Disparities in Utilization of Preventive Services for Diabetes Complications Among US Adults with Diabetes

GERALD OBINNA OZOTA
PhD Student
Pharmaceutical Economics and Policy
Chapman University School of Pharmacy

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INTRODUCTION

- Diabetes mellitus is a group of metabolic disorders that affect the metabolism of glucose and are characterized by elevated blood glucose.
- The 2025 International Diabetes Federation (IDF) diabetes report estimated 38 million people with diabetes in the United States in 2024
- The American Diabetes Association estimates the cost of managing prediabetes and diabetes at $412.9 billion, and this puts people with diabetes at a 2.6 times greater healthcare cost.

INTRODUCTION

These complications (diabetic neuropathy, nephropathy, and retinopathy etc.) arising from diabetes pose a serious burden to quality of life and functional daily activities

In previous studies, preventive services are operationalized as receiving annual foot and dilated eye exams, which align with the American Diabetes Association's recommendations. However, these studies have examined diabetes complication preventive services individually, using multiple databases without.

Service	Recommended Frequency	Clinical Purpose	Guideline Source
HbA1c Testing	≥2 times/year (stable); quarterly if uncontrolled	Monitor long-term glycemic control	American Diabetes Association
Eye Exam (Retinopathy Screening)	Annually	Detect and prevent diabetic retinopathy	American Diabetes Association
Foot Exam	≥1 time/year	Identify neuropathy, ulcers, amputation risk	Centers for Disease Control and Prevention
Lipid Profile (Cholesterol Test)	Annually	Reduce cardiovascular disease risk	American Diabetes Association
Influenza Vaccination	Annually	Prevent infection-related complications	Centers for Disease Control and Prevention

Aims and Objectives

To evaluate the determinants and consequences of receipt of recommended diabetes preventive services among U.S. adults, with particular focus on the role of disease severity and its relationship with healthcare utilization.

Aims and Objectives

Aim 1:

Determine the prevalence and sociodemographic determinants of receiving recommended diabetes preventive services

Rationale:

Uptake of preventive services remains suboptimal and may vary across population subgroups.

Approach:

Using nationally representative MEPS data (2018–2022), we will estimate the prevalence of receiving all five recommended diabetes preventive services (CARE_ALL5) and examine associations with race/ethnicity, insurance status, education, age, and sex using survey-weighted logistic regression.

Hypothesis 1:

Individuals with lower socioeconomic status (e.g., lower education, public or no insurance) and minority racial/ethnic groups will have lower odds of receiving all recommended preventive services.

Aims and Objectives

Aim 2:

Evaluate the impact of disease severity on receipt of preventive services and assess confounding

Rationale:

Patients with greater disease burden may have more healthcare contact, potentially influencing preventive care uptake and confounding observed associations.

Approach:

We will construct a Chronic Disease Severity Index (CDSI) and incorporate it into multivariable models. Sensitivity analyses will compare models with and without CDSI to quantify confounding effects.

Hypothesis 2:

Higher disease severity (as measured by CDSI) will be associated with a greater likelihood of receiving preventive services, and adjusting for CDSI will attenuate sociodemographic disparities.

Aims and Objectives

Aim 3:

Assess the association between receipt of preventive services and medication utilization

Rationale:

Preventive care is often assumed to reduce downstream healthcare utilization, but real-world patterns may reflect increased engagement with care.

Approach:

We will examine the relationship between CARE_ALL5 and medication utilization (total prescription refills) using survey-weighted negative binomial regression, adjusting for sociodemographic factors and CDSI.

Hypothesis 3:

Receipt of all recommended preventive services will be associated with higher medication utilization, reflecting greater healthcare engagement rather than reduced utilization.

Significance

This study will provide novel insight into whether preventive care functions as a cost-reducing strategy or as a marker of healthcare engagement, with implications for policy, resource allocation, and health equity.

