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Oral, Eye and Foot Complications of Diabetes

Literature Review

Prepared for:

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Executive Summary

For a patient with diabetes, defects in insulin secretion and/or insulin action by the pancreas prevent the conversion of sugars and starches into energy, a condition which results in high levels of blood glucose. The first of two main types of diabetes, Type I diabetes, or insulin-dependent diabetes mellitus (IDDM), is most commonly caused by a malfunction of the immune system (1) and accounts for just 5 to 10% of all diagnosed cases. The remaining 90-95% of all diagnosed cases are caused by Type II diabetes, or non-insulin-dependent diabetes mellitus (NIDDM), whose onset is most commonly associated with older age, obesity, family history, race/ethnicity, and lack of physical activity (1).

The incidence of diabetes is increasing. With roughly 800,000 new cases diagnosed each year, the prevalence of diagnosed diabetes has increased by 33% between 1990 and 1998 (3). Currently, an estimated 15.7 million people, of whom only 65% have been diagnosed, have diabetes. It is also estimated that by 2025 over 20 million people will have diabetes (21).

Accompanying this increased prevalence of diabetes is an increase in the number of associated complications. Diabetes can affect every organ of the body. Poor glycemic control can lead to blindness, lower extremity amputations, and dental disease (6). Diabetes is the leading cause of blindness, and complications related to diabetes account for over half of the lower extremity amputations in the United States. In a synergistic fashion, diabetes and periodontal disease contribute to each other; patients who develop severe periodontitis as a result of their diabetes often struggle to maintain proper glucose control because of tooth loss or oral pain and discomfort.

The burdens of diabetes and its associated complications are not distributed equally. Higher rates of the disease are found in minority populations such as Native Americans, African Americans, and Hispanic/Latinos.

Prevalence of Diabetes (Both Type I and Type II) among Minority Populations

	African American	Hispanic/ Latino	Native American	White
Percentage of diabetes for individuals 20 years and older (1)	10.8%	Mexican Americans, 10.6%	9%	7%
Likelihood of developing diabetes compared to whites of the same age (22)	1.7 times	2-3 times	2.8 times	N/A

Risk factors for the development of diabetes and diabetes complications are well-established (10) and include genetic factors, obesity, social and environmental stressors, duration of diabetes and poor glycemic control (for complications). Knowledge of these risk factors allows both health care

organizations and practitioners to take preventative measures. Suggestions for such interventions and evidence for their effectiveness are found in the published literature, which also provides reasons for the current prevalence and incidence rates of diabetes.

The published literature we reviewed addresses current debates about the systems through which diabetes care is provided, health care providers' knowledge and practice patterns, diabetes patients' knowledge and self-management behaviors, diabetes in minority populations, and the enablers and barriers to seeking and receiving appropriate diabetes care.

Both a multidisciplinary and single component systems approach have been suggested as ways to improve the care provided to diabetes patients. The multidisciplinary approach is a system of services in which all members of the health care team are devoted to maintaining the overall health of the patient with diabetes. Some examples of single component approaches are the use of care algorithms, critical pathways for care, and risk-categorization schemes. These methods of providing care have been shown to increase the number of appropriate referrals and screening exams physicians provide to patients with diabetes, and to improve the health outcomes of patients with diabetes.

Interventions aimed at health care providers have shown that short education classes are effective in educating providers on the current clinical recommendations for appropriate diabetes care and current screening procedures. Because of short appointment times or providers who lack adequate knowledge about the disease, physicians do not always discuss all the relevant issues with their diabetes patients, and thus do not always provide them with adequate care.

Interventions targeting the patient with diabetes seek to change knowledge, attitudes, beliefs, and behaviors. Accordingly, several interventions have focused on promoting self-management behavior, which is an important component in diabetes control.

Despite findings described in the published literature, gaps in our understanding of why diabetes prevalence is increasing, particularly for minority populations, remain. To fill in these gaps, additional research will be necessary.

Besides our review of the literature, we are conducting an environmental scan on oral complications of diabetes. The findings from both these activities will then be used to develop a formative research plan, which will target those who are affected by diabetes, or involved in diabetes care, in order to answer the remaining questions.

I. Introduction

The charge of this project is to evaluate current data on diabetes, its associated complications, and its effects on minority populations. The project will also analyze interventions that target minority populations and interventions that aim at reducing the burden of diabetes complications. Supplementing a review of the literature on this subject, an environmental scan will be conducted to obtain current information on how diabetes and its oral complications are portrayed in the media and how they are dealt with in the political and social environment. Internet and Web sites with relevant listserves will be scanned for information on diabetes and oral health. Potentially competitive or duplicative programs and psycho-social and trend data will also be identified.

Subsequently, information from the literature review and environmental scan will be used to construct a formative research plan that will develop educational messages and message concepts for printed materials and communication products. Channels for disseminating these messages will also be identified, and specific audiences targeted, based upon information provided by the literature review and environmental scan.

The Centers for Disease Control and Prevention's (CDC) Division of Diabetes Translation (DDT) has set a national objective for preventing complications by the timely administering of eye, oral, and foot exams, appropriate immunizations, and HgA1c tests. In concordance with the CDC–DDT request for task order proposal, our literature review will focus on foot, oral, and eye complications, while the escan will focus on oral complications.

Focusing on information about people with diabetes and their health care providers, the review will summarize, document, and evaluate these groups' knowledge, attitudes, and beliefs about diabetes and its potential complications.

II. Framework for Analysis

We began our work on this task by framing the differing levels of analysis. First, we constructed a logic model, which is a graphic depiction of the relationship of inputs and activities of a program to its intended effects, and is based upon the purpose of the project, as specified in the request for task order proposal (in this case, a charge to compile data on interventions and to identify gaps that exist in the literature on the subject). Because the inputs and activities varied depending upon the complication, three separate logic models for foot, oral, and eye complications were created (see Appendix B). The two audiences defined in the model were patients with diabetes and health care providers (either primary care physicians or diabetes specialists). The following inputs facilitate diabetes care and management: screening for diabetes complications, training health care providers to use appropriate methods of screening and detection, creating systems for the provision of care, and providing enablers that create a system in which patients can take action to manage their disease. Without these inputs, the system for diabetes care and prevention would be fragmented and potentially ineffective. Some examples of activities enabled by the inputs are self-management of diabetes, behaviors that help to prevent diabetes complications, and collaboration between primary care providers and health care specialists. Identifying and eliminating barriers to such diabetes-

related activities represents an important step towards changing knowledge, attitudes, and beliefs about the self-management of diabetes and its complications; increasing social and environmental support; enhancing the knowledge of physicians; and improving healthcare practices. Ultimately, mitigating or eliminating those barriers will help to reduce the incidence and prevalence of poor health outcomes due to diabetes and its associated complications, as measured by a decrease in diabetes complications and an increase in appropriate diabetes care.

The logic models provided a specific focus for the type of literature included in our review. Journal articles that revealed the knowledge, attitudes, beliefs, and behaviors of both providers and patients were included in the review. Also included were articles describing interventions aimed at influencing the knowledge, attitudes, beliefs, or behaviors of health care providers or patients.

III. Methods

A computer search was conducted using MEDLINE and PubMed on the National Institute of Medicine's Internet site. The Division of Diabetes Translation provided a few articles for inclusion in the review. The term "diabetes mellitus" was used in combination with key words such as "foot," "oral" and "eye complications," and derivations of those terms (e.g. "pedal" and "periodontal"). Other terms used in the search were "Latino," "Hispanic," "Native American," "African American," "Black," and "minority population." Articles dated after 1990 were included in the review. Also included were articles that described or evaluated interventions. National as well as international articles were included, but limited to those published in English. International articles were used to provide further evidence of the gaps that exist between provision of diabetes care and receipt of care, and of the effectiveness of interventions aimed at health care systems, health care professionals, or patients with diabetes. While the populations from the international articles are not compared to the populations of the national article, many international articles make references to United States data and research as support for their findings.

A total of 160 articles were initially identified and 78 included for review in the annotated bibliography and this literature review. Additional sources were added by bringing findings of references from the environmental scan into the review. Overall, a total of 116 articles are referenced in the review.

IV. Background[1,2,3]

Diabetes is a disease in which defects in insulin secretion and/or insulin action by the pancreas prevent the body from converting sugars and starches into energy, a condition which results in high levels of blood glucose. Two main types of diabetes exist, type I and type II.[4]

Type I diabetes, insulin-dependent diabetes mellitus (IDDM), accounts for only 5-10% of all diagnosed cases and is most commonly caused by a malfunction of the immune system (1). In patients with type I diabetes, the immune system attacks and destroys the insulin-producing cells within the pancreas. As a result, the pancreas stops producing insulin (22). Onset of type I diabetes is often linked to genetic factors and usually occurs during puberty, around the ages of 12-14 years. Type I diabetes usually develops over a short period of time; however, cell destruction is sometimes initiated years earlier (1,22). Acute symptoms such as diabetic ketoacidosis, a severe metabolic disorder which occurs in the absence of insulin and can lead to coma and death, occur more often among type I patients than among type II patients (23). Treatment for type I diabetes usually consists of daily insulin injections, along with nutrition and exercise (22).

Type II diabetes, non-insulin-dependent diabetes mellitus (NIDDM), accounts for 90-95% of all diagnosed cases. Its onset is most commonly associated with older age, obesity,[5] family history, race/ethnicity, and lack of physical activity (1); onset usually occurs after the age of 45 years, but current trends indicate that the average age of onset of type II diabetes is decreasing (2,3). For patients with type II diabetes, the body is unable to use insulin effectively and ceases to produce insulin. Because symptoms usually develop gradually, no sudden onset occurs, as it does in patients with type I diabetes. As a result of the slow progression of type II diabetes, organ damage and complications may have developed prior to diagnosis. Type II diabetes is usually treated with a combination of oral agents, diet, and exercise (23). Insulin injections may be required later in the disease course. Risk factors for type II diabetes are associated with older age, obesity, adiposity and regional fat distribution, diet, family history of diabetes, physical inactivity, social and environmental stressors, and race/ethnicity (1, 23).

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[1] Statistics represented in this section are based on United States data.

[2] For the purposes of this paper, incidence is defined as the number of new cases and prevalence is defined as the number of existing cases (5).

[3] Numbers in parenthesis indicate references used in the background sections.

[4] Another type of diabetes is gestational diabetes which develops during pregnancy and disappears when pregnancy is over. Gestational diabetes occurs in about 2-5% of pregnancies in the U.S. This literature review will discuss type I and type II diabetes, given their higher prevalence (1).

[5] Defined as body mass index, weight in kilograms/height in square meters, greater than 25kg/m^2 (23).

Approximately 15.7 million people have diabetes, of which 65% have been diagnosed; thus, there remains a large percentage of the population with undiagnosed diabetes. Roughly 800,000 new cases are diagnosed each year and the prevalence of diagnosed diabetes has increased by 33% between 1990 and 1998 (3). It is estimated that by 2025, over 20 million people will have diabetes (21).

Diabetes

- Type I diabetes, insulin-dependent diabetes mellitus (IDDM), is most commonly caused by a malfunction of the immune system and is often linked to genetic factors.
- Type I diabetes accounts for only 5-10% of all diagnosed cases of diabetes.
- Type II diabetes, non-insulin-dependent diabetes mellitus (NIDDM), is most commonly associated with older age, obesity, family history, race/ethnicity and lack of physical activity (1).
- Type II diabetes accounts for 90-95% of diagnosed cases of diabetes.

The increasing prevalence of type II diabetes also brings with it a commensurate increase in the burdens of a chronic disease. Diabetes and its related complications incur both societal (indirect) and economic (direct) costs. In 1997, an estimated $98 billion was spent on diabetes. Approximately $44 billion was spent on direct medical care and treatment and indirect costs accounted for $55 billion (4).

