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DEMOGRAPHIC PREDICTORS OF CHRONIC DISEASE MANAGEMENT  
OUTCOMES – A PARADIGM APPLIED TO DIABETES TYPE 2

By

SUSAN ALEX ROBINSON

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

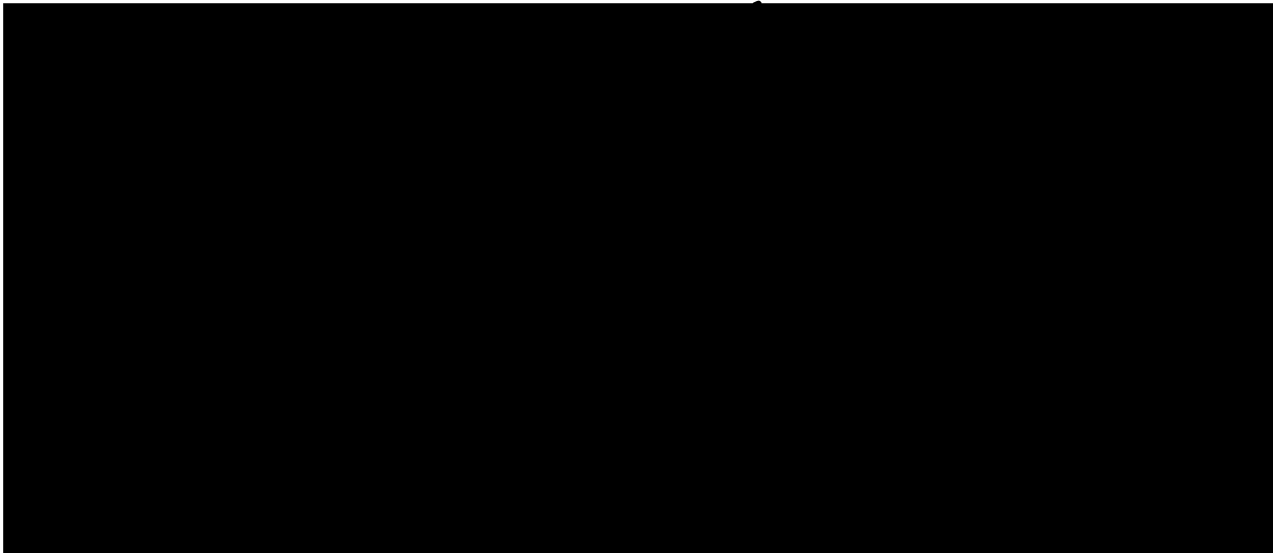
NURSING

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA SAN FRANCISCO



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## Dedication

This dissertation is dedicated to John Robinson. As a committed husband, a devoted friend, and an all encompassing support system, his sustained encouragement and practical assistance has made possible the completion of this dissertation. In engaging our child from toddler hood through preschool years on countless occasions and his willingness to do whatever it took to ensure my success, I admire his kindness, and selfless considerations. In gratitude and recognition of his untiring commitment to help me realize my goals, I dedicate this dissertation to him.

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To my mother and my deceased father who always knew that I would one day achieve this goal, I am grateful for their hope, love, and faith in me. To Ben and Gloria Robinson, parents that I gained through marriage, I feel extremely fortunate and forever grateful. Their support, encouragement, affection for life and knowledge, and interest in supporting my endeavor will always be cherished. To my daughter Gloria, whose young age and vivacity propelled me to take breaks I would have not allowed myself, I have learned my priorities.

# DEMOGRAPHIC PREDICTORS OF CHRONIC DISEASE MANAGEMENT OUTCOMES – A PARADIGM APPLIED TO DIABETES TYPE 2

Susan A. Robinson, RN, MS, PhD

University of California, San Francisco, 2005

## Abstract

Diabetes Mellitus -Type 2 and its complications are leading causes of morbidity and mortality in the United States. While multi-component interventions used in diabetes management programs are clearly beneficial, prevalence of health disparities and achievements of optimal disease management remain low. This may be due to lack of interventions that are customized to a patient's sociodemographic make-up. This study explored whether demographic characteristics predict quality of care and clinical outcomes.

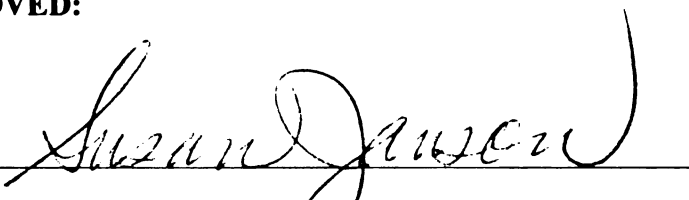
**Methods:** A post-hoc multivariate repeated measures design, nested in a prospective cohort study, using secondary analysis was used. Generalized Estimating Equation statistical model was used to determine if sociodemographic characteristics predict changes in clinical and process (quality) of care diabetes outcomes in patients with DM-Type 2 who were enrolled in a diabetes management program (N = 315).

**Results:** Blood Pressure (BP)  $\geq$  130/80 ( $p < .05$ ) and aspirin prescription ( $p < .0001$ ) increased with increasing age while the frequency of eye ( $p < .01$ ) and foot exams ( $p < .01$ ) decreased with increasing age. Compared to males, females had more primary care clinic visits ( $p < .01$ ) and hospitalizations ( $p < .05$ ) per month. Hispanics had more urgent care clinic visits ( $p < .05$ ) and emergency department (ED) visits ( $p < .01$ ) per month and fewer hospitalizations ( $p < .05$ ) per month than non-Hispanics. Asians had more foot exams

( $p < .05$ ) and fewer ED visits ( $p < .05$ ) per month than Whites. Non-married patients were more likely to have an eye exam ( $p < .05$ ) than married patients and married patients were more likely to have an aspirin prescription ( $p < .01$ ) than non-married patients. Having BP  $\geq 130/80$  ( $p < .05$ ) was higher in English speaking patients than non-English speaking patients. English speaking patients had fewer primary care visits ( $p < .0001$ ) per month and more aspirin prescriptions ( $p < .05$ ) than non-English speaking patients. LDL  $\geq 100$  ( $p < .05$ ), aspirin prescription ( $p < .01$ ), and frequency of primary care ( $p < .0001$ ) and ED visits ( $p < .01$ ) per month were higher among MediCare/MediCal patients.

**Conclusion:** Sociodemographic characteristics are predictive of diabetes health status, process (quality) of care, and utilization of healthcare services. Knowledge of these relationships informs the development of targeted interventions to specific sub-populations to improve the delivery of care for diabetes type 2.

**APPROVED:**



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## CHAPTER ONE: STUDY PROBLEM AND SIGNIFICANCE

### Introduction

Many factors influence the management of diabetes care. DM -Type 2, the more prevalent form of diabetes, is a chronic metabolic disorder due to insulin deficiency and /or resistance. It is primarily characterized by elevated blood glucose levels and by medical complications that lead to morbidity. To prevent acute complications and to reduce the risk of long-term complications, the American Diabetes Association's (ADA's) recommendations include diagnostic and therapeutic actions that are known or believed to favorably affect health outcomes of patients with diabetes. These standards provide clinicians, patients, and researchers with the treatment goals and tools to evaluate the quality of diabetes care (American Diabetes Association, 2004b).

Implementation of diabetes management programs that use a multidisciplinary team of providers with various skills have led to interventions that improve the process (quality) of diabetes care (Joshi & Bernard, 1999). Overall, however, disease management programs vary in scope, content, and utilization rate. Little is known of their impact on improving the rate of diabetes complications (Sidorov et al., 2002).

Disease management intervention programs have been shown to reduce the use of emergent healthcare services and improve the overall health status of diabetic patients while reducing the direct costs of care (Sadur et al., 1999; Sidorov et al., 2002; Wagner, Sandhu et al., 2001). Proactive use of non-emergent healthcare services to prevent complications is a positive outcome of disease management programs as it forestalls complications requiring further expenditure of resources.

## Study Problem

Substantial attention has been focused on improving the organizational delivery of diabetes care and decreasing the economic impact by preventing disease complications. However, diabetes remained the sixth leading cause of death in the United States in 2000 (American Diabetes Association, 2002). Epidemiological studies have documented sociodemographic differences among people with diabetes. The prevalence and complications of diabetes were higher among women (9.3 million) than men (8.7 million), people over 60 years, among racial and ethnic minorities, such as Native American/American Indian, African American, Hispanic, and Latino, and among those with significant socioeconomic barriers that hindered efforts to improve care (American Diabetes Association, 2002; Beckles et al., 1998; Chin, Zhang, & Merrell, 1998; Harris, 2001).

Several epidemiological studies have documented variation gaps in the level of preventive care among diabetic patients and gaps in the performance of recommended optimal care by providers by demographic characteristics (Beckles et al., 1998; Chin et al., 1998; Harris, 2000, 2001; Harris, Eastman, Cowie, Flegal, & Eberhardt, 1999). Diabetes management programs provide effective management of diabetes patients by promoting disease control and prevention of complications set forth by the ADA. However, evaluation studies of diabetes management programs have reported the outcomes of interventions in patients with sub-optimal glycemic control, without accounting for socio-economic or demographic differences, or have failed to analyze the effect of sociodemographic characteristics on diabetes outcomes, and have subsequently failed to modify the interventions to incorporate these differences (Parchman & Burge,

2002; Sidorov et al., 2002; Wagner, Sandhu et al., 2001). There is a paucity of evidence in the literature on whether diabetic patients with or without complications, and with health insurance, use the appropriate healthcare services differently. Similarly, there is little information about the relationship of sociodemographic characteristics to sub-optimal diabetes outcomes, process of care actions recommended by the ADA, and differences in utilization rate of healthcare services after implementation of diabetes management programs. The use of multi-component diabetes interventions is clearly beneficial; however, without measuring and understanding the community and organizational context of care, the success of such programs cannot be adequately assessed (Bell et al., 2001; Cretin, Shortell, & Keeler, 2004; Harris et al., 1999). A recent interdisciplinary training program focused on quality improvement of diabetes management, provided data to examine the factors related to processes and outcomes of care through secondary analysis. This study was intended to assess and predict the variations related to demographics at a facility-level and better understand how to efficiently inform and implement the appropriate interventions to improve the delivery of diabetes care.

#### Purpose of the Study

The purpose of this secondary analysis was to explore the effect of sociodemographic characteristics on markers of diabetes health status, process (quality) of care measures, and utilization of health services.

#### Research Questions

The specific aims for this study depicted in Figure 1 were to:

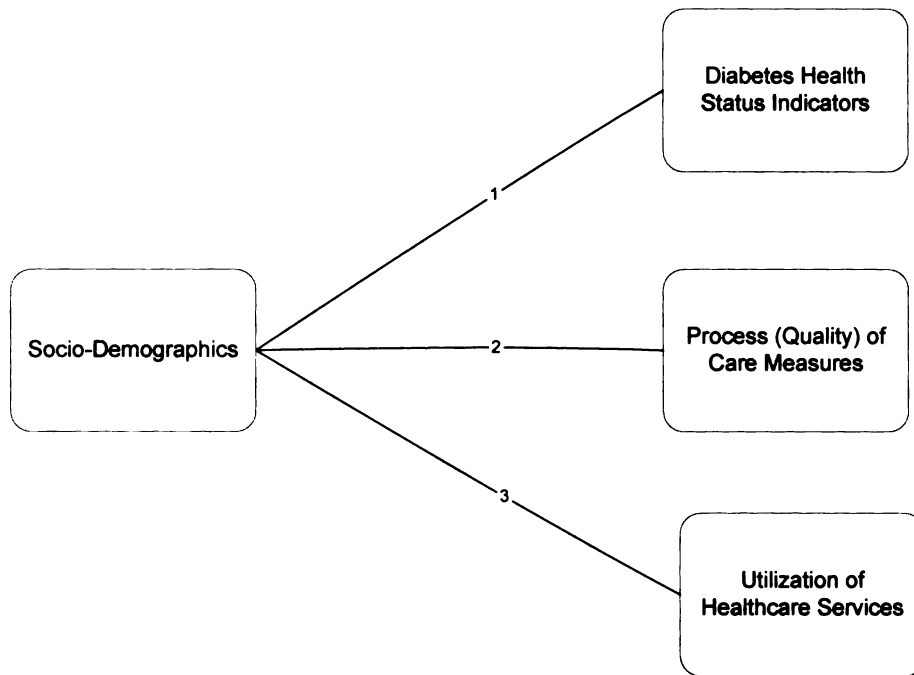


Figure 1: Organization of Variables

- 1) Determine if sociodemographic characteristics (age, gender, race, marital status, insurance, and primary language) are related to markers of diabetes health status (glycosylated hemoglobin [HbA1c], blood pressure [BP], and low-density lipoprotein [LDL])
- 2) Determine if sociodemographic characteristics are related to process (quality) of care measures (eye exam, foot exam, use of aspirin, and diabetes self-management techniques)
- 3) Determine if sociodemographic characteristics are related to utilization of health services: non-emergent care visits (general medicine clinic and urgent care (same day ambulatory care services [SAC]), and emergent visits (emergency department visit and hospitalization).

## Significance

Epidemiological studies suggest that the cost of management and treatment of diabetes mellitus - Type 2 (referred to as DM - Type 2) is rising. The direct and indirect cost of diabetes was 132 billion dollars in 2002 (American Diabetes Association, 2002; Hogan, Dall, & Nikolov, 2003). Diabetes management research is a high priority at the National Institutes for Health (NIH), the Center for Disease Control and Prevention (CDC), and the Department of Health and Human Services (HHS), and points to the need for improving chronic illness care through innovative and meaningful approaches. Managing and improving diabetes outcomes requires consideration of a complex array of factors that need to be evaluated and supported.

Subsequently, large amount of resources have been invested in developing best practice approaches, including guidelines, education programs, or other tangible products and services (Joshi, 1999). However, many patients have poor glycemic control and only 44% of patients with DM - Type 2 meet the optimal target HbA1c of less than 7% (Harris et al., 1999; Mazze, 1994; Nathan, 1995).

Research implications from the Cochrane review and other studies suggest that while many multifaceted models in diabetes management programs are being tested, the choice of components within the models has not been based on theoretical or empirical rationale (Renders et al., 2003). With advances in computerized disease registries, there is a need to determine whether meaningful information about the development of potential interventions can be extracted by linking sociodemographic factors to diabetes health status indicators, process of care measures, and patterns in utilization of healthcare services (Joshi & Bernard, 1999; Krein, Hofer, Kerr, & Hayward, 2002; Renders et al.).



Meaningful data are an important component in providing information to assess and to improve the health status for population based programs and provide valuable knowledge when linked to quality improvement efforts. With advances in technology, more efficient feedback mechanisms along with inter-operable and intra-operable information systems, the development of a practical health care system engaged with its population that functions within the constraints of an institution's shared and limited resources will improve the quality and delivery of care.

Management of outpatient chronic illnesses is a challenge and requires a perspective that incorporates patients' participation or lack thereof with the health care system and the community at large. Disease management approaches that use Continuous Quality Improvement (CQI) principles have shown huge opportunities to improve care. The findings of this analysis will make a contribution to the body of knowledge about managing diabetes in the context of sociodemographics and may provide recommendations for practice to institutions.

## CHAPTER TWO: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

### Conceptual Framework of Managing Chronic Diseases

With the emergence of Continuous Quality Improvement (CQI) principles in the 1990s, health and disease management have attracted the attention of health care organizations as an innovative strategy to direct and improve the quality of care (Bernard, Townsend, & Sylvestri, 1998; Joshi & Bernard, 1999). The initial focus on cutting costs rather than improving quality evolved to the accountability of high-quality health care as demand from multiple stakeholders increased (Joshi & Bernard, 1999). Subsequently, developing and implementing CQI principles in disease management received greater support as the best approach to achieving improved patient outcomes (Joshi & Bernard, 1999). Joshi and Bernard (1999) defined the disease management framework as consisting of multiple components:

patient and family education; provider education; health risk assessment and stratification; preventive services and wellness activities; clinical guidelines, protocols, and algorithms; case management; home care services; clinical information systems and decision support; outcomes tracking and reporting; practice profiling; and feedback (p. 385).

These components may be implemented separately in many organizations. However, when multiple components are integrated and coordinated in a single program with a focus on improving the health of a population, this vertical integration of programs is often referred to as a disease management program.

*Evidence-Based Practice.* Evidence-based practice is based on the principle that the medical treatments found to be safe and efficacious should be adopted by providers and

patients to decrease physician practice variation and appropriateness of services (Guyatt et al., 2000; Rutledge & Grant, 2002; Van de Ven & Schomaker, 2002). Standards of medical care, based on a large body of evidence, exist to support a range of interventions, including treatment goals and tools to evaluate the process (quality) of care in diseases such as diabetes (American Diabetes Association, 2004b). In the 1990s, an effort to assist practitioners in decision making at the level of the individual patient and to integrate research into practice, showed that outcomes improved when published standards of care recommended by the ADA were adopted (Nyman, Murphy, Schryver, Naessens, & Smith, 2000). However, published standards were followed at varying levels by providers, showing that few situations in modern health care have a high degree of certainty and agreement, and rigid guidelines are often rigidly abandoned (Plsek & Greenhalgh, 2001). This is because guidelines provide the recommended course of action that covers almost all circumstances; however, clinicians have to judge the relevance of the guidelines that may apply to each patient. Further, multiple conditions and treatments that alter with time and with treatment and interact recursively make guideline implementation complex (Welsby, 2002).

*Improving Chronic Care Illness Care.* The Chronic Care Model was developed as an evidence-based guide for provider organizations desiring to improve chronic illness care (see Figure 2)(Wagner, 1998; Wagner, Austin et al., 2001). The evidence-based guide is a synthesis of the best available support from clinical trials for a particular disease. The six essential factors of the Chronic Care Model are (a) health care organization; (b) linking community resources available outside the organization to the health care organization; (c) self-management support for patients to increase confidence and skills in managing

the chronic condition by identifying barriers and setting goals to improve self management of chronic illness (Holman & Lorig, 2000); (d) decision support systems to standardize processes of care to improve quality (Woolf, Grol, Hutchinson, Eccles, & Grimshaw, 1999); (e) health care delivery system redesign to encourage and enable productive interactions with the delegation of care to a team rather than an individual provider (Wagner, 2000); and (f) clinical information systems for collecting, organizing, and summarizing, individual or aggregate patient data (Wagner, Austin et al., 2001).

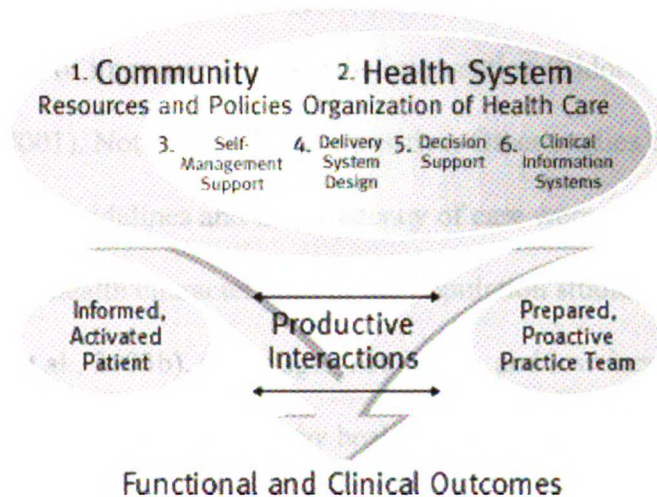


Figure 2: Overview of the Chronic Care Model (Wagner, 1998)

Currently, there is considerable interest in promoting the Chronic Care Model (CCM) to guide management of chronic illnesses. The Chronic Care Model is evidence-based, has intuitive appeal, and its holistic approach is an attempt to involve the patients and their families in shared responsibility for chronic disease management. Furthermore, the model seeks to improve and maintain outcomes by fostering community linkages.

*Use of the Chronic Care Model and Related Literature.*

The effects of the interventions recommended by the CCM on patient health outcomes have shown different results (Bell et al., 2001; Heisler, Smith, Hayward, Krein, & Kerr, 2003b; Sidorov et al., 2002; Wagner, Sandhu et al., 2001). For example, in two studies, interventions such as computerized diabetes registries, nurse case management, individual and group patient education, promotion of diabetes guidelines by nurses to providers and patients, continuing medical education for providers, early specialty referral, and communication through detailed documentation, resulted in improved glycemic control, self-efficacy, patient satisfaction, reduced health care utilization (fewer hospitalizations and higher ambulatory care use), and increased cost-savings within 6 months to 2 years of improvement after the intervention (Sidorov et al., 2002; Wagner, Sandhu et al., 2001). Not all results were positive. Other studies of lower compliance with diabetes care guidelines and inconsistency of care were associated with demographic and health characteristics of the population studied (Bell et al., 2001; Heisler, Smith et al., 2003b). Older age, insulin use, and low-income was associated with inconsistent and poor quality of care by health professionals.

Healthcare disparities related to age and race were found in some of the quality of care processes (frequency of blood pressure and LDL testing and foot and eye exams) even within one facility or health care system (Bell et al., 2001; Heisler, Smith et al., 2003b). These study interventions equally targeted patients with sub-optimal glycemic control without the assessment or evaluation of differences in sociodemographic characteristics (Parchman & Burge, 2002; Sidorov et al., 2002). For example, in examining whether disease management programs improved outcomes, studies by Sidorov et al. (2002) assessed gender and education level, and Parchman & Burge (2002)

assessed age, gender, and insurance type, and used samples with significant differences in demographic characteristics, but failed to analyze their effect on diabetes outcomes or to recommend plans to incorporate these differences in future interventions.

The six essential factors in the Chronic Care Model are comprehensive in concept and have been applied at varying degrees in different diabetes management programs. This variability may be due to the constraints of limited or shared resources, characteristics of the population served, and lack of tools to identify, prioritize, and customize population-based needs within a program. Also, the goal of appropriately placed accountability for quality improvement falls short due to the challenges related to lack of comparison groups and the mixed results of profiling on the changing practice pattern of individual providers (Balas et al., 1996; Mainous, Hueston, Love, Evans, & Finger, 2000).

Moreover, quality improvement programs for disease management have focused on identifying the practice environment (for the provider and the system) as the main sources of problems and solutions for improved diabetes care. Practice interventions have focused on decreasing practice variations by profiling individual providers and by implementing system changes that improve one or more of the many services that support diabetes management

### Literature Review

A review of critical empirical literature addressing diabetes management interventions in primary care settings conducted in outpatient and community settings resulted in 34 studies. The specific aim of this review was to examine the linkages between diabetes health status outcomes, diabetes management process (quality) of care,

and utilization of health care services within the context of sociodemographic characteristics.

### Diabetes Health Status Indicators

The most common indicators of diabetes health status are glycosylated hemoglobin (HbA1c), blood pressure (BP), low density lipoprotein (LDL); these outcomes provide a snapshot of a diabetic patient's health state.

*Glycosylated hemoglobin.* According to the American Diabetes Association (2004b), the target HbA1c level is 7% or lower with testing performed every one to two times a year if stable, and quarterly if treatment changes or if a patient does not meet therapeutic goals. A review of the literature found that in a national survey on health status and outcomes, 58% of patients with diabetes had HbA1c values greater than 7%, including 73% of insulin treated patients, 61% of patients taking oral agents, and 35% of those treated by diet alone, with a mean HbA1c at 7.8% (Harris, 2000). Patients aged less than 45 years had lower adjusted odds of being in control with HbA1c  $\leq$  9.5% compared to patients aged 45 to 64 years (OR = 0.32, 95% CI, 0.17-0.62) with no difference between 45 to 64 years of age and those over 65 years of age (Bell et al., 2001).

Another study, comparing health plans that agreed to participate in the California Collaborative To Improve Diabetes Management Project, found that the mean HbA1c values improved for all plans; with the exception of one health plan, the mean HbA1c values improved and were statistically significant ( $p < 0.05$ ); however a quarter of the patients included in the sample had HbA1c  $>$  9.5% (Wasserman et al., 2001).

