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Changes in diabetes prescription patterns following Affordable Care Act Medicaid expansion

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ABSTRACT

Introduction Most patients with diabetes mellitus are prescribed medications to control their blood glucose. The implementation of the Affordable Care Act (ACA) led to improved access to healthcare for patients with diabetes. However, impact of the ACA on prescribing trends by diabetes drug category is less clear. This study aims to assess if long-acting insulin and novel agents were prescribed more frequently following the ACA in states that expanded Medicaid compared with non-expansion states.
Research design and methods In this analysis of a natural experiment, prescriptions reimbursed by Medicaid (US public insurance) for long-acting insulins, metformin, and novel agent medications (DPP4 inhibitors, sodium/glucose cotransporter 2 inhibitor antagonists, and glucagon-like peptide-1 receptor agonists) from 2012 to 2017 were obtained from public records. For each medication category, we performed difference-in-differences (DID) analysis modeling change in rate level from pre-ACA to post-ACA in Medicaid expansion states relative to Medicaid non-expansion states.
Results Expansion and non-expansion states saw a decline in both metformin and long-acting insulin prescriptions per 100 enrollees from pre-ACA to post-ACA. These decreases were larger in non-expansion states relative to expansion states (metformin: absolute DID = +0.33, 95% CI=0.323 to 0.344) and long-acting insulin (absolute DID: +0.11; 95% CI=0.098 to 0.113). Novel agent prescriptions in expansion states (+0.08 per 100 enrollees) saw a higher absolute increase per 100 Medicaid enrollees than in non-expansion states (absolute DID= +0.08, 95% CI=0.079 to 0.086).
Conclusions There was a greater absolute increase for prescriptions of novel agents in expansion states relative to non-expansion states after accounting for number of enrollees. Reducing administrative barriers and improving the ability of providers to prescribe such newer therapies will be critical for caring for patients with diabetes—particularly in Medicaid non-expansion states.

INTRODUCTION

About 1 in 10 individuals (34 million) in the USA have diabetes.[1] Most patients with diabetes are prescribed medications to control their blood glucose.[2] These medications assist with long-term glycemic control and reduce the risk of diabetes-related complications

SIGNIFICANCE OF THIS STUDY

WHAT IS ALREADY KNOWN ABOUT THIS SUBJECT?

⇒ Medicaid expansion following the Affordable Care Act (ACA) dramatically increased access to medical care among low-income populations.
⇒ The implementation of the ACA led to overall improved access to medication among enrollees.
⇒ Novel agents for diabetes including sodium/glucose cotransporter 2 inhibitors, glucagon-like peptide-1 receptor agonists, and DPP4 inhibitors are associated with numerous clinical benefits when compared with insulin, including lower risk of hypoglycemia and beneficial impacts on cardiovascular and renal function.

WHAT ARE THE NEW FINDINGS?

⇒ Prescriptions of novel agents increased more in Medicaid expansion states compared with non-expansion states following implementation of the ACA.

HOW MIGHT THESE RESULTS CHANGE THE FOCUS OF RESEARCH OR CLINICAL PRACTICE?

⇒ Medicaid expansion was found to be associated with increased access to novel diabetes medications.
⇒ Reducing administrative barriers and improving the ability of providers to prescribe such newer therapies will be critical for caring for patients with diabetes—particularly in Medicaid non-expansion states.

like ophthalmic, renal, and peripheral nerve disease.[3] Additionally, some novel agents including glucagon-like peptide-1 receptor agonists (GLP-1) and sodium/glucose cotransporter 2 inhibitors (SGLT2) have also been associated with reduced cardiovascular events among diabetes patients, may lead to some weight loss, and carry a lower risk of iatrogenic hypoglycemia.[4–6] For certain patients, these novel agents are components of guideline-directed medical therapy.[4] However, in the USA, the cost of diabetes medication can be a significant barrier,

especially for low-income patients and those who lack adequate health insurance coverage.[7][8]

The US Patient Protection and Affordable Care Act (ACA) substantially improved access to health insurance and healthcare services. The ACA mandated health insurance coverage, called for the expansion of Medicaid (US publicly funded health insurance) to adults earning ≤138% of the federal poverty level (FPL), and provided subsidies to those making between 100% and 400% of the FPL to help purchase individual health insurance. Following the Supreme Court ruling allowing states to choose whether or not to expand Medicaid, 36 states (and the District of Columbia) expanded and 14 states did not (as of May 2020).[9]

