanic, Asian/Hawaiian Pacific Islander, American Indian/Alaska Native, Other/Multiracial, and Don't Know. For **education**, the possible categories *are Did not Graduate High School, Graduated High School, Attended College or Technical School, Graduated from College or Technical School, or Don't Know/Not Sure*.

Predictors from other sources. To operationalize enabling resources, GDP per capita by state, Medicaid by state, and region variables were brought in from other datasets.[28,29] Data on state-level **GDP per capita** were obtained from the U.S. Department of Commerce Bureau of Economic Analysis.[66] Data were taken from the year 2005 because it represents the midpoint of the dataset. This variable used the North American Industry Classification System, which has been in use in Canada, the United States, and Mexico since 1997. Data on the state level proportion of people on **Medicaid by state** was obtained from Kaiser's state health facts website.[67] Enrollment was based on data from the 2009 fiscal year because it was the only available data. **Region** variables were defined according to the US Census Bureau and were included to see if there were any larger geographic patterns. States in the northeast region were Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey and Pennsylvania. States in the South region were Maryland, Delaware, the District of Columbia, Virginia, West Virginia, Kentucky, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Texas, and Oklahoma. Midwest states included Ohio, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas. States in the west region included Alaska, Hawaii, Washington, Oregon, California, Idaho, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada.

Analysis. All analyses were conducted using STATA 12 and SAS 9.3 and accounted for the complex survey design by using the primary sampling unit, strata, and final weights throughout the analysis. All years of data were linked together to form one dataset. First, basic descriptive statistics were calculated to determine the mean age, % female, race/ethnicity, and education of the population, both overall and by sex. Second, age adjusted proportions were calculated for each of the health behaviors overall, by sex, and by state, using the population from the 2000 US Census stratified into four age groups. Statistical software was used to multiply age-specific prevalences for each of the behaviors by age-specific weights consisting of the proportion of the 2000 US population in each age group. Age adjusted prevalences were also conducted by state in two time periods, 2000-2005 and 2006-2010, to determine changes over time while minimizing the influence of outliers.

Third, state level multiple linear regression models were calculated to determine the predictors of the change for each of the diabetes care behaviors over the two time periods. The change for each behavior was calculated by subtracting the proportions from the two time periods described above. State-level predictors were chosen based on Anderson's model,[28,29] and. the models were in the form $Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7$ where x_1 = GDP per capita, x_2 = proportion on Medicaid, x_3 = proportion female, x_4 = proportion Black, x_5 = proportion Hispanic, x_6 = proportion with a college degree, and x_7= region. Information on proportion Black and Hispanic was taken from the U.S. Census Bureau Population Estimates Program from 2005, while proportion female and proportion college educated were taken using all years of the BRFSS dataset.[68] Complete data was unavailable for Illinois, Kansas, Maryland, Nebraska, Oregon, Rhode Island, Guam, Puerto Rico, and the Virgin Islands, so these states and territories were dropped from the dataset. Washington D.C. was also dropped from the dataset because it is a city, not a state, which left 44 states for analysis. Histograms and probability plots were visually inspected for the four health behaviors and all were found to demonstrate adequate normality. Correlations, partial correlations, and partial plots were conducted to determine if any relationships existed among the dependent variables. Forwards, backwards, and stepwise selection algorithms were used, which all generated the same models. All possible model selection methods were also used to select models based on R-squared, adjusted R-squared, and Mallow's Cp instead of p-values.[69] Regression diagnostics, including testing the normality of the residuals, examining outliers, and multicollinearity, were then performed to check the model's fit.

Chapter 4 - Results

This sample of 234,776 individuals with diabetes was 49.6% female and the average age was 58.9. 81.7% of the sample had at least a high school education, while 22.8% had completed at least 4 years of college. 65.4% of the individuals were non-Hispanic White, 13.7% were non-Hispanic Black, and 13.9% were Hispanic. Complete unadjusted demographic information is available overall and by sex in table 1.

The overall age adjusted prevalences of biannual A1C measurements, annual foot examinations, self-monitoring of blood glucose, and diabetes education can be found in Table 2. These percentages were 64.0, 67.6%, 60.6%, and 56.8%, respectively. Breakdowns of these prevalences by sex, race, and age can also be found in Table 2. Similar percentages of men and women engaged in the four diabetes care behaviors and there were no larger differences by age. However, a smaller proportion of Hispanics appeared to meet the diabetes care recommendations compared to the other racial groups. For HbA1c, only 55.0% of Hispanics met the recommendations compared to 66.9% of Whites and 63.3% of Blacks. For diabetes education, 49.3% of Hispanics met the recommendations, compared to 58.5% of Whites and 59.6% of Blacks. For SMBG, 50.1% of Hispanics met the recommendations, compared to 63.4% of Whites and 64.5% of Blacks, and for annual foot examinations, 58.2% of Hispanics met the recommendations compared to 68.4% among Whites and 74.6% among Blacks.

Figure 2 examines the number of behavioral recommendations. In this sample, 5.3% met none of the recommendations, 13.5% met one recommendation, 24.0% met two recommendations, 31.3% met three recommendations, and 26.0% met all four of the recommendations.

Table 3 demonstrates the prevalence of the four diabetes care behaviors by year across all states. Over the eleven year period in which the data were analyzed, the percentage of people meeting the recommendations appeared to increase for all four behaviors. From 2000 to 2010, biannual A1c measurements increased from 59.1% to 66.9%, diabetes education increased from 53.4% to 58.3%, self-monitoring of blood glucose increased from 48.8% to 64.1%, and annual foot examinations increased from 61.4% to 67.9%.

Prevalence of state-level diabetes care behaviors. The state-level age adjusted prevalence of each of the four diabetes care behaviors can be found together overall in Table 4 and by behavior and sex in Tables 5-8. For the biannual A1C measurement, the percentages ranged from 48.0% in Guam to 73.6% in New Hampshire. Minnesota had the highest percentage of people with diabetes who had ever had diabetes education with 77.2% while the Virgin Islands had the lowest with 35.1%. For self-monitoring of blood glucose, Tennessee had the highest percentage of people meeting the recommendations with 74.0%, while Guam had the lowest with 38.4%. Minnesota had the highest percentage of people with diabetes meeting the recommendations for annual foot examinations with 80.9%, while Puerto Rico had the lowest with 43.1%.

The prevalence of meeting the recommendations at the state level was also examined by sex with few significant differences. There were no significant differences by sex at the state level for A1c and diabetes education. For annual foot examinations, only North Carolina had a significant sex difference with 78.0% of men meeting the recommendations compared to 71.6% of women. However, many states had significant sex differences for self-monitoring of blood glucose. Alaska, Illinois, Pennsylvania, South Carolina, and South Dakota all had a significantly larger percentage of women meeting the recommendations compared to men (Table 7).

These estimates can be directly compared to the Healthy People 2020 goals. For annual foot examinations, only 8 states currently meet the goal of 74.8%. Other behaviors showed similar results with only four states meeting the HP 2020 recommendation for biannual A1c of 71.1%, 11 states meeting the goal for diabetes education of 62.5%, and only one state meeting the goal for daily self-measurements of their blood glucose of 70.4%.

Changes over time in state-level diabetes care behaviors. The state-level age adjusted prevalence of each diabetes care behavior in two time points can be found in Tables 9-12. For HbA1c, 28 states and territories demonstrated increases over time while 20 demonstrated decreases. Michigan had the largest percentage point increase of 13.3, while Hawaii had the largest percentage point decrease with -17.4. For diabetes education, 25 states demonstrated increases over time, while 23 demonstrated decreases. Minnesota had the largest percentage point increase with 7.7, while Guam had the largest percentage point decrease with -8.8. For self-monitoring of blood glucose, 38 states showed increases over time, while 10 showed decreases. Puerto Rico had the largest percentage point increase with 20.8, while Nevada had the largest decrease with -10.4. For annual foot examinations, 27 states demonstrated increases while 21 demonstrated decreases over time. Michigan had the highest percentage point increase in meeting the recommendation for annual foot examinations with 15.5, while Nevada had the largest decrease with -15.8.

Although significance testing was not conducted at the state level, the confidence intervals of the behaviors at the two time points were compared to determine if the increases and decreases were substantial. For A1c, only Hawaii and Michigan, the two extremes, had confidence intervals that did not overlap. For diabetes education, there were no states that had confidence intervals that did not overlap during the two time points. SMBG had seven states demonstrate significant differences over time, including Alabama, Michigan, Mississippi, New York, Tennessee, Vermont, and Puerto Rico. For annual foot examinations, Idaho, Michigan, and Vermont significantly increased the proportion meeting the recommendations over time, while Nevada and Pennsylvania demonstrated decreases.

Bivariate associations of state-level diabetes care behaviors and predictors. A correlation matrix for the state-level changes in diabetes care behaviors and the predictors can be found in Table 13. Significant relationships were found between several of the behaviors, including biannual A1c measurements and annual foot examinations ($p=0.0005$), A1c and self-monitoring of blood glucose ($p=0.0120$), A1c and diabetes education ($p=0.0032$), and annual foot examinations and self-monitoring of blood glucose ($p<.0001$). No significant relationships were found between diabetes education and self-monitoring of blood glucose and diabetes education and annual foot examinations.

Significant relationships were also found between the predictors and the change in diabetes care behaviors. Self-monitoring of blood glucose levels was significantly associated with proportion female ($p=0.004$), proportion on Medicaid ($p=0.0108$), proportion black ($p=0.0082$), and region ($p=0.0378$). No other significant relationships were found between the predictors and the behaviors, although the association between A1c and proportion on Medicaid approached significance (p=0.0775).

There were also several significant relationships among the predictors. There was a significant relationship between GDP per capita and proportion female (p=0.0101), GDP per capita and percent college educated (p<.0001), proportion female and Medicaid (p=0.0146), proportion female and college education (p=0.0001), Medicaid and college educated (p=0.0638), and proportion Hispanic and college educated (p=0.0273).

Predictors of state-level diabetes care behaviors. Predictive multiple linear regression models were run for each of the four diabetes care behaviors (Tables 14 & 15). Predictor variables included state-level GDP, proportion of state on Medicaid, proportion female, proportion Black, proportion Hispanic, proportion college educated, and region. The full models had no significant predictors at the .05 level. For the fitted models, there were no significant predictors for diabetes education and annual foot examinations. However, the model for self-monitoring of blood glucose explained 23.44% of the variability and had two significant predictors, proportion on Medicaid (β =0.26414, p=0.0805) and proportion female (β =0.80132, p= 0.0343). The model for A1c explained 7.24% of the variability, and had one significant predictor, proportion Medicaid (β =0.24851, p= 0.0775).

Overall, these results indicated that there were state-level disparities in diabetes care behaviors and that few states are on track to meet the Healthy People 2020 goals. Many states demonstrated increases in the proportion meeting the diabetes care recommendations, but few of these increases were significant. When multiple linear regression models were run, diabetes education and annual foot examinations had no significant predictors, while SMBG had two significant predictors, proportion female and proportion on Medicaid, and A1c had one significant predictor, proportion on Medicaid.

Chapter 5 – Discussion

This study was designed to determine whether there were state-level differences in diabetes care behaviors, whether these differences have changed over time, and what factors predict the change over time. The first hypothesis of this study was that the four diabetes care behaviors varied by state. This question was answered by calculating the age adjusted prevalences of the four diabetes care behaviors by state, and the analysis indicated that there was substantial variation for all behaviors. This finding is consistent with previous research, which also found that there were large differences in the percentage of the state population meeting diabetes care recommendations.[39] The results from this research question also demonstrated that very few states are meeting the recommendations for Healthy People 2020. Although the year 2020 is still several years away, states must make a renewed commitment to meet these goals in seven years.

Additionally, some states were universally strong or weak on all behaviors, while others were strong on some but weak on others. For instance, Minnesota ranked in the top 5 states for all four behaviors, and was first overall for two of them. In contrast, the state of Tennessee had the highest percentage of people with diabetes that met the recommendations for self-monitoring of blood glucose levels, but had average levels for all of the other behaviors. Additionally, many of the territories such as Puerto Rico, Guam, and the Virgin Islands had some of the lowest proportions of people meeting the recommendations out of all the states. Although the behaviors each demonstrated intra-state variability, each diabetes care behavior had a slightly different distribution. For example, the range for meeting the A1c recommendation was 25.6 percentage points, while the range for diabetes education was 42.2. This variation demonstrates that the behaviors cannot be treated equally and that each responds differently to the state level factors.

The second purpose of this study was to determine if the state level variations changed over time. To answer this question, the change in the behaviors was examined during two time periods: 2000-2005 and 2006-2010. This portion of the analysis demonstrated that some states increased the percentage of the diabetes population that met the recommendations for diabetes care behaviors, while other states decreased the percentage for the same behaviors. This finding contrasts with previous research that found increases over time, although this research has not been conducted at the state level.[16,18,39,54] One previous study examined state-level changes in annual foot examinations and A1c measurements. This study found that 31 states demonstrated increases in annual foot examinations from 2000 to 2003, while 14 demonstrated decreases, while in the present study, 27 states demonstrated increases while 21 demonstrated decreases from 2000-2005 to 2006-2010.[39] A similar discrepancy was found for A1c measurements, where 36 states increased and 8 decreased, while in the present study 28 states and territories demonstrated increases over time while 20 demonstrated decreases. The authors of the previous study discussed regression to the mean as a likely cause of some of the decreases, and this explanation is certainly possible in this study as well.[39] However, this difference could also be due to the fact that the previous study only used single year comparisons while this study used groups of years to examine changes over time.

The comparison of confidence intervals indicated that very few of the changes represent true increases or decreases over time. This indicates that while some states are improving, in most states there has been no major change in the proportion meeting the recommendations for diabetes care behaviors over the past ten years. Like the results to the first research question, these findings demonstrate the renewed focus the states must take in order to improve diabetes care to meet the *Healthy People 2020* goals. However, these results could also be a function of the analysis. If additional years of older data were considered in this analysis, it is possible that more states would have demonstrated increases.