Interventions using an audit system of monitoring and feedback found that the percentage of patients with HbA1c  $>$  8.5% decreased from 41% to 13% ( $p = 0.01$ ), with better results

among patients with less severe disease (de Grauw et al., 2002). In the same study, mean HbA1c value of 8.2% improved to 7.1% ( $p = 0.0001$ ) and the number of patients with mean HbA1c > 8.5% decreased from 41% to 13% ( $p=0.001$ ) (de Grauw et al., 2002). A study evaluating the impact of chronic care clinics on outcomes of care found no significant difference in the mean HbA1c values between baseline and 24 months after intervention (Wagner, Grothaus et al., 2001). Other studies showed that mean HbA1c values decreased from 8.02% to 6.7% in the post intervention period (absolute decrease, 1.05%, 95% CI, 0.82% to 1.27%) (Nyman et al., 2000). A study examining the effectiveness of computerized system in improving diabetes care found that patients with HbA1c > 8% declined from 37% to 21 %, a 43% relative improvement ( $p < 0.01$ ); however, a two year follow-up after the cessation of quality improvement interventions resulted in an increased percentage (33%) of inadequately treated diabetic patients and the number of patients with Hba1c levels < 8% declined significantly at the end of 5 years, reflecting a reversal of the CQI program ( $p = .05$ ) (Goldberg et al., 2002). Interventions with academic detailing, hot lists, increased team time, and automatic letters in a randomized prospective trial found significant change in the mean HbA1c ( $-0.25 \pm 1.55$ ) at  $p < 0.001$  (Stroebel et al., 2002). A significant change in mean HbA1c by 1.3% ( $p < 0.0001$ ) was seen with using cluster visit model interventions (Sadur et al., 1999)

A study on racial disparities in diabetes care reported that 83% of Black patients had a HbA1c < 9.5% compared with 86% of White respondents ( $p > 0.20$ ) (Heisler, Smith et al., 2003b). In other studies, the percentage of patients with HbA1c level below 8% was



reported, but significance in the difference was not reported (Stys, 2002; Wagner, Glasgow et al., 2001).

*Blood pressure.* According to the American Diabetes Association (2004b), the target BP goal of <130/80 mmHg and performance of a BP test with every clinic visit is recommended. A review of the literature indicated that a national survey on health status and outcomes found that 59% of diabetic patients had a blood pressure >140/90 mmHg (Harris, 2000). With audit enhanced monitoring interventions, there was little change in mean systolic BP from 161 mmHg to 158 mmHg and mean diastolic pressure from 88 mmHg to 85 mmHg (de Grauw et al., 2002). An intervention study (N= 139) using home based patient education reported 74 (53%) of diabetic patients maintaining a BP  $\leq$  130/85, 14 (47%) patients improved their systolic BP, 6 (86%) of patients achieved normal diastolic BP, and 16 (43%) of patients with BP  $\geq$ 130/85 reported BP  $\leq$  130/85 at follow-up after one year (significance was not reported) (Stys, 2002). A study on racial disparities in diabetes care reported that a significantly lower percentage (32%) of Black patients had BP < 140/90 mmHg than the percentage (47%) of White patients ( $p=0.003$ )(Heisler, Smith et al., 2003b). After participating in a 2-year initiative to improve diabetes care in ethnic minority communities, there were no significant changes in BP measurements between the start and end in a study conducted by Hosler et al (2002).

*Low density lipoproteins.* According to the American Diabetes Association (2004b), the recommended target LDL goal is less than 100 mg/dl and the performance of a LDL test annually is recommended. A review of the literature indicated that a national survey on health status and outcomes found that 15.4% of diabetic patients had LDL <100

mg/dl, 33.9% with LDL 100-129 mg/dl, 30.2% with LDL 130-159 mg/dl, and 20.5% with LDL  $\geq$ 160 mg/dl (Harris, 2000). A study on racial disparities in diabetes care reported that Blacks had less than half the odds of White patients of having an LDL  $<$ 130 (OR=0.49, 95% CI, 0.27-0.89) (Heisler, Smith et al., 2003b).

There was no significant change in lipid profile after the first or second year of the intervention in the multifaceted interventions targeting mainly primary care providers, patients, and the health care system (Kirkman, Williams, Caffrey, & Marrero, 2002). Significant improvements of 52% to 72% in lipid levels of cholesterol less than 192mg/dl were seen following diabetes intervention ( $p < .001$ ) (de Grauw et al., 2002). These included patients with cardiovascular morbidity who had a target goal of cholesterol more than 192mg/dl and patients who are smokers without cardiovascular morbidity who had a target goal of cholesterol to HDL ratio of less than 5 mmol/L (de Grauw et al., 2002).

In summary, reaching the ADA recommended target goal for HbA1c, BP, and LDL for diabetic patients remains challenging. Some intervention studies indicated improvement in patient outcomes; however, challenges related to lack of comparison groups or the type, level, and amount of intervention applied, the population served, the setting, and the amount of resources available varied. Sustaining comprehensive interventions in busy day-to-day practice settings remains formidable, and studies that explore socio-demographic characteristics to guide the allocation of resources for targeted and sustainable interventions remains lacking.

#### Diabetes Processes of Care

The performance of foot and eye exams and the use of aspirin and diabetes self-management training is recommended for all diabetic patients and is a reflection on

whether the process (quality) of care delivered is effective in meeting the ADA performance goals (Beckles et al., 1998).

*Eye exam.* According to the American Diabetes Association (2004b), performance of a dilated eye exam annually is recommended. Eye exam performance rates of patients within a practice/facility at baseline ranged from 38% to 84% with final end point performance rates ranging between 46% and 79.1%, within time periods ranging from 1 to 2 years ( $OR = 1.6$ ,  $95\%CI$ , 1.1-2.3,  $p = .0001$  to  $p = .05$ ) (Chin et al., 2004; Khunti, Ganguli, Baker, & Lowy, 2001; Kirkman et al., 2002; McCulloch, Price, Hindmarsh, & Wagner, 1998; Nyman et al., 2000; Sidorov et al., 2002).

*Foot exam.* According to the American Diabetes Association (2004b), performance of a foot exam annually is recommended. Foot exam performance rates of patients within a practice/facility at baseline ranged from 19% to 86% with final end point performance rates ranging between 42% and 97%, within time periods ranging from 1 to 2 years ( $OR = 2.7$ ,  $95\%CI$ , 1.8-4.1,  $p = .0001$  to  $p = .05$ ) (Chin et al., 2004; Hosler, Godley, & Rowland, 2002; Khunti, Ganguli, Baker et al., 2001; Kirkman et al., 2002; Nyman et al., 2000).

*Aspirin use.* According to the American Diabetes Association (2004b), to prevent cardiovascular events, aspirin has been recommended as a primary therapy for diabetics over 40 years of age with no cardiovascular risk factors and as a secondary therapy for diabetics with cardiovascular risk factors. In the U.S., adults with diabetes have at least one risk factor for cardiovascular disease (CVD), and should be considered a potential candidate for aspirin therapy (Rolka, Fagot-Campagna, & Narayan, 2001). Change in aspirin use from 1997 to 2001 among diabetics increased from 37.5% to 48.7%

respectively, after the ADA's position statement. In 2001, 74.2% (95%CI, 70.9%-77.5%) of diabetics with CVD used aspirin regularly, but only 37.9% (95%CI, 35.1%-40.7%) of those without CVD used aspirin regularly (Persell & Baker, 2004).

Another study found that out of 71% of diabetic individuals being counseled about aspirin use, 66% were taking daily aspirin; however, individuals with known CVD were more likely to be counseled (OR = 4.9%, 95%CI, 2.9-8.1) and to use aspirin (OR = 2.1%, 95%CI, 1.2-3.7) (Krein, Vijan, Pogach, Hogan, & Kerr, 2002).

*Diabetes self-management training.* Skilled behaviors, such as taking medications, monitoring blood glucose levels, following a diet, engaging in regular exercise, and caring for their feet to promote diabetes health and prevent complications are often called “self-management” (Heisler, Smith, Hayward, Krein, & Kerr, 2003a). Randomized controlled trials on the effectiveness of self-management training interventions in DM – Type 2 have led to better glycemic control (Norris, Engelgau, & Narayan, 2001). The evaluation of diabetes self-management has been reported in a variety of ways. In one study, better scores of a patient's self-evaluation on their diabetes self-management was significantly associated with lower HbA1c ( $p < 0.01$ ) (Heisler, Smith et al., 2003a). Another study found that a higher level of patient trust in physician was associated with lower levels of difficulty completing self-care activities ( $p = 0.001$ ) (Bonds et al., 2004).

#### *Utilization of Healthcare Services*

The frequency with which healthcare services are utilized by diabetic patients represents the efficacy of the diabetes management program in providing preventive care by delaying complications and decreasing costs related to emergent healthcare services. Indicators for utilization of health care services include the number of non-emergent

(e.g., primary care, ambulatory care, and urgent care) and emergent care (e.g., emergency department and hospitalization) visits.

Utilization of non-emergent services was significantly lower among patients who had attained glycemic control or participated in CQI diabetes programs after 1 to 2 years ( $p = .001$ ) (Goldberg et al., 2002; Sadur et al., 1999; Wagner, Sandhu et al., 2001) and this lower utilization rate continued even after 5 years ( $p = .004$ ) (Wagner, Sandhu et al., 2001). In these studies, the utilization of non-emergent services was as low as 22%, or in some cases fewer than 1.3 visits annually. Other studies showed that the utilization of non-emergent services among persons with diabetes increased from 73% to 84% (de Grauw et al., 2002). Sidorov et al (2002) found statistically significant differences in the mean primary care office visits per year when controlling for age, sex, and insurance type (8.36 vs. 7.78,  $p = .001$ ).

A statistically significant relationship between continuity of care and quality of care has been shown among persons with diabetes ( $r = .15$ ,  $p = .04$ ) (Parchman & Burge, 2002). Patients with diabetes who saw their health care providers within the last year were significantly more likely to have had an eye exam, foot exam, lipid testing, two BP measurements, and better glycemic control; 41.5% of patients with an HbA1c level greater than 8% made less than four visits to their physician annually, 35.4% of them made four to six annual physician visits, 39.8% of them made seven to 10 annual physician visits, and 30.9% of them made greater than 10 annual physician visits (Harris et al., 1999). Inequalities in organization of services in primary care for diabetes patients found that only 14% of facilities had practice-based access to ophthalmologic services (Khunti, Ganguli, & Lowy, 2001).

Utilization of emergent care health care services, such as hospitalization rates, has been shown to stabilize after diabetes intervention for a duration of 3 years ( $p = .04$ ) (Goldberg et al., 2002). The CQI interventions included use of a database, chart reminders for preventive care, and pharmacist outreach. In a study conducted by Sidorov et al (2002), after implementation of a diabetes management program that included individual and group patient education, promotion of clinical guidelines, early and appropriate specialty referral, and case management by nurses, there were no significant difference in the mean emergency department 0.49 visits per member per year compared to 0.56 visits per year in the control group, and there were significant ( $p = .001$ ) differences between the two groups for mean primary care office visits (8.36 vs. 7.78) per year when controlling for age, sex, and insurance type.

### Sociodemographic Characteristics

Demographic characteristics have been used as proxies for collective attitudes, beliefs, and values in a group with similar characteristics and represent opportunities or barriers of certain groups. Characteristics, such as: age and gender serves as an indirect measure of social role, physical and/or biological differences; race and ethnicity represent a group of people belonging to a social group with common national, geographic, religious, or linguistic identity and may represent common perceptions about symptoms, assumptions about causes, when to seek treatment, and the perceived role of provider-patient relationship. Characteristics such as marital status may provide indication of domestic help, available family support, or isolation; primary language may represent barriers or facilitators of communication; and insurance may be an indirect indicator of

socioeconomic status representing possession of better medical coverage and access than others.

Several epidemiological studies have examined demographic characteristics and have reported gaps in the level of preventive care among diabetic patients and gaps in the practices of providers that are recommended for optimal care (Beckles et al., 1998; Chin et al., 1998; Harris, 2000, 2001; Harris et al., 1999). However, the relationships among, diabetes health status outcomes, process (quality) of care outcomes, and utilization of healthcare services, with sociodemographic characteristics have been sparsely reported (see Table 1).

**Table 1. Number of Studies Reporting Diabetes Health Status Outcomes, Process of Care and Utilization of Healthcare Services by Sociodemographic Characteristics**

	Sociodemo graphics									
Diabetes	Not	Age	Gender	Race	Education	Insurance	Language	Income	Marital	
Outcomes	Reported								Status	
Health Status										
(DMI)	11	1	1	3	1	1		1		1
Process-of-										
Care (DMI)	12	3	3	4	3	3	1	1		2
Utilization of										
Healthcare										
Services										
(DMI)	5	1	1	2	2					1

*Note.* DMI = Diabetes Management Indicators



*Linking Sociodemographic Characteristics and Related Diabetes Management Outcomes  
/Utilization of Healthcare Services Literature*

*Age and gender.* The age group 75 to 84 years had favorable results on the measures of HbA1c, eye exam, lipids, and influenza vaccine compared to those 85 years and older (Chin et al., 1998). Compared to persons 65 years and older with diabetes who were non-insulin users, there were statistically significant fewer eye exams among 18 to 44 year olds (OR = 0.36, 99%CI, 0.20-0.67) and 45 to 64 year olds (OR = 0.60, 95%CI, 0.39-0.92) (Beckles et al., 1998). There were no gender difference in the frequency of obtaining a HbA1c or eye exam (Chin et al., 1998).

After adjusting for socioeconomic characteristics and coronary vascular disease (CVD), aspirin use between 1997 and 2001 was less common among women, in both, ages 35 to 49 years (adjusted Rate Ratio [RR] = 0.35, 95% CI, 0.24-0.51) and ages 50 to 64 years (adjusted Rate Ratio [RR] = 0.69, 95% CI, 0.53-0.88) and in younger men aged 35 to 49 years (adjusted Rate Ratio [RR] = 0.62, 95% CI, 0.43-0.85) compared with men 65 years and older (Persell & Baker, 2004). In a study to improve diabetes care strategies for low-income and underserved patients, the absence of difficulties with self care had significant positive associations with greater age and male gender (both  $p < 0.01$ ); understanding of self-care was significantly associated with increased age, higher glucose reading, and absence of leg and feet complaints (all at  $p < 0.01$ ) (Anderson et al., 2003). Thus, routine monitoring of patient-focused self-care outcomes could help improve the long-term outcomes in the diabetic population.

*Race/ethnicity.* Among patients funded by Medicare, the frequency of obtaining an HbA1c test among Blacks was significantly lower at 19% compared to Whites at 27% in

Medicare patients (Chin et al., 1998). In contrast, a study on disparities in diabetes care at the VA found no significant difference between Blacks (82%) and Whites (86%) in HbA1c testing (Heisler, Smith et al., 2003b). The proportion of Mexican-Americans (65.5%) with HbA1c levels above 7% was significantly higher in comparison to Whites (55.1%) ( $p < .001$ ) (Harris, 2001). Ethnic and racial disparities within facilities persisted, independent of any facility effects after controlling for other demographic characteristics such as gender, education, income, diabetes related complication, and subjective health status (Bell et al., 2001). In a study by Harris et al (1999), HbA1c levels less than 6% were found in 26.1% of non-Hispanic Whites, 16.7% of non-Hispanic Blacks, and 20% of Mexican Americans ( $p$  value not stated); glycemic control (HbA1c level greater than 8%) was poorer for non-Hispanic Blacks (45.7%) and Mexican Americans (40.8%) as compared to non-Hispanic Whites (35.7%) ( $p$ -value not stated); and having an HbA1c value greater than 8% was higher in non-Hispanic Black women ( $OR = 1.77, 99\%CI, 1.13-2.77$ ) and Mexican-American men ( $OR = 1.42, 80\%CI, 0.80-2.51$ ).

Statistically significant differences in the frequency of BP checks were noted between Mexican Americans (71.3%) and Whites (83.1%) (Harris, 2001). In the same study, ethnic minorities, of whom African Americans comprised the majority, tended to have greater frequency of BP testing ( $OR = 0.83, 95\%CI, 0.43-1.61$ ), but less optimal BP control than Whites ( $OR = 1.43, 95\%CI, 0.89-2.30$ ). African Americans (68.1%) and Mexican-Americans (61.8%) were significantly less likely to have their cholesterol levels checked as compared to 80% of Whites ( $p < .001$ ). Similarly, Heisler et al (2003) found a significantly lower percentage of Black diabetic patients (32%) with BP readings less than 140/90 mg/hg as compared to 47% of White diabetic patients ( $p = .003$ ); these ethnic



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and racial disparities in BP values persisted even after controlling for other demographic characteristics such as gender, education, income, diabetes-related complications, and subjective health status ( $p < .001$ ).

After participating in a 2-year initiative to improve diabetes care in ethnic minority communities, there were no significant changes in eye exam measurements between the start and end of the study (Hosler et al., 2002). In a disparities in diabetes care study conducted at the VA, there was no statistically significant difference between Blacks (82%) and Whites (84%) for foot exams (Heisler, Smith et al., 2003). In the same study, a significantly lower proportion of Blacks (72%) as compared to Whites (80%) received LDL testing in the past 2 years ( $p < .05$ ). After adjusting for between facility variation, there were still within-facility ethnic and racial disparities for LDL testing, with Black patients having less than half the odds ratio of White patients. Eye exams were significantly lower among Blacks (32%) as compared to Whites (41%) ( $p < .05$ ) (Heisler, Smith et al., 2003).

In a study conducted by Harris (2001), LDL level less than 100 mg/dl was significantly ( $p < .05$ ) higher among Mexican Americans (21.1%) in comparison to White patients with diabetes (15.4%). For LDL levels between 100 and 129 mg/dl, the proportion of Blacks (24.9%) was significantly lower than for Whites (32.8%) ( $p = .001$ ). Similar findings were reported in another study (Heisler, Smith et al., 2003b). LDL levels less than 130 mg/dl was significantly less prevalent in Blacks (72%) compared to Whites (80%) at  $p < .05$ . After controlling for other demographic characteristics such as gender, education, income, diabetes related complication, and subjective health status, ethnic and racial disparities persisted ( $p < .05$ ) (Heisler, Smith et al., 2003b).

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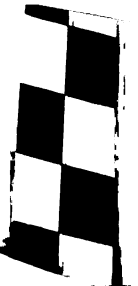
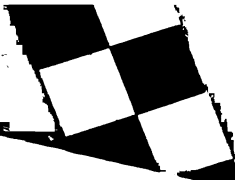
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Among the studies reviewed, primary language was described, but was not included in the analysis of diabetes outcomes (Saha, Arbelaez, & Cooper, 2003). One exception was a study conducted at the VA (Walsh, Katz, & Sechrest, 2002). The study sample was ethnically heterogeneous (Hispanic versus non-Hispanic Whites), but culturally homogeneous (a majority spoke English). In comparison to other studies, study findings from this VA study revealed better diabetes health outcomes in the Hispanic group among those who spoke English and had similar access to care. In a study exploring racial differences in patient-physician relationships contributing to disparities in the quality of health care, Asian persons with diabetes were least likely to receive appropriate services for HbA1c, eye exam, and BP as compared to Blacks, Hispanics and Whites. However, the use of health care services was not related to the frequency of patient-physician interactions (Saha et al., 2003).

*Socioeconomic status.* In the studies reviewed, marital status was described but not included in the analysis of diabetes outcomes (Goldberg et al., 2002; Parchman & Burge, 2002). For education, improvement in lipid measurement favored those with 12 years or more of education ( $p = .01$ ) (Chin et al., 1998). Insulin users with less than a high school education also had significantly lower rates of foot exams than those with education levels higher than high school (Beckles et al., 1998). In general, agreement on priority treatment goals between patients and physicians was low (Heisler, Vijan et al., 2003). Patients with more education ( $p = .01$ ), greater belief in the efficacy of diabetes treatment ( $p = .01$ ), and who shared in treatment decision making with their health care providers ( $p = .03$ ) were more likely to agree with health care providers on treatment goals. This mutual agreement was associated with higher patient diabetes care self-efficacy ( $p =$

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.005) and assessments of their diabetes self-management ( $p = .004$ ). In one study of low-income populations with diabetes in North Carolina, persons younger than 45 years had a lower HbA1c or better glycemic control as compared to persons between 45 to 64 years ( $OR = 0.32$ , 95%CI, 0.17-0.62) (Bell et al., 2001). Similar age group differences were seen with patients' lipid profile ( $OR = 0.38$ , 95%CI, 0.21-0.70).

*Insurance.* HbA1c testing was significantly lower overall for 26% for all Medicare patients in one study (Chin et al., 1998). In another study, among insulin and non-insulin users with diabetes, foot and eye exams were significantly lower among those without insurance (Beckles et al., 1998). Diabetes patients, regardless of insurance, who received at least one test averaged almost two tests annually and showed statistically significant improvement in their HbA1c test values (Wasserman et al., 2001).

*Utilization of Health Care Services.* The number of non-emergent annual physician visits was 9.7 for White patients and 8.4 for Blacks ( $p \leq .05$ ), but it was not statistically significant for other sociodemographic characteristics such as gender, education and age (Chin et al., 1998). Health status outcomes for Caucasians, African Americans, and Mexican Americans with diabetes were not significantly associated with having a primary source of ambulatory care, number of physician visits per year, or having any type of insurance (Harris, 2001). A significantly higher number of visits to the health care provider were seen in non-insulin users with less than a high school education, but there was no difference by age or insurance status ( $OR = 3.0$ , 95% CI, 1.95-6.63) (Beckles et al., 1998).

Statistical differences in emergency department visits related to a diabetes diagnosis varied significantly between Blacks (39%) and Whites (29%) ( $p < .01$ ), between females



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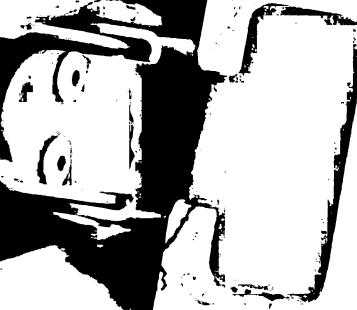
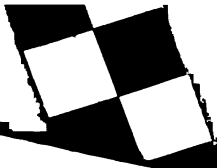
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(32%) and males (26%) ( $p < .05$ ), between persons with less than 12 years of education (34%) and those with more than 12 years education (25 %) ( $p < .01$ ), and between persons 85 years and older (35%) and persons between 65 and 74 years (29%) ( $p < .05$ ) (Chin et al., 1998). Hospital admission rates related to diabetes were significantly higher for persons 85 years and older (37%) as compared to those younger than 85 years (29%).

In summary, studies relating sociodemographics characteristics with the indicators of diabetes management have been sparsely reported, and the results of these studies have not been used to inform the selection of patient centered interventions for future practice. Differences in diabetes outcomes and utilization of healthcare services by sociodemographic characteristics have been equivocal based on setting, resources, and the length and type of intervention applied. Studies exploring the characteristics of diabetic patients specific to sociodemographic factors are needed. A perspective that incorporates the sociodemographic characteristics of a diabetic patient's interactions with the healthcare system is needed to understand the management of diabetes in an outpatient setting.

### Methodological Issues

The 34 studies reviewed were heterogeneous in terms of purpose, type of outpatient or community setting; design (see Table 2), intervention, and outcome. Reported outcomes included a combination of measures related to diabetes outcomes the processes of care, and utilization of healthcare services. A review in the Cochrane database consisted of 41 studies from 1966 to 1999; this study assessed the effects of different interventions in diabetes management, disease management programs, and evaluation of continuous quality improvement (CQI) interventions on glycemic control in primary care



clinics (Renders et al., 2003). Due to its methodological limitations, the reviewers provided a qualitative assessment of the heterogeneous interventions, settings, and the patient populations reviewed; they surmised that some of the favorable effects leading to improved patient outcomes were multifaceted professional interventions (a combination of three or more interventions with trained healthcare providers), organizational interventions (such as medical record systems that track patients with regularity and provide prompt recall), and patient oriented interventions (patients identifying problems and agreeing to potential solutions)(Renders et al.).

**Table 2. Summary of the Type of Study Design (N = 34)**

Type of Study Design	Number of Studies
Epidemiological	6
Randomized-controlled trial	3
Controlled before/after	10
Cross-sectional	14
Historical cohort	1

Ironically, disease management programs, like the chronic care model (CCM) designed to reduce differences in care, have large variances in design, development, implementation, and the cost impact to patients of diabetes management programs; these programs lack a performance improvement framework (Sidorov et al., 2002; Steffens, 2000; Weingarten et al., 2002).

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## Summary Limitation of Current Knowledge

Management of outpatient chronic illnesses, such as diabetes, is a challenge and requires a systems perspective that incorporates patients' interactions, or lack thereof, with the health care system and the community at large. A review of the literature related to diabetes management interventions in primary care settings revealed a wide range of study designs to diabetes outcomes of care. Given the availability of a database registry from a prospective cohort study and the need for new research related to previous work of others, a post-hoc study was an appropriate method to explore the link between diabetes health status outcomes, diabetes process (quality) of care, and utilization of healthcare services within the context of sociodemographic characteristics.