Over 20 million adults gained public or private health insurance coverage.[10] The ACA is associated with a decline in both the rate of uninsured patients and the rate of undiagnosed diabetes;[11] an increase in diabetes diagnosis,[12][13] access to preventive care and eye examinations;[14] improved glycemic control;[15] and a reduction in diabetes-related expenditures.[16][17]

Some studies have demonstrated increases in prescriptions filled among patients with Medicaid following the ACA.[18][19] These studies showed higher rates of diabetes prescriptions in states that expanded Medicaid programs relative to states that did not expand. Medicaid expansion opened access to healthcare coverage to a different population than previously eligible.[16][19] Previous studies have shown that those newly eligible for Medicaid following expansion were overall healthier and had fewer chronic conditions, but that among those with chronic health problems, their condition was more likely to be out-of-control.[20][21] It is unknown whether the change in the make-up of the Medicaid population led to differential prescription patterns for specific classes of diabetes medications. Thus, the purpose of this study was to assess if long-acting insulin and novel agent medications were prescribed more following the ACA in states that expanded Medicaid compared with non-expansion states. We specifically focus on long-acting insulin (over short-acting or intermediate-acting insulin) as it is commonly prescribed for poorly controlled diabetes and less burdensome to patients given the generally simpler dosing schemes.[4][22–24]

METHODS

A total of 26 137 642 prescription claims were extracted from Medicaid state drug utilization data from 2012 to 2017 obtained from the US Centers for Medicare and Medicaid Services (CMS).[25] These data are publicly available and not identifiable; therefore, the research did not involve human subjects and institutional review Board approval was not necessary.

Inclusion /exclusion criteria

Medication claims were cross-referenced with National Drug Codes for all insulins, drugs containing the character string 'metformin,' and a list of novel agent prescription classes including GLP-1 agonists, DPP4 inhibitors, and SGLT2 inhibitors.[26] The database includes the number of prescriptions reimbursed by Medicaid by type per US state per quarter per year. Claims with less than 11 prescriptions were suppressed by CMS for privacy purposes and were therefore excluded. However, these excluded claims comprised a small proportion of the sample and did not affect various classes differentially.

Primary outcomes: diabetes medications

Drug claims were categorized into three classes: (1) metformin, (2) long-acting insulin, and (3) novel agents (GLP-1 agonists, SGLT2 inhibitors, DPP4 inhibitors, novel agent combination therapies, and metformin combination therapies). Metformin data were included as a common first-line agent for type 2 diabetes mellitus that reflects the overall prevalence of diagnosed and treated diabetes among Medicaid enrollees. A list of the specific medications included in each class is in online supplemental appendix 1.

Primary independent variable: expansion status

States were considered to have expanded Medicaid eligibility if they expanded as of January 2014. Expansion states included 25 states (Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Rhode Island, Vermont, Washington, and West Virginia) and the District of Columbia. A total of 19 non-expansion states included Alabama, Florida, Georgia, Idaho, Kansas, Maine, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Wisconsin, and Wyoming. During our study period, six states (New Hampshire, Pennsylvania, Alaska, Indiana, Louisiana, and Montana) expanded at a later date and were excluded from this analysis. The excluded states accounted for a minority of prescriptions (10% of novel agents, 9% of long-acting insulin, and 8% of metformin).

Statistical analyses

First, we estimated average rates of prescriptions in each diabetes medication category (metformin, long-acting insulin, novel agents) by year and expansion status. We report unadjusted and adjusted prescription rates per 100 Medicaid enrollees by expansion and non-expansion status from 2012 to 2017. Number of enrollees per state per year served as the denominator for the rates.[27] For each diabetes medication category, we performed a difference-in-difference (DID) analysis modeling change in rate level from pre-ACA to post-ACA. The unit of analyses for our models were state-years (ie, each state contributed 6 yearly observations across our study period of 2012–2017). We produced overall unadjusted and adjusted rates per 100 Medicaid enrollees by pre-ACA and post-ACA period for each expansion group and estimated