Methods

Study Design

This study will use a cross-sectional design analyzing pooled data from the 2018–2022 Medical Expenditure Panel Survey (MEPS). The study population will be restricted to US adults aged ≥18 years with diagnosed diabetes, identified using the MEPS diabetes indicator (DCSDIABDX = 2).

MEPS employs a complex, multistage probability sampling design; therefore, all analyses were conducted using diabetes care person-level weight (DIABWEIGHT), which will be pooled and divided by 5 to account for multiple years (DIABWT_P). Stratification (STRATANN) and clustering (PSUANN) variables will be applied in all models to ensure nationally representative, design-adjusted estimates.

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Methods

Category	Variables	Description
Dependent Variables	CARE_ALL5	Receipt of all 5 diabetes preventive services (Yes/No)
	TOTAL_REFILLS	Medication utilization (total prescription refills)
Key Independent Variables	CARE_ALL5	Exposure in utilization model
	RACE_ETH	Race/ethnicity
	INS_CAT	Insurance status
	EDU3	Education level
	SEX_F	Sex
	AGE	Continuous age
Covariate (Adjustment)	CDSI	Chronic Disease Severity Index (disease burden)
Additional / Stratification	YEAR	Survey year (2018–2022)
	CDSI_CAT	Categorized disease severity
	REFILL_CAT	Categorized utilization
	Individual services	Foot exam, eye exam, A1C, cholesterol, flu

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Methods

Condition Category	Variable (MEPS)	Definition	CDSI Points
Cardiovascular Events	HEARTATTEV	History of myocardial infarction (heart attack)	10
	CHEARTDIEV	Coronary heart disease	8
	ANGIPECEV	Angina pectoris	8
	STROKEV	Stroke or transient ischemic attack	7
Diabetes-related Complications	DIAKIDNPR	Diabetes-related kidney problems	3
	DIAEYEPR	Diabetes-related eye problems	3
Functional Limitation	LMTPHYS / DIFWLKCLM	Physical limitation or difficulty walking/climbing	3
Metabolic Conditions	CHOLHIGHEV	High cholesterol	2
Hypertension (Multiple diagnoses)	HYP2TIME	Repeated or multiple hypertension diagnoses	2
Hypertension (Single diagnosis)	HYPERTENEV	Single hypertension diagnosis	1

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The CDSI was calculated as an additive score by summing weighted points assigned to each condition. Individuals with multiple comorbid conditions accumulated higher scores, reflecting greater disease burden and severity.

CDSI Score Range	Category	Interpretation
0	None	No chronic disease burden
1–3	Mild	Low severity / few conditions
4–7	Moderate	Moderate disease burden
≥8	Severe	High comorbidity and/or severe conditions

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Methods

Statistical Analysis

Weighted prevalence estimates will be obtained using PROC SURVEYMEANS, and subgroup differences will be examined using design-adjusted crosstabulations (PROC SURVEYFREQ).

To assess disparities, survey-weighted multivariable logistic regression models (PROC SURVEYLOGISTIC) were used to estimate adjusted odds ratios (AORs) for each preventive service outcome.

All analyses will be conducted in SAS 9.4, accounting for MEPS' complex sampling design to produce nationally representative and variance-corrected estimates.

$$log(\pi 1-\pi)=\beta 0+\beta 1X1+\ldots+\beta pXp$$

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Methods

$\log(1-\pi\pi)=\beta 0+\beta 1(\text{Race/Ethnicity})+\beta 2(\text{Income})+\beta 3(\text{Education})+\beta 4(\text{Insurance})+\beta 5(\text{income category})+\ldots+\beta pXp$

β_0 (Intercept)
The log-odds of receiving all 5 services when all predictors = 0 (reference group).

