The Effect of Reduced Drug Copayments on Adherence to Oral Diabetes Medications Among Childless Adults in Wisconsin Medicaid

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ABSTRACT

BACKGROUND: Medication adherence is an indicator of the quality of drug use, which is associated with better health outcomes and reduced health care expenditures. Drug cost sharing can be a barrier to adherence, especially for low-income individuals with chronic conditions. Most of the existing studies in a Medicaid population have evaluated the effects of increasing drug copayments, but few studies have evaluated the effects of reducing drug copayments on medication adherence. Medicaid coverage for low-income childless adults in Wisconsin was expanded on April 1, 2014, which included reductions in drug copayments and monthly caps on out-of-pocket spending.

OBJECTIVE: To evaluate changes in adherence to oral diabetes medications using proportion of days covered (PDC) among Medicaid childless adults with type 2 diabetes after the 2014 Medicaid drug copayment reduction.

METHODS: A difference-in-differences design was used to compare the changes in medication adherence between childless adults (treatment group) and parents/caretakers (control group). Wisconsin Medicaid's administrative enrollment records, pharmacy claims, and medical claims data were analyzed. Medication adherence was evaluated for 4 commonly used oral diabetes drug classes (i.e., biguanides, sulfonylureas, dipeptidyl peptidase-IV inhibitors, and thiazolidinediones) by adapting the medication adherence quality measures endorsed by the Pharmacy Quality Alliance. The PDC for all diabetes drugs was calculated among patients who filled ≥ 2 prescriptions for any of the 4 drug classes. PDC for each drug class was also measured among patients who had ≥ 2 drug fills for each drug class. The proportion of adherent patients was evaluated using a threshold of $\text{PDC} \geq 0.80$.

RESULTS: Average PDC for all diabetes drugs was 0.87 in the childless adults at baseline and significantly increased by 0.02 ($P=0.025$) relative to the parents/caretakers after the copayment reduction. The baseline proportion of adherent patients ($\text{PDC} \geq 0.80$) among the childless adults was 76% and significantly increased by 6.2 percentage points ($P=0.003$) relative to the control group. The odds of adherence to oral antidiabetic drugs increased by 47%, resulting in the proportion of adherent patients in the childless adults group reaching almost 80% after the coverage expansion. In the per class analyses, a significant effect was found for biguanides; the proportion of adherent patients increased by 5.5 percentage points in childless adults compared with the control group ($P=0.022$).

CONCLUSIONS: This program evaluation found that a reduction of drug copayments in Wisconsin Medicaid improved the quality of medication use by increasing adherence to oral antidiabetic drugs among childless adults.

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What is already known about this subject

- Cost sharing for prescription drugs is a common barrier to adherence to medications, which improved when cost sharing was reduced in private health insurance.
- Previous studies conducted within a Medicaid population have found reduced medication adherence after drug coverage restrictions, but few studies have evaluated adherence changes when drug coverage was expanded in Medicaid.

What this study adds

- After a reduction in drug copayments, medication adherence to oral antidiabetics measured using proportion of days covered (PDC) significantly increased among childless adults in the Wisconsin Medicaid population.
- The proportion of adherent patients with $\text{PDC} \geq 0.80$ also significantly increased among childless adults following the drug copayment reduction in Wisconsin Medicaid.

Diabetes is now the most costly chronic illness in the United States, with diagnosed diabetes expenses totaling \$327 billion in 2017.^{1,2} One way to promote efficient diabetes care is to improve adherence to diabetes medications, since it can lead to better glycemic control and help avoid complications, which, in turn, can prevent the use of more expensive forms of health care services, such as hospitalizations and emergency department visits.³ Medication adherence, the extent to which a patient acts in accordance with the prescribed interval and dose, as well as dosing regimen,⁴ is a widely used measure to optimize the quality of medication use.⁵