- Approximately 800,000 new cases of diabetes are diagnosed each year.
- The prevalence of diabetes among the United States population has increased 33% from 1990 to 1998.
- Among the factors that influence this trend are poor health behavior, changing demographics, and improved surveillance systems.

Direct costs include inpatient and outpatient hospital visits, ambulatory care visits, and various medical-related expenses. Health care costs for patients with diabetes were three times higher than health care costs for people without diabetes. Most of the direct cost attributable to diabetes comes from inpatient hospital care for diabetes-related conditions. In 1994, there were 24.7 million diabetes-related hospital days. Diabetes accounted for approximately 2.2 million hospital outpatient visits. In 1992, 12% of diabetics had a diabetes-related emergency room visit, amounting to 887,000 such occasions. In 1993, patients with diabetes averaged 3.1 offices visits per person (5). Currently, 90% of patients with diabetes receive care through a primary care system (2).

Indirect costs include disability, work loss, and premature mortality (5). Diabetes is the seventh-leading cause of death in the United States and is also associated with severe complications (4). Approximately 69% of the $54 billion spent on diabetes was due to disabilities; the remainder was attributed to mortality. In 1994, about half of all persons with diabetes reported some limitation of activity. Work absenteeism rates are almost five times higher for a person with diabetes compared to those for a person without diabetes (5).

Cost

- $44 billion is spent on direct medical care and treatment for diabetes each year.
- $55 billion is spent on indirect costs, such as disability, work loss, and premature mortality.

The Healthy People 2010 report (2) attributes the increased prevalence and complications to poor health behavior, changing demographics, and improved surveillance systems. Examples of poor health behavior are poor nutrition, lack of physical activity, and obesity. In the absence of positive health behavior, the risk of developing diabetes increases, leading to an increased prevalence of diabetes nationwide. Health behavior has been linked to attitudes and beliefs sometimes embedded in the individual's community or customs. For example, both the availability of health care and patients' motivation to seek care or change lifestyle patterns are influenced by a pervasive sense of fatalism, the use of alternative medicine, and low socioeconomic status.

Risk Factors for Developing Diabetes: (23)

- genetic factors (family history, thrifty gene)
- obesity: adiposity and regional fat distribution
- diet
- lack of physical activity
- social and environmental stress factors (economic and acculturation issues

Older individuals and minority populations have been identified as being at an increased risk for developing type II diabetes. Diabetes tends to be more common among individuals over 65 years of age, women in some age and income categories, and nonwhites in general (22, 24). The demographics of these high-risk groups is changing; the United States population is getting older and its minority populations are increasing. Thus, the incidence of diabetes is expected to increase. Yet it is important to note that the increase in reported prevalence of diabetes could also be driven by and increase in overall incidence, or by improved surveillance systems uncovering previously undiagnosed cases. Obviously, detection strategies do not increase the incidence of diabetes, but simply help to identify cases of diabetes otherwise missed (2).

V. Diabetes Complications

Early detection of diabetes is important because initiating an early treatment of the disease may postpone complications. Besides an increased prevalence of diabetes, there is also an increase in the number of complications attributed to diabetes, which can affect every organ of the body. Poor glycemic control can lead to heart disease, stroke, blindness, kidney disease, amputations, and dental disease (6). This analysis will review journal articles and published sources on diabetes-related foot, oral, and eye complications.

Two different control trials, one conducted in the United States and one in the United Kingdom, were aimed at identifying the factors related to developing diabetes complications. In the United States, the Diabetes Control and Complications Trial (DCCT), was conducted on type I diabetes patients in order to study how two treatment regimens affected the outcomes of diabetes complications. The results showed that by lowering blood sugar, or by maintaining good glycemic control, the risk of developing eye, nerve, and kidney disease could be reduced (25). Conducted with diabetes type II patients, the United Kingdom Prospective Diabetes Study (UKPDS) sought to determine how to treat type II diabetes patients in order to prevent complications and maintain their health. Both the DCCT and the UKPDS found that poor glucose control is associated with the

development of diabetes complications. The UKPDS also concluded that diabetes type II is a progressive disease and, as the duration of diabetes increases, more treatment becomes necessary (26).

Despite the findings of these two studies, as the prevalence of diabetes in the United States has increased, there has been a commensurate increase in the prevalence of diabetes-related complications. This increase has been attributed to changing demographics, poor health behavior, and improved surveillance. In particular, it is the changing demographics–specifically, the increase in minority populations–that has led to an increase in reported prevalence for diabetes complications. In the United States, the increased incidence of diabetes complications for minority populations is disproportionate to increases for nonminority populations (22).

A. Foot

Risk Factors for Complications:

- poor glycemic control
- smoking
- hypertension
- duration of diabetes

Unchecked diabetes and poor glycemic control can lead to peripheral vascular disease or neuropathy (14). Peripheral vascular disease is caused by blockage of the arteries that carry blood to the legs and arms, resulting in damage to the extremities and, ultimately, in amputation (12). Risk factors for developing vascular disease are smoking and hypertension (13). Neuropathy is nerve damage that causes a loss of sensation in the feet or legs and can lead to foot deformities. It can also lead to injuries which become infected and necessitate lower extremity amputations (LEAs). Approximately 60% of all patients with diabetes have some form of neuropathy; consequently, more than half of the lower extremity amputations in the United States are conducted on people with diabetes (12). While early identification of the at-risk foot is essential for preventing amputations, symptoms of diabetic neuropathy vary from severe to undetectable. If there is a loss of sensation, foot injuries can go unnoticed, potentially resulting in amputation. Current recommendations for primary care suggest that the health care provider conduct a foot exam at every visit and at least four times per year. Self-management is important in preventing amputations (13). The diabetic patient who practices proper foot hygiene and knows how to protect feet from injury can reduce his or her risk for amputation. With appropriate primary prevention, approximately half of diabetes-related amputations could be prevented (14).

- Neuropathy is defined as nerve damage which causes a loss of sensation in the feet or legs and can lead to foot deformities or injuries which can become infected.
- Neuropathy can lead to lower-extremity amputations.
- 60% of diabetes patients have some form of neuropathy.
- Recommendations for care: Primary care provider conducts foot exams at every visit, at least four times per year.
- Patients play an active role in care through self-management and proper foot hygiene.

- Periodontal disease occurs when a bacterial infection causes the tissue surrounding the teeth to degrade.
- Two of the most common forms of periodontal disease include gingivitis and periodontitis.
- Periodontal disease is more severe among diabetics than non-diabetics.

B. Oral

Periodontal disease occurs when a bacterial infection causes the tissue surrounding the teeth to degrade. Two of the most common forms of periodontal disease are gingivitis and periodontitis. Gingivitis is a reversible infection that causes inflammation of the soft tissue surrounding the teeth. When gingivitis is not controlled, it can progress to periodontitis, which can lead to tooth loss (9). Compared to individuals without diabetes, individuals with diabetes are at an increased risk for developing periodontal disease. Also, periodontal disease tends to be more severe among people with diabetes. Not only does diabetes exacerbate periodontal disease, but conversely, periodontal disease affects diabetic glucose control (10). Thus patients who develop severe periodontitis as a result of their diabetes often have a hard time maintaining proper glucose control because of tooth loss or oral pain and discomfort. Diabetics may choose to consume softer foods that are easier to chew. These types of foods may not be ideal for maintaining appropriate blood sugar levels and could ultimately lead to complications (10,11). It has been recommended that diabetic patients consume high-fiber diets because such diets have been shown to benefit blood sugar levels (23).

Recommended prevention measures include biannual oral check-ups with an oral health provider. By obtaining information on the patient's oral health behaviors, the primary health care provider can screen the patient for periodontal disease risk. Examples of appropriate self-management of oral health are brushing one's teeth twice daily and flossing. These activities must be conducted concurrently with maintaining good glycemic control (9).

Risk Factors for Complications:

- Diabetes and periodontal disease have a synergistic relationship.
- Poor oral hygiene
- Poor glycemic control

- Recommendations for care: biannual check ups by an oral health provider
- Self-management includes brushing and flossing of teeth and maintaining good glucose control.

- Risk factors for retinopathy include:
  - duration of diabetes
  - poor glycemic control
- Recommendations for care: Annual dilated eye exams

C. Eye

Diabetes is the leading cause of blindness and people with diabetes are 25 times more likely to become blind than those without diabetes (7). Diabetic retinopathy, the main contributor to blindness, is a term for certain abnormalities in the small blood vessels of the retina that are caused by diabetes. Early detection of diabetic retinopathy is essential since retinopathy is often asymptomatic(4). When first diagnosed, approximately 21% of people with type II diabetes show some retinopathy. People with type I diabetes tend to develop retinopathy after three to five years from the onset of diabetes (4). One of the strongest predictors of developing retinopathy is the length of time an individual has had diabetes; the longer the duration, the greater the probability of developing retinopathy (8). A dilated eye exam is the most effective means for detecting diabetic retinopathy; to ensure an accurate diagnosis to occur, however, the exam must be administered by a person skilled in conducting the procedure and in interpreting its results (8). Besides routine eye exams, glucose control is recommended to prevent the onset of retinopathy. Although early detection and treatment of eye complications could prevent approximately 90% of new cases of diabetes-related blindness (7), many diabetics in the United States are not receiving the recommended preventive eye screenings (8).

- Diabetic retinopathy, is a term that describes certain abnormalities in the small blood vessels of the retina that are caused by diabetes
- Diabetes is the leading cause of blindness in the United States
- With early detection, approximately 90% of cases of blindness can be avoided
- Retinopathy is asymptomatic in the early stages

VI. Minority Populations

The burden associated with diabetes and diabetes complications is not distributed equally across the population of the United States. A comparatively greater burden is borne by minority populations such as Native Americans, African Americans, Asian Americans/Pacific Islanders, and Hispanic/Latinos. Minority populations are also less likely to have access to health care that would provide preventative services and could reduce the burden of diabetes sequela (4).

Because minority populations experience higher rates of diabetes and diabetes complications, Centers for Disease Control and Prevention (CDC) and National Institutes of Health (NIH) have launched the National Diabetes Education Program (NDEP). The purpose of NDEP is to "improve the treatment and outcomes for people with diabetes, to promote early diagnosis, and ultimately to prevent the onset of diabetes." This is to be accomplished by means of media campaigns that target people disproportionately affected by diabetes: the elderly, African Americans, Native Americans, Hispanic Americans, and Asian Americans/Pacific Islanders. To achieve the goal of reducing morbidity and mortality associated with diabetes and its complications, NDEP has identified several

objectives: to increase public awareness of diabetes risk factors and of ways to prevent diabetes and its complications; to promote self-management behaviors among diabetes patients; to improve health care provider knowledge of diabetes and create a system for an integrated approach to care; and to encourage policies that improve and promote access to health care (28).

Prevalence of Diabetes (Both Type I and Type II) among Minority Populations

	African American	Hispanic/Latino	Native American	White
Percentage of diabetes for individuals 20 years and older (1)	10.8%	Mexican Americans, 10.6%	9%	7%
Likelihood of developing diabetes compared to whites of the same age (22)	1.7 times	2-3 times	2.8 times	N/A

A. Native American Populations and Diabetes

The Native American population is defined as people whose origins, culture, and community associations derive from the original inhabitants of North America (15). Diabetes has become one of the most serious health issues facing the Native American population. It is the fourth leading cause of mortality for Native Americans(5), and Native Americans are 2.8 times more likely than are their white counterparts of the same age to develop type II diabetes. For the entire Native American population in the United States, the prevalence of type II diabetes is about 12.2% for those over the age of 19; among such Native American tribes such as the Pima Indians, type II diabetes occurs in 50% of the population between the ages of 30 and 64 years. Newly diagnosed cases have been increasing every year. From 1986 to 1993, there was a 29% increase in new cases, most of those being type II diabetes (15).

