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Carmen S. Ng Date

Impact of Limited English Proficiency on Self-Management of Diabetes among Individuals in California from 2009-2012

By

Carmen S. Ng

MSPH

Health Policy and Management

_____

Joseph Lipscomb

Committee Chair

_____

Laura M. Gaydos

Committee Member

_____

Kimberly J. Rask

Committee Member

_____

Kara Jacobson

Committee Member

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By

Carmen S. Ng

Bachelor of Science

Massachusetts Institute of Technology, 2012

Thesis Committee Chair: Joseph Lipscomb

An abstract of

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

in partial fulfillment of the requirements for the degree of

Master of Science in Public Health

in Health Policy and Health Services Research

2015

Abstract

Impact of Limited English Proficiency on Self-Management of Diabetes among Individuals in California from 2009-2012

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Type 2 diabetes is an epidemic that not only is growing in prevalence, but also has detrimental consequences including kidney disease and blindness. Although self-management is one way to assist in decreasing morbidity and mortality due to diabetes, there are many barriers along the pathway to successful self-management. This study examined the association between limited English proficiency (LEP), a common communication barrier, and self-management. We analyzed two cycles of data collected by the California Health Interview Survey (2009, 2011-2012). Using multivariate logistic regressions, we assessed the relationship of LEP with process indicators including usual source of care, receipt of care plan (either receipt of a physical copy or discussion of care plan), and self-efficacy; and we further assessed the relationship of these factors with three indicators of diabetes self-management: biannual foot examinations, annual eye examinations, and self-monitoring of blood glucose. LEP individuals were less likely to have a usual source of care (OR: 0.344, 95% CI: 0.150, 0.791) and less likely to discuss or have a written care plan (OR: 0.529, 95% CI: 0.324, 0.865; OR: 0.427, 95%CI: 0.241, 0.758). They were also 38% (OR: 0.624, 95% CI: 0.403, 0.967) less likely to comply with self-monitoring blood glucose guidelines. English proficiency was not a significant predictor for self-efficacy or for foot and eye examinations. Diabetics with LEP status were less likely to have a usual source of care, to have received a care plan to manage their disease, and to be adhering to guidelines about self-monitoring of blood glucose. The receipt of a care plan is a significant predictor of adherence to all self-management actions measured in this study. Our results are consistent with previous studies indicating the importance of the care plan. Efforts to discuss and distribute a care plan should be encouraged in all medical interactions for all diabetic individuals, and this may be especially important for those without a usual source of care. Our results also revealed pervasive effects of LEP on self-management behaviors. This study suggests prioritization of vulnerable and increasing LEP populations through increasing access to healthcare and reducing communication barriers through medical interpreters.

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Introduction

Over the past 20 years, the incidence of diabetes has tripled, with newly diagnosed cases of diabetes increasing from 493,000 per year in 1980 to 1.5 million in 2011 [1]. The epidemic of type 2 diabetes has detrimental chronic consequences including kidney diseases, adult-onset blindness, and lower limb amputations, as well as doubling the risk of chronic diseases including heart disease and stroke [2-4]. These, in turn, generate morbidity, excess mortality, and substantial economic costs [5]. An effective way to decrease morbidity as well as optimizing quality of life for diabetic individuals is through diabetes self-management. These activities include, but are not limited to, knowledge of medical condition, glucose monitoring, and lifestyle changes [6]. The American Diabetes Association recommends an assessment of diabetes knowledge and self-management skills at least once per year [5]. To assess and improve upon the patient's self-management skills and knowledge, there must be effective communication between the physician and patient, but significant barriers persist.

The 2011 American Community Survey reported that approximately 60 million individuals in the United States spoke a language other than English, and of those, 42% rated their English speaking ability less than 'very well' [7]. Although government and other state laws have mandated that translated materials be distributed for limited English proficient (LEP) individuals, these individuals continue to report lower quality of care and more trouble communicating with their doctor, all of which are critical in effective self-management of diabetes [8]. Because self-management activities are crucial to prevent severe downstream consequences, it is essential to understand the pathway

through which LEP affects management performance. Therefore, this study will investigate the impact of LEP on self-management through self-efficacy.

Literature Review

Diabetes in the United States

According to the American Diabetes Association (ADA), 'diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both' [9]. As of 2012, the Centers for Disease Control and Prevention (CDC) found that half of the United States adult population have one or more chronic health conditions [10], with diabetes being one of the most prevailing conditions. The recent rapid increase in those diagnosed with diabetes is due to changes in clinical thresholds as well as true increases in prevalence [11]. Studies have also predicted the prevalence of diabetes increasing from 171 million to 489 million by 2030 [12, 13]. Evidence has shown that diabetes is not only the leading cause of many acute events including kidney disease, lower limb amputations not related to accidents, and adult-onset blindness, but also a key risk factor, doubling the risk, for heart disease and stroke [2, 4]. Additionally through these events, diabetes was ranked the seventh leading cause of death [3, 10, 14]. Although diabetes has many downstream consequences that increase morbidity and mortality, much of these complications are preventable and can be reduced with the proper management. Given the prevalence and consequences of diabetes, it is important to place priority on self-management skills to maintain the quality of life for patients and reduce preventable complications. Though there are many

types of diabetes, our study focuses on type 2 diabetes, or adult onset diabetes, which accounts for approximately 90-95% of all diabetes cases [3].

Self-Management

Previous studies on diabetes have stressed the importance of proper self-management. Self-management of chronic disease is defined as strategies or actions that the patient takes to manage their chronic disease outside of hospitals or physician offices [15]. The management strategies entail dealing with symptoms, treatment, and physical and social lifestyle changes [16]. Evidence has shown that self-management has improved outcomes for those who have chronic illnesses, especially limiting hospital and emergency visits, compared to those who do not self-manage effectively [17, 18]. Patient self-management of diabetes, including activities such as disease knowledge, appropriate glucose monitoring and management, have been shown to improve glycemic control [19], reduce outpatient clinic utilization rate [20], and limit unnecessary emergency room admissions [21].

Important variables in promoting self-management in diabetic patients include self-efficacy and patient-physician communication. Self-efficacy is defined as the confidence in one's own ability to exercise control over their life [22]. Many studies have shown that higher self-efficacy lead to increased likelihood of engaging in self-care behaviors [17, 18, 21, 23, 24]. The success of self-management is also dependent upon the communication between health professionals and patients [17]. Effective communication between patient and physician allows the physician to gather information to diagnose accurately, counsel appropriately, and to establish a relationship with the patient, all of which are essential in self-management support [16, 25]. Tools facilitating

good patient-physician communication include having a usual source of care and the receipt of a self-management plan [14, 26, 27] . The National Standards for Diabetes Self-Management Education, endorsed by the American Diabetes Association, recommends a discussion of a management plan between the physician and patient. The relationship between self-management and the plan is important, as self-management behaviors are positively associated with the presence of a plan detailing activities to manage the patient's chronic disease [18, 20, 24, 28, 29].

Barriers to Self-Management

Because of the complexity of diabetes regimens and the importance of effective communication with the physician, many barriers may exist in managing the disease. Two most commonly studied barriers to communication include health literacy and English proficiency. Health literacy is defined as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" [30]. Two meta-analyses of the literature regarding health literacy and diabetes found that patients with limited health literacy are less likely to perform self-care behaviors, and have poorer clinical outcomes when compared to their counterparts with adequate health literacy [31, 32]. However, previous literature has mixed reviews on the impact of health literacy on glycemic control [33].

Limited English proficient (LEP) populations are defined as those who speak English less than 'very well,' and approximately half of the immigrant population in the United States are LEP [34]. With this in mind, it should also be noted that the immigrant population in the United States is increasing and has quadrupled from 1970 to 2007,

increasing from 9.6 million to 38.1 million [35]. Half of the LEP population reside in California, Texas, and New York; in fact, nearly 20% of California population is LEP [36].

Studies have shown that LEP status has detrimental effects on navigating the health system as well as understanding health information and treatment, thus affecting health behaviors and health outcomes [37]. LEP patients have decreased access to care, decreased quality of care, decreased patient-provider connection, and greater dissatisfaction with their providers [8, 38-40]. Language differences between physician and patient has not only led to ineffective communication, but also lower quality of care [41]. For example, one study showed that LEP patients are less likely to receive management plans from their doctor than their non-LEP counterparts [42]. Effective communication is crucial for chronic disease patients, and can lead to a lower reported health status and increased mental distress in LEP patients when compared with non-LEP patients [43, 44]. Studies have also shown that language barriers have caused miscommunications with providers that may lead to long-term complications and increased emergency room visits [45]. Poor health outcomes and mental health status in turn, can decrease self-management levels [29, 46].