Cost sharing is an important factor that affects medication adherence, often becoming a barrier for patients to initiate or refill their prescription drugs.^{6,7} Studies have shown that increasing cost sharing (i.e., higher out-of-pocket costs) decreases medication adherence,⁸⁻¹² and this relationship is more intense among individuals with lower income.^{13,14} A majority of the existing literature has focused on the effects of increases in drug cost sharing, but few studies have evaluated changes in medication adherence when cost sharing is reduced.⁸⁻¹² The existing evidence of the effects of reduced cost sharing are mainly from private health insurance plans that have implemented a value-based insurance design.¹⁵⁻¹⁷ Because of the lower income and poorer health status of the Medicaid

population than the privately insured population, reduced drug cost sharing may have a bigger effect on medication adherence among Medicaid enrollees.^{13,14,18}

Although there are a few studies of Medicaid populations on expanded drug coverages, most of them are nearly 3 decades old and do not specifically focus on evaluating medication adherence, an important domain of optimal quality of medication use that can affect health outcomes.¹⁹⁻²² These studies evaluated changes in the quantity of medications used by measuring the number of prescriptions or the amounts of active ingredients per prescription, instead of medication adherence. Studying changes in medication adherence moves beyond just assessing changes in the number of drug fills and provides evidence on how the quality of drug use within Medicaid is affected by such policy changes.

Our study evaluated the effects of reduced Medicaid drug copayments on medication adherence by taking advantage of a natural experiment in Wisconsin, which was a Medicaid coverage expansion for low-income adults without dependent children (hereafter referred to as “childless adults”). Childless adults were covered by the Wisconsin Medicaid Core Plan through a section 1115 demonstration waiver. The Core Plan had a limited scope of covered services and required higher copayments compared with the Standard Plan for traditional Medicaid enrollees, such as uninsured children, pregnant women, and parents/caretakers with low income.^{23,24} As of April 1, 2014, the existing 1115 waiver was amended for Wisconsin to continue to cover childless adults with revised eligibility criteria and expanded benefit packages. The Core Plan was terminated, and all childless adults with income $\leq 100\%$ of the federal poverty level (FPL) who had been enrolled in the Core Plan were transitioned to the Standard Plan, which expanded health coverage for childless adults in various ways.^{23,24} This study focused on the expansion of prescription drug benefits.

The Core Plan covered generic drugs and a limited number of brand name drugs, and copayments per drug fill were charged up to \$4 for generic drugs and up to \$8 for brand name drugs. The limit on maximum monthly copayment amounts was \$24 per month per pharmacy. The Standard Plan had a more comprehensive drug formulary, with coverage for more brand name drugs, drug copayments of \$1 for generic drugs and \$3 for brand name drugs, and lower maximum monthly copayments at \$12 per month per pharmacy.^{23,24}

Oral diabetes medications were chosen for this study because they are major agents in the management of type 2 diabetes, the most common form of diabetes.²⁵ More than 90% of patients with type 2 diabetes using diabetes medications are treated with oral agents alone.²⁶ It was also possible to isolate the unique effects of reduced drug copayments among these drugs, since the commonly used oral diabetes drugs were already covered in the Core Plan, and the only change for these drugs after the policy change was the reduction of drug copayments.

This study provides empirical evidence on the improved quality of drug use after a reduction of drug copayments in Wisconsin Medicaid by showing the increased adherence to oral diabetes medications among childless adults.

Methods

Study Design and Data Source

This study used a difference-in-differences design to compare the pre-post changes in medication adherence between study groups. The evaluation period included 1 full year before and after the effective date of Wisconsin Medicaid’s 2014 drug coverage expansion, with the preperiod from April 1, 2013, to March 31, 2014, and the postperiod from April 1, 2014, to March 31, 2015. Wisconsin Medicaid’s enrollment records, medical claims, and pharmacy claims data were evaluated for the period of January 1, 2013–March 31, 2015. Enrollment records and medical claims defined the study cohorts and obtain demographic data. The pharmacy claims data contained detailed information on prescription drug use, such as drug name, drug therapeutic category, fill date, and days supply, which were used for defining adherence outcomes.

