

Primary Care Provider Encounter Cadence and HbA1c Control in Older Patients With Diabetes



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Introduction: Primary care provider encounters are associated with health and well-being; however, limited evidence guides optimal primary care provider rate of visit, referred to as encounter cadence. This study measures associations between primary care provider encounter cadence and diabetes outcomes among individuals newly diagnosed with type 2 diabetes mellitus.

Methods: In this retrospective cohort study, 7,106 people enrolled in Medicare Advantage and newly diagnosed with type 2 diabetes mellitus between July 1, 2012 and June 30, 2013 were identified and followed for 36 months. Two methods measured primary care provider encounter cadence: total primary care provider encounters (frequency) and quarters with primary care provider encounter (regularity). Logistic regression measured relationships between primary care provider encounter cadence and non-insulin diabetes medication adherence, HbA1c control, emergency department visits, and inpatient admissions. Non-insulin diabetes medication adherence was defined according to the National Committee for Quality Assurance, Healthcare Effectiveness Data and Information Set specifications and measured using healthcare claims data. Post-hoc models examined adherence and diabetes control among those nonadherent ($n=5,212$) and with noncontrolled HbA1c ($n=326$) during the encounter/cadence period. Data were extracted and analyzed in 2017.

Results: Adjusted models indicated that both frequency (AOR=1.08, 95% CI=1.06, 1.10) and regularity (AOR=1.18, 95% CI=1.13, 1.22) of primary care provider encounters were associated with increased odds of adherence. Post-hoc analyses indicated that more frequent (AOR=1.12, 95% CI=1.10, 1.15) and regular (AOR=1.27, 95% CI=1.22, 1.33) primary care provider encounters were associated significantly with adherence and were associated directionally with HbA1c control.

Conclusions: More frequent and regular primary care provider encounters are associated with an increased likelihood of non-insulin diabetes medication adherence. These findings contribute to data needed to establish evidence-based guidelines for primary care provider encounter cadence for those newly diagnosed with type 2 diabetes mellitus.

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INTRODUCTION

There is evidence to suggest that regular primary care visits are associated with health and well-being.^{1–3} The generally accepted cadence for regular visits can range from 1 to 4 times a year depending on various physician and patient characteristics; however, there is little evidence to support the rationale for an exact schedule.⁴ Ideally, some sort of primary care follow-up guidelines should be followed, but such

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recommendations are typically avoided owing to concerns about patient and disease heterogeneity, as well as lack of evidence.⁵

Studies that have examined the relationship between primary care provider (PCP) encounters and health outcomes among patients with hypertension found that shorter time between encounters, or more frequent primary care use, were associated with improvements in blood pressure,⁶ fewer cardiovascular events,⁷ and fewer deaths.^{7,8} Another study evaluated changes in blood pressure by time between primary care visits among patients with hypertension and diabetes. This study found that blood pressure normalized more quickly for patients who visited their PCP monthly than for those who visited their PCP less frequently.² A study of patients with diabetes showed that their time to achieve targeted HbA1c, cholesterol, and blood pressure control was significantly shorter for patients who visited their PCP every 1–2 weeks versus 3–6 months.⁹

Other research has shown the difficulty of predicting patient behavior with regard to PCP visits. For example, work by Yasaitis et al.¹⁰ showed that after controlling for health status, sociodemographic, and patient preferences, the largest impact on outpatient physician visit rates was from local physician supply and how often physicians felt they should see their patients. Specifically related to diabetes, Asao and colleagues¹¹ reported that the likelihood of a patient with diabetes revisiting their provider was highly variable and was linked to the severity of the disease and patient sociodemographic characteristics. They also stated that better processes of diabetes care were related to a higher revisit frequency.

Given the chronic nature of diabetes, it is important to promote diabetes management as early as possible to avoid life-limiting long-term complications.¹² Current guidelines for treatment of type 2 diabetes mellitus (T2DM) include HbA1c testing, but do not offer recommendations for how frequently patients should be seen by their PCP.¹³ It remains unclear how primary care visit cadence (i.e., frequency and regularity of visits) affects diabetes management and related healthcare utilization among patients newly diagnosed with diabetes. Understanding this relationship can inform related practices, and in turn, keep patients healthier and prevent diabetes-related complications as well as avoidable healthcare utilization.