While both health literacy and English proficiency play key roles in determining self-management and outcomes in diabetic patients, much of the recent literature has studied only the mechanisms linking self-care and health literacy [31-33, 47]. Some studies examining health literacy have excluded those who are LEP from their analytic sample when the majority of LEP individuals have low health literacy [33, 47, 48]. Another study found that those with LEP status are more vulnerable than those who have

only low health literacy, which laid a foundation for this study [48]. The analyses conducted in this study add to the literature regarding English proficiency and diabetes self-management through self-efficacy. Similar analyses have been conducted in chronic disease, but none have focused on diabetes. One particularly striking analysis by Ejebe et. al found persistent differences in asthma self-efficacy stratified by race, ethnicity, and income; non-Latino whites were more likely to have higher levels of self-efficacy after adjusting for covariates, and the relationship was mediated by English proficiency [28]. Ejebe et al., however, did not measure the impact of self-efficacy and other covariates on self-management activities. The study presented here will not only investigates the relationship in another chronic disease, but also extend the scope of the inquiry. This study presents a means of measuring the impact of LEP and other proximal factors on patients' self-management of diabetes.

Methodology

Study Objective and Research Questions

This study will explore the effect of LEP on usual source of care, receipt of care plan, self-efficacy, and indicators of self-management of type 2 diabetes. The study will answer the following questions:

(1) What is the impact of English proficiency on usual source of care?

H_1: After controlling for covariates, individuals with limited English proficiency are less likely to have a usual source of care.

(2) What is the impact of English proficiency on care plan?

H_2: After controlling for covariates, individuals with limited English proficiency are less likely to receive a care plan

(3) What is the impact of English proficiency on self-efficacy?

H_3: After controlling for covariates, individuals with limited English proficiency are more likely to have lower self-efficacy.

(4) What is the impact of English proficiency on self-management?

H_4: After controlling for covariates, individuals with limited English proficiency are less likely to engage in self-management behaviors.

Data Source

We used data from the 2009 and 2011-2012 cycles of the California Health Interview Survey (CHIS), a population based study. Conducted by the UCLA Center for Health Policy Research, CHIS is the nation's largest state health survey. Data were collected using a random-dial telephone survey for each two-year cycle. The CHIS collects information on a variety of health topics using extensive questionnaires to assess needs and to budget accordingly. The complex survey design allows for oversampling a variety of minorities, including LEP populations. Approximately 50,000 non-institutionalized households are surveyed each cycle. Separate interviews are conducted for adults (18 years and above), adolescents (ages 12-17), and children (11 and below).

This cross-sectional study used the publicly available files and the corresponding sample weights to enable construction of representative samples of the California population. Weights are based on the State of California's Department of Finance

population estimates and projections. The weighted data are representative of California's residential population during their respective years. The analytic sample included all individuals reporting a diagnosis of type 2 diabetes aged 18 and older at the time of the interview with complete information on study variables, which resulted in 9,519 individuals. This study excluded those who were pregnant, those who had gestational diabetes only, as well as those with a self-reported diagnosis of borderline or pre-diabetes, due to uncertain behaviors of those with this status. After applying exclusion criteria, the final sample in this study was 4,688 individuals.

Theoretical Framework

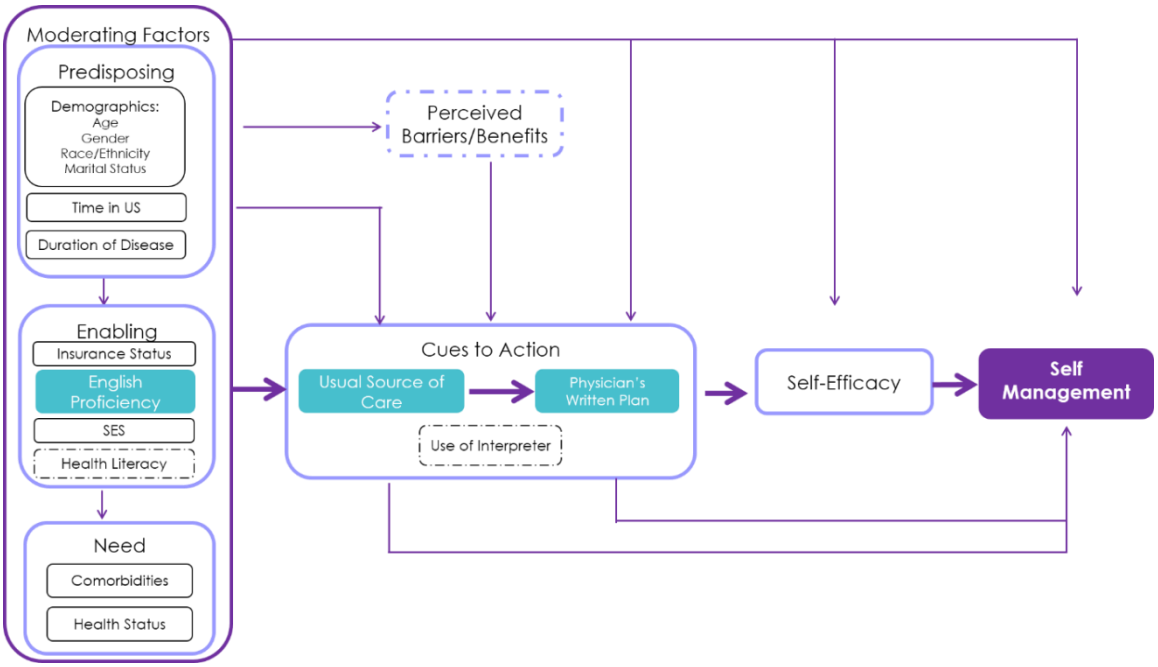
This study used a theoretical framework that combines the Andersen and Aday Behavioral Model of Health Care Utilization and the Health Belief Model to examine the relationship between LEP status and self-management of diabetes through self-efficacy.[49-51] The Andersen and Aday model categorized health-influencing characteristics as contextual- and individual-level, and further categorizing them as predisposing, enabling, and need characteristics, though contextual level characteristics were unable to be captured for this study. The Health Belief Model incorporated individual perceptions, moderating factors, and cues to action to determine one's self-efficacy. Self-efficacy is the belief in one's own ability to carry out all the actions required to complete a task [52]. The adapted contextual framework used in this study incorporated the moderating factors from the Health Belief Model into the Andersen and Aday's categories of predisposing, enabling, and need factors of the individual patient.

Figure 1 illustrates the theoretical framework that is used for the primary research questions. Modifying factors are classified into predisposing, enabling, and need factors

on the left. Individual perceptions are not easily measured, as these include intrinsic beliefs about the task. These include, but are not limited to, perceived seriousness, susceptibility, benefits, and barriers. Unmeasured constructs are denoted with dashed boxes. Cues to action are reminders that motivate one to change behavior. These can include talking with a specialist, a poster on the wall, or mass media campaigns. In this study, the most salient hypothesized cues to action are usual source of care, receipt of a written plan from the physician, and use of an interpreter in the clinical setting. We were unable to capture interpreter presence in our study. These cues influence self-efficacy, which in turn, is hypothesized to affect behavior change, including self-management and health care utilization.

The exposure of interest is a modifying factor, categorized as an individual-enabling characteristic, English proficiency. The intermediate outcomes of interest are usual source of care, receipt of care plan, and self-efficacy. The endpoint measures are indicators of self-management: self-monitoring blood glucose, annual eye examinations, and semiannual foot examinations. The thickened purple arrows mark the pathway of the relationship of interest.

Figure 1. Conceptual Framework



Measurement

Key Variables

Limited English Proficiency (LEP) -- An individual with LEP is defined as someone who does not speak English as their primary language and may have a limited written or spoken proficiency [53]. LEP was assessed using a question from CHIS for our study. Individuals who spoke a language other than English were asked, "How well do you speak English?" We classified LEP as those who reported anything less than 'very well,' consistent with the definition adopted by the U.S. Census Bureau [54]. Those who speak English 'very well' or English only were classified as English proficient.

Cues to Action

Usual Source of Care (USOC) -- The continuity of care has often been associated with better glucose control, other self-management skills, and a place where patients may receive cues to action [55]. We captured usual source of care with a dichotomous variable. Respondents were asked 'Is there a place that you usually go to when you are sick or need advice about your health' and 'Is your doctor in a private doctor's office, a clinic or hospital clinic, an emergency room, or some other place?' Those who responded 'no,' or 'don't know' to the first question were categorized as not having a usual source of care. Those who responded 'emergency room' to the latter question were also categorized as not having a usual source of care.