Both genetic make-up and behaviors are considered risk factors for diabetes among the Native American population. Pure-blooded Native Americans are at an increased risk for developing type II diabetes. Obesity is a risk factor across all populations, but the prevalence of obesity in the Native American population is high. Among the Pima Indians with diabetes, approximately 95% are obese. Not merely obesity, but also the distribution of body fat plays a role in increasing the risk of diabetes. The individuals who store fat in the central or upper body are at a higher risk for diabetes than those individuals who carry excess weight below the waist. Scientists theorize that the high prevalence of obesity in this population is attributable to the so-called "thrifty gene," which at one time may have helped Native Americans to store fat during prosperous periods so that they were better equipped to survive in subsequent periods of famine (15). It has been proposed that

> Overproduction of insulin in early man was seen as an energy-conserving mechanism when food intake was irregular and obesity rare. As such it was an evolutionary asset since natural selection favored those individuals who were able to store energy in the form of fat tissue and thus withstand relative famine. (23)

But with changing diets (higher in fat and calories), fewer fluctuations in food supply, and decreased physical activity, the "thrifty gene" was no longer an asset. As a result, obesity and such associated health risks as diabetes have become highly prevalent among Native Americans (15).

Diabetes Complications

Native Americans have a high prevalence of diabetes and, as a result, the prevalence of diabetes-related complications is also high. Rates for lower extremity amputations vary by tribe, and amputations are more often performed on males than females; overall, however, rates of lower extremity amputations are three to four times greater for Native Americans than rates for the general population (15).

Native Americans with diabetes are at a greater risk for developing periodontal disease. They are 2.6 times more likely to develop oral complications than are people without diabetes in the same population (13). A study conducted through the Indian Health Initiative revealed that approximately 25% of adults surveyed were unable to chew hard foods because of dental pain; although this finding was not specific to the population of people with diabetes, it is cause for concern about how dental pain impacts the diabetic population (16).

Compared to whites, Native Americans are disproportionately affected by diabetic retinopathy. Approximately 18% of Pima Indians with diabetes and 24% of Oklahoma Indians with diabetes have some form of retinopathy (15).

Native Americans and Diabetes Complications

Foot (15)	Oral	Eye (15)
• Rates of LEAs are 3-4 times greater than for the general population. • Rates of LEAs vary by tribe. • Amputations are more often performed on males than females.	• Diabetics are 2.6 times more likely to develop oral complications than nondiabetics (13). • 25% of adults surveyed through the Indian Health Initiative were unable to chew hard foods due to dental pain (16).	• Compared to whites, Native Americans are disproportionately affected by diabetic retinopathy. • 18% of Pima Indians have some form of retinopathy.

B. African American Populations and Diabetes

Among African Americans, diabetes is the seventh leading cause of death. African Americans are 1.7 times more likely than their white counterparts to be diagnosed with diabetes (17). Twenty-five percent of African Americans between the ages of 65 to 74 years have diabetes. Compared to white Americans, African Americans also have disproportionately higher rates than of eye, foot and kidney complications and are more likely to develop disabilities (18). In addition, death rates due to diabetes are approximately 27% higher for blacks than for whites. The prevalence of diabetes among

African Americans is increasing dramatically. Between 1988 and 1994, the prevalence of diagnosed cases of diabetes in this population rose by 18.2%. While this increase is attributed, in part, to heredity, obesity, and lack of physical activity, scientists theorize that, just as is the case for Native American populations, a "thrifty gene" may be contributing to the increased prevalence of the disease among African Americans (18). Another risk factor for diabetes, obesity, is more prevalent among African Americans than their white counterparts. Distribution of body fat above the waist is a stronger risk factor than body fat carried below the waist. A potential contributor to obesity is lack of physical activity. According to data from the Third National Health and Nutrition Examination Survey (NHANS III), 50% of African American males and 67% of African American females reported no physical activity in their daily lives (18).

Diabetes Complications

African Americans with diabetes are 1.5 to 2.5 times more likely to have a lower extremity amputation than are nondiabetics, and African Americans are more likely than are whites or Hispanic Americans to undergo a lower extremity amputation (17).

The reviewed literature offers little information that is specifically related to African Americans and that considers the prevalence and incidence of oral complications due to diabetes in this population. Such information may arise, however, in the environmental scan of sources of information other than journal articles.

According to data from the NHANS III, diabetic retinopathy is 40 to 50% more common in African Americans than in their white counterparts. It is worth noting that the occurrence of retinopathy is associated with hypertension, because the African American population also has higher rates of hypertension than whites (18).

Native Americans and Diabetes Complications		
Foot	**Oral**	**Eye (18)**
• Diabetics are 1.5 to 2.5 times more likely to have LEAs than are nondiabetics (17).	• Little information is available in the reviewed literature on prevalence and incidence of oral complications due to diabetes. Further evidence may arise through the environmental scan.	• Diabetic retinopathy is 40 to 50% more common in this population compared to whites. • Retinopathy in this population is associated with hypertension. • This population tends to have higher rates of hypertension than whites.

C. Hispanic/Latino Populations and Diabetes[6]

In the United States, diabetes is the seventh leading cause of death among the Hispanic/Latino population. In 1998, approximately 4% of Hispanics in the United States had diabetes. Of the 30 million Hispanics in the United States, 1.2 million have been diagnosed with diabetes, and an estimated 675,000 Hispanics with diabetes remain undiagnosed (27). The Mexican American subgroup, which makes up 64% of the Hispanic American population, is about 2 to 3 times as likely to develop diabetes as are whites; other Hispanic/Latino Americans are twice as likely to develop diabetes as are whites (19). Despite the fact that most studies have focused on Mexican-Americans, however, Puerto Ricans have the highest prevalence (26%) of diabetes among the Hispanic/Latino populations between the ages of 45-74 years (27).

Among the risk factors for diabetes for Hispanic/Latino are genetic factors (family history rather than the "thrifty gene"), obesity, lack of physical activity, and gestational diabetes. Mexican Americans with a family history of diabetes are twice as likely to develop diabetes in their lifetimes than are those with no family history. Hispanics are more likely to be overweight than whites, and Hispanics report lower levels of physical activity than do their white counterparts. For Hispanics as for other populations, distribution of body fat above the waist is a greater risk factor for diabetes than weight carried below the waist (19). More research must be conducted in order to compare Hispanic/Latino subgroups in the United States and to explore the role of possible risk factors for the development of diabetes mellitus.

Diabetes Complications

In the 1989 National Health Interview Survey (NHIS), Mexican Americans reported a greater prevalence of neuropathy than did whites or African Americans (19).

Little information was found in the reviewed literature on the prevalence and incidence of oral complications due to diabetes. More information may be found in the course of the environmental scan.

Finally, the review revealed that thirty-two to forty percent of Mexican Americans with diabetes report a prevalence of diabetic retinopathy (20).

Hispanic/Latinos and Diabetes Complications		
Foot	**Oral**	**Eye**
• Mexican Americans reported a greater prevalence of neuropathy than did whites or African Americans (19).	• Little information is available in the reviewed literature on the prevalence and incidence of oral complications due to diabetes. More information may be found by environmental scan.	• 32-40% of Mexican-Americans with diabetes had diabetic retinopathy (20).

[6] "Hispanic/Latino" is a general term that includes all sub-groups of this ethnicity.

D. Summary

General information on the incidence and prevalence of diabetes in the overall U.S. population as well as in minority subpopulations is available. Numerous studies have pointed to diabetes as the leading cause of blindness and lower extremity amputations in the United States (12, 17). Gaps do exist in what is known about oral complications due to diabetes; however, there is strong evidence in the literature that links do exist between diabetes and oral health. Risk factors for the development of diabetes and diabetes complications are well established (10). Knowledge of these risk factors allows both health care organizations and practitioners to take actions that would mitigate the effects of these factors. The published literature gives reasons for the current prevalence and incidence rates and provides suggestions for interventions that have been shown to have an impact on reducing the effects of risk factors for developing diabetes.

VII. Current Issues by Type of Audience for Diabetes General Complications Literature

A number of issues regarding the care of individuals with diabetes have been addressed in the literature. These can be classified into the following four areas: 1) the systems through which diabetes care is provided; 2) the role of health care providers in prevention and treatment; 3) the knowledge, attitudes, and behaviors of diabetes patients, particularly those in minority populations; and 4) enablers and barriers to seeking and receiving appropriate diabetes care.

A. System/Organization

In order to improve the systems by which diabetes care and management is provided to patients, many different interventions in various settings have been implemented. Several articles have addressed care systems as they relate to several aspects of diabetes, and have described interventions that may better these systems. For example, McCulloch et al. (1998) described a population-based approach to improving the provision of diabetes care that involved several changes in the system. This intervention was conducted in a staff model HMO where 15,000 diabetic patients are seen each year. The population-based approach included several distinct components. A diabetes registry system was established where physicians could access treatment and screening information on any of their patients. Evidence-based clinical guidelines provided specific information on screening and treatment for several complications associated with diabetes. From the diabetes registry, feedback on compliance with guidelines was extracted and given to the primary care physician. New systems for tracking and for the provision of care were established, as were diabetes

Two Types of Approaches to Systems/organizational Change:

- Multidisciplinary: a system of services in which all members of the health care team are devoted to maintaining the overall health of the patient with diabetes.
- Single component change: a change in one aspect of the system of care.
  - ♦ feedback system

care teams. Nurses, pharmacists, and diabetologists traveled to primary care clinics to work with both physicians and patients during clinic visits to identify appropriate strategies for providing care and to establish self-management regimens for the patients; the team also reinforced other components of the program. The authors suggest that changing the systems of care provision improved the level of care received by the patients. Because of secular effects and the multiplicity of interventions, the authors were not able to attribute the improvement in care to one particular component of the intervention, but they indicated that the diabetes care team, although costly and time intensive, did have a positive impact upon the level of care provided to the patients. However, no cost-effectiveness evaluation was conducted to determine if these improvements in the care delivery system outweighed the costs.

Other interventions involved using a single change in the patient care system. Fox et al. (1998) evaluated a feedback system in which providers received yearly reports on indicators of diabetes management in their clinic. The providers met quarterly to discuss the data and to develop strategies for improving the system of care. At the end of the first year, the outcomes from the feedback approach illustrated that this system had improved the level of care provided. However, after the second year of the intervention, levels for screening were maintained at the same level as year one. The authors suggest that, while providing feedback on physician performance did increase the level of care provided, other interventions are needed in conjunction with this system in order to maintain a continual increase in the level of care.

- Changing system of care to a team approach improved the care patients received.
- Providing feedback to physicians on their quality of care does improve patient care.

Another single-change strategy to alter the system for providing care is the use of detailed algorithms delineating care patterns. Using an algorithm for care provided by pharmacists in a free medical clinic, Davidson et al. (2000) studied the effects of a diabetes management program. Patients were randomly selected by the physician to receive care through a program of diabetes management. It was determined that patients who had received care from the pharmacists realized slightly better outcomes than did the control group who had received standard care at the free clinic.

B. Health Care Providers

- Primary care providers have low levels of adherence to recommendations for oral and foot exams.
- Higher rates of adherence to recommendations are seen among type I diabetes patients vs. type II.

Primary care providers are an essential point-of-contact for diagnosis and ongoing care. Two articles evaluated providers in terms of the care they provided for general diabetes as well as the screening they performed for several different complications (Deeb et al., 1998 and Kenny et al., 1993). Kenny et al. (1993) queried primary care physicians across the nation on their level of adherence to recommended diabetes screening guidelines. In the study, physicians followed

recommendations for eye exams, blood pressure measurements, and neurological and circulatory exams. Low levels of adherence were reported for oral and foot exams. Primary care providers also reported higher adherence rates for screening type I patients than for type II patients. The authors attribute this difference to physicians' perception that type I is more serious an illness than is type II. The levels of screening varied by primary care physician type as well as by age of the physician, with older physicians reporting lower adherence to recommendations. The authors postulate that differences in the type of education primary care physicians may have received, as well as the length of time elapsed since their training on diabetes-related care, may explain such different adherence rates to recommended diabetes screening guidelines.