The third purpose of this study was to determine the state-level predictors of the change in the four health behaviors. For diabetes education and annual foot examinations, none of the seven predictors were significant. This result was not surprising because there were no significant bivariate associations between diabetes education and annual foot examinations, and the predictors. In contrast, self-monitoring of blood glucose had two significant predictors, proportion on Medicaid and proportion female, such that a higher proportion of the state on Medicaid and a higher proportion female predicted a larger change in self-monitoring of blood glucose at the state level. A1c had one predictor, proportion on Medicaid, such that a higher proportion of the state on Medicaid predicted a larger change in A1c at the state level. These results make sense considering the significant and near significant bivariate associations between the predictors and these two diabetes care behaviors. Additionally, the finding that proportion on Medicaid is a significant predictor of SMBG and A1c indicates that there is something important about states as a unit of analysis beyond just demographic factors. If this level was not important, the percentage of people with diabetes meeting the recommendations would more constant across states.

There are several reasons why change in self-monitoring of blood glucose and A1c had significant predictors, while change in diabetes education and annual foot examination did not. This result may have occurred because more states demonstrated increases than decreases in SMBG and to a lesser extent A1c, while for diabetes education and annual foot examinations, the number of states demonstrating increases was similar to decreases. Additionally, the mean change over time for SMBG was larger than it was for the other variables, whose means were close to zero. Although the reason for this change is unknown, it is possible that many states have emphasized SMBG more in their diabetes programming compared to the other diabetes care behaviors. If all states demonstrated large increases in the four diabetes care behaviors over time, it is likely that the more of the variables would have been important predictors.

Proportion Medicaid and proportion female were two predictors that did not show up frequently in the determinants literature, but the logic behind the relationships is clear. When a larger percentage of a state's population is on Medicaid, there is usually a smaller portion of the population that is uninsured. Previous research has shown that uninsured individuals under 65 are less likely to receive HbA1c tests, and less likely to report self-monitoring of blood glucose.[52] Additionally, people on Medicaid have a consistent form of insurance, and previous research has shown that those with consistent health insurance more likely to receive diabetes preventive health care compared to those with no insurance or partial insurance.[53] However, some studies have found results indicating that a greater percentage of people with commercial health insurance had HbA1c testing compared to people on Medicaid.[70]

At least on the individual level, there is plausibility for the relationship between proportion female and self-monitoring of blood glucose because in general, women tend to use more health services than men. Specifically, research has indicated that women are likely to visit a primary care clinic and obtain diagnostic services more often than men.[71] This result is logical in this sample because several states had a significantly higher proportion of females meeting the SMBG recommendation than males. Additionally, many of the states with lower proportions of females were Western states, such as Alaska, Wyoming, and North Dakota. For this reason, it is possible that proportion female is actually a proxy for another variable, such as urban/rural environment. However, only individual level analyses could properly investigate this relationship.

Even in the models that had important predictors, these models only explained a small amount of the variability. This means that there is still a large amount of state-level variation that is unexplained by the seven predictors. Future research should return to the literature to examine other state-level predictors not used in this dataset that might be determinants of diabetes care.

These predictors can also be examined within the context of Anderson's Model of Health Service Use.[28,29] According to this model, only one predisposing component and one enabling component were predictive for one of the behaviors and one enabling component for another behavior. This finding contrasts with previous research using the model, where studies using nationally representative datasets on diabetes found specific components predictive of diabetes care behaviors.[56,57] However, it is possible that the model was just not applied correctly in this project. In this study, only the predisposing and enabling components of the model were used, neglecting the need component, as was done in an earlier study.[57] However, it is possible that elements of the need component such as insulin status or time since the diabetes diagnosis are actually important predictors of the change in diabetes care behaviors, as was found in another study.[56] Additionally, it is possible that the wrong aspects of the predisposing and enabling components of the model were chosen. The model may have been more useful if variables describing health beliefs and social networks were chosen. Also, this model may only be designed for use on the individual level, not the state level as was used in this study. In the same way, this model may not be best used to explain the change over time in diabetes care behaviors. Only future research can determine whether using this model with aggregate level data is a valid approach. Lastly, it is possible that some of the behaviors such as diabetes education and self-monitoring of blood glucose levels do not qualify as health services, so the model does not apply. Future research should examine the use of this model with diabetes care behaviors more thoroughly.

Strengths and Limitations

This study has several strengths. One of its main strengths is that it uses nationally representative data. Using a complex sampling and weighting strategy, the BRFSS samples people from all different races and locations across the United States, which contrasts with community-based studies that sample from only one area with no weighting and thus have limited generalizability. This sampling technique increases the generalizability of the findings, making them relevant to more people. This increased generalizability gives a representative view of the entire United States, and is the main strength of the study.

Additionally, this study's state level analysis represents an important contribution to the literature. Much of the previously published literature on diabetes care behaviors has only been conducted on the individual level. Although the individual level is important for determining behavior causation, it is also important to recognize the context in which the behaviors occur. Because several determinants of diabetes care behaviors happen on the state level, this study adds a new angle to the previous literature.

Another strength of this analysis is that it examines data from more than one year. Most past analyses of diabetes care behaviors only examine them in one year. Although these cross-sectional snapshots can provide valuable information, they only capture what is going on during one moment in time. This analysis examines the data over a period of eleven years, so it reflects more stability than studies that only included data from one year.

In spite of these findings, the results have several limitations. Because this project did not involve original data collection, analyses were limited to the variables present in the BRFSS data set. For this reason, we were unable to fully account for some of the determinants of the health behaviors that are present in the published literature, especially self-monitoring of blood glucose. For this analysis, we could not fully operationalize individual aspects of theory like self-efficacy, intentions, and health beliefs. Future research on these behaviors should collect data on these determinants so they can be included in the mathematical models.

Several of the questions changed over the eleven year period where the data was used. In 2004, the question assessing diabetes status was changed to include a response for gestational diabetes. Since this study included data from before the question change, this response had to be collapsed to make comparisons. Future research should compare people with gestational diabetes to those with diagnosed diabetes to determine if there is a difference between the groups on a variety of health outcomes.

In addition, the 2000-2010 BRFSS data was only collected among individuals with landlines. As of 2012, 35.8% of Americans use cell phones as their only means of telephone communication.[72] Using these methods, only a certain portion of the population can be selected for inclusion in the study. The 2011 BRFSS methodology has been changed to include cell phones but due to the changes in the weighting, comparisons could not be easily made with the older data. With this change, future analyses of BRFSS data will be more representative of the United States population.

Additionally, the BRFSS does not include people who are institutionalized, including those in nursing homes or those who are homeless. Because this population is not included, the percentage of people meeting the recommendations as presented in this paper could overestimate the actual numbers since people in these groups tend to have poor health. This could potentially mean that the changes over time are potentially inaccurate. Separate studies on diabetes care behaviors must be conducted to examine these issues in these populations.

Additionally, all the variables in the BRFSS dataset are self-reported. For this analysis, this means that all the individuals had to report a diabetes diagnosis from their doctor. It does not include people who have undiagnosed diabetes or those that did not remember their diagnosis. Additionally, data on all of the diabetes care behaviors were self-reported. Although it may be infeasible to obtain objective measures of self-monitoring of blood glucose levels, objective information on annual foot examinations and HbA1c tests could be obtained from medical records. Future research should focus on using objective measurements of diabetes status and behaviors to increase precision and decrease the probability of recall bias.

Another weakness of the study is the richness of the dataset. Although there were many observations overall, the cell sizes decreased when examining the variables by state and year. Some states did not collect data on the diabetes module every year, so changes over time could not be examined for every state. In the future, states should be encouraged to complete all of the optional modules to increase the richness of the data when making state-level comparisons.

A final limitation of this analysis is that it aggregates data across years. Although this increases the sample size, it does not provide up to date estimates of the diabetes care behaviors. Year by year estimates may be higher or lower than the numbers reported in this paper. Future research can examine the data in individual years to obtain accurate, up-to-date estimates, providing that the sample size is large enough to do so.

Implications

Despite these weaknesses, the results of this study have major implications for public health practice on both the policy and programmatic levels. At this point, most states are not meeting the Healthy People 2020 guidelines for diabetes care behaviors, so changes need to be made in order for improvements to occur. Because there are such disparities in diabetes care behaviors across the states, health officials should consider setting multilevel objectives, where states currently meeting the guidelines can try to maintain and set new goals, while states not meeting the guidelines can still strive for continuous increases.[39] States, such as Mississippi, Missouri, and Washington that do not require coverage for diabetes treatment to be included in health insurances policies, and Alabama, Idaho, North Dakota and Ohio that do not require insurance coverage for diabetes treatment should consider adopting legislation to fix this problem. Other states can consider expanding their Medicaid programs and other forms of health insurance so a greater percentage of the population can be covered. In addition, states should pass legislation that increases the amount of funding for diabetes care.

Additionally, program planners in state health departments can use this data to target health programs and improve diabetes care outcomes. For example, in a state like Hawaii, with above average percentages meeting the recommendations for A1c tests and annual foot examinations, but below average percentages of meeting the recommendations for self-monitoring of blood glucose levels and diabetes education, health officials may want to design a program that targets the behaviors that do not fare as well. In this way, state officials can use the results of this study to tailor diabetes programs to meet the needs of their populations. In doing so, they should keep informed of the latest diabetes research and adopt cutting edge methods for improving diabetes care behaviors.

This study also has implications for future research in the field of diabetes. Because few of the predictors were significant, more research needs to be done on the determinants of diabetes care behaviors, especially at the state-level, where few studies have been completed. This research can involve multiple methods of inquiry. For example, researchers could conduct focus groups in communities with people with diabetes so they could ask open ended questions about what affects their use of diabetes health services. On a larger level, surveys can be designed to operationalize all the components of Anderson's model to determine the determinants of diabetes care behaviors across states.[28,29] Additionally, using multilevel models to determine predictors of diabetes care behaviors on both the aggregate and individual levels would represent a significant advance in the literature. Using these methods, researchers would have a better idea about what factors encourage people to engage in diabetes care behaviors.

Proportions meeting the diabetes care recommendations were among the lowest in Puerto Rico, Guam, and the Virgin Islands. Although they are territories of the United States, they are insular areas that are not privy to many of the advantages of United States citizenship. Although they are included in BRFSS, they are distinct from the other states and may have different determinants of diabetes care behaviors. Although a few studies have been completed on diabetes in these areas, they appear older and possibly out of date. New research is needed to determine if U.S. territories have the same diabetes determinants as the rest of the United States.

Diabetes is a major health problem in the United States but its more serious consequences can be prevented when individuals with the condition engage in key care behaviors. Programs can be designed to promote these behaviors but first researchers must examine the current prevalence of the behaviors. This research completed the first step by determining the pooled prevalences of the diabetes care behaviors, how they changed over time, and what their predictors are. Future research can build on this information by using multi-level models and additional predictors to gain a further understanding of the relationships. These models can include state-level factors like proportion on Medicaid along with individual level demographic variables and determinants like self-efficacy and intentions. The models can also adjust predictors for gender and test to see whether any of the state-level differences exist beyond just the distribution of demographic factors. With this information, public health practitioners can design programs to help ease the chronic disease burden in the United States and make Americans healthier overall.

References

1. Kannel WB, McGee DL. Diabetes and cardiovascular disease. The Framingham study. *Jama.* May 11 1979;241(19):2035-2038.

2. Murphy SL XJ, Kochanek KD. Deaths:Preliminary Data for 2010. *National Vital Statistics Reports.* 2012;60(4).

3. Economic costs of diabetes in the U.S. In 2007. *Diabetes care.* Mar 2008;31(3):596-615.

4. Boyle JP, Thompson TJ, Gregg EW, Barker LE, Williamson DF. Projection of the year 2050 burden of diabetes in the US adult population: dynamic modeling of incidence, mortality, and prediabetes prevalence. *Popul Health Metr.* 2010;8:29.

5. Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services; 2011.

6. Kanjilal S, Gregg EW, Cheng YJ, et al. Socioeconomic status and trends in disparities in 4 major risk factors for cardiovascular disease among US adults, 1971-2002. *Arch Intern Med.* Nov 27 2006;166(21):2348-2355.

7. Norris SL, Lau J, Smith SJ, Schmid CH, Engelgau MM. Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control. *Diabetes care.* Jul 2002;25(7):1159-1171.

8. Litzelman DK, Slemenda CW, Langefeld CD, et al. Reduction of lower extremity clinical abnormalities in patients with non-insulin-dependent diabetes mellitus. A randomized, controlled trial. *Annals of internal medicine.* Jul 1 1993;119(1):36-41.

9. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet.* Sep 12 1998;352(9131):837-853.

10. Consensus statement on self-monitoring of blood glucose. *Diabetes care.* Jan-Feb 1987;10(1):95-99.

11. Benjamin EM. Self-Monitoring of Blood Glucose: The Basics. *Clinical Diabetes.* 2002;20(1):45-47.

12. American Diabetes A. Standards of medical care in diabetes--2012. *Diabetes Care.* Jan 2012;35 Suppl 1:S11-63.

13. Boulton AJ, Armstrong DG, Albert SF, et al. Comprehensive foot examination and risk assessment: a report of the task force of the foot care interest group of the American Diabetes Association, with endorsement by the American Association of Clinical Endocrinologists. *Diabetes care.* Aug 2008;31(8):1679-1685.

14. Funnell MM, Brown TL, Childs BP, et al. National standards for diabetes self-management education. *Diabetes care.* Jan 2012;35 Suppl 1:S101-108.

15. Saaddine JB, Engelgau MM, Beckles GL, Gregg EW, Thompson TJ, Narayan KM. A diabetes report card for the United States: quality of care in the 1990s. *Ann Intern Med.* Apr 16 2002;136(8):565-574.

16. Okoro CA, Mokdad AH, Ford ES, Bowman BA, Vinicor F, Giles WH. Are persons with diabetes practicing healthier behaviors in the year 2001? Results from the Behavioral Risk Factor Surveillance System. *Preventive medicine.* Feb 2004;38(2):203-208.

17. Beckles GL, Engelgau MM, Narayan KM, Herman WH, Aubert RE, Williamson DF. Population-based assessment of the level of care among adults with diabetes in the U.S. *Diabetes Care.* Sep 1998;21(9):1432-1438.

18. Saaddine JB, Cadwell B, Gregg EW, et al. Improvements in diabetes processes of care and intermediate outcomes: United States, 1988-2002. *Ann Intern Med.* Apr 4 2006;144(7):465-474.