Study Population

The treatment group was composed of childless adults with type 2 diabetes who were continuously enrolled in Wisconsin Medicaid during the evaluation period and transitioned from the Core Plan to the Standard Plan as of April 1, 2014. Parents/caretakers with type 2 diabetes, income $\leq 100\%$ FPL, and who were continuously enrolled in the Standard Plan during the evaluation period were selected as a comparison group because they were not affected by the drug coverage expansion, and their Medicaid coverage was not changed during the evaluation period. Type 2 diabetes diagnosis was defined as having any inpatient or outpatient medical claim with type 2 diabetes as a primary, secondary, or tertiary diagnosis in the preperiod (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes 250.0x–250.9x, where x=0 indicates controlled or x=2 indicates uncontrolled type 2 diabetes).

Key Variables of Interest

Among the variety of measures used in the literature that estimate medication adherence from pharmacy claims data, this study adapted the proportion of days covered (PDC) approach to measuring medication adherence endorsed by the Pharmacy Quality Alliance (PQA) because it has a clear specification and has been widely used by many private and public insurers. As an organization for promoting medication safety, adherence, and appropriate use, PQA develops various quality measures of medication use, some of which are used to report performance related to medications in health insurance plans.^{5,27} Its diabetes medication adherence measures have been used by the Centers for Medicare & Medicaid Services (CMS) to evaluate

FIGURE 1 Sample Construction Process for Sensitivity Analysis

CLAs = childless adults; DPP-IV = dipeptidyl peptidase-IV; PARs = parents/caretakers; PDC = proportion of days covered; TZD = thiazolidinedione.

medication-associated quality in Medicare Part D and health insurance marketplace plans.^{5,27,28}

This study focused on 4 oral diabetes drug classes: biguanides, sulfonylureas, dipeptidyl peptidase-IV (DPP-IV) inhibitors, and thiazolidinediones (TZDs). These classes were chosen because they are the most commonly used oral diabetes medications for which PQA has endorsed per-class medication adherence measures.⁵ In addition, each of these classes had a large enough sample size in our data for statistical analysis. Following PQA's adherence measure guideline, we did not evaluate adherence to insulins because the days supply information of insulins in claims data is considered inaccurate due to the frequent adjustment of insulin dosing.^{28,29} Active ingredients for each drug class were determined based on the American Hospital Formulary Service Pharmacologic-Therapeutic Classification System that was available in the data. A detailed list of drug ingredients for each drug class we used for our study is available upon request.

This study modified the PQA's adherence measure in the following aspects. While the PQA's adherence measure excludes patients who have 1 or more prescriptions for insulin in the measurement period, we did not exclude them in order to retain every patient who experienced the drug copayment reduction for using the 4 oral diabetes drug classes. Also, we found that following the exact PQA guidelines resulted in consistent study findings (results available upon request). In addition, our outcome measures did not include other antidiabetic drug classes, such as incretin mimetic agents, meglitinides, and

sodium glucose co-transporter2 inhibitors because of the low incidence of these drugs in the study population and the lack of PQA measures for the individual drug class.

Adherence was measured by using PDC, which was defined by the following equation:

$$\text{PDC} = \frac{\text{Number of days with medication available}}{\text{Number of days in the specified time interval}}$$

The PDC ratio could range from 0 to 1, and the average PDC was calculated for each study group in each study period. In addition to the continuous PDC, we also evaluated a binary outcome for each patient that classified an individual as adherent or not, using the PQA threshold of $\text{PDC} \geq 0.80$. The proportion of adherent patients with $\text{PDC} \geq 0.80$ among the total number of patients was assessed for each study group in each study period.

This study estimated medication adherence for oral antidiabetics in 2 ways, adapting PDC measures endorsed by PQA.⁵ The sample construction process for each PDC measure is described in Figure 1.