both within-group and between-group differences. For each diabetes medication category, we performed generalized estimating equation (GEE) Poisson regression models with the following variables: an indicator denoting expansion status (state expanded Medicaid vs did not expand), an indicator for period (pre-ACA vs post-ACA), and the interaction terms between expansion status and period. In adjusted analyses, to account for differential diabetes prevalence between states and exogenous economic determinants, models were adjusted for state-level prevalence of diabetes (obtained from the Behavioral Risk Factor Surveillance System) and unemployment rates (obtained from the US Bureau of Labor Statistics).[28 29] For all GEE models, we specified a Poisson distribution with a log link, an offset equal to log(Medicaid enrollees that year) and we utilized model-based standard errors that assumed an autoregressive correlation matrix of degree 1 to account for the autocorrelation of yearly observations within states. We used DID estimation to assess whether the change observed from pre-ACA to post-ACA was different in the expansion group relative to the non-expansion group. To provide a comprehensive view of this change over ACA implementation, we report both absolute changes in the rates within and between groups as well as relative changes in rates within and between groups. We descriptively report state-level trends to ascertain whether a single state or cluster of states disproportionately impacted overall trends. Data analyses were performed in R V.3.6.0 and V.3.6.2, and Stata V.14, and statistical significance was set at type I error of 5%.

RESULTS

During the study period, there were 52 492 630 metformin prescriptions, 23 997 214 long-acting insulin prescriptions, and 4 362 787 novel agents prescriptions.

Figure 1 presents unadjusted expansion and non-expansion state yearly trends in metformin, long-acting insulin, and novel agent prescription rates from 2012 to 2017. Prior to Medicaid expansion (2012–2013), prescription rates for metformin and long-acting insulin were consistently higher in expansion states compared with non-expansion states. Expansion and non-expansion states had similar novel agent prescription rates prior to Medicaid expansion. Across all medication categories, unadjusted prescription trends were fairly parallel between expansion and non-expansion groups prior to Medicaid expansion. After Medicaid expansion, we observed differences in how prescription trends differed by expansion status, mainly starting in 2015. For metformin, non-expansion states show a similar trend after 2014 as they did prior to 2014; for expansion states, we observed a small gradual increase in prescription rates following the ACA. A similar trend was observed for long-acting insulin. For novel agent medication, we observed that for both expansion and non-expansion groups, there was a steady increase in the rate of prescriptions. However,

as shown in table 1, expansion states saw a higher unadjusted absolute increase in novel agent prescriptions per 100 Medicaid enrollees (expansion: +0.52 per 100 enrollees, non-expansion: +0.29 per 100 enrollees; absolute DID comparing expansion vs non-expansion states= +0.23, 95% CI=0.228 to 0.235; table 1).

Results from the adjusted GEE Poisson regression model are reported in table 2. In absolute terms, after covariate adjustments, both expansion and non-expansion states saw a decline in metformin prescriptions per 100 enrollees from pre-ACA to post-ACA, with non-expansion states showing a larger decline (absolute DID estimate from pre-ACA to post-ACA expansion–non-expansion: $-0.18 - (-0.52)=0.33$, 95% CI=0.323 to 0.344). In relative terms, expansion states saw a 1.1% relative decline in Metformin prescription rates from pre-ACA to post-ACA while non-expansion states saw a 6.3% decrease over the same time period (relative DID comparing relative change from pre-ACA to post-ACA between expansion and non-expansion: 0.989/0.937 = 1.056, 95% CI=1.055 to 1.057).

A similar trend was observed for long-acting insulin prescriptions. States that did not expand Medicaid saw a larger decline in long-acting insulin prescriptions per 100 enrollees than in expansion states resulting in an absolute DID estimate of 0.11 or 11 per 10 000 enrollees (95% CI=0.098 to 0.113). Expansion change in prescription rates from pre-ACA to post-ACA was −4.3%, for non-expansion it was −8.3% (relative DID=1.044, 95% CI=1.043 to 1.046).

Lastly, for novel agent prescriptions, the difference observed in the unadjusted rates is diminished. We observed an overall small increase in expansion states and no change in non-expansion states (expansion: +0.08 per 100 enrollees, non-expansion: 0 per 100 enrollees, absolute DID comparing expansion vs non-expansion= +0.08, 95% CI=0.079 to 0.086). In relative terms, expansion states saw a 7.1% relative increase in novel agent prescription rates from pre-ACA to post-ACA while non-expansion states saw <1% change over the same time period (relative DID=1.066, 95% CI=1.061 to 1.071).