19. US Department of Health and Human Services. Office of Disease Prevention and Health Promotion. Healthy People 2020. http://healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=8. Accessed February 27 2012.

20. Shen YC, Zuckerman S. Why is there state variation in employer-sponsored insurance? *Health Aff (Millwood).* Jan-Feb 2003;22(1):241-251.

21. Spillman BC. Adults without health insurance: Do state policies matter? Whether uninsured adults can get coverage from public programs depends largely on the state they live in. *Health Affair.* Jul-Aug 2000;19(4):178-187.

22. Medicaid Enrollment as a Percent of Total Population, 2009. http://www.statehealthfacts.org/comparemaptable.jsp?ind=199&cat=4. Accessed November 16, 2012.

23. State Diabetes Control Programs,. http://www.diabetes.org/advocate/our-priorities/funding/diabetes-control-programs.html. Accessed February 11, 2013.

24. Georgia Department of Health. Diabetes Prevention and Control Program. http://health.state.ga.us/programs/diabetes/index.asp. Accessed February 11, 2013.

25. Minnesota Department of Health. Minnesota Diabetes Program. http://www.health.state.mn.us/diabetes/. Accessed February 11, 2013.

26. National Conference of State Legislatures. Overview: State Diabetes Laws 2007-2012. 2013; http://www.ncsl.org/issues-research/health/diabetes-state-legislation-overview-2007-2010.aspx. Accessed February 11, 2013.

27. National Conference of State Legislatures. Providing Diabetes Health Coverage: State Laws and Programs. May 2011; http://www.ncsl.org/issues-research/health/diabetes-health-coverage-state-laws-and-programs.aspx.

28. Andersen RM. *A Behavioral Model of Families' Use of Health Services.* 1968.

29. Andersen RM. Revisiting the Behavioral-Model and Access to Medical-Care - Does It Matter. *J Health Soc Behav.* Mar 1995;36(1):1-10.

30. Nadkarni A, Kucukarslan SN, Bagozzi RP, Yates JF, Erickson SR. Examining determinants of self management behaviors in patients with diabetes: an application of the Theoretical Model of Effortful Decision Making and Enactment. *Patient education and counseling.* Nov 2011;85(2):148-153.

31. Sarkar U, Fisher L, Schillinger D. Is self-efficacy associated with diabetes self-management across race/ethnicity and health literacy? *Diabetes care.* Apr 2006;29(4):823-829.

32. Grispen JE, Ronda G, Dinant GJ, de Vries NK, van der Weijden T. To test or not to test: a cross-sectional survey of the psychosocial determinants of self-testing for cholesterol, glucose, and HIV. *BMC public health.* 2011;11:112.

33. Brown-Guion SY, Youngerman SM, Hernandez-Tejada MA, Dismuke CE, Egede LE. Racial/Ethnic, Regional, and Rural/Urban Differences in Receipt of Diabetes Education. *Diabetes Educ.* Mar 12 2013.

34. Adams AS, Mah C, Soumerai SB, Zhang F, Barton MB, Ross-Degnan D. Barriers to self-monitoring of blood glucose among adults with diabetes in an HMO: a cross sectional study. *BMC health services research.* Mar 19 2003;3(1):6.

35. Coonrod BA, Betschart J, Harris MI. Frequency and determinants of diabetes patient education among adults in the U.S. population. *Diabetes care.* Aug 1994;17(8):852-858.

36. Thackeray R, Merrill RM, Neiger BL. Disparities in diabetes management practice between racial and ethnic groups in the United States. *Diabetes Educ.* Jul-Aug 2004;30(4):665-675.

37. Levine DA, Allison JJ, Cherrington A, Richman J, Scarinci IC, Houston TK. Disparities in self-monitoring of blood glucose among low-income ethnic minority populations with diabetes, United States. *Ethnicity & disease.* Spring 2009;19(2):97-103.

38. Saaddine JB, Engelgau MM, Beckles GL, Gregg EW, Thompson TJ, Narayan KM. A diabetes report card for the United States: quality of care in the 1990s. *Ann Intern Med.* Apr 16 2002;136(8):565-574.

39. Mukhtar Q, Jack L, Jr., Martin M, Murphy D, Rivera M. Evaluating progress toward Healthy People 2010 national diabetes objectives. *Prev Chronic Dis.* Jan 2006;3(1):A11.

40. Stratton IM, Adler AI, Neil HA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *Bmj.* Aug 12 2000;321(7258):405-412.

41. Wagner EH, Sandhu N, Newton KM, McCulloch DK, Ramsey SD, Grothaus LC. Effect of improved glycemic control on health care costs and utilization. *Jama.* Jan 10 2001;285(2):182-189.

42. Stettler C, Allemann S, Juni P, et al. Glycemic control and macrovascular disease in types 1 and 2 diabetes mellitus: Meta-analysis of randomized trials. *Am Heart J.* Jul 2006;152(1):27-38.

43. Plank J, Haas W, Rakovac I, et al. Evaluation of the impact of chiropodist care in the secondary prevention of foot ulcerations in diabetic subjects. *Diabetes care.* Jun 2003;26(6):1691-1695.

44. McCabe CJ, Stevenson RC, Dolan AM. Evaluation of a diabetic foot screening and protection programme. *Diabet Med.* Jan 1998;15(1):80-84.

45. Boren SA, Fitzner KA, Panhalkar PS, Specker JE. Costs and benefits associated with diabetes education: a review of the literature. *Diabetes Educ.* Jan-Feb 2009;35(1):72-96.

46. Duncan I, Birkmeyer C, Coughlin S, Li QE, Sherr D, Boren S. Assessing the value of diabetes education. *Diabetes Educ.* Sep-Oct 2009;35(5):752-760.

47. Graziani C, Rosenthal MP, Diamond JJ. Diabetes education program use and patient-perceived barriers to attendance. *Family medicine.* May 1999;31(5):358-363.

48. Shah BR, Booth GL. Predictors and effectiveness of diabetes self-management education in clinical practice. *Patient education and counseling.* Jan 2009;74(1):19-22.

49. Oladele CR, Barnett E. Racial/Ethnic and social class differences in preventive care practices among persons with diabetes. *BMC public health.* 2006;6:259.

50. Richard P, Alexandre PK, Lara A, Akamigbo AB. Racial and ethnic disparities in the quality of diabetes care in a nationally representative sample. *Prev Chronic Dis.* Nov 2011;8(6):A142.

51. Heisler M, Smith DM, Hayward RA, Krein SL, Kerr EA. Racial disparities in diabetes care processes, outcomes, and treatment intensity. *Medical care.* Nov 2003;41(11):1221-1232.

52. Nelson KM, Chapko MK, Reiber G, Boyko EJ. The association between health insurance coverage and diabetes care; data from the 2000 Behavioral Risk Factor Surveillance System. *Health Serv Res.* Apr 2005;40(2):361-372.

53. Gold R, DeVoe J, Shah A, Chauvie S. Insurance continuity and receipt of diabetes preventive care in a network of federally qualified health centers. *Medical care.* Apr 2009;47(4):431-439.

54. Kuo S, Fleming BB, Gittings NS, et al. Trends in care practices and outcomes among Medicare beneficiaries with diabetes. *Am J Prev Med.* Dec 2005;29(5):396-403.

55. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *Jama.* Jan 1 2003;289(1):76-79.

56. Yamashita T, Kart CS, Noe DA. Predictors of adherence with self-care guidelines among persons with type 2 diabetes: results from a logistic regression tree analysis. *Journal of behavioral medicine.* Dec 13 2011.

57. Pu J, Chewning B. Racial difference in diabetes preventive care. *Res Social Adm Pharm.* Dec 12 2012.

58. Nelson DE, Holtzman D, Bolen J, Stanwyck CA, Mack KA. Reliability and validity of measures from the Behavioral Risk Factor Surveillance System (BRFSS). *Sozial- und Praventivmedizin.* 2001;46 Suppl 1:S3-42.

59. Schneider AL, Pankow JS, Heiss G, Selvin E. Validity and reliability of self-reported diabetes in the atherosclerosis risk in communities study. *American journal of epidemiology.* Oct 15 2012;176(8):738-743.

60. Jackson JM, Defor TA, Crain AL, et al. Self-reported diabetes is a valid outcome in pragmatic clinical trials and observational studies. *Journal of clinical epidemiology.* Mar 2013;66(3):349-350.

61. Espelt A, Goday A, Franch J, Borrell C. Validity of self-reported diabetes in health interview surveys for measuring social inequalities in the prevalence of diabetes. *J Epidemiol Community Health.* Jul 2012;66(7):e15.

62. Centers for Disease Control and Prevention. **Behavioral Risk Factor Surveillance System Operational and User's Guide**. 2006; ftp://ftp.cdc.gov/pub/Data/Brfss/userguide.pdf.

63. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. 2013; http://www.cdc.gov/brfss/index.htm.

64. Fowles JB, Rosheim K, Fowler EJ, Craft C, Arrichiello L. The validity of self-reported diabetes quality of care measures. *International journal for quality in health care : journal of the International Society for Quality in Health Care / ISQua.* Oct 1999;11(5):407-412.

65. Gonder-Frederick LA, Julian DM, Cox DJ, Clarke WL, Carter WR. Self-measurement of blood glucose. Accuracy of self-reported data and adherence to recommended regimen. *Diabetes Care.* Jul-Aug 1988;11(7):579-585.

66. U.S. Department of Commerce Bureau of Economic Analysis. 2005; http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=10&isuri=1&7007=2005&7093=Levels&7090=70&7035=-1&7036=-1&7001=11000&7002=1&7003=1000&7004=NAICS&7005=101&7006=XX.

67. The Kaiser Family Foundation. Medicaid Enrollment as a Percent of Total Population, 2009. http://www.statehealthfacts.org/comparetable.jsp?ind=199&cat=4&sub=52&yr=92&typ=2&sort=a.

68. U.S. Census Bureau. Race and Hispanic Origin in 2005. http://www.census.gov/population/pop-profile/dynamic/RACEHO.pdf.

69. Hocking RR. A Biometrics Invited Paper. The Analysis and Selection of Variables in Linear Regression. *Biometrics.* 1976;32(1):1-49.

70. Landon BE, Schneider EC, Normand SL, Scholle SH, Pawlson LG, Epstein AM. Quality of care in Medicaid managed care and commercial health plans. *Jama.* Oct 10 2007;298(14):1674-1681.

71. Bertakis KD, Azari R, Helms LJ, Callahan EJ, Robbins JA. Gender differences in the utilization of health care services. *The Journal of family practice.* Feb 2000;49(2):147-152.

72. Blumberg SJ and Luke JV. *Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, January–June 2012.* Division of Health Interview Statistics, National Center for Health Statistics;2012.

Tables

Table 1 – Demographic Information among Persons with Diabetes

	Overall	Men	Women
Average Age (n=233,361)	Mean (95% CI) 58.9 (58.7-59.0)	Mean (95% CI) 58.5 (58.3-58.7)	Mean (95% CI) 59.2 (59.1-59.4)
Education (n=233,288)	% (95% CI)	% (95% CI)	% (95% CI)
Never attended school or only attended kindergarten	0.4 (0.3-0.4)	0.3 (0.2-0.4)	0.5% (0.4-0.6)
Completed Grades 1-8	7.6 (7.3-7.9)	6.8 (6.4-7.3)	8.4 (8.0-8.8)
Completed grades 9-11	10.0 (9.7-10.3)	8.7 (8.3-9.1)	11.3 (11.0-11.7)
completed grade 12 or GED	32.6 (32.2-33.0)	30.2 (29.6-30.7)	35.1 (34.6-35.6)
Completed 1-3 years of college	26.3 (26.0-26.7)	25.7 (25.1-26.2)	27.1 (26.6-27.5)
Completed 4 or more years of college	22.8 (22.5-23.2)	28.1 (27.5-28.7)	17.4 (17.0-17.9)
Refused education question	0.3 (0.2-0.3)	0.3 (0.2-0.3)	0.3 (0.2-0.3)
Race/Ethnicity (n= 233,333)	% (95% CI)	% (95% CI)	% (95% CI)
White Non-Hispanic	65.3 (64.9-65.8)	67.1 (66.4-67.9)	63.5 (62.9-64.1)
Black Non-Hispanic	13.7 (13.4-14.0)	11.7 (11.3-12.2)	15.8 (15.4-16.2)
Hispanic	13.9 (13.5-14.3)	13.5 (12.8-14.2)	14.3 (13.8-14.9)
Asian/Native Hawaiian/ Pacific Islander	2.1 (1.9-2.3)	2.5 (2.2-2.8)	1.7 (1.4-1.9)
American Indian/Alaska Native	1.6 (1.5-1.7)	1.6 (1.4-1.8)	1.6 (1.4-1.7)
Other Race	2.5 (2.3-2.7)	2.7 (2.5-2.9)	2.3 (2.1-2.5)
Refused Race question	0.8 (0.8-0.9)	0.9 (0.8-1.0)	0.8 (0.7-0.9)

Data from 2000-2010 Behavioral Risk Factor Surveillance System

Table 2 – Age adjusted diabetes care behaviors overall, by sex, by race/ethnicity, and by age