PDC for All Diabetes Drugs. Medication adherence to all diabetes drugs was first measured among patients who filled ≥ 2 prescriptions for any of the 4 diabetes drug classes (i.e., biguanides, sulfonylureas, DPP-IV inhibitors, and TZDs) on 2 unique dates of service in the pre- and postperiods. This measure is consistent with the PQA measure that is used by CMS to assess adherence to medication use.³⁰ The numerator was the number of days covered by at least 1 drug from any of

the 4 classes, which was calculated based on the prescription fill date and days supply. If a patient had multiple prescriptions within the same drug class and overlapping days supply, we adjusted the start date of the next fill to be the day after the previous fill had ended. The denominator for the pre- and postperiods was the number of days between the first fill date and the last day of the preperiod (i.e., March 31, 2014) and the number of days between the first fill date and the last day of the postperiod (i.e., March 31, 2015), respectively.

PDC for Each Drug Class. The second approach measured the PDC separately for each diabetes drug class using the set of 4 PQA measures: biguanides, sulfonylureas, DPP-IV inhibitors, and TZDs. Each measure was assessed only among patients who filled ≥ 2 prescriptions for that drug class on 2 unique dates of service in both study periods. The numerator was the number of days covered by at least 1 drug of that drug class. Adjustments for overlapping days supply and the denominator were calculated using the same approach as in the first adherence measure.

Statistical Analysis

Descriptive statistics and chi-square tests were used to summarize population characteristics and compare the equivalence between the study groups.

A difference-in-differences approach was used to compare the change of the outcome variables between the treatment and control groups after the 2014 drug coverage expansion. Multivariate ordinary least squares (OLS) regression models were estimated for all outcome variables. The analytic models were adjusted for covariates that may be related with adherence to antidiabetics based on the Andersen Behavioral Model of Health Services Utilization.³¹ Age, sex, race, and ethnicity were included as predisposing factors, and education level was included as an enabling factor affecting drug use. As a measure of health care need, we included whether the individual's type 2 diabetes was under control or not during the preperiod.

To assess the robustness of the results, a sensitivity analysis was performed using an alternative population and PDC calculation. For the sensitivity analysis, the PDC was calculated among the entire sample that was initially defined with the inclusion criteria, unconditional to having 2 drug fills in both study periods. This enabled the assessment of medication adherence in a broader population to avoid missing any diagnosed patients who did not have ≥ 2 drug fills. The numerator was the same as in the primary analysis, but 365 days was used as the denominator for everyone in the sample. This approach of using a uniform denominator of 365 days is a traditional way that has been used by other researchers for assessing medication adherence.³²⁻³⁴ For this analysis, we also adjusted the days supply using drug claims from January to March 2013 in order to account for diabetes drug fills made before the beginning of

TABLE 1 Characteristics of Study Samples for Diabetes, All Classes Analysis

	Treatment Group: Childless Adults n = 677	Control Group: Parents/ Caretakers n = 1,852	P Value ^a
Female, %	52.9	64.3	<0.001
Age as of April 2014, years, %			
19-34	4.3	12.0	<0.001
35-50	25.4	66.7	
51-64	70.3	21.2	
Race, %			
White	69.7	53.9	<0.001
Black	15.1	19.3	
Other	6.7	9.9	
Missing	8.6	16.9	
Hispanic, %	6.9	14.0	<0.001
High school graduate, %	80.4	78.0	0.205
Uncontrolled type 2 diabetes in the preperiod, %	14.3	17.8	<0.050

^aChi-square test for equality in frequencies across categories by groups.

the preperiod (i.e., April 1, 2013). Any overlapping days supply was adjusted using the same approach as in the primary analysis.

All statistical analyses were performed using Stata/SE 15.1 (StataCorp, College Station, TX). Standard errors were clustered at the person level.