Physician's Written Plan – Cues to action also include the written plan from the provider, which the individual could then apply recommended strategies to manage their condition. In this study, the presence of a physician's written plan was captured by a 3-level categorical variable, indicating those who did not discuss a plan, those who discussed but did not receive a plan, and those who received a physical copy of their plan.

Self-Efficacy

The perception of control is important in completing an activity such as self-management. For this study, self-efficacy is captured as a dichotomous variable; the individual ranked their confidence in managing their diabetes. Respondents were asked 'How confident are you in managing your diabetes?' Individuals rated their confidence level in four categories: very confident, somewhat confident, not too confident, or not confident at all. Those who responded with 'very confident' and 'somewhat confident'

were categorized as higher self-efficacy, while those who responded with ‘not too confident’ and ‘not confident at all’ were categorized as lower self-efficacy.

Self-Management Indicators

After consulting literature and professionals in the field, we created a binary indicator for the achievement of the recommended rate for each self-management activity.

Self-monitoring blood glucose (SMBG) is a binary variable indicating the individual’s adherence with glucose monitoring according to their medication status. Individuals who reported taking insulin and/or diabetic pills had an adherence rate of twice per day. Those who reported taking diabetic pills had an adherence rate of once per week. Those who reported no medication had an adherence rate of once per month.

Foot examination is a binary variable indicating the compliance of semiannual foot examinations.

Eye examination is a binary variable indicating the compliance of an annual eye examination.

Moderating Factors

Predisposing characteristics

Confounding predisposing characteristics included age, gender, race/ethnicity, marital status, and duration of disease. Age is measured with a continuous variable ranging from 18 to 85 at the time of interview. Gender is a dichotomous variable. Race/ethnicity is a categorical variable. Individuals were categorized into non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic Asian, Alaskan Native/American Indian, or Other. “Other” included those who self-identify as mixed race. Marital status

is a categorical variable; individuals were married/living with partner, unmarried/single, or divorced/widowed/separated. Duration of disease is a dichotomous variable indicating whether the individual was diagnosed with diabetes for more than two years. Time in the United States is a categorical variable indicating whether the individual was born in the United States, has lived in the US for 0-14 years since immigrating, or 15 years or more since immigrating.

Enabling Characteristics

This study used self-reported income and educational attainment as measures of financial and capital access to resources. Socioeconomic status (SES) was assessed by federal poverty level (FPL) and a categorical measure of education (less than high school, high school diploma, some college, and college graduate or more.) Health insurance status is a categorical variable. Individuals were categorized as Medicaid, Medicare, private insurance only, or uninsured. Those who reported having Medicare with supplemental insurance were categorized as having private insurance due to the nature of the Medi-Gap insurance, while those who were dual enrollees in Medicaid and Medicare were categorized as Medicaid.

Need Characteristics

Health status is a multi-dimensional concept measuring many components including physical illness, mental well-being, and social functioning.[56] This study used self-reported health status, mental health status, presence of other chronic diseases, and body mass index (BMI) to measure this construct. Severity refers to the extent of compromise or physiologic decompensation from the illness.[57] Due to difficulty in capturing severity, this study used self-reported health-status as a proxy for severity. Self-

reported health status is assessed as a rank ordered variable. Individuals reported their health status as excellent, very good, fair, or poor. Body mass index (BMI) was a categorical variable. Mental health status was captured with the K-6 module, a validated instrument, and those with a score of higher than 13 were categorized as having serious psychological distress [58]. This study also controlled for presence of other comorbidities (either heart disease or asthma) as a binary variable. Table 1 presents the measurements and their respective categorizations.

Table 1. Measurements

Constructs	**Measures**
English Proficiency (EP)	Dichotomous • English Proficient (reference group) • Limited English Proficient (LEP)
Usual Source of Care (USOC)	Dichotomous • No • Yes
Physician's Written Plan	Categorical • Did not discuss plan (reference group) • Discussed plan, no written plan • Discussed plan, received written plan
Self-Efficacy	Dichotomous • Lower Self-Efficacy (reference group) • Higher Self-Efficacy

Self-Management	• Self-Monitoring Blood Glucose (SMBG)
	  ○ No (reference group)
	  ○ Yes
	• Foot Examination
	  ○ No (reference group)
	  ○ Yes
	• Eye Examination
	  ○ No (reference group)
	  ○ Yes

Age	Categorical • 18-34 (reference group) • 35-44 • 45-54 • 55-64 • 65+
Gender	Dichotomous

	• Male (reference group) • Female
Race/Ethnicity	Categorical • White[1] (reference group) • African American[1] • Latino • Asian/Pacific Islander[1] • Alaskan Native/American Indian[1] • Other
Marital Status	Categorical • Married/Living with Partner (reference group) • Single/Never Married • Divorced/Separated/Widowed

Socioeconomic Status (SES)	• Federal Poverty Level (FPL)
	  ○ 0-99% (reference group)
	  ○ 100-199%
	  ○ 200-299%
	  ○ ≥300%
	• Education (Categorical)
	  ○ Less than high school (reference group)
	  ○ High school graduate
	  ○ Some college
	  ○ College graduate

Duration of Disease	Dichotomous • Less than two years (reference group) • Greater than two years

Health Status	• BMI Class (Categorical)
	  ○ Not Overweight (reference group)
	  ○ Overweight
	  ○ Class I Obesity
	  ○ Class II Obesity and higher
	• Self-Reported Health Status (Categorical)
	  ○ Good (reference group)
	  ○ Fair
	  ○ Poor
	• Mental Health Status using the K-6 module (Dichotomous)
	  ○ No Serious Distress (reference group)
	  ○ Serious Psychological Distress
	• Comorbidities (Dichotomous)
	  ○ No (reference group)
	  ○ Yes

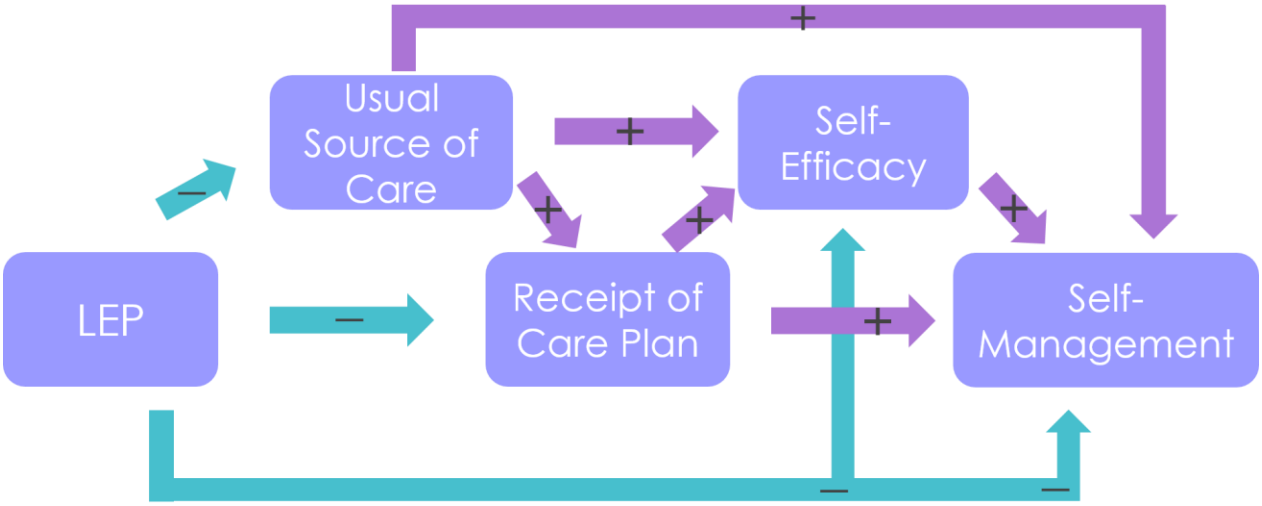
Time in US	Categorical • Born in US (reference group) • 0-14 years • 15+ years
Health Insurance Status	Categorical • Private/Medi-Gap (reference group) • Medi-Cal/Other Public • Medi-Care • Uninsured

[1] Status includes those who were not Hispanic/Latino

Focal Relationships

Figure 2 presents a closer examination of our relationship between LEP and self-management of diabetes involving other factors including usual source of care, receipt of care plan, and self-efficacy. Although our hypotheses focus on the direct effects of LEP, we expect LEP to affect self-management through other pathways involving these intermediate factors. The blue arrows represent direct effects from LEP to intermediate and endpoint measurements. Purple arrows signify alternate pathways in which LEP can affect self-management. We predict that the direct negative associations between LEP and the intermediate and endpoint factors will be enhanced by the positive associations among these factors.

