MSU Michigan Applied Public Policy Research Grant
Project Report
Executive Summary
A Risk-Based Model of Diabetic Case Management:
Improving the Quality of Primary Care for the Michigan Medicaid Diabetic Population

Principal Investigator: Grace Kreulen, PhD, RN (MSU)
Co-investigators: Julie Lundvick, Mary Wilson & David Faichney (St. Mary's Health Systems, Grand Rapids, MI), Manfred Stommel (MSU)

The overall purpose of this study is enhancement of the quality of primary care to the Michigan Medicaid diabetic population. This study examined characteristics of a population low-income patients with diabetes receiving primary care in southwestern Michigan. A sample of 446 medical records was audited to obtain descriptive information about the sample. The data provide a one-year window from which to view the characteristics and care of a low-income diabetic population. The population studied was primarily female, middle age, English-speaking, and not employed. White, Black and Hispanic ethnic groups were equally represented in the sample. Sixty-five percent were enrolled in Medicaid with the remainder not insured.

Specific Aims

The specific aims of this study were to:

1) Identify factors that place the Michigan Medicaid and low income individual with diabetes at risk for poor health outcomes and high cost care; and
2) Develop a diabetic risk profile that delineates risk factors predictive of negative outcomes in this population.

Findings

Specific Aim 1. Risk characteristics present in this low income population include obesity, high levels of smoking and alcohol use, poor glycemic control, hypertension, obesity, lipidemia, inactivity, difficulty accessing diabetes medications and supplies, and coexisting chronic diseases. Two-thirds did not get the recommended annual ophthalmologic exam, suggesting difficulty accessing care and inadequate care management. The amount of missing data related to laboratory tests and evaluation for development of chronic diabetes complications suggests lapses in care protocols that can also increase risk for poor outcomes.

The low-income diabetics studied were primarily type 2 diabetics (95%) who were diagnosed in their 40th decade of life. In addition to diabetes, they had 4 other medical diagnoses (including diagnosed complications of diabetes). Eighty-six percent of the patients had developed at least one chronic diabetes complication, and 22% had severe complications that were clinically non-reversible. The chart audit revealed that 24% had nephropathy, 12% retinopathy, 77% had cardio, coronary and/or cerebral vascular disease, 40% had peripheral vascular disease, 23% had peripheral neuropathy and 12% had autonomic neuropathy. Over the course of the audit year, the greatest degradation in complication level occurred in peripheral vascular and cardiovascular disease, with 10% and 9% of the cases having worse disease, respectively. Blood glucose levels and blood pressure were moderately elevated (HbA1c = 8.4, BP = 136/82). One quarter had foot lesions and 1/3 had elevated renal function tests.

In terms of diabetes risk factors, 35% were current smokers (53% total smokers), 12% had abused alcohol, and 9% had abused drugs. Additionally, 59% were obese, 62% were hypertensive,

and 51% had elevated lipid levels. The average weight was 206 lbs. with a Body Mass Index of 34. Two-thirds had a family history of diabetes and 1/3 had a psychiatric disease history. In terms of functional and self-care status, 90% ambulated independently, 65% performed SBGM (83% of these1-4 times daily), 43% had an exercise self-care plan and 38% performed foot exams. Many (80%) had trouble accessing diabetes medication and supplies.

The patients studied had high numbers of clinic, phone, and subspeciality visits during the year when compared with non-diabetic patients, however, they were not high for a diabetes diagnosis. On the average 8 clinic visits, 5 phone visits and 3 referral visits were made by each low income diabetic. During the audit year patients, on the average, received physical exams 5 times, foot exams 3 times, blood pressures and weights 8-7 times, discussions of blood glucose levels 6 times and exercise 1 time, review of medications 5 times, and diabetes care teaching 2 times. Provider practice style appeared adequate and most patients appeared to participate in decision making during clinic visits. Lab exam of blood glucose (HbA1c) were done 2 times, lipids 1 time and renal tests 1.5 times. During the year, referrals to ophthalmologists were made for 2/3rd of the cases, but only 1/3rd of the charts indicated that the visit was made. Referrals to podiatrists were made in 1/5 of the cases and to registered dietitians and certified diabetes educators in 1/3rd of the cases. Additionally, 18% of the population experienced admission to either the emergency department or hospital during the year (average 0.34 admissions).

While the amount and type of care receive appears adequate, the chart audit revealed large amounts of standard diabetes care information was missing, especially related to recommended laboratory tests and documentation of examination for chronic diabetes complications. There were inadequate hemoglobin A1c blood glucose tests, complete lipid and renal function tests, and height measurement. Additionally, there was missing information in more than 30% of the charts that suggest inadequate checking for the silent signs of nephropathy, retinopathy, peripheral neuropathy and autonomic neuropathy.

Specific Aim 2. Risk profiles were identified for the outcomes of non-reversible diabetes complications and hospital/emergency admissions.

Non-reversible complications. Factors which increased the likelihood of having non-reversible diabetes complications were enrollment in Medicaid, receiving care exclusively from a MD/DO, higher blood glucose levels, longer duration of diagnosis, increasing age, being male, and physical inactivity.

Hospital/emergency admissions. Clinical factors were such strong predictors of admission that they overpowered the non-clinical factors, making them non predictive. Among the clinical factors, difficulty with metabolic control increased risk for admission. Experiencing moderate to severe hypoglycemia was associated with a much higher risk for admission than any other variable, and having moderate to severe hyperglycemic reactions also contributed. When non-clinical factors were considered alone, the most important factors that increased risk for admission were alcohol abuse, doing self-blood glucose monitoring, experiencing difficult adjustment to diabetes diagnosis and care, physical inactivity, receiving care from both a MD/DO and NP/PA or a MD/DO alone, and being male.

Policy Implications

Policy recommendations from this study include:

1. Increased reimbursement for preventive care for low income diabetics that will promote better blood glucose management, effective self-care, and prevention of acute and chronic complications. Options for supplementary support interventions for the highest risk include:

- A risk-based nurse case management system that would provide extra services to high risk patients to enhance glycemic control and care follow-up.
- A computer-based telephone intervention system to assist low income diabetics in control of blood glucose levels and other care management concerns.

2. Inclusion of language in Medicaid managed care contracts to insure provision of:
   - Screening for all diabetes complications on each routine diabetes visit and early treatment of all diabetes complications.
   - Incentives for referrals to ophthalmology, dietitians, educators and podiatry.
   - Training for providers to increase their ability effectively work with individuals who have the increased burden of being in the lower socioeconomic strata.
   - Diabetes screening of all patients and prompt effective treatment when diagnosed.
   - Obesity screening of all patients and prompt effective treatment when indicated.
3. Development of a diabetes-specific risk-adjusted Medicaid capitation payment system that will better support the cost of delivering essential diabetes care services to the low income.

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The overall purpose of this study is enhancement of the quality of primary health care services to the Michigan Medicaid diabetic population. Quality care for this population includes coordinated and continuous comprehensive health and educational services that are tailored to the special needs of low-income persons. This study involved an in depth audit of the medical charts of low income persons receiving primary care for diabetes to identify and describe factors that put low income diabetics at risk for poor health outcomes and high cost system utilization.

Review of the literature. Diabetes is the 7th leading cause of death in Michigan and in the US. Approximately 15 million Americans and 375,000 Michigan residents have been diagnosed with diabetes. Total cost for health care of diabetics is four times greater than for nondiabetics (Rubin, Altman & Mendelson, 1994). In 1994, estimated costs for diabetes care in Michigan exceeded $2 billion (80% from hospitalization), while lost productivity due to premature death, illness and disability cost Michigan citizens an additional $2.1 billion (MCHD). Outcomes data collected by the Michigan Diabetes Outreach Network in 1995 showed that 50% of the 7,800 diabetics surveyed had experienced one or more hospitalizations in the previous 12 months. Thirteen percent of these Michigan diabetics were African American, 2.8% Hispanic, 3.5% American Indian and 59.2% white. Blacks are twice as likely to have diabetes than whites and are more likely to experience diabetes complications and disability (Ford, Tilley & McDonald, 1998).

Diabetes is a high demand, life long disease that requires careful management to prevent crisis events, reduce the development of secondary complications and decrease high cost utilization of emergency and hospital services. Clinical trials have demonstrated that complications of diabetes can be slowed or even prevented by intensive therapy and careful management of the disease (DCCT Research Group, 1993; UK Prospective Diabetes Study Group, 1998, Testa & Simonson, 1998). In ideal situations, 90% of diabetic care is self-administered and 10% is health system provided. If diabetics are to effectively care for their chronic condition(s), they must have sufficient self-care knowledge, skills, supplies, medications and health system support. Diabetics that are ill equipped to manage their personal care become high cost system users and develop serious complications such as kidney failure, nerve damage, hypertension, vascular disease, blindness and lower extremity amputation. Diabetics require continuous, comprehensive and supportive primary care services to maintain wellness (McCulloch, 1998). They are ill-served by an episodic primary care system structured to respond to acute patient problems only.

Although most of the Michigan Medicaid population is in managed care health plans, access to needed primary care and educative services continues to be problematic. Low-income individuals with chronic conditions are especially vulnerable to health care quality problems and increased burden of poor health (Commission on Consumer Protection and Quality in the Health Care Industry, 1998). Vulnerable populations have fewer societal and environmental resources (including

education, employment, social connectedness, social status power) and increased exposure to risk factors (related to nutrition, exercise, alcohol, cigarettes, drug use, health care access) (Flaskerud & Winslow, 1998). These 'vulnerability factors' interact to limit the person's ability to access care, receive appropriate care from qualified health providers and communicate with providers. Primary care providers in general have difficulty providing the intense level of care now required for proper diabetic management, and find it almost impossible to meet the complex care needs of vulnerable diabetics.