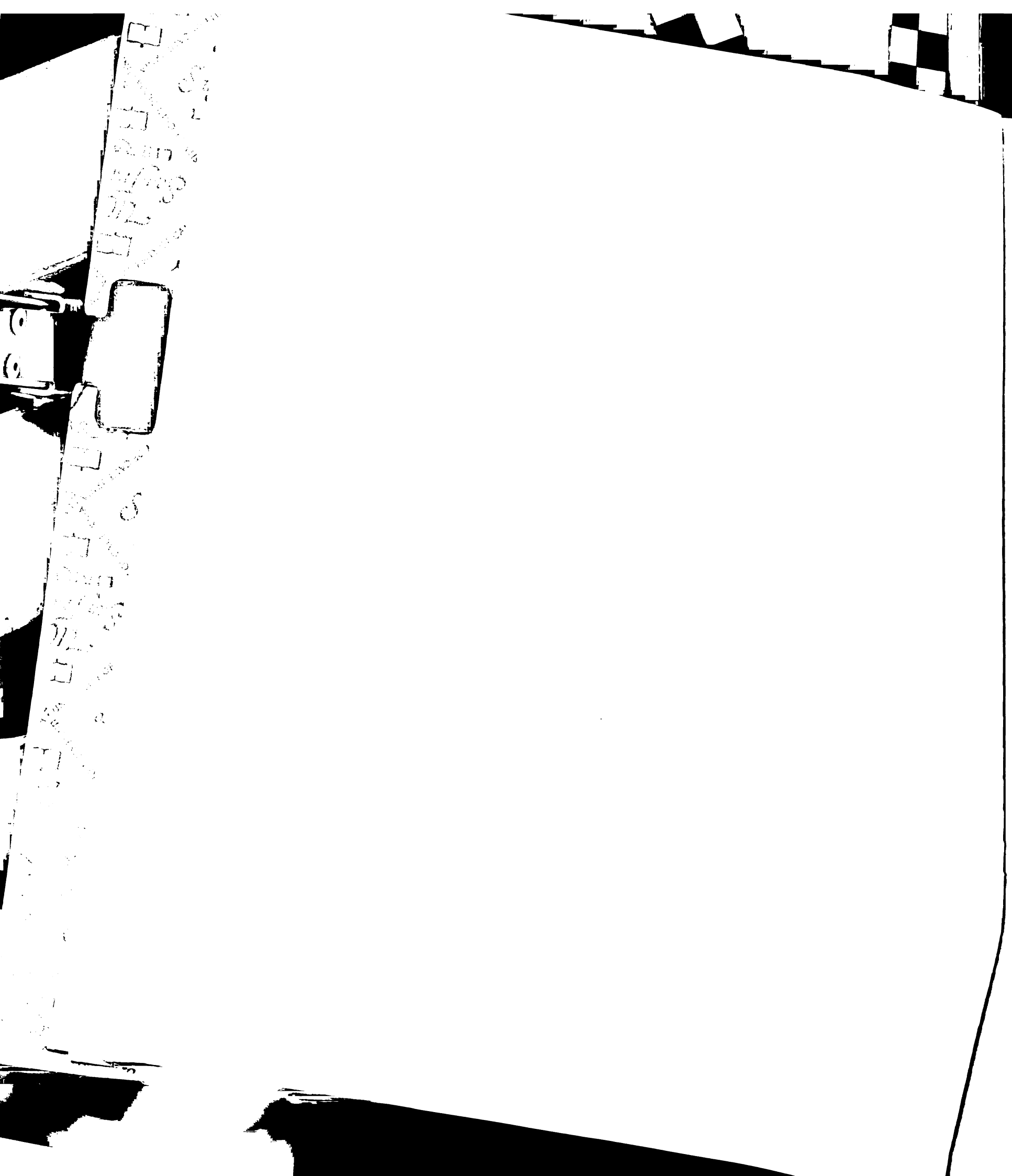
The use of multi-component interventions is clearly beneficial. Yet, the literature on decisions related to the selection of interventions that considered the socio-demographic characteristics of the population served is limited. Exploring demographic relationships to inform interventions and improve the delivery of care is within the nursing domain of knowledge. It could provide useful information to improve diabetes outcomes, decrease health disparities, and define institutional efforts directed at interventions. By identifying specific sociodemographic characteristics that affect outcome, targeted and more meaningful interventions can be designed for subpopulations of patients with diabetes mellitus - type 2.

*Purpose of Current Study.* In this study, sociodemographic characteristics were used to predict diabetes health status outcomes, and differences in process of care and utilization of healthcare services. With restrictions imposed by a post-hoc design and secondary analysis, where long term follow-up is not possible, linkage to long-term



outcomes was not feasible. The sociodemographic characteristics available for this study were limited and did not include educational level, income level, and known enabling characteristics such as physical and psychosocial abilities/disabilities, work commitments, and related scheduling barriers to health care, adherence to medications, and perceived stressors. More comprehensive data collection of these added variables would provide more conclusive information on factors that contribute to successful diabetes outcomes. However, this study provides exploratory information for determining future research.





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## GLOSSARY OF TERMS

**Blood Pressure (BP):** A proportion of the systolic blood pressure over the diastolic blood pressure required for proper cardiovascular perfusion.

**Categorical Medical Residents:** Medical residents who transition through primary care clinical experience as a prelude to their specialist education.

**Chronic Care Model (CCM):** The Chronic Care Model identifies the essential elements of a health care system that encourage high-quality chronic disease care. These elements are the community, the health system, self-management support, delivery system design, decision support and clinical information systems. Evidence-based change concepts under each element, in combination, foster productive interactions between informed patients who take an active part in their care and providers with resources and expertise. The model can be applied to a variety of chronic illnesses, health care settings and target populations. The bottom line is healthier patients, more satisfied providers, and cost savings (Improving Chronic Illness Care, 2002)

**Continuous Quality Improvement (CQI):** A cyclic series of steps (identifying opportunity for improvement, collect data, choose an approach, develop the concepts and process, implement, evaluate and improve) designed to enhance disease management programs leading to improved patient and program outcomes (Mensing et al., 2003). Six factors form the foundation for all CQI activities: achieve leadership commitment to quality, be customer focused, use a multidisciplinary approach, be data driven, use a balanced performance measurement system, and integrate and align management systems (Joshi & Bernard, 1999)

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... (Lodha & Bernard, 1999)

**Diabetes Management Programs (DMP):** Disease management programs are focused on diabetes, multifaceted and are guided by recommended evidence-based practice. The standards of care are intended to provide clinicians the recommended diagnostic and therapeutic actions that are known or believed to favorably affect health outcomes of patients with diabetes.

**Emergency Department (ED) Visit:** Patient services provided for acute problems seen in the emergency department.

**Eye Exam:** An eye examination involving dilation of the pupil to rule out diabetes related retinopathy.

**Foot Exam:** A neurological exam of the foot to rule out diabetes related neuropathy

**General Medicine Practice (GMP):** A part of the outpatient Ambulatory Care Center at UCSF (Parnassus campus) focusing on general medicine. Based on location within the building, the practices are administratively labeled General Medicine A or General Medicine B.

**Glycosylated Hemoglobin (HbA1c):** This measure assesses how well controlled a diabetes patient's blood sugar levels are, over the past two to three months. In general HbA1c < 7% is considered optimal.

**Hospitalization visits:** An acute problem requiring hospitalization of a patient.

**ICD-9 Code:** International Classification of Diagnosis, originally developed for the purpose of billing

**Low Density Lipoprotein (LDL):** A component of cholesterol responsible for negatively affecting the blood vessels and causing cardiovascular morbidity.

**Medical Resident:** All physicians in training with various medical specialties.

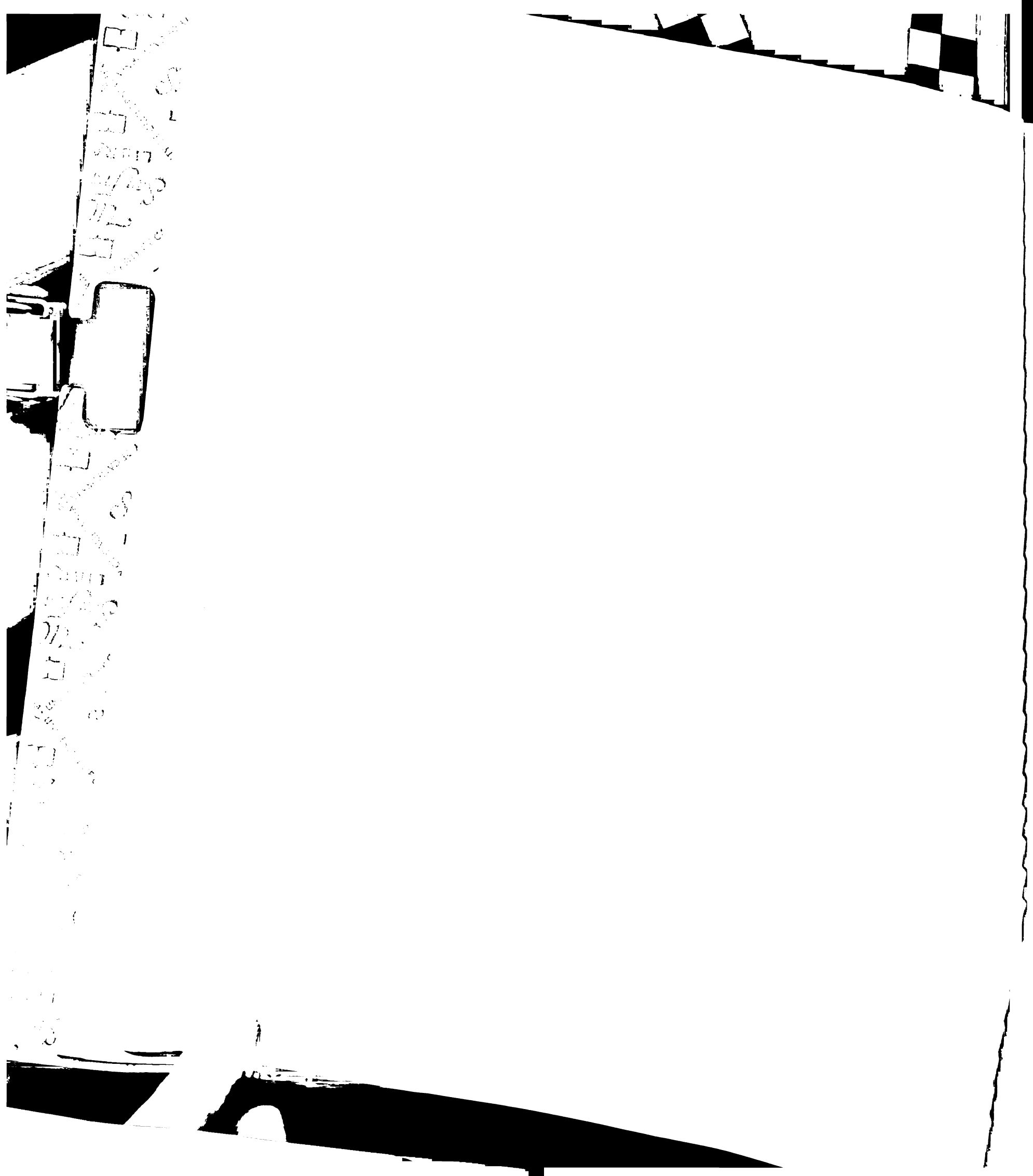
**Microvascular Complication:** Microvascular complications is primarily characterized by elevated blood glucose levels. The microvascular complications include diabetic retinopathy leading to blindness and peripheral arterial disease leading to amputations, diabetic nephropathy leading to chronic renal failure, and diabetic neuropathy leading to nerve disease (Genuth et al., 2003).

**Macrovascular Complication:** Macrovascular complications include myocardial infarction, stroke, coronary artery disease (CAD), hypertension, and hyperlipidemia. Macrovascular complications such as heart disease and stroke are two to four times more likely in diabetics than in non-diabetics (American Diabetes Association, 2004a). CAD is the leading cause of death in diabetic patients and its overall prevalence is higher among diabetics than non-diabetic patients (Kannel & McGee, 1979; Zellweger & Pfisterer, 2001).

**Nurse Practitioner Students:** Graduate nursing students in the second year of a university two year masters program.

**Outcome:** The change in health status between two or more end points.

**PDSA (Plan-Do Study-Act) Cycle:** The pursuit of quality improvement techniques, furthered by Shewhart (a pioneer in quality improvement), has come to be termed as the PDSA (Plan, Do, Study, Act) cycle. The PDSA cycle relies on cycles of learning, philosophy in the scientific method of hypothesis generation, experimentation, observation, and hypothesis testing; it provides a framework for trial-and-error methodology to test change; and has found application in diabetes management programs (Bennett & Slavin, 2002). The cycle begins with a plan and ends with an action based on the learning gained from the PDSA phases of the cycle, with improvement coming from



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building and applying this knowledge (Bennett & Slavin, 2002). This approach tests changes on a smaller scale rather than an in-depth study of the problem before changes are attempted. This may lead to other or bigger changes, allowing design problems to be detected earlier, and thus, it reduces efforts to alter other massive changes. See Figure 1 for a depiction of the PDSA cycle as perceived by the National Primary Care Development Team (2002).

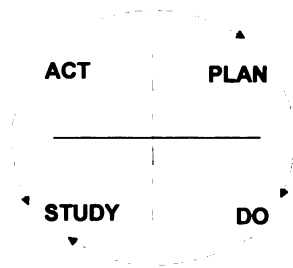


Figure 1: Plan-Do-Study-Act (PDSA) Cycle

**Pharmacy Students:** Students in the 4<sup>th</sup> year of the PharmD. Program.

**Primary Care Internal Medicine Residents:** Medical residents who have internal medicine as their core area of specialty that focuses on primary care.

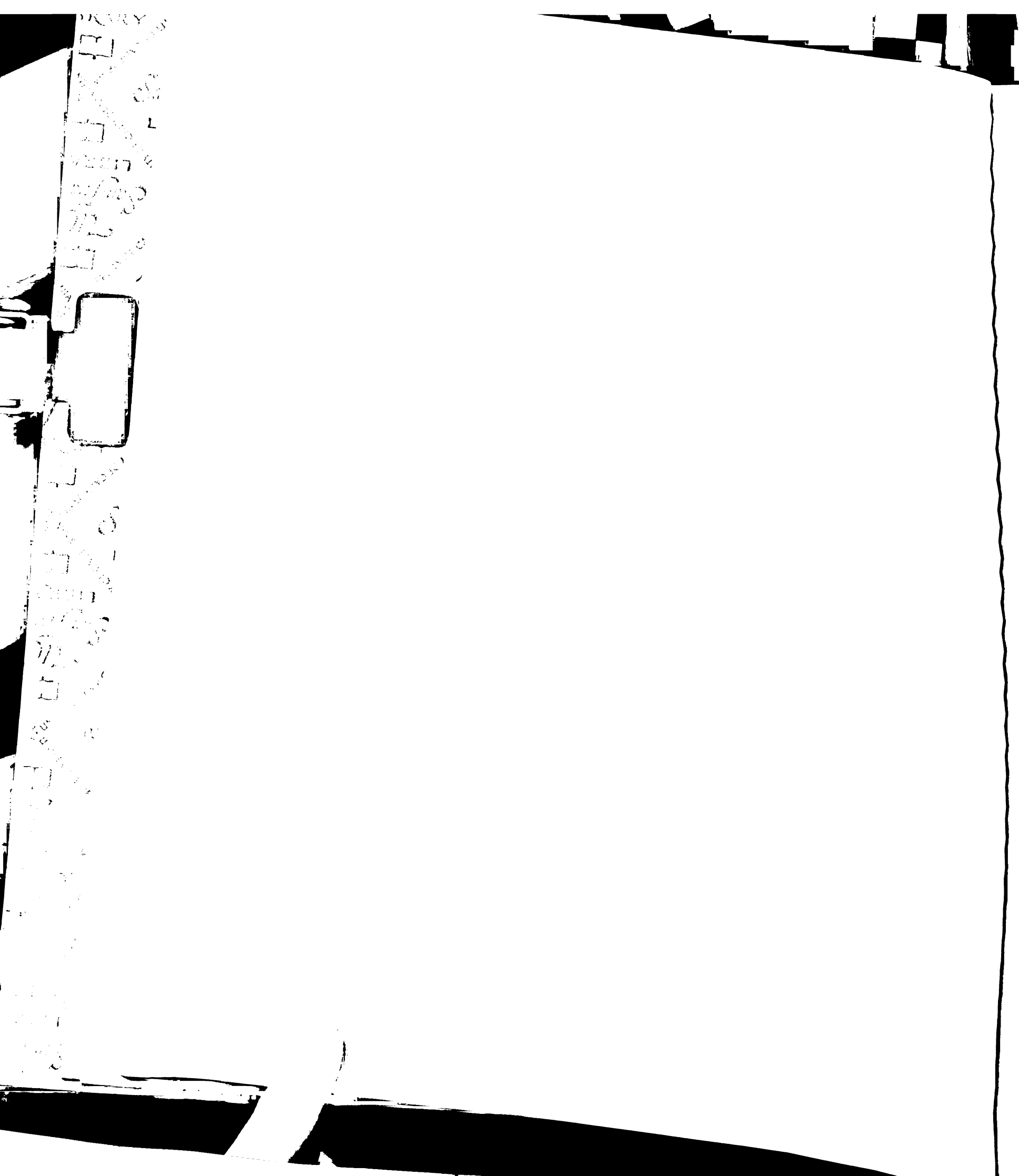
**Processes of care (Process measures):** The content, actions, and procedures initiated by a provider or practice in response to an assessed situation.

**STOR and IDX database:** Databases used at UCSF to collect and track patient information.

**Primary Care:** Patient services related to the prevention and outpatient management of disease.

**Primary Care Provider:** A provider who is identified to manage and coordinate all aspects of a patient's primary care.

**Type of Care:** The experimental and comparison group assigned in the primary study





**DM -Type 2:** Ranges from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance. It accounts for 90-95% of those with diabetes and was previously referred to as non-insulin-dependent diabetes, type II diabetes, or adult onset diabetes (American Diabetes Association, 2004a).

**Urgent Care Visit:** Patient services related to the prevention and outpatient management of non-emergent conditions needing more immediate attention than primary care seen in the Same-day Ambulatory Clinic (SAC)

**Usual Care:** The delivery of care based on diabetes standards of care without a specified quality improvement goal targeting providers or the system.

**Utilization of Healthcare Services:** The use of available health care services to meet the health care needs of patients. Many factors affect health care utilization including access, transportation, insurance coverage, patient satisfaction, availability of services, and cost to the patient and the institution.



## CHAPTER THREE: METHODS

### Study Design

This study was a post-hoc, multivariate repeated measures, secondary analysis of data collected originally in a prospective cohort study, Take Care To Learn (TCTL): University of California (UCSF) Diabetes Management Program registry, supported by the Robert Wood Johnson Foundation, 2001 – 2003. The predictor variables were sociodemographic characteristics of the sample. The outcome variables included diabetes health status indicators, diabetes process (quality) of care measures, and utilization of healthcare services. This design is suited to answer the research question, which is exploratory in nature, hypothesis seeking, and may provide findings relevant to health disparity and potential interventions in disease management programs to provoke or produce meaningful changes at a population level.

### Setting

The original prospective cohort study was conducted in the General Medicine Practices at the Parnassus campus (PC) and the Mount Zion campus (MZC) of University of California, San Francisco (UCSF), an urban, university-affiliated outpatient ambulatory care service.

### Sample

The target population for this study was adult patients with a diagnosis of DM -Type 2 care for by primary care medical residents and enrolled in a diabetes management program between July 1, 2002 and December 31, 2003. The accessible population was diabetic patients in the original primary care study. The study sample consisted of patients meeting the inclusion criteria for the original study which were: 1) patients



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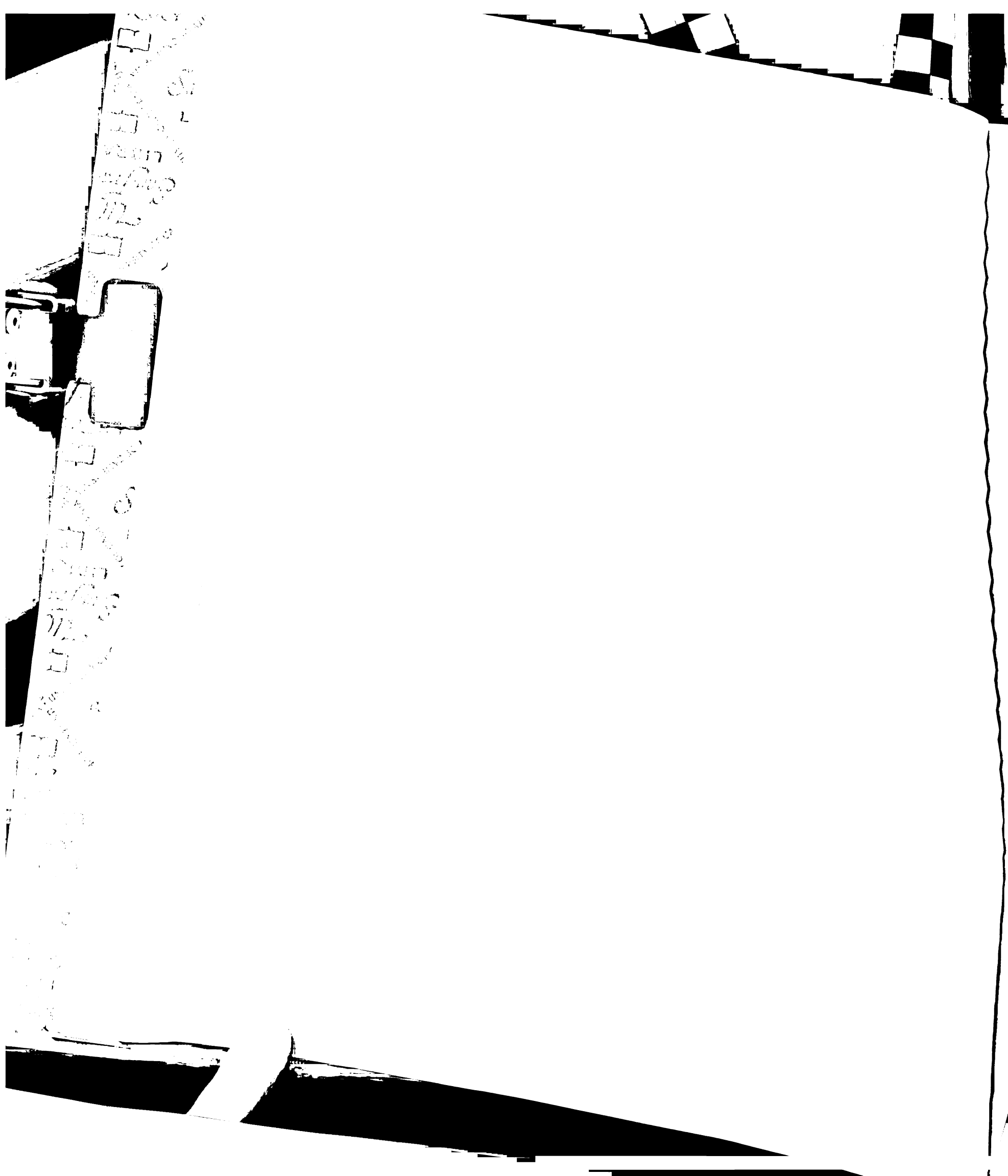


identified with a diagnosis of DM – Type 2 using the existing problem list and the appropriate ICD9 codes for diabetes for whom the primary care medical resident served as the primary provider, 2) patients in the original study belonged to one of two cohorts: patients in the Diabetes Management Program if the primary provider was a primary care internal medicine resident, and in usual care if the provider was a categorical internal medicine resident, and 3) patients with at least one visit to the clinic between July 1, 2002 and December 31, 2003 (to decrease drop-out bias related to change in health coverage). The exclusion criteria for the original study were: 1) diabetic patients assigned to faculty or nurse practitioners, and 2) patients with gestational diabetes or Diabetes -Type 1. To determine if improvement of quality of care can be linked to outcomes, only data from patients assigned (N=315) to the Diabetes Management Program under the care of primary care internal medicine residents were used for this analysis.

