Sex Based Disparities in Cost Related Medication Nonadherence in Older Adult Patients with Type 2 Diabetes from the All of Us Database

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BACKGROUND

CRITICAL BURDEN
Type 2 Diabetes (T2DM) affects nearly 30% of all adults over the age of 65 in the U.S. -- effective medication adherence is crucial to prevent serious complications.

COST BARRIERS
High medication costs hinder adherence, leading to poorer outcomes; understanding this barrier is essential for improving outcomes.

SEX DISPARITIES
Investigating sex-based disparities in cost-related medication nonadherence (CRN) can inform targeted interventions

AIM

To examine the association of sex and CRN in patients over the age of 65 who are prescribed medication for the treatment of T2DM

METHODS

- Data from the **All of Us Research Program**, a diverse biomedical database funded by the NIH
- A total of **6,450 participants aged 65 years or older** and diagnosed with **T2DM** with a **prescription for medication** used to treat T2DM **within 90 days** of diagnosis
- **Independent variable** was sex at birth
  - Male vs Female
- **Outcome variables** were responses to **seven questions on CRN**
  1. Was there any time when you needed prescription medicines but did not get it because you *could not afford it*?
  2. Did you *skip medication doses* to save money?
  3. Did you *take less medicine* to save money?
  4. Did you *delay filling a prescription* to save money?
  5. Did you *ask* your doctor *for a lower cost medication* to save money?
  6. Did you *buy prescription drugs from another country* to save money?
  7. Did you *use alternative therapies* to save money?
- **Covariates:**
- **Sociodemographic factors** (Age at time of survey, Income, Race/Ethnicity, Education, Insurance Status)
- **BMI** (encoded as categorical variable)
- **Comorbidities** (Charlson Comorbidity Index, Alcohol Use Disorder, Substance Use Disorder, Cigarette Use History)
- **Medication Use History** (Biguanide, DPP-4 Inhibitor, GLP-1 Agonist, SGLT-2 Inhibitor, Sulfonylurea, Thiazolidinediones, Alpha-glucosidase inhibitors, Bile Acid Sequestrants, Dopamine-2 Agonists, Meglitinides, Insulins and Analogues)

Statistical Analysis
- **Chi-square and Analysis of Variance** (ANOVA) were used to test the baseline characteristics of the sample grouped by sex
- **Multivariable Logistic Regression Models** were used to estimate the association between sex and CRN, adjusting for all covariates. All analyses were performed on the *All of Us* Researcher Workbench Platform using *sklearn* in Python v3.10.12

RESULTS

Table 1

Baseline Descriptive Characteristics of the Sample by Sex (N=6450).

Characteristic	Male (n=3075)	Female (n=3375)	p-value
Age, Median (IQR)	74.00 (70.00,78.00)	72.00 (68.00,76.00)	<0.0001
Race and Ethnicity, No. (%)			
Non-Hispanic White	2382 (77.5)	1950 (60.6)	
Hispanic/Latino	239 (7.8)	449 (13.9)	
Non-Hispanic Black	252 (8.2)	651 (20.2)	
Non-Hispanic Asian	47 (1.5)	34 (1.1)	<0.0001
Non-Hispanic Multiple	36 (1.2)	35 (1.1)	
Other Ethnicity	34 (1.1)	33 (1.0)	
Non-Hispanic MENA	NA	NA	
Non-Hispanic NHPI	NA	NA	
Income, No. (%)			
<25k	420 (13.7)	826 (25.7)	
25k - 50k	538 (17.5)	664 (20.6)	
50k - 100k	885 (28.8)	702 (21.8)	<0.0001
100k - 150k	479 (15.6)	275 (8.5)	
>150k	340 (11.1)	174 (5.4)	
Education, No. (%)			
Less than High School or Equiv.	152 (4.9)	316 (9.8)	
High School or GED	362 (11.8)	535 (16.6)	<0.0001
Some College/Vocational College or Advanced	822 (26.7)	1016 (31.6)	
Degree	1704 (55.4)	1295 (40.2)	
Insurance, No. (%)			
Employer or Union	385 (12.5)	436 (13.5)	
Medicaid	314 (10.2)	359 (11.2)	
Medicare	754 (24.5)	759 (23.6)	
Mixed	166 (5.4)	57 (1.8)	
Purchased	57 (1.9)	85 (2.6)	
Other Insurance	161 (5.2)	83 (2.6)	<0.0001
No Insurance	64 (2.1)	71 (2.2)	
Employer/Medicare	314 (10.2)	359 (11.2)	
Medicare/Medicaid	109 (3.5)	278 (8.6)	
Medicare/Other	287 (9.3)	53 (1.6)	
Medicare/Purchased	250 (8.1)	271 (8.4)	
BMI , No. (%)			
<18.5	NA	NA	
18.5 - 25	308 (10.0)	299 (9.3)	<0.0001
25 - 30	966 (31.4)	704 (21.9)	
>30	1798 (58.5)	2200 (68.3)	
Comorbidities, No. (%)			
Cigarette Use	1648.0 (53.6)	1343.0 (41.7)	<0.0001
Alcohol Use Disorder	204 (6.6)	72 (2.2)	<0.0001
Substance Use Disorder	195 (6.3)	158 (4.9)	<0.0001
Charlson Comorbidity Index	6.00 (5.00,8.00)	6.00 (5.00,8.00)	<0.0001