Nurse diabetes case management services provided to diabetics in primary care (Mazzuca et al, 1997; Weinberger et al, 1995) and managed care settings in Georgia, Florida, Tennessee and Maryland (Aubert et al, 1998; Capitation Management Report, 1998; LoBianco, Mills & Moore, 1996, National Health Information, 1998) have been shown to result in improved glycemic control, improved health status and quality of life and lower costs of care. Advanced practice nurse case management models that match resources to risk have been shown to help those at highest risk avert costly health crises and complications (Forbes, 1999; Lamb, 1996; Phillips-Harris, 1998; Taylor, 1999). Risk-based disease management models are being used in capitated Medicaid settings and have delivered both lower cost and better care (Elias, 1998). A risk-based NP diabetes case management program is a cost-effective approach which can remove barriers to meeting the complex needs of vulnerable diabetics and enhance the quality of diabetic services available to the Michigan Medicaid population.

Aims. The public policy issue addressed in this study was enhancement of the quality of primary health care services to Michigan Medicaid population with diabetes. The specific aims of this study were to:

3) Identify factors that place the Michigan Medicaid and low income individual with diabetes at risk for poor health outcomes and high cost care; and
4) Develop a diabetic risk profile that delineates risk factors predictive of negative outcomes in this population.

The risk framework used in the study was adapted from the effectiveness model of Iezzoni (1997), which considers clinical and nonclinical factors in both patient and outcome domains that impact quality of care. This model was adapted to address the specific clinical and nonclinical aspects of diabetes care management. The list of risk and outcome categories, risk and outcome concepts and variables are presented in Table 1a and 1b.

This study is the first step in a diabetes primary care quality improvement effort focused on the development and implementation of a risk-sensitive advanced nurse practice model of diabetic care for use in Michigan Medicaid managed care primary practice settings. In future studies, a tool will be developed and tested to index risk in this group. The nursing diabetes case management model will 1) link patient risk level to stratified levels of diabetic care, and 2) specify care guidelines of varying levels of resource intensity for patients at low, moderate and high-risk for destabilization. The diabetes case management guidelines will be based on diabetic care standards (American Diabetes Association, 2001; MDCH, 1999) and will be designed to provide care that is accessible, acceptable, and meets the multifaceted health-related needs of low-income vulnerable diabetics.

Methods

This study was conducted in partnership with St. Mary's Health Systems Center for Diabetes and Endocrinology in Grand Rapids, Michigan. Data were obtained from a comprehensive audit of the charts of 446 low-income individuals receiving primary care for diabetes in the Grand Rapids area. Clinical and nonclinical factors impacting the diabetic's health status (including physical, psychoemotional, cultural, socioeconomic, and environmental factors) were identified via a

literature review and extensive collaboration with diabetic clinical experts. These factors became the basis for the chart audit variable list. Access to care, utilization, risk behavior, self-care behavior, demographic, social support, clinical/disease indicator and provider practice data were collected for each subject over a one-year period. Three clinical nurse researchers were trained in audit procedures and tested for interrater reliability. A total of 864 charts of low-income patients receiving primary care for diabetes were evaluated for inclusion in the study. Eligibility criteria were: diabetes mellitus (DM) diagnosis, 18 years or older, have first clinic visit between 1-1-97 and 1-1-2000, have health insurance that indicates low-income and have >= one clinic visit for DM diagnosis 9-12 months after the first visit. Clinic sites at which audits were conducted included 3 outpatient clinics (23% of audits) and 3 community-based clinics (29%) in the St. Mary's Health System, 2 Advantage Health community clinics (10%) and 1 Cherry Street Health Services clinic, a federally qualified community-based health center clinic (38%). Human subjects approval was received from MSU, St. Mary's Health Systems and Cherry Street Health Services of Grand Rapids. An ACCESS data entry program was developed for data entry and transfer. Data was collected for care received between January 1997 and May 2000. Investigators from the MSU College of Nursing conducted data analysis using sequential logistic regression techniques. Significant predictors from each category of patient and health system risk factors were combined and regressed on the outcome variables of non-reversible complications and hospital/emergency admission.

Findings

This report will 1) describe patient and health system factors thought to increase the low-income diabetic patient' s risk for negative health outcomes, and 2) describe factors predictive of non-reversible diabetes complications and high cost utilization in this population.

Description of the sample.

The sample for this study consisted of the charts of 446 low-income individuals receiving primary care services for diabetes mellitus at ten clinics in Grand Rapids, Michigan. Descriptive data for the sample are presented in Tables 2-7 and will be discussed in the remainder of this section.

Demographics (Table 2). The age range for the subjects was from 20 to 92, with a mean of 54 years. Fifty-nine percent were between the ages of 45 and 65. Approximately two thirds of the subjects were female (65%) and a third male (35%). The racial distribution in the subjects was quite equal, with 33% White, 36% Black and 26% Hispanic (6% other). The main language spoken was English (74%), however, one fifth of the sample's primary language was Spanish (20%). One quarter of the sample was employed or in school and the remaining were unemployed (34%), disabled (16%) or retired (13%). A majority of the employed (59%), disabled (77%) and unemployed (65%) subjects were between 45 and 65 years of age. Educational and occupational status information was not included in adequate amounts in the charts audited to be reported.

Health insurance. Two-thirds (65%) of the sample had Medicaid coverage (14% of these were dually eligible), one-third were self-pay/sliding fee scale (31%) and the remaining were on Medicare only (4.3%). Of the Medicaid recipients, 29% (127) were enrolled in traditional Medicaid, 5% (23) were on the State Medical Plan with the remaining in managed care plans, such as Care Choices (14%), Community Choice Michigan (12%) and other (5.4%). Insurance coverage was stable as evidenced by the fact that 94% did not change insurer and 96% did not change health plans during the year.

Social support. Thirty-two percent of the sample was partnered and lived with family or friends. Sixty percent of the sample was single and, of these single individuals, two-thirds lived

with others and one-third lived alone. Overall, 70% of the sample lived with family/friends or in a group setting and 22% lived alone. The presence of a social support was mentioned in 83% of the charts audited, with 18% of the subjects having negative life stressors in their lives and 13% having positive social supports (the remaining 52% were not identified as negative or positive). Negative stressors mentioned included 'stress at home,' specific diseases in family members (chronic renal failure, autism, alcohol/drug abuse, cancer, HIV), abuse, financial difficulty, family/self in prison, caregiver burdens (as grandparents, single moms, family members) and loss/death of family members.

Disease status (Table 3). A majority of the sample (95%) had diabetes type 2 (DM2) and received oral medication/s alone or with insulin (63%). A small number (8%) controlled their diabetes with food and exercise only, while the remaining 23% received insulin 2-4 times per day. Seventy-nine (18%) subjects were newly diagnosed without previous diabetes care and 100 (22%) had had their diabetes diagnosis less than one year. The average age at diagnosis was 43 years and the average length of time since diagnosis was 6years. In addition to the diagnosis of diabetes, subjects had an average of 3.65 additional diagnoses. The highest numbers of non-diabetes diagnoses were cardiovascular (68.6%), psychiatric (28%), endocrine/metabolic (46%), and musculoskeletal/integumentary (42%). One patient died during the audit year from cardiovascular disease.

Acute diabetes complications (Table 3b). The occurrence of two acute metabolic complications of diabetes, hypoglycemia and hyperglycemia, were assessed for the audit year. While these complications can be minor if picked up early and properly managed, if untreated they can lead to serious life-threatening complications. Moderate to severe hypoglycemia and hyperglycemic reactions are complications that result in increased clinic utilization (phone and office visits) and emergency department/ hospital admissions. Hypoglycemia was not a diabetes care management problem in this sample in that only 4% had moderate to severe hypoglycemia for which they required assistance to treat. (An additional 21% self-treated their hypoglycemia, 50% did not experience hypoglycemia and 25% had no reference to hypoglycemia in their charts.) Hyperglycemia was a bigger problem in this sample in that 42% had moderate to severe hyperglycemic reactions (37% had no hyperglycemic reactions, 22% had no reference to hyperglycemia in their charts).

Diabetes chronic complications (Table 3c, 3d). The presence and level of two microvascular (nephropathy and retinopathy) and four macrovascular (cardiovascular/ cerebrovascular, peripheral vascular, peripheral neuropathy, and autonomic neuropathy) categories of diabetes complications were assessed both at the start and end of the audit year (See Table __). With the exception of cardiovascular/ cerebrovascular complications, where 12% (n=54) had congestive heart failure, myocardial infarction and/or stroke, very few individuals had developed complication endpoints at the start of the audit year: Less than 1% of the sample had endstage renal disease (n=4) and blindness (n=2). Less than 2% had a lower extremity amputation (n=6) and less than 5% had autonomic nervous system complications of hypoglycemia unawareness (n=8) and sexual nonfunction (n=13). Additionally, with the exception of cardiovascular/ cerebrovascular disease, where 77.4% (n = 345) had moderate, severe or end stage disease, less than one third of the subjects had nephropathy complications (22%), retinopathy (11%), peripheral vascular disease (29%), peripheral neuropathy (19%) and/or autonomic neuropathy (11%). It must be noted that 24% to 57% of charts lacked information regarding the presence or absence of the specific diabetes complications, with the exception of cardiovascular/ cerebrovascular complications where all but 2 charts contained cardiovascular/cerebrovascular status information (primarily blood pressure data).