The aim of this study is to measure the associations between primary care rate of visit—referred to as encounter cadence—and medication adherence, HbA1c control, emergency department (ED) visits, and inpatient admissions.

METHODS

This observational retrospective cohort study was conducted using an administrative claims database from Humana Inc., a large national health and well-being company. The database included inpatient and outpatient medical, pharmacy, and laboratory-related claims and enrollment data for individuals currently and formerly enrolled in a commercial Medicare Advantage or Medicare Advantage Prescription Drug plan.

The enrollment period for the study was July 1, 2012 through June 30, 2013. The index date, which varied by patient, was defined as the date of evidence of a new T2DM diagnosis in the claims data during the enrollment period. The baseline period reflected the 12 months before the index date. The exposure/cadence period was the 24 months immediately after the index date. The outcomes period was defined as Months 25–36 after the index date. All information extracted from the database was limited to service dates between July 1, 2011 and June 30, 2016 (Figure 1). Data were extracted and analyzed in 2017. This study was approved by Advarra's IRB.

Study Sample

The study cohort included individuals newly diagnosed with T2DM. New T2DM diagnosis was defined as an incident of diabetes diagnosis during the enrollment period, without diabetes claims (ICD-9-CM codes 250.xx, 357.2, 362.0x, 366.41) during the baseline period. Patients must also have had the following: (1) at least one acute inpatient encounter with a diabetes diagnosis in the primary, secondary, or tertiary positions in the enrollment period; or (2) at least 2 outpatient visits, observation visits, or ED visits; or (3) non-acute inpatient encounters on different dates of service in the enrollment period or subsequent 12 months, with the first visit occurring during the enrollment period, with a diabetes diagnosis in the primary, secondary, or tertiary position; or (4) evidence of insulin or non-insulin antihyperglycemics on an ambulatory basis during the enrollment period.

A total of 23,954 patients enrolled in Medicare were identified as newly diagnosed with T2DM. Patients were excluded from the study if they had evidence of T2DM, or a Charlson Comorbidity Index (CCI) score >3, during the baseline period (July 1, 2011–June 30, 2012); were not continuously enrolled in a Medicare Advantage Prescription Drug plan throughout the study period (July 1, 2011–June 30, 2016); were aged <65 years or >85 years during the study period; or had evidence of cancer, chronic kidney disease, end-stage renal disease, hospice, skilled nursing facility utilization, or disability at any

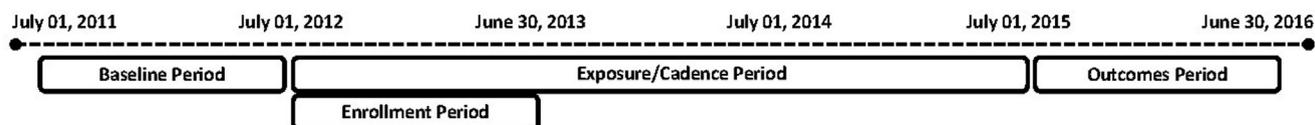


Figure 1. Study design.

time during the study period. Patients who filled a prescription for metformin but did not have a diagnosis of T2DM in the enrollment period (July 1, 2012–June 30, 2013) were excluded from the study. Additionally, those individuals newly diagnosed with T2DM, as identified through pharmacy claims, but who did not have a qualifying PCP encounter during the encounter/cadence period (July 1, 2012–June 30, 2015), were also excluded from the analysis (Appendix Figure 1, available online). This final exclusion resulted in a cohort of 7,106 patients.

Measures

The independent measure of PCP encounter cadence was measured using 2 methods: total number of PCP encounters (frequency) and numbers of quarters with a PCP encounter (regularity). The encounter/cadence period (July 1, 2012–June 30, 2015) consisted of 8 distinct quarters (90 days/quarter; Quarter 1 began on the index date). A diabetes-specific PCP encounter was defined as an office visit with a primary care or specialty provider with a diabetes ICD-9-CM code in the primary, secondary, or tertiary position.

