Primary Care Services use as a Factor in Glycemic and Cholesterol Management in Type 2 Diabetes: A Retrospective Study

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Submitted to: JMIR Preprints
on: December 11, 2024

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Abstract

Background: The early detection of pre-symptomatic individuals and the proactive implementation of health guidance through regular primary care visits are essential strategies for the secondary and tertiary prevention of diabetic complications. An interdisciplinary team approach significantly enhances the care of patients with diabetes, integrating the expertise of physicians, dietitians, clinical navigators, pharmacists, and mental health professionals. Central to this collaborative model is the active participation of patients, who play a vital role in managing their health outcomes. This integrated approach facilitates comprehensive care, promoting better health management and improved quality of life for individuals with diabetes.

Objective: We aimed to evaluate the association among regular primary care visits, hemoglobin A1C (HbA1C) and low-density lipoprotein (LDL) levels in patients with type 2 diabetes mellitus.

Methods: We randomly sampled data from 200 patients' electronic medical records. Mann–Whitney and chi-square tests were used to investigate the association between glycemic control lipid profile and the number of patient visits.

Results: The mean age of the participants was 61.78 years and the average body mass index was 34.5 kg/m2. Females constituted 61.79% of participants. The predominant race seen at the clinic was Black (43.8%), followed by White (42.69%). Patient adherence to scheduled visits was not statistically significantly associated with either HbA1C or LDL (chi-square = 1.1, p-value = 0.29 for HbA1c and chi-square = 1.12, p-value = 0.99 for LDL).

Conclusions: In the sample studied, no statistically significant association existed between adherence to primary care visits and either HbA1C or LDL levels. This data can guide physicians to invest on favoring high-quality primary care contact rather than high frequency of visits. Clinical Trial: IRB approved

(JMIR Preprints 11/12/2024:69947)
DOI: https://doi.org/10.2196/preprints.69947

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Keywords: Diabetes, primary care, glycemic control, follow-up, HbA1c, LDL, low density lipoprotein

Running title: primary care services, glycemic control and hyperlipidemia management

Introduction

Diabetes mellitus (DM) represents a global pandemic, with about 415 million people living with the condition. This number is expected to increase to about 642 million people by 2040. According to the American Diabetes Association, type 2 diabetes affects 29.1 million Americans, or 9.3% of the population, with an incidence of 1.4 million new cases annually (1, 2). The lifetime risk for developing type 2 diabetes is 40%, with 86.1 million Americans identified as prediabetic and 20% of people living with undiagnosed diabetes. (2) One-third of adults with diabetes do not reach the recommended A1C goal of <7% (3). These statistics indicate a growing need for primary care intervention.

Early detection of pre-symptomatic individuals and the institution and implementation of health guidance through initiation and maintenance of primary care visits is crucial for secondary and tertiary prevention of diabetic complications. Hence, the Center for Disease Control and Prevention (CDC) has developed a toolkit for diabetes care and education specialists who form an essential part of the diabetes health care team (4).

Patients with diabetes benefit from an interdisciplinary team for their care (5). Such teams might include physicians, dietitians, clinical navigators, pharmacists, and experienced mental health professionals. Patients represent a crucial component of this team, benefitting from assuming an active role in their care in this collaborative and integrated approach (5).

Diabetes management toward preventing complication relies on glycemic control, as measured by glycosylated hemoglobin (HbA1C) (6). Specific patient factors are essential to assessing this control. For instance, the goal for adults over 60 years is between 7-8%, and for younger people, a target closer to 6.5% is acceptable (6). The general goal for other

populations is 7%, but clinicians must be mindful to treat the individual patient rather than a HbA1C data point (6). A retrospective chart review by Marincic et. al. in 2018 (7) measured weight, body mass index (BMI), HbA1c, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides (TG), and TG-to-HDL ratio in patients with type 2 diabetes who engaged in diabetes self-management education (DSME) and medical nutrition therapy (MNT). They noticed a reduction in the study outcomes in the selected sample of patients who participated in DSME and MNT from baseline to the end of the program. In the Southwest Family Health Center, a Federally Qualified Health Center providing outpatient care to patients in the greater Bridgeport, Connecticut area, patients routinely practice DSME and MNT. This study seeks to measure the association of HgbA1C outcome data with frequency of primary care visits.

Primary care plays a vital role in the healthcare delivery system. Levels of care provided by primary care physicians (PCPs) may also include secondary and tertiary care in some cases such as diabetes management (8). Given the adult endocrinologist to patient ratio of approximately 1 to 6,194 according to the National Provider Identifier Registry (1) and the consequent lengthy average wait time of about four months for subspecialty consultation, primary care physicians provide care to approximately 90% of individuals with type 2 diabetes (1).