An exploratory descriptive analysis of state-level trends showed relatively similar rates across states with few influential state rates that could have overwhelmingly impacted results (online supplemental appendices 2 and 3).

DISCUSSION

We found a greater increase for prescriptions of novel agent medications per 100 enrollees in expansion states relative to non-expansion states. These medications have gained popularity given early data showing numerous benefits—especially for cardiovascular and renal comorbidities, and as adjunctive pharmacotherapies,[5 6 30 31] despite remaining expensive.[32] This analysis suggests that Medicaid patients in expansion states were more likely to

(a) Metformin

(b) Long-acting Insulin
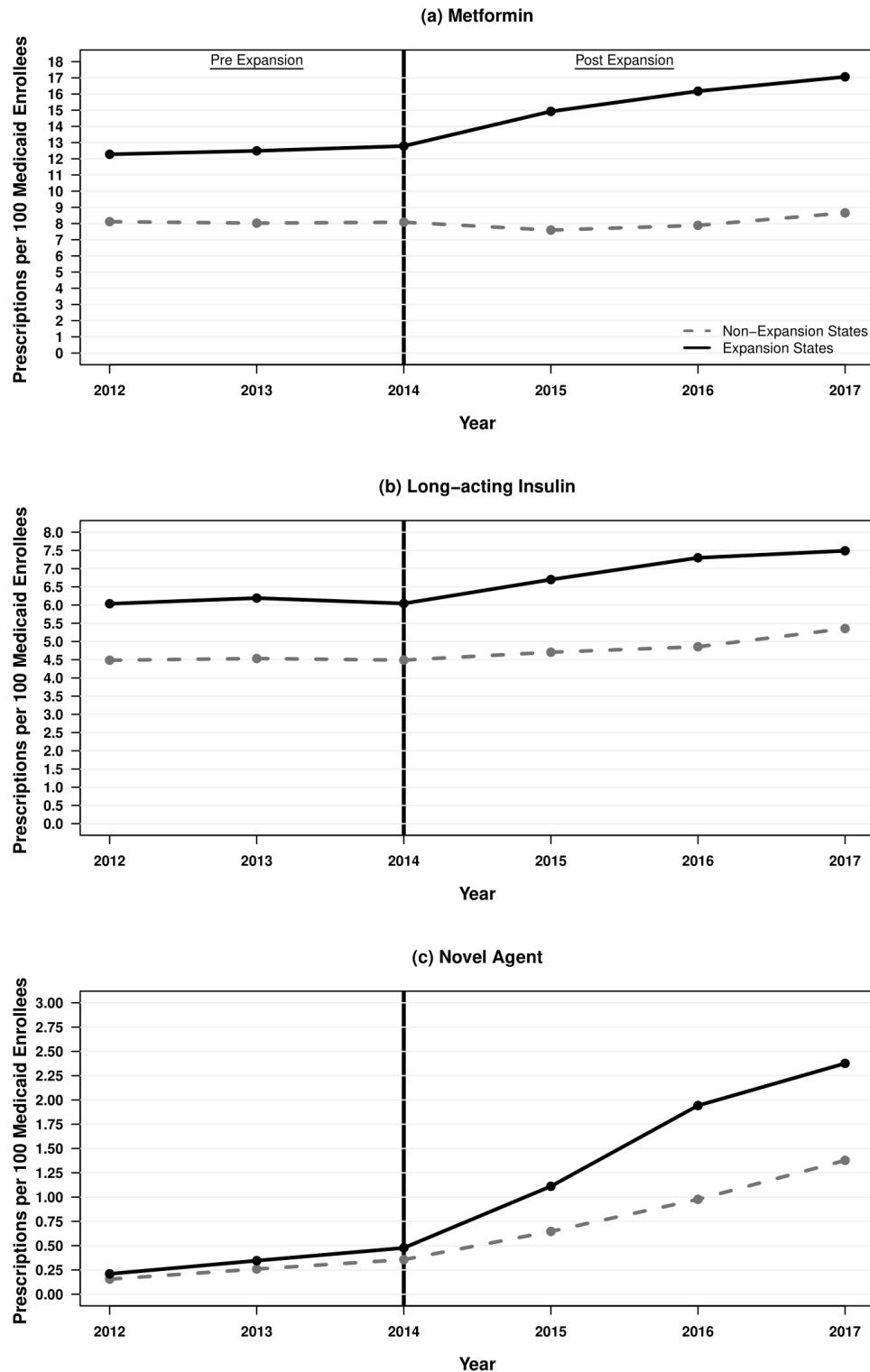
(c) Novel Agent

Figure 1 Unadjusted Medicaid expansion and non-expansion state yearly trends in (A) metformin, (B) long-acting insulin, and (C) novel agent prescription rates from 2012 to 2017.