β_1 (Race/Ethnicity)
Each racial/ethnic category (compared with the reference group, usually Non-Hispanic White) changes the log-odds of receiving all 5 services.
A negative $\beta_1 \rightarrow$ lower odds of receiving all 5 services.
A positive $\beta_1 \rightarrow$ higher odds

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Results

Aim 1: Prevalence & Determinants of Preventive Care

- **Low uptake of comprehensive care:** Only ~15% of adults received all 5 recommended diabetes preventive services (CARE_ALL5).
- **Substantial variation across services:**
A1C testing was highest (~78%), while cholesterol screening was lowest (~38%), indicating gaps in comprehensive care delivery.
- **Sociodemographic disparities observed:**
Lower uptake among racial/ethnic minorities and individuals with lower educational attainment.

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Results

Table 1: Sample Characteristics by Receipt of All 5 Services

Characteristic	Did NOT Receive All 5 n (%)	Received All 5 n (%)	Row % Received	p-value
Overall	18,251,369 (84.7)	3,292,633 (15.3)	—	—
Race/Ethnicity				**<0.001**
NH White	10,639,184 (82.3)	2,282,312 (17.7)	17.7%	
NH Black	2,685,930 (87.1)	396,145 (12.9)	12.9%	
Hispanic	3,124,804 (90.1)	341,566 (9.9)	9.9%	
Other	1,801,452 (86.9)	272,610 (13.1)	13.1%	
Insurance				**<0.001**
Dual	1,923,395 (85.3)	331,748 (14.7)	14.7%	
Medicare	6,955,497 (78.0)	1,961,953 (22.0)	22.0%	
Medicaid	1,943,071 (91.4)	183,169 (8.6)	8.6%	
Private	6,637,370 (89.8)	756,260 (10.2)	10.2%	
Uninsured	732,897 (92.8)	56,761 (7.2)	7.2%	
Age Group				**<0.001**
18–34	954,146 (95.3)	47,328 (4.7)	4.7%	
35–49	2,699,863 (92.7)	211,596 (7.3)	7.3%	
50–64	6,837,306 (87.5)	976,162 (12.5)	12.5%	
65+	7,760,054 (79.0)	2,057,546 (21.0)	21.0%	
Sex				**0.045**
Male	9,054,461 (83.4)	1,797,827 (16.6)	16.6%	
Female	9,196,908 (86.0)	1,494,806 (14.0)	14.0%	
CDSI (Severity)				**<0.001**
0	1,806,660 (94.3)	109,787 (5.7)	5.7%	
1–3	4,072,821 (86.9)	613,454 (13.1)	13.1%	
4–7	7,031,994 (85.2)	1,223,673 (14.8)	14.8%	
8+	5,339,894 (79.9)	1,345,718 (20.1)	20.1%	

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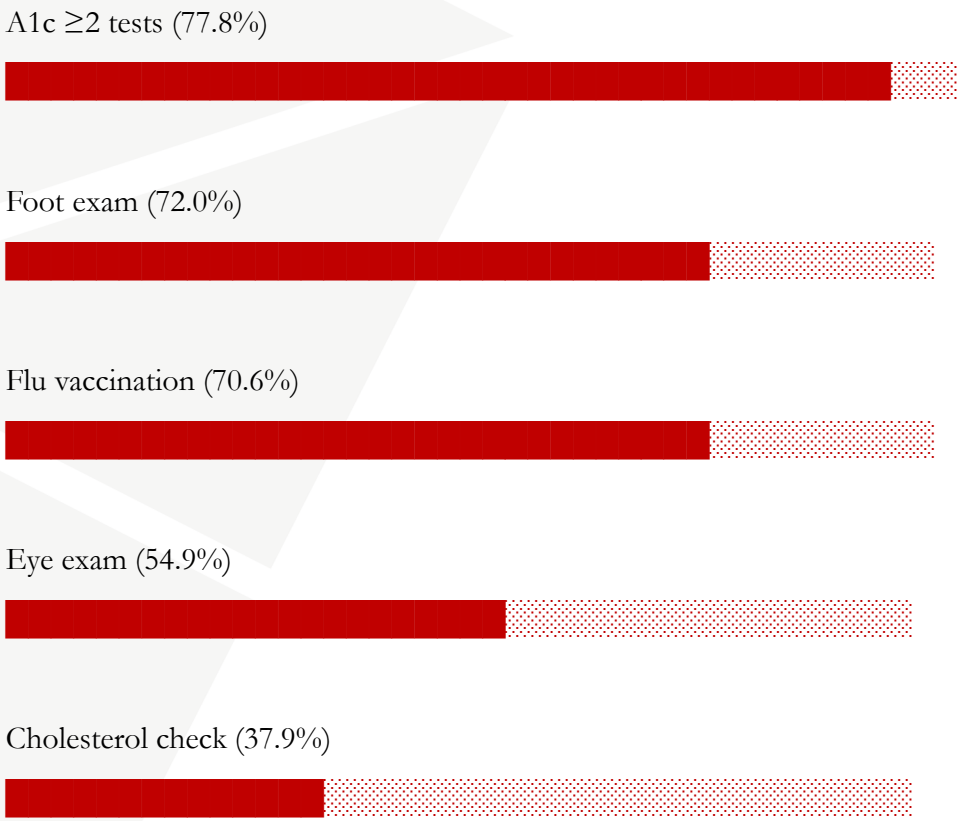
Results