#### *Diabetes Management Program Activities in the Study*

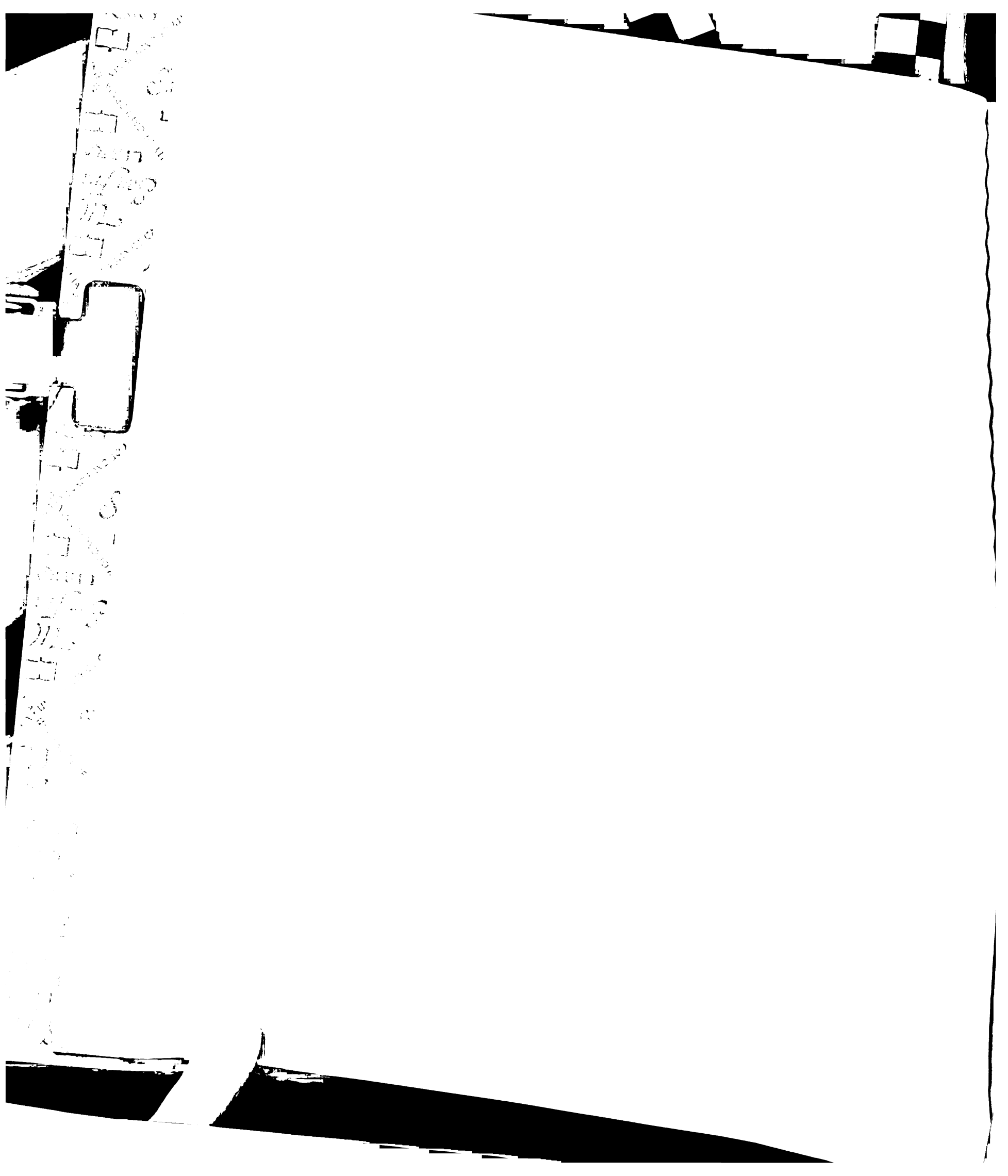
The purpose of the original study was to establish an interdisciplinary, high quality Diabetes Disease Management Program in the UCSF General Medicine Practices (GMP) by training primary care medical residents, nurse practitioner graduate students and pharmacy students to work in teams. The goals were to 1) improve individual and population outcomes of the diabetic patients in the GMPs, 2) expand and activate the Diabetes Management Program, and 3) train primary care internal medicine residents, adult nurse practitioner students, and pharmacy students in chronic illness management through use of the Chronic Care Model (CCM)(Wagner, Austin et al., 2001).

Program activities to improve the quality of care, for patients assigned to the Diabetes Management Program, included opportunities to enhance support of patient self-



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management and family care-givers, incorporate evidence-based guidelines and other decision support into management, making better use of clinical information systems, and applying interdisciplinary, collaborative teamwork to care for the diabetic patient. Specifically, the intervention team participated in a curriculum covering the principles and practice of evidence-based diabetes care, the CCM, efficient quality improvement (QI) methods such as setting QI goals and use of the Plan-Do-Study-Act (PDSA) cycles, and principles and practice of efficient interdisciplinary team care and barriers to collaboration. Examples of interventions using the PDSA cycles included using the clinical information system for assessment and initiation of outreach to diabetics not in regular care, integration of team performance reports into the process of care, and facilitation of referrals for laboratory testing and preventative screening. Decision support was enhanced by improved instruction in the use of the healthcare system database-generated point-of-care reminders and establishment of a system for team review of clinical indicators. Delivery system design for care of this panel of patients was enhanced by: 1) developing and using a WEB-CT program to facilitate team communication and resource information between clinicians, patient, and family, 2) initiation of an active follow-up program, and 3) development of new visit formats such as planned visits, group visits, phone visits, and mini-clinics. Support for patient self-management was established through an explicit documented goal setting process for every patient in the panel, individual self-management needs assessment, and development of an illustrated patient education resource file. Community linkages were facilitated through referral to community agency resources for patient self-management information, support group for patients and care-givers, and through social worker referrals.

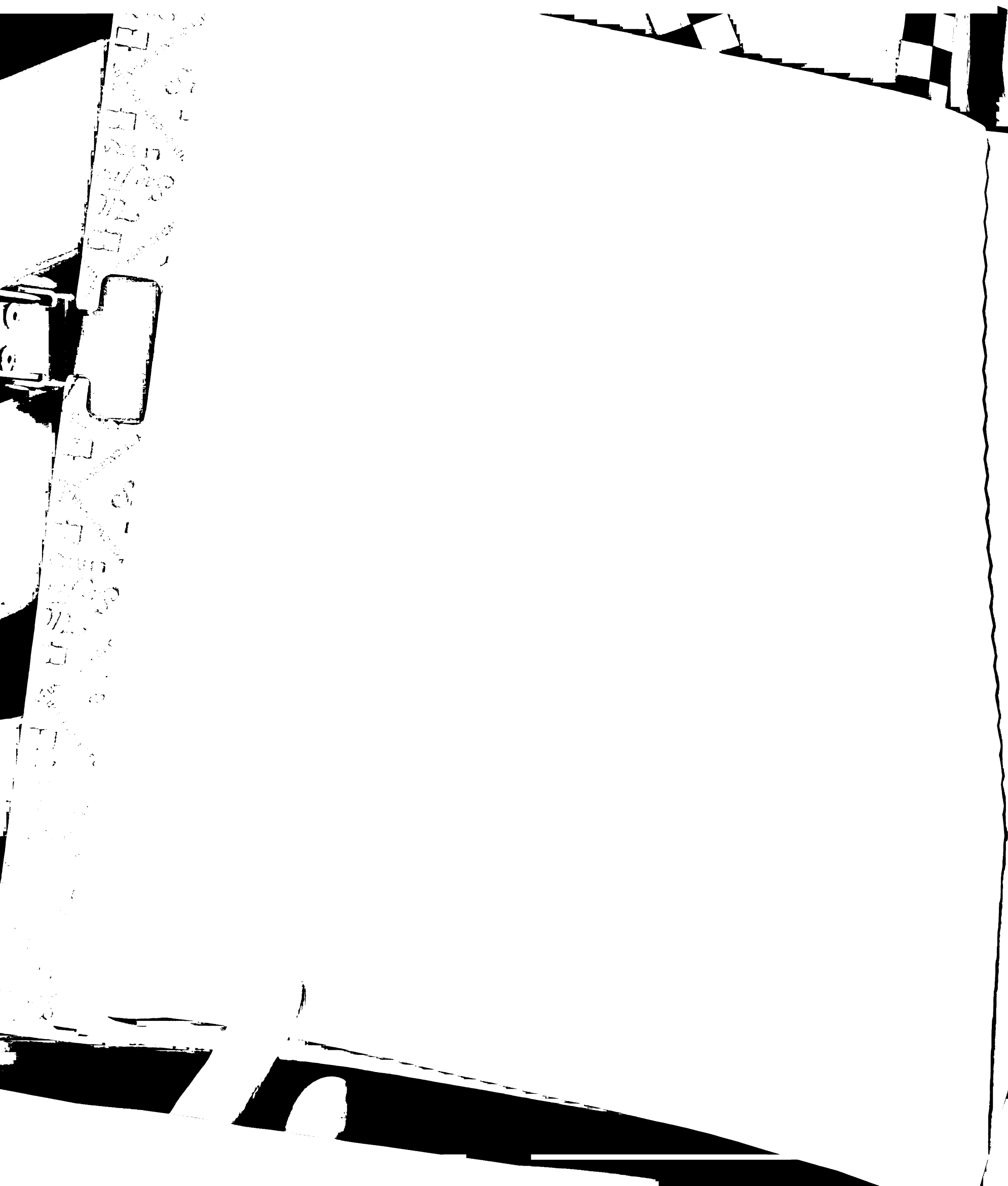




## Source of Data and Measurement

The original data source, UCSF's clinical databases were used to create the registry for the original UCSF Diabetes Management Program study. All identifiers were stripped from the study data set and developed by aggregates or individual codes. The data collection for the original study was initiated in June 2002 and ended on December 2003. Data for the current study was obtained from the original study's expanded dataset. The specific methods of data collection in the original study were set up by a registry coordinator who created a separate FileMakerPro database for this program using the two existing database systems, STOR and IDX. Briefly, the following describes the data set in the original study: GMPs utilize two distinct but integrated information systems. The IDX system collects and tracks all scheduling, appointment history, billing and collections, ICD9 codes for all services provided, and identification of the primary care provider. The STOR system contains all demographic data, medications, problem lists, hospitalization information, and diagnostic test results including laboratory, radiology, cardiology, pathology, pulmonary function, and microbiology. Information related to learner education was obtained via questionnaires.

In addition, to allow monitoring of patient care, a reminder/monitoring template for the panel of patients in the original study was created to include all the crucial elements of diabetes care including: vital signs, diagnostic tests, medical therapies, education and counseling, diet and exercise performance, smoking status, specialty consultations, resource utilization, clinical outcomes, the preventative and self-management indicators and their measures have been recorded in units recommended in the Collaborative



Cooperative Healthcare Reporting Initiative's (CCHRIs) basic guidelines for diabetes care, 2001 (see Appendix A)(Collaborative Project From the California Cooperative Healthcare Reporting Initiative, 2001). The template used recommended time points for re-evaluation, based on the ADA national standards.

Data for the sample of this study was reviewed with the registry coordinator to identify key sociodemographic, process, and outcome variables. A code sheet defining the sociodemographic variables used in the UCSF database systems was provided. The original datasets were provided in Excel format. Outcome variables were made available in three month time periods starting at baseline from June 2002 through December 2003, the end of the study. Every effort was made to verify that the operational definitions of the variables of interest were consistent with the data registry.

#### *Preliminary Evaluation of the Sources of Data*

A preliminary evaluation of the TCTL: UCSF Diabetes Management Program data set was undertaken with the following goals: 1) establish feasibility of obtaining and using the data on an external device such as a USB drive, 2) to examine ten percent of the data for the predictor and outcome variables of interest and screen for missing, incorrect, logical inconsistencies, incomplete, or unforeseen potential sources of error, outliers and for distributional properties 3) to determine the original values of the variables of interest to verify potential for coding the intended content, and 4) to determine the degree of difficulty in merging the excel spreadsheets into one and to code and export them into a SPSS statistical program.

In the preliminary evaluation of the original data, 552 patients had an ICD9 diagnosis of diabetes mellitus, but 435 patients met the original study's inclusion criteria. Of these

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435 patients, 315 patients were assigned to the primary care Diabetes Management Program and are the target sample for this analysis. The data for this analysis (N = 315) were compiled into one Excel spreadsheet. The variables were re-labeled and converted to SPSS eliminating all identifiers. At both steps the sample was cross-checked to ensure that the data were integrated correctly and transferred accurately and completely, eliminating the need to re-enter data. These steps were taken to maintain accuracy. The feasibility of obtaining the data and the experience of working on the original team as a research associate, expertise in chronic care illness, quality improvement, and database management facilitated development of this study.

#### Human Subjects Assurance

The University of California, San Francisco Committee on Human Subjects Research granted an exempt certification for this study since aggregate data with no subject identifiers were used for this secondary analysis

#### Data Collection and Management Procedures

Verbal permission for use of the data was obtained from the principal investigators of the original study. The variables needed for each field were identified on an excel spreadsheet and submitted to the registry coordinator. The complete data set that matched the variables in the spreadsheet for this study was obtained. This dataset was screened for extreme outliers, errors, duplicates, and distributional properties, and incorrect data; the evaluation of such data was discussed with experts in the field and methods for treating them were decided on an individual basis. The variables were coded for SPSS and a sample of N=315 were cross-checked with the original data in Excel to ensure accuracy. The data set for this study was saved on zip disks in two secure locations.

## Study Measures/Variables

The variables of interest are the following: sociodemographics, diabetes health status indicators, process (quality) of care variables, and utilization of health care services.

### *Validity of Measures*

The validity of diabetes health status indicators and process of care measures is established by evidence-based practice guidelines. Evidence-based practice is based on the principle that the medical treatments found to be safe and efficacious should be adopted by providers and patients (Van de Ven & Schomaker, 2002). Standards of medical care, based on a large body of evidence, exists to support a range of interventions, including treatment goals and tools to evaluate the quality of care in diseases such as diabetes (American Diabetes Association, 2004b). A grading system developed by the ADA (2004b), and modeled after existing methods was used to clarify and codify the evidence that forms the basis for the recommendations on diabetes health status indicators and process of care measures.

*Diabetes Health Status Indicators.* Diabetes health status indicators reflect the health state of a diabetic patient and refer to the number of patients in a practice that achieve the recommended test threshold or frequency of a medical exam. Health status indicators through laboratory evaluation include HbA1c, lipid profile (include total cholesterol, HDL cholesterol, triglycerides, and LDL cholesterol), BP, microalbumin, serum creatinine, lipid profile, thyroid stimulating hormone if indicated, urinalysis, and electrocardiogram if indicated (American Diabetes Association, 2004b).

*Process (Quality) of Care Measures.* Process (quality) of care measures refers to the number of patients in a practice that obtain the recommended test, exam, and/or requisite primary care visits at appropriate time periods. Process (quality) of care measures refer to whether the appropriate things were done for the appropriate people at the correct time points, or how well program activities were implemented (Beckles et al., 1998). Process of care measures include eye exams, foot exams, diabetes education, health maintenance education related to smoking, nutrition, and lifestyle factors that influence the self-management of diabetes (American Diabetes Association, 2004b). In addition prescription of aspirin, statins, and angiotensin converting enzyme [ACE] inhibitors / angiotensin receptor blockers [ARB] to prevent cardiovascular complications was documented. Based on the scope of a diabetes care program and the available resources for a given practice, these processes of care measures are implemented and documented to varying degrees of comprehensiveness.

*Utilization of Healthcare Services.* The variable, utilization of health services, is intended to measure the frequency and type of healthcare services used by diabetic patients. Measurement of this variable in evaluating quality of care, can reflect good care or poor care (Rubin, Pronovost, & Diette, 2001). For example, measuring the frequency of non-emergent care visits can reflect good care if it prevents unnecessary emergency department visits or hospitalizations related to complications. On the other hand, increased frequency of visits to a primary care provider may reflect deteriorating health status, or close monitoring due to change in treatment strategy. The most common diabetes indicators for use of health care services include the number of non-emergent

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(e.g., primary care/ambulatory care, and urgent care) and emergent care (e.g., emergency department and hospitalization) visits.

### *Variables Used for this Analysis*

*Demographics.* The original demographic variables: age, gender, race, ethnicity, marital status, primary language, and insurance were included in this study. The demographic data were originally given by the patient to the STOR intake clerk at the time of the first appointment with the system using a questionnaire. Hence, potential bias related to input of the data into the system exist. Similarly, with the influence of urbanization, education, and actual economic status, information collected on any or all of the above demographic characteristics may not be representative of a collective attitude, belief, value, opportunity, or barrier and may contribute to an internal validity bias. However, homogeneous or heterogeneous characteristics of these data will determine their influence on the outcome variables. The inter-correlation of these demographic factors has been set at 0.2 for clinical significance.

*Diabetes Health Status Indicators.* The diabetes health status indicators collected for the original study included diagnostic tests such as vital signs (temperature, heart rate, blood pressure, and respiratory rate) HbA1c, LDL, microalbumin, creatinine, and other diagnostic tests through radiology, cardiology, pathology, pulmonary function, microbiology when indicated, and a problem list initiated by the provider. These variables originate from the provider, are entered by a clerk in the STOR system, and are copied directly into the registry system. For the proposed study the variables HbA1c, BP, and LDL will be used. Evaluating the other variables is beyond the scope of this study.

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Evaluating HbA1c for microvascular complications, and LDL and BP for macrovascular complications provides clinicians a quick assessment of a diabetic patient's health status.

The diabetes health status indicators are compared to thresholds based on established CCHRI guidelines (Collaborative Project From the California Cooperative Healthcare Reporting Initiative, 2001). Maintenance of the following threshold values have also been recommended for the management and prevention of diabetes morbidity and mortality. According to the American Diabetes Association (2004b), the target HbA1c level is 7% or lower with testing performed one to two times every year if stable, and quarterly if treatment changes or if a patient does not meet therapeutic goals. The target BP goal of <130/80 mmHg and performance of a BP test with every clinic visit is recommended. The target LDL goal is less than 100 mg/dl and the recommended target performance rate of a LDL test is annual. The appropriateness in the use of the variables HbA1c, BP, and LDL are discussed in Measurement Issues (see Appendix B). These threshold values of the health status indicators provide a measure of the state of diabetes health in a patient and maintaining these values plays an important role in decreasing morbidity and mortality in diabetes patients.

*Process (Quality) of Care.* The process of care measures collected for the original study included dilated eye exam, foot exam, use of medications including aspirin, ACE/ARB, and statin drugs, medical therapies related to preventative and self-management practices, performance of education and counseling related to smoking, diet, and exercise, and specialty consultations. These variables originate from the provider, are entered by a clerk into the STOR system, and are copied directly into the registry system.



Process of care measures in this study include performance of 1) an annual dilated eye exam to diagnose and manage the presence or progression of diabetic retinopathy; 2) an annual neurovascular foot exam to identify risk factors predictive of ulcers and amputation; 3) use of an anti-platelet agent such as Aspirin therapy to prevent primary and secondary cardiovascular events, 4) diabetes self-management education and skills integrated in a diabetes management program to facilitate improvement in healthcare outcomes is recommended for diabetes management (Mensing et al., 2003). Since the use of ACE/ARB and statin drugs are predicated on outcome variables (BP and LDL respectively) that covary with time and the lack of more detailed data that link process of care measures to actual events such as acute illness and social support, the other process variables have been excluded from this study.

*Utilization of Healthcare Services.* Utilization of healthcare services collected for the original study included all visits to the outpatient and inpatient departments. These variables originate when the desk clerk verifies the time of the visit. Of these outpatient appointments, general medicine visit to SAC (urgent care), GMP (for primary care), visits to specialty clinics, and emergency department visits are entered into the STOR system and hospitalization is entered into the IDX system. The data related to these fields are copied directly into the registry system. Since patients in the Diabetes Management Program may concurrently possess other forms of health care insurance or healthcare access, a loss to follow-up bias exists. Depending on co-morbidity, 4-5 visits to a primary care setting every year for follow-up care would meet the ADA diabetes management guideline. For this proposed study, general medicine visit to SAC (urgent care), GMP (for primary care), emergency department visits, and hospitalizations will be used to



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determine the impact of the diabetes management programs on utilization of preventive care (non-emergent services) versus acute care (emergent services).

### Analysis

The patients in the Diabetes Management Program obtained the requisite visit, exam, or test when initiated by the patient or by the provider. Since data were collected as a condition of medical need and were spaced over different time points, analysis of the data at each time point did not seem appropriate. For example, depending on the patient's health status, during a general medicine visit, an HbA1c or LDL laboratory test may be ordered for this patient and conversely the same patient may not be due for their annual eye exam. The collection of outcomes data directed by evidence-based guidelines versus collection at pre-set intervals for all patients provides evaluation of the practical aspect of using data to inform patient care practices. As a result of differences in how outcomes data are collected at different time points between patients, the outcomes data for this study were assembled into two or three time points. The following describes how this was achieved while maintaining data integrity.

The outcome variables were coded in three month intervals, starting at baseline from June 2002 to December 2003; this resulted in seven time periods: baseline (T0) and T1 (Time 1) to T6 (Time 6) respectively. The baseline outcomes data (T0), obtained from June 2001 to June 2002, contained the most recent value of the diabetes health status indicators, the process of care indicators, and an annual mean number of visits per month for the utilization of healthcare services outcome. The outcomes variables HbA1c, BP, and LDL for time periods T0 to T6 were consolidated into three time intervals: Baseline (T0), midpoint (T1 to T3 = first 9 months), and end point (T4 to T6 = second 9 months)





respectively. In all three intervals, the most recent value within the interval was used for analysis. Since process of care outcomes are recommended annually, the variables for this section were dichotomized into two time intervals: Baseline (T0) and end point (T1 to T6 = 18 months). Similarly, for utilization of health care services outcome variables, data was measured quantitatively as a frequency and recorded for this study as Baseline (T0) and endpoint (T1 to T6 = 18 months) respectively. The measure of the data at “endpoint” was the mean numbers of visits over 12 months. It was computed as a weighted 12 month average for all data available from T1 to T6.

In summary, preparing the data in this fashion allowed comparison of outcomes over time: diabetes health status indicators were compared from baseline to mid-point and from baseline to end point while process of care and utilization of healthcare services outcomes were compared from baseline to end point. The specific variables, indicators, and their respective coding are described in Table 3. The specific cut-points and categories for dichotomizing the variables were determined by the distribution of the predictor variables in the data set and by the clinical guideline recommendations for the outcome variables. Of note, ethnicity was coded and categorized based on institutional guidelines.