Change in chronic complications over year. Subjects had an average of 1.7 complications (of the six total) at the start of the audit year. There was a significant increase in number of complications noted in the charts at the end of the audit year (mean = 1.8, t=3.01 p< .05). The presence of non-reversible severe or endpoint diabetes complications was assessed for all complications except autonomic neuropathy. Non-reversible complications included end-stage renal disease/proteinuria, blindness/proliferative retinopathy, CHF, MI, Stroke, LE amputation, no pulses/foot ulcers, no LE sensation/reflexes. There was a significant increase in the number of individuals with non-reversible complications over the course of the year (mean start of year = .34 ± .80, end of year = .42 ± .86, t = 5.34 p<.001). At the end of the audit year, 27% of the individuals had non-reversible diabetes complications v. 22% at the start of the year.

Acute clinical stability (Table 3e). Data was collected on weight/height, blood glucose, lipids, renal function, blood pressure and foot status (See Table 5). At the start of the audit year, the average subject weighed 205 pounds and was moderately obese (Body Mass Index (BMI) = 34). Over half of the sample was obese (59%) and over a quarter was overweight (29%). Blood glucose levels for the sample were moderately elevated (HbA1c = 8.42 ± 2.25), as were systolic / diastolic blood pressures (135.5 ± 20.31/ 81.73 ± 12.10). Over the course of the audit year, half of the sample (51%) had elevated lipid levels (LDL, HDL, triglycerides and/or cholesterol) while approximately one third (30%) had at least one elevated renal test (urine microalbumin spot, serum BUN or creatinine, 24 hour creatinine, microalbumin and protein). In terms of foot status, 4% had foot ulcers and 24% had pre-ulcerative foot lesions.

Risk behaviors/history (Table 4). Risk behavior data on tobacco, alcohol and drug use, activity level and risk history data of family history of DM and personal psychiatric disease are presented in Table 5. Approximately ½ of the subjects (45%) did not use tobacco products, however, 35% were current smokers and 18% past smokers. The charts of 61% of the sample reported no alcohol consumption, while 23% reported past/present use and 12% past/present abuse. Past/present drug abuse was noted in the chart for 9% of the sample, while 72% reported not using drugs. A full 68% of the sample was physically inactive while 16% reported engaging in specific physical activity. Two thirds (65 %) of the diabetics studied reported a family history of diabetes, while 35% reported a personal history of psychiatric disease. As reported previously, over half of the sample was obese, hypertensive, and dyslipidemic.

Functional Status/ Self-care Ability and Performance (Table 5). Functional status included ability to perform activities of daily living as well as cognitive and psychological status (see Table 6). Ability to perform activities of daily living was assessed by ambulatory ability. Only 2% arrived at the clinic in a wheelchair, 8% used a cane/assistance, and the remaining 90% ambulated to clinic independently. Most of the sample (91%) demonstrated appropriate cognitive functioning in acquiring the knowledge and ability to understand their DM diagnosis and care, while 9% demonstrated cognitive dysfunction in this area. Almost 2/3rd of the sample (62%) experienced difficult psychological adjustment to DM diagnosis and care and 1/3rd (37%) demonstrated appropriate adjustment.

Self-care tasks assessed in the chart audit included diet, medication management, exercise, foot care, and self blood glucose monitoring (SBGM),. On the average, subjects performed 3.13 of these 5 self-care tasks. Diet self-care was reported for 86%, medication management for 91%, exercise self-care for 34% and foot self-care for 38%. SBGM was performed by 65% of the subjects and was done from 1 to 4 times daily by 54% of the subjects and less than daily by 11%. From 3-11% of the subjects performed self-care tasks with assistance.

Utilization (Table 6). Clinic, phone and missed visits, subspeciality visits and hospital and emergency department admissions were counted for the one year audit period (see Table 7). On the average, each person made 8 clinic visits, 3.3 subspeciality visits, 5 phone visits during the year and missed 1 clinic visit). Data from the chart audit and the St. Mary's Hospital database revealed that 13% were admitted to an emergency department from 1 to 9 times during the year with a diabetes diagnosis, and 10% had 1 to 4 hospital admissions with a diabetes diagnosis. Table 9b shows that prior emergency and hospital admission rates recorded in the charts were similar to those during the audit year (10% and 8%, respectively).

Access to care (Table 7). Type of clinic provider, receipt of subspeciality referrals, frequency of receipt of recommended diabetes and preventive care, provider practice style and patient involvement in care decisions was assessed for the one-year period studied (see Tables 9a-9d).

Primary care providers and subspeciality referrals (Table 7a). The primary providers seen in the clinic were MD/DO and NP/PAs. Almost ½ (48%)of the subjects saw only MD/DO primary providers, 27% saw only NP/PA primary providers and 25% saw both types of primary providers during the year. Additional providers seen during clinic visits included RNs (29%), registered dietitians (RD) (18%), certified diabetes educators (CDE) (11%), and social workers (7%). Less than 3 % saw podiatrists, pharmacists, mental health workers, or an ophthalmologist during the year of audited clinic visits.

On the average, subjects received 2.48 subspeciality referrals from their primary care providers. Eighty-five percent received 1 or more subspeciality referral. Of those who received a subspeciality referral, 81% made one or more referral visit. Referrals were made to endocrinologists (5% received referral/4% made referral visits), RDs (34% received referral/20% made visits), certified diabetes educators (37% received referral/23% made visits), ophthalmologists (60% received referral/31% made visits) and podiatrists (19% received referral/14% made visits). Referrals were also made to more than 10 additional types of subspeciality clinicians. Table 7b gives data for care received for DM prior to the audit year and indicates comparable utilization patterns related to ophthalmologists, podiatrists, and diabetes educators.

Receipt of recommended diabetes care (Table7c). During 8 clinic visits made by the average patient during the audit year, he/she received a physical exam 5 times, foot exams 3 times, and some type of diabetes teaching 2 times. Blood pressure was measured 8 times, weight 7 times, HbA1c 2 times, lipids 1 time, and urinalysis for renal function assessment 1.5 times. Additionally, providers reviewed blood glucose levels/ SMBG reports with the patient 6 times during the audit year, reviewed medication management 5 times, monitored exercise levels 1 time, and prescribed diet/ reviewed diet management 2 times. Forty-five percent of current smokers received smoking cessation counseling from 1-6 times during the course of the year, while 55% of current smokers did not receive cessation counseling. An annual flu vaccination was received by 27% of the patients and pneumococcal vaccination w/in 6 year period by 20%.

Preventive care was assessed via ordering and follow-up for recommended cancer screening tests for breast cancer, cervical cancer and colorectal cancer (Table 7d). Breast and cervical cancer screening were appropriately ordered for all but 12-14% of the cases, while colorectal cancer screening was not noted for 41% of the audited cases. Mammogram and/or clinical breast exam was ordered at least every 2 years in 37% of the cases and was received by 31% of the cases with 28% normal findings and 2% abnormal with follow-up. A pap test was ordered at least every three years in 45% of the cases and was received by 41.5% of the cases with 37% normal findings and 5% abnormal findings (20 w/ followed-up of abnormality, 1 w/out). An annual digital rectal exam, annual fecal occult blood cards and/or colonoscopy every 3-5 years was ordered in 32% of the cases

and was received by 30% of the cases with 26% normal findings and 4% abnormal (14 w/follow-up, 3 w/out).

Provider practice style and patient involvement in care decisions (Table 7e). Charts were reviewed to identify the practice patterns of providers and involvement of patients in their care decisions. Greater than 90% of providers had documented a plan of care, return appointments, consideration of patient social needs and barriers to care, and notification of patient of test results/ clinical concerns. Up-to-date problem lists were evidenced in 84% of the charts, 66% used diabetes flow sheets, and 46% of the charts included a prescribed diet plan. Target goals for blood glucose levels were included for 29% of the patients, while lipid and blood pressure target goals were present in < 10% of the charts. In 72% of the charts there was evidence that patients were involved in their care decisions, and 31% of patient set treatment goals predominately related to SBGM, exercise, and weight management.

Group Comparisons

To give insight into risk factor relationships in this sample of low-income diabetics, comparisons were made between the obese and non-obese, those with poor v. better metabolic control, those with no v. some diabetes chronic complications and those with high v. lower utilization. Group comparisons involved comparison of each group using t-tests and chi-square tests for the identification of significant differences.

Obese v. non-obese. Fifty-nine percent of the diabetic patients were obese, defined as a BMI of >30. The obese were significantly more likely to be younger females, non-Hispanic, with less social support, more psychiatric and coronary diagnoses, and less nephropathy and retinopathy complications. They were less active, performed more SBGM, and had fewer hypoglycemic episodes requiring treatment. Additionally the obese had significantly more clinic and phone visits, and more subspeciality referrals.

Metabolic control: Blood glucose control. Twenty-three percent of the patients had HbA1c blood glucose tests in the very high range, defined as <9.5, indicating inadequate management of glucose metabolism. Those with poor glucose control were significantly younger at diagnosis, performed less self-care (medication, exercise and foot self-care), and made fewer phone visits. They more often were on Medicaid, had a difficult adjustment to their diabetes diagnosis and care, used alcohol, and had hyperglycemic reactions.

Metabolic control: Hyperglycemic reactions v. no hyperglycemic reaction. Fifty-three percent of the sample experienced hyperglycemic reactions that were moderate or severe and required treatment. Characteristics of those with poor metabolic control resulting in hyperglycemic reactions included being younger, employed, having higher blood glucose and cholesterol levels, fewer cardiac diagnoses and greater deterioration in peripheral vascular disease over the year. Additionally those who experienced hyperglycemic reactions had more clinic, phone and dietitian visits and more hospital and emergency room admissions.