INDIVIDUAL PREVENTIVE SERVICES



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Aim 2: Role of Disease Severity (CDSI)

- **Higher disease severity increased the likelihood of receiving preventive care**, indicating greater healthcare contact among sicker patients.
- **CDSI was a strong independent predictor of medication utilization**, confirming that clinical burden drives healthcare use.
- **Adjustment for CDSI attenuated several associations**, particularly for age and education, demonstrating confounding by underlying health status.

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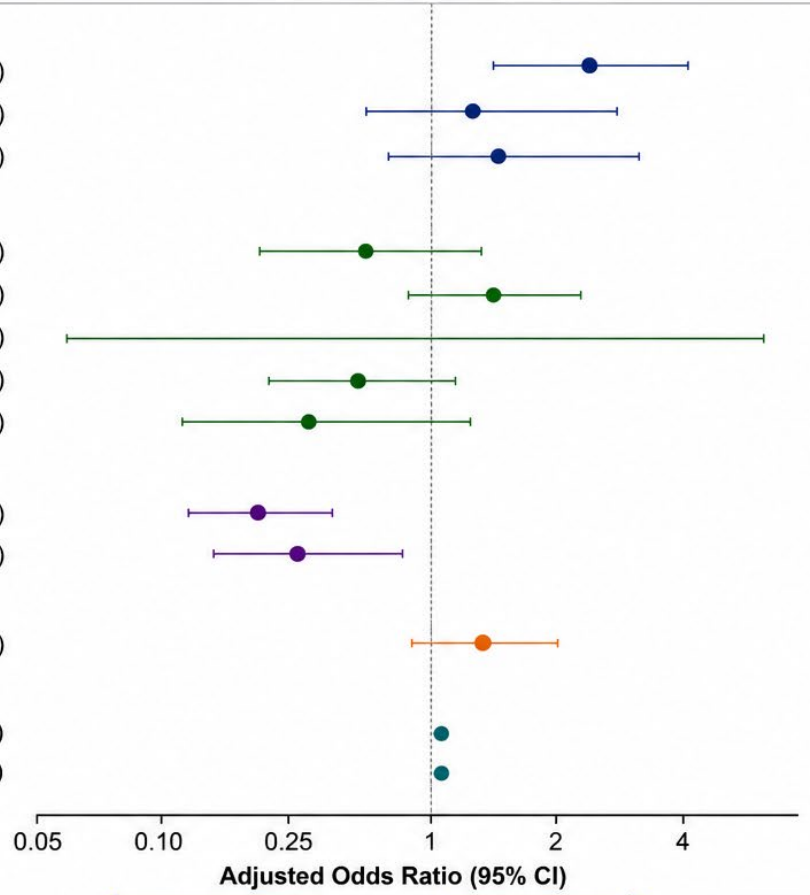
Results

Adjusted Odds of Receiving All 5 Diabetes Care Services

(Survey-Weighted Logistic Regression, MEPS 2018–2022)