**Table 3: Coding of Variables for Use in Analysis**

<b>Variables</b>	<b>Original Values</b>	<b>Recoded Value</b>	<b>N = 315</b>
<b>Sociodemographic</b>			
Age	Continuous		
Gender	Dichotomous	0 = Male 1 = Female	132 183
Race	Nominal (8 race groups): American/Eskimo/Aleut, Other, Asian /Pacific Islander, Black, Native,	1 = Asian	86
		2 = Black	78
		3 = Other	51
		4 = White	100

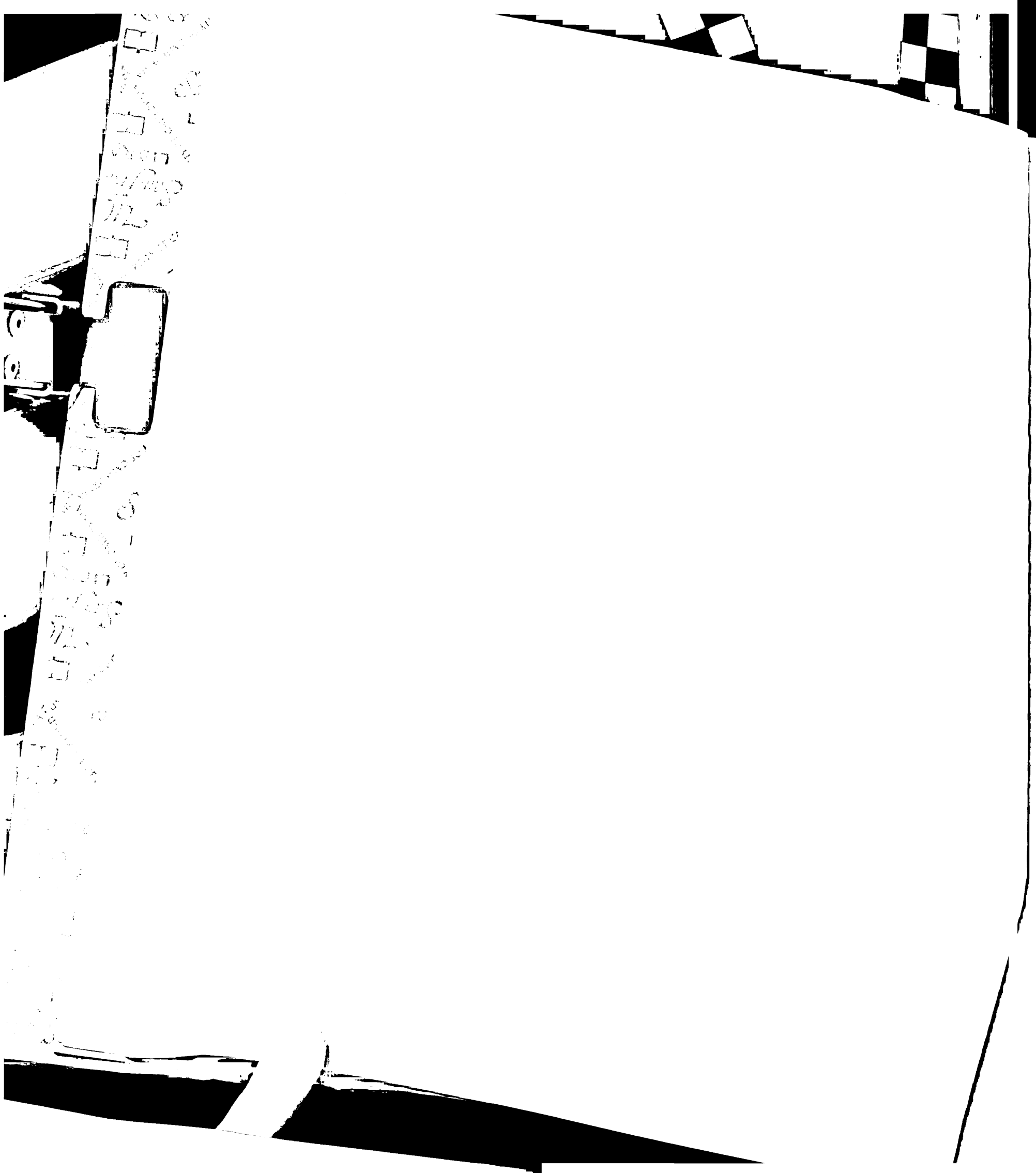
	Other Israeli, Russian Immigrant, Unknown, White		
Ethnicity	Nominal (3 groups) Hispanic, Non-Hispanic, Unknown	0 = Hispanic 1 = Non-Hispanic	36 279
Marital Status	Nominal (5 categories): Married, Divorced, Separated, Single, Widowed, Unknown	0 = Not Married 1 = Married	188 127
<b>Sociodemographic</b>			
<b>Variables</b>	<b>Original Values</b>	<b>Recoded Value</b>	<b>N =</b> <b>315</b>
Primary Language	Nominal (15 different groups): Arabic, American Sign Language, Cantonese, English, Hindu, Italian, Japanese, Korean, Mandarin, Other, Russian, Spanish, Tagalog, Urdu, Vietnamese	0 = Non-English 1 = English	117 198
Insurance	Nominal (11 different groups): Capitation Senior, Capitation Commercial, Medicare, Indemnity, Managed Care, Medi-Cal (Medicaid), HealthNet, Blue Cross/Blue Shield, Self Pay, Other	0 = Non-MediCare/Medi-Cal 1 = MediCare/Medi-Cal	82 233

### Diabetes Health Status Indicators

Variables	Original Values	Recoded Value
HbA1c	Analyzed at 3 points in time = Baseline, Midpoint, Endpoint	0 = HbA1c < 7.0% 1 = HbA1c ≥ 7.1%
BP	Analyzed at 3 points in time = Baseline, Midpoint, Endpoint	0 = BP < 130/80 1 = BP ≥ 130/80
LDL	Analyzed at 3 points in time = Baseline, Midpoint, Endpoint	0 = LDL < 100 1 = LDL ≥ 100

### Process (Quality) of Care Measures

Variables	Original Values	Recoded Value
Eye exam	Analyzed at 2 points in time = Baseline, and	0 = Eye exam not done



	Endpoint	1 = Eye exam done
Foot exam	Analyzed at 2 points in time = Baseline Analyzed at 2 points in time = Baseline	0 = Foot exam not done 1 = Foot exam done

<b>Process (Quality) of Care Measures</b>		
<b>Variables</b>	<b>Original Values</b>	<b>Recoded Value</b>
Use of diabetes self-management techniques	Analyzed at 2 points in time = Baseline	0 = Diabetes Self-Management Not Done 1 = Diabetes Self-Management Done
Use of Aspirin	Analyzed at 2 points in time = Baseline, and Endpoint	0 = Not on Aspirin
		1 = On Aspirin
		1 = On ACE/ARB

#### **Utilization of Healthcare Services**

Primary Care (General Medicine Visits)	Continuous	Mean number of visits over 12 months
Urgent Care (SAC Visits)	Continuous	Mean number of visits over 12 months
Emergency Department Visit	Continuous	Mean number of visits over 12 months
Hospitalization	Continuous	Mean number of visits over 12 months

#### *Data Analysis Plan*

Most of the outcome variables were coded as dichotomous and the others as count variables (frequencies). Generalized Estimating Equations (GEE) analysis is being increasingly used to analyze longitudinal and other correlated data, especially when they are binary or in the form of counts; GEE uses combinations of observations to extract the appropriate amount of information from correlated data and seeks more efficient

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...amount of information from completed data and each user clinician  
 ...in the form of output (O) can complement observations to extract the  
 ...and after completed data reports when they  
 ...Generalized Learning (GL) steps is being  
 ...and the other as output

The Analysis Flow

Continuation	Diagnosis
Continuation	Emergency
Continuation	Physician Care (GAC)
Continuation	Physician Care (GAC)
Continuation	Physician Care
Continuation	Physician Care

Mean number of visits over 12 months
Mean number of visits over 12 months
Mean number of visits over 12 months
Mean number of visits over 12 months

Continuation	Use of Aspirin
Continuation	Use of Aspirin
Continuation	Use of Aspirin
Continuation	Use of Aspirin

Continuation	Analysis
Continuation	Analysis
Continuation	Analysis
Continuation	Analysis

estimators of regression parameters. The main benefit of GEE is the production of reasonably accurate standard errors (Hanley, Negassa, Edwardes, & Forrester, 2003; Hardin, 2003; Sheu, 2000; Zeger & Liang, 1986). For all variables, the method for analyzing the data was GEE because the data were not normally distributed. GEE allowed taking within-subject correlations into account, and allowed examination of dichotomous and frequency outcomes over time. Similarly, appropriate arrangement of data into two or three time points re-formatted the existing dataset to meet the assumptions of GEE so that data, if missing, occurred due to a random effect rather than as a function of practice guidelines.

All data were analyzed using SPSS, SAS, and STATA. SPSS was used to obtain descriptive information. Frequencies and percentages were performed on all the predictor variables and the outcome variables. Measures of central tendency were performed on all demographic and continuous outcome variables. With the help of a statistician, GEE analysis was performed. This was a two step GEE regression with repeated measures on patients. For research questions 1 and 2, SAS PROC GENMOD version 8 was used for the repeated measures (longitudinal) logistic regression, which uses a binomial distribution with a logit link. Following the prediction, the interaction of the demographic variable with time was analyzed to determine if the variable predicted differently as a function of time. For research question 3, STATA version 8 XTGEE was used to analyze the count variables that were over-dispersed ( $SD > \text{mean}$ : urgent care, emergency department visits, and hospital visits); this was modeled using a negative binomial distribution with a log link. Similarly, STATA was used to do GEE analysis for the repeated measures (longitudinal or multi-level linear regression) for the variable that was



approximately distributed (general medicine visits); for this analyses, the GEE regression was modeled using a Gaussian distribution with an identity link.

Correlation between observations over time was expected to decrease as separation in time increased. For example, correlations for observations between time 1 and time 2 were greater than those between time 1 and time 3. Therefore, it was reasonable to expect the correlation structure to be autoregressive. Hence, the correlation structure was modeled as autoregressive with a lag of 1 (AR[1]). Despite this expectation, robust estimates of standard errors were used in case the correlation structure differed from AR(1).

For the stated research questions, the two step regression models using GEE analysis, were created to predict the outcome variable (Littell, Milliken, Stroup, & Wolfinger, 1996). In model 1, the main effects model, examined:

- a) Whether each of the predictor variables (sociodemographic characteristics) predicted the outcomes when averaged over time.
- b) Whether time intervals ( $[T_{\text{Baseline-Midpoint}}]$  and  $[T_{\text{Baseline-Endpoint}}]$ ) predicted the outcomes when controlling for the predictor variables (sociodemographic characteristics). Time was treated as a class (categorical) variable.

In model 2, the interaction model, examined:

- a) Whether the interactions of the predictor variables (sociodemographic characteristics) with time predicted the outcomes. Time was treated as a continuous variable





- i. If the interactions of the predictor variable and time were significant, a determination of the time interval at which significance occurred was determined by testing the parameter estimates for two portions of the predictor-by-time interaction( $[T_{\text{Baseline-Midpoint}}]$  or  $[T_{\text{Baseline-Endpoint}}]$ ).
- b) If one of the time intervals was significant, a post-hoc analysis was performed to determine the time point (baseline, midpoint, and/or endpoint) at which significant change occurred.

The set of predictor variables (sociodemographics) was individually entered as blocks for each of the outcome variables. The prediction analysis was limited to entering the variables individually versus entering them as pairs or as a combination of predictors in the models. This is because the purpose of the study is exploratory and a determination of how each of the predictors was related to each other in pairs or in combinations was unknown. Regression coefficients ( $\beta$ ), semi-robust standard errors (SE), Chi square likelihood ratios ( $\chi^2_{\text{LR}}$ ), odds ratios (OR), incidence ratio rates (IRR), and significance levels ( $\alpha = .05$ ), were obtained with the GEE analysis using SAS and STATA programs.



## CHAPTER FOUR: RESULTS

### Sample Description

There were 315 patients enrolled in the diabetes management program between June 2002 and December 2003. The demographic data had no missing values. All patients were included in the outcome variables and missing observation values were attributed to non-random effects. That is, the missing values between patients were based on patient need or provider scheduling based on guidelines. Results of the descriptive characteristics and GEE are presented in this chapter. The unit of analysis was the patient. Reported (N's) are the number of patients who participated in the Diabetes Management Project.

The profiles for the outcome variables (diabetes health status indicators, process (quality) of care indicators, and utilization of healthcare services) across time periods (baseline, endpoint, and/or midpoint) were developed using GEE. These time periods provided a way to determine change in outcomes across time.

#### *Demographic Characteristics*

Table 4 describes the demographic characteristics in the study sample (N = 315). A majority of the sample were females (58.1%), non-Hispanic (88.6%), not married (59.7%), English speaking (62.9%), and with MediCare/MediCal insurance (74%). The median age was 67.8 years with a range of 22 to 94 years. Out of 279 non-Hispanic patients, there were approximately equal numbers of males (n = 113) and females (n = 116). Males overall outnumbered females in each of the race categories: Asians (63%), Blacks (63%), Whites (55%). Females accounted for 64% of non-married patients while 51% were married males. Among the English, and non-English speaking patients, the majority were females, 65% and 62% respectively. MediCare/MediCal patients were

predominantly female (61%) and the non- Medicare/MediCal patients were predominantly male (51%). In the Medicare/MediCal category, 70% of patients had Medicare and 64% were females. Similarly, from the 30% MediCal patients, 59% were females.

**Table 4: Descriptive Characteristics (frequencies and measures of central tendency) of the study population (N = 315)**

<b>Demographics</b>		<b>Mean</b>	<b>SD</b>
Age (years)		64.43	15.76
		<b>Median</b>	<b>Min-Max</b>
		67.79	22-94
	<b>N</b>	<b>%</b>	
Gender	Male	132	41.9
	Female	183	58.1
Ethnicity	Non-Hispanic	279	88.6
	Hispanic	36	11.4
Race	Asian	86	27.3
	Black	78	24.8
	Other	51	16.2
	White	100	31.7
Marital Status	Not Married	188	59.7
	Married	127	40.3
Primary Language	Non-English	117	37.1
	English	198	62.9
Insurance	(All other insurance) = Non-Medicare/MediCal	82	26
	Medicare/MediCal	233	74

The number of participants with data for each of the outcome variables measured is described in Table 5. The Ns in this table represent the actual number of patients (versus observations) who obtained a test/exam at baseline, midpoint, and endpoint. For utilization of healthcare services, patients reported with no visits were included in the

analysis with visits recorded as zero. The mean was based on all 630 observations with N=315, over two times. Except for General Medicine visits, mean Distributions for these variables were overly dispersed ( $SD > 2 \times \text{Mean}$ ). Mean general medicine visits was ( $6.2 \pm 4$ ), mean urgent care visits was ( $0.5 \pm 1.3$ ), mean emergency department visits was ( $0.9 \pm 1.8$ ), and mean hospitalizations was ( $0.5 \pm 1.2$ ).

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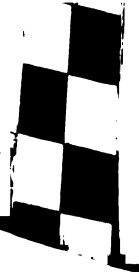
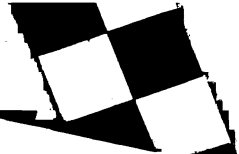
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**Table 5: Performance rates by each of the outcome variables**

Diabetes Health Status Indicators	Baseline		Mid-Point		End-Point				
	N	%	N	%	N	%			
HbA1c (n = 297)	272	91.6	253	85.2	224	75.4			
BP (n = 315)	305	96.8	284	90.2	267	84.8			
LDL (n = 286 )	241	84.3	205	71.7	168	23.8			
Process (Quality) of Care	Baseline		Mid-Point		End-Point				
	N	%	N	%	N	%			
Foot Exam (n = 176)	117	66.5	-	-	111	63.1			
Eye Exam (n = 192)	150	78.1	-	-	154	80.2			
Aspirin Use (n = 225)	183	81.3	-	-	182	80.9			
Use of Diabetes Self-Management Techniques (n = 127)	62	48.8	-	-	93	73.2			
Utilization of Healthcare Services	Baseline		Mid-Point		End-Point				
	N	%	N	%	N	%			
Primary Care Visit (n = 311)	294	94.5	6.7, 3.66	6, 6	294	94.5	6.5, 4.1	5.3, 4	1.3, 26.7
Urgent Care (n = 97)	78	80.4	2.3, 2.3	1, 1	46	47.4	2.6, 1.9	2, 1.3	1.3, 10
Emergency Department (n = 168)	137	81.5	2.3, 2.3	1, 1	81	48.2	2.7, 2.4	2, 1.3	1.3, 14.7
Hospitalization (n = 114)	95	83.3	2.2, 1.9	2, 1	43	37.7	2.2, 1.5	1.3, 1.3	1.3, 8.7



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**Table 2: Performance rates by each of the outcome variables**

Discharge Health Status Indicators

Emergency Department (n = 174)  
 Urgent Care (n = 91)  
 Primary Care Visit (n = 188)  
 (TOTAL n of Medication Refills = 711)

Performance Indicator	n	Mean	SD	Mid-Point		End-Point	
				Mean	SD	Mean	SD
Emergency Department	174	82.3	55.18	51.1	13.13	13.81	
Urgent Care	91	81.2	53.53	51.1	13.13	13.10	
Primary Care Visit	188	80.4	53.53	51.1	13.13	13.10	
<b>Total</b>	<b>453</b>	<b>81.2</b>	<b>53.53</b>	<b>51.1</b>	<b>13.13</b>	<b>13.81</b>	

Discharge Health Status Indicators

Performance Indicator	n	Mean	SD	Mid-Point		End-Point	
				Mean	SD	Mean	SD
Emergency Department	174	82.3	55.18	51.1	13.13	13.81	
Urgent Care	91	81.2	53.53	51.1	13.13	13.10	
Primary Care Visit	188	80.4	53.53	51.1	13.13	13.10	
<b>Total</b>	<b>453</b>	<b>81.2</b>	<b>53.53</b>	<b>51.1</b>	<b>13.13</b>	<b>13.81</b>	

To answer Research questions 1 thru 3, GEE was used to obtain the chi-square likelihood ratios ( $X^2_{LR}$ ) for all the models and the coefficient cited for age is the multiplicative factor. All Model 1  $X^2_{LR}$  were significant. The only difference between Model 1 and Model 2 is the addition of the interaction in Model 2. Therefore for Model 2, only the significant interactions are reported.

### Question 1- Results

Are sociodemographic characteristics (age, gender, race, marital status, insurance, and primary language) related to markers of diabetes health status (glycosylated hemoglobin [HbA1c], Blood pressure [BP], low-density lipoprotein [LDL])?

Tables 6, 7, and 8 below follow the same general format and show the predictors of diabetes health status indicators by each outcome variable: HbA1c, BP and LDL. The outcome criteria used in the analyses are also listed below.

**Table 6: Diabetes Health Status Indicators: HbA1c**  
HbA1c  $\geq$  7% as criterion

<b>AGE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		970.21	745		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.52	0.45		
	Age	-0.002	0.006	-0.25	1.0
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.18	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.08	1.54
<b>GENDER</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		968.25	745		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.56	0.18		
	Female	-0.25	0.2	-1.23	0.78
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.19	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.07	1.54



**HbA1c  $\geq$  7% as criterion**

<b>ETHNICITY</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		969.22	745	-----	
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.38	0.14		
	Hispanic	0.26	0.31	0.85	1.3
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.17	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.09	1.54
<b>RACE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		963.48	743	-----	
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.32	0.19		
	Asian	-0.06	0.25	-0.22	0.94
	Black	0.1	0.26	0.39	1.11
	Other	0.53	0.3	1.75	1.7
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.17	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.06	1.54
<b>MARITAL STATUS</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		969.78	745	-----	
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.4	0.15		
	Married	0.04	0.2	0.19	1.04
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.18	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.09	1.54
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		967.38	745	-----	
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.26	0.18		
	English	0.26	0.2	1.3	1.3
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.18	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.07	1.54
<b>INSURANCE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		968.96	745	-----	
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.3	0.26		
	MediCare/MediCal	0.14	0.22	0.64	1.15
	Time <sub>Baseline-Midpoint</sub>	-0.03	0.15	-0.18	0.97
	Time <sub>Baseline-Endpoint</sub>	0.43	0.14	3.09	1.54

Model 1

Predictor	OR	95% CI
Intercept	1.0	
Intercept	1.54	

Predictor	OR	95% CI
Intercept	1.0	
Asian	1.78	
Black	1.17	
Other	0.97	
Intercept	1.54	

Predictor	OR	95% CI
Intercept	1.0	
Married	1.04	
Intercept	1.54	

Predictor	OR	95% CI
Intercept	1.0	
English	1.3	
Intercept	1.54	

Predictor	OR	95% CI
Intercept	1.0	
Medicare/Medicaid	1.18	
Intercept	1.54	

Model	OR	95% CI
Model 1	1.54	
Model 2	1.78	
Model 3	1.17	
Model 4	0.97	
Model 5	1.04	
Model 6	1.3	
Model 7	1.18	

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<b>HbA1c ≥ 7% as criterion</b>
Z <sup>a</sup> : Wald statistic: Tests for interactions are reported as $\chi^2_{LR}$ * < .05 ** < .01 *** < .001 **** < .0001 b: For Model 2 only the statistic for the interaction is reported when significant
For df = 743 - 745, Critical value for $\chi^2$ at $\alpha = 0.05$ are 807.52 - 809.61 For df = 743 - 745, Critical value for $\chi^2$ at $\alpha = 0.01$ are 792.81 - 794.88 For df = 743 - 745, Critical value for $\chi^2$ at $\alpha = 0.001$ are 835.61 - 837.73

None of the predictors (age, gender, ethnicity, race, marital status, primary language, or insurance) significantly predicted HbA1c level.

**Table 7: Diabetes Health Status Indicators: BP ≥ 130/80**

**BP ≥ 130/80 as criterion**

<b>AGE</b>					
<b>Model</b>		$\chi^2_{LR}$		<b>df</b>	
1		1097.22		852	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.57	0.4		
	Age	0.01	0.005	2.53*	1.01
	Time <sub>Baseline-Midpoint</sub>	0.47	0.17	2.82	1.6
	Time <sub>Baseline-Endpoint</sub>	0.21	0.15	1.38	1.23
<b>GENDER</b>					
<b>Model</b>		$\chi^2_{LR}$		<b>df</b>	
1		1104.21		852	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.23	0.16		
	Female	0.24	0.18	1.35	1.27
	Time <sub>Baseline-Midpoint</sub>	0.46	0.16	2.81	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.36	1.22
<b>ETHNICITY</b>					
<b>Model</b>		$\chi^2_{LR}$		<b>df</b>	
1		1104.2		852	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.43	0.13		
	Hispanic	-0.44	0.28	-1.61	0.64
	Time <sub>Baseline-Midpoint</sub>	0.46	0.17	2.77	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.32	1.22

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BP ≥ 130/80 as criterion

<b>RACE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		1097.37	850		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.52	0.18		
	Asian	-0.28	0.23	-1.19	0.76
	Black	0.13	0.23	0.58	1.14
	Other	-0.56	0.26	-2.11	0.57
	Time <sub>Baseline-Midpoint</sub>	0.46	0.17	2.77	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.3	1.22
<b>MARITAL STATUS</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		1102.52	852		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.51	0.14		
	Married	-0.31	0.18	-1.74	0.73
	Time <sub>Baseline-Midpoint</sub>	0.46	0.16	2.77	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.35	1.22
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		1105.51	852		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.22	0.17		
	English	0.25	0.18	1.41	1.28
	Time <sub>Baseline-Midpoint</sub>	0.46	0.16	2.78	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.35	1.22
<b>2<sup>b</sup></b>	English by Time <sub>Baseline-Midpoint</sub>	-0.64	0.28	6.48*	0.53
<b>INSURANCE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		1106.43	852		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.3	0.19		
	MediCare/MediCal	0.1	0.2	0.5	1.11
	Time <sub>Baseline-Midpoint</sub>	0.46	0.16	2.8	1.58
	Time <sub>Baseline-Endpoint</sub>	0.2	0.15	1.37	1.22
Z <sup>a</sup> : Wald statistic: Tests for interactions are reported as $\chi^2_{LR}$					
* < .05					
** < .01					
*** < .001					
**** < .0001					
OR: Odds Ratio					
b: For Model 2 only the statistic for the interaction is reported when significant					



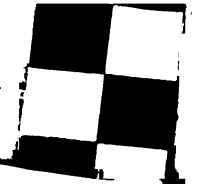
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*[Faded text and markings]*



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**BP ≥ 130/80 as criterion**

For df = 850 - 852, Critical value for $\chi^2$ at $\alpha = 0.05$ are 918.94 - 921.02
For df = 850 - 852, Critical value for $\chi^2$ at $\alpha = 0.01$ are 903.25 - 905.31
For df = 850 - 852, Critical value for $\chi^2$ at $\alpha = 0.001$ are 948.85 - 950.96

The predictive odds of BP ≥130/80 were 0.05 times greater for every five year increment in age ( $p < .05$ ). With primary language as the predictor, the difference between baseline and midpoint was significant ( $p < .05$ ) when controlling for Time (baseline-endpoint). A post-hoc analysis, to determine the time point at which significance occurred, showed that, when looking at uncorrected Odds Ratio (OR), at baseline, English speaking patients were 1.42 times more likely to have BP ≥130/80 compared to non-English speaking patients. By inspecting the odds ratios for all time interval pairs, time interval from midpoint-endpoint would also be significant since its complex ratios are even greater (OR = 2.76, at endpoint) than the time interval baseline to midpoint.

**Table 8: Diabetes Health Status Indicators: LDL ≥ 100 mg/dl**

**LDL ≥ 100 as criterion**

<b>AGE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		842.92	610		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.63	0.46		
	Age	-0.01	0.006	-1.78	0.99
	Time <sub>Baseline-Midpoint</sub>	0.29	0.17	1.7	1.34
	Time <sub>Baseline-Endpoint</sub>	0.27	0.18	1.56	1.31
<b>GENDER</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		847.01	610		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.29	0.19		
	Female	0.23	0.2	1.15	1.26
	Time <sub>Baseline-Midpoint</sub>	0.3	0.17	1.76	1.35

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	Time <sub>Baseline-Endpoint</sub>	0.28	0.17	1.63	1.32
<b>LDL <math>\geq</math> 100 as criterion</b>					
<b>ETHNICITY</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
1		848.86	610		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.13	0.15		
	Hispanic	-0.13	0.31	0.43	0.88
	Time <sub>Baseline-Midpoint</sub>	0.29	0.17	1.7	1.26
	Time <sub>Baseline-Endpoint</sub>	0.28	0.17	1.59	1.32
<b>RACE</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
1		847.77	608		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.003	0.22		
	Asian	-0.26	0.26	0.98	0.77
	Black	-0.21	0.26	0.78	0.81
	Other	-0.13	0.3	0.42	0.88
	Time <sub>Baseline-Midpoint</sub>	0.29	0.17	1.68	1.26
	Time <sub>Baseline-Endpoint</sub>	0.28	0.18	1.55	1.32
<b>MARITAL STATUS</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
1		849.53	610		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.18	0.17		
	Married	0.08	0.2	0.4	1.08
	Time <sub>Baseline-Midpoint</sub>	0.29	0.17	1.71	1.26
	Time <sub>Baseline-Endpoint</sub>	0.28	0.17	1.6	1.32
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
1		849.66	610		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.14	0.2		
	English	-0.02	0.21	0.11	0.98
	Time <sub>Baseline-Midpoint</sub>	0.29	0.17	1.71	1.26
	Time <sub>Baseline-Endpoint</sub>	0.28	0.17	1.6	1.32
<b>INSURANCE</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
1		843.61	610		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.2	0.23		
	MediCare/MediCal	-0.46	0.23	-2.01*	0.63
	Time <sub>Baseline-Midpoint</sub>	0.3	0.17	1.7	1.35
	Time <sub>Baseline-Endpoint</sub>	0.28	0.18	1.57	1.32
2 <sup>b</sup>	MediCare/MediCal by Time <sub>Baseline-Endpoint</sub>	1.04	0.41	3.55*	2.83

---

**LDL  $\geq$  100 as criterion**

Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as  $\chi^2_{LR}$

\* < .05

\*\* < .01

\*\*\* < .001

\*\*\*\* < .0001

b: For Model 2 only the statistic for the interaction is reported when significant; OR: Odds Ratio

**For df = 608 - 610, Critical value for  $\chi^2$  at  $\alpha = 0.05$  are 666.47 - 668.57**

**For df = 608 - 610, Critical value for  $\chi^2$  at  $\alpha = 0.01$  are 653.1 - 655.17**

**For df = 608 - 610, Critical value for  $\chi^2$  at  $\alpha = 0.001$  are 692.05 - 694.18**

For the predictor, interaction between insurance and time, the difference between baseline and end point LDL levels was significant when controlling for Time (baseline-midpoint). A post-hoc analysis, to determine the time point at which significance occurred, showed that, when looking at uncorrected OR, at endpoint patients with MediCare/MediCal insurance were 1.1 times more likely to have LDL  $\geq$  100 compared to those without MediCare/MediCal insurance. Whereas, at baseline and midpoint, patients with MediCare/MediCal were 0.5 times as likely to have LDL  $\geq$  100 as patients without MediCare/MediCal.