The dependent measures were non-insulin diabetes medication (NIDM) adherence, HbA1c control, ED visits, and inpatient admissions. All of them were measured in the outcomes period (July 1, 2015–June 30, 2016). NIDM adherence and HbA1c control were defined in accordance with the National Committee for Quality Assurance, Healthcare Effectiveness Data and Information Set specifications.¹⁴ Proportion of days covered (PDC) methodology was used to calculate medication adherence. Patients were considered adherent to a medication if their PDC was $\geq 80\%$. The most recent HbA1c in the outcomes period was used; HbA1c control was defined as HbA1c $< 8.0\%$.¹⁴ Patients were required to have an HbA1c value, reported in healthcare claims data submitted for laboratory work, in both the encounter/cadence and outcomes periods to be included in analyses for HbA1c control. ED visits that resulted in an inpatient hospitalization were considered inpatient admissions. Inpatient admissions included acute hospitalizations and excluded skilled nursing facilities.

Covariates available in the data were selected based on their known and theoretic relationship with the independent and dependent measures. All were measured in the baseline period, unless otherwise stated. Demographic covariates included sex,¹⁵ age (measured at index date),¹⁶ race/ethnicity,¹⁷ rural/urban residency,¹⁸ Medicare–Medicaid dual eligibility,¹⁹ low-income subsidy status,²⁰ and special needs program utilization.²¹ The special needs program refers to a type of Medicare Advantage plan restricted to those with specific conditions or characteristics; the goal of these plans is to tailor the benefits to the member's particular needs. Additional covariates included the following: CCI score; presence of hypertension, coronary artery disease, heart failure, and chronic obstructive pulmonary disease; HbA1c control; NIDM adherence; and renin-angiotensin system antagonist (cardiovascular disease) and statin (hyperlipidemia) adherence.²² Conditions, HbA1c control, and medication adherence were measured in the exposure/cadence period.

Statistical Analysis

Univariate analyses were used to describe the baseline demographics and clinical characteristics of the study cohort. Bivariate comparisons (i.e., *t*-test, chi-square test of independence, and

Spearman rank-order correlation) measured the associations between covariates, independent, and dependent measures. Multivariable logistic regression models, which adjusted for covariates, were used to estimate AORs between PCP encounter cadence and dependent measures.

Post-hoc regression models for the NIDM adherence and HbA1c control measures limited the sample to those who were nonadherent (PDC $< 80\%$) and not in control (HbA1c $\geq 8.0\%$), respectively, during the encounter/cadence period. An α level of 0.05 was used for significance testing. The data analysis for this study was generated using SAS, version 9.4.

RESULTS

At baseline, the 12-month period before T2DM diagnosis, the study cohort ($N=7,106$) participants were female (51.2%), aged 72.4 years (mean), white/Caucasian (80.9%), and from the South region of the U.S. (62.4%; Table 1). During the 24-month exposure/cadence period, on average, individuals visited their PCP 5.8 (SD=3.5) times, and had 4.1 (SD=1.9) quarters with a PCP encounter (Table 1).

The multivariable logistic regression models showed that both frequency (AOR=1.08, 95% CI=1.06, 1.10) and regularity (AOR=1.18, 95% CI=1.13, 1.22) of PCP encounters were associated with increased odds of NIDM adherence (Appendix Table 1, available online). HbA1c control was not associated with PCP encounter frequency (AOR=0.98, 95% CI=0.94, 1.02) or regularity (AOR=0.98, 95% CI=0.90, 1.06) (Appendix Table 2, available online). ED visits were not associated with PCP encounter frequency (i.e., number of PCP encounters; AOR=1.01, 95% CI=1.00, 1.03) or regularity (i.e., number of quarters with a PCP encounter; AOR=0.99, 95% CI=0.96, 1.03; Appendix Table 3, available online). Inpatient admissions also were not associated with the frequency (AOR=1.00, 95% CI=0.98, 1.03) or regularity (AOR=0.98, 95% CI=0.93, 1.02) of PCP encounters (Appendix Table 4, available online).

Post-hoc analyses of individuals who were nonadherent (PDC $< 80\%$, $n=5,212$) and not in control (HbA1c $\geq 8.0\%$, $n=326$) during the encounter/cadence period found a significant association between NIDM adherence and PCP encounter frequency (AOR=1.12, 95% CI=1.10, 1.15) and regularity (AOR=1.27, 95% CI=1.22, 1.33; Table 2). The odds of HbA1c control were not significantly associated with PCP encounter frequency (AOR=1.06, 95% CI=1.00, 1.12) or regularity (AOR=1.13, 95% CI=0.98, 1.30; Table 3).