Predictor	aOR (95% CI)	p-value
Race / Ethnicity (Ref: Hispanic)		
NH White	1.50 (1.05 – 2.16)	**0.027**
NH Black	1.15 (0.74 – 1.78)	0.540
Other	1.23 (0.78 – 1.92)	0.373
Insurance (Ref: Dual eligible)		
Medicaid	0.82 (0.52 – 1.29)	0.394
Medicare	1.21 (0.91 – 1.61)	0.191
Other public	0.36 (0.05 – 2.68)	0.314
Private	0.75 (0.51 – 1.11)	0.154
Uninsured	0.57 (0.29 – 1.14)	0.110
Education (Ref: Bachelor's or higher)		
High school or less	0.61 (0.48 – 0.78)	**<0.001**
Other degree	0.68 (0.49 – 0.95)	**0.023**
Sex (Ref: Female)		
Male	1.15 (0.95 – 1.40)	0.161
Continuous Variables (per 1 unit increase)		
Age (per 1 year)	1.02 (1.01 – 1.03)	**0.002**
CDSI (per 1 point)	1.02 (1.01 – 1.03)	**0.001**



aOR = adjusted odds ratio; CI = confidence interval

Model adjusted for race/ethnicity, insurance, education, sex, age, and CDSI

Survey design: stratified, clustered (Taylor series variance estimation), weighted

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Results

Sensitivity Analysis:

Adjustment for disease severity (CDSI) resulted in minimal changes in effect estimates (<10%), indicating limited confounding. The associations between education, race/ethnicity, and receipt of preventive services remained robust after accounting for disease severity.

Predictor	Model 1: No CDSI aOR (95% CI)	Model 2: +CDSI aOR (95% CI)	% Change	Interpretation
Race/Ethnicity (Ref: Hispanic)				
NH White	**1.54 (1.08–2.21)**	**1.50 (1.05–2.16)**	↓2.6%	Stable effect
NH Black	1.18 (0.76–1.83)	1.15 (0.74–1.78)	↓2.5%	No change
Other	1.26 (0.80–1.97)	1.23 (0.78–1.92)	↓2.4%	No change
Insurance (Ref: Dual)				
Medicaid	0.78 (0.49–1.22)	0.82 (0.52–1.29)	↑5.8%	Slight shift
Medicare	1.13 (0.86–1.50)	1.21 (0.91–1.61)	↑6.7%	Slight increase
Other public	0.31 (0.04–2.28)	0.36 (0.05–2.68)	↑15%	Unstable (small N)
Private	0.69 (0.47–1.01)	0.75 (0.51–1.11)	↑9.0%	Moves toward null
Uninsured	0.53 (0.27–1.05)	0.57 (0.29–1.14)	↑7.5%	Moves toward null
Education (Ref: Bachelor's+)				
High school or less	**0.63 (0.49–0.81)**	**0.61 (0.48–0.78)**	↓2.7%	Strong, unchanged
Other degree	**0.69 (0.50–0.97)**	**0.68 (0.49–0.95)**	↓1.4%	Stable
Sex (Ref: Female)				
Male	1.18 (0.97–1.43)	1.15 (0.95–1.40)	↓2.5%	No change
Age (continuous)	**1.022 (1.010–1.035)**	**1.019 (1.007–1.032)**	↓0.3%	Stable
CDSI	—	**1.019 (1.008–1.030)**	—	New predictor

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Results

Aim 3: Preventive Care & Medication Utilization

- **Receiving all 5 preventive services was associated with higher medication utilization** (IRR = 1.14, $p < 0.001$). suggesting that patients receiving comprehensive preventive care may be more engaged with the healthcare system and therefore more likely to receive prescription medications.
- **This association remained significant after adjusting for CDSI**, indicating an independent effect.
- **Insurance status was the strongest driver of utilization**, with dual-eligible individuals showing >3× higher use compared to the uninsured.
- **Racial disparities persisted**, with Hispanic and NH Black individuals having lower utilization compared to NH White individuals.