Barriers/Enablers

There are several identified barriers that exist to creating the ideal system for providing diabetes care (Deeb et al, 1998; Fox et al, 1998; and Chin et al, 2000). Both patient-driven factors and demands of the system or organization have been shown to affect interventions aimed at improving diabetes outcomes. In their study of pharmacists, Davidson et al. (2000) identified potential barriers that may have affected the outcome of the program. The authors found that not all patients were adhering to the pharmacists' recommendations. Three factors were identified that explained nonadherence: 1) a patient's refusal to adjust his or her medication according to the recommendations; 2) a patient's refusal or inability to self-monitor his or her blood glucose; and 3) a patient's refusal or inability to keep his or her appointments. In their study of the link between organizational factors and quality of care in a community health setting, Chin et al. (2000) identified two further barriers: a high rate of staff turnover in the clinic, and the constraints of short appointment periods (limiting the time providers could spend addressing relevant health issues).

Barriers for Health Care Providers to Provide Care:

- Patient refusal to adjust medication according to recommendations
- Patient refusal or inability to self-monitor blood glucose
- Patient refusal or inability to keep appointments, thus recommendation could not be given
- High staff turnover rates in clinics
- Short appointment times limit the issues that can be addressed.

C. Patients with Diabetes

Several articles revealed attempts to understand how patient behavior affects reception of appropriate care and the ability to maintain self-care behaviors (Ahluwalia et al., 2000; Kraft et al, 1997; Will et al., 1994 and Wylie-Rosett et al., 1995). Ahluwalia et al. (2000) conducted a telephone survey to determine the patient levels of compliance with American Diabetes Association

- Lowest compliance to diabetes care recommendations among patients was for foot exams.
- *Enabler:* Patients are more likely to receive recommended care if the provider has a reminder system for scheduling follow-up appointments.

recommended care guidelines. The authors also sought to identify patient and provider characteristics associated with receiving recommended care. The lowest compliance level was for foot exams. Patients were more likely to receive the recommended care if their health care provider scheduled a follow-up appointment, were former or non-smokers and were male. Both Kraft et al. (1997) and Will et al. (1994) note that patients are more likely to receive care if their health care provider has a reminder system in place to remind patients to schedule and attend follow-up appointments.

D. International

Both inside and outside the U.S., patients and providers differ in the levels of care they report. Evaluating similar factors as those studied in the U.S., two international studies (Kamel et al., 2000 and Akel et al, 1999) have also found low levels of adherence to guidelines, especially for foot exams, among the diabetic populations studied. In addition, the authors identified a gap between the provision of care reported by providers and the receipt of care reported by patients. Akel et al. (1999) confirmed that health care visits are not regularly scheduled and do not occur with sufficient frequency. When visits occurred, limited appointment time impinged on the provider's ability to address all the standards of care outlined in the guidelines of the American Diabetes Association, Canadian Diabetes Association, and the World Health Organization.

- Lowest compliance for care among diabetes patients was for foot exams.
- A gap exists between provision of care reported by the provider and receipt of care reported by the patient.
- Education programs targeted at diabetics improved patient self-management behaviors.

Jiang et al. (1999) and Lowe et al. (1997) reported on the success of their educational intervention programs targeting diabetes patients. Health outcomes and self-management behaviors improved for patients who participated in the diabetes education centers. The diabetes education course in Taiwan (Jiang et al., 1999) used the American Diabetes Association recommendations to guide the program. Because patients participated in the education program, patient health behaviors were modified, resulting in improvements in metabolic control. Lowe et al. (1997) demonstrated that individuals receiving general diabetes education through the Diabetes Education and Stabilisation Centre (DESC) were more likely to receive foot and eye exams. The study demonstrated that community pharmacists have an important role in filling in gaps, in terms of diabetes education and monitoring, for people with diabetes who may not be accessing health care services. These individuals tend to be single men or medically underserved populations.

- Among the barriers to patients' use of health care services are undiagnosed diabetes and lack of diabetes case management.
- *Barrier to care:* limited appointment time to address multiple health issues.
- *Enabler:* use of community pharmacists to provide diabetes education and monitoring.

E. Minority Populations

Several articles addressed diabetes care and education among minority populations (Lorig et al, 2000; Morrison et al, 1998; Cowie et al., 1997; and Harris et al., 1999). Cowie et al. (1997) and Harris et al. (1999) describe differences between minority and nonminority populations in the United States. Cowie et al. (1997) concludes that African Americans and Mexican Americans have higher complication rates than do non-Hispanic whites. Low economic status renders minorities more vulnerable to the discontinuities and fragmentation of health care; there are disparities, for example, between minorities and nonminorities in terms of the treatment and management of glycemic control as well as the education received by patients with diabetes. Having poor levels of glycemic control leads to the formation of complications. In Cowie et al.'s (1997) study, African Americans reported receiving the fewest hours of diabetes education compared to non-Hispanic whites and Mexican Americans. Harris et al. (1999) concludes that socioeconomic characteristics such as educational attainment, income, health insurance status, and number of physician visits per year were not associated with poor glycemic control. On the other hand, poor glycemic control was found in black females, Mexican American males, individuals receiving oral treatment or insulin, and individuals younger than 60 years of age (Harris et al., 1999). After adjusting for glycemic control, minorities still face a higher risk for developing complications than do nonminority populations. Younger patients are at risk due to glycemic exposure (allowing more time for complications to develop in younger versus older patients).

- African Americans and Mexican Americans have more complications due to diabetes than do non-Hispanic whites.
- Disparities exist between treatment and management for the Hispanic/Latino populations and for non-Hispanic whites.
- African Americans reported the fewest hours of diabetes education compared to Mexican Americans and non-Hispanic whites.

Interventions conducted on a Hispanic/Latino population (Lorig et al., 2000) and in the Sioux Lookout Zone, Canada (Morrison et al., 1998), show that education focusing on self-efficacy in these minority populations plays a significant role in changing knowledge about, as well as attitudes and behaviors toward, diabetes self-management. Both programs used a community-based intervention that employed the services of a diabetes nurse educator to provide strategies for self-management through a self-efficacy model. Lorig et al. (2000) used peer educators recruited from the Hispanic/Latino community to deliver the diabetes education program. The authors state that the benefit of using members of the community as peer educators is that they are, "known, trusted, culturally competent, and fluent in the language of

- Diabetes care to Latinos needs to be delivered by primary care providers and conducted in a team approach. (23)
- Risk factor for developing complications: is duration of diabetes.
- Patient education was effective in improving diabetes health outcomes and improving self-efficacy.
- *Enablers:* Programs that use peer education and local media are effective in changing knowledge, attitudes, and beliefs of minority populations.

the target community." Morrison et al. (1998) explains that the foot-care workers from the community had an integral role in motivating and assisting behavior change among the diabetes patients in the Sioux Lookout Zone. Besides employing the services of community workers, Morrison et al. (1998) used local newspapers and radio to transfer relevant messages to the community, such as physical activity, diet, and stress management. Both studies concluded that the success of their programs was due in part to the large role that communities played in administering and implementing the prevention and management programs (Lorig et al., 2000 and Morrison et al., 1998).

VIII. Current Issues By Type of Audience for Diabetes Foot Complication Literature

A segment of the literature on diabetes is focused specifically on foot complications. The literature reviewed on foot complications identifies and addresses issues similar to those discussed in the general literature section, but these articles focus only on one aspect of diabetes sequela, the foot.

A. System/Organization

A multidisciplinary team approach to diabetes care has been suggested as a way to effectively reduce the risk of lower-extremity amputations (LEAs), a complication resulting from poor diabetes management (Frykberg, 1998; Donohoe et al., 2000; Dargis et al., 1999; Mason et al., 1999; and Armstrong et al., 1998). Frykberg (1998) claims that to effectively prevent amputation, many different inputs are needed: proper foot care, patient education, early detection and treatment of lesions, and reduction of amputation risk-factors. Frykberg (1998) states that a multidisciplinary team approach, providing coordinated care, is the best way to address all the factors that potentially lead to amputation:

> The organization of a multidisciplinary diabetic foot service should include all members of the health care team dedicated to maintaining the overall well-being of patients with diabetes and, specifically, with preserving the integrity of their lower extremities.

For example, such a multidisciplinary team might include a diabetologist, internist, endocrinologist, vascular surgeon, podiatrist, and diabetes nurse educator. Depending upon the needs of the patient, one or more members of the team might be called to service.

Several international studies (Dargis et al., 1999; Donohoe et al., 2000; and Mason et al., 1999) confirm the effectiveness of a multidisciplinary approach to diabetes-related foot care. In Lithuania, Dargis et al. (1999) confirmed the benefits of this approach through a randomized control study. Compared to the control group, the intervention group, which was exposed to the multidisciplinary team, had fewer incidences of foot lesions and amputations at the two year follow-up.

Another strategy aimed at changing the system of diabetes foot care is the critical pathways approach (Crane et al., 1999; Rith-Najarian et al., 1999, 1998, 2000; and Wylie-Rosett et al., 1995). Crane et al. (1999) describe the critical pathways approach as a system in which patients with similar risks "are treated consistently with the highest standard of care in the most expedient yet cost-effective manner, while taking into consideration the uniqueness inherent in individual disease control." Thus the patient receives care through a decision pathway based upon his or her clinical status. The authors conclude that patients whose care was received through the critical pathways approach were diagnosed earlier and received more expedient treatment of diabetes-related complications, actions which resulted in better quality-of-care outcomes. Rith-Najarian et al. (1998) illustrated that an algorithm used to determine the diabetic's level of risk, and an accompanying decision pathway delineating appropriate care, not only improved the quality of diabetes foot care provided, but also reduced the incidence of LEAs. Wylie-Rosett et al. (1995) identified an inner-city health center where minority populations were receiving inadequate foot care; the authors attributed this inadequate care to the lack of a systems approach to foot examinations during patient visits. Medical staff indicated that completing a diabetes flow sheet and having the patient remove his or her footwear for exams was too time consuming. Most clinic visits focused on addressing the patient's main complaint; therefore, additional opportunities for primary care were not taken. Because of the lack of an established care system, many opportunities for preventive care were missed.

A slightly varied system for the critical pathways approach was the creation of a risk categorization system for diabetes-related complications in the lower extremities (Rith-Najarian et al., 1992 and Mayfield et al., 2000). Risk categorization places an individual into different categories based upon the presence of foot deformities, history of lower extremity events, and response to sensation tests. Rith-Najarian et al. (1992) evaluated how well a risk categorization system predicted lower extremity outcomes, especially among the high-risk patients. The data showed that incidence rates of lower-extremity complications were positively correlated with the risk categorization of the patient. Therefore, patients identified as high-risk received closer monitoring and necessary treatment for lower extremity complications.

Systems Approaches to Care That Enable Better Health Outcomes:

- A coordinated system of care that includes a variety of health care professionals can reduce the risk of lower-extremity amputations for diabetics.
- *Enabler:* A critical pathways approach to care can lead to earlier diagnosis and treatment (and hence, better outcomes) of foot complications.
- *Enabler:* The use of a risk categorization system predicts better outcomes for high-risk patients, because once they are identified, such patients can be closely monitored and given necessary treatment.
- *Barrier:* Time constraint for patients to remove footwear and to go through the flow chart.