Results

Description of Study Population

Figure 1 illustrates a flowchart of the identification process and final sample size for each PDC measure. For the first measure, PDC for all diabetes drugs, 667 childless adults and 1,852 parents/caretakers were included. The childless adults were significantly older on average than the parents/caretakers and had higher proportions of male, non-Hispanic white, and lower rates of uncontrolled diabetes in the preperiod. The 2 groups had similar proportions of high school graduates (Table 1). Patients who filled ≥ 2 fills in a drug class on 2 unique days in both study periods were determined separately for each drug class and were included in the second set of adherence measures.

Effects on Medication Adherence

The mean unadjusted PDC for all diabetes drugs increased from 0.87 to 0.89 in the treatment group, while it was stable at 0.80 in the control group (Figure 2). A fully adjusted difference-in-differences OLS regression demonstrated that the average PDC significantly increased by 0.02 ($P=0.025$) in the childless adults after the drug coverage expansion relative to the

FIGURE 2 Mean Unadjusted PDC Before and After Drug Copayment Reduction

CLAs=childless adults; DPP-IV=dipeptidyl peptidase-IV; PARs=parents/caretakers; PDC=proportion of days covered; TZD=thiazolidinedione.

parents/caretakers (Table 2). The proportion of adherent patients ($PDC \geq 0.80$) also increased only in the treatment group, from 76% to 81%, and was around 63% in the control group in both periods (Figure 3). The difference-in-differences analysis estimated that the proportion of adherent patients significantly increased by 6.2 percentage points ($P=0.003$) in the childless adults compared with the parents/caretakers (Table 2).

When the adherence measures for the individual therapeutic classes were applied, a significant effect was found only for the biguanides in the fully adjusted models. The childless adults' average PDC for biguanides was 0.85 in the preperiod and increased by 0.02 ($P=0.036$) relative to the parents/caretakers. The proportion of adherent patients was 72% in the childless adults, and it increased by 5.5 percentage points ($P=0.022$) relative to the parents/caretakers (Table 2). Full results of the difference-in-differences regression models are available in Appendices A and B (available in online article).

The sensitivity analysis using the alternative PDC measure and the entire study sample (i.e., regardless of the number of drug fills) found that the baseline adherence to all diabetes drugs over 365 days was lower in both treatment and control groups compared with the primary analysis. The average PDC over 365 days was 0.51 in the treatment group and 0.37 in the control group; the proportion of adherent patients was 39% in the treatment and 23% in the control group. The fully adjusted difference-in-differences models found the average PDC sig-

nificantly increased by 0.03 ($P=0.001$) in the childless adults relative to the control group, and the proportion of adherent patients also significantly increased by 3.2 percentage points ($P=0.012$) relative to the control group (Table 2). Full regression results are available upon request.

Discussion

This study evaluated the effects of reduced drug copayments on the quality of medication use by measuring adherence to oral diabetes medications among type 2 diabetic childless adults enrolled in Wisconsin Medicaid. By adapting the widely used PQA medication adherence measures, we found significantly improved adherence to oral antidiabetics in the childless adults compared with the parents/caretakers who were continuously enrolled in the Standard Plan.

The PDC for all diabetes drugs among the parents/caretakers in this study was comparable to that seen among traditional Medicaid enrollees who used sulfonylureas and metformin in 2 other states. The baseline average PDC in the other states was 0.79, which was similar to 0.80 in our study. Likewise, the baseline proportion of adherent patients was 61%-63%, which was consistent with 63% in our study.³⁵ To our knowledge, this is the first study reporting medication adherence in low-income childless adults enrolled in Medicaid, which had better adherence to antidiabetic drugs throughout the study period than the traditional Medicaid enrollees in Wisconsin Medicaid and

TABLE 2 Difference-in-Differences Regression Estimates for Effect of Reduced Drug Copayment on Medication Adherence