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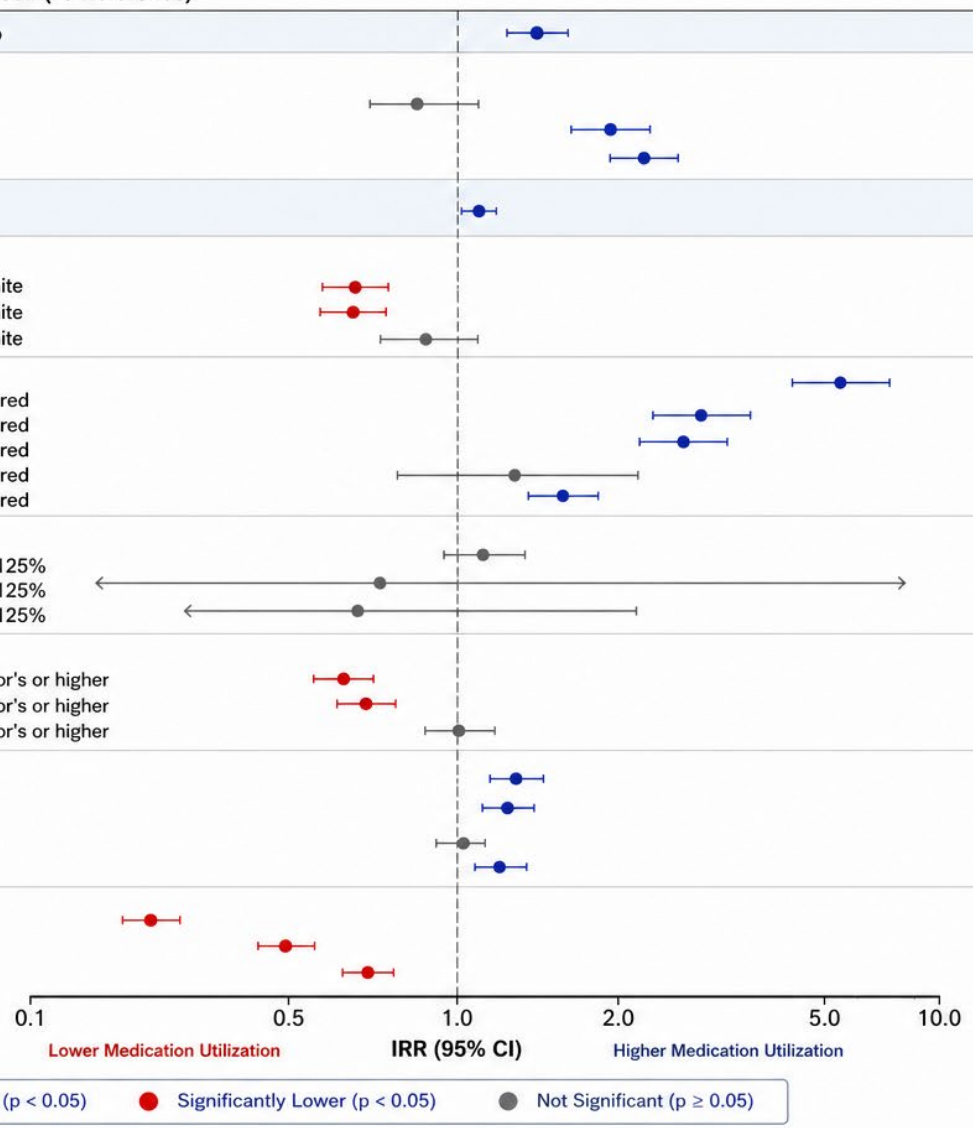
Results

Adjusted Incidence Rate Ratios (IRR) for Medication Utilization (Total Refills)

Negative Binomial Regression (MEPS 2018–2022, N = 6,035)