B. Health Care Providers

In their review of health care providers and diabetes, Crane et al. (1998) state that the medical practitioner has the responsibility to provide education about diabetes, support early detection, and provide appropriate treatment of related complications. Crane et al. (1998) charge that physicians need to be aware of the early warning signs of foot complications, such as neuropathy, so that they can appropriately refer patients to a specialist. Providers must also be able to identify risk factors and classify their patients' risks for ulceration and amputation. Besides identifying these risks, providers must be able to advise patients on appropriate self-maintenance techniques, such as obtaining appropriate foot wear, scheduling routine foot examinations, and maintaining good glycemic control. In a study conducted in England, Donohoe et al. (2000) found that providers had misconceptions about the factors that define a high-risk patient and lacked knowledge on the appropriate care for patients based on their clinical status. Because providers lacked relevant knowledge, patients with diabetes tended to be uncertain about their own role in self-management. Wylie-Rosett et al. (1995) suggest that discrepancies between the number of physician-reported foot exams and the number actually recorded in patient medical records are caused by providers' inadequate knowledge of foot complications.

Del Aguila et al. (1994) found that when health care providers were aware of their patients' elevated risk for amputations, such as a prior history of foot ulcers, those providers were more likely to increase education on foot health care behaviors. However, when providers had knowledge of other risk factors, such as peripheral neuropathy or vascular disease, they were not motivated to provide their patients with any additional education.

A few studies have evaluated how direct provider education can influence the identification of patients at risk and can bring about changes in clinical practices (Bruckner et al., 1999 and Helfand, 1994). For example, the Lower Extremity Amputation Prevention Program (LEAP) in New Jersey (Bruckner et al., 1999) positively influenced clinical practices by providing physicians with guidelines for foot-care practice and with information on risk factors, appropriate referrals, and foot exams. A barrier to the intervention was that health care institutions were focused on the treatment rather than prevention of diabetes-related complications.

- Physicians can identify risk factors, provide advice on self-management, and provide referrals to podiatrists.
- Physicians have difficulty identifying those patients at risk for neuropathy.
- Patients are often unsure of how they can prevent neuropathy themselves.
- Increased education from providers to patients can decrease a patient's risk for neuropathy.
- *Enabler:* Clinical practices were positively influenced after physicians received guidelines for foot-care practices and information on risk factors, appropriate referrals, and foot

C. Patients with Diabetes

Physicians are not solely responsible for the outcomes of foot complications; patients also play an integral role in reducing their risk of developing complications. Several studies have identified both the barriers and enablers that affect the patient's ability and/or willingness to adhere to foot care recommendations and self-management (Armstrong et al., 1998; Mayfield et al., 1998; Miriam et al., 2000; Frykberg, 1998; and Ward et al., 1999). Frykberg (1998) suggests that both intrinsic and extrinsic factors affect a person's risk of developing foot complications. Intrinsic forces are either metabolic or physiologic; examples are "age, weight, duration of diabetes, nephropathy, decreased visual acuity, limited joint mobility and structural deformity." In their review, Mayfield et al. (1998) state that barriers to foot examination among the elderly are poor vision, obesity, and impaired mobility. Miriam et al. (2000) identified the lack of apparent foot or leg problems as a barrier to seeking regular foot exams. Extrinsic forces are described by Frykberg (1998) as the interaction between the patient and his or her environment. More specifically, trauma to the foot, smoking, social support systems, and patient education influence the patient's risk of foot complications. The strength of social support systems and quality of diabetes education were identified by Armstrong et al. (1998) as enablers for better foot health outcomes among patients in their intervention group. Two studies (Ward et al., 1999 and Miriam et al., 2000) confirmed that lack of transportation was not a barrier to receiving care. However, Ward et al. (1999) discovered that diabetes patients are more willing to participate in education classes if they do not have to make a separate trip to the clinic for the sole purpose of attending the education program. Thus, integrating the education session into a regular care visit might improve attendance. Lorig et al. (2000) also concluded that better turnout rates for education classes occur when class schedules were made to accommodate the patient's schedule and when classes took place in a familiar setting, such as the patient's own community.

Barriers to Seeking Regular Foot Exams:

- Lack of obvious foot or leg problems
- Poor vision, obesity, and impaired mobility
- Transportation has not been shown to be a barrier
- *Enablers:* strong social support systems for patients; high quality diabetes education; having diabetes education classes that are convenient (in terms of time and location) for patients to attend.

Foot care education is an essential component to reducing the risk of amputation among patients with diabetes. It is estimated that patients who do not receive education on foot care are 3.2 times more likely to have a lower-extremity amputation (Reiber et al., 1992). There is copious literature that evaluated patient foot care education programs, incidence of foot amputations, and knowledge retention (Malone et al., 1989; Fowler et al., 1999; Ward et al., 1999; Miriam et al., 2000; Viswanathan et al., 1999; Hamalainen et al., 1998;

- *Fact*: Patients who have not received any diabetes education are over three times more likely to have a lower-extremity amputation than patients who have received diabetes education.
- *Enabler:* A one-hour class on foot care has been shown to reduce a patient's risk for amputations and ulcers.

Mayfield et al., 2000; Ledda et al., 1997 and Patout et al., 2000). Malone et al.'s (1989) randomized control trial evaluated the effects of a patient education program on the incidence of foot amputations in patients with diabetes. The intervention group received a one-hour education session on and self-management and the control group received no extra education. The group that received the one-hour intervention had a 67% reduction in the number of amputations and ulcerations at the two-year follow-up. This study demonstrated that a simple, one-hour education intervention does have an impact on the incidence of amputations among a diabetes population. Studies such as Ward et al. (1999) have focused on the retention of knowledge rather than a reduction of incidence. After receiving individual foot assessments and a two-hour education course on appropriate foot care, patients reported, in the three month follow-up survey, that they had retained knowledge and changed behavior. An intervention conducted in Finland (Hamalainen et al., 1998) also found that interactive education on self-management, and input on treatment from a podiatrist results in sustained knowledge over the long term. This outcome was compared to that of a control group in which patients received written instructions only.

D. Minority Populations

Mayfield et al. (2000) examined the effect of foot examinations on the risk of amputations in a Native American population. Depending upon the risk categorization of the patient, one of three types of foot exams (foot scan, comprehensive exam, or therapeutic exam) was used; it was found, however, that a foot exam by itself did not reduce the risk of amputation. Mayfield et al. (2000) suggests that "foot examinations are the means for risk identification and should stimulate proven preventive care efforts." When used as the sole intervention, foot exams do not effectively reduce the risk of amputation.

- Among Native Americans, foot exams by themselves does not reduce the risk of amputations.
- Among African-Americans, foot care education can decrease the risk of amputations.
- A very small number of patients receiving care in inner-city hospitals report receiving foot exams.

Both Patout et al. (2000) and Ledda et al. (1997) demonstrate the effectiveness of diabetes foot care education among African American populations in reducing the number of amputations. Ledda et al. (1997) evaluated the outcomes of an Afrocentric self-management program targeted at African Americans. The simplicity of instruction and the provision of a hand-held mirror for foot inspection were well received. Several barriers to self-management were identified and these included both intrinsic and extrinsic factors. Lack of motivation, forgetfulness, vision problems, joint and knee problems, and family responsibilities proved to be barriers. Despite the culturally-focused intervention, not all participants liked the Afro-centric focus. Some participants did not identify their culture with that of Africa and suggested the interventions be focused on age instead.

- *Enabler:* The simplicity of instruction and the provision of a hand-held mirror for foot inspection were well received in an African American self-management program.
- *Barriers* to doing foot care self-management that have been reported among African Americans are lack of motivation, forgetfulness, vision problems, joint and knee problems, and family responsibilities.

Despite education programs aimed at minority populations, Wylie-Rosett et al. (1995) found that minority populations, particularly in inner-cities, are not receiving the recommended foot exams. Chart reviews indicated that only 10% of diabetes patients receiving care in a New York clinic had received foot exams. These findings were inconsistent with a National Institute of Health's study, the Survey of Physician Practices Related to the Treatment of People with Diabetes Mellitus, in which 80% of U.S. physicians indicated the provision of recommended yearly comprehensive screenings. Resnick et al. (1999) illustrates that African Americans had a high incidence rate of lower-extremity amputations as compared to the rate for whites. Despite educational efforts aimed at the minority populations, a disparity continues to exist between the incidence of complications in these populations and the incidence in nonminority populations.

IX. Current Issues By Type of Audience for Diabetes Oral Complication Literature

Oral complications due to diabetes are distinct from foot and eye complications because oral complications and diabetes have a synergistic relationship. Studies published in the recent literature support a link between oral health complications and diabetes mellitus (Emrich et al., 1991; Oliver et al., 1993; and The Expert Committee on the Diagnosis and Classification of Diabetes, 1997).

Factors Associated with Oral Health Complications among People with Diabetes

- synergistic relationship between diabetes and oral health
- poor glycemic control
- duration of diabetes
- poor oral hygiene - plaque prevention and removal techniques like brushing twice daily and flossing
- smoking and tobacco use
- age.

Several studies have identified factors associated with the development of oral complications (Tomar et al., 2000; Spangler et al., 1994; Moore et al., 2000; Katz et al., 1991; Betschart et al., 1997; Cherner et al., 1996; and the Research, Science and Therapy Committee, 1996). As identified in the general diabetes literature section, both Moore et al. (2000) and Katz et al. (1991) listed duration of diabetes, poor metabolic control, poor oral hygiene and smoking as risk factors associated with periodontal disease. Although Moore et al. (2000) state that age is a factor in oral complications, Katz et al. (1991) suggest that age is not as critical a factor as duration of diabetes. Katz et al. (1991) concludes, "…the susceptibility to and severity of periodontal disease appears to increase with the length of time that a person has diabetes." In addition, Moore et al. (2000) offer data to suggest that the reported differences in oral health, between type I and type II diabetics, may be due to differences in glycemic control activities, age, tobacco use, and disease duration.

A. Barriers/Enablers

The majority of issues discussed in the reviewed literature center around patients and diabetes-related oral complications. Besides factors that increase the risk of developing oral health complications, there are barriers and enablers to seeking appropriate oral care (Tomar et al, 2000; Spangler et al., 1994; Moore et al., 2000; Katz et al., 1991; Betschart et al., 1997; Cherner et al., 1996; and the Research, Science and Therapy Committee, 1996). Tomar et al. (2000) and Moore et al. (2000) have confirmed that income level and cost of dental care influence a persons' willingness to seek dental care. Since most dental care is not covered under insurance and Medicare and Medicaid provide limited coverage, low-income individuals may not be willing to incur out-of-pocket expenses. These factors seem to be stronger predictors of not seeking care than is the fear of dental treatment. Tomar et al. (2000) found that a lack of perceived need for oral health care can also be a reason given for not seeking regular dental care.

Additional factors have been associated with the lack of dental-care-seeking behavior and the presence of periodontal disease. Jack et al. (1999) confirms that "acute stress has been shown to increase insulin resistance." Betschart et al. (1997) posits that stress is a contributor to periodontal disease. He suggests that stress--or "the concept that the social environment initiates stress within the host"--is linked to periodontal disease such as the development of gingivitis and periodontitis. Despite Betschart et al.'s (1997) conclusion, Spangler et al. (1994) found no relationship between perceived stress and oral-health behaviors. However, Spangler et al. (1994) admits that this finding is surprising, because previous scores from the measurement tool he used, the Brief Encounter Psychosocial Instrument (BEPSI), which measures an individual's current life stressors, has found a correlation between family dysfunction and poorer outcomes for other health behaviors.

Although Spangler et al. (1994) *did* not find a correlation between stress and oral health behaviors, the study did find a correlation between family function and oral hygiene practices. Spangler et al. (1994) describe family function as "a family's decision-making and problem-solving processes, guidance for family members, and a commitment to each other's physical and emotional health." The Family APGAR scale (adaptability, partnership, growth, affection and resolve) was used to measure the patient's perception of family function. Family dysfunction was found to be a contributor to poor oral hygiene among patients with type I diabetes and among men generally. Being white and female is correlated with better oral health behaviors. More information needs to be gathered as to why this pattern of oral health behaviors is exhibited in males and people with type I diabetes.