Diabetes complications v. no complications. Fourteen percent (60) of the patients had no indication of diabetes complications in their chart. Those without diabetes complications were significantly younger, had an exercise self-care plan, were on one oral medication per day, and made fewer phone visits than those with complications. They more often had normal blood pressure and renal function tests, no hyperglycemic reactions, did not have health insurance and were Hispanic/Latino.

Utilization. High utilizers of clinic visits, missed visits, phone visits and referral visits were compared with lower utilizers. High utilizers included the 60% of the patients that had 7 or more clinic visits, the 25% that had 2 or more missed clinic visits, the 31% that had 6 or more phone visits, and the 28% that had 4 or more subspeciality referral visits. High clinic visit utilizers were

significantly younger, employed, recently diagnosed, had problems getting medications/supplies, and did more SBGM. Those with 2+ missed clinic visits were significantly more likely to be younger, Black, on Medicaid, and tobacco, alcohol and drug users. High phone utilizers were significantly more likely to be female, White, enrolled in Medicaid, have more DM complications, do more SBGM, and be tobacco users. Those with high numbers of referral visits were significantly more likely to be English speaking, Medicaid enrollees, have more coexisting diagnoses, do more SBGM, have elevated lipid tests, more foot lesions and more diabetes complications (including hypoglycemia).

Comparison of this population with other diabetic populations

Comparisons were made between the chart audit data collected for this study and the MDCH Grand Rapids Area Diabetes Outreach Network (TENDON) data set. TENDON data is collected during face-to-face interview with diabetics. Data for patients with Medicaid or no health insurance were analyzed. Data were comparable for age, sex, age at diagnosis, % with amputations, weight and BMI, hemoglobin A1c, lipid tests, blood pressure, receipt of ophthalmology exam, performance of self-blood glucose monitoring and extent of foot problems. The TENDON population reported more emergency and hospital admissions, more dietitian visits, and more with kidney and eye disease. This may reflect more accurate reporting during the TENDON interview than is possible in a chart audit.

It appears that the 446 low income diabetics reported on in this study are similar in many respects to the low income diabetics followed by TENDON.

Predictors of presence of non-reversible diabetes complications

Non-reversible complications included end-stage renal disease/proteinuria, blindness/proliferative retinopathy, congestive heart failure (CHF), heart attack (MI), stroke, lower extremity (LE) amputation, absent LE pulses/presence of foot ulcers, and no LE sensation/ reflexes. Twenty-two percent of the patients studied had at least one non-reversible complication. All risk factors collected at the start of the audit year were evaluated both conceptually and empirically for suitability as predictors of diabetes complications. Due to the limited number of DM1 cases and to avoid confounding interpretation of results, prediction analysis was limited to data from cases with a DM2 diagnosis (N = 425). Initial analysis involved group predictor modeling, in which significant predictors of any non-reversible diabetes complication were identified from risk factor categories (disease status, demographics, risk and functional status, self-care behavior, and utilization groups) using logistic regression analysis techniques. Next risk predictor modeling was done, in which all disease, demographic and risk/functional status variables that predicted non-reversible complications at the $p < .10$ level in group models were entered into a combined regression equation to identify predictors of risk for non-reversible complications. Finally, all groups of predictor variables that predicted non-reversible complications at the $p < .10$ level, including self-care and clinic-care variables that occurred during the audit year, were regressed on non-reversible complications in combined predictor models.

Results of the 5 group models, the risk model and the combined model are presented in Table 8. All significant group predictors maintained their predictive power across all the models as indicated by the consistent B's and odds ratios. In interpretation of the models, the following explanatory statements can be made about low-income individuals with DM2 (odds based on combined model):

- Enrollment in Medicaid insurance is associated with a 2.3 times greater risk of having non-reversible complications than having no insurance.

- Receiving care exclusively from a MD/DO primary care provider, as opposed to NP/PA care only or in combination with MD/DOs, is associated with 1.9 times greater risk of developing non-reversible complications
- A 0.10 rise in HbA1c (blood glucose level) is associated with a 1.3 times higher risk of having non-reversible complications.
- For every additional year a person has diagnosed diabetes there is a 1.1 time greater likelihood of having non-reversible complications.
- A one-year increase in age is associated with a 1.3 times higher risk of having non-reversible complications.
- Men have a .67 times greater risk of having non-reversible complications than women.
- Inactive individuals have a .66 times greater likelihood of having non-reversible complications than those who engage in regular moderate physical activity.

Predictors of admission to emergency department and/or hospital

Data regarding admissions to emergency departments and to hospitals that was collected during the chart audit was verified and supplemented with admission data obtained from the St. Mary's Hospital database. A single dichotomous variable was constructed to indicate whether or not the individual was admitted for emergency and/or hospital care for a diabetes diagnosis during the audit year in which 1 = admitted and 0 = not admitted. Eighteen percent of the patients studied had at least one hospital or emergency admission. The analysis procedure described for non-reversible complications was followed to determine predictors of admission. Once again, analysis was limited to data from cases with a DM2 diagnosis.

Results of the 5 group models, the risk model and the combined model predicting hospital/emergency admission are presented in Table 9. In the risk and combined models, the presence of moderate/severe hypoglycemia and hyperglycemia predicted admissions so strongly that they suppressed the effects of other significant group predictors. It is obvious that hypoglycemia and hyperglycemia reactions are primary risk factors for admission in this population. The presence of moderate to severe hypoglycemia requiring treatment was so strong that it suppressed the effects of demographic, risk/functional status, self-care behavior and utilization factors. To uncover the impact of these non-clinical factors on admissions, we removed the clinical factors from the equations. When the clinical variables were excluded from the risk predictor models, exercise level (B = -1.45, odds .24) entered with alcohol abuse (B = 1.02, odds 2.8) in predicting admissions. When these variables were excluded in the combined model, all other significant group predictors maintained their power as indicated by the consistent B's and odds ratios in the group and combined models for these variables as shown in Table 9. Conversely, when the hypoglycemia and hyperglycemia variables were included in the combined equation, hypoglycemia was a very strong predictor (B = 2.92, odds 18.52) with alcohol abuse (B = 1.30, odds 3.68), exercise self-care (B = -.908, odds .40), and having a NP/PA provider (B = -1.61, odds .199), while hyperglycemia became nonsignificant.

In interpretation of the final model, it is important to stress that moderate/severe hypoglycemia is a strong predictor of admissions that overrides non-clinical factors, as if making them irrelevant to basic survival. It is possible that the non-clinical predictors serve as precursors to hypoglycemia and hyperglycemia leading to admissions, but this was not tested. The following explanatory statements can be made about non-clinical factors predictive of hospital and emergency department admissions for low-income individuals with DM2:

- Past and current alcohol abuse is associated with a 4.0 times higher risk of admission than moderate nor no alcohol use.

- Individuals who do SBGM have a 2.55 times greater risk of admission than those who do not self-monitor their blood glucose.
- Individuals who experience difficult psychological adjustment to their
- diabetes diagnosis and care have a 2.05 times greater risk of admission than those with appropriate adjustment.
- Inactive individuals have a .80 times greater likelihood of admission then individuals with a moderate physical activity level.
- Individuals receiving care from a NP/PA only have a .70 times lesser risk of admission than those receiving care from an MD/DO only or both provider types.
- Males tend to be .46 times more likely to have an admission (trend effect).

Summary of factors that place the low income diabetic at risk for poor outcomes.

Risk characteristics present in this low income population include obesity, high levels of smoking and alcohol use, poor glycemic control, hypertension, obesity, lipidemia, physical inactivity, difficulty accessing diabetes medications and supplies, and coexisting chronic diseases. Two-thirds of the diabetics did not get the recommended annual ophthalmologic exam, suggesting difficulty accessing care and inadequate care management. The amount of missing data related to laboratory tests and chronic diabetes complications suggests lapses in care protocols that can also lead to increased risk for poor outcomes.

The patients studied had high numbers of clinic, phone, and subspeciality visits during the year when compared with non-diabetic patients, however, they are not high for a diabetes diagnosis. Provider practice style appeared adequate and most patients appeared to participate in decision making during clinic visits. While the amount and type of care receive appears adequate, the chart audit revealed large amounts of standard diabetes care information was missing, especially related to recommended laboratory tests and documentation of examination for chronic diabetes complications. There were inadequate hemoglobin A1c blood glucose tests, missing lipid and renal function tests and height measurements (essential for computing BMI). Additionally, there was missing information in more than 30% of the charts that suggest inadequate checking for the silent signs of complications, specifically related to nephropathy, retinopathy, peripheral neuropathy and autonomic neuropathy.

Limitations

Chart audit data is limited in that it is incomplete and therefore the results of the predictive modeling in the study must be considered preliminary findings. While we can reasonably assume that information contained in charts more or less reflects reality, we cannot assume that because something is not mentioned in a chart it did not exist. Rather, we must assume that things not mentioned in a chart may have existed but were not considered/ assessed. This is especially true with diabetes care, in which chronic complications develop silently in their early stages without warning symptoms and signs that the diabetic can report to their provider. It is the responsibility of the provider to screen each diabetic for indications of complications through careful physical exam, referral for ophthalmic exam and laboratory testing. When important diabetic assessment information is not mentioned in a chart, such as renal function, it may be that the provider did not conduct a complete evaluation of the patient.

Policy Implications

There is no alternative to proper management of blood glucose levels in the diabetic patient. Poor metabolic control leads immediately to costly hospital and emergency room admissions, and,

over a period of 5-10 years, to the development of long-term, disabling and costly diabetes complications. Health systems need to insure that all providers carefully and effectively monitor HbA1c levels per ADA Standards for Care (2001). Providers must effectively empower and support adequate blood glucose control through proper self-management of medications, glucose monitoring, diet, and activity. Measures must be taken to strengthen the provider's ability assist low income diabetics to overcome the psychological distress that accompanies diabetes diagnosis and care and to effectively care for their diabetes. Diabetics at highest risk for having difficulty with self-management and experiencing poor glycemic control need to be provided with supplementary support interventions designed to maximize their metabolic control.