Figure 2. Focal Relationship Graphic



Statistical Analysis

To address the primary research questions, we implemented descriptive analyses and four logistic regression models to assess the relationships between key independent and dependent variables.

Analytic Strategy

$$log\left[\frac{P(USOC = Yes)}{P(USOC = No)}\right] = \beta_0 + \beta_1(Age) + \beta_2(Gender) + \beta_3(Race/Ethnicity) + \beta_4(Marital\ Status) + \beta_5(SES) + \beta_6(Duration) + \beta_7(Health\ Status) + \beta_8(EP) + \beta_9(Time\ in\ US) + \beta_{10}(Insurance\ Status) + \varepsilon \quad \textbf{1}$$

$$\begin{cases} log\left[\frac{P(Care\ Plan = Discussed, did\ not\ receive)}{P(Care\ Plan = Did\ not\ discuss)}\right] \\ log\left[\frac{P(Care\ Plan = Discussed\ and\ received\ )}{P(Care\ Plan = Did\ not\ discuss)}\right] \end{cases} = \beta_0 + \beta_1(Age) + \beta_2(Gender) + \beta_3(Race/Ethnicity) + \beta_4(Marital\ Status) + \beta_5(SES) + \beta_6(Duration) + \beta_7(Health\ Status) + \beta_8(English\ Proficiency) + \beta_9(Time\ in\ US) + \beta_{10}(Insurance\ Status) + \beta_{11}(USOC) + \varepsilon \quad \textbf{2}$$

$$log\left[\frac{P(Self-Efficacy=Higher)}{P(Self-Efficacy=Lower)}\right] = \beta_0+\beta_1(Age)+\beta_2(Gender)+\beta_3(Race/Ethnicity)+\beta_4(Marital\ Status)+\beta_5(SES)+\beta_6(Duration)+\beta_7(Health\ Status)+\beta_8(English\ Proficiency)+\beta_9(Time\ in\ US)+\beta_{10}(Insurance\ Status)+\beta_{11}(USOC)+\beta_{12}(Care\ Plan)+\varepsilon \quad \textbf{3}$$

$$log\left[\frac{P(Self-Management=Yes)}{P(Self-Management=No)}\right] = \beta_0+\beta_1(Age)+\beta_2(Gender)+\beta_3(Race/Ethnicity)+\beta_4(Marital\ Status)+\beta_5(SES)+\beta_6(Duration)+\beta_7(Health\ Status)+\beta_8(English\ Proficiency)+\beta_9(Time\ in\ US)+\beta_{10}(Insurance\ Status)+\beta_{11}(USOC)+\beta_{12}(Care\ Plan)+\beta_{13}(Self-Efficacy)+\varepsilon \quad \textbf{4}$$

Where β_j is the impact of predictor variable j on the log-odds of the dependent variable
Blue indicates a predicted positive effect on dependent variable with respect to the reference group
Red indicates a predicted negative effect on dependent variable with respect to the reference group
Green indicates a predicted unknown effect on dependent variable with respect to the reference group

The first model is a binary logistic regression to estimate the relationship between English proficiency and USOC after controlling for all covariates. The second model is a polytomous logistic regression that estimated the relationship between English proficiency and receipt of care plan controlling for all covariates in the first model as well as usual source of care. The third model is a logistic regression that estimated the relationship between English proficiency and self-efficacy controlling for all covariates in the second model as well as receipt of care plan. The fourth model is the complete model that takes into account the full set of predictor variables used to estimate each of the self-management indicators. The fourth model estimated the independent relationship of English proficiency and self-monitoring blood glucose, foot examinations, and eye examinations, respectively, taking into account the full set of available predictor

variables. Data cleaning, formatting, manipulation, and analyses were performed in Stata 13.0. All analyses use CHIS sampling weights to adjust for nonresponse and the complex survey design.

Sensitivity Analyses

To test the robustness of findings to alternative operational definitions of LEP and self-efficacy, all models were re-estimated with these two variables re-constructed using different cut-points. Specifically, LEP individuals were those who reported speaking English 'not well' or 'not at all.' Those who had higher self-efficacy were re-categorized with a stricter definition, including only those who reported 'very confident.'

Results

Descriptive Statistics

The weighted distribution of characteristics of individuals with diabetes, stratified by English proficiency, is shown in Table 2. While the distribution of gender, year of survey, and foot examinations were similar between the two groups, the groups were statistically different for all other characteristics. The mean age for English proficient and LEP groups were 61 and 58, respectively. LEP individuals were more likely to report lower education, lower income, poorer health status, overweight, being born outside of the United States, less likely to have a usual source of care, receipt of care plan, and lower compliance with self-monitoring of blood glucose.

Table 2. Weighted Descriptive Statistics of Individuals with Diabetes in California Health Interview Survey, 2009 & 2011-2012

	English Proficient N=3491	**Limited English Proficient N=1197**	**Total N=4688**	**P-Value**
Weighted N	1,429,352	863,933	2,293,285	
Age (mean)	61.4	58.3	60.2	0.003**
Year				0.475
2009	53.1%	50.4%	52.1%	
2011	46.9%	49.6%	47.9%	
Race/Ethnicity				<0.001***
White[1]	52.6%	1.7%	33.4%	
Hispanic	19.8%	82.8%	43.5%	
African-American[1]	12.9%	0.4%	8.2%	
Asian/PI[1]	9.3%	14.9%	11.4%	
NA/AI[1]	2.4%	0.1%	1.5%	
Other	3.0%	0.1%	1.9%	
Gender				0.277
Male	52.9%	56.8%	54.3%	
Female	47.1%	43.2%	45.7%	
Education				<0.001***
Less than high school	13.5%	66.3%	33.4%	
High school graduate	30.9%	15.3%	25.0%	
Some college	28.4%	10.4%	21.6%	
College graduate	27.2%	8.1%	20.0%	
Marital Status				<0.001***
Married/Living with partner	56.3%	72.8%	62.5%	
Widowed/Separated/Divorced	28.5%	21.0%	25.7%	
Never married	15.2%	6.2%	11.8%	
Time in US				<0.001***
Not Born in US	12.5%	90.7%	42.0%	
Born In US	87.5%	9.3%	58.0%	
Self-Reported Health Status				<0.001***
Poor	14.2%	18.9%	16.0%	
Fair	25.8%	54.2%	36.5%	
Good	60.1%	26.9%	47.6%	
BMI Class				0.009**
Not Overweight	16.3%	19.3%	17.4%	

Overweight	35.7%	37.9%	36.6%	
Class I Obesity	23.9%	27.7%	25.3%	
Class II Obesity+	24.1%	15.1%	20.7%	
Duration of Disease				0.210
Less than 2 years	13.8%	16.7%	14.9%	
More than 2 years	86.2%	83.3%	85.1%	
Insurance Status				<0.001***
Private	66.9%	39.9%	56.7%	
Medi-Cal/Other	19.1%	38.7%	26.5%	
Medicare	4.7%	1.9%	3.6%	
Uninsured	9.3%	19.5%	13.1%	
Usual Source of Care				<0.001***
No	4.1%	16.4%	8.8%	
Yes	95.9%	83.6%	91.2%	
Comorbidities				<0.001***
No	63.5%	80.2%	69.8%	
Yes	36.5%	19.8%	30.2%	
Self-Efficacy				0.016*
Low	38.0%	46.8%	41.3%	
High	62.0%	53.2%	58.7%	
SMBG				<0.001***
No	23.2%	35.2%	27.7%	
Yes	76.8%	64.8%	72.3%	
Eye Exam				0.099
No	23.5%	28.2%	25.3%	
Yes	76.5%	71.8%	74.7%	
Foot Exam				0.497
No	45.1%	47.7%	46.1%	
Yes	54.9%	52.3%	53.9%	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] Status only includes those who are non-Hispanic

In the tables that follow examining our four main hypothesis, predictor variable effects are reported as odds ratios with associated 95% confidence intervals.

Research Question 1: *Does English proficiency predict usual source of care for individuals with diabetes?*

Consistent with our hypothesis, our results showed that English proficiency was a significant determinant in usual source of care after controlling for individual characteristics. Those who were LEP were 66% less likely to have a usual source of care (OR: 0.344, 95% CI: 0.150, 0.791). We also see that those who were uninsured were less likely to have a usual source of care (OR: 0.229, 95% CI: 0.110, 0.473), while duration of more than two years of disease (OR: 2.669, 95% CI: 1.490, 4.779) and categorization of class II obesity or higher were positively associated with usual source of care (OR: 2.063, 95% CI: 1.055, 4.032).