Table 1. BMI – Body Mass Index in kg/m², in compliance with All of Us Data Dissemination Policy, categories with <20 participants marked as NA

Figure 1

Prevalence of CRN Responses by Sex (N=6450).
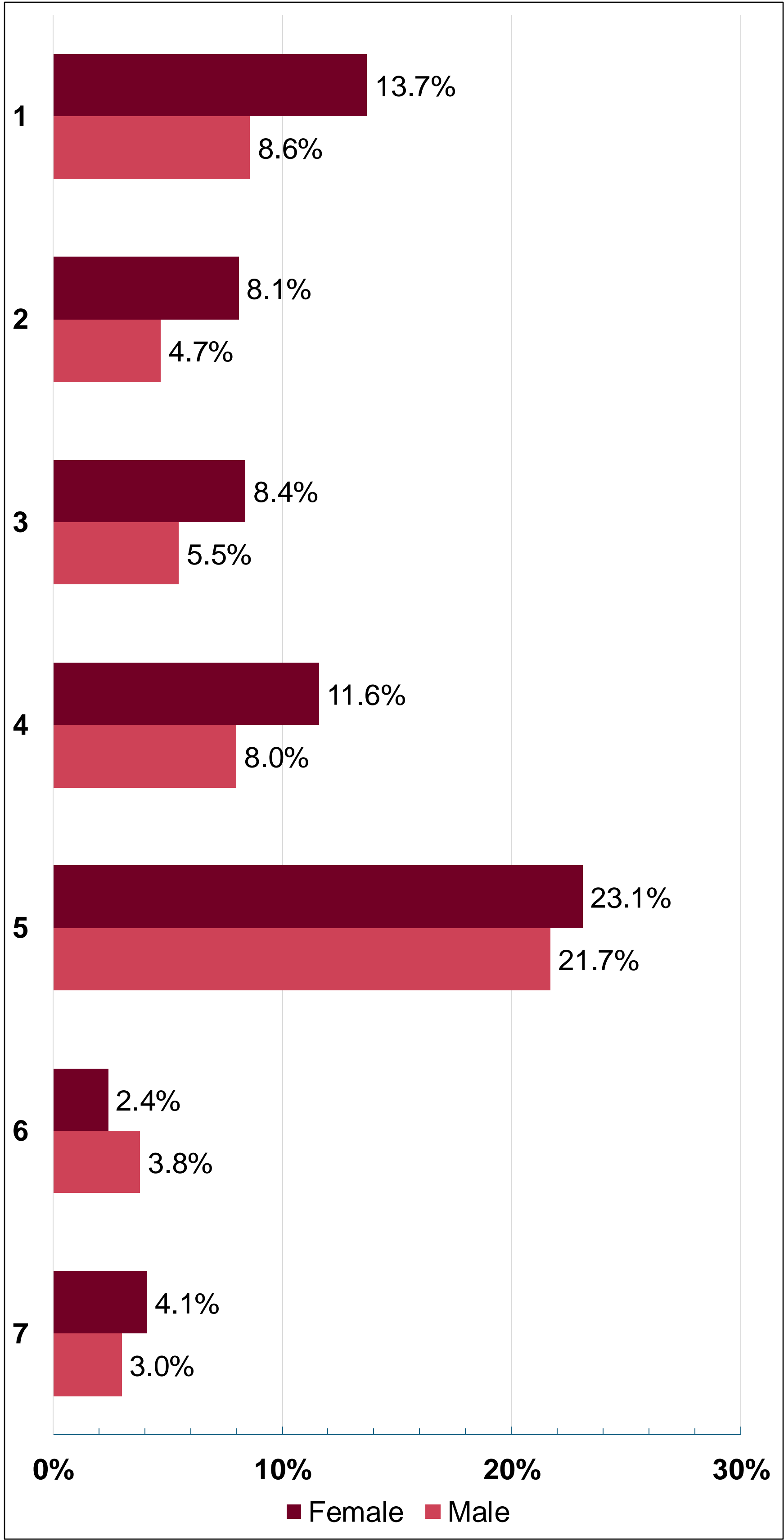
Figure 1. Question number corresponds to the questions listed in the methods section on the left.