Greater emphasis must be placed on preventive care for diabetes complications. Health systems need to take proactive measures to support and motivate providers to screen all diabetics for signs of acute and chronic complications at each clinic visit. Documentation of preventive care is essential. Smoking cessation programs need to be integrated into all diabetes care protocols and alcohol treatment offered to alcohol abusers.

Early diagnosis of diabetes and proper early treatment is critical in limiting acute and chronic complication development. Measures should be taken to promote public awareness and knowledge of diabetes, and to insure that newly diagnosed diabetics receive adequate education, support and clinical management.

Obesity prevention is a major problem with diabetics. Low income people tend to be more obese and more physically inactive than other income persons. Obesity makes individuals more prone to developing diabetes and also to having more difficulty with metabolic management once diagnosed. Primary care providers should be required to assess, not only diabetic patients, but all clients for overweight and obesity following the NIH obesity guidelines (1998) and to provide clinical intervention when indicated. All obese persons should be evaluated as pre-diabetic. Additionally, measures must be taken at the State level to promote population-level obesity control and physical activity programs.

Policy recommendations from this study include:

1. Increased reimbursement for preventive care for low income diabetics that will promote better blood glucose management, effective self-care, and prevention of acute and chronic complications. Options for supplementary support interventions for the highest risk include:
    - A risk-based nurse case management system that would provide extra services to high risk patients to enhance glycemic control and care follow-up. A program like is currently available to MediCal diabetics in California and has been shown to be effective (Friedrich, 2000).
    - A computer-based telephone intervention system to assist low income diabetics in decision-making related to control of blood glucose levels and other care management concerns. The applicability of such a system to low-income populations was reported in Diabetes Care by Piette, et al.(1999).
2. Inclusion of language in Medicaid managed care contracts to insure provision of:
    - Screening for all diabetes complications on each routine diabetes visit and early treatment of all diabetes complications to prevent development of advanced, non-reversible disease.
    - Incentives for completed patient referrals to ophthalmology, dietitians, educators and podiatry.
    - Training for providers to increase their ability effectively work with individuals who have the increased burden of being in the lower socioeconomic strata.

- Preventive screening of all patients for diabetes and prompt effective treatment when diagnosed.
- Preventive screening of all patients for obesity and prompt effective treatment when indicated

4. Development of a diabetes-specific risk-adjusted Medicaid capitation payment system so that providers are able to deliver services required for proper diabetes management.

Table 1.
1a. Diabetes Risk Variables Studied

Risk category	Risk factor/independent variable	Measures
Demographics	Age	
	Sex	
	Ethnicity/ Race	
	Primary Language	
	Education	
	Occupation	FT, PT, disability due to DM
	Employment Status	QHP, other, none
	Health insurance	Marital status/living status, accompanied to
	Social support	clinic
	Community characteristics	Zip code
Principal diagnosis	Type	DM1/ DM2
	Duration	Years since diagnosis
		Age at diagnosis, Onset of DM
		Onset of Oral meds, Onset of Insulin
	Severity	Level of complications
		Staged Diabetes Management DM Stage
	Medication use	Insulin, oral, both, neither
Acute clinical stability	Blood glucose	HbA1c
	Lipid profile	Cholesterol, HDL/LDL, Triglicerides
	Renal profile	UA for protein, microalbumin if UA neg
		BUN/Creatinine if UA/Microalb positive
History since DX prior to adm. visit	Prior DM Care hx	Primary care, D Ed in past, Dilated eye exam, Hospital/ ER use
	Prior self-care status	Diet , SMBG, Self-foot exam, Exercise
		Injection/medication management
Comorbid disease	Comorbidity level	Count of existing disease diagnoses
Risk behaviors	Hypertension	Systolic/Diastolic BP
	Hyperlipidemia	Lipid profile
	Obesity	BMI/ weight
	Tobacco use	Current status, ex tobacco user, never used
	Substance abuse	Alcohol and illegal drug use
	DM history	Family Hx DM, Hx gestational DM
	Exercise v inactivity	Hx, reported behavior
Physical functional status	ADL	Reported ability for basic self-care activities, ambulatory ability
	IADL	Employment / disability status
Psycho-behavioral functional status	Cognitive functioning	DM knowledge level
	Psychological adjustment to DM	Pt. Report re. how feeling about disease
	Competing demands	stability, family care demands, divorce, intact family/not intact
Attitudes/ preferences	Involvement in care	Patient goals and wishes defined:
	♦ Treatment preference	♦ individual target HbA1c
	♦ Risk reduction preference	♦ level of risk willing to take
		♦ effort prepared to make for control
	propensity to seek care	# actual visits to PCP & speciality provider / appointments

Risk category	Risk factor/independent variable	Measures
Treatment effectiveness	Self-care DM management: ♦ SBGM ♦ Medication ♦ Exercise ♦ Diet ♦ Foot Care	Skill adequacy/proficiency/frequency
	Treatment regimen adherence	
	Resource utilization	Frequency of clinic visits, No show rate
Access to care	Regular source of care	Y/N, type PCP
	Referral to subspecialty provider	Y/N, provider name, # referral visits
	Receipt of recommended DM care	
	♦ Physical exam Foot exam BP monitoring Wgt monitoring BG levels Med. management Exercise	Y/N, frequency
	♦ HbA1c annually	Frequency received
	♦ Dilated eye exam annually	Referred Y/N, visit made Y/N
	♦ Lipid profile annually	Ordered Y/N
	♦ Urine test annually	Urinalysis/microalbumin/albumin
	♦ Smoking screening/cessation	Counseling received
	♦ Dietitian visit	Referred Y/N, # visits
	♦ Podiatrist visit	Referred Y/N, visit made Y/N
	♦ D M education	Referred Y/N, # DM ed visits
	♦ Flu shot annually	Y/N
	♦ Pneumococcal immunization	Y/N
	Preventive care received	Breast and Colon cancer screening
	Complementary therapy use	Y/N, type, frequency
	Provider practice style	Target goals noted in chart: BS, HbA1c, Cholesterol, Hgt, Wgt,

1b. Diabetes Outcomes Variables Studied

Outcome category	Outcome/ dependent variable	Measures @ DM admission and 1 yr
Metabolic control (Acute clinical stability)	Glycemic control	♦ HbA1c
	Lipoprotein levels	♦ LDL ♦ Triglycerides ♦ HDL
Acute complications	Hypoglycemic reactions	# episodes in previous 12 months with loss of consciousness, treated with assistance, and self-treated
	Hyperglycemic reactions	# episodes of DKA in previous 12 months # of hyperglycemia symptoms reported
Chronic Complications	Microvascular	Nephropathy Retinopathy
	Macrovascular	Coronary heart / cardiovascular disease Cerebrovascular disease Peripheral vascular disease Peripheral neuropathy Autonomic neuropathy
Health services outcomes	Utilization	# ER admissions for DM # hospital admissions for DM # urgent care visits for DM
	Mortality	Yes/no

Table 2
Descriptive Data for the Sample (N=446)

Variable	n	% of sample	Mean	SD	Range
Demographics [1]					
Age			54	13	20-92
20-45	103	23.3			
45-65	259	58.5			
65-95	81	18.3			
Missing	3	0.7			
Sex					
Male	158	35.4			
Female	288	64.6			
Race					
White	148	33.2			
Black	159	35.7			
Hispanic	120	26.9			
Asian, Pacific Islander, Native American, other	17	3.8			
Missing	2	0.4			
Language					
English	332	74.4			
Spanish	88	19.7			
Other	16	3.6			
Missing	10	2.2			
Employment Status					
Employed/In school	111	24.9			
Unemployed	151	33.9			
Disabled, not working	73	16.4			
Retired	57	12.8			
Missing	54	12.1			
Access to medication/supplies					
Problems due to lack of money +/or access	332	74.5			
No evidence of problems	88	19.7			
Missing	6	1.3			
Health Insurance					
Health Insurance					
Medicaid (inc. dually eligible 13.7%)	227	64.6			
Medicare	19	4.3			
Self-pay[2]	139	31.2			

[1] Educational and occupational status data was not present in adequate amounts in the charts reviewed to be reportable (71% and 43% missing data, respectively). Missing data is information that was not available in the chart during the audit.

[2] Self-pay includes 124 with discounted sliding fee payment scales and 15 with full payment, income at =< 200% of federal poverty levels.