DISCUSSION

The present findings indicate that PCP encounter frequency and regularity are significantly associated with an increased likelihood of NIDM adherence among

Table 1. Study Cohort Characteristics

Characteristics	n (%)
N	7,106 (100.0)
Female	3,639 (51.2)
Age, years, mean (SD)	72.4 (4.8)
U.S. region of residence	
Northeast	185 (2.6)
South	4,434 (62.4)
Midwest	1,834 (25.8)
West	653 (9.2)
Race/ethnicity	
White/Caucasian	5,748 (80.9)
Black/African American	933 (13.1)
Other	425 (6.0)
Rural resident	953 (13.4)
Medicare–Medicaid dual eligibility	537 (7.6)
Low-income subsidy	829 (11.7)
Special needs program	148 (2.1)
Charlson Comorbidity Index score	
0	2,694 (37.9)
1	1,995 (28.1)
2	1,340 (18.9)
3	1,077 (15.2)
Comorbid conditions	
Hypertension	3,799 (53.5)
Coronary artery disease	880 (12.4)
Heart failure	159 (2.2)
COPD	463 (6.5)
Insulin use	275 (3.9)
PCP encounter frequency, mean (SD) ^a	5.8 (3.5)
PCP encounter regularity, mean (SD) ^b	4.1 (1.9)
Medication adherence, diabetes	
Adherent	1,894 (26.7)
Nonadherent	5,212 (73.3)
Medication adherence, cardiovascular	
Adherent	2,856 (40.2)
Nonadherent	4,250 (59.8)
Medication adherence, hyperlipidemia	
Adherent	2,543 (35.8)
Nonadherent	4,563 (64.2)
HbA1c, mean (SD) ^c	6.8 (1.3)
ED visits, mean (SD)	0.3 (0.7)
Inpatient admissions, mean (SD)	0.1 (0.4)

Note: All characteristics measured during the baseline period, unless otherwise indicated.

^aMean PCP encounters during 24-month exposure/cadence period.

^bMean number of quarters with ≥ 1 PCP encounter(s) during the 8-quarter (24 months) exposure/cadence period.

^cMean HbA1c value calculated only for patients with HbA1c score in both the PCP exposure/cadence and the outcomes measurement periods ($n=3,076$).

COPD, chronic obstructive pulmonary disease; ED, emergency department; PCP, primary care provider.

individuals newly diagnosed with T2DM; however, HbA1c control, ED visits, and inpatient admissions are not associated with PCP cadence. These nonsignificant

findings were somewhat unexpected. Previous research has shown that HbA1c control was achieved more quickly for individuals with more frequent PCP encounters,⁹ and suggests a negative association between primary care use and ED visits.^{3,23,24}

These results suggest that PCP encounters could be more impactful for certain segments of the study cohort. Likely, individuals struggling to adhere to their medication regimens, or those unable to control their glucose levels, would benefit most from more frequent and regular visits to their PCP. Through post-hoc analyses, the data revealed that for those who were nonadherent to their NIDM at baseline, each additional PCP encounter during the encounter/cadence period increased the likelihood of NIDM adherence in the outcomes period by 12%. Additionally, there was a similar, yet nonsignificant, directional pattern for those with noncontrolled HbA1c at baseline—the likelihood of HbA1c control in the outcomes period increased with every PCP encounter in the encounter/cadence period. This finding aligns with existing evidence that the time to achieve diabetes control was significantly shorter for those who visited their PCP more often.⁹ Furthermore, this result may be expected as it is possible that the increased number of visits by patients to their PCP helped to reinforce the importance of medication adherence, thus, leading to the increase in numbers.

To the authors' knowledge, there is little evidence to guide providers on optimal PCP encounter cadence for those newly diagnosed with T2DM; the findings provide evidence that frequency and regularity of PCP encounters are associated with an increased likelihood of adherence to NIDM. More frequent and regular PCP encounters may be appropriate for individuals newly diagnosed with T2DM to establish adherence to NIDM, which is essential to diabetes management.²⁵ The findings also provide evidence to support more frequent PCP encounters for individuals previously nonadherent to NIDM, which is especially important for individuals newly diagnosed with T2DM, as it is imperative to promote diabetes management as early as possible to avoid life-limiting long-term complications.¹²