	HbA1c (n=233,361) % (95% CI)	Diabetes Education (n=233,342) % (95% CI)	SMBG (n=233,361) % (95% CI)	Annual Foot Examination (n=233,361) % (95% CI)
Overall	64.0 (63.2-64.7)	56.8 (56.1-57.5)	60.6 (59.8-61.3)	67.6 (66.9-68.3)
Gender				
Men	63.6 (62.4-64.7)	55.6 (54.5-56.8)	57.9 (56.7-59.1)	68.3 (67.2-69.4)
Women	64.4 (63.5-65.2)	58.0 (57.1-58.9)	63.3 (62.5-64.2)	66.9 (66.0-67.7)
Race/Ethnicity				
White, Non-Hispanic	66.9 (66.1-67.7)	58.5 (57.7-59.3)	63.4 (62.6-64.2)	68.4 (67.6-69.2)
Black, Non-Hispanic	63.3 (61.7-64.9)	59.6 (58.0-61.3)	64.5 (62.9-66.1)	74.6 (73.0-76.1)
Hispanic	55.0 (52.7-57.3)	49.3 (47.0-51.6)	50.1 (47.8-52.4)	58.2 (56.0-60.5)
Asian/Native Hawaiian/Pacific Islander	64.6 (58.6-70.6)	50.2 (44.3-56.1)	45.9 (40.3-51.5)	65.5 (59.9-71.0)
American Indian/Alaska Native	65.3 (61.2-69.4)	59.2 (55.0-63.4)	66.3 (62.5-70.0)	75.9 (72.5-79.3)
Other	62.2 (57.8-66.7)	54.8 (50.4-59.1)	62.4 (58.0-66.7)	67.6 (63.2-72.0)
Refused race	54.9 (47.9-61.8)	52.8 (45.8-59.9)	57.9 (50.9-64.9)	61.0 (53.9-68.1)
Age				
Age 18-44	60.0 (58.7-61.3)	58.4 (57.1-59.7)	60.8 (59.5-62.1)	64.5 (63.3-65.8)
Age 45-64	68.8 (68.2-69.4)	57.2 (56.5-57.8)	59.6 (59.0-60.3)	70.8 (70.2-71.4)
Age 65-74	70.6 (69.8-71.3)	54.9 (54.1-55.8)	62.8 (61.9-63.6)	72.3 (72.0-73.6)
Age 75 +	64.9 (64.0-65.9)	46.9 (45.9-47.9)	60.4 (59.4-61.3)	70.0 (69.0-70.9)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
SMBG stands for self-monitoring of blood glucose

Table 3 – National Prevalence of Diabetes Care Behaviors by Year, 2000-2010

	A1c % (95% CI)	Diabetes Education % (95% CI)	SMBG % (95% CI)	Annual Foot Examination % (95% CI)
2000	59.0 (55.6-62.5)	53.4 (50.0-56.9)	48.8 (45.3-52.3)	61.4 (57.9-64.8)
2001	61.2 (58.7-63.7)	54.1 (51.6-56.6)	55.9 (53.4-58.4)	64.8 (62.3-67.2)
2002	65.6 (63.2-68.1)	57.7 (55.2-60.1)	57.2 (54.6-59.7)	67.9 (65.4-70.4)
2003	64.0 (61.6-66.4)	55.7 (53.3-58.1)	58.8 (56.4-61.2)	68.3 (66.1-70.5)
2004	65.7 (63.5-67.8)	58.0 (55.7-60.2)	60.9 (58.6-63.2)	68.0 (65.9-70.2)
2005	60.5 (58.1-62.9)	56.0 (53.5-58.4)	62.7 (60.4-65.1)	67.4 (65.1-69.8)
2006	64.5 (62.5-66.5)	55.6 (53.4-57.8)	64.8 (62.7-67.0)	68.6 (66.6-70.6)
2007	65.3 (62.9-67.7)	58.9 (56.5-61.3)	63.2 (60.7-65.6)	70.1 (67.9-72.4)
2008	65.2 (63.2-67.3)	57.8 (55.7-59.9)	63.5 (61.4-65.6)	67.8 (65.7-69.9)
2009	64.9 (62.5-67.3)	58.7 (56.4-61.0)	63.2 (60.8-65.5)	69.3 (67.0-71.6)
2010	66.9 (65.0-68.8)	58.3 (56.3-60.2)	64.1 (62.2-66.0)	67.9 (66.0-69.8)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
SMBG stands for self-monitoring of blood glucose

Table 4 – Percentage and Rank of Meeting the Four Diabetes Care Behavior Recommendations by State among Persons with Diabetes, 2000-2010

	A1c	A1c Rank	Diabetes Education	DE Rank	SMBG	SMBG Rank	AFA	AFA Rank
Overall	64.0 (63.2-64.7)	---	56.8 (56.1-57.5)	--	60.6 (59.8-61.3)	--	67.6 (66.9-68.3)	--
Alabama	67.9 (65.2-70.6)	19	58.2 (55.3-61.1)	26	65.7 (62.9-68.4)	9	71.0 (68.4-73.6)	29
Alaska	63.5 (58.0-69.0)	35	57.2 (51.5-63.0)	30	59.0 (53.2-64.9)	42	72.0 (67.1-76.9)	23
Arizona	57.0 (52.4-61.7)	51	55.6 (51.0-60.2)	36	61.5 (57.0-66.0)	32	65.1 (60.6-69.5)	42
Arkansas	60.6 (57.1-64.2)	43	45.8 (42.2-49.3)	50	59.1 (55.6-62.7)	41	55.8 (52.2-59.3)	53
California	58.6 (54.9-62.3)	47	57.6 (54.0-61.3)	28	51.0 (47.3-54.8)	51	61.0 (57.5-64.6)	52
Colorado	65.8 (61.9-69.8)	26	62.1 (57.9-66.3)	13	61.0 (56.9-65.0)	35	69.3 (65.4-73.2)	32
Connecticut	67.5 (64.1-70.8)	20	51.8 (48.4-55.2)	44	60.3 (56.9-63.7)	38	71.0 (67.8-74.2)	28
Delaware	65.7 (62.0-69.4)	28	46.6 (42.7-50.5)	48	62.8 (59.1-66.6)	24	77.6 (74.7-80.5)	3
District of Columbia	63.4 (58.4-68.5)	36	65.5 (60.7-70.3)	7	64.6 (59.5-69.8)	15	77.1 (72.6-81.6)	5

Florida	61.3 (58.1-64.5)	40	54.1 (50.9-57.3)	41	61.1 (58.1-64.2)	34	66.5 (63.4-69.6)	39
Georgia	65.5 (62.7-68.4)	30	60.1 (57.2-63.0)	19	63.0 (60.2-65.9)	23	69.9 (67.2-72.7)	31
Hawaii	72.9 (69.0-76.8)	2	54.8 (50.5-59.1)	39	52.8 (48.5-57.1)	50	75.0 (71.2-78.7)	8
Idaho	56.7 (53.6-59.9)	52	61.9 (58.8-65.1)	15	58.6 (55.5-61.6)	44	64.0 (61.0-67.0)	47
Illinois	67.9 (61.7-74.1)	18	63.5 (57.2-69.9)	9	66.4 (60.6-72.2)	6	73.3 (67.4-79.3)	18
Indiana	63.0 (59.9-66.2)	37	61.9 (58.7-65.0)	14	63.2 (60.0-66.4)	21	68.0 (64.9-71.1)	35
Iowa	70.0 (66.7-73.3)	8	67.1 (63.8-70.3)	4	67.2 (64.2-70.2)	4	71.9 (68.6-75.2)	24
Kansas	65.8 (61.0-70.7)	27	61.5 (56.6-66.3)	16	55.1 (50.1-60.1)	49	62.8 (57.9-67.7)	49
Kentucky	68.3 (65.7-71.0)	15	53.0 (50.2-55.7)	42	67.3 (64.8-69.9)	3	64.1 (61.4-66.9)	46
Louisiana	58.6 (55.6-61.5)	48	60.2 (57.2-63.2)	18	64.7 (61.8-67.7)	13	70.0 (67.2-72.7)	30
Maine	66.1 (62.1-70.1)	25	61.3 (57.4-65.3)	17	59.0 (55.0-63.1)	43	76.0 (72.5-79.5)	6
Maryland	68.5 (61.8-75.2)	12	54.2 (47.4-61.0)	40	65.0 (59.2-70.8)	12	73.8 (67.7-79.9)	13

Massachusetts	70.3 (67.0-73.5)	7	52.1 (48.4-55.8)	43	64.1 (60.9-67.4)	16	74.4 (71.1-77.6)	10
Michigan	65.6 (61.1-70.0)	29	56.6 (51.9-61.2)	34	62.8 (58.4-67.1)	25	65.7 (61.1-70.2)	41
Minnesota	70.5 (66.7-74.2)	5	77.2 (74.1-80.3)	1	68.5 (65.2-71.9)	2	80.9 (77.5-84.3)	1
Mississippi	60.1 (56.6-63.5)	45	47.0 (43.6-50.4)	46	65.0 (61.8-68.3)	11	64.9 (61.6-68.3)	43
Missouri	64.7 (60.6-68.9)	33	58.6 (54.4-62.8)	24	62.4 (58.2-66.7)	26	71.0 (67.1-75.0)	27
Montana	60.5 (56.9-64.2)	44	63.3 (59.9-66.7)	12	64.1 (60.6-67.5)	17	73.1 (69.8-76.3)	19
Nebraska	68.2 (62.3-74.0)	16	64.5 (58.7-70.3)	8	64.7 (59.0-70.4)	14	71.1 (65.4-76.8)	26
Nevada	58.4 (54.0-62.9)	49	55.6 (51.2-60.1)	35	58.4 (54.0-62.9)	45	61.5 (57.0-65.9)	51
New Hampshire	73.6 (70.3-76.9)	1	66.6 (63.4-69.7)	5	66.2 (63.1-69.2)	7	80.5 (77.7-83.2)	2
New Jersey	64.9 (61.4-68.5)	31	44.5 (41.1-47.8)	51	63.7 (60.2-67.1)	20	66.2 (62.6-69.8)	40
New Mexico	61.7 (58.9-64.6)	39	59.8 (57.0-62.6)	20	65.8 (63.2-68.5)	8	73.7 (71.1-76.2)	15
New York	70.4 (66.4-74.4)	6	46.2 (41.8-50.6)	49	60.0 (55.5-64.4)	40	73.4 (69.3-77.5)	17

North Carolina	66.5 (64.1-68.9)	24	59.3 (57.0-61.7)	21	63.2 (60.8-65.5)	22	74.4 (72.1-76.7)	9
North Dakota	64.8 (60.5-69.0)	32	59.0 (54.7-63.2)	23	61.9 (57.7-66.2)	28	77.6 (73.9-81.2)	4
Ohio	61.8 (58.2-65.4)	38	55.6 (52.0-59.2)	37	62.3 (58.9-65.8)	27	64.5 (61.0-68.0)	44
Oklahoma	61.2 (58.2-64.1)	41	59.23 (56.3-62.1)	22	60.2 (57.2-63.0)	39	64.3 (61.4-67.2)	45
Oregon	72.4 (67.4-77.3)	3	69.8 (64.0-75.6)	2	66.6 (61.2-71.9)	5	74.2 (69.0-79.4)	11
Pennsylvania	69.7 (66.6-72.8)	10	57.0 (53.9-60.2)	31	60.7 (57.5-63.9)	37	74.1 (71.0-77.1)	12
Rhode Island	68.4 (62.4-74.4)	13	47.0 (40.9-53.0)	47	57.0 (51.1-63.0)	47	72.4 (66.7-78.1)	21
South Carolina	64.5 (61.9-67.1)	34	58.4 (55.8-61.0)	25	63.9 (61.3-66.5)	18	72.3 (69.8-74.7)	22
South Dakota	71.8 (68.8-74.9)	4	68.0 (65.0-71.0)	3	61.6 (58.4-64.8)	31	73.6 (70.7-76.5)	16
Tennessee	68.6 (65.7-71.5)	11	56.7 (53.6-59.6)	32	74.0 (71.6-76.5)	1	68.6 (65.7-74.6)	34
Texas	58.0 (55.1-61.0)	50	56.6 (53.6-59.6)	33	56.8 (53.8-59.8)	48	62.5 (59.5-65.5)	50
Utah	66.8 (63.5-70.1)	23	63.4 (60.1-66.8)	11	61.8 (58.3-65.3)	29	71.1 (67.7-75.6)	25

Vermont	69.8 (66.0-73.6)	9	54.8 (51.3-58.4)	38	61.7 (58.3-65.1)	30	75.7 (72.7-78.6)	7
Virginia	67.2 (63.5-70.8)	22	57.8 (53.7-61.8)	27	58.2 (54.1-62.2)	46	67.6 (63.4-71.8)	37
Washington	68.0 (65.9-70.1)	17	65.9 (63.8-67.0)	6	65.3 (63.2-67.3)	10	72.8 (70.8-74.7)	20
West Virginia	67.2 (64.3-70.1)	21	48.9 (46.0-51.9)	45	63.8 (61.0-66.7)	19	67.6 (64.8-70.4)	36
Wisconsin	68.4 (64.2-72.6)	14	63.5 (59.4-68.6)	10	60.8 (56.7-64.8)	36	73.8 (70.0-77.6)	14
Wyoming	59.4 (55.9-62.9)	46	57.5 (54.1-61.0)	29	61.5 (58.2-64.8)	33	63.0 (59.7-66.4)	48
Guam	48.0 (40.9-55.1)	54	44.2 (36.9-51.4)	52	38.4 (31.7-45.1)	54	68.9 (61.9-76.0)	33
Puerto Rico	61.0 (57.7-64.2)	42	36.6 (33.3-39.9)	53	36.9 (33.7-40.1)	53	43.1 (39.9-46.4)	54
Virgin Islands	48.13 (43.3-52.9)	53	35.1 (30.5-39.6)	54	46.4 (41.7-51.2)	52	66.6 (62.0-71.3)	38

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Data are in the form % (95% Confidence Interval)
DE stands for diabetes education, SMBG stands for self-monitoring of blood glucose, AFA stands for annual foot examination

Table 5 – State Level Prevalence of Meeting the A1c Recommendations among Persons with Diabetes overall and by sex, 2000-2010

	A1c Overall	A1c Overall Rank	A1C Male	A1C Female
Overall	64.0 (63.2-64.7)	---	63.6	64.4
Alabama	67.9 (65.2-70.6)	19	68.6 (64.0-73.2)	67.4 (64.2-70.6)
Alaska	63.5 (58.0-69.0)	35	61.9 (53.6-70.3)	64.8 (57.6-72.0)
Arizona	57.0 (52.4-61.7)	51	60.2 (52.8-67.5)	54.0 (48.4-59.6)
Arkansas	60.6 (57.1-64.2)	43	59.9 (54.5-65.4)	61.1 (56.5-65.8)
California	58.6 (54.9-62.3)	47	57.3 (51.7-62.9)	60.0 (55.3-64.7)
Colorado	65.8 (61.9-69.8)	26	63.4 (57.5-69.3)	68.4 (63.3-73.4)
Connecticut	67.5 (64.1-70.8)	20	67.8 (62.6-73.0)	67.1 (63.0-71.3)
Delaware	65.7 (62.0-69.4)	28	64.1 (58.2-70.1)	67.4 (62.8-71.9)
District of Columbia	63.4 (58.4-68.5)	36	61.2 (52.5-69.8)	65.2 (59.3-71.1)
Florida	61.3 (58.1-64.5)	40	60.1 (55.1-65.1)	62.7 (59.0-66.4)
Georgia	65.5 (62.7-68.4)	30	68.5 (64.2-72.8)	62.4 (59.0-65.9)
Hawaii	72.9 (69.0-76.8)	2	73.4 (67.5-79.3)	72.4 (67.5-77.2)