Variable	n	% of sample	Mean	SD	Range
Stability in insurance coverage					
No change in health insurer	417	93.5			
No change in health plan	426	95.5			
Social Support					
Marital Status					
Married/partnered	143	32.1			
Separated/widowed/ divorced	162	36.3			
Single/ never married	105	23.5			
Missing	36	8.1			
Living arrangement					
Living alone	97	21.7			
Living with family/friends	295	66.1			
Lives in group setting	19	4.3			
Missing	2	0.4			
Social support network					
Social support present	370	83			
Positive support network	57	12.8			
Negative life stressors in network	81	18.2			
Quality of support not defined	232	52			
Social support absent	7	1.6			
Missing	69	15.5			

Table 3

3a. Disease Status for the Sample (N=446)

Variable	n	% of sample	Mean	SD	Range
Diabetes type					
DM1: treated w/ insulin 2-4 x/day	21	4.7			
DM2	425	95.3			
Treated w/ food & exercise only	36	8.1			
Treated w/ one oral agent	191	42.8			
Treated w/ oral agent ± insulin	117	62.7			
Treated w/ insulin 2-4 x/day	82	22.9			
Age at diagnosis	440		43	15	17-92
DM duration (years since diagnosis)	426		6	8	0-47
Less than one year	100	22.4			
1-5 years	173	38.8			
6-10 years	70	15.7			
11 years or more	83	18.6			
Missing	20	4.5			

Variable	n	% of sample	Mean	SD	Range
Coexistent diseases[3]					
# Diagnoses (non-DM)	446		3.65	2.57	0-14
# Systems with diagnoses (non-DM)	446		2.94	1.84	0-10
Cardiovascular	306	68.6			
Peripheral vascular	37	8.3			
Pulmonary	88	19.7			
Ophthalmic	38	8.5			
Ear, Nose, Throat	42	9.4			
Gastrointestinal/ hepatic	88	19.7			
Renal	41	9.2			
Neurologic	55	12.3			
Psychiatric	123	27.6			
Endocrine/ metabolic	206	46.2			
Genitourinary	70	15.7			
Musculoskeletal/ integumentary	185	41.5			
Oncologic/ hematologic	20	4.5			
Other	11	2.5			
No diagnosis other than DM	31	7.0			

3b. Diabetes Acute Clinical Complications for one year period (N=446)

Variable	n	% of sample
Hypoglycemic episodes		
Endpoint reached	0	
Severe (w/ loss of consciousness, seizures)	4	0.8
Moderate (w/ confusion)	14	3.0
Self-treated	94	21.2
None	225	50.4
Missing	109	24.8
Hyperglycemic reactions		
Endpoint reached	0	
Severe (ketoacidosis/hyperosmolar)	8	1.7
Moderate (clinical signs)	178	40
None	164	37
Missing	96	21.5

[3] Coexistent disease diagnoses were assessed as part of the chart audit. Comorbidity (presence of disease processes unrelated to the focal disease) could not be assessed due to the fact that DM complications affect multiple systems making evaluation of a diagnosis as unrelated to DM impossible.

3c. Chronic Complications at Start and End of Audit Year (N=446)

	Start of year		End of year	
	n	% of sample	N	% of sample
Nephropathy				
Endpoint: ESRD	4	.9	7	1.6
Advanced	28	6.3	36	8.1
Moderate	62	13.9	65	14.6
Not present	126	28.3	131	29.4
Missing	226	50.7	207	46.4
Retinopathy				
Endpoint: Blindness 1-2 eyes	2	.4	3	.6
Advanced	21	4.7	21	4.7
Moderate	27	6.1	29	6.5
Not present	87	19.5	92	20.6
Missing	309	69.3	301	67.5
Cardiovascular (CHD,CVD,CBVD)				
Endpoint:	54	12.1	59	13.2
CHF only	12	2.7	15	3.4
MI only	21	4.7	20	4.5
Stroke only	11	2.5	11	2.5
CHF and Stroke	2	.4	3	0.7
CHF and MI	4	.9	6	1.3
Stroke and MI	3	.7	3	0.7
CHF, MI and Stroke	1	.2	1	0.2
Advanced	43	9.6	39	8.7
Moderate	248	5.6	247	55.7
Not present	99	22.2	101	22.6
Missing	2	.4	0	
Peripheral Vascular Disease				
Endpoint: amputation	6	1.3	10	2.2
Advanced	14	3.1	12	2.7
Moderate	108	24.2	125	28
Not present	218	48.9	196	43.9
Missing	100	22.4	103	23.1
Peripheral neuropathy				
Endpoint: amputation	6	1.3	10	2.2
Advanced	11	2.5	12	2.7
Moderate	67	15.0	79	17.9
Not present	176	39.5	153	34.3
Missing	186	41.7	192	43.0
Autonomic Neuropathy				
Endpoint:	21	4.7	29	6.5
Hypoglycemia unawareness	8	1.8	11	2.5

	Start of year		End of year	
	n	% of sample	N	% of sample
Sexual non-function[4]	13	2.9	16	3.6
Postural hypotension	0		1	.2
Gastroparesis	0		1	.2
Moderate	27	6.1	24	5.4
Not present	146	32.7	134	30.0
Missing	252	56.5	259	58.1

3d. Chronic complication summary data (N=446)

Variable	n	% of sample	Mean	SD	Range
Number of chronic complications					
At start of year	446		1.68	1.27	1-6
At end of year	446		1.81	1.36	1-6
Non-reversible complications-					
At start of year			.34	.80	0-5
No non-reversible complications present	347	78			
Non-reversible complications present	99	22			
At end of yr			.42	.86	0-5
No non-reversible complications present	325	73			
Non-reversible complications present	121	27			
Increase in # non-reversible complications over year					
No increase	415	93			
Increase	31	7			

[4] Represents data on males only. No sexual function data in charts for females with diabetes.

3e. Acute clinical stability: Descriptive Data at start of year (N=446)

Variable	n	Mean	SD	Median	Range
BMI (kg/m^2)	445	33.76	9.01	31.90	17.39 - 69.06
Weight (lbs)	442	205.50	58.32	198.50	86.20 - 433.00
Blood glucose: HbA1c	348	8.43	2.25	7.90	4.50 - 17.50
Lipid profile					
LDL (mg/dl)	260	122.18	42.95	120.00	33 - 295
Cholesterol (mg/dl)	328	215.43	56.88	208.50	105 - 533
HDL (mg/dl)	300	45.19	13.35	43.00	8 - 103
Triglicerides (mg/dl)	324	281.28	455.88	189.50	50 - 6915
Renal profile					
Urine Microalbumin spot (ug/mg creatinine)	228	269.81	934.09	18.00	2 - 9236
Serum BUN (mg/dl)	335	16.84	12.12	14.00	.9 - 130
Serum Creatinine (mg/dl)	337	1.04	1.05	.80	.1 - 12.80
Blood Pressure					
Systolic	445	135.31	20.31	132.00	80 - 218
Diastolic	445	81.73	12.10	80.00	40 – 142
Foot Status					
No lesions	248	55.6			
Pressure/fungal lesions, calluses	106	23.8			
Foot ulcers	16	3.6			

Table 4
Risk Behaviors / History descriptive data (N=446)

Variable	n	% of sample
Tobacco use		
Non user	200	44.8
Ex-user	80	17.9
Current user	155	34.8
Missing	11	2.5
Alcohol use		
Non user	270	60.5
Past / present use	104	23.3
Past/ present abuse	53	11.9
Missing	19	4.3
Drug use		
Non user	320	71.7
Past / present abuse	38	8.5
Missing	88	19.7
Activity level		
Physically inactive	301	67.5
Moderately active	46	10.3
Active (≥ 20 min exercise 3x/wk)	23	5.2
Missing	76	17.0
Obesity level (based on BMI)		
Obese	261	58.5
Overweight	125	28.0
Normal/under weight (4)	60	13.5
Missing	1	.2
Hypertension		
Severely hypertensive	75	16.8
Moderately hypertensive	202	45.3
Normal Tensive	168	37.7
Missing	1	.2
Lipid levels		
Severely elevated	139	31.2
Moderately elevated	88	19.7
Normal	102	22.9
Missing	117	26.2
Family history diabetes mellitus		
Yes	291	65.2
No	82	18.2
Missing	73	16.4
History psychiatric disease		
Yes	155	34.8
No	116	26.0
Missing	175	39.2
History gestational diabetes	18	4

Table 5
Functional Status/ Self-Care Ability and Performance (N = 446)

Variable	n	% of sample	Mean	SD	Range
Activities of Daily Living					
Ambulates independently	400	89.7			
Ambulates with cane/assistance	35	7.8			
Non-ambulatory, uses wheelchair	11	2.5			
Cognitive function					
Knowledge/ability to understand DM	404	90.6			
Evidence of cognitive dysfunction	41	9.2			
Missing	2	.4			
Psychological adjustment to DM					
Positive/appropriate adjustment	166	37.2			
Difficulty adjustment	278	62.3			
Missing	2	.4			
Self-care level during audit year					
Total number of 5 DM self-care tasks performed during year	446		3.13	1.18	0-5
1. Diet self-care					
Independent performance	333	74.7			
Performs with assistance	49	11.0			
Does not perform[5]	55	12.3			
Missing	9	2.0			
2. Medication management self-care					
Independent performance	361	80.9			
Performs with assistance	44	9.9			
Does not perform	36	8.1			
Missing	5	1.1			
3. Exercise plan self-care					
Independent performance	136	30.5			
Performs with assistance	13	3.6			
Does not perform	208	55.6			
Missing	89	10.3			
4. Foot self-care					
Independent performance	153	34.3			
Performs with assistance	18	4.0			
Does not perform	16	3.6			
Missing	259	58.1			
5. SBGM self-care					
Independent performance	255	57.2			
Performs with assistance	34	7.6			
Does not perform	113	25.3			
Missing	44	9.9			

[5] Unable, unwilling to or does not perform self-care task

Variable	n	% of sample	Mean	SD	Range
Frequency SBGM performed					
< daily	50	11.2			
daily	239	53.6			
once daily	26	5.8			
twice daily	139	31.2			
three – four times / day	74	16.6			
Clinic interaction self-care					
Independent performance	379	85.0			
Performs with assistance	43	9.6			
Does not perform	15	3.4			
Missing	9	2.0			
Complementary therapy use during yr.					
Yes[6]	31	7%			
Not noted in chart	415	93			

Table 6
Utilization and Mortality Data (N=446)