Table 2

OR and aOR for Univariable and Multivariable Logistic Regression Model for CRN as a Function of Sex (N=6450)

Medication Barrier	Male (n=3075)	Female (n=3375)	OR (95% CI)	P-value	aOR (95% CI)	p-value
1. Could not afford medication	264 (8.6)	461 (13.7)	1.68 (1.44-1.98)	<0.0001	1.28 (1.07-1.53)	0.0066
2. Skipped medication to save money	144 (4.7)	274 (8.1)	1.8 (1.46-2.21)	<0.0001	1.46 (1.16-1.84)	0.0014
3. Took less medication to save money	168 (5.5)	282 (8.4)	1.58 (1.29-1.92)	<0.0001	1.26 (1.01-1.58)	0.0374
4. Delayed filling medication	245 (8.0)	390 (11.6)	1.51 (1.28-1.78)	<0.0001	1.25 (1.03-1.51)	0.0217
5. Asked for lower cost medication	668 (21.7)	781 (23.1)	1.08 (0.96-1.22)	0.1732	1.04 (0.91-1.19)	0.5768
6. Bought medications from another country	118 (3.8)	80 (2.4)	0.61 (0.46-0.81)	0.0007	0.64 (0.46-0.87)	0.0049
7. Used alternative therapy to save money	93 (3.0)	138 (4.1)	1.37 (1.05-1.79)	0.0221	1.06 (0.79-1.43)	0.7056

Table 2. OR – Odds ratio, CI – Confidence interval, aOR – Adjusted Odds Ratio; aOR adjusts for sociodemographic factors, BMI, comorbidities, medication use history

DISCUSSION

RESULTS & INTERPRETATION
- Older adult **female patients** with diabetes had **higher odds** of the following compared to older adult male patients with diabetes
  - **Not being able to afford medication.**
  - **Skipping medication to save money.**
  - **Taking less medication to save money.**
  - **Delaying filling medication.**

- Older adult **female patients** with diabetes had **lower odds** of the following compared to older adult male patients with diabetes
  - **Buying medications from a foreign country to save money.**

STUDY STRENGTHS
- Utilizes a large, diverse, representative sample of older adults with diabetes in the United States enhancing the generalizability of the study
- Leverages electronic health record data on comorbidities and medication history combined with responses to survey questions
- Multivariable logistic regression approach allowed for multiple explanatory variable to be explored simultaneously, reducing the effect of confounding factors

STUDY LIMITATIONS
- Limited details on level of medication non-adherence and complications from non-adherence
- Limited data on certain ethnic groups, preventing inclusion of more detailed ethnic categories in regression model
- CRN questions were not specific to diabetes or its medications and may thus represent CRN across a broad range of conditions and medications

Figure 2

THERE ARE A **VARIETY OF FACTORS INFLUENCING CRN** IN OLDER ADULTS.