Idaho	56.7 (53.6-59.9)	52	56.2 (51.0-61.4)	57.6 (53.9-61.4)
Illinois	67.9 (61.7-74.1)	18	67.2 (58.8-75.7)	68.8 (60.0-77.7)
Indiana	63.0 (59.9-66.2)	37	62.5 (57.1-67.9)	63.5 (60.1-67.0)
Iowa	70.0 (66.7-73.3)	8	68.4 (63.6-73.2)	71.6 (67.3-75.9)
Kansas	65.8 (61.0-70.7)	27	63.0 (54.9-71.2)	68.5 (62.5-74.5)
Kentucky	68.3 (65.7-71.0)	15	68.7 (64.6-72.8)	68.0 (64.6-71.3)
Louisiana	58.6 (55.6-61.5)	48	58.7 (53.8-63.6)	58.6 (55.2-62.0)
Maine	66.1 (62.1-70.1)	25	67.3 (61.3-73.3)	64.6 (59.5-69.7)
Maryland	68.5 (61.8-75.2)	12	67.6 (57.4-77.8)	69.3 (60.9-77.8)
Massachusetts	70.3 (67.0-73.5)	7	69.5 (64.7-74.4)	71.1 (66.9-75.4)
Michigan	65.6 (61.1-70.0)	29	66.3 (59.8-72.8)	64.7 (58.7-70.7)
Minnesota	70.5 (66.7-74.2)	5	71.1 (65.6-76.7)	69.7 (64.8-74.6)
Mississippi	60.1 (56.6-63.5)	45	59.4 (53.8-65.0)	60.7 (56.4-65.0)
Missouri	64.7 (60.6-68.9)	33	63.3 (56.9-69.8)	66.4 (61.7-71.2)
Montana	60.5 (56.9-64.2)	44	58.8 (52.8-64.9)	62.2 (57.7-66.7)
Nebraska	68.2 (62.3-74.0)	16	72.9 (64.7-81.1)	62.8 (54.9-70.7)

Nevada	58.4 (54.0-62.9)	49	57.6 (51.1-64.1)	58.9 (52.9-65.0)
New Hampshire	73.6 (70.3-76.9)	1	72.6 (67.7-77.4)	74.8 (70.6-79.0)
New Jersey	64.9 (61.4-68.5)	31	66.2 (60.8-71.6)	63.5 (59.1-67.8)
New Mexico	61.7 (58.9-64.6)	39	62.4 (58.1-66.7)	61.1 (57.4-64.9)
New York	70.4 (66.4-74.4)	6	68.8 (62.7-75.0)	71.8 (66.8-76.8)
North Carolina	66.5 (64.1-68.9)	24	68.8 (65.4-72.2)	64.7 (61.4-68.0)
North Dakota	64.8 (60.5-69.0)	32	62.7 (56.4-69.1)	66.9 (61.4-72.5)
Ohio	61.8 (58.2-65.4)	38	57.6 (52.3-63.0)	66.2 (61.8-70.6)
Oklahoma	61.2 (58.2-64.1)	41	59.6 (54.7-64.6)	62.3 (58.7-65.9)
Oregon	72.4 (67.4-77.3)	3	74.0 (66.8-81.2)	70.6 (63.7-77.4)
Pennsylvania	69.7 (66.6-72.8)	10	70.0 (65.2-74.8)	69.6 (65.7-73.4)
Rhode Island	68.4 (62.4-74.4)	13	67.3 (58.6-76.0)	69.4 (61.3-77.6)
South Carolina	64.5 (61.9-67.1)	34	61.8 (57.5-66.1)	67.1 (64.1-70.1)
South Dakota	71.8 (68.8-74.9)	4	70.3 (65.5-75.0)	73.4 (69.6-77.3)
Tennessee	68.6 (65.7-71.5)	11	68.6 (63.4-73.8)	68.8 (65.4-72.1)
Texas	58.0 (55.1-61.0)	50	58.6 (54.0-63.3)	57.7 (54.2-61.2)

Utah	66.8 (63.5-70.1)	23	66.1 (61.1-71.1)	67.5 (63.2-71.7)
Vermont	69.8 (66.0-73.6)	9	67.6 (61.3-74.0)	72.2 (68.3-76.1)
Virginia	67.2 (63.5-70.8)	22	66.1 (60.9-71.3)	68.4 (63.6-73.1)
Washington	68.0 (65.9-70.1)	17	66.8 (63.5-70.1)	69.2 (66.7-71.8)
West Virginia	67.2 (64.3-70.1)	21	66.5 (62.0-71.0)	67.8 (64.1-71.6)
Wisconsin	68.4 (64.2-72.6)	14	67.0 (60.8-73.2)	69.6 (63.9-75.3)
Wyoming	59.4 (55.9-62.9)	46	58.4 (53.1-63.7)	60.6 (56.3-65.0)
Guam	48.0 (40.9-55.1)	54	45.0 (35.2-54.9)	52.5 (42.6-62.5)
Puerto Rico	61.0 (57.7-64.2)	42	64.0 (59.0-69.0)	58.3 (54.0-62.5)
Virgin Islands	48.1 (43.3-52.9)	53	46.0 (36.7-55.3)	49.7 (44.5-54.8)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Data are in the form % (95% Confidence Interval)

Table 6– State level prevalence of Diabetes Education overall and by sex, 2000-2010

	DE overall	Overall Rank	DE Male	DE Female
Alabama	58.2 (55.3-61.1)	26	56.3 (51.3-61.3)	59.6 (56.3-62.8)
Alaska	57.2 (51.5-63.0)	30	55.4 (46.7-64.1)	58.9 (51.3-66.5)
Arizona	55.6 (51.0-60.2)	36	52.3 (44.8-59.8)	58.5 (53.1-63.8)
Arkansas	45.8 (42.2-49.3)	50	42.4 (37.0-47.9)	48.7 (44.0-53.3)
California	57.6 (54.0-61.3)	28	56.9 (51.6-62.3)	58.3 (53.6-63.1)
Colorado	62.1 (57.9-66.3)	13	58.4 (52.4-64.5)	66.1 (60.6-71.5)
Connecticut	51.8 (48.4-55.2)	44	49.4 (44.0-54.9)	54.1 (49.8-58.4)
Delaware	46.6 (42.7-50.5)	48	41.4 (35.4-47.4)	51.9 (47.0-56.8)
District of Columbia	65.5 (60.7-70.3)	7	67.7 (59.8-75.7)	63.7 (57.9-69.6)
Florida	54.1 (50.9-57.3)	41	53.6 (48.7-58.6)	54.6 (50.8-58.3)
Georgia	60.1 (57.2-63.0)	19	59.9 (55.2-64.6)	60.2 (56.8-63.5)
Hawaii	54.8 (50.5-59.1)	39	52.2 (45.3-59.1)	57.7 (52.8-62.6)
Idaho	61.9 (58.8-65.1)	15	58.9 (53.6-64.1)	64.8 (61.3-68.4)
Illinois	63.5 (57.2-69.9)	9	64.1 (55.5-72.8)	63.1 (54.1-72.0)

Indiana	61.9 (58.7-65.0)	14	59.1 (53.7-64.7)	64.3 (61.0-67.7)
Iowa	67.1 (63.8-70.3)	4	65.2 (60.7-69.7)	68.9 (64.2-73.7)
Kansas	61.5 (56.6-66.3)	16	60.6 (52.9-68.4)	62.1 (56.1-68.2)
Kentucky	53.0 (50.2-55.7)	42	53.3 (49.1-57.5)	52.6 (49.0-56.2)
Louisiana	60.2 (57.2-63.2)	18	59.4 (54.4-64.4)	61.0 (57.7-64.3)
Maine	61.3 (57.4-65.3)	17	60.9 (55.0-66.7)	61.8 (56.7-66.9)
Maryland	54.2 (47.4-61.0)	40	50.5 (39.7-61.3)	58.1 (50.1-66.0)
Massachusetts	52.1 (48.4-55.8)	43	50.1 (44.6-55.5)	54.2 (49.3-59.2)
Michigan	56.6 (51.9-61.2)	34	54.5 (47.7-61.3)	58.9 (52.7-65.1)
Minnesota	77.2 (74.1-80.3)	1	76.6 (72.2-81.0)	77.9 (73.6-82.2)
Mississippi	47.0 (43.6-50.4)	46	48.1 (42.5-53.7)	46.2 (42.1-50.4)
Missouri	58.6 (54.4-62.8)	24	57.9 (51.3-64.4)	59.4 (54.4-64.3)
Montana	63.3 (59.9-66.7)	12	63.7 (58.4-69.0)	63.3 (58.9-67.6)
Nebraska	64.5 (58.7-70.3)	8	64.9 (56.0-73.8)	63.8 (56.6-71.1)
Nevada	55.6 (51.2-60.1)	35	49.4 (43.0-55.8)	61.3 (55.4-67.2)
New Hampshire	66.6 (63.4-69.7)	5	66.6 (62.4-70.9)	66.3 (61.9-70.8)

New Jersey	44.5 (41.1-47.8)	51	45.2 (40.2-50.2)	43.6 (39.4-47.8)
New Mexico	59.8 (57.0-62.6)	20	59.8 (55.6-64.0)	59.9 (56.2-63.6)
New York	46.2 (41.8-50.6)	49	45.0 (38.4-51.6)	47.6 (41.7-53.5)
North Carolina	59.3 (57.0-61.7)	21	58.1 (54.6-61.6)	60.4 (57.1-63.6)
North Dakota	59.0 (54.7-63.2)	23	54.9 (48.6-61.2)	63.4 (57.9-68.9)
Ohio	55.6 (52.0-59.2)	37	53.63 (48.2-59.0)	57.5 (52.9-62.1)
Oklahoma	59.23 (56.3-62.1)	22	58.1 (53.3-63.0)	60.2 (56.6-63.7)
Oregon	69.8 (64.0-75.6)	2	63.3 (54.4-72.2)	77.1 (71.4-82.7)
Pennsylvania	57.0 (53.9-60.2)	31	54.2 (49.4-59.1)	60.1 (56.3-63.8)
Rhode Island	47.0 (40.9-53.0)	47	44.2 (35.5-52.9)	50.0 (41.9-58.1)
South Carolina	58.4 (55.8-61.0)	25	56.7 (52.5-61.0)	59.9 (56.9-63.0)
South Dakota	68.0 (65.0-71.0)	3	65.2 (60.5-69.9)	70.1 (67.3-74.7)
Tennessee	56.7 (53.6-59.6)	32	58.2 (52.7-63.7)	55.6 (52.1-59.2)
Texas	56.6 (53.6-59.6)	33	54.6 (50.0-59.3)	58.7 (55.2-62.2)
Utah	63.4 (60.1-66.8)	11	64.7 (60.1-69.2)	62.4 (57.5-67.2)
Vermont	54.8 (51.3-58.4)	38	58.7 (53.5-63.9)	51.0 (46.7-55.3)

Virginia	57.8 (53.7-61.8)	27	59.4 (54.5-64.2)	56.2 (49.7-62.6)
Washington	65.9 (63.8-67.0)	6	63.5 (60.2-66.8)	68.2 (65.7-70.7)
West Virginia	48.9 (46.0-51.9)	45	47.7 (43.2-52.3)	50.2 (46.3-54.1)
Wisconsin	63.5 (59.4-68.6)	10	58.0 (51.5-64.5)	68.8 (64.0-73.7)
Wyoming	57.5 (54.1-61.0)	29	54.4 (49.1-59.6)	61.0 (56.7-65.4)
Guam	44.2 (36.9-51.4)	52	37.1 (27.6-46.6)	52.8 (43.4-62.1)
Puerto Rico	36.6 (33.3-39.9)	53	37.2 (32.1-42.4)	36.1 (32.0-40.2)
Virgin Islands	35.1 (30.5-39.6)	54	32.0 (23.6-40.5)	37.1 (32.1-42.2)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Data are in the form % (95% Confidence Interval)
DE stands for diabetes education

Table 7 – State Level Prevalence of Self-Monitoring of Blood Glucose among Persons with Diabetes, overall and by sex, 2000-2010

	SMBG	Overall Rank	SMBG Male	SMBG Female
Alabama	65.7 (62.9-68.4)	9	62.2 (57.4-67.0)	68.7 (65.6-71.7)
Alaska	59.0 (53.2-64.9)	42	50.0 (41.2-58.9)	66.0 (58.9-73.0)
Arizona	61.5 (57.0-66.0)	32	59.6 (52.3-67.0)	63.4 (58.1-68.7)
Arkansas	59.1 (55.6-62.7)	41	56.3 (50.8-61.8)	61.7 (57.1-66.4)
California	51.0 (47.3-54.8)	51	46.0 (40.6-51.4)	56.6 (51.9-61.4)
Colorado	61.0 (56.9-65.0)	35	56.8 (50.7-62.8)	66.0 (60.8-71.1)
Connecticut	60.3 (56.9-63.7)	38	57.0 (51.6-62.5)	63.7 (59.5-67.9)
Delaware	62.8 (59.1-66.6)	24	60.6 (54.5-66.7)	65.2 (60.7-69.7)
District of Columbia	64.6 (59.5-69.8)	15	67.0 (58.7-75.4)	62.8 (56.4-69.3)
Florida	61.1 (58.1-64.2)	34	60.3 (55.6-65.0)	62.1 (58.4-65.8)
Georgia	63.0 (60.2-65.9)	23	62.5 (58.1-67.0)	63.3 (59.9-66.7)
Hawaii	52.8 (48.5-57.1)	50	56.5 (50.3-62.7)	48.6 (43.6-53.6)
Idaho	58.6 (55.5-61.6)	44	55.8 (50.7-61.0)	61.5 (57.9-65.1)