Several studies have shown that patients who have more frequent provider encounters have better health outcomes (9-11). Current guidelines for diabetes management do not include recommendations on frequency of outpatient visits. Instead, they have adopted the Chronic Care Model (CCM). This method focuses on patient-centered collaborative care, evolving from a reactive to a proactive approach. It guarantees that visits are arranged in a team-oriented manner to provide comprehensive, long-term care for diabetes and related

conditions. and to achieve both collaborative communication and goal setting between all team members (12). Assessment of glycemic status is recommended at least semiannually in patients who are meeting treatment goals and at least quarterly or as needed in patients whose therapy has recently changed or in those who are not meeting glycemic goals (13). Advantages of more frequent follow-up visits, however, may not be limited only to treatment intensification and testing. To date, research on the relationship between PCP visits and glycemic control in diabetic population has produced mixed results, with some studies suggesting improved control with more visits, while others report no significant correlation.

Although several previous studies measured several parameters including medication adherence, follow-up phone calls (1, 14-16) associated with glycemic control, none has yet been conducted in Southwest Family Health Center. The purpose of this analysis was to investigate the association of regular primary care visits with glycemic and cholesterol control among patients with an established diagnosis of type 2 diabetes.

Methods

Study Population

Participants were either male or female between the ages of 18-89 years with an established diagnosis of type 2 diabetes who had an index visit to the PCP at the Southwest clinic during 2017 with available and recorded observations (HbA1c, BMI, LDL, HDL). Participants with chronic kidney disease requiring dialysis and those not meeting the aforementioned criteria were excluded from the study. We abstracted data for these patients clinic's electronic medical records (EMR), NextGen, through NextGen's imbedded report writer. Using a random number generator in Excel, patients were selected for participation in the analysis.

Based on Institutional Review Board (IRB) approval for review of these records, 2242 patients with diabetes were seen at the clinic in January 2017 through December 2019. Of these patients, 200 were randomly identified for the study.

Study Outcomes and covariables

The American College of Physician guidance statement defines “good control” as a HbA1c of less than or equal to 7 (5).Following the definition of poor glycemic control in prior studies and according to the American Diabetes Association (ADA). recommendations well-controlled HbA1c was defined as ≤ 7% and participants with values above 7% were defined as poorly controlled. We selected participants with quarterly measured HbA1c levels,
We defined adherence as at least three visits to primary care per year. Race was self-reported by the participants, categorized into White, Black, and other. **Figure 1** shows the inclusion and exclusion criteria and the participant selection flow chart.

Ethical consideration

Because the study was a retrospective chart review and the data analyzed were anonymized, the need for informed consent was waived according to the ethical guidelines for medical and health research involving human subjects in Connecticut. The Hartford Healthcare Institutional Review Board for Clinical Research approved this study.

Statistical analysis

Selection bias was eliminated from this study with the use of an excel function, RAND, which randomized the patients selected. The Mann–Whitney U tests were used to measure the correlation between HbA1c and the total number of visits during the study as well as between LDL and the total number of visits during the study. X-squared analysis was used to measure the association between adherence to PCP visits and glycemic control. To investigate the possible association between race and total number of visits as well as insurance and total number, we employed the Kruskal-Wallis test. All statistical analysis used R 4.2.0. The level of statistical significance was set at 0.05.

Risk Estimation

Multiple logistic regression analyses were implemented to estimate the effect of PCP non-visits on the outcome (Hb A1c and LDL levels) after adjusting for sex, age, race, and BMI.

Results

Patient population

HbA1c at baseline and at the end of the study were categorized into two groups: >7% and ≤7%. LDL was categorized into <100 mg/dl and ≥ 100 mg/dl , based on the recommendation to add statin therapy to lifestyle modification if LDL cholesterol remains >100 mg/dl (17).

~~We defined adherence as at least three visits to a primary care clinic per year and good glycemic control as a HbA1c ≤7%~~. About 200 participants met the criteria; however, after removing the patients with missing values, only 89 participants were available for analysis. The descriptive statistics of the participants are shown in **Table 1**. The mean age of the

participants was 61.78 and average BMI was 34.5kg/m^2. Female patients constituted a greater proportion of participants (61.79%). The predominant race seen at the clinic was Black patients, constituting 43.8% of the study population, followed closely by White patients (42.7%). The majority of the participants had Medicaid as their insurance payor group (53.9%).