Table 3. Binary Logistic Regression Analysis of Individual Characteristics on Usual Source of Care in Individuals with Diabetes

	Usual Source of Care (Odds Ratio)	**95% Confidence Interval**
Age		
18-34	Ref.	Ref.
35-44	1.583	(0.523, 4.786)
45-54	2.055	(0.743, 5.682)
55-64	1.350	(0.521, 3.501)
65+	2.173	(0.886, 5.325)
Gender		
Male	Ref.	Ref.
Female	1.110	(0.695, 1.772)
Race/Ethnicity		
White[1]	Ref.	Ref.
Hispanic	1.586	(0.675, 3.726)
African-American[1]	0.892	(0.403, 1.971)
Asian/PI[1]	2.570	(0.500, 13.205)
NA/AI[1]	0.617	(0.018, 21.379)
Other	2.247	(0.227, 22.255)

Education		
Less than high school	Ref.	Ref.
High school graduate	2.306**	(1.229, 4.327)
Some college	2.778**	(1.496, 5.157)
College graduate	1.440	(0.556, 3.733)
Marital Status		
Married/Living with partner	Ref.	Ref.
Widowed/Separated/Divorced	1.079	(0.651, 1.789)
Never married	0.943	(0.446, 1.994)
Federal Poverty Level		
0-99%	Ref.	Ref.
100-199%	0.988	(0.557, 1.754)
200-299%	0.930	(0.426, 2.033)
300%	1.645	(0.742, 3.648)
Duration of Disease		
< 2 years	Ref.	Ref.
2+ years	2.669**	(1.490, 4.779)
Year of Survey		
2009	Ref.	Ref.
2011	0.899	(0.579, 1.398)
Self-Reported Health Status		
Good	Ref.	Ref.
Fair	1.041	(0.561, 1.932)
Poor	0.812	(0.392, 1.681)
Mental Health Status		
No serious distress	Ref.	Ref.
Serious Psychological Distress	0.798	(0.403, 1.579)
Comorbidities		
None	Ref.	Ref.
Yes	1.485	(0.801, 2.753)
BMI Class		
Not Overweight	Ref.	Ref.
Overweight	1.679	(0.881, 3.199)
Class I Obesity	1.494	(0.726, 3.074)
Class II Obesity+	2.063*	(1.055, 4.032)

English Proficiency		
English Proficient	Ref.	Ref.
Limited English Proficient	0.344*	(0.150, 0.791)
Time in US		
Born in US	Ref.	Ref.
0-14	1.053	(0.552, 2.010)
15+ years	1.257	(0.493, 3.204)
Insurance Status		
Private	Ref.	Ref.
Medi-Cal/Other	0.546	(0.298, 1.001)
Medicare	0.508	(0.195, 1.328)
Uninsured	0.229***	(0.110, 0.475)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] Status includes those who are non-Hispanic

Research Question 2: *Does English proficiency predict receipt of care plan for individuals with diabetes?*

The results of our polytomous logistic regression offer strong support for our hypothesis. Limited English proficiency was a significant determinant in the receipt of a care plan. Compared to those who were English proficient, LEP individuals were about two times more likely to not discuss a care plan than discussing or receiving a copy of their care plan, (OR: 0.529, 95% CI: 0.324, 0.865; OR: 0.427, 95% CI: 0.241, 0.758, respectively). Usual source of care was also a significant factor, those who had a usual source of care were 2.5 times more likely to discuss a care plan than not discussing a plan (OR: 2.511, 95% CI: 1.513, 4.167). Those who had a usual source of care were also 7 times more likely to have a copy of their care plan compared to those who did not have a copy (OR: 7.421, 95% CI: 3.830, 14.378). Longer duration of disease was positively

associated with discussion and receipt of care plan (OR: 2.818, 95% CI: 1.847, 4.300; OR: 1.063, 95% CI: 1.063, 2.376, respectively).

Table 4. Polytomous Logistic Regression Analysis of Individual Characteristics on Receipt of Written Plan in Individuals with Diabetes[2]

	Discussed, No Written Plan (OR)	**95% Confidence Interval**	**Received Plan (OR)**	**95% Confidence Interval**
Age				
18-34	Ref.	Ref.	Ref.	Ref.
35-44	1.843	(0.415, 8.183)	0.705	(0.131, 3.798)
45-54	1.323	(0.322, 5.441)	0.467	(0.090, 2.423)
55-64	1.042	(0.265, 4.104)	0.401	(0.083, 1.948)
65+	0.876	(0.214, 3.575)	0.254	(0.051, 1.274)
Gender				
Male	Ref.	Ref.	Ref.	Ref.
Female	1.021	(0.749, 1.391)	0.957	(0.674, 1.359)
Race/Ethnicity				
White[1]	Ref.	Ref.	Ref.	Ref.
Hispanic	0.871	(0.502, 1.511)	1.385	(0.753, 2.546)
African-American[1]	1.661	(0.930, 2.968)	1.362	(0.756, 2.453)
Asian/PI[1]	0.834	(0.403, 1.727)	1.483	(0.723, 3.042)
NA/AI[1]	0.377	(0.093, 1.522)	1.464	(0.207, 10.349)
Other	1.083	(0.290, 4.044)	1.362	(0.210, 8.816)
Education				
Less than high school	Ref.	Ref.	Ref.	Ref.
High school graduate	1.460	(0.953, 2.236)	1.357	(0.858, 2.146)
Some college	1.400	(0.889, 2.205)	1.594	(0.929, 2.736)
College graduate	1.777*	(1.105, 2.859)	1.560	(0.894, 2.724)
Marital Status				
Married/Living with partner	Ref.	Ref.	Ref.	Ref.
Widowed/Separated /Divorced	0.986	(0.702, 1.384)	1.359	(0.908, 2.033)
Never married	1.251	(0.620, 2.526)	1.194	(0.589, 2.421)
Federal Poverty				

Level				
0-99%	Ref.	Ref.	Ref.	Ref.
100-199%	0.603*	(0.390, 0.932)	1.123	(0.707, 1.783)
200-299%	0.733	(0.434, 1.238)	1.581	(0.958, 2.610)
300%	0.878	(0.502, 1.536)	1.606	(0.888, 2.905)
Duration of Disease				
< 2 years	Ref.	Ref.	Ref.	Ref.
2+ years	2.818***	(1.847, 4.300)	1.589*	(1.063, 2.376)
Year of Survey				
2009	Ref.	Ref.	Ref.	Ref.
2011	1.055	(0.789, 1.411)	0.805	(0.573, 1.129)
Self-Reported Health Status				
Good	Ref.	Ref.	Ref.	Ref.
Fair	1.534*	(1.091, 2.157)	1.093	(0.776, 1.540)
Poor	1.319	(0.872, 1.994)	1.283	(0.818, 2.012)
Mental Health Status				
No serious distress	Ref.	Ref.	Ref.	Ref.
Serious Psychological Distress	0.730	(0.444, 1.200)	0.451	(0.818, 2.012)
Comorbidities				
None	Ref.	Ref.	Ref.	Ref.
Yes	1.438	(0.981, 2.109)	1.684**	(1.157, 2.451)
BMI Class				
Not Overweight	Ref.	Ref.	Ref.	Ref.
Overweight	1.143	(0.746, 1.751)	1.497	(0.991, 2.261)
Class I Obesity	1.225	(0.773, 1.941)	1.245	(0.787, 1.971)
Class II Obesity+	0.909	(0.544, 1.518)	1.360	(0.803, 2.302)
English Proficiency				
English Proficient	Ref.	Ref.	Ref.	Ref.
Limited English Proficient	0.529*	(0.324, 0.865)	0.427**	(0.241, 0.758)
Time in US				
Born in US	Ref.	Ref.	Ref.	Ref.

0-14	0.887	(0.553, 1.422)	0.646	(0.379, 1.101)
15+ years	0.370*	(0.147, 0.931)	0.302*	(0.112, 0.812)
Insurance Status				
Private	Ref.	Ref.	Ref.	Ref.
Medi-Cal/Other	0.548**	(0.373, 0.804)	0.843	(0.555, 1.282)
Medicare	1.295	(0.721, 2.324)	1.062	(0.569, 1.983)
Uninsured	0.594	(0.343, 1.030)	1.226	(0.643, 2.337)
Usual Source of Care				
None	Ref.	Ref.	Ref.	Ref.
Yes	2.511***	(1.513, 4.167)	7.421***	(3.830, 14.378)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] Status only includes those who are non-Hispanic

[2] Shows the relative risks of each group compared to those who did not discuss a plan as reference

Research Question 3: *Does English proficiency predict self-efficacy in diabetic individuals?*

Counter to our hypothesis, multivariate analysis showed that LEP was not a significant determinant of self-efficacy (OR: 0.893, 95% CI: 0.558, 1.428) after accounting for the influence of usual source of care and having a care plan, both of which are strongly influenced by LEP (Table 5). However, other covariates were shown to be significant indicators, including self-reported health status, usual source of care, and receipt of care plan. Those who reported a poor and fair health status were 70% (OR: 0.296, 95% CI: 0.402, 0.704) and 46% (OR: 0.532, 95% CI: 0.203, 0.432) less likely to be confident in their self-management, respectively. Those who had a usual source of care were about 2 times more likely to have more confidence in managing their diabetes compared to their counterparts (OR: 1.925, 95% CI: 1.186, 3.123). Those who discussed and/or received a copy of their care plan were about two times more likely to have higher

self-efficacy than those who did not (OR: 1.678, 95% CI: 1.243, 2.265; OR: 1.846, 95% CI: 1.300, 2.623, respectively).