Variable	n	% of sample	Mean	SD	Range
Clinic Utilization					
Clinic visits in year	446		8.15	3.86	2-29
Average days between clinic visits	446		68.10	56.81	12-428
Missed clinic appointments	446		1.03	1.60	0-10
Phone visits	446		4.91	6.61	0-52
Emergency and Hospital Utilization					
Emergency Dept. visits for DM					
Yes	58	13.0			
No	388	87.0			
Total ED visits made during year			.21	.77	0-9
Hospital admissions for DM					
Yes	45	13.0			
No	401	89.9			
Total hospital admissions			.13	.44	0-4
Total hospital /emergency admissions	466		.34	.97	0-9
Admitted	80	17.9			
Not admitted	366	82.1			
Mortality					
Mortality due to DM during year	0				
Other deaths--hypertension	1				

[6] Complementary therapy use categories: Lifestyle management=1, ingestibles=13, mind-body=1, hands-on/energy healing=3, spirituality belief-based=6, community-based counseling=10

Table 7.
Access to care
7a. Access to providers and subspeciality referrals (N=446)

Variable	n	% of sample	Mean	SD	Range
Number of times providers seen in clinic[7]					
MD/DO	324	72.6	4.74	4.31	0-22
Nurse Practitioner (NP)	34	7.6	.20	.98	0-10
Physician's assistant (PA)	211	47.3	2.49	3.40	0-19
Registered Nurse	130	29.1	.57	1.42	0-13
Registered dietitian (RD)	78	17.5	.27	.69	0-4
Certified diabetes educator (CDE)	51	11.4	.22	.82	0-8
Ophthalmologist	3	.7			
Pharmacist	7	1.6			
Podiatrist	10	2.4			
Mental health provider	4	.4			
Social worker	33	7.4	.13	.29	0-3
Primary provider type during year					
MD/ DO only	216	48.4			
NP / PA only	120	27.0			
MD/DO and NP/PA both	108	24.2			
Referrals to sub specialists/ visits made					
Subspeciality referrals made	446		2.48	1.84	0-10
Subspeciality Visits made	377		3.31	4.65	0-39
Endocrinologist referral	24	5.4			
Referral visit/s made	17	3.8			
Registered Dietitian	152	34.1			
Referral visit/s made	90	20.2			
Certified Diabetes Educator	164	36.8			
Referral visit/s made	101	22.6			
Ophthalmologist	266	59.6			
Referral visit/s made	130	30.5			
Cardiologist	65	14.6			
Referral visit/s made	58	13.0			
Nephrologist	26	5.8			
Referral visit/s made	20	4.6			
Podiatrist	84	18.8			
Referral visit/s made	62	13.9			
Orthopedist	46	10.3			
Referral visit/s made	36	8.1			
Vascular surgery/ surgery	41	9.2			
Referral visit/s made	39	8.7			
Dentist	28	6.3			

[7] The N and % of sample for these variables indicate the number who actually saw this clinician type during the audit year, while the mean and distribution data are based on the total sample of 446.

Variable	n	% of sample	Mean	SD	Range
Referral visits made	8	1.8			
Mental health provider	37	8.3			
Referral visits made	26	5.8			
Dermatology/ wound specialist	18	4.0			
Referral visits made	12	2.7			
Gastroenterologist	31	7.0			
Referral visits made	22	4.9			
Physical medicine, PT, OT	22	5.4			
Referral visits made	17	3.8			
Neurologist/neurosurgeon	19	4.3			
Referral visits made	18	4.0			
Other	85	19.1			
Referral visits made	72	16.1			

7b. Access to Care: History of DM Care Prior To First Visit (N=446)

Variable	n	% of sample
No previous DM diagnosis	79	17.7
Not noted in chart	3	.7
Primary care		
Utilized prior	354	79.4
Not utilized prior	10	2.2
Diabetes education		
Utilized prior	182	40.8
Not utilized prior	182	40.8
Dilated eye exam		
Utilized prior	176	37.4
Not utilized prior	197	44.2
Podiatrist care		
Utilized prior	68	15.2
Not utilized prior	296	66.4
Hospital Admission		
Utilized prior	37	8.3
Not utilized prior	320	71.7
Emergency Dept. Admission		
Utilized prior	45	10.1
Not utilized prior	319	71.5

7c. Access to Care: Receipt of recommended DM care during year (N=446)

Variable	n	% of sample	Mean	SD	Range
Number of times specific care received					
1. Physical Exam: head heart lung etc	446		4.77	2.68	0-18
Received	443	99.3			
Not received	3	.7			
2. Foot exam	442		2.75	2.03	0-10
Received	392	88.7			

Variable	n	% of sample	Mean	SD	Range
Not received	50	11.3			
3. Blood pressure monitoring	446		7.53	3.50	2-22
Received	446	100%			
Not received	0	0			
4. Weight monitoring	446		7.24	3.46	0-20
Received	444	99.6			
Not received	2	.4			
5. Blood glucose monitoring/ SBGM	446		6.22	.880	0-20
Received	439	98.4			
Not received	7	1.6			
6. Medication management	446		4.60	3.31	0-17
Received	400	89.7			
Not received	46	10.3			
7. Exercise monitoring	444		1.07	1057	0-10
Received	225	50.7			
Not received	219	49.3			
8. Diet prescription/ review	444		1.81	1.89	0-10
Received	315	70.9			
Not received	129	29.1			
9. DM Teaching	442		1.65	2.22	0-14
Received	425	55.4			
Not received	197	44.6			
10. HbA1c blood glucose monitoring	444		2.07	1.35	0-7
Received	393	88.5			
Not received	51	11.5			
11. Lipid profile	441		1.27	1.20	0-6
Received	312	70.7			
Not received	129	29.3			
12. Urinalysis	443		1.49	1.60	0-14
Received	341	77.0			
Not received	102	23.0			
13. Smoking cessation advice	437		.30	.84	0-6
Received (45% of current smokers)	69	15.8			
Not received (55% current smokers)	368	84.2			
14. Flu vaccination	439		.28	.47	0-2
Received	118	26.9			
Not received	321	73.1			
15. Pneumococcal vaccination	439		.20	.40	0-1
Received (past 6 yrs)	87	19.8			
Not received (past 6 yrs)	352	80.2			

7d. Access to Care: Receipt of Preventive Care, Provider Practice Style and Patient Involvement in Care Decisions (N = 446)

Variable	n	% of sample
Preventive care received		
1. Breast Cancer Screening		
Received	126	30.5
Ordered, not received	28	6.3
Not indicated	226	50.7
Not ordered	56	12.6
2. Cervical Cancer Screening		
Received	185	41.5
Ordered, not received	17	3.8
Not indicated	179	40.1
Not ordered	65	14.6
3. Colorectal Cancer Screening		
Received	132	29.6
Ordered, not received	10	2.2
Not indicated	122	27.4
Not ordered	182	40.8
Provider Practice Style		
Target goals set for blood glucose/ HbA1c	130	29.1
Target goals for lipids	39	8.7
Target goals for blood pressure	42	9.4
Evidence of use of diabetes flow sheet	293	65.7
Diet plan prescribed	203	45.5
Up to date problem list	371	83.9
Documented plan of care	438	98.2
Documented return appointment	424	95.1
Evidence of consideration of patient social needs and barriers to care	440	98.7
Notify patient of test results/concerns	430	96.4
Patient Involvement in Care		
Evidence of participation in decisions	323	72.4
Evidence patient sets treatment goals	139	31.2
1. HbA1c	3	.7
2. SBGM	60	13.5
3. Lipids	1	.2
4. Exercise	63	14.1
5. BP	0	0
6. Smoking	28	6.3
7. Weight	47	10.5
8. Other	28	6.3

Table 8
Predictors of Non-Reversible Diabetes Complications in DM2 (N = 425)

	Group Predictor Model[8]		Risk Predictor Model[9]		Combined Predictor Model[10]	
Variables by Group	B	Odds	B	Odds	B	Odds
Disease status						
Blood glucose level (HbA1c to x.xx level)	.156***	1.169	.237***	1.267	.224***	1.277
Body Mass Index (BMI = kg/ m^2)	.022	.978				
Stage of DM disease (1=yes, 0=no)						
Stage 1b (1 oral med per day)	-.261	.771				
Stage 1c (oral meds ± insulin)	.178	1.195				
Stage 2-4 (insulin only)	.121	1.128				
DM duration (years since dx)	.095***	1.100	.084***	1.088	.086***	1.090
Psychiatric diagnosis (1=yes, 0=no)	.438	1.550				
Demographics						
Age (in years)	.036***	1.037	.025*	1.025	.025*	1.025
Race (1=yes, 0=no, comparison Hispanic)						
Black	.062	1.064				
White	.463	1.589				
Sex (1=female, 0=male)	-.724**	.485	-1.103***	.332	-1.103***	.332
English language (1=yes, 0=no)	-.142	.867				
Medicaid (1=yes, 0=self-pay)	.901**	2.463	.885**	2.424	.827**	2.288
Problems getting meds/supplies (1=yes, 0=no)	.041	1.042				
Negative social support (1=yes, 0=no)	-.098	.907				
Risk and functional status						
Exercise level (1=active, 0=inactive)	-1.001**	.368	-1.021*	.360	-1.075***	.341
Alcohol Abuse (1=yes, 0=no)	-.259	.772				
Difficult psych adjustment to DM (1=yes, 0=no)	.057	1.059				
Difficulty understanding DM dx and care (1=yes)	.366	1.442				
Self-care behavior						
Diet self-care management (1=yes, 0=no)	.499	1.647				
Has an exercise self-care plan (1=yes, 0=no)[11]	-.652**	.521				
Utilization / provider type						
Number clinic visits	.015	1.015				
Number phone visits	.026	1.027				
Number missed clinic visits	.056	1.057				
Provider type (1=yes, 0=no, comparison both)						
MD/DO only	.662*	1.938			.629*	1.876
NP/PA only	.436	1.547				
Visits to Dietitian +/or CDE (1=yes, 0=no)	-.310	.734				

Note. B = beta, Odds = odds ratio, DM 2= diabetes mellitis type 2, MD = medical doctor, NP = nurse practitioner, PA = physicians' assistant, CDE = certified diabetes educator.
* = p <.05, ** = p <.01, *** = p < .001.