BMI and study participants

The proportion of obese participants (BMI >30 kg/m2) was reported in **Table 2** and **Table 3.** Our study showed that 76% of female participants were obese (n=45). Based on race, the majority (78%) of obese participants were White (n=30), followed by Black patients (n=28), then other (n=7).

LDL and adherence

In **Table 4,** the distribution of participants LDL and their adherence to PCP visits is illustrated. ~~Compliance was defined as at least 3 visits per year for the purposes of this study.~~ No difference was observed in terms of adherence to PCP visits across the groups with different glycemic controls (X-square = 1.1212e-05, p-value = 0.9973).

HbA1c and adherence

Although the distribution of the number of visits is different, we did not observe a difference

in terms of adherence between patients with good glycemic control and the patients with bad glycemic control (X-squared = 1.1002, p-value = 0.2942, **Table 5**).

Impact of race on HbA1c

Further analysis was performed to measure the correlation between race and HbA1c, and between race and number of visits. There was no statistically significant difference in the number of visits between the different race groups (Kruskal-Wallis chi-squared = 0.10055, df = 2, p-value = 0.951) as well as between different glycemic control groups (X-squared = 0.68665, p-value = 0.7094).

Insurance and total visit number

We also investigated the correlation between the insurance payor types and the total number of visits during the study period. The number of visits between the different insurance groups (Kruskal-Wallis, chi-square = 11.643, df = 12, p-value = 0.4748) did not reach statistical significance.

Discussion

This retrospective chart review of routine data described demographic features and evaluated the correlation between regular PCP visits and achievement of LDL control and glycemic control in 89 adult patients with diabetes at the Southwest Family Health Center in Bridgeport, Connecticut. As of 2019, Bridgeport is an underserved city with a poverty rate of 21.8% and a median household income of $46,662/year (18). The Southwest Family Health

Center is dedicated to providing accessible medical health services to underserved vulnerable individuals and to at-risk communities who reside in Southwest Bridgeport community. This center is also affiliated with St. Vincent's Medical Center, an academic teaching hospital in the same community. These demographic data are consistent with the study population, as most of the patients had Medicaid as their insurance payor group (53.93%). Moreover, 43.8% of the study participants self-identified as Black. Black race and Medicaid-eligible consumers are defined as underserved, vulnerable, and special needs populations according to the Department of Health and Human Services (HHS)(19).

The authors hypothesized that regular contact with primary care providers will improve indicators of good glycemic control and good cholesterol control in patients with an established diagnosis of diabetes. The data from this analysis does not support this hypothesis. Previous analyses suggest that a lack of integrated care in PCP follow-ups is a major factor in failure to achieve adequate glycemic control in patients with diabetes.

In this research cohort, attending more than three PCP visits per year did not substantially enhance HbA1c or LDL levels. The findings from this study are consistent with findings from other studies(15, 20) in which the number of visits per year over five per year offered no added benefit to the glycemic control(15).-

Both patient-related and disease-related variables might explain these results. Patient related factors that increase PCP visits may not correlate with better glycemic or cholesterol control, or they may correlate negatively with these factors, offsetting any benefit from more frequent visits. For example, patients with poorly controlled diabetes are also more likely to have poorly controlled comorbidities that warrant increased visits (21). On the other hand, a

patient with well-controlled diabetes may inherently need less PCP contact. The results of this study may also indicate that patients who have poorly controlled diabetes may face other barriers to good health (e.g., inadequate insurance coverage, poor health literacy, poor access to healthy food) which increased PCP visits may not benefit.

Disease-related factors that result in the lack of correlation with number of visits and glycemic control include the complexity of diabetes and its multi-organ system effects. Patients with longer standing disease may require more intense therapy and more visits to achieve better glycemic and/or cholesterol control. This study did not evaluate the relationship between the duration of disease and glycemic or cholesterol control.

These findings suggest that patients may benefit from well-spaced, high-quality PCP contact at regular intervals rather than from increasing their PCP visits. Consistent with the currently accepted approach to comprehensive management of diabetes, the content of the visits are critical targets for patient benefit (12). A patient-centered approach to address social determinants of health, medication costs, medication adverse effects, patient priorities, and shared decision making are essential to high-quality visits. Such visits further include a multidisciplinary approach to glycemic control with a focus on nutrition, sleep and emotional well-being (12).