Illinois	66.4 (60.6-72.2)	6	59.6 (54.2-65.1)	72.7 (65.7-79.6
Indiana	63.2 (60.0-66.4)	21	59.6 (54.2-65.1)	66.7 (63.5-69.9)
Iowa	67.2 (64.2-70.2)	4	64.8 (60.4-69.3)	69.6 (65.7-73.6)
Kansas	55.1 (50.1-60.1)	49	55.1 (46.9-63.4)	55.4 (49.2-61.5)
Kentucky	67.3 (64.8-69.9)	3	66.0 (62.1-69.8)	68.6 (65.3-72.0)
Louisiana	64.7 (61.8-67.7)	13	61.8 (56.9-66.8)	67.4 (64.2-70.5)
Maine	59.0 (55.0-63.1)	43	57.7 (51.7-63.7)	60.7 (55.7-65.8)
Maryland	65.0 (59.2-70.8)	12	62.7 (53.6-71.7)	67.4 (60.3-74.5)
Massachusetts	64.1 (60.9-67.4)	16	62.6 (57.7-67.5)	65.8 (61.6-70.0)
Michigan	62.8 (58.4-67.1)	25	63.6 (57.4-69.7)	61.8 (55.8-67.9)
Minnesota	68.5 (65.2-71.9)	2	64.3 (59.2-69.4)	73.4 (69.3-77.4)
Mississippi	65.0 (61.8-68.3)	11	64.8 (59.8-69.9)	65.4 (61.2-69.5)
Missouri	62.4 (58.2-66.7)	26	58.8 (52.3-65.4)	66.3 (61.6-71.1)
Montana	64.1 (60.6-67.5)	17	65.5 (60.2-70.8)	63.4 (59.0-67.8)
Nebraska	64.7 (59.0-70.4)	14	67.6 (59.5-75.6)	61.5 (53.7-69.2)
Nevada	58.4 (54.0-62.9)	45	55.1 (48.6-61.6)	62.0 (55.9-68.0)

New Hampshire	66.2 (63.1-69.2)	7	64.9 (60.7-69.1)	67.4 (63.0-71.8)
New Jersey	63.7 (60.2-67.1)	20	62.9 (57.6-68.3)	64.3 (60.4-68.3)
New Mexico	65.8 (63.2-68.5)	8	62.4 (58.2-66.5)	69.2 (65.8-72.5)
New York	60.0 (55.5-64.4)	40	55.8 (49.1-62.5)	64.4 (58.8-70.0)
North Carolina	63.2 (60.8-65.5)	22	60.1 (56.6-63.6)	65.8 (62.6-69.1)
North Dakota	61.9 (57.7-66.2)	28	60.6 (54.4-66.8)	63.4 (57.7-69.1)
Ohio	62.3 (58.9-65.8)	27	60.3 (55.1-65.5)	64.4 (60.0-68.8)
Oklahoma	60.2 (57.2-63.0)	39	60.3 (55.5-65.1)	60.6 (57.0-64.2)
Oregon	66.6 (61.2-71.9)	5	67.1 (59.7-74.6)	65.9 (58.4-73.5)
Pennsylvania	60.7 (57.5-63.9)	37	56.2 (51.4-61.1)	65.7 (62.1-69.4)
Rhode Island	57.0 (51.1-63.0)	47	51.2 (42.3-60.0)	63.5 (55.8-71.1)
South Carolina	63.9 (61.3-66.5)	18	58.8 (54.5-63.1)	68.7 (65.8-71.6)
South Dakota	61.6 (58.4-64.8)	31	56.5 (51.6-61.4)	67.3 (63.4-71.2)
Tennessee	74.0 (71.6-76.5)	1	72.9 (68.5-77.3)	75.2 (72.4-78.0)
Texas	56.8 (53.8-59.8)	48	54.2 (49.6-58.9)	59.6 (56.1-63.0)
Utah	61.8 (58.3-65.3)	29	61.4 (56.4-66.5)	62.7 (57.8-67.5)

Vermont	61.7 (58.3-65.1)	30	60.8 (55.5-66.2)	62.7 (58.6-66.9)
Virginia	58.2 (54.1-62.2)	46	60.3 (55.4-65.2)	55.7 (49.7-61.7)
Washington	65.3 (63.2-67.3)	10	63.0 (59.7-66.3)	67.6 (65.2-70.1)
West Virginia	63.8 (61.0-66.7)	19	60.5 (56.1-64.9)	66.8 (63.2-70.5)
Wisconsin	60.8 (56.7-64.8)	36	59.3 (53.2-65.3)	62.4 (57.1-67.8)
Wyoming	61.5 (58.2-64.8)	33	57.6 (52.6-62.7)	65.7 (61.4-69.9)
Guam	38.4 (31.7-45.1)	54	34.3 (25.2-43.5)	44.9 (35.2-54.6)
Puerto Rico	36.9 (33.7-40.1)	53	32.7 (28.0-37.4)	40.8 (36.6-45.0)
Virgin Islands	46.4 (41.7-51.2)	52	41.4 (32.3-50.5)	49.8 (44.6-55.1)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Data are in the form % (95% Confidence Interval)
SMBG stands for self-monitoring of blood glucose

Table 8 – State Level Prevalence of Meeting the Annual Foot Examination Recommendation among Persons with Diabetes, overall and by sex, 2000-2010

	AFA Overall	AFA Overall Rank	AFA Male	AFA Female
Alabama	71.0 (68.4-73.6)	29	70.7 (66.2-75.2)	71.2 (68.2-74.3)
Alaska	72.0 (67.1-76.9)	23	69.2 (60.7-77.8)	73.3 (67.6-79.0)
Arizona	65.1 (60.6-69.5)	42	64.8 (57.7-71.9)	65.2 (59.8-70.7)
Arkansas	55.8 (52.2-59.3)	53	56.6 (51.1-62.1)	55.1 (50.5-59.8)
California	61.0 (57.5-64.6)	52	61.7 (56.4-66.9)	60.2 (55.6-64.8)
Colorado	69.3 (65.4-73.2)	32	68.7 (62.8-74.5)	69.8 (64.7-74.9)
Connecticut	71.0 (67.8-74.2)	28	73.3 (68.5-78.1)	68.8 (64.7-73.0)
Delaware	77.6 (74.7-80.5)	3	80.7 (76.5-84.9)	74.3 (70.4-78.3)
District of Columbia	77.1 (72.6-81.6)	5	75.5 (67.6-83.3)	78.4 (73.2-83.5)
Florida	66.5 (63.4-69.6)	39	67.7 (62.9-72.6)	65.2 (61.5-68.8)
Georgia	69.9 (67.2-72.7)	31	71.5 (67.2-75.7)	68.4 (65.0-71.7)
Hawaii	75.0 (71.2-78.7)	8	75.8 (70.2-81.5)	74.0 (69.4-78.7)
Idaho	64.0 (61.0-67.0)	47	67.4 (62.8-72.0)	61.2 (57.5-64.9)
Illinois	73.3 (67.4-79.3)	18	77.8 (70.3-85.4)	69.3 (60.7-78.0)

Indiana	68.0 (64.9-71.1)	35	68.5 (62.9-74.0)	67.5 (64.2-70.7)
Iowa	71.9 (68.6-75.2)	24	71.7 (67.0-76.3)	72.2 (67.5-76.9)
Kansas	62.8 (57.9-67.7)	49	66.5 (58.7-74.3)	60.1 (54.0-66.2)
Kentucky	64.1 (61.4-66.9)	46	65.4 (61.2-69.6)	62.9 (59.4-66.3)
Louisiana	70.0 (67.2-72.7)	30	69.3 (64.7-74.0)	70.7 (67.6-73.7)
Maine	76.0 (72.5-79.5)	6	78.5 (73.4-83.5)	73.2 (68.5-77.9)
Maryland	73.8 (67.7-79.9)	13	70.7 (60.5-80.9)	77.4 (71.8-83.0)
Massachusetts	74.4 (71.1-77.6)	10	76.6 (71.7-81.4)	72.0 (67.6-76.3)
Michigan	65.7 (61.1-70.2)	41	64.7 (58.1-71.3)	66.8 (60.7-72.9)
Minnesota	80.9 (77.5-84.3)	1	80.9 (75.6-86.1)	81.0 (76.8-85.2)
Mississippi	64.9 (61.6-68.3)	43	65.6 (60.2-71.0)	64.4 (60.1-68.7)
Missouri	71.0 (67.1-75.0)	27	73.7 (67.6-79.7)	67.9 (63.1-72.7)
Montana	73.1 (69.8-76.3)	19	74.6 (69.4-79.8)	71.8 (67.7-75.9)
Nebraska	71.1 (65.4-76.8)	26	72.3 (63.7-80.8)	70.0 (62.5-77.5)
Nevada	61.5 (57.0-65.9)	51	60.1 (53.6-66.5)	62.2 (56.2-68.2)
New Hampshire	80.5 (77.7-83.2)	2	83.2 (79.4-87.0)	77.1 (73.1-81.1)

New Jersey	66.2 (62.6-69.8)	40	67.3 (61.8-72.7)	65.0 (60.8-69.3)
New Mexico	73.7 (71.1-76.2)	15	75.2 (71.5-79.0)	72.2 (68.7-75.7)
New York	73.4 (69.3-77.5)	17	75.7 (69.7-81.7)	71.2 (65.7-76.7)
North Carolina	74.4 (72.1-76.7)	9	78.0 (75.0-80.9)	71.6 (68.3-74.9)
North Dakota	77.6 (73.9-81.2)	4	81.7 (76.9-86.4)	73.0 (67.7-78.4)
Ohio	64.5 (61.0-68.0)	44	63.8 (58.4-69.2)	65.3 (60.8-69.8)
Oklahoma	64.3 (61.4-67.2)	45	63.6 (58.7-69.5)	64.8 (61.3-68.3)
Oregon	74.2 (69.0-79.4)	11	76.5 (69.1-83.9)	71.6 (64.4-78.9)
Pennsylvania	74.1 (71.0-77.1)	12	72.8 (68.0-77.7)	75.5 (72.1-78.9)
Rhode Island	72.4 (66.7-78.1)	21	70.9 (62.4-79.3)	74.2 (66.6-81.7)
South Carolina	72.3 (69.8-74.7)	22	71.4 (67.3-75.5)	73.0 (70.3-75.8)
South Dakota	73.6 (70.7-76.5)	16	73.4 (69.0-77.8)	73.8 (70.1-77.5)
Tennessee	68.6 (65.7-74.6)	34	71.6 (66.5-76.6)	66.2 (62.9-69.5)
Texas	62.5 (59.5-65.5)	50	61.5 (56.8-66.1)	63.8 (60.3-67.3)
Utah	71.1 (67.7-75.6)	25	73.2 (68.3-78.1)	69.1 (64.3-73.8)
Vermont	75.7 (72.7-78.6)	7	78.3 (73.8-82.9)	73.0 (69.2-76.8)

Virginia	67.6 (63.4-71.8)	37	70.6 (65.3-75.8)	64.6 (58.1-71.1)
Washington	72.8 (70.8-74.7)	20	74.2 (71.2-77.3)	71.3 (68.9-73.7)
West Virginia	67.6 (64.8-70.4)	36	68.6 (64.1-73.0)	66.7 (63.1-70.3)
Wisconsin	73.8 (70.0-77.6)	14	75.2 (69.7-80.7)	72.5 (67.3-77.7)
Wyoming	63.0 (59.7-66.4)	48	64.7 (59.7-69.8)	61.2 (56.9-65.6)
Guam	68.9 (61.9-76.0)	33	70.7 (61.4-80.0)	65.4 (55.1-75.6)
Puerto Rico	43.1 (39.9-46.4)	54	43.3 (38.3-48.3)	43.1 (38.9-47.2)
Virgin Islands	66.6 (62.0-71.3)	38	62.2 (53.4-71.1)	69.7 (64.7-74.8)

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Data are in the form % (95% Confidence Interval)
AFA stands for annual foot examination

Table 9 – Change in State Level A1c among Persons with Diabetes from 2000-2005 to 2006-2010 (n=233,361)

	A1C 2000-2005	A1C 2006-2010	Percentage Point Change
Alabama	67.6 (63.5-71.7)	68.2 (64.7-71.7)	0.6
Alaska	63.0 (55.7-70.2)	64.1 (56.2-71.9)	1.1
Arizona	59.4 (52.8-66.0)	55.0 (48.7-61.4)	-4.4
Arkansas	60.4 (56.0-64.8)	61.1 (55.3-66.9)	0.7
California	56.4 (52.0-60.9)	65.2 (58.9-71.5)	8.8
Colorado	66.6 (61.6-71.5)	64.0 (57.8-70.2)	-2.6
Connecticut	68.2 (64.3-72.2)	66.5 (60.9-72.1)	-1.7
Delaware	67.7 (62.2-73.3)	64.1 (59.0-69.2)	-3.6
District of Columbia	55.6 (46.3-65.0)	67.4 (61.7-73.2)	11.8
Florida	56.8 (52.1-61.6)	65.1 (60.8-69.4)	8.3
Georgia	63.2 (59.2-67.2)	67.3 (63.4-71.2)	4.1
Hawaii	82.8 (78.0-87.7)	65.4 (60.2-70.6)	-17.4*
Idaho	56.1 (52.1-60.1)	57.6 (52.6-62.5)	1.5
Illinois	--	67.9 (61.7-74.1)	N/A