Table 5. Binary Logistic Regression Analysis of Individual Characteristics on Self-Efficacy in Individuals with Diabetes

	Self-Efficacy (Odds Ratio)	**95% Confidence Interval**
Age		
18-34	Ref.	Ref.
35-44	1.293	(0.485, 3.448)
45-54	0.490	(0.202, 1.191)
55-64	0.652	(0.281, 1.516)
65+	1.024	(0.427, 2.453)
Gender		
Male	Ref.	Ref.
Female	0.684**	(0.540, 0.867)
Race/Ethnicity		
White[1]	Ref.	Ref.
Hispanic	1.047	(0.689, 1.592)
African-American[1]	0.628	(0.301, 1.307)
Asian/PI[1]	0.464**	(0.281, 0.767)
NA/AI[1]	2.321	(0.296, 18.226)
Other	1.696	(0.771, 3.730)
Education		
Less than high school	Ref.	Ref.
High school graduate	1.018	(0.713, 1.453)
Some college	1.397	(0.995, 1.961)
College graduate	1.132	(0.768, 1.668)
Marital Status		
Married/Living with partner	Ref.	Ref.
Widowed/Separated/Divorced	1.098	(0.808, 1.491)
Never married	0.919	(0.583, 1.450)
Federal Poverty Level		
0-99%	Ref.	Ref.
100-199%	0.870	(0.589, 1.283)
200-299%	0.870	(0.557, 1.359)
300%+	0.769	(0.499, 1.184)
Duration of Disease		

< 2 years	Ref.	Ref.
2+ years	0.804	(0.575, 1.124)
Year of Survey		
2009	Ref.	Ref.
2011	0.840	(0.649, 1.089)
Self-Reported Health Status		
Good	Ref.	Ref.
Fair	0.532***	(0.203, 0.432)
Poor	0.296***	(0.402, 0.704)
Mental Health Status		
No serious distress	Ref.	Ref.
Serious Psychological Distress	0.645	(0.396, 1.050)
Comorbidities		
No	Ref.	Ref.
Yes	1.117	(0.804, 1.552)
BMI Class		
Not Overweight	Ref.	Ref.
Overweight	0.980	(0.692, 1.387)
Class I Obesity	0.956	(0.680, 1.342)
Class II Obesity+	0.782	(0.530, 1.156)
English Proficiency		
English Proficient	Ref.	Ref.
Limited English Proficient	0.893	(0.558, 1.428)
Time in US		
Born in US	Ref.	Ref.
0-14	1.232	(0.746, 2.035)
15+ years	1.272	(0.635, 2.546)
Insurance Status		
Private	Ref.	Ref.
Medi-Cal/Other	0.872	(0.611, 1.243)
Medicare	1.236	(0.694, 2.201)
Uninsured	1.769**	(1.080, 2.898)
Usual Source of Care		
None	Ref.	Ref.
Yes	1.925**	(1.186, 3.123)
Receipt of Care Plan		

No discussion	Ref.	Ref.
Discussed, did not receive	1.678***	(1.243, 2.265)
Discussed and received	1.846***	(1.300, 2.623)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
[1] Status includes those who are non-Hispanic

Research Question 4: *Does English proficiency predict self-management actions for individuals with diabetes?*

After controlling for all covariates, there was no significant direct association between English proficiency and eye or foot examinations (OR: 1.060, 95% CI: 0.568, 1.976; OR: 0.861, 95% CI: 0.531, 1.398, respectively), but those who were LEP were 38% less likely to comply with self-monitoring blood glucose guidelines (OR: 0.624, 95% CI: 0.403, 0.967).

Investigation of the available set of predictors revealed multiple significant trends (Table 6, 7, 8). Multivariate analyses also showed statistically significant associations between discussion and receipt of a written plan with all three indicators of self-management. It is important to keep in mind the significant negative influence of LEP on discussion and receipt of written plan concerning these results. Those who discussed a written plan were about two times more likely to comply with self-monitoring blood glucose guidelines, (OR: 2.253, 95% CI: 1.614, 3.147), about one and half times more likely to have their annual eye examination, (OR: 1.645, 95% CI: 1.162, 2.330), and about two times more likely to have their foot examinations (OR: 2.099, 95% CI: 1.503, 2.933). Those who have a copy of their written plan were about three times more likely to comply with self-monitoring blood glucose guidelines, (OR: 2.740, 95% CI: 1.892, 3.967), about one and half times more likely to have their annual eye examination, (OR:

1.597, 95% CI: 1.068, 2.389), and about two times more likely to have their foot examinations (OR: 2.395, 95% CI: 1.688, 3.398). Multivariate analyses showed that self-efficacy was not a statistically significant predictor in SMBG nor foot examinations, and there were no significant associations between usual source of care and any of the self-management indicators.

In summary, our hypothesis that LEP has an adverse effect on diabetes care, after controlling for other covariates, was sustained for one of the three indicators. Receipt of care plan and self-efficacy were also positively associated with self-management indicators.

Table 6. Binary Logistic Regression Analysis for Individual Characteristics on Self-Management Indicator: Self – Monitoring Blood Glucose

	SBMG (Odds Ratio)	**95% Confidence Interval**
Age		
18-34	Ref.	Ref.
35-44	1.436	(0.533, 3.874)
45-54	0.491	(0.201, 1.198)
55-64	0.741	(0.320, 1.718)
65+	0.767	(0.331, 1.779)
Gender		
Male	Ref.	Ref.
Female	1.096	(0.830, 1.449)
Race/Ethnicity		
White[2]	Ref.	Ref.
Hispanic	1.038	(0.672, 1.604)
African-American[2]	2.511***	(1.494, 4.219)
Asian/PI[2]	0.953	(0.579, 1.571)
NA/AI[2]	0.429	(0.042, 4.328)
Other[2]	0.644	(0.151, 2.738)
Education		
Less than high school	Ref.	Ref.

High school graduate	1.036	(0.654, 1.639)
Some college	0.966	(0.657, 1.419)
College graduate	0.849	(0.544, 1.326)
Marital Status		
Married/Living with partner	Ref.	Ref.
Widowed/Separated/Divorced	0.814	(0.616, 1.076)
Never married	0.521*	(0.317, 0.857)
Federal Poverty Level		
0-99%	Ref.	Ref.
100-199%	0.840	(0.552, 1.277)
200-299%	0.942	(0.575, 1.543)
300%+	0.910	(0.570, 1.451)
Duration of Disease		
<2 years	Ref.	Ref.
2+ years	1.086	(0.731, 1.614)
Year of Survey		
2009	Ref.	Ref.
2011	1.091	(0.838, 1.422)
Self-Reported Health Status		
Good	Ref.	Ref.
Fair	0.989	(0.734, 1.332)
Poor	0.867	(0.572, 1.313)
Mental Health		
No serious distress	Ref.	Ref.
Serious Psychological Distress	0.766	(0.474, 1.238)
Comorbidities		
None	Ref.	Ref.
Yes	0.998	(0.763, 1.304)
BMI Class		
Not Overweight	Ref.	Ref.
Overweight	0.978	(0.684, 1.398)
Class I Obesity	1.136	(0.749, 1.723)
Class II Obesity+	1.026	(0.659, 1.597)
English Proficiency		
English Proficient	Ref.	Ref.
Limited English Proficient	0.624*	(0.403, 0.967)

Time in US		
Born in US	Ref.	Ref.
0-14 years	1.137	(0.735, 1.759)
15+ years	1.158	(0.630, 2.129)
Insurance Status		
Private	Ref.	Ref.
Medi-Cal/Other	1.219	(0.809, 1.835)
Medicare	1.363	(0.806, 2.305)
Uninsured	0.614*	(0.378, 0.998)
Usual Source of Care		
No	Ref.	Ref.
Yes	1.428	(0.855, 2.385)
Receipt of Care Plan		
No discussion	Ref.	Ref.
Discussed, did not receive	2.253***	(1.614, 3.147)
Discussed and received	2.740***	(1.892, 3.967)
Self-Efficacy		
Lower	Ref.	Ref.
Higher	0.982	(0.733, 1.317)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[2] Status includes those who are non-Hispanic