be prescribed diabetes medications that are more in line with the most up-to-date standards.[4 31]

Patients who have very poor glycemic control or who have significant barriers to insulin adherence may be better candidates for these novel agents.[22 23] Adherence to regimens of the novel agents may be easier for patients with a higher burden of social determinants of health

because they have generally simpler dosing schemes and/or may be taken orally.[24] As noted in previous studies, newly enrolled patients with chronic conditions, including diabetes, were more likely to be in a poorly managed state.[20 21] As these patients (who were previously unable to afford private insurance but also did not meet pre-ACA criteria for Medicaid enrollment) entered

Table 1 Unadjusted rates in diabetes-related prescriptions pre-ACA and post-ACA Medicaid expansion between expansion groups

Prescription	Expansion	Non-expansion
Number of states	25	19
Metformin		
Pre-ACA, rate per 100 enrollees	15.84	8.14
Post-ACA, rate per 100 enrollees	16.67	8.10
Absolute change pre- to post-ACA	0.83	−0.04
Absolute DID (95% CI)	0.87 (0.866 to 0.886)	Ref.
Relative change pre-ACA to post-ACA	5.3%	−0.5%
Relative DID (95% CI)	1.058 (1.056 o 1.059)	Ref.
Long-acting insulin		
Pre-ACA, rate per 100 enrollees	6.69	4.79
Post-ACA, rate per 100 enrollees	6.78	4.68
Absolute change pre-ACA to post-ACA	0.09	−0.11
Absolute DID (95% CI)	0.20 (0.195 to 0.210)	Ref.
Relative change pre-ACA to post-ACA	1.4%	−2.3%
Relative DID (95% CI)	1.038 (1.036 to 1.039)	Ref.
Novel agents		
Pre-ACA, rate per 100 enrollees	1.01	0.53
Post-ACA, rate per 100 enrollees	1.53	0.81
Absolute change pre-ACA to post-ACA	0.52	0.29
Absolute DID (95% CI)	0.23 (0.228 to 0.235)	Ref.
Relative change pre-ACA to post-ACA	51.2%	54.5%
Relative DID (95% CI)	0.978 (0.974 to 0.983)	Ref.

Expansion states included 25 states (Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Rhode Island, Vermont, Washington, and West Virginia) and the District of Columbia. A total of 19 non-expansion states included Alabama, Florida, Georgia, Idaho, Kansas, Maine, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Wisconsin, and Wyoming. During our study period, 6 states (New Hampshire, Pennsylvania, Alaska, Indiana, Louisiana, and Montana) expanded later and were excluded from this analysis. For each diabetes medication category, we performed generalized estimating equation (GEE) Poisson regression models with the following variables: an indicator denoting expansion status (state expand Medicaid vs did not expand), an indicator for period (pre-ACA vs post-ACA) and the interaction terms between expansion status and period. For all GEE models, we specified a Poisson distribution with a log link, an offset equal to log(Medicaid enrollees that year) and assumed an autoregressive correlation matrix of degree 1 to account for the autocorrelation of yearly observations within states.
ACA, Affordable Care Act; DID, difference-in-differences.

Medicaid in expansion states, providers might have been more likely to recommend lower-maintenance options for glycemic control despite the increased administrative hurdles (eg, limited formularies requiring prior authorizations and quantity limitations). Another possible explanation for the higher prescription rates in expansion states may be the increase in diagnosed diabetes[12 13] that accompanied improved primary care access following expansion. Additionally, the continued rise in insulin costs may push providers and Medicaid programs to pursue non-insulin alternatives for glycemic control when available. Appropriate coverage of novel drugs may represent equitable care for populations of patients at higher risk for poor glycemic control in the setting of competing social comorbidities. Despite the differential increase in expansion states, the novel agent medications were prescribed at a much lower overall ratio relative to long-acting insulins. Patients in non-expansion states, where a larger uninsured population exists, may face greater hurdles to accessing novel diabetes agents

when compared with newly enrolled Medicaid patients in expansion states. Rapid translation of clinical evidence showing the benefits of these novel agents into reimbursement structures could reduce the number of high cost insulin claims Medicaid and other insurers must reimburse and increase access to novel agents.