### Question 2 - Results

Are sociodemographic characteristics related to process (quality) of care measures (eye exam, foot exam, use of aspirin, and diabetes self-management techniques)?

The analyses for this question are shown in Tables 9, 10, 11, and 12:

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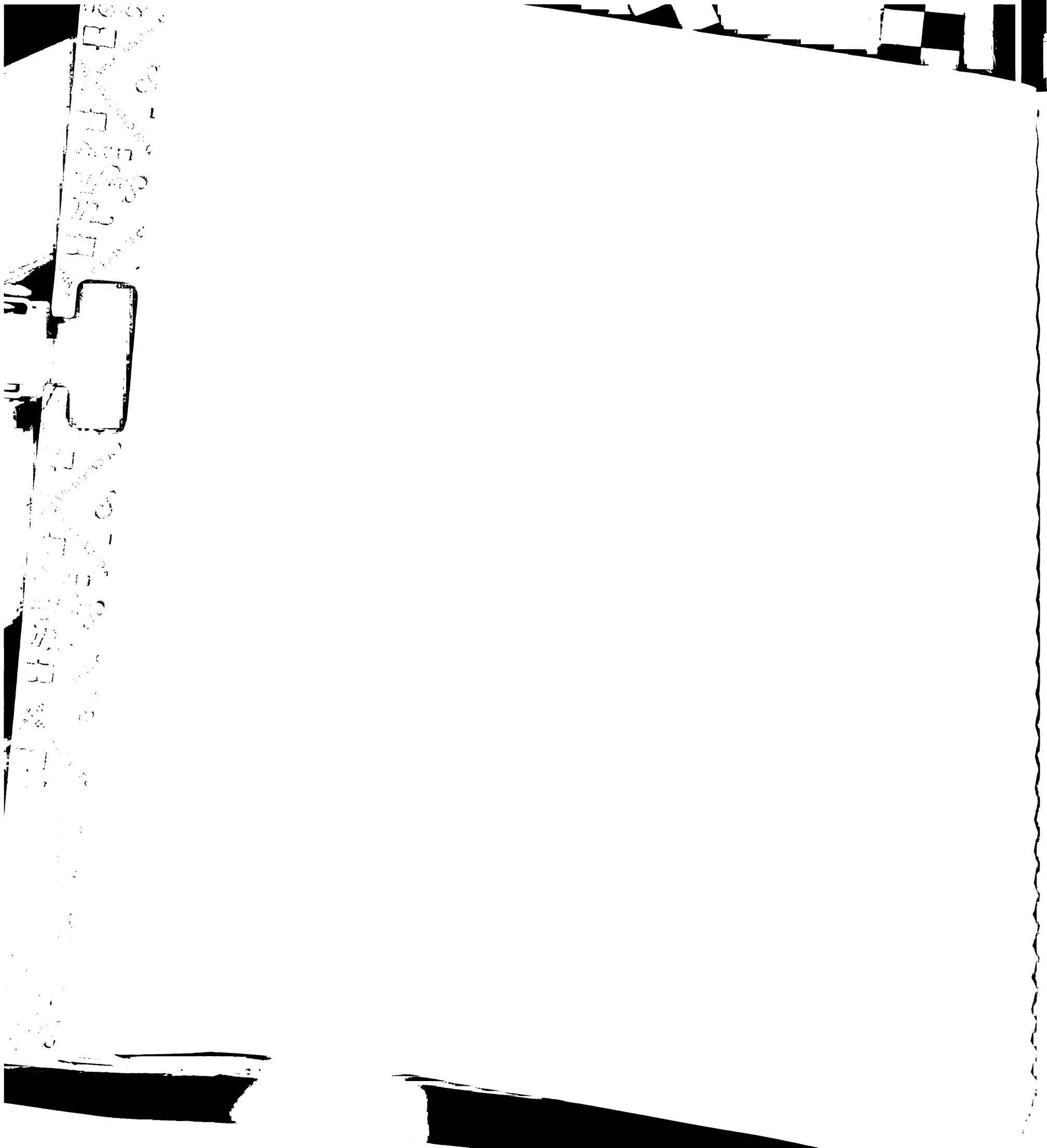


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**Table 9: Process (Quality) of Care Indicators: Eye Exams**

**Eye Exams Done as criterion**

<b>AGE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		858.68	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	1.28	0.4		
	Age	-0.02	0.006	-3.07**	0.82
	Time <sub>Baseline-Endpoint</sub>	0.05	0.12	0.45	1.05
<b>GENDER</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		872.35	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.08	0.16		
	Female	-0.06	0.19	-0.32	0.94
	Time <sub>Baseline-Endpoint</sub>	0.05	0.11	0.45	1.05
<b>ETHNICITY</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		870.76	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.08	0.12		
	Hispanic	-0.33	0.32	-1.03	0.72
	Time <sub>Baseline-Endpoint</sub>	0.05	0.11	0.45	1.05
<b>RACE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		835.47	625		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.3	0.19		
	Asian	-0.87	0.26	3.34***	0.42
	Black	0.38	0.26	1.42	1.46
	Other	-0.64	0.31	-2.09	0.53
	Time <sub>Baseline-Endpoint</sub>	0.05	0.12	0.45	1.05
<b>MARITAL STATUS</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		866.19	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.21	0.14		
	Married	-0.41	0.2	-2.04*	0.66
	Time <sub>Baseline-Endpoint</sub>	0.05	0.11	0.45	1.05
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
1		871.13	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.08	0.18		
	English	0.19	0.21	0.94	1.21
	Time <sub>Baseline-Endpoint</sub>	0.05	0.12	0.45	1.05





<b>Eye Exams Done as criterion</b>					
<b>INSURANCE</b>					
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>		
<b>1</b>		<b>872.47</b>	<b>627</b>		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.02	0.2		
	MediCare/MediCal	0.03	0.22	0.13	1.03
	Time <sub>Baseline-Endpoint</sub>	0.05	0.11	0.45	1.05

Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as  $\chi^2_{LR}$   
\* < .05  
\*\* < .01  
\*\*\* < .001  
\*\*\*\* < .0001  
OR: Odds Ratio  
b: For Model 2 only the statistic for the interaction is reported when significant

For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.05$  are 684.27 - 686.36  
For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.01$  are 670.72 - 672.79  
For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.001$  are 710.18 - 712.31

When controlling for time and other categories, the predictive odds of having an eye exam done for every 5 year increment in age are reduced by a factor or multiple of 1.05. When controlling for time and other categories, Whites are 2.4 times more likely to have an eye exam done compared to Asians ( $p < .001$ ). When controlling for time and other categories, non-married patients are 1.52 times more likely to have an eye exam done than married patients.

**Table 10: Process (Quality) of Care Indicators: Foot Exams**

<b>Foot Exam Done as criterion</b>					
<b>AGE</b>					
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>		
<b>1</b>		<b>815.43</b>	<b>627</b>		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	1.66	0.38		
	Age	-0.02	0.005	-2.91**	0.82
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.16	-0.54	0.92

### Eye Exam Done as criterion

Model	1	2	3
AGE	0.05	0.05	0.05
Predictors	1.0	1.0	1.0
Intercept	1.0	1.0	1.0
Time since last exam	1.0	1.0	1.0
OR	1.03	1.03	1.03
SE	0.02	0.02	0.02

than married patients.

an eye exam done compared to 7 years for... When controlling for time and other categories, non-married patients are... more likely to have an eye exam done.

When controlling for time and other... more likely to have an eye exam done every 2 year interval...

When controlling for time and other... the relative odds of having an eye exam done for every 2 year interval...

### Table 18: Process (Quality) of Care Indicators: Eye Exams

#### Eye Exam Done as criterion

Model	1	2	3
AGE	0.05	0.05	0.05
Predictors	1.0	1.0	1.0
Intercept	1.0	1.0	1.0
Time since last exam	1.0	1.0	1.0
OR	0.82	0.82	0.82
SE	0.04	0.04	0.04

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**Foot Exam Done as criterion**

<b>GENDER</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		824.42	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.6	0.16		
	Female	0.01	0.18	0.07	1.01
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92
<b>ETHNICITY</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		823.39	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.64	0.12		
	Hispanic	-0.26	0.28	-0.94	0.77
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92
<b>RACE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		822.32	625		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.71	0.18		
	Asian	-0.29	0.23	-1.23	0.75
	Black	-0.03	0.24	-0.11	0.97
	Other	-0.06	0.27	-0.21	0.94
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92
<b>2<sup>b</sup></b>	Asian by Time <sub>Baseline-Endpoint</sub>	0.94	0.39	7.54*	2.56
<b>MARITAL STATUS</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		821.54	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.73	0.14		
	Married	-0.29	0.18	-1.57	0.75
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		823.88	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.53	0.17		
	English	0.13	0.19	0.68	1.14
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92
<b>INSURANCE</b>					
<b>Model</b>		$X^2_{LR}$	<b>df</b>		
<b>1</b>		824.23	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.67	0.19		
	MediCare/MediCal	-0.08	0.2	-0.42	0.92
	Time <sub>Baseline-Endpoint</sub>	-0.08	0.15	-0.54	0.92

<b>Foot Exam Done as criterion</b>	
Z <sup>a</sup> : Wald statistic: Tests for interactions are reported as $\chi^2_{LR}$	
* < .05	
** < .01	
*** < .001	
**** < .0001	
OR: Odds Ratio	
b: For Model 2 only the statistic for the interaction is reported when significant	
<b>For df = 625 - 627, Critical value for <math>\chi^2</math> at <math>\alpha = 0.05</math> are 684.27 - 686.36</b>	
<b>For df = 625 - 627, Critical value for <math>\chi^2</math> at <math>\alpha = 0.01</math> are 670.72 - 672.79</b>	
<b>For df = 625 - 627, Critical value for <math>\chi^2</math> at <math>\alpha = 0.001</math> are 710.18 - 712.31</b>	

When controlling for time and other categories, the predictive odds of having a foot exam done for every 5 year increase in age are reduced by a factor of 0.9. With race as the predictor variable, the difference for foot exams done between baseline and end point was significant for Race when controlling for Time (baseline-midpoint). A post-hoc analysis, to determine the time point at which significance occurred, showed that, when looking at uncorrected OR, the odds of having a foot exam among Asians were 2.54 times greater than whites at endpoint, the odds of having a foot exam among Blacks were 1.04 times greater than whites at baseline, and the odds of having a foot exam among other races were 2.07 times greater than whites at baseline.

**Table 11: Process (Quality) of Care Indicators: Aspirin Use**

<b>Aspirin Used as criterion</b>					
<b>AGE</b>					
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>		
		790.05	627		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-2.53	0.41		
	Age	0.04	0.006	7.03****	1.04
	Time <sub>Baseline-Endpoint</sub>	0.01	0.13	0.11	1.01
<b>2<sup>b</sup></b>	Age by Time <sub>Baseline-Endpoint</sub>	0.02	0.01	3.19*	1.02

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**Aspirin Used as criterion**

<b>GENDER</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		857.39	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.3	0.16		
	Female	0.03	0.2	0.13	1.03
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01
<b>ETHNICITY</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		856.95	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.33	0.12		
	Hispanic	-0.17	0.32	-0.55	0.84
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01
<b>RACE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		855.06	625		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.38	0.18		
	Asian	0.06	0.25	0.25	1.06
	Black	-0.26	0.26	-1	0.77
	Other	-0.11	0.3	-0.36	0.90
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01
<b>MARITAL STATUS</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		854.22	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.2	0.14		
	Married	0.3	0.2	1.48	1.35
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01
<b>2<sup>b</sup></b>	Married by Time <sub>Baseline-Endpoint</sub>	0.75	0.24	5.10**	2.12
<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		851.5657	627		
	<b>Predictors</b>	$\beta$	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.57	0.17		
	English	-0.41	0.2	-2.01*	0.66
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01
<b>2<sup>b</sup></b>	English by Time <sub>Baseline-Endpoint</sub>	-0.56	0.26	2.68*	0.57



**Aspirin Used as criterion**

<b>INSURANCE</b>					
<b>Model</b>		$\chi^2_{LR}$	<b>df</b>		
<b>1</b>		<b>845.3</b>	<b>627</b>		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	-0.15	0.19		
	MediCare/MediCal	0.64	0.21	2.98**	1.9
	Time <sub>Baseline-Endpoint</sub>	0.01	0.12	0.11	1.01

Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as  $\chi^2_{LR}$   
 \* < .05  
 \*\* < .01  
 \*\*\* < .001  
 \*\*\*\* < .0001  
 OR: Odds Ratio  
 b: For Model 2 only the statistic for the interaction is reported when significant

**For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.05$  are 684.27 - 686.36**  
**For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.01$  are 670.72 - 672.79**  
**For df = 625 - 627, Critical value for  $\chi^2$  at  $\alpha = 0.001$  are 710.18 - 712.31**

The odds of having Aspirin prescribed at endpoint was 1.5 times greater than the odds of aspirin prescribed at baseline for age <=57. The odds of Aspirin prescribed at baseline are 1.2 times greater than the odds of aspirin prescribed at endpoint for age 58-73. The odds of Aspirin prescribed at endpoint are 1.3 times greater than the odds of aspirin prescribed at baseline for age >=73.

With marital status as the predictor, the difference for aspirin prescribed between baseline and end point was significant when controlling for Time (baseline-midpoint). A post-hoc analysis, to determine the time point at which significance occurred, showed that, when looking at uncorrected OR, the odds of aspirin prescribed at endpoint, among married patients, were 2.12 times greater than non-married patients.

With primary language as the predictor, the difference for aspirin prescribed between baseline and end point was significant when controlling for Time (baseline-midpoint). A post-hoc analysis, to determine the time point, at which significance occurred, showed



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that, when looking at uncorrected OR, the odds of aspirin prescribed among English speaking patients were 1.75 times greater than non-English speaking patients at endpoint.

When controlling for time and other categories, MediCare/MediCal patients are 1.9 times more likely to have Aspirin prescribed than non-MediCare/MediCal patients.

**Table12: Process (Quality) of Care Indicators: Diabetes Self-management Techniques**

**DM Self-Management Technique Done as criterion**

<b>AGE</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
<b>1</b>		694.73	627		
	<b>Predictors</b>	<b>β</b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.86	0.42		
	Age	0.0001	0.006	0.02	1
	Time <sub>Baseline-Endpoint</sub>	0.54	0.17	3.13	1.72
<b>GENDER</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
<b>1</b>		694.7	627		
	<b>Predictors</b>	<b>β</b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.89	0.17		
	Female	-0.04	0.2	-0.18	0.96
	Time <sub>Baseline-Endpoint</sub>	0.54	0.17	3.13	1.72
<b>ETHNICITY</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
<b>1</b>		694.72	627		
	<b>Predictors</b>	<b>β</b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.87	0.13		
	Hispanic	-0.03	0.29	-0.12	0.97
	Time <sub>Baseline-Endpoint</sub>	0.54	0.17	3.13	1.72
<b>RACE</b>					
<b>Model</b>		<b>X<sup>2</sup><sub>LR</sub></b>	<b>df</b>		
<b>1</b>		686.55	625		
	<b>Predictors</b>	<b>β</b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>
	Intercept	0.52	0.18		
	Asian	0.59	0.26	2.25	1.8
	Black	0.59	0.26	2.24	1.8
	Other	0.36	0.31	1.14	1.43
	Time <sub>Baseline-Endpoint</sub>	0.54	0.17	3.13	1.72

<b>DM Self-Management Technique Done as criterion</b>						
<b>MARITAL STATUS</b>						
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>			
1		694.5	627			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>	
	Intercept	0.84	0.15			
	Married	0.09	0.21	0.42		
	Time <sub>Baseline-Endpoint</sub>	0.54	0.17	3.13		
<b>PRIMARY LANGUAGE</b>						
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>			
1		693.94	627			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>	
	Intercept	0.97	0.19			
	English	-0.16	0.21	-0.75	0.85	
	Time	0.54	0.17	3.13	1.72	
2 <sup>b</sup>	English by Time <sub>Baseline-Endpoint</sub>	-0.97	0.36	5.82**	0.38	
<b>INSURANCE</b>						
<b>Model</b>		<b><math>\chi^2_{LR}</math></b>	<b>df</b>			
1		694.48	627			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z<sup>a</sup></b>	<b>OR</b>	
	Intercept	0.96	0.22			
	MediCare/MediCal	-0.12	0.24	-0.49	0.89	
	Time	0.54	0.17	3.13	1.72	
Z <sup>a</sup> : Wald statistic: Tests for interactions are reported as $\chi^2_{LR}$						
* < .05						
** < .01						
*** < .001						
**** < .0001						
OR: Odds Ratio						
b: For Model 2 only the statistic for the interaction is reported when significant						
For df = 625 - 627, Critical value for $\chi^2$ at $\alpha = 0.05$ are 684.27 - 686.36						
For df = 625 - 627, Critical value for $\chi^2$ at $\alpha = 0.01$ are 670.72 - 672.79						
For df = 625 - 627, Critical value for $\chi^2$ at $\alpha = 0.001$ are 710.18 - 712.31						

With primary language as the predictor, the difference for Diabetes self-management use between baseline and end point was significant when controlling for Time (baseline-midpoint). A post-hoc analysis, to determine the time point, at which significance occurred, showed that, when looking at uncorrected OR, the odds of Diabetes self-management use among English speaking patients were 2.65 times greater than non-English speaking patients at baseline and not at endpoint..

### Question 3 - Results

Are sociodemographic characteristics related to utilization of healthcare services: non-emergent care visits (general medicine clinic and urgent care (same day ambulatory care services [SAC]), and emergent visits (emergency department visit, and hospitalization)?

For the following analysis, IRR is the percent increase or decrease in the predictor value for a one unit increase in the predictor. Interpretation of IRR is done by subtracting 1 from the IRR.

**Table 13: Utilization of Healthcare Services: General Medicine Visits**

**General Medicine Visits as criterion**

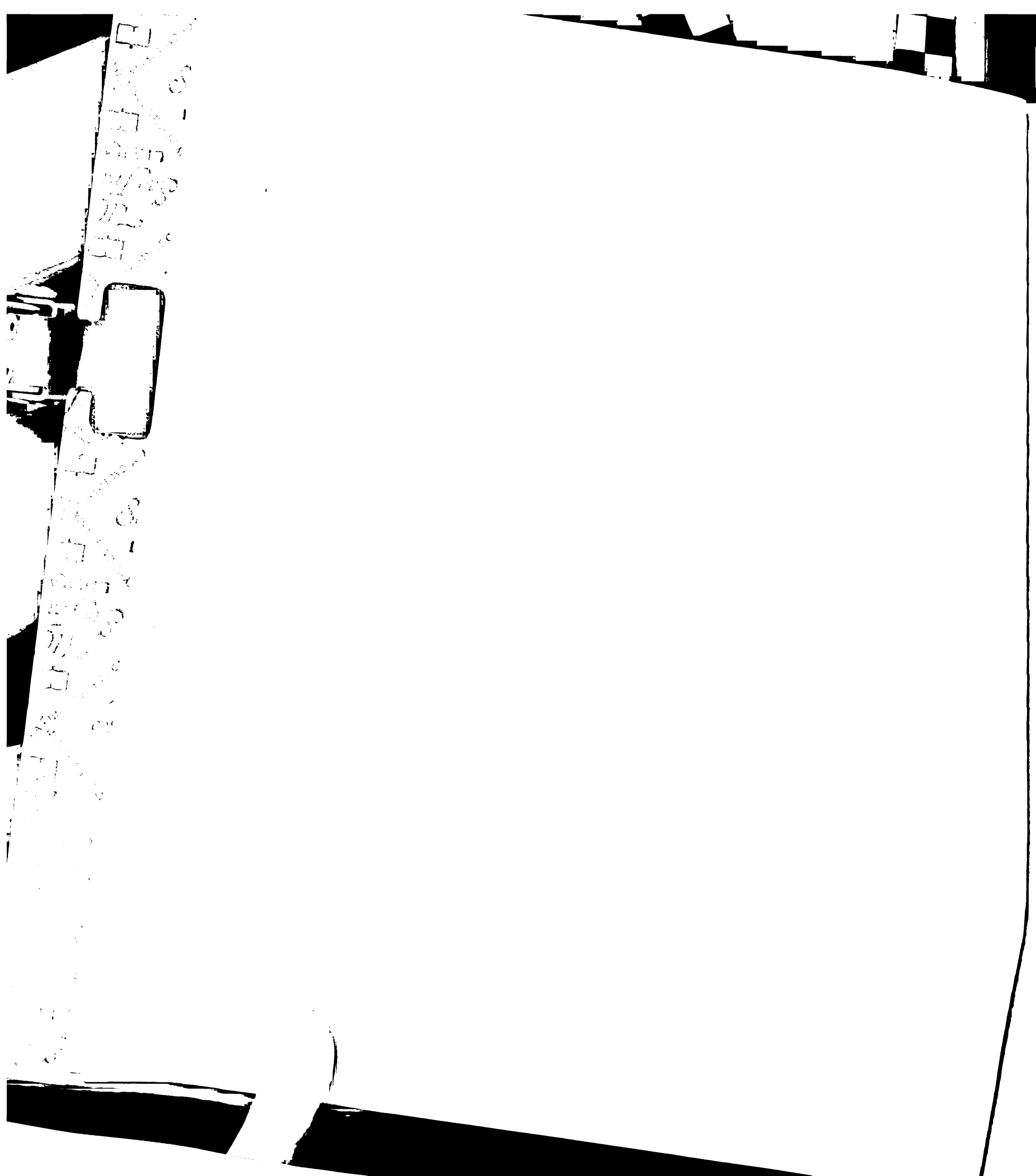
<b>AGE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		20.94	2		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>	
	Intercept	2.7	0.83		
	Age	0.05	0.01	4.52****	
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47	
<b>GENDER</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		6.84	2		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>	
	Intercept	5.67	0.30		
	Female	0.98	0.38	2.60**	
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47	
<b>ETHNICITY</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		0.47	2		
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>	
	Intercept	5.98	0.62		
	Hispanic	0.30	0.63	-2.01	
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-3.69	

MARY

**General Medicine Visits as criterion**

<b>RACE</b>				
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>	
1		1.04	4	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>
	Intercept	6.22	0.34	
	Asian	0.20	0.48	0.42
	Black	0.05	0.50	0.11
	Other	-0.31	0.57	-0.54
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47
<b>MARITAL STATUS</b>				
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>	
1		2.19	2	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>
	Intercept	6.46	0.27	
	Married	-0.55	0.38	-1.43
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47
<b>PRIMARY LANGUAGE</b>				
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>	
1		13.64	2	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>
	Intercept	7.11	0.32	
	English	-1.39	0.38	-3.64****
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47
<b>INSURANCE</b>				
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>	
1		42.67	2	
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>Semi Robust SE</b>	<b>Z</b>
	Intercept	4.40	0.34	
	MediCare/MediCal	2.49	0.38	6.49****
	Time <sub>Baseline-Endpoint</sub>	-0.12	0.26	-0.47
<p>Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as <math>\chi^2_{LR}</math>            * &lt; .05            ** &lt; .01            *** &lt; .001            **** &lt; .0001            OR: Odds Ratio            b: For Model 2 only the statistic for the interaction is reported when significant</p>				

When controlling for time and other categories, with every ten year increase in age there was an average 0.5 more GM visits per month. When controlling for time and other categories, female patients reported an average 0.98 more GM visits/month than men. When controlling for time and other categories, English speaking patients reported an

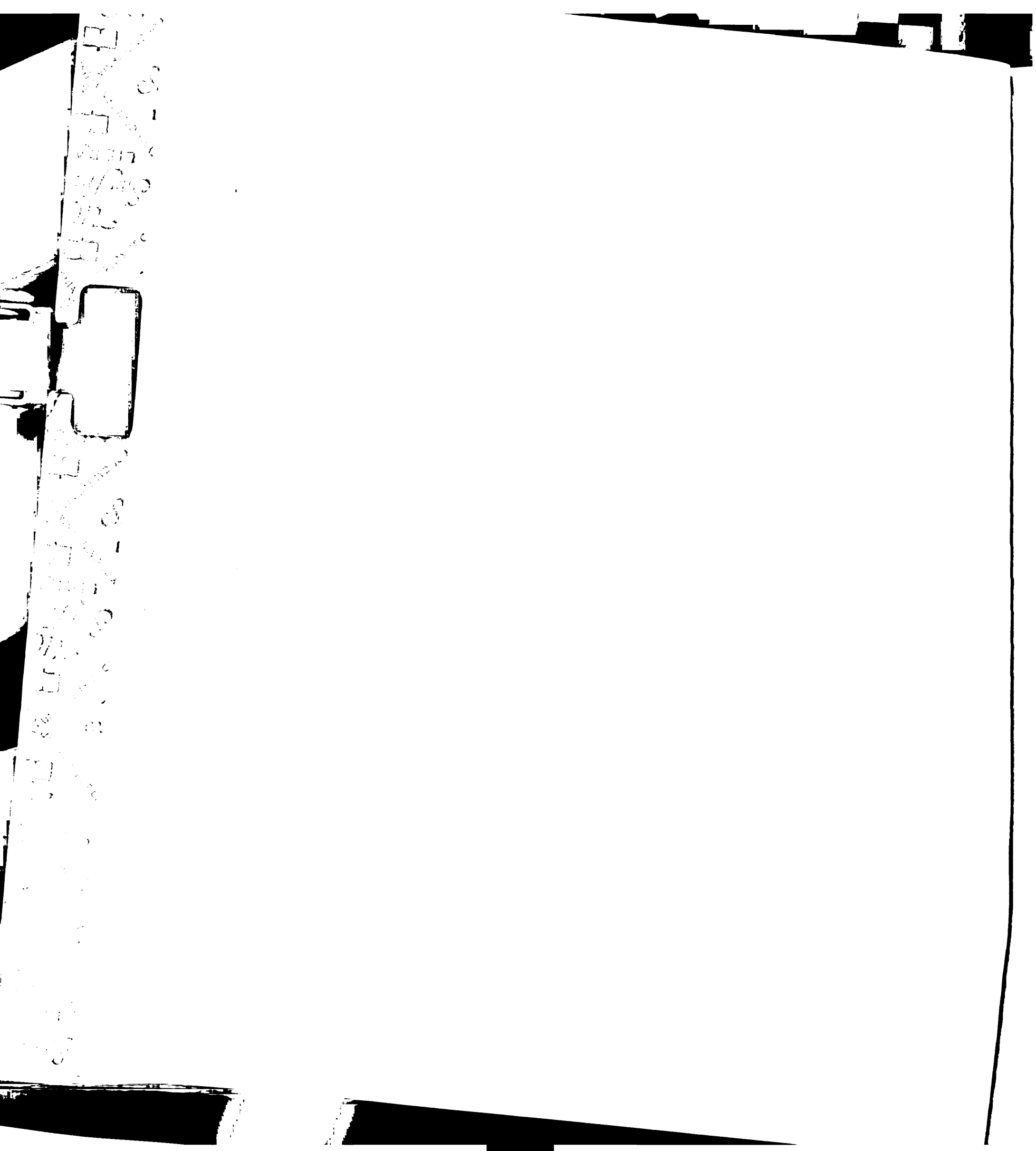


average 1.4 fewer GM visits per month than non-English speaking patients. When controlling for time and other categories, MediCare/MediCal patients reported an average 2.49 more GM visits per month than other insurance patients.