This study also analyzed the relationship between demographic features and glycemic control. These data showed a higher percentage of women seeking treatment follow-up compared to men as well as a higher proportion of metabolic risk factors among women, particularly obesity, with BMI above 30 Kg/m^2. This finding is consistent with

the CDC report that indicated that women were 33 % more likely than men to visit ambulatory clinics for annual examinations, preventive services and management of chronic diseases (22). These differences may be associated with differences in health perceptions and reporting of symptoms and illnesses related to reproductive biology and gender specific conditions (23).

Forjuoh et al conducted a study to determine the nature and magnitude of existing health disparities in patients with type 2 diabetes by race and ethnicity. They reported no significant racial or ethnic differences in the rate of counseling on diet, exercise, and home blood glucose monitoring (24). In addition, they found no significant differences in the mean number of hospital admissions, emergency room visits, and referrals for specialty care. However, the mean HbA1c levels for African American (9.9%) and Hispanic (9.0%) patients were significantly higher than the mean for White patients (8.7%; P<.0001), even after controlling for BMI and age.

Conversely, in 2013, Taylor et. al. conducted a study using data from the Carolinas healthcare system to estimate the independent effect of race or ethnicity on the number of emergency department (ED) visits, hospitalizations, and primary care office visits, adjusting for significant confounding variables in each patient group (25). Their findings suggest that the rates of diabetes-related ED visits were two to three times higher for the Black population than for the White population. Diabetic patients who self-identify as Black reportedly had lower rates of all-cause primary care office visits when compared to patients who self-identify as White.

The data from this study did not show statistically significant difference in the number of

visits between the different insurance groups (p-value = 0.4748). Among these data, however, some insurance payors were represented either by only one patient or by a very low number of patients, which may explain this finding. This study limitation can affect the generalizability of this finding as the small sample size may not accurately reflect the overall trends or characteristics of insurance payors, leading to potential bias or inconclusive results. It is important to acknowledge this limitation when interpreting and applying the study findings to a broader population.

Some studies suggest a disparity in access to healthcare based on health insurance coverage. Zhang et al conducted a meta-analysis to assess the association between private health insurance and health care utilization (26) . They found that patients with private insurance used public health care less frequently than people without private insurance.. Surprisingly, despite this lower utilization of public health services, individuals with private insurance were more likely to require hospitalization. This suggests that while private health insurance may ease the financial burden on both patients and the public health insurance system, it does not necessarily reduce the need for hospital care (26). Factors for this finding include fragmented care coordination as individuals with private insurance may receive care from multiple providers without a central care coordination mechanism that can lead to gaps in care, or conflicting treatment plans, increasing the risk of hospitalization.

Additionally, private insurance status may be associated with higher socioeconomic status, which can influence health behaviors, access to resources, and overall health outcomes. Individuals with private insurance may be more likely to engage in risky behaviors or have higher stress levels, leading to increased hospitalization rates (25).

On the other hand, Sharma et al (27) conducted a national audit of primary care physicians to assess the relationship between state Medicaid fees for primary care services and access to Medicaid, Medicare, uninsured, and privately insured patients who differed by race or ethnicity and sex. They found that states with higher Medicaid fees had a higher likelihood of appointment offers and shorter wait times for Medicaid patients compared to uninsured patients, whereas appointment offers and wait times for Medicare and privately insured patients were unaffected by Medicaid fees.

Their analysis suggested a 27%-point disadvantage for Medicaid versus Medicare in appointment offers in mean state Medicaid fees. This difference decreased to 6% when Medicaid and Medicare fees were equal. This finding suggests that permanent fee congruence to Medicare could eliminate most of the disparity in appointment offers for Medicaid patients, which could positively affect the management of chronic conditions at the primary care level.

Of note, in the current study, the insurance payor types, and the race of participants were found to have no significant correlation with the number of PCP visits This finding may call for further specific studies on racial and health insurance disparities in seeking health care services in this community.

Our study has several strengths. While some studies focus on the relationship between access to PCP and other health outcomes, to our knowledge, none of these studies addressed the potential factors affecting the number of visits and glycemic control and/or LDL parameters in Connecticut or in the New England region. We were able to obtain data from 89 patients with diabetes from diverse backgrounds and health insurance coverage plans. We have also focused on the primary care setting, where longitudinal diabetes

management occurs. Importantly, our results reflect both clinics in which both primary care physicians and mid-level practitioners cared for patients because it provides a comprehensive view of the care provided in these settings. This information can help inform future decisions regarding staffing, resource allocation, and quality improvement initiatives in healthcare settings.

Although this retrospective chart review was limited in patient numbers and data collection, we were able to examine the relationship between PCP visits adherence and the measures of glycemic and cholesterol control.