Indiana	63.6 (59.7-67.4)	62.7 (57.8-67.5)	-0.9
Iowa	69.3 (64.6-74.1)	70.8 (66.3-75.2)	1.5
Kansas	65.8 (61.0-70.7)	--	N/A
Kentucky	69.9 (66.3-73.4)	67.1 (63.3-70.9)	-2.8
Louisiana	56.9 (52.6-61.3)	60.0 (56.1-64.0)	3.1
Maine	65.3 (60.0-70.7)	67.3 (61.3-73.3)	2.0
Maryland	68.5 (61.8-75.2)	--	N/A
Massachusetts	69.4 (65.2-73.7)	71.5 (66.4-76.6)	2.1
Michigan	57.8 (50.1-65.5)	71.1 (66.1-76.2)	13.3*
Minnesota	71.1 (66.1-76.0)	69.8 (64.3-75.4)	-1.3
Mississippi	61.1 (56.0-66.1)	59.2 (54.6-63.9)	-1.9
Missouri	64.5 (58.9-70.0)	65.0 (58.8-71.1)	0.5
Montana	57.8 (52.6-63.1)	63.2 (58.3-68.1)	5.4
Nebraska	68.2 (62.3-74.0)	--	N/A
Nevada	62.0 (55.6-68.4)	56.0 (50.1-61.9)	-6.0
New Hampshire	74.0 (70.1-77.8)	73.3 (68.0-78.6)	-0.7

New Jersey	65.6 (61.7-69.5)	62.9 (54.9-70.9)	-2.7
New Mexico	57.9 (53.7-62.1)	64.9 (61.0-68.8)	7.0
New York	70.1 (65.8-74.5)	72.2 (62.4-81.9)	2.1
North Carolina	67.6 (64.1-71.0)	65.7 (62.4-69.0)	-1.9
North Dakota	69.3 (62.7-75.9)	61.0 (55.5-66.6)	-8.3
Ohio	63.4 (58.7-68.0)	59.4 (54.1-64.7)	-4.0
Oklahoma	60.2 (56.4-64.0)	62.8 (58.2-67.4)	2.6
Oregon	--	72.4 (67.4-77.3)	N/A
Pennsylvania	68.5 (64.2-72.9)	70.6 (66.2-74.9)	2.1
Rhode Island	68.4 (62.4-74.4)	--	N/A
South Carolina	61.9 (58.4-65.5)	67.1 (63.3-70.9)	5.2
South Dakota	73.3 (69.7-76.9)	69.9 (64.7-75.2)	-3.4
Tennessee	67.2 (63.1-71.3)	69.6 (65.6-73.6)	2.4
Texas	57.7 (54.4-61.0)	58.6 (53.2-64.0)	0.9
Utah	67.6 (62.8-72.3)	66.0 (61.4-70.6)	-1.6
Vermont	69.9 (65.4-74.4)	69.5 (63.0-76.0)	-0.4

Virginia	66.9 (61.5-72.3)	67.2 (62.5-71.9)	0.3
Washington	69.4 (66.2-72.6)	66.4 (63.7-69.1)	-3.0
West Virginia	68.4 (64.3-72.5)	66.1 (62.1-70.1)	-2.3
Wisconsin	68.4 (63.1-73.6)	68.4 (62.0-74.9)	0.0
Wyoming	58.5 (53.7-63.3)	60.3 (55.1-65.4)	1.8
Guam	46.3 (35.2-57.3)	48.9 (39.8-58.0)	2.6
Puerto Rico	57.2 (52.4-62.1)	63.8 (59.4-69.2)	6.6
Virgin Islands	44.4 (37.9-50.9)	50.6 (44.0-57.2)	6.2

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Percentage, 95% confidence interval
-- indicates that no data was collected in the state during the selected time period
* Significant difference at .05 level

Table 10 – Change in State Level Diabetes Education among Persons with Diabetes from 2000-2005 to 2006-2010

	DE 2000-2005	DE 2006-2010	Percentage Point Change
Alabama	56.6 (52.3-60.9)	59.6 (55.8-63.4)	3.0
Alaska	57.7 (50.4-65.1)	56.8 (48.4-65.1)	-0.9
Arizona	57.3 (51.0-63.5)	54.1 (47.7-60.5)	-3.2
Arkansas	43.6 (39.2-48.0)	50.6 (44.5-56.7)	7.0
California	56.9 (52.5-61.2)	60.4 (54.0-66.8)	3.5
Colorado	62.6 (57.3-67.8)	60.9 (54.7-67.1)	-1.7
Connecticut	52.0 (47.8-56.2)	51.5 (45.7-57.2)	-0.5
Delaware	46.4 (40.7-52.1)	46.5 (41.2-51.8)	0.1
District of Columbia	67.3 (60.1-74.5)	64.5 (58.4-70.6)	-2.8
Florida	52.7 (47.8-57.6)	55.3 (51.1-59.4)	2.6
Georgia	60.6 (56.8-64.4)	59.6 (55.4-63.8)	-0.1
Hawaii	58.3 (51.4-65.1)	52.2 (47.0-57.5)	-6.1
Idaho	62.4 (58.6-66.2)	61.0 (56.0-66.1)	-1.4
Illinois	--	63.5 (57.2-69.9)	N/A

Indiana	61.9 (58.2-65.6)	61.7 (56.8-66.7)	-0.2
Iowa	68.9 (64.7-73.1)	65.0 (60.0-69.9)	-3.9
Kansas	61.5 (56.6-66.3)	--	N/A
Kentucky	50.9 (46.8-55.0)	54.6 (50.8-58.3)	3.7
Louisiana	60.6 (56.4-64.9)	59.5 (55.4-63.6)	-1.1
Maine	61.1 (55.9-66.3)	61.6 (55.7-67.6)	0.5
Maryland	54.2 (47.4-61.0)	--	N/A
Massachusetts	51.2 (46.4-56.0)	53.3 (47.5-59.2)	2.1
Michigan	53.9 (46.2-61.6)	58.4 (52.7-64.2)	4.5
Minnesota	73.3 (68.4-78.1)	81.0 (77.3-84.7)	7.7
Mississippi	48.0 (42.9-53.1)	46.3 (41.7-50.9)	-1.7
Missouri	57.0 (51.4-62.5)	60.1 (53.7-66.6)	3.1
Montana	61.9 (56.7-67.0)	64.7 (60.3-69.1)	2.8
Nebraska	64.5 (58.7-70.3)	--	N/A
Nevada	56.7 (50.1-63.2)	54.8 (48.9-60.8)	-1.9
New Hampshire	63.9 (59.7-68.1)	69.2 (64.7-73.7)	5.3

New Jersey	43.7 (40.0-47.5)	47.0 (39.4-54.5)	3.3
New Mexico	59.4 (55.3-63.4)	60.1 (56.3-64.0)	0.7
New York	46.2 (41.4-51.0)	45.7 (34.7-56.7)	-0.50%
North Carolina	62.2 (59.0-65.3)	57.4 (54.1-60.6)	-4.8
North Dakota	59.1 (52.6-65.5)	58.8 (53.2-64.3)	-0.3
Ohio	58.0 (53.3-62.7)	51.7 (46.4-56.9)	-6.3
Oklahoma	59.1 (55.4-62.8)	59.4 (54.8-64.1)	0.3
Oregon	--	69.8 (64.0-75.6)	N/A
Pennsylvania	54.1 (49.5-58.6)	59.3 (54.9-63.6)	5.2
Rhode Island	47.0 (40.9-53.0)	--	N/A
South Carolina	55.2 (51.7-58.8)	61.5 (57.9-65.1)	6.3
South Dakota	69.2 (65.8-72.7)	66.3 (61.0-71.5)	-2.9
Tennessee	56.9 (52.6-61.3)	56.5 (52.2-60.7)	-0.4
Texas	56.2 (53.0-59.5)	57.1 (51.6-62.6)	0.9
Utah	63.1 (57.9-68.3)	63.7 (59.4-68.1)	0.6
Vermont	53.4 (49.0-57.9)	56.1 (50.5-61.7)	2.7

Virginia	54.2 (47.9-60.5)	61.6 (57.1-66.0)	7.4
Washington	65.4 (62.2-68.5)	66.4 (63.8-69.0)	1.0
West Virginia	49.8 (45.5-54.1)	48.3 (44.2-52.4)	-1.5
Wisconsin	67.0 (61.8-72.2)	60.3 (54.0-66.5)	-6.7
Wyoming	53.9 (49.1-58.8)	61.0 (56.2-65.7)	7.1
Guam	50.2 (38.7-61.6)	41.3 (32.1-50.6)	-8.9
Puerto Rico	34.0 (29.4-38.6)	38.6 (34.1-43.1)	4.6
Virgin Islands	38.9 (32.3-45.5)	32.3 (26.3-38.3)	-6.6

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Percentage, 95% confidence interval
-- indicates that no data was collected in the state during the selected time period
DE stands for diabetes education

Table 11: Change in State Level Self-Monitoring of Blood Glucose from 2000-2005 to 2006-2010 among Persons with Diabetes

	SMBG 2000-2005	SMBG 2006-2010	Changes
Alabama	61.5 (57.3-65.7)	69.3 (65.7-72.8)	7.8*
Alaska	54.9 (47.2-62.6)	62.2 (53.8-70.6)	7.3
Arizona	63.7 (57.6-69.7)	59.7 (53.4-66.1)	-4.0
Arkansas	59.4 (55.0-63.8)	58.7 (52.6-64.7)	-0.7
California	49.7 (45.3-54.1)	54.6 (47.8-61.3)	4.9
Colorado	60.3 (55.1-65.4)	62.6 (56.6-68.7)	2.3
Connecticut	60.3 (56.2-64.4)	60.4 (54.8-66.1)	0.1
Delaware	63.8 (58.2-69.3)	61.9 (56.7-67.1)	-1.9
District of Columbia	59.1 (49.7-68.6)	67.6 (61.5-73.7)	8.5
Florida	58.5 (53.7-63.3)	63.3 (59.4-67.3)	4.8
Georgia	59.9 (56.0-63.8)	65.4 (61.4-69.5)	5.5
Hawaii	50.5 (43.2-57.8)	54.5 (49.3-59.6)	4.0
Idaho	57.7 (53.8-61.7)	59.6 (54.8-64.3)	1.9
Illinois	--	66.4 (60.6-72.2)	N/A

Indiana	60.7 (56.9-64.4)	65.2 (60.2-70.2)	4.5
Iowa	65.9 (61.6-70.1)	68.6 (64.4-72.8)	2.7
Kansas	55.1 (50.1-60.1)	--	N/A
Kentucky	63.6 (59.9-67.4)	70.2 (66.7-73.7)	6.6
Louisiana	61.6 (57.3-66.0)	67.7 (63.8-71.6)	6.1
Maine	59.6 (54.3-65.0)	57.9 (52.0-63.9)	-1.7
Maryland	65.0 (59.2-70.8)	--	N/A
Massachusetts	64.1 (60.1-68.1)	64.5 (59.1-69.8)	0.4
Michigan	53.7 (46.1-61.3)	69.0 (63.9-74.1)	15.3*
Minnesota	70.5 (65.8-75.3)	66.6 (61.8-71.3)	-3.9
Mississippi	58.6 (53.6-63.6)	69.5 (65.3-73.6)	10.9*
Missouri	57.9 (52.3-63.6)	66.8 (60.5-73.2)	8.9
Montana	66.4 (61.5-71.4)	61.8 (56.9-66.6)	-4.6
Nebraska	64.7 (59.0-70.4)	--	N/A
Nevada	64.6 (58.6-70.5)	54.2 (48.3-60.2)	-10.4
New Hampshire	63.1 (58.9-67.3)	69.2 (64.8-73.6)	6.1

New Jersey	63.0 (59.4-66.6)	65.0 (56.3-73.7)	2.0
New Mexico	62.1 (58.0-66.2)	68.9 (65.5-72.2)	6.7
New York	57.4 (52.6-62.3)	75.4 (66.9-83.8)	18.0*
North Carolina	61.3 (57.8-64.7)	64.6 (61.3-67.8)	3.3
North Dakota	63.3 (56.9-69.7)	60.9 (55.3-66.5)	-2.4
Ohio	62.2 (57.6-66.8)	62.5 (57.4-67.6)	0.3
Oklahoma	59.3 (55.5-63.0)	61.6 (56.9-66.2)	2.3
Oregon	--	66.6 (61.2-71.9)	N/A
Pennsylvania	58.1 (53.6-62.5)	62.8 (58.3-67.2)	4.7
Rhode Island	57.0 (51.1-63.0)	--	N/A
South Carolina	61.4 (58.0-64.9)	66.3 (62.5-70.1)	4.9
South Dakota	61.8 (57.7-65.8)	61.4 56.2-66.6)	-0.4
Tennessee	69.3 (65.3-73.3)	77.4 (74.4-80.4)	8.1*
Texas	54.1 (50.8-57.4)	60.5 (55.0-66.1)	6.4
Utah	62.6 (57.3-67.9)	61.0 (56.3-65.6)	-1.6
Vermont	56.8 (52.2-61.4)	67.5 (63.0-72.1)	10.7*

Virginia	55.0 (48.8-61.3)	61.3 (56.6-66.0)	6.3
Washington	64.7 (61.5-67.9)	65.9 (63.3-69.4)	1.2
West Virginia	59.8 (55.6-64.1)	67.3 (63.5-71.0)	7.5
Wisconsin	56.9 (51.3-62.4)	64.4 (58.8-70.0)	7.5
Wyoming	59.8 (55.0-64.5)	63.1 (58.5-67.8)	3.3
Guam	38.6 (27.7-49.4)	38.9 (30.4-47.3)	0.3
Puerto Rico	25.1 (21.2-28.9)	45.8 (41.3-60.3)	20.7*
Virgin Islands	41.3 (34.6-48.0)	50.5 (43.9-57.1)	9.2

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Percentage, 95% confidence interval
-- indicates that no data was collected in the state during the selected time period
SMBG stands for self-monitoring of blood glucose

Table 12: Change in State Level Annual Foot Examinations among Persons with Diabetes from 2000-2005 to 2006-2010

	AFA 2000-2005	AFA 2006-2010	Changes
Alabama	69.7 (65.8-73.6)	72.1 (68.6-75.5)	2.4
Alaska	71.3 (65.0-77.5)	72.6 (65.4-79.8)	1.3
Arizona	67.4 (61.7-73.2)	62.9 (56.6-69.3)	-4.5
Arkansas	54.4 (50.0-58.8)	58.7 (52.7-64.7)	4.3
California	59.6 (55.3-63.9)	65.5 (59.3-71.6)	5.9
Colorado	68.3 (63.4-73.3)	71.7 (66.0-77.4)	3.4
Connecticut	70.2 (66.4-74.1)	72.0 (66.6-77.3)	1.8
Delaware	78.2 (74.0-82.4)	77.1 (73.1-81.1)	-1.1
District of Columbia	77.3 (70.3-84.4)	77.0 (71.3-82.8)	-0.3
Florida	63.0 (58.1-67.9)	69.5 (65.7-73.3)	6.5
Georgia	69.1 (65.3-73.0)	70.5 (66.7-74.4)	1.4
Hawaii	79.1 (73.4-84.7)	72.0 (67.2-76.8)	-7.1
Idaho	60.0 (56.1-63.9)	68.5 (64.1-73.0)	8.5*
Illinois	--	73.3 (67.4-79.3)	N/A