**Table 14: Utilization of Healthcare Services: Urgent Care Visits**

<b>Urgent Care Visits as criterion</b>					
<b>AGE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		2.33	2		
		-----			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	-0.48	0.62		
	Age	-0.001	0.009	-0.16	1.0
	Time <sub>Baseline-Endpoint</sub>	-0.21	0.14	-1.5	0.81
<b>GENDER</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		3.31	2		
		-----			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	-0.45	0.20		
	Female	-0.23	0.26	-0.90	0.79
	Time <sub>Baseline-Endpoint</sub>	-0.21	0.14	-1.53	0.81
<b>ETHNICITY</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		7.36	2		
		-----			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	0.14	0.32		
	Hispanic	-0.89	0.33	-2.67**	0.41
	Time <sub>Baseline-Endpoint</sub>	-0.17	0.14	-1.25	0.84
2 <sup>b</sup>	Hispanic by Time	0.73	0.35	2.05*	2.08
	Hispanic <sub>Baseline</sub>	0.31	0.11	-3.17	0.69
	Hispanic <sub>Endpoint</sub>	0.64	0.24	-1.19	0.36
<b>RACE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		6.23	4		
		-----			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	-0.75	0.26		
	Asian	-0.015	0.29	-0.05	0.99
	Black	0.08	0.34	0.24	1.08
	Other	0.70	0.4	1.78	2.01
	Time <sub>Baseline-Endpoint</sub>	-0.2	0.14	-1.39	0.82





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<b>Urgent Care Visits as criterion</b>				
<b>MARITAL STATUS</b>				
<b>Model</b>	<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1	2.50	2		
	-----			
	<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
Intercept	-0.54	0.19		
Married	-0.1	0.26	-0.37	0.90
Time <sub>Baseline-Endpoint</sub>	-0.21	0.14	-1.50	0.81
<b>PRIMARY LANGUAGE</b>				
<b>Model</b>	<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1	2.61	2		
	-----			
	<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
Intercept	-0.6	0.25		
English	0.03	0.28	0.13	0.90
Time <sub>Baseline-Endpoint</sub>	-0.21	0.14	-1.51	0.81
<b>INSURANCE</b>				
<b>Model</b>	<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1	2.24	2		
	-----			
	<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
Intercept	-0.64	0.31		
MediCare/MediCal	0.08	0.34	0.24	1.08
Time <sub>Baseline-Endpoint</sub>	-0.21	0.14	-1.50	0.81
Z <sup>a</sup> : Wald statistic: Tests for interactions are reported as $\chi^2_{LR}$ * < .05 ** < .01 *** < .001 **** < .0001 OR: Odds Ratio b: For Model 2 only the statistic for the interaction is reported when significant				

With ethnicity as the predictor variable, when controlling for time, Hispanics had 36% fewer urgent care visits at baseline and 90% more urgent care visits at endpoint than non-Hispanics. Therefore, the percent of urgent care visits for Hispanics grew by a factor of 2.5 compared to non-Hispanics.

**Table 15: Utilization of Healthcare Services: Emergency Department Visits**

**Emergency Department Visits as criterion**

<b>AGE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		3.24	2		
		-----			
		<b>Semi Robust</b>			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	0.08	0.46		
	Age	-0.001	0.007	-0.18	1.00
	Time <sub>Baseline-Endpoint</sub>	-0.21	0.12	-1.75	0.81
<b>GENDER</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		5.55	2		
		-----			
		<b>Semi Robust</b>			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	-0.2	0.15		
	Female	0.32	0.19	1.68	1.38
	Time <sub>Baseline-Endpoint</sub>	-0.21	0.13	-1.71	0.81
<b>ETHNICITY</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		6.44	2		
		-----			
		<b>Semi Robust</b>			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	0.47	0.23		
	Hispanic	-0.57	0.23	-2.44*	0.57
	Time <sub>Baseline-Endpoint</sub>	-0.18	0.12	-1.52	0.84
2 <sup>b</sup>	Hispanic by Time	0.87	0.32	2.71**	2.39
	Hispanic <sub>Baseline</sub>	0.40	0.11	-3.27	0.60
	Hispanic <sub>Endpoint</sub>	0.96	0.26	-0.15	0.04
<b>RACE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		24.83	4		
		-----			
		<b>Semi Robust</b>			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	-0.02	0.16		
	Asian	-0.54	0.20	-2.67*	0.58
	Black	0.31	0.25	1.22	1.36
	Other	0.20	0.27	0.74	1.22
	Time <sub>Baseline-Endpoint</sub>	-0.21	0.12	-1.74	0.81
<b>MARITAL STATUS</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		4.15	2		
		-----			
		<b>Semi Robust</b>			
	<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
	Intercept	0.07	0.13		
	Married	-0.17	0.19	-0.89	0.84
	Time <sub>Baseline-Endpoint</sub>	-0.22	0.12	-1.81	0.80

**Emergency Department Visits as criterion**

<b>PRIMARY LANGUAGE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		3.0	2		
		----- <b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	0.05	0.15			
English	-0.09	0.18	-0.52	0.91	
Time <sub>Baseline-Endpoint</sub>	-0.21	0.12	-1.73	0.81	
<b>INSURANCE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		11.38	2		
		----- <b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	-0.44	0.16			
MediCare/MediCal	0.56	0.19	2.91**	1.75	
Time <sub>Baseline-Endpoint</sub>	-0.22	0.12	-1.79	0.80	
<p>Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as <math>\chi^2_{LR}</math>            * &lt; .05            ** &lt; .01            *** &lt; .001            **** &lt; .0001            OR: Odds Ratio            b: For Model 2 only the statistic for the interaction is reported when significant</p>					

With ethnicity as the predictor variable, Hispanics had 49% more ED visits at baseline and 161% more ED visits at endpoint than non-Hispanics. Therefore, the percent of ED visits for Hispanics grew by a factor of 3.3 compared to non-Hispanics.

When controlling for time and other categories, Asians had 42% fewer ED visits than Whites. When controlling for time and other categories, Patients with MediCare and/or MediCal had 75% more ED visits than non- MediCare/MediCal patients.

**Table 16: Utilization of Healthcare Services: Hospitalizations**

**Hospitalization Visits as criteria**

<b>AGE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		14.73	2		
		-----			
		<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	-0.87	0.50			
Age	0.007	0.007	1.00	1.01	
Time <sub>Baseline-Endpoint</sub>	-0.58	0.15	-3.81	0.56	
<b>GENDER</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		18.85	2		
		-----			
		<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	-0.66	0.16			
Female	0.42	0.20	2.06*	1.52	
Time <sub>Baseline-Endpoint</sub>	-0.57	0.15	-3.81	0.57	
<b>ETHNICITY</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		15.15	2		
		-----			
		<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	0.1	0.28			
Hispanic	-0.58	0.29	-2.01*	0.56	
Time <sub>Baseline-Endpoint</sub>	-0.56	0.15	-3.69	0.57	
<b>RACE</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		23.29	4		
		-----			
		<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	-0.35	0.19			
Asian	-0.49	0.27	-1.84	0.61	
Black	0.12	0.28	0.42	1.13	
Other	0.17	0.32	0.52	1.19	
Time <sub>Baseline-Endpoint</sub>	-0.58	0.15	-3.80	0.56	
<b>MARITAL STATUS</b>					
<b>Model</b>		<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1		14.70	2		
		-----			
		<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>	
Intercept	-0.35	0.15			
Married	-0.10	0.22	-0.46	0.90	
Time <sub>Baseline-Endpoint</sub>	-0.58	0.15	-3.83	0.56	



**Hospitalization Visits as criteria**

<b>PRIMARY LANGUAGE</b>				
<b>Model</b>	<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1	14.46	2		
	-----			
	<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
Intercept	-0.28	0.17		
English	-0.18	0.21	-0.86	0.84
Time <sub>Baseline-Endpoint</sub>	-0.58	0.15	-3.79	0.56
<b>INSURANCE</b>				
<b>Model</b>	<b>Wald <math>\chi^2</math></b>	<b>df</b>		
1	19.26	2		
	-----			
	<b>Semi Robust</b>			
<b>Predictors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>Z<sup>a</sup></b>	<b>IRR</b>
Intercept	-0.78	0.26		
MediCare/Medical	0.5	0.28	1.80	1.65
Time <sub>Baseline-Endpoint</sub>	-0.59	0.15	-3.91	0.55
<p>Z<sup>a</sup>: Wald statistic: Tests for interactions are reported as <math>\chi^2_{LR}</math></p> <p>* &lt; .05</p> <p>** &lt; .01</p> <p>*** &lt; .001</p> <p>**** &lt; .0001</p> <p>OR: Odds Ratio</p> <p>b: For Model 2 only the statistic for the interaction is reported when significant</p>				

When controlling for time and all other predictor categories, females had 52% more hospitalizations than males. When controlling for time and other predictor categories, Hispanics had 44% fewer hospitalizations than non-Hispanics.





## CHAPTER FIVE: DISCUSSION

### Principal Findings

The difference in the outcome variables, diabetes health status, process (quality) of care, and utilization of healthcare services are outlined and possible explanations for some of the differences are posed. Interesting aspects of the results are explored and limitations of the data and findings are included in this chapter. Finally, implications for selection of interventions in diabetes management programs and future research are presented.

#### *Diabetes Health Status Differences*

Of the diabetes health status indicators, no significant differences related to the sample demographic characteristics was detected when  $HbA1c \geq 7\%$  was used as the criterion. Some epidemiological studies have reported sub-optimal HbA1c results for Blacks and Hispanics. This study separated race and ethnicity based on institutional guidelines, and hence, results could not be compared to existing studies that did not use the same criteria. Due to the nature of the program, it is possible that all patients in the diabetes management program were targeted for a HbA1c related intervention. However, there was no overall significant difference in the number of patients with  $HbA1c \geq 7\%$  when controlling for time or across categories. This finding may indicate that dichotomization of the outcome variable may have not been sufficient to detect a positive or a negative change from baseline. Patients with  $HbA1c < 7\%$  may have not worsened. However, it is plausible that patients with  $HbA1c \geq 7\%$ , may have improved or worsened in the 18 month study duration, with an increase or decrease in their baseline HbA1c respectively, and subsequently remained within their original baseline category of HbA1c

$\geq 7\%$ . Studies evaluating improvement of HbA1c have used threshold values  $\leq 8\%$  (de Grauw et al., 2002; Khunti, Ganguli, Baker et al., 2001; Stys, 2002). Other studies have evaluated change in the mean HbA1c levels by 1% (Sadur et al., 1999; Wagner, Sandhu et al., 2001). As a change in HbA1c by 1% has clinical significance, use of continuous data using mean HbA1c versus nominal (threshold value) data for this outcome variable in future research is reasonable.

When controlling for time, there was a significant difference in BP  $\geq 130/80$  related to age. Given that the median age of the study sample was 68 years, this finding is in keeping with the progressive nature of diabetes morbidity. With 100% participation by patients related to the measurement of BP, non-English speaking patients had significantly higher number of patients with BP  $\geq 130/80$  than English speaking patients. There is a paucity of literature to corroborate the findings related to the effect of primary language on BP in a diabetes population and possible explanations for this finding are limited. One possible explanation may be that non-English speaking patients may be prescribed a simpler regimen of medications leading to better medication adherence, but this is only a speculation. This finding cannot be explained further within the present secondary analysis.

There was a significant difference in LDL  $\geq 100$  related to insurance coverage. Patients on MediCare/MediCal were more likely to have LDL  $\geq 100$  than patients without MediCare/MediCal insurance at the end of the diabetes management program. MediCare/Medical patients comprised 74% of the study sample. Of the study sample who had MediCal, 22% were patients  $< 65$  years of age while all non-MediCare/MediCal patients comprised 26% of the study sample. Hence, progressive worsening of LDL

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values related to age is not a plausible explanation. This finding alludes to the lack of accessibility and/or affordability of more effective LDL lowering medications among MediCare/MediCal patients. Although the effects of elevated LDL over time are devastating leading to potentially fatal cardiovascular events, there are no immediate symptoms of hyperlipidemia. Therefore, it is reasonable to assume that given financial constraints, prescriptions for LDL lowering medications may not be filled among Medicare/Medical patients. Although there is a lack of studies related to LDL and insurance status, studies exploring patients' insurance status in relation to diabetes outcomes have found that Medicare patients had lower rates of diabetes assessments (Chin et al., 1998).

#### *Process (Quality) of Care Outcomes*

The process (quality) of care outcome results in this study is conflicting and inconsistent with the published literature. This section will summarize the results of this study analysis and provide possible explanations for the inconsistencies.

Overall, the odds of having an eye exam done were significantly less with increasing age, with Whites more likely to have exams than Asians, and non-married patients likely to have more exams than married patients. Previous studies documenting the frequency of eye exams in relation to demographics among diabetics reported varying results. Some studies reported lower performance rates on eye exams among 18-44 years of age compared to 45 to 64 years of age (Beckles et al., 1998), and lower eye exam rates among Blacks compared to Whites (Heisler, Smith et al., 2003), while other studies focused on ethnic minorities, have shown no significant differences in the frequency of eye exams among minorities compared to Whites (Hosler et al., 2002).

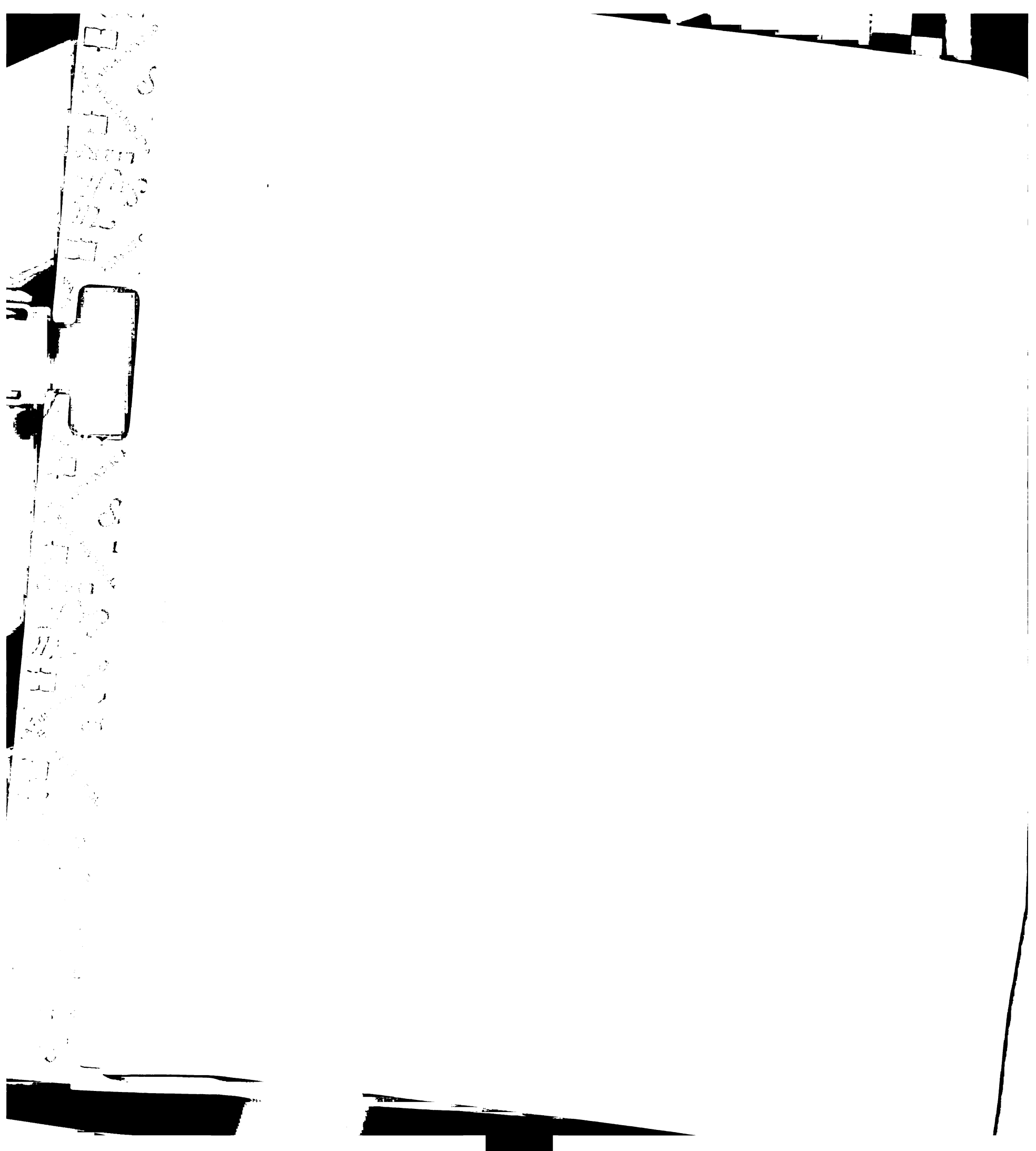
Similar to eye exam results, the odds of having a foot exam done were significantly less with increasing age. In contrast to eye exam performance, significant differences in the performance of foot exams by race over time showed that Whites were significantly less likely than other racial categories to have had a foot exam at the endpoint of the diabetes management program. We can speculate that healthcare providers may be influenced by the racial characteristics of their patients. Other studies have found no difference in foot exam performance between Blacks and Whites (Heisler, Smith et al., 2003) and lower rates of foot exams were found among insulin users with less than a high school education (Beckles et al., 1998).

Patients  $\leq 57$  years of age and patients  $\geq 73$  years of age, married patients, and English speaking patients were more likely to be taking aspirin at the endpoint of the diabetes management program than those between the ages of 58 and 73 years. Irrespective of time-point, overall, MediCare/Medical patients were significantly more likely to be taking aspirin than non-MediCare/MediCal patients. There is a paucity of literature related to social support and process of care outcomes among diabetes or those on MediCare or MediCal. Studies related to aspirin use among diabetics found aspirin use was less among women 35 to 64 years of age and among men 35 to 49 years of age (Persell & Baker, 2004). Studies related to primary language and diabetes process of care outcomes at the VA, revealed better diabetes health outcomes in the Hispanic group among those who spoke English and had similar access to care and was attributed to being culturally homogeneous (a majority spoke English) although the cohort was ethnically heterogeneous (Hispanic versus non-Hispanic Whites) (Walsh et al., 2002).

Since the results of this secondary analysis and other published existing studies cannot be corroborated, interpretation is approached with caution.

Use of diabetes self-management techniques was significantly higher among English speaking patients at the end of the diabetes management program compared to non-English speaking patients. Studies related to treatment decision making and prioritizing treatment goals found higher levels of education contributed to greater agreement and higher patient diabetes care self-efficacy and assessments of diabetes self-management (Heisler, Vijan et al., 2003). These results imply the possible lack of non-English based teaching related to diabetes self-management techniques or that health professionals spend less time educating these patients in self-management

Performance of preventative health exams depend on a number of factors. The factors that contribute to clinicians meeting these performance measures for patients could include one or more of the following factors: (a) provider compliance with guidelines in ordering the exam in a timely manner; (b) patient perception and belief in the efficacy of preventative health practices and its benefits or burden; (c) availability and flexibility in scheduling exams by health care institution; (d) patient management and coordination of work and family commitments; and (e) social support in taking care of non-emergent preventative health needs. Improvement in the process (quality) of care outcomes has been positively linked to the degree and type of system level interventions which have multiple components (Wagner, Glasgow et al., 2001). However, system-level interventions vary based on the type, level, and amount of interventions applied, population served, setting, amount of available resources, inadequate information technology support systems, and opportunity to introduce change within existing systems.



When tested in busy day-to day practice settings, these comprehensive interventions remain formidable due to the inability to change the systems of care or to incorporate interventions tested in academic or highly managed settings with fewer patients or providers. These results provide exploratory information related to process (quality) of care and demographic characteristics. However, more research related to exploring patient related factors is needed to adequately interpret such data at a facility level.

### *Utilization of Healthcare Services*

Independent of other sociodemographic characteristics or time, general medicine average visits per month increased and was associated with increasing age, being female, and having MediCare/MediCal insurance. General medicine average visits per month decreased among English speaking patients. Compared to non-Hispanics, Hispanics had significantly greater number of urgent care clinic visits by the end of the diabetes management program. It is unclear as to (a) why general medicine visits decreased among English speaking patients during the time period of this analysis; or (b) why Hispanics had significantly more urgent care visits over time; or (c) why Urgent care clinic visits increased over time among Hispanic patients. Epidemiological studies have reported fewer non-emergent visits among Blacks compared to Whites (Chin et al., 1998) and a higher number of visits among those with less than a high school education (Beckles et al., 1998).

Hispanics had significantly higher emergency department visits than non-Hispanics. Overall, Asians had fewer emergency department visits than Whites, while those with Medicare/MediCal insurance had greater numbers of emergency department visits than



those with non-Medicare/Medical Insurance. Overall, females were hospitalized more than males and Hispanics had fewer hospitalizations than non-Hispanics.