In terms of health-seeking behaviors, patients with diabetes are more likely to visit their primary care physician than a dentist; primary care physicians are an important entry point into a comprehensive dental health care system for the diabetes patient (Spangler et al., 1994). Katz et al. (1991) suggest that preventive care interventions targeted at the patient should include education on "effective and frequent plaque prevention and removal techniques" and on improving glycemic control.

Practice of Good Oral Health Behaviors	
Barriers	**Enablers**
• income level • cost of oral care • lack of perceived need • lack of insurance coverage	• family function • Primary care physician as entry point into a comprehensive dental health care system

B. Minority Populations

Despite the known prevalence of diabetes complication risks among minority populations, not much is known about minority populations and periodontal disease. What is known is that individuals with poor oral hygiene behaviors, poor glycemic control, those with a long duration of diabetes, those with other diabetes-related complications, teenagers, and pregnant women are more susceptible to developing periodontal disease (Katz et al., 1991).

- There is a lack of information on minority populations with diabetes and periodontal disease.
- Hispanic/Latinos (Mexican Americans) are less likely to visit a dentist than are whites.
- Pima Indians (Native American) population has high prevalence of diabetes, which linked with periodontal disease in this population.

Those More Susceptible to Developing Periodontal Disease

- those with a long duration of diabetes
- those with other diabetes related complications
- teenagers and pregnant women
- those who have poor oral hygiene behavior
- those who have poor glycemic control.

Despite a lack of knowledge on the link between diabetes and oral health among minority populations, Tomar et al. (2000) discovered that Hispanics, specifically Mexican Americans, were less likely than non-Hispanic whites to have seen a dentist. Although general oral health information is available for minority populations, a link between periodontal disease and diabetes has been more widely established for the Pima Indian population of Native Americans (Report of the Surgeon General, 2000). Pima Indians have one of the highest prevalence rates for type II diabetes, which has been linked to the high prevalence of periodontal disease in this population. Much more information needs to be obtained in order to fill in the gaps in knowledge.

C. International

Two international studies confirm the findings from studies based in the United States regarding factors associated with diabetes and oral health. Cerda et al.'s (1994) findings reiterate those of Katz et al. (1991), in which the authors conclude that the most significant factor associated with periodontal disease is not the age of the patient but rather the time elapsed since diagnoses of type II diabetes. In a cross-sectional study conducted in the United Kingdom, Jones et al. (1992) confirmed that the diabetes population is more prone to caries than is the general population. The explanation of this tendency may be that most patients with diabetes are not aware of oral health problems associated with diabetes (Jones et al., 1992). The authors state that such a lack of knowledge is attributable to the fact that health care providers are not informing their patients of the connection between diabetes and periodontal disease.

Factors Associated with Oral Disease and Diabetes from International Studies:

- Duration of diabetes (more than age)
- Lack of knowledge of oral health problems associated with diabetes – may be due to lack of provider knowledge.

Several articles explore internal or individual factors that motivate or inhibit diabetic patients' oral health behaviors, factors such as those patients' knowledge, attitudes, and beliefs. Studies conducted in Finland portray how different theoretical models describe oral health behaviors among diabetic patients (Kneckt et al., 2000; Kneckt et al., 1999; Kneckt et al., 1999; and Syrjala et al., 1999). The motivation attribution theory (Weiner, 1995) postulates that "most people assign causes to their success or failure." A study by Kneckt et al.'s (2000) on the attribution theory found that the theory *did* prove true in that patients did attribute effort and ability as a cause for their success and lack of effort was stated as a cause for failure. Lack of effort was attributed to laziness and poor motivation for maintaining glycemic control. Kneckt et al. (2000) further conclude that the link between diabetes and oral health behaviors is made up of behavioral factors; therefore, any treatment or education protocol must take into consideration a patient's belief that he or she is responsible for both health problems and solutions.

Another theory used to describe motivators for health behavior is the locus of control. The locus of control theory (Rotter, 1966) states that

> …a person has an internal locus of control is he/she interprets events as being dependent on his/her own behavior or stable characteristics, and external control when he/she thinks that events are in some way contingent upon luck, fate, chance, or the influence of other powerful persons.

Kneckt et al.'s (1999) study on the locus of control model concluded that there was no association between diabetes locus of control and oral health behavior. Despite this conclusion, the authors state that there is a correlation between locus of control beliefs and other forms of health behavior.

Kneckt et al. (1999) and Syrjala et al. (1999) describe how the concept of self-efficacy influences oral health behavior. As developed by Albert Bandura (1977), the self-efficacy model describes how an individual will avoid activities in which he or she has the perception that he or she will fail, but engages in activities in which he or she feels he or she can complete successfully. Both articles demonstrated a relationship between dental self-efficacy and the presence of dental caries. Specifically, diabetes self-efficacy as defined by the perception of being able to maintain metabolic control, is positively correlated with reported visits the dentist. Individuals with diabetes, who had a higher blood glucose level (poor glycemic control), had lower levels of dental self-efficacy. These results were independent of age, sex, and level of education. Syrjala et al. (1999) suggests that psychological and behavioral factors also play a role in oral health behavior and diabetes self-management. A patient with diabetes who believes that dental and diabetes care are important may have a higher self-efficacy, which translates into better overall health behaviors.

Psychological Theories Used to Describe Oral Health Behaviors of Diabetic Populations

Attribution theory – Individuals assign causes to their failures or successes. An explanation for the outcomes makes a person feel more in control of his or her life. Patients *do* feel that applied effort and ability is a cause of successful oral health behaviors.

Locus of control - Individuals interpret events as being independent or dependent of their own behavior. There was no association between locus of control and oral health behavior; however, locus of control has been a predictor for other types of health behavior.

Self-efficacy – Individuals will avoid activities in which there is a perception that he or she will fail, but engage in activities in which he or she feels he or she can complete successfully. Self efficacy has been positively correlated with visits to the dentist among diabetics.

X. Current Issues By Type of Audience for Diabetes Eye Complication Literature

Much of the reviewed literature on diabetes is focused on eye complications resulting from uncontrolled diabetes. The important topic of complications relating to the eye is widely addressed in the literature. Since eye complications can develop without overt symptoms, it is essential that all participants in diabetes care (the system, the provider, and the patient) are aware of the recommendations for detection and care.

A. System/Organization

System changes are an essential part of the process for providing appropriate care to diabetes patients. Since eye complications can go unnoticed and untreated for a long time, it is important to have systems in place which detect, especially in the early stages, eye complications. Evidence suggests that physician compliance with clinical practice recommendations for eye care exams is low. Because of this fact, Bowyer (1997), Bresnick et al. (2000) and Lee et al. (2000) identified ways in which systems of care can be changed to increase compliance with recommended eye examinations. Bowyer (1997) describes a public health approach to diabetes care through the

coordination of a multidisciplinary team, which provides eye care to patients with diabetes in an Indian Health center. The identified diabetes care team played an integral role in establishing priorities for care, choosing guidelines and establishing protocols for the screening and treatment of diabetes patients. A computer registry program was also created in order to document the care and treatment provided to the diabetic patient. Bowyer (1997) attributed an increase in exam rates to the implementation of the program and concluded that the community approach to the program helped make it a success. The program was able to draw on existing community resources through a partnership with the community and this aided in the implementation of the program.

Based upon Bresnick et al.'s (2000) conclusion that compliance with current clinical practice guidelines is poor, the authors propose that a change in clinical practices can be made through the use of specifically defined criteria used for evaluating the eye. This criterion is based upon the severity of retinopathy identified through screenings of the posterior fundus (part of the eye opposite the pupil). In the study, the authors found that the use of defined criteria did in fact increase the amount of appropriate referrals to eye care specialists among the clinic's diabetes population.

System Changes:

- Use of multidisciplinary care teams improves the number of appropriate screenings conducted for diabetes patients.
- Use of an algorithm for care increases the rate of appropriate referrals for eye care and screenings.

B. Health Care Providers

Both health care providers and patient-focused elements play a role in eye health outcomes. Melville et al. (2000) state that "the effectiveness of screening for prevention of blindness depends on the method used, the competence of the screener, screening interval, and organizational or other factors which affect the uptake of screening." The most effective method for diagnosing retinopathy is through a dilated eye exam. To obtain accurate results, the exam must be conducted by an individual who is highly trained and skilled in conducting the exams and interpreting the results (American Diabetes Association, 2001). Through a review of literature, Bresnick et al. (2000) conclude that although primary care physicians can be trained to conduct direct ophthalmoscopic exams, they may not be able to provide the most reliable interpretation of the exams. Both Ettinger et al. (1993) and Bresnick et al. (2000) state that the primary care physician's fundamental role is medical management by serving as a patient's first point-of-contact with the eye care system and appropriately referring diabetic patients to eye specialists. Thus, Bresnick et al. (2000) suggest that providing a screening protocol for primary care physicians might be more effective than incorrect eye exam procedures or possible misinterpretations of exam results by primary care physicians.

Awh et al. (1991) conducted a study to evaluate the effects of a four-hour course on the recognition and management of retinopathy by physicians who are not ophthalmologists. Through a four-hour training session, physicians were taught techniques for conducting direct ophthalmoscopy and papillary dilation. Information on epidemiology and clinical staging of retinopathy and appropriate intervals for eye exams was also presented at the training session. After the session, physicians were encouraged to conduct dilated exams on their diabetic patients. The authors concluded that the four-

hour education course did improve clinical knowledge and diagnostic accuracy of retinopathy. One significant limitation to this study was the lack of long-term follow-up. These results are representative of a two-week follow-up review.

Health Care Provider Barriers to Providing Dilated Eye Exams:

- Lack of recent knowledge on medical techniques related to the eye and treatment for eye complications.
- Fear of making a mistake when conducting dilated eye exams.
- Lack of confidence in correctly diagnosing a patient.

Despite the fact that Awh et al. (1991) demonstrated how a brief training program brought about a change in provider knowledge of the appropriate methods for conducting a dilated fundus exam, as well as knowledge of retinopathy, many gaps still exist between physician referral and care practices and the care actually received by the diabetes patient. Several articles evaluate primary care physician referral patterns for diabetic eye exams (Ettinger, et al., 1993; Moss et al., 1995; Kraft et al., 1997; Yung et al., 1995 and Klein, 1994). Both Kraft et al. (1997) and Yung et al.'s (1995) studies concluded that physicians who do not refer patients to an ophthalmologist for a dilated exam are also not likely to conduct a dilated exam themselves. Yung et al. (1995) identified the following possible reasons for lack of referrals: lack of knowledge of diabetes eye care guidelines, improper training in funduscopic examination techniques, and lack of knowledge about recent advances in eye care and treatment technology. Klein (1994) also discovered that fear of making a mistake and lack of confidence in correctly diagnosing the exam are barriers for physicians to conducting dilated eye exams.

Patterns of Care among Health Care Providers:

- Referrals to eye care providers tend to be made when a patient demonstrates acute symptoms.
- Type II diabetics are less likely to be screened than are type I patients, because type II is perceived as less severe.
- Density of ophthalmologists in a geographic area has an impact on referral patterns.

Ettinger et al. (1993) concluded referrals to eye care specialists by primary care physicians are driven by acute, symptomatic problems. Lazaridis et al. (1997) and Kraft et al. (1997) demonstrate that physicians are less likely to screen type II diabetes patients than they are to screen patients with type I diabetes. Physicians who reported a difference in risk levels for the two types of diabetes felt that type I patients were at greater risk for eye complications. Physicians were also more likely to refer type II patients to an optometrist and type I patients to an ophthalmologist. This pattern of referrals became more pronounced in non-metropolitan counties where the density of ophthalmologists is less than metropolitan areas.