The analyses did not detect a significant association between PCP encounter cadence and ED visits or inpatient admissions. This may be due, in part, to the health of the study cohort participants. The study cohort included relatively healthy (CCI ≤ 3) individuals, enrolled in a Medicare Advantage health plan, with very few (one or fewer) average ED visits or inpatient admissions at baseline. Low average ED visits and inpatient admissions, with very little variance, may have made it difficult to detect a significant association with PCP encounter cadence. However, nonsignificant findings

Table 2. Odds of NIDM Adherence^a Accounting for PCP Encounter Frequency and Regularity^b

Characteristics	PCP encounter frequency		PCP encounter regularity	
	OR (95% CI)	p-value	OR (95% CI)	p-value
PCP encounter frequency				
Number of visits	1.12 (1.10, 1.15)	<0.001	—	—
PCP encounter regularity				
Number of quarters	—	—	1.27 (1.22, 1.33)	<0.001
Sex				
Female	0.79 (0.66, 0.94)	0.009	0.79 (0.66, 0.94)	0.008
Age	0.95 (0.94, 0.97)	<0.001	0.95 (0.94, 0.97)	<0.001
Race/ethnicity				
White/Caucasian	1.00	—	1.00	—
Black/African American	0.99 (0.77, 1.27)	0.716	0.96 (0.75, 1.23)	0.538
Other	1.08 (0.76, 1.53)	0.638	1.10 (0.78, 1.56)	0.527
Residence				
Urban	1.00	—	1.00	—
Rural	1.21 (0.95, 1.55)	0.120	1.21 (0.95, 1.54)	0.132
Medicare–Medicaid dual eligibility	0.56 (0.34, 0.92)	0.022	0.54 (0.33, 0.89)	0.015
Low-income subsidy	1.50 (1.04, 2.16)	0.030	1.60 (1.12, 2.30)	0.011
Special needs program	0.44 (0.20, 1.00)	0.049	0.44 (0.20, 0.99)	0.047
Charlson Comorbidity Index score				
0	1.00	—	1.00	—
1	1.06 (0.85, 1.33)	0.262	1.07 (0.83, 1.30)	0.251
2	1.24 (0.97, 1.58)	0.422	1.20 (0.94, 1.54)	0.492
3	1.36 (1.05, 1.77)	0.062	1.33 (1.02, 1.72)	0.074
Comorbid conditions				
Hypertension	0.71 (0.59, 0.86)	<0.001	0.68 (0.57, 0.83)	<0.001
Coronary artery disease	0.80 (0.60, 1.06)	0.121	0.82 (0.62, 1.09)	0.172
Heart failure	1.06 (0.58, 1.94)	0.846	1.08 (0.59, 1.98)	0.794
COPD	0.95 (0.66, 1.35)	0.753	0.96 (0.67, 1.37)	0.820
Insulin use	1.09 (0.75, 1.59)	0.658	1.29 (0.89, 1.86)	0.180
Medication adherence, cardiovascular ^c				
Adherent	1.99 (1.65, 2.40)	<0.001	1.95 (1.62, 2.35)	<0.001
Nonadherent	1.00	—	1.00	—
Medication adherence, hyperlipidemia ^c				
Adherent	1.77 (1.47, 2.13)	<0.001	1.73 (1.43, 2.08)	<0.001
Nonadherent	1.00	—	1.00	—

Note: Boldface indicates statistical significance ($p < 0.05$).

^aNonadherent in exposure/cadence period.

^b $n = 5,212$.

^cMeasured during the PCP exposure/cadence period.

COPD, chronic obstructive pulmonary disease; NIDM, non-insulin diabetes medication; PCP, primary care provider.

such as these should be considered when developing evidence-based guidelines for PCP encounter cadence.

Limitations

This study has several limitations, many of which are common to claims-based analyses, such as potential coding errors, missing data, and fixed variables. Relevant variables and outcomes were identified to the extent such information was available from administrative, medical, and pharmacy claims. The retrospective nature of the data prevents the authors from inferring a causal

relationship between PCP encounter cadence and the dependent variables. Prospective, longitudinal studies are needed to better understand PCP encounter cadence, and its effect on outcomes such as NIDM adherence and diabetes progression. Additionally, generalization of the study results should be approached with caution, as the geographic distribution of the study population does not match the U.S. population, with most of the cohort residing in the southern portion of the country. Furthermore, the low percentage of minorities enrolled in the study also limits the generalizability of the study results.