Published studies assessing similar associations among demographic characteristics and health outcomes varied in their results. Overall, Blacks, females, and persons with less than 12 years of education have been reported with higher emergency department visits, and persons 85 years or older had higher emergency department visits and hospitalization (Chin et al., 1998)

In summary, being insured by MediCare or MediCal was predictive of increased utilization of healthcare services, both general medicine visits and emergency department visits. Similarly, females tended to utilize primary care and had higher hospitalization rates. Hispanic patients' use of urgent care visits and emergency department visits dominated other demographic groups. Although primary care visits are desirable over urgent care and emergency department visits, there was a predominance of primary care visits among females and among those with MediCare/MediCal insurance. MediCare/MediCal patients had higher emergency department visits and females had higher hospitalization use. The higher use of the emergency department by women and MediCare/Medical patients may indicate complications related to severity of disease in these groups and represent challenges faced by providers in managing diabetes related complications. Alternatively, an increase in urgent care and emergency department visits by Hispanics may point to cultural factors related to how care is accessed. Such results also point to the need for developing focused interventions to address the diverse demographic composition of patients whose healthcare facility could improve the delivery and quality of care

## Limitations

The use of a secondary analysis in this study was facilitated by the availability of a diabetes registry, and familiarity with the primary study's data management. The advantages of a secondary analysis are that it can be done inexpensively with fewer resources in a shorter time frame than a prospective clinical study. This approach allowed finding associations among clinical and outcome variables for future areas of research, and was effective in exploring evidence to guide future practice. However, such a design also posed common sources of potential selection bias. The disadvantage of this design was selection bias due to patient drop-out over time related to loss or change in health insurance, move to another healthcare system, or transfer to a non-resident provider. Since data were collected for a different purpose in the original study, the inability to determine the accuracy of the original data and limits in the choice of variables available for the study posed an additional problem. However, verifying the context in which the data was collected and the accuracy of the data at different steps added to its validity. This non-differential bias likely attenuated any observed effect or associations to sufficiently describe potential confounders that may have influenced the predictor variable.

This study used an existing, ongoing, database which also posed limitations related to control over variable selection and measurement. Since all the data collection for existing databases are pre-defined and pre-determined, and frequently unknown, they are subject to inconsistencies with the current study's goals and definitions. However, for the present study, the variables were examined in detail to understand and accurately code the variables of interest without loss of content. Also, since the data needed for this study

were objective data and did not need interpretation or abstraction, its collection methods poses fewer quality problems.

In this study, emergency department visits and hospitalization visits were only recorded if the subject was admitted to UCSF; hence admission to another local facility was not included. Subsequently, this limitation may have affected the estimation of the true association between the predictor variable and utilization of health care services related to emergent visits. Since this study was conducted in an urban university affiliated setting, generalizability is limited by characteristics unique to the distribution of this study sample, its setting and its providers. Often, disease management and treatment measures are based on guidelines. While guidelines may have explicit criteria for selection of treatment, many areas are left to the judgment of the provider. Similarly an emergency department visit is assumed to be related to acute problems; however, it only reflects the healthcare setting utilized and not the reason of the visit. Utilizing several criterion sets in the same sample allowed adjustment of diabetes health state to fit the study questions, increased confidence in the prediction, and facilitated replication; however, it also may have skewed the sample to a non-representative core (McGlashan, Carpenter, & Bartko, 1988).

In this study, the patients were exposed to the six essential factors of the CCM; however, all the components in the model could not be tested. The diabetes management program attempted to provide linkages to community resources, developed a delivery system design in customizing care to patient needs and values, and obtained support from senior leaders in the organization of health care delivery. Although the concept and variable, diabetes self-management, was developed, most of these components could not

be directly tested as it was based on reporting by providers that were not documented consistently. The clinical information system and decision support systems played an important part in decreasing provider variation through reminders and in improving the delivery of care; however, documenting these results would have required additional resources that was not within the scope of the study. While providers in the study reported implementation of the concepts embodied in the CCM, lack of documentation efforts inhibited the ability to test the CCM's effectiveness. Moreover, important conceptual variables, while holistic in approach, are difficult to define, develop, and measure

Use of comparative cohort groups in future research may provide a useful perspective to study quality outcomes data. Since the present study did not attempt to study causality, and was intended to look at associations, the advantages of using an existing database far outweighed its disadvantages.

#### Research Significance and Practical Implications

Management of outpatient chronic illness is a challenge and requires a perspective that incorporates patients' interactions or lack thereof with the health care system and the community at large. Disease management approaches that use Continuous Quality Improvement (CQI) principles have shown huge opportunities to improve care. The findings of this study provide information for recommendations for practice to institutions. Moreover, the findings from this study can be used to guide the development of interventions that will optimize selection of patient interventions in population-based diabetes programs.

Information driven by data is fundamental to CQI programs. However, databases from individual programs that are not linked to its core systems represent redundant and sub-optimal use of available resources. Linking data that show or reflect diabetes health status outcomes, the process of care delivered, and utilization of health services provides meaningful information to assess and develop interventions for population based programs. Such knowledge when linked to long-term outcomes of diabetes management programs will provide insight into its effectiveness. With newer technology and more integrated systems, mechanisms that provide feedback to disease management programs will also provide knowledge specific to institutions. Institution specific knowledge allows assessment and prioritization of resources and provides direction in targeting interventions to improve the quality and delivery of care.

This study demonstrated that demographic characteristics are predictive of certain diabetes health status outcomes, process (quality) of care outcomes, and utilization of health care services. These findings merit further research and suggest the following recommendations. The first recommendation is to replicate this study in other healthcare settings to ascertain that specific hospital settings or geographic factors did not obscure or define relationships between the variables. The second recommendation is to design a prospective study with well defined sociodemographic characteristics that provide a more direct measure than proxy measures that attempt to measure them indirectly. These variables may include education, income, social support, medications taken, reason for visit, and diagnosis at time of visit. Similarly, capturing data related to provider intent, patient agreement, or patient refusal will provide meaningful information to develop and implement effective diabetes management programs. For example, a patient may be in

agreement with a treatment plan, however, lack of resources and / or support related to social conflict may provide additional knowledge in developing and incorporating a more appropriate intervention. Additionally, threshold points set by guidelines do not conclusively capture clinically significant health status changes when these changes do not reach threshold values. For example, although the desirable outcome for LDL is less than 100, a change in LDL value from 110 to 100 would be more meaningful than that from 101 to 99. Similarly, a reduction of 1% in HbA1c leads to a 21% reduction in risk of diabetes related complications and death and has clinical significance (UK Prospective Diabetes Study, 1998). A realistic expectation for a diabetes patient with increased morbidity is to make positive incremental changes in HbA1c from 10% to 8% over time. The significance of this result would be undetectable if the outcome was measured based on a dichotomized target HbA1c threshold value of < 7%. Hence, a more realistic and practical consideration to determine the effectiveness of interventions is to measure a positive or a negative change in health status outcome from baseline value to end point rather than target threshold points.

Although many interventions are known to be helpful in improving the management of diabetes, a determination of the characteristics and needs unique to the population served reflects the practices of providers and institutions. Considerations of demographic, provider, institutional practices and available resources provide a way of developing more meaningful interventions for a given population.

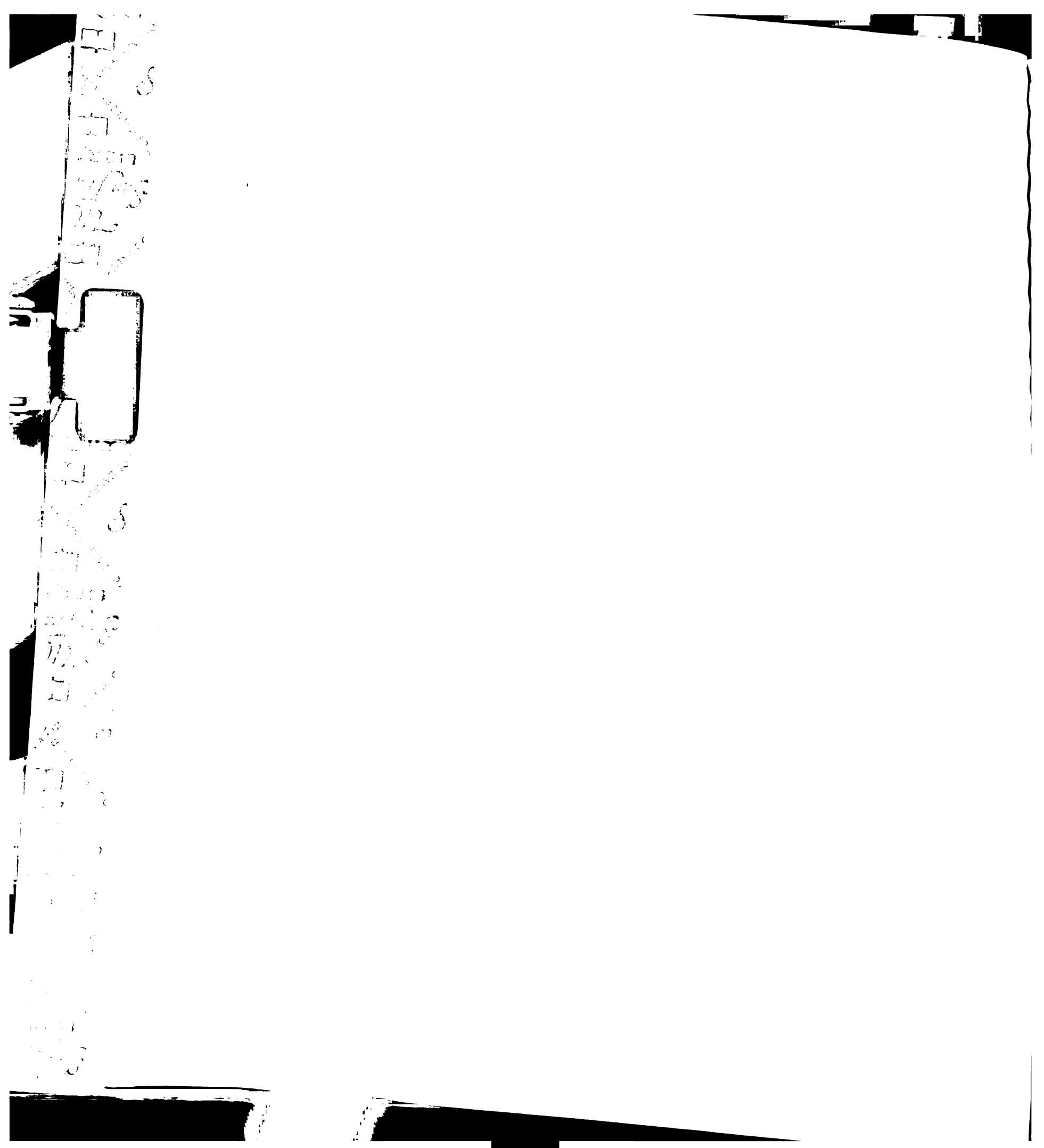
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# Appendix A

## Diabetes Evidence Based Guidelines

(Collaborative Project From the California Cooperative Healthcare Reporting Initiative, 2001)



### 2001 BASIC GUIDELINES FOR DIABETES CARE

A COLLABORATIVE PROJECT FROM THE CALIFORNIA COOPERATIVE HEALTHCARE REPORTING INITIATIVE (CCHRI) AND PARTICIPATING HEALTH PLANS

PHYSICAL AND EMOTIONAL ASSESSMENT		LAB EXAM	
<b>Blood Pressure, Weight</b>	<b>Adults:</b> Every visit. Blood pressure target goal < 130/80 mmHg. <b>Children:</b> (add height, plot on growth charts) Every visit. Blood pressure target goal < 90th percentile age standard, normal weight for height (see standard growth charts)	<b>HbA1c</b>	<b>Quarterly:</b> if treatment changes or if not meeting goals; 1-2 times/year if stable. <b>Target goal:</b> < 7.0% or < 1% above lab norms. <b>Caution:</b> modify if necessary to prevent significant hypoglycemia.
<b>Foot Exam</b> (for adults)	<b>Every "diabetes visit":</b> thorough visual inspection. <b>Annually:</b> pedal pulses; neurological exam.	<b>Microalbuminuria</b>	<b>Annual/Quarterly Rates</b> (Screen patients with type 1 diabetes)
<b>Diilated Eye Exam</b> (by a trained expert)	<b>Type 1:</b> 5 years post diagnosis, then every year. <b>Type 2:</b> shortly after diagnosis, then every year. Note: Internal quality assurance data may be used to support less frequent testing.	<b>Blood Lipids</b> (for adults)	<b>Type 1:</b> 5 years post diagnosis, then every year. <b>Type 2:</b> begin at diagnosis, then every year.
<b>Depression</b>	<b>Annually:</b> Probe for emotional/physical factors linked to depression; treat aggressively with counseling, medication and/or referral.		<b>Initially, then annually</b> <b>Target Goals:</b> cholesterol, triglycerides < 200 mg/dL LDL < 100; HDL > 45 for men HDL > 55 for women non-HDL cholesterol < 130.
SELF-MANAGEMENT TRAINING		INTERVENTIONS	
<b>MANAGEMENT PRIORITIES AND COMPLICATIONS</b>	<b>INITIALLY THEN ANNUALLY:</b> assess knowledge of diabetes, medications, self-monitoring, acute/chronic complications, and problem-solving skills. <b>Every visit:</b> screen for problems with and barriers to self-care; assist patient to identify achievable self-care goals. <b>Caution:</b> appropriate for developmental stage.	<b>ASPIRIN THERAPY</b>	(81-325 mg/day) in adults as primary and secondary prevention of CHD, unless contraindicated.
<b>SELF-GUIDED MONITORING</b>	<b>Type 1:</b> typically test 4 times a day. <b>Type 2 (and others):</b> as needed to meet treatment goals.	<b>SMOKING CESSATION</b>	Screen, advise, and assist at every diabetes care visit, adjusting the frequency as appropriate to the patient's response.
<b>MEDICAL NUTRITION THERAPY</b> (by a trained expert)	<b>INITIALLY:</b> assess needs/condition, assist patient in setting nutrition goals. <b>Follow-up visits:</b> assess progress toward goals, identify problem areas.	<b>VACCINATIONS</b>	Influenza and Pneumococcal, per CDC recommendations.
<b>PHYSICAL ACTIVITY</b>	<b>INITIALLY:</b> assess patient. <b>INITIALLY AND IN FOLLOW-UP VISITS:</b> prescribe physical activity based on patient's needs/condition.	<b>DENTAL EXAMS</b>	At least twice yearly.
<b>WEIGHT MANAGEMENT</b>	<b>INITIALLY, AND IN FOLLOW-UP VISITS:</b> must be individualized for patient.	<b>PRECONCEPTION COUNSELING AND MANAGEMENT</b>	Consult with high risk perinatal programs where available (e.g., "Sweet Success" California Diabetes and Pregnancy Program). <b>Adolescents:</b> special counseling advisable, beginning with puberty.
		<b>PREGNANCY MANAGEMENT</b>	Consult with high risk perinatal programs where available.

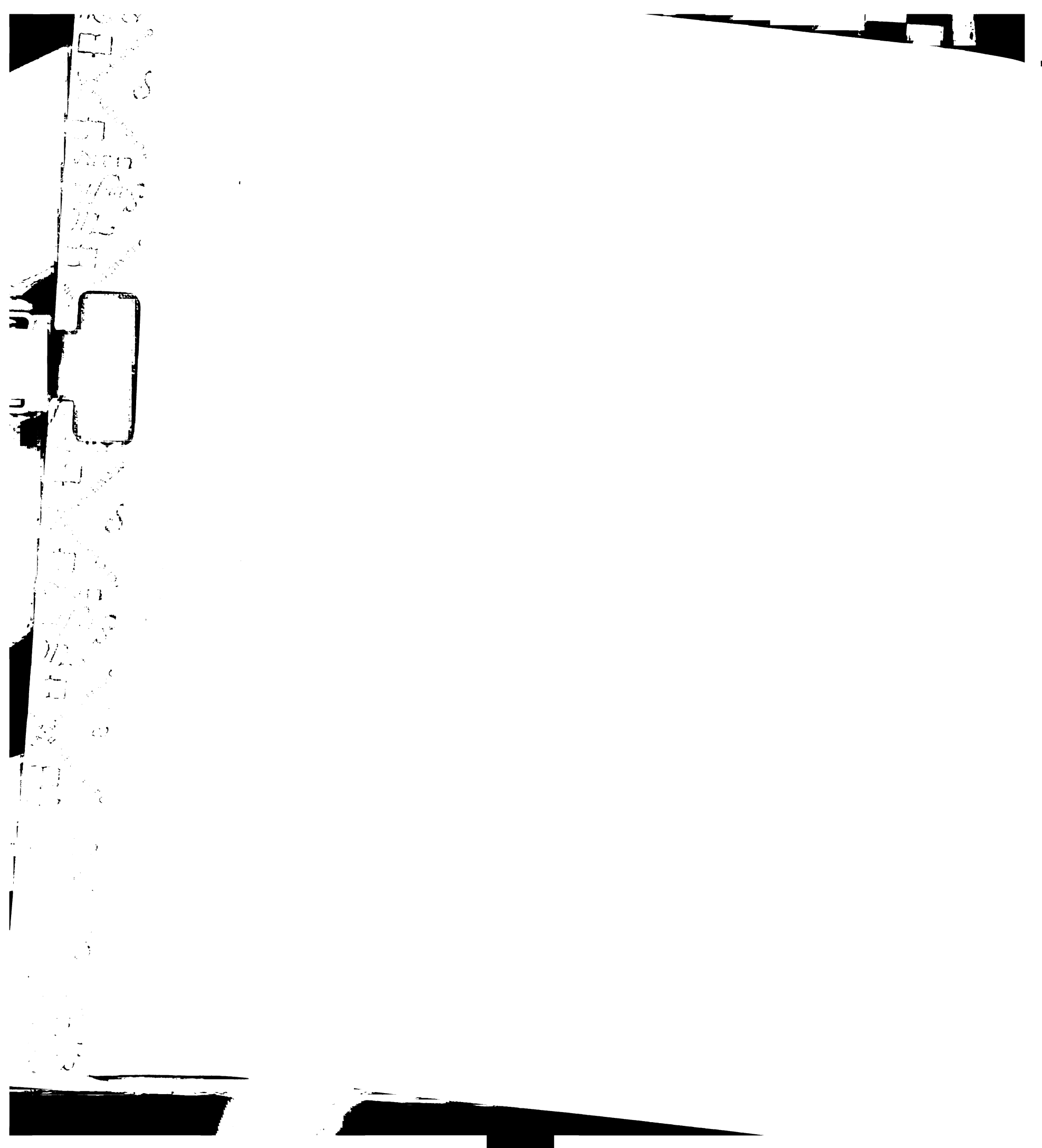
These guidelines are endorsed by the CCHRI participating health care plans and organizations listed below and made possible through the support of the following major sponsors:

<b>HEALTH PLANS:</b>	<b>ACTRA</b>	<b>HEALTH NET</b>	<b>ALTERNATIVE HEALTH PLANS</b>	<b>STATE ORGANIZATIONS:</b>	<b>CDM</b>	<b>HEALTH SPONSORS:</b>	<b>ADVENT PERFORMANCE</b>
Blue Cross of California	Blue Cross of California	Blue Cross of California	Blue Cross of California	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation
Blue Shield of California	Blue Shield of California	Blue Shield of California	Blue Shield of California	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation
CalPERS HealthCare of California	CalPERS HealthCare of California	CalPERS HealthCare of California	CalPERS HealthCare of California	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation	California HealthCare Foundation

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## Appendix B

### Measurement Issues

The measurement of HbA1c has been well established as the most important parameter in clinical chemistry for monitoring the long term metabolic control of diabetic patients. There is no internationally agreed reference method available and therefore the comparability of HbA1c values obtained by different methods and different laboratories is limited; however, they are highly correlated to adverse clinical outcomes (e.g. retinopathy) as are fasting plasma glucose or postprandial plasma glucose levels and are reproducible as fasting plasma glucose levels (McCance et al., 1994). To account for the differing methods of analysis and the reference ranges for glycated hemoglobin measurements that vary substantially from 3.9% to 6.9%, guidelines which define categories of HbA1c concentration within certain standard deviations from a particular method's non-diabetic population mean, have been set for diabetic patients ("Consensus guidelines for the management of insulin-dependent (type 1) diabetes. European IDDM Policy Group 1993," 1993). Its major advantage is that the specimen can be collected without consideration to when the patient last ate.

BP: The optimal technique to measure blood pressure in diagnosing and managing hypertension in an ambulatory care setting remains controversial. The appropriateness of BP in diagnosing and managing hypertension in an ambulatory care setting have compared measurement techniques, measurement at different settings, and measurement by physician and non-physicians. Most studies have examined associations between left ventricular hypertrophy and blood pressure has found strong correlation with ambulatory blood pressure than with office blood pressure (Appel & Stason, 1993). The use of automatic infrasonic recorder measurement of BP when compared to direct intra-arterial diastolic blood pressure could identify the majority of patients with pseudo-hypertension (sensitivity = 93%, specificity = 60 %, positive predictive value = 62%, and negative predictive value = 93%) (Hla & Feussner, 1988).

LDL: A high LDL cholesterol is specifically linked to cardiovascular disease than is total cholesterol. Low-density lipoprotein (LDL) is computed using a calculation of total cholesterol (TC), high-density lipoprotein (HDL), and (TG).  $LDL = TG - HDL - (TG/5)$ . LDL is weakly correlated with and predictive of calcified atherosclerotic plaque (prevalent coronary calcification) as measured by electron beam computed tomography; however high levels of LDL are associated with increased risk for the presence of calcified atheromas (Allison, Wright, & Tiefenbrun, 2003). The use of cholesterol indices as a screening technique for cardiac events is neither highly sensitive or specific (Grover, Coupal, & Hu, 1995)

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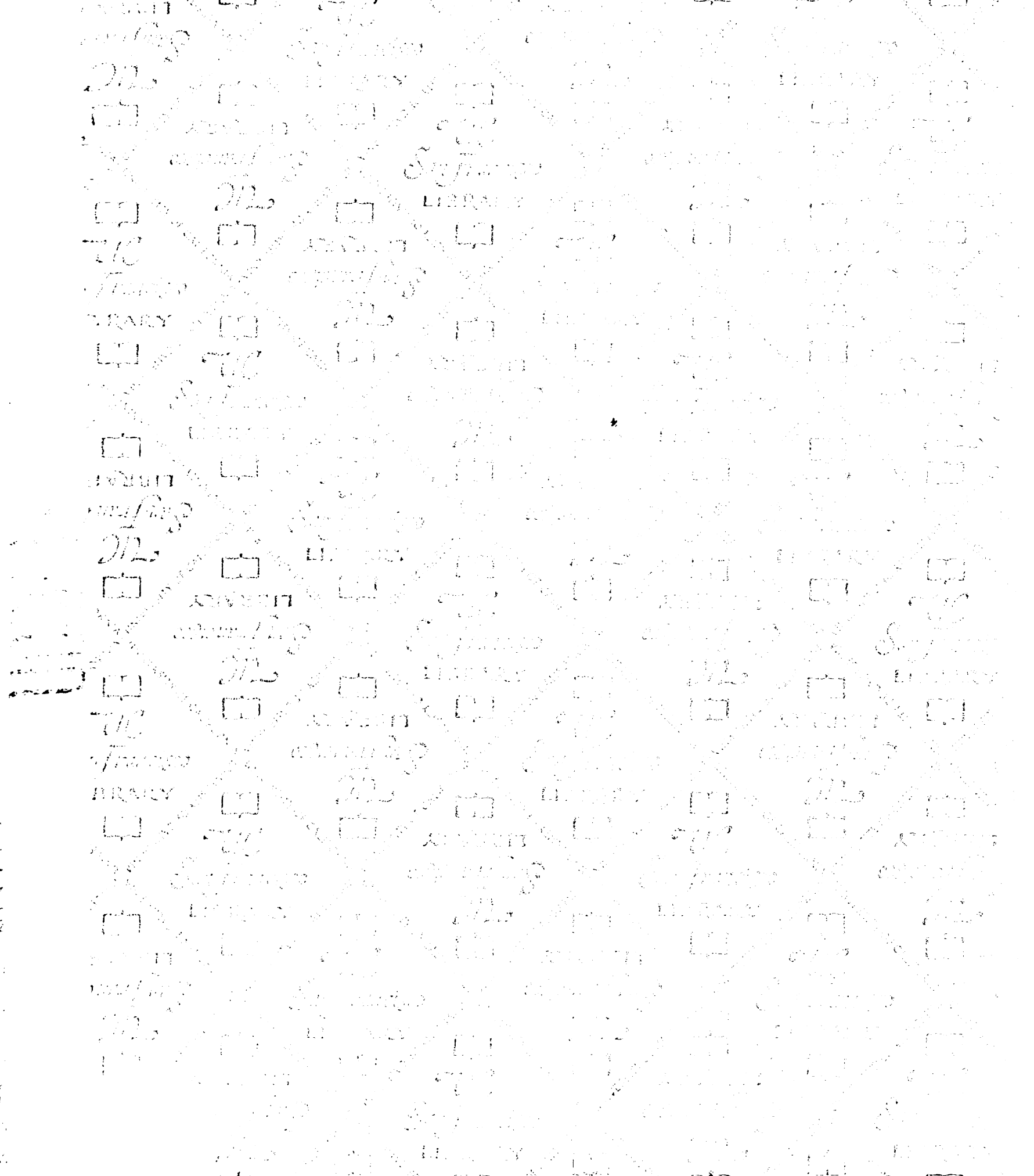
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**For** Not to be taken  
from the room.  
**reference**

8071113



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