[8] Results reflect separate regression equations for each conceptual group of predictors.
[9] Significant predictors from the first three groups of variables (representing status at start of year) were entered simultaneously into the risk predictor model.
[10] Significant predictors from all groups of variables (representing status at start of year plus self-care and clinic care during year) were entered simultaneously into the combined predictor model.
[11] Exercise self-care not entered in final model due to correlational relationship with exercise level, which was a stronger predictor.

Table 9
Predictors of Emergency and/or Hospital Admission in DM2 (N = 425)

	Group Predictor Model[12]		Risk Predictor Model[13]		Combined Predictor Model[14]	
Variables by Group	B	Odds	B	Odds	B	Odds
Disease status						
Body Mass Index (BMI = kg/ m^2)	- .008	.992				
Systolic blood pressure	.002	1.002				
Stage of DM disease (1=yes, 0=no)						
Stage 1b (1 oral med per day)	-1.011	.364				
Stage 1c (oral meds ± insulin)	- .376	.687				
Stage 2-4 (insulin only)	.012	1.013				
DM duration (years since dx)	.007	1.007				
Number coexisting medical diagnoses	- .051	.951				
Psychiatric diagnosis (1=yes, 0=no)	.371	1.449				
Number DM complications, start of year	.230	1.208				
Number non-reversible complications, start of yr	.045	1.046				
Presence of moderate/severe hypoglycemia	3.056***	21.253	3.505***	33.288		
Presence of moderate/sever hyperglycemia	.786*	2.195	.076[t]	2.028		
Cardio/vascular complications(1=yes, 0=no)						
Moderate/ severe complications present	- .222	.296				
CHF, MI and/or Stroke present	-1.219	.143				
Demographics						
Age (in years)	.002	1.002				
Race (1=yes, 0=no, comparison Hispanic)						
Black	.089	1.093				
White	.456	1.577				
Sex (1=female, 0=male)	-.465[t]	.628	.402	.352	-.611[t]	.543
English language (1=yes, 0=no)	.187	1.206				
Medicaid (1=yes, 0=self-pay)	.476	1.610				
Problems getting meds/supplies (1=yes, 0=no)	-.020	.980				
Negative social support (1=yes, 0=no)	.403	1.196				
Risk and functional status						
Exercise level (1=active, 0=inactive)	-1.263*	.283	-.622	.537	-1.584**	.205
Alcohol Abuse (1=yes, 0=no)	1.253***	3.502	.797[t]	2.219	1.377***	3.962
Difficult psych adjustment to DM (1=yes, 0=no)	.596[t]	1.816	.156	1.169	.716*	2.047
Difficulty understanding DM dx and care (1=yes)	.038	1.039				
Ambulatory impairment (1=yes, 0=no)	-.133	.879				

[12] Results reflect separate regression equations for each conceptual group of predictors.
[13] Significant predictors from the first three groups of variables (representing status at start of year) were entered simultaneously into the risk predictor model.
[14] Significant predictors from all groups of variables (representing status at start of year plus self-care and clinic care during year) were entered simultaneously into the combined predictor model. The significant disease status variables of hypo and hyper glycemia were eliminated from the combined regression equation to allow more predictive patient characteristics to enter. Results of the combined model test with disease variables in the regression equation reveal hypoglycemia, alcohol abuse, exercise self-care and NP/PA care as predictors of admission (with the direction and approximate magnitude with which they predicted in the group models).

Table 9 (cont)

Variables by Group	Group Predictor Model B	Group Predictor Model Odds	Risk Predictor Model B	Risk Predictor Model Odds	Combined Predictor Model B	Combined Predictor Model Odds
Self-care behavior						
Diet self-care management (1=yes, 0=no)	-.310	.733				
Performs SBGM (1=yes, 0=no)	.708*	2.030			.936*	2.549
Has an exercise self-care plan (1=yes, 0=no)[15]	- .600**	.549				
Utilization / provider type						
No. clinic visits	- .021	.979				
No. phone visits	.071***	1.076			.046*	1.047
No. missed clinic visits	.090	1.094				
Provider type (1=yes, 0=no, comparison both)						
MD/DO only	.018	1.018				
NP/PA only	-1.075*	.341			-1.222**	.295
Number ophthalmology visits	- .431	.650				
Number podiatry visits	- .285	.752				
Number referral visits made	.049	1.050				
Visits to Dietitian +/or CDE (1=yes, 0=no)	.009	1.009				

Note. B = beta, Odds = odds ratio, DM 2= diabetes mellitis type 2, MD = medical doctor, NP = nurse practitioner, PA = physicians' assistant, CDE = certified diabetes educator.
^{t} = p <.10, * = p <.05, ** = p <.01, *** = p < .001.

[15] Exercise self-care not entered in final model due to correlational relationship with exercise level, which was a stronger predictor.

References

American Diabetes Association (2001). Standards of medical care for patients with diabetes mellitus. www.diabetes.org.

American Diabetes Association (1998). National standards for diabetes self-management education programs and American Diabetes Association review criteria. www.diabetes.org.

Aubert RE, Herman WH, Waters J, Moore W, Sutton D, Peterson B, Bailey, CM, Koplan JP, 1998. Nurse case management to improve glycemic control in diabetic patients in a health maintenance organization. Annals of Internal Medicine, 129, 605-612.

Capitation Management Report (June, 1998). Diabetes nurse case manager program lowers costs, improves glycemic control, 93-95.

DCCT Research Group (1993). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. New England Journal of Medicine, 329: 977-86.

Elias, WS (1998). Health Risk Appraisals. In Kongstvedt, PR, Plocher, DW (eds.). Best Practices Medical Management. Gaithersburg MD: Aspen, 21-34.

Friedrich, M.J. (2000). Enhancing diabetes care in a low-income, high-risk population. JAMA, 283, 467-8.

Flaskerud, JH, Winslow, BJ (1998). Conceptualizing vulnerable populations health-related research. Nursing Research, 47(2), 69-78.

Forbes, MA (1999). The practice of professional nurse case management. Nursing Case Management, 4(1), 28-33.

Ford, ME, Tilley, BC, McDonald, PE (1998). Social support among African-American adults with diabetes, Part 1: Theoretical framework. Journal of the National Medical Association, 90(6), 361-65.

Ford, ME, Tilley, BC, McDonald, PE (1998). Social support among African-American adults with diabetes, Part 2: A review. Journal of the National Medical Association, 90(7), 425-432.

Health Care Quality Commission (1998). Final Report Of The President's Advisory Commission On Consumer Protection And Quality In The Health Care Industry. www.hcqualitycommisssion.gov.

Iezzoni, LI (1997). Dimensions of risk. In Iezzoni, LI (ed). Risk Adjustment for Measuring Health Care Outcomes (2nd ed.). Ann Arbor, MI: Health Administration Press, 29-118.

Lamb, GS (1996). Case management in community nursing centers. In Cohen, EL, ed. Nurse Case Management in the 21st Century. St. Louis: Mosby.

Mazzuca, KB, Farris, NA, Mendenhall, H, Stoupa, RA (1997). Demonstrating the added value of community health nursing for clients with insulin-dependent diabetes. Journal of Community Health Nursing, 14(4), 211-224.

McCulloch, DK (1998). Diabetes Disease Management. In Kongstvedt, PR, Plocher, DW (eds.). Best Practices Medical Management. Gaithersburg MD: Aspen, 363-376.

MDCH (1999). Michigan Department Of Community Health Diabetes Section, Standards for Self-Management Education Programs.

National Health Information (1998). Real-time data, aggressive intervention slash diabetes costs and increase satisfaction. Data Strategies & Benchmarks, May, 71-74.

National Institutes of Health (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults (Publication No. 98-4083). Washington, DC: DHHS.

LoBianco, MS, Mills, ME; Moore, HW. (1996). A model for case management of high cost Medicaid users. Nursing Economics 14(5), p 303-9.

Piette, J.D., McPhee, S.J., Weinberger, M, Mah, C.A., & Kraemer, F.B. (1999). Use of automated telephone disease management calls in an ethnically diverse sample of low-income patients with diabetes. Diabetes Care, 22, 1302-9.

Phillips-Harris, C. (1998). Case management: High-intensity care for frail patients with complex needs. Geriatrics, 53(2), 62-7.

Rubin RJ, Altman WM, Mendleson DN, 1994. Health care expenditures for people with diabetes mellitus, 1992. Journal of Clinical Endocrinology and Metabolism, 78(4), 809A-809F.

Testa, MA, Simonson, D, 1998. Health economic benefits and quality of life during improved glycemic control in patients with type 2 diabetes mellitus: A randomized, controlled, double-blind trial. Journal of the American Medical Association, 280 (17), 1490-96.

Taylor, P (1999). Comprehensive nursing case management: An advanced practice model. Nursing Case Management, 4(1), 2-10.

UK Prospective Diabetes Study Group (1998). Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. The Lancet, 352(9131), 837-853.

Weinberger, M, Kirkman, MS, Samsa GP, Shortliffe EA, Landsman PB, Cowper PA, Simel DL, Feussner JR., 1995. A nurse-coordinated intervention for primary care patients with non-insulin-dependent diabetes mellitus: impact on glycemic control and health-related quality of life. Journal of General Internal Medicine, 10(2), 59-66.