Table 3. Odds of HbA1c Control^a Accounting for PCP Encounter Frequency and Regularity^b

Characteristics	PCP encounter frequency		PCP encounter regularity	
	OR (95% CI)	p-value	OR (95% CI)	p-value
PCP encounter frequency				
Number of visits	1.06 (1.00, 1.12)	0.046	—	—
PCP encounter regularity				
Number of quarters	—	—	1.13 (0.98, 1.30)	0.083
Sex				
Female	0.57 (0.34, 0.95)	0.032	0.58 (0.35, 0.98)	0.041
Age	0.97 (0.92, 1.03)	0.315	0.97 (0.92, 1.03)	0.299
Race/ethnicity				
White/Caucasian	1.00	—	1.00	—
Black/African American	0.59 (0.27, 0.29)	0.432	0.58 (0.27, 1.25)	0.401
Other	0.69 (0.28, 1.74)	0.827	0.69 (0.27, 1.72)	0.830
Residence				
Urban	1.00	—	1.00	—
Rural	0.51 (0.2, 1.13)	0.097	0.52 (0.24, 1.15)	0.107
Medicare–Medicaid dual eligibility	2.14 (0.53, 8.62)	0.285	2.07 (0.52, 8.26)	0.305
Low-income subsidy	0.76 (0.28, 2.06)	0.583	0.82 (0.30, 2.20)	0.687
Special needs program	0.15 (0.02, 1.18)	0.072	0.16 (0.02, 1.27)	0.824
Charlson Comorbidity Index score				
0	1.00	—	1.00	—
1	1.34 (0.64, 2.83)	0.795	1.23 (0.58, 2.61)	0.906
2	1.42 (0.72, 2.80)	0.606	1.37 (0.70, 2.70)	0.558
3	1.29 (0.61, 2.75)	0.907	1.20 (0.57, 2.54)	0.986
Comorbid conditions				
Hypertension	3.08 (1.69, 5.61)	<0.001	3.06 (0.68, 5.57)	<0.001
Coronary artery disease	0.65 (0.27, 1.55)	0.330	0.66 (0.28, 1.58)	0.352
Heart failure	1.25 (0.27, 5.91)	0.777	1.24 (0.27, 5.76)	0.780
COPD	0.94 (0.29, 3.06)	0.921	0.94 (0.29, 3.02)	0.912
Insulin use	0.41 (0.22, 0.78)	0.007	0.44 (0.23, 0.83)	0.012
Medication adherence, diabetes ^c				
Adherent	3.15 (1.70, 5.86)	<0.001	3.05 (1.64, 5.67)	0.004
Nonadherent	1.00	—	1.00	—
Medication adherence, cardiovascular ^c				
Adherent	0.99 (0.56, 1.77)	0.981	0.97 (0.55, 1.73)	0.925
Nonadherent	1.00	—	1.00	—
Medication adherence, hyperlipidemia ^c				
Adherent	1.00 (0.55, 1.82)	0.997	1.02 (0.56, 1.85)	0.959
Nonadherent	1.00	—	1.00	—

Note: Boldface indicates statistical significance ($p < 0.05$).

^aWithout baseline HbA1c control.

^b $n = 326$.

^cMeasured during the PCP exposure/cadence period.

COPD, chronic obstructive pulmonary disease; PCP, primary care provider.

This study utilized data from a Medicare Advantage population newly diagnosed with T2DM with a CCI score ≤ 3 ; therefore, results may not be generalizable to other populations. This was an expected trade-off, as it was important to identify a somewhat restricted and homogeneous population to detect a true relationship between PCP encounter cadence and outcomes.

CONCLUSIONS

Before this study, there has been limited evidence to guide appropriate PCP encounter cadence. The current findings provide evidence that, for individuals newly diagnosed with T2DM and with few comorbid conditions, more frequent and regular PCP encounters are associated with an increased likelihood of adherence to

NIDM, which is an essential component of long-term diabetes management. Future research is needed to examine the relationship between PCP encounter cadence and diabetes outcomes among other populations, such as those with type 1 diabetes mellitus or additional comorbid conditions.

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JMD contributed to study management. SWE, TC, and GH contributed to data analysis. All authors contributed to study design, data interpretation, and manuscript development.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2019.04.018>.

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