Indiana	67.7 (64.2-71.3)	68.0 (63.1-73.0)	0.3
Iowa	69.3 (64.5-74.2)	74.6 (70.3-78.8)	5.3
Kansas	62.8 (57.9-67.7)	--	N/A
Kentucky	61.9 (57.8-65.9)	65.8 (62.1-69.5)	3.9
Louisiana	69.5 (65.4-73.5)	70.3 (66.6-73.9)	0.8
Maine	77.3 (73.0-81.7)	73.6 (67.9-79.2)	-3.7
Maryland	73.8 (67.7-79.9)	--	N/A
Massachusetts	75.1 (71.3-78.9)	73.5 (67.9-79.1)	-1.6
Michigan	56.6 (49.0-64.2)	72.1 (67.1-77.1)	15.5*
Minnesota	81.6 (77.4-85.7)	80.2 (74.8-85.5)	-1.4
Mississippi	68.1 (63.4-72.8)	62.6 (57.9-67.2)	-5.5
Missouri	69.6 (64.3-75.0)	72.4 (66.5-78.2)	2.8
Montana	75.0 (70.4-79.6)	71.3 (66.7-75.9)	-3.7
Nebraska	71.1 (65.4-76.8)	--	N/A
Nevada	70.9 (65.1-76.7)	55.1 (49.2-60.9)	-15.8*
New Hampshire	78.3 (74.5-82.1)	82.6 (78.6-86.6)	4.3

New Jersey	66.3 (62.5-70.2)	65.6 (57.2-73.9)	-0.7
New Mexico	73.9 (70.3-77.4)	73.5 (69.9-77.6)	-0.4
New York	72.2 (67.7-76.7)	81.3 (73.0-89.7)	9.1
North Carolina	76.3 (73.4-79.3)	73.1 (69.8-76.3)	-3.2
North Dakota	79.5 (74.6-84.3)	75.9 (70.7-81.2)	-3.6
Ohio	64.7 (60.0-69.3)	64.4 (59.0-69.7)	-0.3
Oklahoma	65.4 (61.7-69.1)	62.4 (57.7-67.1)	-3.0
Oregon	--	74.2 (69.0-79.4)	N/A
Pennsylvania	79.1 (75.7-82.5)	70.2 (65.8-74.6)	-8.9*
Rhode Island	72.4 (66.7-78.1)	--	N/A
South Carolina	71.9 (68.6-75.2)	72.6 (69.1-76.2)	0.7
South Dakota	72.1 (68.5-75.8)	75.7 (70.9-80.4)	3.6
Tennessee	66.0 (61.7-70.3)	70.4 (66.7-74.1)	4.4
Texas	62.0 (58.7-65.2)	63.2 (57.7-68.8)	1.2
Utah	71.7 (66.5-76.8)	70.5 (66.0-75.0)	-1.2
Vermont	70.4 (66.2-74.6)	81.4 (77.5-85.4)	11.0*

Virginia	65.4 (58.8-72.0)	69.8 (65.2-74.4)	4.4
Washington	73.2 (70.3-76.1)	72.3 (69.8-74.8)	-0.9
West Virginia	65.1 (60.9-69.4)	69.7 (65.9-73.5)	4.6
Wisconsin	72.0 (66.8-77.1)	75.4 (69.9-80.9)	3.4
Wyoming	62.9 (58.1-67.6)	63.1 (58.2-67.9)	0.2
Guam	70.1 (59.3-80.8)	68.6 (59.5-77.7)	-1.5
Puerto Rico	45.9 (41.2-50.7)	41.1 (36.8-45.5)	-4.8
Virgin Islands	66.0 (59.6-72.4)	67.4 (61.0-73.8)	1.4

Data from 2000-2010 Behavioral Risk Factor Surveillance System
Percentage, 95% confidence interval
-- indicates that no data was collected in the state during the selected time period
AFA stands for annual foot examination

Table 13: Bivariate Associations Between Change in State Level Diabetes Care Behaviors and Predictors among Persons with Diabetes

(N = 44)

	A1C	AFA	SMBG	DE	GDP	female	Medicaid	black	Hispanic	college	region
A1C	1.000	**0.501**	**0.376**	**0.435**	-0.164	0.026	*0.269*	0.234	0.166	-0.129	-0.122
		(<.001)	**(0.012)**	**(0.003)**	(0.287)	(0.865)	*(0.078)*	(0.126)	(0.283)	(0.402)	(0.430)
AFA		1.000	**0.634**	0.203	-0.069	0.046	0.211	0.059	-0.091	-0.101	-0.156
			(<.001)	(0.186)	(0.654)	(0.767)	(0.169)	(0.701)	(0.555)	(0.516)	(0.311)
SMBG			1.000	0.078	-0.148	**0.418**	**0.381**	**0.394**	-0.079	-0.248	**-0.314**
				(0.613)	(0.336)	**(0.005)**	**(0.011)**	**(0.008)**	(0.612)	(0.105)	**(0.038)**
DE				1.000	-0.004	-0.179	-0.067	0.077	-0.057	0.078	-0.240
					(0.979)	(0.245)	(0.667)	(0.619)	(0.713)	(0.616)	(0.117)
GDP					1.000	**-0.384**	-0.156	-0.056	0.196	**0.618**	0.004
						(0.010)	(0.311)	(0.720)	(0.203)	**(<.001)**	(0.981)
female						1.000	**0.366**	0.551	-0.244	**-0.543**	-0.190
							(0.015)	**(<.001)**	(0.110)	**(<.001)**	(0.217)
Medicaid							1.000	*0.281*	0.149	**-0.282**	*-0.281*
								(0.065)	(0.334)	**(0.064)**	*(0.065)*
black								1.000	-0.157	-0.177	**-0.429**
									(0.308)	(0.249)	**(0.004)**
Hispanic									1.000	**0.333**	**0.312**
										(0.027)	**(0.039)**
college						-				1.000	0.059
											(0.706)
region											1.00000

Data on diabetes care behaviors, proportion female, and proportion college educated from 2000-2010 Behavioral Risk Factor Surveillance System

Data on GDP per capita from 2005 U.S. Department of Commerce Bureau of Economic Analysis

Data on Medicaid from 2009 Kaiser State Health Facts data

Data on proportion Black and Hispanic from 2005 US Census Bureau Population Estimates

Data on region from US Census Bureau

AFA stands for annual foot examination, SMBG stands for self-monitoring of blood glucose, DE stands for diabetes education, GDP stands for gross domestic product

p-values in parentheses

Bold indicates $p<.05$, italics indicates $p<.10$

Table 14: Summary of Full Multiple Linear Regression Models for Diabetes Care Behaviors (n=44)

	HbA1c	Diabetes Education	SMBG	AFA
Intercept	0.437	0.420*	-0.296	-0.081
	(0.149)	(0.077)	(0.328)	(0.816)
Proportion GDP	0.000	0.000	0.000	0.000
	(0.305)	(0.610)	(0.890)	(0.742)
Proportion Female	-0.776	-0.734	0.647	-0.066
	(0.150)	(0.832)	(0.233)	(0.916)
Proportion Medicaid	0.145	-0.075	0.160	0.306
	(0.414)	(0.588)	(0.372)	(0.145)
Proportion Black	0.223*	0.063	0.177	-0.081
	(0.088)	(0.530)	(0.176)	(0.589)
Proportion Hispanic	0.110	-0.024	0.051	-0.024
	(0.241)	(0.745)	(0.590)	(0.824)
Proportion College	-0.257	-0.113	-0.157	0.290
Educated	(0.447)	(0.666)	(0.643)	(0.463)
East region	0.009	0.020	0.033	0.017
	(0.733)	(0.325)	(0.208)	(0.570)
South region	-0.012	0.014	-0.013	0.040
	(0.708)	(0.570)	(0.689)	(0.279)
Midwest region	0.000	-0.015	0.016	(0.054)
	(0.981)	(0.493)	(0.586)	(0.108)
R^2	0.2241	0.1830	0.3310	0.1379

Data on diabetes care behaviors, proportion female, and proportion college educated from 2000-2010 Behavioral Risk Factor Surveillance System
Data on GDP per capita from 2005 U.S. Department of Commerce Bureau of Economic Analysis
Data on Medicaid from 2009 Kaiser State Health Facts data
Data on proportion Black and Hispanic from 2005 US Census Bureau Population Estimates
Data on region from US Census Bureau
AFA stands for annual foot examination, SMBG stands for self-monitoring of blood glucose, DE stands for diabetes education, GDP stands for gross domestic product
p-values in parentheses
*p-value <.10

Table 15: Summary of Fitted Multiple Linear Regression Models for Diabetes Care Behaviors (n=44)

	SMBG	HbA1c
Intercept	-0.408**	-0.046*
	(0.172)	(0.027)
Proportion Medicaid	0.264*	0.249
	(0.147)	(0.137)*
Proportion Female	0.801*	--
	(0.366)	
R^2	.2344	.0724

Data on SMBG, HbA1c and proportion female from 2000-2010 Behavioral Risk Factor Surveillance System

Data on proportion Medicaid from 2009 Kaiser States Health Facts

Standard errors in parentheses

*p<.10

**p<.05

Figures

Figure 1 – Andersen's Behavioral Model of Health Services Use

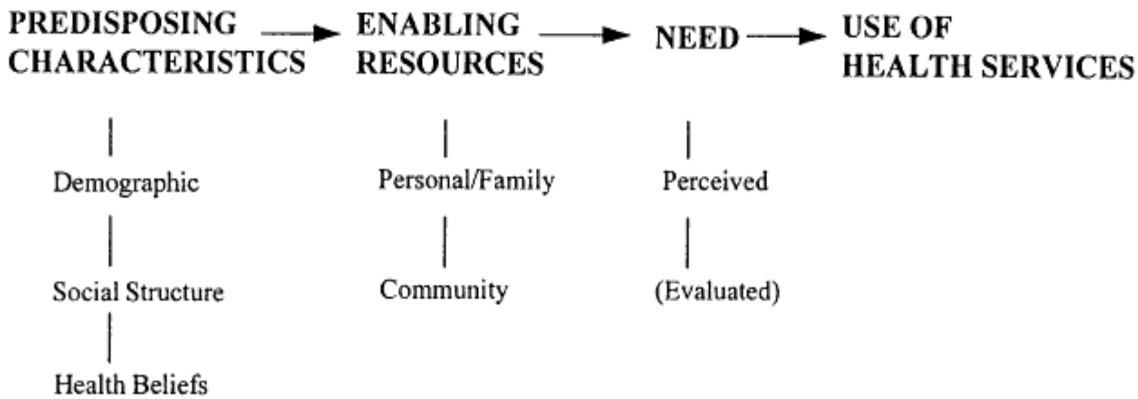
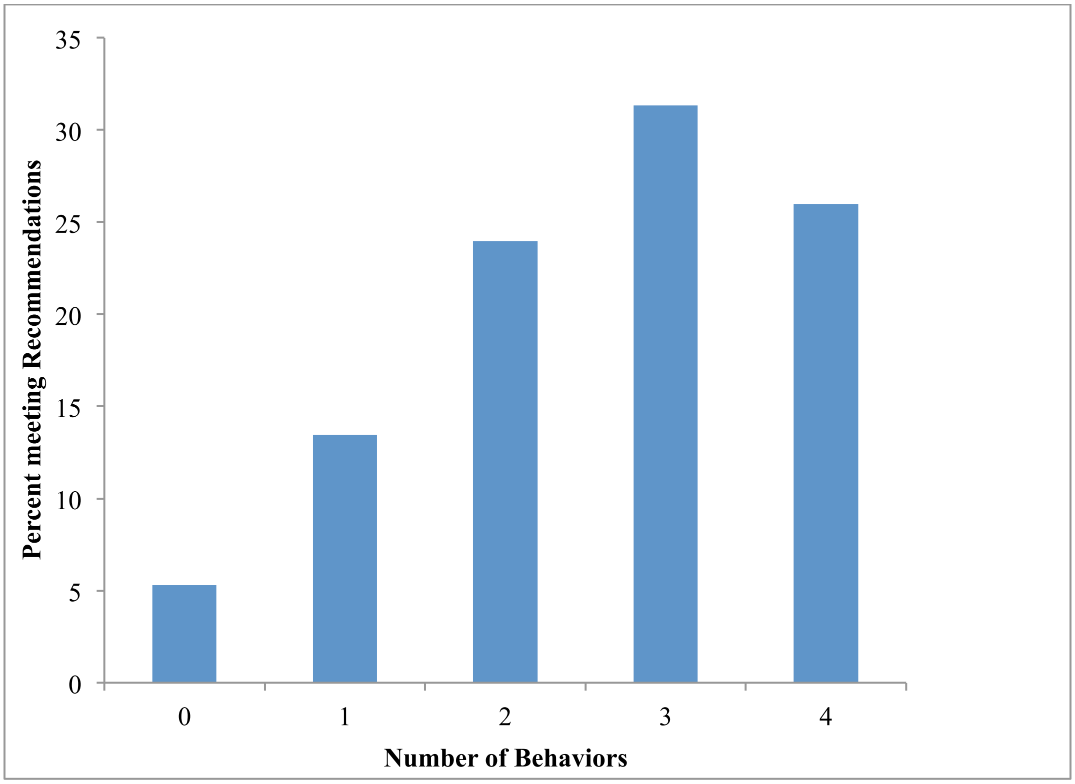


Figure 2 – Distribution of the Proportion Meeting Diabetes Care Behavior Recommendations among Persons with Diabetes



Data from 2000-2010 Behavioral Risk Factor Surveillance System
Behaviors include biannual HbA1c measurements, daily self-monitoring of blood sugar, diabetes education, and annual foot examinations