Table 7. Binary Logistic Regression Analysis for Individual Characteristics on Self-Management Indicator: Eye Examination

	Eye Exam (Odds Ratio)	**95% Confidence Interval**
Age		
18-34	Ref.	Ref.
35-44	2.571	(0.976, 6.773)
45-54	1.190	(0.456, 3.108)
55-64	2.259	(0.935, 5.459)
65+	3.009*	(1.231, 7.353)
Gender		
Male	Ref.	Ref.
Female	1.245	(0.924, 1.677)
Race/Ethnicity		
White[2]	Ref.	Ref.
Hispanic	1.112	(0.705, 1.753)
African-American[2]	2.292**	(1.301, 4.037)

Asian/PI[2]	1.406	(0.725, 2.728)
NA/AI[2]	2.743	(0.199, 37.734)
Other[2]	0.818	(0.149, 4.491)
Education		
Less than high school	Ref.	Ref.
High school graduate	0.879	(0.573, 1.348)
Some college	1.073	(0.710, 1.620)
College graduate	0.863	(0.547, 1.363)
Marital Status		
Married/Living with partner	Ref.	Ref.
Widowed/Separated/Divorced	0.777	(0.575, 1.051)
Never married	0.712	(0.426, 1.188)
Federal Poverty Level		
0-99%	Ref.	Ref.
100-199%	0.841	(0.524, 1.351)
200-299%	0.878	(0.531, 1.453)
300%+	1.380	(0.835, 2.282)
Duration of Disease		
<2 years	Ref.	Ref.
2+ years	1.105	(0.752, 1.625)
Year of Survey		
2009	Ref.	Ref.
2011	0.996	(0.771, 1.286)
Self-Reported Health Status		
Good	Ref.	Ref.
Fair	0.871	(0.636, 1.193)
Poor	1.041	(0.652, 1.663)
Mental Health		
No serious distress	Ref.	Ref.
Serious Psychological Distress	0.861	(0.513, 1.447)
Comorbidities		
None	Ref.	Ref.
Yes	1.495*	(1.097, 2.036)

BMI Class		
Not Overweight	Ref.	Ref.
Overweight	1.570*	(1.081, 2.280)
Class I Obesity	1.328	(0.884, 1.994)
Class II Obesity+	1.317	(0.855, 2.030)
English Proficiency		
English Proficient	Ref.	Ref.
Limited English Proficient	1.060	(0.568, 1.976)
Time in US		
Born in US	Ref.	Ref.
0-14 years	1.593	(0.886, 2.866)
15+ years	0.819	(0.388, 1.730)
Insurance Status		
Private	Ref.	Ref.
Medi-Cal/Other	0.658*	(0.451, 0.959)
Medicare	0.611	(0.359, 1.040)
Uninsured	0.450***	(0.294, 0.688)
Usual Source of Care		
No	Ref.	Ref.
Yes	1.445	(0.879, 2.375)
Receipt of Care Plan		
No discussion	Ref.	Ref.
Discussed, did not receive	1.645**	(1.162, 2.330)
Discussed and received	1.597*	(1.068, 2.389)
Self-Efficacy		
Lower	Ref.	Ref.
Higher	1.368*	(1.025, 1.826)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[2] Status includes those who are non-Hispanic

Table 8. Binary Logistic Regression Analysis for Individual Characteristics on Self-Management Indicator: Foot Examination[1]

	Foot Exam (Odds Ratio)	**95% Confidence Interval**
Age		
18-34	Ref.	Ref.
35-44	0.805	(0.332, 1.952)
45-54	0.810	(0.356, 1.847)
55-64	0.817	(0.395, 1.687)
65+	0.830	(0.393, 1.754)
Gender		
Male	Ref.	Ref.
Female	0.870	(0.698, 1.085)
Race/Ethnicity		
White[2]	Ref.	Ref.
Hispanic	0.998	(0.675, 1.476)
African-American[2]	2.817***	(1.899, 4.177)
Asian/PI[2]	0.671	(0.407, 1.105)
NA/AI[2]	0.618	(0.078, 4.920)
Other[2]	0.674	(0.267, 1.701)
Education		
Less than high school	Ref.	Ref.
High school graduate	0.949	(0.661, 1.362)
Some college	1.059	(0.723, 1.552)
College graduate	1.115	(0.758, 1.640)
Marital Status		
Married/Living with partner	Ref.	Ref.
Widowed/Separated/Divorced	0.979	(0.731, 1.311)
Never married	0.485**	(0.311, 0.757)
Federal Poverty Level		
0-99%	Ref.	Ref.
100-199%	0.848	(0.574, 1.252)
200-299%	0.967	(0.635, 1.473)
300%+	0.905	(0.587, 1.394)
Duration of Disease		
<2 years	Ref.	Ref.
2+ years	2.139***	(1.541, 2.968)
Year of Survey		

2009	Ref.	Ref.
2011	1.055	(0.845, 1.318)
Self-Reported Health Status		
Good	Ref.	Ref.
Fair	1.385*	(1.051, 1.825)
Poor	1.397	(0.914, 2.137)
Mental Health		
No serious distress	Ref.	Ref.
Serious Psychological Distress	0.565*	(0.356, 0.894)
Comorbidities		
None	Ref.	Ref.
Yes	1.211	(0.978, 1.499)
BMI Class		
Not Overweight	Ref.	Ref.
Overweight	1.211	(0.894, 1.641)
Class I Obesity	1.122	(0.781, 1.612)
Class II Obesity+	1.887**	(1.283, 2.777)
English Proficiency		
English Proficient	Ref.	Ref.
Limited English Proficient	0.861	(0.531, 1.398)
Time in US		
Born in US	Ref.	Ref.
0-14 years	1.565*	(1.091, 2.245)
15+ years	1.540	(0.741, 3.203)
Insurance Status		
Private	Ref.	Ref.
Medi-Cal/Other	1.073	(0.767, 1.502)
Medicare	0.675	(0.414, 1.101)
Uninsured	0.695	(0.430, 1.122)
Usual Source of Care		
No	Ref.	Ref.
Yes	1.098	(0.664, 1.815)
Receipt of Care Plan		
No discussion	Ref.	Ref.
Discussed, did not receive	2.099***	(1.503, 2.933)

Discussed and received	2.395***	(1.688, 3.398)
Self-Efficacy		
Lower	Ref.	Ref.
Higher	1.015	(0.807, 1.277)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
[2] Status includes those who are non-Hispanic

Sensitivity Analyses

Alternate definition of LEP resulted in a less significant impact on usual source of care and all self-management indicators, as well as similar impacts on self-efficacy and receipt of care plan compared to the definition in the current model. The weakened effect of LEP on the indicators of self-management indicated that the average of those who spoke English 'very well' and 'well' are similar to the average of those who spoke English 'not well' and 'not at all.' This suggests that there is a meaningful difference and divide between those who spoke English 'very well' and those who spoke English less than 'very well.' These results suggest that our base case definition is more appropriate, which is also consistent with federal usage [54].

Not surprisingly, the alternate definition of self-efficacy resulted in stronger effects and increased significance for adherence in self-monitoring and blood glucose and eye examinations. Although the results of the sensitivity analyses suggest that the alternate definition of self-efficacy performs better statistically here, the definition we have adopted is more frequently found in the literature and promotes comparability of findings. To our knowledge, only one study assesses self-efficacy using the same question and definitions.