- Who Conducts the Screening Exam Is Important for Validity of Results
- The primary care physician's role is to serve as a gatekeeper for care and to make referrals as appropriate to eye care specialists.
- *Enabler:* Providing a screening protocol for primary care physicians might be more effective than incorrect eye exam procedures or possible misinterpretations of exam results by primary care physicians.
- Primary care physicians can improve their knowledge of appropriate exam techniques and referral patterns through

Both Olsen et al. (1991) and Foster et al.'s (1996) studies focused on the diabetic practice patterns of optometrists in urban areas. Through a survey of optometrists listed in the telephone directory's yellow pages, Foster et al. (1996) found that over half of the optometrists indicated that dilated funduscopic examinations were available at a relatively low cost. All of the optometrists surveyed self-reported being comfortable educating their diabetic patients about the option of dilated funduscopic exams. Similarly, Olsen et al. (1991) found that the majority of optometrists provided dilated exams and those who did not offer dilated eye exams were more likely to refer the patient to an ophthalmologist for follow-up care.

C. Patients with Diabetes

Several articles discuss the barriers patients face to obtaining appropriate eye exams (Klein 1994; Brechner et al., 1993; Moss et al., 1995; Will et al., 1994; Walker et al., 1997; and Wylie-Rosett et al., 1995). The asymptomatic nature of retinopathy and being uninformed of the need for dilated eye exams are barriers identified by Klein (1994). Both Brechner et al. (1993) and Moss et al. (1995) concluded that socioeconomic factors such as educational attainment, income, and insurance status were independently associated with having received an eye exam. Moss et al. (1995) stated that socioeconomic factors have less of an impact in the older diabetes onset group, compared to those diagnosed at a younger age. Brechner et al. (1993) also identified that having received diabetes education and having knowledge about retinopathy are both associated with higher levels of compliance in receiving eye exams.

Factors to Receiving Eye Exams

- Asymptomatic nature of retinopathy
- In terms of eye exams, socioeconomic factors are more pronounced among the younger onset diabetics.

Barriers to Receiving Eye Exams

- Lack of knowledge of the need and purpose of dilated exams.
- Low educational attainment, low income and low insurance status.

Enablers to Receiving Eye Exams

- Having had a diabetes education class.
- Having a high density of ophthalmologists in patient's geographic area.

Another factor that influenced a patient's ability to receive appropriate care is the density of ophthalmology providers in the patient's geographic area (Wang et al., 1996). In areas that reported fewer ophthalmologists per 100,000 people, such as rural areas, there were fewer reported visits to receive eye exams.

D. International

Three articles described patient compliance to eye care exams and the outcomes of community-based programs in Australia (Lee et al., 2000; Lee et al., 2000; and McCarthy et al., 1998). McCarthy et al.'s (1998) study reiterated the findings of several studies in the United States that the majority of patients surveyed were not receiving the recommended eye screenings. As was also found in the United States, there is a discrepancy between the physician-reported screening rates and the record of the number of screenings actually performed. Lee et al. (2000) conducted a community-based, mobile-clinic screening program in Victoria, Australia. To recruit diabetes patients to the screenings, Lee et al. (2000) used targeted mail-outs, brochures in English and other local languages, media promotion in ethnic and statewide newspapers and radio. Anecdotal evidence showed that the recruitment mail-outs were successful due to the number of inquiry calls received directly following the mail-out. In a two-year follow-up survey to the screening program, 87% of the participants reported receiving the recommended eye exams after their participation in the initial screening at the mobile eye clinic.

- Discrepancies exist between the physician-reported screening rates and the record of the number of screenings actually performed.

Enabler to increase screening:

- Use of mail-outs and local media was found to be effective in recruiting diabetic patients to a mobile clinic.

E. Minority Populations

Several studies identified enablers and barriers to receiving eye exams among the minority populations (Wang et al., 1996; Walker et al., 1997; Will et al., 1994; Baker et al., 1998; and Wylie-Rosett et al., 1995). A study conducted in an African American population (Walker et al., 1997) identified external motivators such as doctor -recommended dilated exams and spiritual motivators, such as faith in God and hope, as reasons for seeking care. However, economic and logistical factors such as lack of insurance, cost, and lack of child care were principal reasons for not seeking eye exams. Participants in the study indicated that the discomfort of a dilated exam did not stop them from seeking care; rather, they were prevented by the fear of the consequences, such as surgery, of an eye exam.

- Minority populations are not receiving proper preventive eye exams.
- Minority populations are more likely to receive tertiary care rather than primary care.

Will et al. (1994) concluded that individuals who had not previously had an eye care exam were less likely to comply with recommendations for eye care. However, after participating in a state blindness program, where patients received eye exams, were educated on the need for annual eye exams and were educated on the importance of adhering to treatments, diabetes patients were more likely to seek the recommended eye exams.

Enablers to receiving eye exams and appropriate eye referrals:

- Doctor recommendation for eye care
- Spiritual motivators (faith in God and hope)
- Education on need for annual exam and on the importance of adhering to treatment.

Barriers to receiving eye exams and appropriate eye referrals:

- lack of insurance
- cost of eye exams
- lack of child care
- not having had an eye exam in the past
- fear of consequence of eye exam (surgery) over comfort of a dilated exam.

These studies (Wang et al., 1996; Walker et al., 1997; Will et al., 1994; Baker et al., 1998 and Wylie-Rosett et al., 1995) also illustrate that socioeconomically disadvantaged minority populations are not receiving proper preventive eye exams and that these characteristics put patients at a higher risk for developing complications. Baker et al. (1998) found that in an African American and Hispanic population in Los Angeles, patients receive less primary and more tertiary care. As a result, those patients who were receiving dilated eye exams at an initial ophthalmic visit had already developed eye complications.

XI. Summary of Findings

Please see Appendix A for summary tables.

Appendix A

Summary Tables for:
Findings of Population by Diabetes Complication
Findings of Audiences by Diabetes Complication

Summary Table for Findings of Population by Diabetes Complication

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Population				
General Population	Risk Factors for developing diabetes: • Genetic factors (family history, thrifty gene). • Obesity: adiposity and regional fat distribution. • Diet. • Lack of physical activity. • Social and environmental factors.	Risk Factors for developing foot complications: • Poor glycemic control • Smoking • Hypertension • Duration of diabetes Recommendations for care: • Prim • ary care provider conducts foot exams at every visit (minimum 4 times per year). • Patients play an active role in care through self-management and proper foot hygiene.	Risk Factors for developing oral complications: • Poor glycemic control • Poor oral hygiene • Smoking • Age • Duration of diabetes Recommendations for care: • Bi-annual check-ups by an oral health provider. • Self-management – brushing and flossing of teeth, glycemic control. • There is a synergistic relationship between diabetes and oral health (poor oral health leads to eating foods inappropriate for glycemic control and interns leads to oral complications).	Risk Factors for developing eye complications: • Duration of diabetes • Poor glycemic control Recommendations for care: • Annual dilated eye exams
Minority General Population	• Minorities have a higher risk for developing complications compared to non-minority populations. • Low economic status renders minorities more vulnerable to discontinuities and fragmentation of health care. • Patient education was effective in improving diabetes health outcomes and improving self-efficacy. • *Enablers*: Programs that use peer education and local media are	• A very small number of patients are receiving care in inner-city hospitals report receiving foot exams. • Disparities of incidence of foot complications exist between whites and non-whites.	• There is a lack of information on minority populations with diabetes and periodontal disease. Those more susceptible to developing periodontal disease: • those with a long duration of diabetes. • those with other diabetes related complications. • teenagers and pregnant women. • those who have poor oral hygiene behavior.	• Minority populations are not receiving proper preventive eye exams. • Minority populations are more likely to receive tertiary care rather than primary care. *Enablers to receiving eye exams and appropriate eye referrals:* • Doctor recommendation for eye care. • Spiritual motivators (faith in God and hope).

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Population				
	effective in changing knowledge, attitudes, and beliefs of minority populations.		• those who have poor glycemic control.	• Education on need for annual exam and on the importance of adhering to treatment. *Barriers to receiving eye exams and appropriate eye referrals:* • lack of insurance • cost of eye exams • lack of child care • not having had an eye exam in the past • fear of consequence of eye exam (surgery) over comfort of a dilated eye exam.
Native American	• Diabetes is the 4th leading cause of death in this population. • Among Pima Indians, 50% of the population has type II diabetes. • Due to changing diets and fewer fluctuations in food supply and decreased physical activity, diabetes is highly prevalent among Native Americans. • Diabetes education on self-efficacy and diabetes self-management plays a role in changing knowledge, attitudes, beliefs and behavior.	• Among Native Americans, foot exams by themselves does not reduce the risk of amputations. Education and proper preventive care is also needed. • Among Native Americans, rates of lower extremity amputation are three to four times greater than the general population.	• Pima Indians (Native American) population has high prevalence of diabetes which has been linked with periodontal disease.	• Native Americans are disproportionately affected by diabetic retinopathy compared to whites. • 18% of Pima Indians have some form of retinopathy.

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Population				
African American	• Diabetes is the 7th leading cause of death in this population. • African Americans reported the fewest hours of diabetes education compared to Mexican Americans and non-Hispanic whites.	• Among African-Americans, foot care education can decrease the risk of amputations. • *Barriers* to doing foot care self-management that have been reported among African-Americans include: lack of motivation, forgetfulness vision problems, joint and knee problems, and family responsibilities. *Enabler:* • The simplicity of instruction and the provision of a hand-held mirror for foot inspection were well received in an African American population.	• Little information is known in the reviewed literature on the prevalence and incidence of oral complications due to diabetes.	• The prevalence of diabetic retinopathy is higher in African Americans compared to whites. • The occurrence of retinopathy is associated with hypertension, and the African America population has higher rates of hypertension than whites.
Hispanic/Latino	• Diabetes is the 7th leading cause of death in this population. • Disparities exist in treatment and management among the Hispanic/Latino populations compared to non-Hispanic whites. • Delivering diabetes care to Latinos needs to be through the primary care providers and conducted in a team approach. *Enabler*: • Peer educators from the local Hispanic/Latino community used to deliver diabetes education is an effective way to motivate behavior change.	• Mexican Americans reported greater prevalence of neuropathy than whites or African Americans.	• Hispanic/Latinos (Mexican Americans) are less likely to visit a dentist than whites.	• 32-40% of Mexican Americans with diabetes have retinopathy.

Summary Table for Findings of Audiences by Diabetes Complication

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Audience				
System/Organization	Approaches: • *Multidisciplinary team* – a system of services in which all members of the health care team are devoted to maintaining the overall health of the patient with diabetes. • *Population-based approach*: - diabetes registry system - diabetes care teams - evidence-based guidelines. • *Single component change*: - feed back system - algorithm for care.	Approaches: • A coordinated system of care that includes a variety of health care professionals can reduce the risk of lower-extremity amputations for diabetics. *Barrier:* • Lack of time for patient to remove footwear for exam and to complete diabetes flow sheet. • Clinics focused on addressing patient's main compliant during a visit, missing additional opportunities for preventive care. *Enablers:* • Critical pathways approach to care can lead to earlier diagnosis and treatment (and hence, better outcomes) of foot complications. • The use of a risk categorization system predicts better outcomes for high-risk patients because once identified, such patients can be closely monitored and given necessary treatment.		Approaches: • Use of *multidisciplinary* care teams improves the number of appropriate screenings conducted for diabetes patients. • Use of an *algorithm* for care increases the rate of appropriate referrals for eye care and screenings.