	Primary Analysis ^a						Sensitivity Analysis ^a
	All Drug Classes	Biguanides	Sulfonylureas	DPP-IV Inhibitors	TZDs	All Drug Classes	
PDC							
Treatment group × postperiod	0.018 ^b (0.008)	0.019 ^b (0.009)	0.002 (0.015)	−0.025 (0.028)	0.013 (0.040)	0.026 ^c (0.008)	
Treatment group	0.034 ^c (0.009)	0.028 ^c (0.010)	0.037 ^b (0.016)	0.048 ^b (0.024)	0.018 (0.036)	0.078 ^c (0.015)	
Postperiod	0.00001 (0.005)	−0.007 (0.005)	0.007 (0.009)	−0.042 ^c (0.014)	−0.076 ^c (0.027)	0.017 ^c (0.004)	
Proportion of adherent patients (with PDC ≥ 0.80)							
Treatment group × postperiod	0.062 ^c (0.021)	0.055 ^b (0.024)	−0.023 (0.041)	−0.056 (0.056)	−0.036 (0.093)	0.032 ^b (0.013)	
Treatment group	0.050 ^b (0.021)	0.037 (0.024)	0.097 ^b (0.039)	0.083 (0.059)	0.084 (0.088)	0.080 ^c (0.017)	
Postperiod	−0.015 (0.012)	−0.023 (0.014)	0.027 (0.025)	−0.062 ^b (0.029)	−0.114 (0.063)	0.029 ^c (0.006)	

^aStandard errors is in parentheses. Models adjusted for age, sex, race, ethnicity, education level, and uncontrolled type 2 diabetes. Full results for the primary analysis are available in Appendices A and B.

^bSignificant at $P < 0.05$.

^cSignificant at $P < 0.01$.

DPP-IV = dipeptidyl peptidase-IV; PDC = proportion of days covered; TZD = thiazolidinedione.

the other 2 states.³⁵ This could be due to the various factors affecting medication adherence other than out-of-pocket costs, including their perceived health care needs, assessed health status, and patient-physician relationship.^{31,36}

The difference-in-differences estimates were consistent with previous research in non-Medicaid populations in terms of the direction and magnitude of the changes in medication adherence. We found a modest increase of 2 percentage points in the average PDC in the childless adults group compared with the control group, which was comparable to the increase of 4 percentage points in the diabetes medication possession ratio found in private health insurance plans.^{15,16} The proportion of adherent patients increased significantly by 6.2 percentage points in the childless adults group compared with the control group, which corresponded to a 47% increased odds of adherence to antidiabetic drugs. This is equivalent to a 32% decreased odds of nonadherence, which is in contrast to an 8%-25% increased odds of nonadherence to antidiabetic drugs shown in the literature when cost sharing was increased in Medicare Part D and Veterans Affairs plans.¹⁰ However, this is expected since the relationship between cost sharing and medication adherence is more intense among low-income people.^{13,14} Although medication adherence among the childless adults was already quite high in the preperiod, leaving less room for improvement, the drug copayment reduction still led to a significant improvement in adherence.

In the per class analyses, only biguanides showed significant increases in adherence outcomes after the policy change in childless adults relative to parents/caretakers. Adherence to sulfonylureas stayed stable in both study groups, and an insignificant but marginal increase among childless adults was found in the difference-in-differences analyses. Different trends were found in DPP-IV inhibitors and TZDs, such that

adherence decreased in childless adults and parents/caretakers. Difference-in-differences analyses found slightly reduced adherence to DPP-IV inhibitors and marginally increased adherence to TZDs, although both of these findings were not statistically significant. This could be due to the higher costs of these drug classes, especially for DPP-IV inhibitors that were entirely brand name drugs. The 3 other drug classes (i.e., biguanides, sulfonylureas, and TZDs) were predominantly generic drugs in our data. The annual average copayments paid by childless adults in the postperiod was \$13 for DPP-IV inhibitors and \$5 for TZDs, which was higher than \$2 for biguanides and sulfonylureas. Although the 2014 drug coverage expansion considerably reduced patient out-of-pocket costs,²² it might not have been significant enough for low-income Medicaid populations to improve their adherence to the drug class with higher costs. Additionally, there could have been switching behaviors from DPP-IV inhibitors to the other drug classes with generics available, although this study did not assess this behavior.