Variable	Comparison (vs Reference)	IRR (95% CI)	p-value
CARE_ALL5	Yes vs No	1.14 (1.08 – 1.20)	<0.0001
AGE GROUP (vs ≥65)			
18–34	vs ≥65	0.90 (0.79 – 1.03)	0.1271
35–49	vs ≥65	1.31 (1.19 – 1.44)	<0.0001
50–64	vs ≥65	1.40 (1.28 – 1.53)	<0.0001
SEX (vs Male)	vs Male	1.05 (1.01 – 1.09)	0.0159
RACE / ETHNICITY (vs NH White)			
Hispanic	vs NH White	0.79 (0.73 – 0.86)	<0.0001
NH Black	vs NH White	0.78 (0.72 – 0.86)	<0.0001
Other	vs NH White	0.93 (0.83 – 1.05)	0.2456
INSURANCE (vs Uninsured)			
Dual	vs Uninsured	3.28 (2.89 – 3.72)	<0.0001
Medicaid	vs Uninsured	2.48 (2.16 – 2.75)	<0.0001
Medicare	vs Uninsured	2.33 (2.06 – 2.64)	<0.0001
Other public	vs Uninsured	1.23 (0.84 – 1.82)	0.2941
Private	vs Uninsured	1.46 (1.31 – 1.63)	<0.0001
INCOME (vs Poor <125%)			
High ≥400%	vs Poor <125%	1.09 (0.97 – 1.23)	0.1742
Low 125–199%	vs Poor <125%	0.83 (0.14 – 4.77)	0.8298
Middle 200–399%	vs Poor <125%	0.73 (0.28 – 1.87)	0.5066
EDUCATION (vs Bachelor's or higher)			
High school or less	vs Bachelor's or higher	0.70 (0.63 – 0.77)	<0.0001
Some college / Associate	vs Bachelor's or higher	0.77 (0.70 – 0.85)	<0.0001
Graduate degree	vs Bachelor's or higher	1.00 (0.90 – 1.12)	0.9570
YEAR (vs 2022)			
2018	vs 2022	1.18 (1.10 – 1.25)	<0.0001
2019	vs 2022	1.15 (1.07 – 1.22)	<0.0001
2020	vs 2022	1.02 (0.96 – 1.08)	0.5993
2021	vs 2022	1.10 (1.04 – 1.17)	0.0015
DISEASE SEVERITY (CDSI_CAT) (vs 8+)			
0	vs 8+	0.42 (0.39 – 0.46)	<0.0001
1–3	vs 8+	0.62 (0.59 – 0.66)	<0.0001
4–7	vs 8+	0.80 (0.76 – 0.84)	<0.0001



Model: Negative Binomial Regression
Outcome: Total Prescription Refills
Weights: DIABWT_P

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Limitation

- The study is observational and cross-sectional; therefore, causal relationships cannot be established.

- Preventive services (e.g., eye exam, A1C) are self-reported in MEPS and may be subject to recall or reporting bias.

- Although we adjusted for disease severity using CDSI, unmeasured confounders (e.g., provider behavior, health literacy, access to specialists) may still influence the results.

Findings should be interpreted as associations reflecting healthcare engagement rather than causal effects of preventive care.

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Conclusion

This study demonstrates that the uptake of comprehensive diabetes preventive services among U.S. adults remains low, with substantial variation across individual components of care. Significant sociodemographic disparities persist, particularly by race/ethnicity and educational attainment, highlighting ongoing gaps in equitable access to preventive healthcare.

Disease severity, as measured by the Chronic Disease Severity Index (CDSI), was a strong determinant of both preventive care and medication utilization, indicating that individuals with greater clinical burden are more likely to interact with the healthcare system. However, adjustment for disease severity only partially explained observed disparities, suggesting that structural and access-related factors continue to play a critical role.

Importantly, receipt of all five recommended preventive services was associated with higher, not lower, medication utilization, even after accounting for disease severity. This finding suggests that comprehensive preventive care functions as a marker of healthcare engagement rather than a mechanism for reducing downstream resource use.

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THANKS

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