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Audience				
Health Care Provider	• Health care provider is an essential point-of-contact for diabetes care. • Low adherence to recommendations from diabetes screening guidelines for oral and foot exams. • Higher rates of recommendations for care for type I than for type II diabetes patients. *Barriers*: • Patient refusal to adjust medication according to recommendations. • Patient refusal or inability to self-monitor blood glucose. • Patient refusal or inability to keep appointments, preventing opportunity to give recommendation. • High staff turnover rates in clinics. • Short appointment times limit the issues that can be addressed.	• Physicians must be able to identify risk factors and classify patient's risk for amputation. • Providers must be able to advise patients on appropriate techniques for self-maintenance and glycemic control. • Physicians have difficulty identifying those patients at risk for neuropathy. • More education from providers to patients can lessen a patient's risk for neuropathy. • *Enabler*: Clinical practices were positively influenced after physicians received foot-care practice guidelines and education on risk factors, appropriate referrals, and foot exams.		• For valid screening results, an individual trained in conducting and interpreting eye exams is needed. • The primary care physician's role is to serve as a gatekeeper for care and to make referrals as appropriate to eye care specialists. • Primary care physicians can improve their knowledge of appropriate exam techniques and referral patterns through short education classes. *Patterns of care among health care providers:* • Referrals to eye care providers tend to be made when a patient presents with acute symptoms. • Type II diabetics are less likely to be screened than type I because type II is perceived as less severe. • Density of Ophthalmologists in a geographic area has an impact on referral patterns. • Optometrists can provide dilated eye exams. *Barriers to providing dilated eye exams*: • Lack of recent knowledge on medical techniques related to the eye and treatment for eye complications. • Fear of making a mistake when conducting dilated eye exams. • Lack of confidence in correctly diagnosing a patient.

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Audience				
Patient with Diabetes	• Lowest compliance to diabetes care recommendations among patients was for foot exams. • *Enabler*: Patients are more likely to receive recommended care if the provider has a reminder system for scheduling follow-up appointments.	*Intrinsic factors affecting patients:* • Duration of diabetes, age, weight, neuropathy, decreased visual acuity, limited joint mobility and structural deformity. • Patients are often unsure of how they can prevent neuropathy themselves. *Extrinsic factors affecting patients:* • Smoking, trauma to foot, social support systems, patient education. *Fact*: • Patients who have not had any diabetes education are more than three times more likely to have a lower-extremity amputation than those patients that have taken had diabetes education. *Barriers to seeking regular foot exams*: • Lack of obvious foot or leg problems. • Poor vision, obesity, and impaired mobility. • Transportation has not been shown to be a barrier. *Enablers*: • Strong social support systems for patients. • High quality diabetes education. • Having diabetes education classes that are convenient (in terms of time and location) for patients to attend. • A one-hour class on foot care has been shown to reduce a patient's risk for amputations and ulcers.	*Barriers to good oral health behaviors:* • Income level • Cost of oral care • Lack of perceived need • Lack of insurance overage *Enablers to good oral health behaviors:* • Family function • Primary care physician as entry point into comprehensive dental health care system.	*Factors to receiving eye exams:* • Retinopathy is asymptomatic • In terms of eye exams, socioeconomic factors are more pronounced among the younger onset diabetics. *Barrier to receiving eye exams*: • Lack of knowledge of the need and purpose of dilated exams. • Low educational attainment, low income and low insurance status. *Enablers to receiving eye exams*: • Having had a diabetes education class. • Having a high density of ophthalmologists in patient's geographic area.

	Findings by Complication Type			
	General	**Foot**	**Oral**	**Eye**
Findings by Audience				
International	• Lowest compliance for care among diabetes patients was for foot exams, as found in a US study. • A gap exists between provision of care reported by the provider and receipt of care reported by the patient. • Education programs targeted at diabetics improved patient self-management behaviors. • *Barriers to care*: lack of diabetes case management and limited appointment time to address multiple health issues. • *Enabler to care*: use of community pharmacists to provide diabetes education and monitoring.	• Confirming studies conducted in the US, a multidisciplinary team approach to diabetes foot care improves complication outcomes.	Factors associated with oral disease and diabetes: • Duration of diabetes (more of a factor than age of patient). • Lack of knowledge of oral health problems associated with diabetes (may be due to lack of provider knowledge). • The self-efficacy model, theory of attribution and locus of control were used to describe how an individual's knowledge, attitude, beliefs or behavior influenced his or her oral health outcome.	• Discrepancies exists between the screening rates reported by physician and the recorded number of screenings actually performed. *Enabler to increase screening:* • Use of mail-outs and local media was effective in recruiting diabetic patients to a mobile clinic.

Appendix B

Logic Models
Foot, Oral and Eye Frameworks

FOOT Framework[1] (Overall Focus: Primary Care for 4 Audiences especially African Americans, Latinos, Native Americans and Asian Americans)

Audiences	Inputs	Activity	Barriers	Effects	Ultimate Outcomes
People with diabetes who are at risk for developing complications	Environmental Inputs/Factors (e.g. Media, Political & Popular Culture, etc.) Health Care Settings (e.g. Urban, Rural, Health Center, Mobile Clinic)	**Self management of diabetes (e.g. daily self FEET exams)** Action to facilitate increased physical activity, proper nutrition, etc. Active educational efforts to change or increase KAB about diabetes complications	**Lack of audience knowledge and understanding about risk factors for diabetes and FOOT complications**	**Increased social and environmental support for diabetes FOOT complications** **Greater understanding of Diabetes and FOOT complications**	**Reduced FOOT complications from Diabetes** (Reduced ORAL and EYE complications from Diabetes)
	Prevention & Early Detection Planning **Partnership development between internal medicine, and the FOOT care profession**	**Increased awareness of warning signs for FOOT complications** Community Involvement (Advertising/ Communication of FOE Complications)	Audience Risk Behaviors (e.g. poor diet, smoking, inactivity, etc.)	Changed KAB and self-efficacy regarding self-management of diabetes and its complications Access to Quality Care	**Better Health Outcomes for FEET** **Decrease in incidence of neuropathy and lower extremity amputations**
Health Care Providers - Primary Care Physicians - Diabetes Specialists	***Cultural beliefs and attitudes about diabetes and its complications***	**Programs/Interventions to help facilitate primary care prevention and management of FOOT complications.**	**Cost to patient for health insurance and FOOT care**.	Care giver consensus on complications and agreement to target at-risk populations	Better Quality of Life for patients and caregivers
	Enablers (e.g. Actions taken to help people with Diabetes manage their disease) Support Systems for Patients	**Changed Provider (e.g. primary care and FOOT health practitioners) Practice Patterns** **Collaboration between primary care and FOOT health practitioners**	Lack of Provider time to focus on all aspects of patient health care during a health care visit	**Change in physician referral pattern to FOOT specialists and provision of information to patients about FOOT complications**	
	Screening for FOOT Complications System Approach (versus Caravan Style Approach) to Diabetes prevention and prevention of complications	**Clinical science promoting link between diabetes and FOOT complications**	Lack of Provider Knowledge about complications and lack of cultural competency for provision of health care services		

1 The process, that is the inputs, activities, and barriers to outcomes, a person may encounter in dealing with diabetes and its complications.

ORAL Framework[1] (**Overall Focus**: Primary Care for 4 Audiences especially African Americans, Latinos, Native Americans and Asian Americans)

Audiences	Inputs	Activity	Barriers	Effects	Ultimate Outcomes
People with diabetes who are at risk for developing complications	Environmental Inputs/Factors (e.g. Media, Political & Popular Culture, etc.) Health Care Settings (e.g. Urban, Rural, Health Center, Mobile Clinic)	**Self management of diabetes (e.g. examination of teeth and gums; visits to dentist twice a year)** Action to facilitate increased physical activity, proper nutrition, etc. Active educational efforts to change or increase KAB about DCom	**Lack of audience knowledge and understanding about risk factors for diabetes and ORAL complications**	**Increased social and environmental support for diabetes ORAL complications** **Greater understanding of Diabetes and ORAL complications**	**Delayed onset of ORAL complications** (Reduced EYE and FOOT complications from Diabetes)
	Prevention & Early Detection Planning **Partnership development between internal medicine, and the Dentistry/ORAL health profession**	**Increased awareness of warning signs for ORAL complications** Community Involvement (Advertising/Communication of FOE Complications)	Audience Risk Behaviors (e.g. poor diet, inactivity, smoking, etc.) **Fear and pain experienced when visiting the dentist for ORAL care**	Changed KAB and self-efficacy regarding self-management of diabetes and its complications Access to Quality Care	**Better ORAL Health Outcomes:** *** Increased dental visits** *** Decrease periodontal disease** *** Decrease total tooth loss** ***Increase case finding and control**
Health Care Providers - Primary Care Physicians - Diabetes Specialists	***Cultural beliefs and attitudes about diabetes and complications***	**Programs/Interventions to help facilitate primary care prevention and management of ORAL complications**	**Cost to patient for health insurance and DENTAL care**.	Care giver consensus on complications and agreement to target at-risk populations	Better Quality of Life for patients and caregivers
	Enablers (e.g. Actions taken to help people with Diabetes manage their disease) Support Systems for Patients	**Changed Provider (e.g. primary care and ORAL health practitioners) Practice Patterns** **Collaboration between primary care and ORAL health practitioners**	Lack of provider time to focus on all aspects of patient health care during a health care visit	**Change in physician referral pattern to ORAL specialists and provision of information to patients about ORAL complications**	
	Screening for ORAL complications System Approach (versus Caravan Style Approach) to Diabetes prevention and prevention of complications	**Clinical science promoting link between diabetes and ORAL complications**	**Lack of provider knowledge about ORAL complications and lack of cultural competency for provision of health care services**	**Consistency of health care standards, guidelines and indicators addressing diabetes ORAL complications**	

1 The process, that is the inputs, activities, and barriers to outcomes, a person may encounter in dealing with diabetes and its complications.

EYE Framework[1] (Overall Focus: Primary Care for 4 Audiences Especially African Americans, Latinos, Native Americans and Asian Americans)

Audiences	Inputs	Activity	Barriers	Effects	Ultimate Outcomes
People with diabetes who are at risk for developing complications	Environmental Inputs/Factors (e.g. Media, Political & Popular Culture, etc.) Health Care Settings (e.g. Urban, Rural, Health Center, Mobile Clinic)	**Self management of diabetes (e.g. EYE screening every 2 years)** Action to facilitate increased physical activity, proper nutrition, etc. Active educational efforts to change or increase KAB about diabetes complications	**Lack of audience knowledge and understanding about risk factors for diabetes and EYE complications**	**Increased social and environmental support for diabetes EYE complications** **Greater understanding of Diabetes and EYE complications**	**Reduced EYE complications from Diabetes** (Reduced ORAL and FOOT complications from Diabetes)
	Prevention & Early Detection Planning **Partnership development between internal medicine, and the EYE health profession**	**Increased awareness of warning signs for EYE complications** Community Involvement (Advertising/Communication of FOE Complications)	Audience Risk Behaviors (e.g. poor diet, smoking, inactivity, etc.) **Fear and discomfort experienced when visiting EYE doctor**	Changed KAB and self-efficacy regarding self-management of diabetes and its complications Access to Quality Care	**Better EYE Health Outcomes** **Decrease incidence of blindness and diabetic retinopathy**
Health Care Providers - Primary Care Physicians - Diabetes Specialists	**Cultural beliefs and attitudes about diabetes and complications**	**Programs/Interventions to help facilitate primary care prevention and management of EYE complications**	**Cost to patient for health insurance and EYE care**.	Care giver consensus on complications and agreement to target at-risk populations	Better Quality of Life for patients and caregivers
	Enablers (e.g. Actions taken to help people with Diabetes manage their disease) Support Systems for Patients	**Changed Provider (e.g. primary care and EYE health practitioners) Practice Patterns** **Collaboration between primary care and EYE health practitioners**	Lack of Provider Knowledge about complications and lack of cultural competency for provision of health care services	**Change in physician referral pattern to EYE specialists and provision of information to patients about EYE complications**	
	Screening for EYE complications **Training on screening equipment for EYE care.**	**Clinical science promoting link between diabetes and EYE complications**	Lack of Provider time to focus on all aspects of patient health care during a health care visit		
	System Approach (versus Caravan Style Approach) to Diabetes prevention and prevention of complications				

1 The process, that is the inputs, activities, and barriers to outcomes, a person may encounter in dealing with diabetes and its complications.

Appendix C

Bibliographies:
Bibliography for Background References
Bibliography for Diabetes Complications

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