Other factors can include
- Health literacy
- Attitude towards brand medication
- Type of disease
- Monitoring of medication therapy
- Awareness and belief in therapy
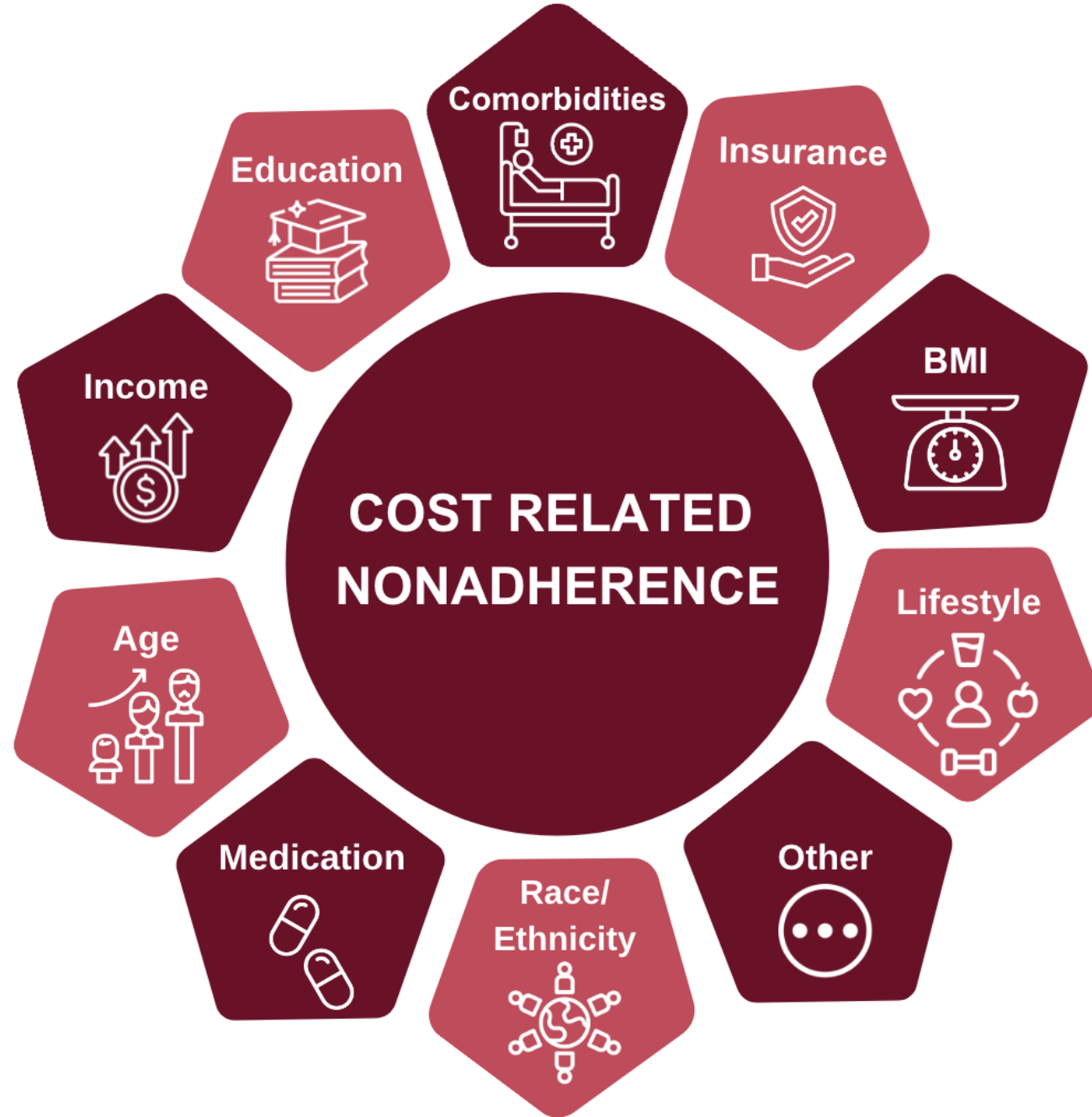- Community attitude towards medicine
- Trust in healthcare providers

Figure 2. Variables used in logistic regression model that impact impact cost related nonadherence. Other variables for future research are mentioned in the caption to the right

IMPLICATIONS

PRECISION TAILORED INTERVENTIONS
- Identifying older adults at higher risk of CRN is critical to improve outcomes involving the long-term complications of diabetes.

RESEARCH NEEDS
- Examine the relationship between CRN and outcome measurements such as major adverse cardiac events, emergency room visits, and other complications of diabetes.

FUTURE POLICY
- Future policy should involve addressing the barriers to CRN; interventions can include real-time benefit pricing tools, supplementing brand-name medications with generics, and improving healthcare access and coverage.

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