Discussion

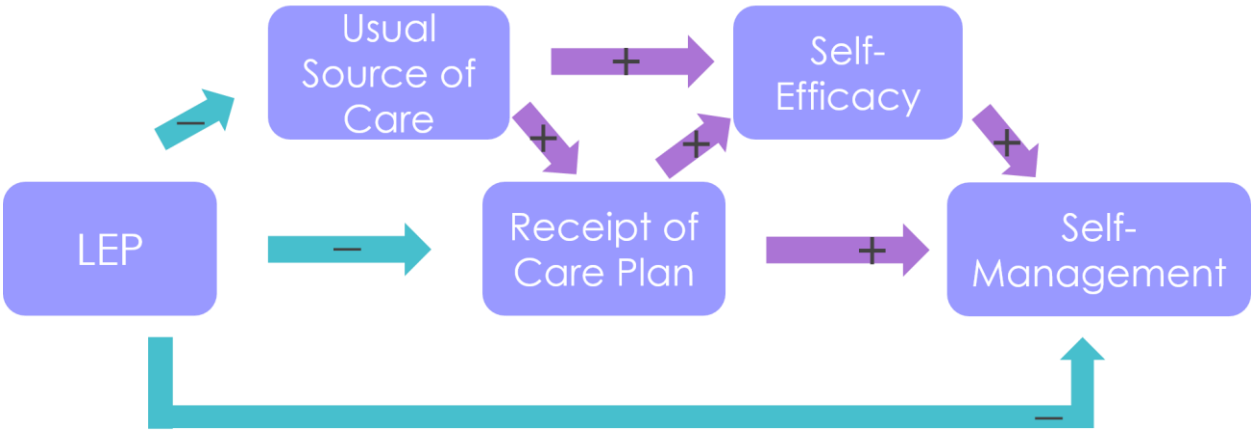
Key Findings

This study used secondary data from a population based sample of adults with diabetes and/or heart disease in California to examine the association between self-efficacy and English proficiency. We determined that English proficiency impacts self-management through different pathways, including being positively correlated with usual source of care and receipt of written care plan. Our results confirmed the majority of our hypotheses.

Consistent with the literature on LEP disparities, diabetic individuals with limited English proficiency are less likely than their counterparts to have a usual source of care. Although usual source of care was not significantly associated with self-management indicators, our study showed that there were indirect effects working through both self-efficacy and especially through receipt of care plan. Through those pathways, we found that having a usual source of care has positive effects on self-management. Similarly, LEP individuals were also less likely to discuss or receive a care plan, even after controlling for usual source of care and other covariates, while receipt of care was positively associated with both self-efficacy and self-management. Although LEP was not significantly associated with self-efficacy, LEP had indirect effects through usual source of care and receipt of care plan, resulting in an overall negative effect on self-efficacy. We also found that self-efficacy was positively associated with one indicator of self-management. Finally, LEP was negatively associated with one self-management indicator, SMBG. The overall effect of LEP on self-management is not only limited to the results in the final model. While our results show direct-effect significance for only

one indicator, Figure 3 is a graphical representation of the direct and indirect negative effects from LEP on these indicators through usual source of care, receipt of care plan, and self-efficacy. Direct effects from LEP are indicated with blue arrows, while indirect effects are signified through purple arrows.

Figure 3. Multiple Pathways



Clinical Implications

Although our results did not fully support all of our hypotheses, they provide insight into the interplay of certain variables affecting self-management for those with diabetes. Those who were in possession of a care plan were more likely to have higher self-efficacy, but results showed that LEP individuals were less likely to have a plan; in fact, less than one third of the LEP individuals reported having a copy of their care plan despite the fact that evidence-based guidelines for self-management have articulated the importance of written plans. Considering the positive associations between receipt of care plan and all self-management indicators, our study underscores the importance of

distributing and discussing a tailored care plan between physician and patient, as consistent with the National Standards for Diabetes Self-Management Education and Support [14]. Because of the pervasive effects of LEP on receipt of care plan and self-monitoring of blood glucose, we also recommend prioritizing LEP patients during medical interactions, especially through providing a more detailed medical plan or medical care plan in the primary language of the individual.

Policy Implications

While those who had a usual source of care were more likely to have a care plan and higher self-efficacy, LEP status was negative correlated with both usual source of care and receipt of care plan, suggesting that LEP is a significant barrier to medical care. Although the Affordable Care Act (ACA) health reforms are intended to reduce the inequities of access to healthcare, many individuals who signed up for ACA did not use their healthcare insurance [56, 59]. Our study suggests implementation of outreach programs to teach individuals about the benefits of using insurance, including having a usual source of care. Nonetheless, health reforms and increase in access may not be sufficient to improve all of these indicators, and our findings suggest a need to prioritize access and communication with physicians for LEP populations. An important implication is that policymakers look into provisions regarding translated materials and the use of professionally trained interpreters. Research has shown that professional medical interpreters have successfully reduced communication barriers for LEP populations as well as improving health outcomes and increased satisfaction with providers [45, 60]. Providing professionally trained interpreters during medical interactions for LEP patients may increase rates for receipt of care plan, or at least similar

to their English proficient counterparts, and in turn, improve self-management activity adherence rates.

Limitations

Our study has several limitations. First, because we are using cross sectional data, finding support for hypothesized causality and mediation between covariates and dependent variables becomes much more difficult. Second, the results of this study are subject to measurement bias, as all data from this study were self-reported and reported retrospectively. Recall bias and social desirability bias could influence results. For example, a diabetic individual who does not keep a log of their glucose check may not report their frequency accurately.

Third, our findings are only representative of the population of California from 2009-2012. The enactment of the Knox-Keene Health Services Act required California's Department of Managed Health Care (DMHC) and select plans covered by the California Department of Insurance to establish language access regulations and standards that require insurers to provide verbal interpretations in all languages and written translations in threshold languages; in addition, by 2009, all health maintenance organizations (HMO) were required to have fully implemented language access policies and procedures. The increased supply of readily available professional medical interpreters that is not captured in our study may impact the association between our key independent and dependent variables. Literature has shown that professional medical interpreters have been used to bridge the communication gap between patients and providers; but on the contrary, ad-hoc interpreters have been shown to have negative impacts on health outcomes. Because we are unable to capture the effect of medical interpreters, we may have underestimated

the impact of LEP in our results. To our knowledge, California is currently the only state with this type of policy regarding medical information and interpreters. In spite of these limitations, the present study is one of the first to capture the net effect of English proficiency and nuanced effects of other variables on self-efficacy in individuals with diabetes.

Fourth, self-efficacy is assessed from one question in the survey, which does not allow us to capture all aspects of self-efficacy. However, one previous study examining self-efficacy has captured it in a way similar to this study; and we have also addressed different definitions of higher and lower self-efficacy in our sensitivity analyses, which indicated that model findings were robust to variations in the definition employed here regardless of how we defined self-efficacy.

Fifth, we were also unable to capture the gamut of self-management activities relevant to diabetes, especially diet and exercise. Nonetheless, this was the first study to examine the association of LEP on any self-management behaviors through self-efficacy.

Further Research

Longitudinal data could offer additional insight on determinants of self-management that could not be captured in a cross-sectional study, especially self-efficacy and self-management. These two multi-faceted constructs are not only complex, but can change over time. Longitudinal data would allow access to the sequence of events and thus allow investigation of the sensitivity and provide a more accurate assessment of the constructs than those from cross-sectional studies. For example, we could capture self-efficacy before and after an event such as an emergency room visit. The information

attained could provide a more nuanced explanation for the constructs and further provide evidence for providers to advise self-management routines for the most optimal outcomes.

Future surveys following a cohort could incorporate questionnaires that evaluate a more complete measure of self-management, such as the 11-item Summary of Diabetes Self-Care Activities (SDSCA) [24, 61, 62]. Incorporating the SDSCA would capture different degrees of self-management, aside from self-efficacy, including self-check, exercise, diet, and medication adherence to confirm the relationship between limited English proficiency and self-management using an established scale. Longitudinal studies would also be able to assess determinants of costly outcomes including emergency department visits and hospitalization for patients with chronic disease without endogeneity.

We also recommend using the new, not yet released, CHIS 2013 to evaluate the effect of medical interpreters on LEP diabetic individuals. With this population-based survey, one can assess the expected increase in utilization of interpreters and effectiveness of the provision regarding interpreters with a difference-in-difference model. Our results were likely not affected, as we controlled for year of survey and the majority of our data was after the mandate, but the sample size was not large enough to evaluate the impact of professionally trained medical interpreters. Similarly, because the amendment to the Knox-Keene Health Care Services Act mandates that the professionally trained interpreter be paid by the individual's health insurance, future research can also examine the relationship between interpreter use and individual level health insurance status [63].

Conclusion

This study revealed that LEP individuals are less likely to adequately self-monitor blood glucose, and are less likely to discuss or receive a written plan, an important factor for all indicators of self-management. This study also showed that those with a usual source of care were more like to receive a written copy of their care plan; therefore, policymakers should consider providing assistance to individuals not only to reduce barriers to effective physician-patient communication through medical interpreters, but also to increase and promote access to healthcare through outreach programs.

Future research on this relationship will be particularly important for similar chronic diseases due to the complex regimens needed to maintain the quality of life for those diagnosed with chronic diseases. In addition to investigating the effects of communication barriers on low health literacy and/or LEP individuals, future research should examine the effect of medical interpreters as a means of reducing barrier to successful self-management, as well as interventions that could effectively improve health outcomes for individuals with chronic disease.

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