In addition to the use of medication adherence measures endorsed by the PQA, our sensitivity analysis measured adherence using an alternative measure from previous literature. It is worth noting that the PDC and the proportion of adherent patients were around 40%-60% lower than using the PQA measure. Such differences are partly due to the more stringent patient inclusion criteria in the PQA's measure specification, which only included continuous users of the drug class who have ≥2 drug fills on 2 unique dates in the preperiod and postperiod. The requirement of 2 drug fills allows the evaluation of adherence in a more consistent group of drug users, by excluding patients who might have switched to another therapy or stopped the medication due to adverse drug events after a single drug fill. However, the patients who had no drug fill or only 1 drug fill in the study period were not excluded

FIGURE 3 Mean Unadjusted Proportion of Adherent Patients Before and After Drug Copayment Reduction

CLAs = childless adults; DPP-IV = dipeptidyl peptidase-IV; PARs = parents/caretakers; PDC = proportion of days covered; TZD = thiazolidinedione.

from the sensitivity analysis, and this produced lower levels of adherence, although it might not necessarily be representative of poor adherence. In general, the sensitivity analysis found consistent effects of the policy to the primary analysis, but it found a slightly larger magnitude of increase in the continuous PDC and a slightly smaller increase in the proportion of adherent patients. This finding suggests the importance of careful identification and selection of an appropriate adherence measure in research or quality reporting, since it can have a large effect on the estimates of medication adherence.

Limitations

This study has several important limitations. Only Medicaid pharmacy claims data were used for evaluating medication adherence, which assumes that the days supply for each fill in the data was accurate and that the drug refill patterns corresponded to the patient's medication intake pattern. In addition, this study exclusively focused on the 4 most commonly used oral antidiabetic drug classes and did not assess adherence to other antidiabetic drug classes. Finally, caution should be exercised when generalizing the findings of this study. Of note, these findings may not generalize to individuals who did not have stable enrollment in Medicaid, since we only included individuals with continuous enrollment during the study period.

Conclusions

This study showed an improved quality of oral antidiabetic medication use by childless adults with type 2 diabetes when drug copayments were reduced in Wisconsin Medicaid. Both the mean adherence and the proportion of adherent patients to oral antidiabetic drugs significantly increased among childless adults following the benefit change.

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DISCLOSURES

This study was conducted as part of a larger study funded by the Wisconsin Department of Health Services. The authors are solely responsible for the content of this study. The authors report an evaluation contract with the Wisconsin Department of Health Services, unrelated to this study.

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APPENDIX A Difference-in-Differences Linear Regression Estimates of Effects of 2014 Wisconsin Coverage Expansion on PDC for Oral Antidiabetics

Drug Class	Coefficient (Standard Error)				
	All Classes	Biguanides	Sulfonylureas	DPP-IV Inhibitors	TZDs
Treatment group x postperiod	0.018 ^a (0.008)	0.019 ^a (0.009)	0.002 (0.015)	-0.025 (0.028)	0.013 (0.040)
Treatment group	0.034 ^b (0.009)	0.028 ^b (0.010)	0.037 ^a (0.016)	0.048 ^a (0.024)	0.018 (0.036)
Postperiod	0.00001 (0.005)	-0.007 (0.005)	0.007 (0.009)	-0.042 ^b (0.014)	-0.076 ^b (0.027)
Female	-0.014 (0.007)	-0.014 (0.008)	0.001 (0.012)	-0.008 (0.019)	-0.033 (0.035)
Aged 35-49 years	0.051 ^b (0.014)	0.039 ^b (0.015)	0.081 ^b (0.030)	0.080 ^a (0.032)	-0.101 (0.056)
Aged 50+ years	0.101 ^b (0.015)	0.093 ^b (0.015)	0.113 ^b (0.031)	0.138 ^b (0.036)	0.024 (0.053)
Black	-0.096 ^b (0.010)	-0.091 ^b (0.011)	-0.091 ^b (0.022)	-0.104 ^b (0.025)	-0.124 ^a (0.050)
Other race	-0.068 ^b (0.014)	-0.056 ^b (0.014)	-0.072 ^a (0.028)	-0.068 ^a (0.034)	-0.061 (0.056)
Missing race	-0.006 (0.018)	-0.007 (0.019)	-0.046 (0.029)	0.025 (0.054)	-0.155 ^a (0.064)
Hispanic	-0.037 (0.020)	-0.041 (0.021)	-0.016 (0.035)	-0.111 ^a (0.055)	0.151 (0.089)
High school graduate	0.017 (0.009)	0.018 ^a (0.010)	0.008 (0.018)	0.033 (0.023)	-0.011 (0.040)
Uncontrolled type 2 diabetes	-0.012 (0.010)	-0.028 ^a (0.011)	-0.008 (0.015)	-0.001 (0.023)	-0.117 ^b (0.045)
Constant	0.771 ^b (0.017)	0.766 ^b (0.018)	0.742 ^b (0.034)	0.681 ^b (0.040)	0.937 ^b (0.080)