Other factors may also limit this study. First, all data used in this study are collected from electronic medical and billing records created for reasons other than research. These system designs affected the availability of all requested information over the study period. For example, we planned initially to measure other parameters such as blood pressure trends during the study period along with other lifestyle activities such as smoking and alcohol use. Pooling thess data would have allowed for a holistic understanding of a patient's health status. It would given us a broader context to the patient's glycemic and lipid control, beyond just their interaction with their PCP. Moreover, It could have helped to identify correlations and patterns between these variables and their impact on glycemic and lipid control. For instance, patients with high blood pressure who smoke may have more difficulty managing their blood sugar and lipid levels, regardless of the frequency of their PCP visits. These measures could not be pooled. Further investigations of the effect of these measures in our client base. Second, these data do not distinguish between routine scheduled appointments and last-minute encounters. The acuity of care could be different between these two types of visits. This distinction is important because patients may have different reasons for these types of encounters, which could impact their glycemic control.

By not differentiating between the two, the analysis may not accurately reflect the true relationship between primary care physician visits and glycemic control.

In conclusion, we clarified the evidence supporting a positive influence of regular PCP visits on the measures of glycemic and cholesterol control, however, the frequency of visits had no notable improvement. The quality of each visit is likely more important than the frequency of visits. The findings of this study may enable stronger clinician-patient relationships by suggesting less need for high frequency of potentially inconvenient visits without sacrificing patient outcomes in glycemic and cholesterol control.

Disclosure

The authors declare no conflict of interest.

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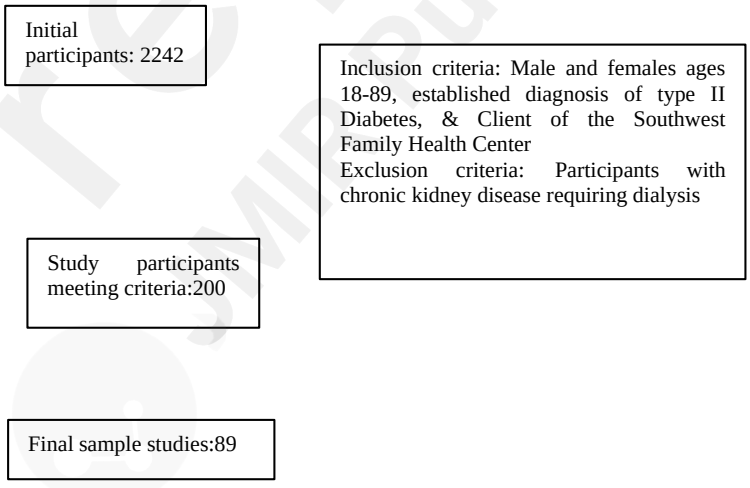
Figure 1 Flow sheet showing selection and patient participation.



Tables

Table 1. Descriptive statistics of participants

	Mean (SD)

Age, yrs	61.78 (10.44)
BMI	34.51 (12.84)
	% (N)
Gender, Female	61.79 (55)
Ethnicity, Hispanic or Latino	34.83 (31)
Race	
Black / African American	43.82 (39)
White	42.69 (38)
other races (minority)	13.48 (12)
Payor	
Aetna 14079	4.49 (4)
Aetna 981106 Managed Medicare	2.24 (2)
Anthem 533	2.24 (2)
Anthem 533 Managed Medicare	14.60 (13)
Bridgeport Hospital Breast Care Center	1.12 (1)
Cigna Healthcare 182223	1.12 (1)
Connecticare	6.74 (6)
Medi Medi PPS	4.49 (4)
Medicaid	53.93 (48)
Medicare	1.12 (1)
Optum Health Solutions	3.37 (3)
Soldiers Sailors and Marine Fund	1.12 (1)
United Healthcare 31362	3.37 (3)

Table 2 shows the comparison of gender for obese (BMI ≥ 30 kg/m2) and nonobese (BMI < 30 kg/m2) participants.

	BMI < 30 N=24	BMI >30 N=65
Female N=55	13	42
Male N=34	11	23

Table 3 shows the comparison of race for obese (BMI ≥ 30 kg/m2) and nonobese (BMI < 30 kg/m2)

	BMI < 30 N=24	BMI >30 N=65
Black/ African American	11	28
White	8	30
Other	5	7

Table 4 shows the distribution of LDL and compliance with primary care visits

	LDL≥100 N=35	LDL<100 N=54
Adherence	5	9
No adherence	30	45

Table 5. *Showing the distribution of HbA1c and compliance to primary care visits*

	HbA1c>7 N=49	HbA1c≤7 N=40
Adherence	10	4
No adherence	39	36