^aSignificant at $P < 0.05$.^bSignificant at $P < 0.01$.

DPP-IV = dipeptidyl peptidase-IV; PDC = proportion of days covered; TZD = thiazolidinedione.

APPENDIX B Difference-in-Differences Linear Regression Estimates of Effects of 2014 Wisconsin Coverage Expansion on Proportion of Adherent Patients to Oral Antidiabetics

Drug class	Coefficient (Standard Error)				
	All Classes	Biguanides	Sulfonylureas	DPP-IV Inhibitors	TZDs
Treatment group x postperiod	0.062 ^a (0.021)	0.055 ^b (0.024)	-0.023 (0.041)	-0.056 (0.056)	-0.036 (0.093)
Treatment group	0.050 ^b (0.021)	0.037 (0.024)	0.097 ^b (0.039)	0.083 (0.059)	0.084 (0.088)
Postperiod	-0.015 (0.012)	-0.023 (0.014)	0.027 (0.025)	-0.062 ^b (0.029)	-0.114 (0.063)
Female	-0.017 (0.016)	-0.026 (0.017)	0.013 (0.028)	-0.034 (0.041)	-0.074 (0.069)
Aged 35-49 years	0.100 ^a (0.028)	0.081 ^a (0.031)	0.115 (0.060)	0.186 ^a (0.068)	-0.027 (0.096)
Aged 50+ years	0.208 ^a (0.030)	0.198 ^a (0.033)	0.211 ^a (0.062)	0.305 ^a (0.077)	0.199 (0.104)
Black	-0.190 ^a (0.022)	-0.188 ^a (0.024)	-0.141 ^a (0.048)	-0.194 ^a (0.053)	-0.228 ^b (0.097)
Other race	-0.137 ^a (0.029)	-0.133 ^a (0.031)	-0.122 ^b (0.057)	-0.128 (0.070)	-0.078 (0.107)
Missing race	-0.022 (0.041)	0.001 (0.045)	-0.097 (0.078)	0.155 (0.095)	-0.258 ^b (0.118)
Hispanic	-0.083 (0.045)	-0.100 ^b (0.049)	-0.046 (0.089)	-0.357 ^a (0.098)	0.222 (0.165)
High school graduate	0.030 (0.020)	0.035 (0.022)	0.030 (0.040)	0.044 (0.048)	-0.025 (0.089)
Uncontrolled type 2 diabetes	-0.022 (0.021)	-0.046 (0.024)	-0.015 (0.034)	0.020 (0.052)	-0.263 ^a (0.098)
Constant	0.576 ^a (0.035)	0.559 ^a (0.039)	0.486 ^a (0.072)	0.386 ^a (0.083)	0.730 ^a (0.154)

^aSignificant at $P < 0.01$.^bSignificant at $P < 0.05$.

DPP-IV = dipeptidyl peptidase-IV; PDC = proportion of days covered; TZD = thiazolidinedione.