Limitations

This study has some limitations. The data are Medicaid reimbursement claims; all medications that were self-paid are excluded. No information on diabetes diagnosis, diabetes type, and combination regimens are available. Because these are drug claims, some prescriptions rarely may have been prescribed to patients without a diabetes diagnosis (eg, metformin for treatment of polycystic ovarian syndrome). A delay between 2014 expansion and measurable change in prescription claim trends may exist and could vary across states which could slightly distort the results. Of note, SGLT2 inhibitors were not made widely available until after the period of study

Table 2 Adjusted rates in diabetes-related prescriptions pre-ACA and post-ACA Medicaid expansion between expansion groups

Prescription	Expansion	Non-expansion
Number of states	25	19
Metformin		
Pre-ACA, adjusted rate per 100 enrollees	17.00	8.18
Post-ACA, adjusted rate per 100 enrollees	16.82	7.66
Absolute change pre-ACA to post-ACA	−0.18	−0.52
Absolute DID (95% CI)	0.33 (0.323 to 0.344)	Ref.
Relative change pre-ACA to post-ACA	−1.1%	−6.3%
Relative DID (95% CI)	1.056 (1.055 to 1.057)	Ref.
Long-acting insulin		
Pre-ACA, adjusted rate per 100 enrollees	7.09	4.90
Post-ACA, adjusted rate per 100 enrollees	6.79	4.49
Absolute change pre-ACA to post-ACA	−0.30	−0.41
Absolute DID (95% CI)	0.11 (0.098 to 0.113)	Ref.
Relative change pre-ACA to post-ACA	−4.3%	−8.3%
Relative DID (95% CI)	1.044 (1.043 to 1.046)	Ref.
Novel agents		
Pre-ACA, adjusted rate per 100 enrollees	1.20	0.58
Post-ACA, adjusted rate per 100 enrollees	1.28	0.58
Absolute change pre-ACA to post-ACA	0.08	0.00
Absolute DID (95% CI)	0.08 (0.079 to 0.086)	Ref.
Relative change pre-ACA to post-ACA	7.1%	0.5%
Relative DID (95% CI)	1.066 (1.061 to 1.071)	Ref.

Expansion states included 25 states (Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Rhode Island, Vermont, Washington, and West Virginia) and the District of Columbia. A total of 19 non-expansion states included Alabama, Florida, Georgia, Idaho, Kansas, Maine, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Wisconsin, and Wyoming. During our study period, 6 states (New Hampshire, Pennsylvania, Alaska, Indiana, Louisiana, and Montana) expanded later and were excluded from this analysis. For each diabetes medication category, we performed generalized estimating equation (GEE) Poisson regression models with the following variables: an indicator denoting expansion status (state expand Medicaid vs did not expand), an indicator for period (pre-ACA vs post-ACA), the interaction terms between expansion status and period, state unemployment rate and state diabetes prevalence. For all GEE models, we specified a Poisson distribution with a log link, an offset equal to log(Medicaid enrollees that year) and assumed an autoregressive correlation matrix of degree 1 to account for the autocorrelation of yearly observations within states. Rates were adjusted for state-level unemployment rate and diabetes prevalence.
ACA, Affordable Care Act; DID, difference-in-differences.

began. Thus, some of the tabulations of pre-ACA novel agent prescriptions could have been underestimated. Additionally, national trends could have been explained by a few very populous states. However, state-level analysis in online supplemental appendices 2 and 3 shows that the overall observed trend was consistent across the vast majority of individual states. Because of the state-level aggregation, the data do not include patient demographic data or other health-related confounders; though we adjusted for state-level unemployment and diabetes prevalence. Our study cannot make direct conclusions about the newly enrolled Medicaid expansion population, but it does support findings suggested in prior studies.[16 19–21] Finally, it is uncertain whether medication claims are for new or refilled prescriptions, how many unique individuals received prescriptions, and what dosages were administered per prescription.

In conclusion, Medicaid beneficiaries in expansion states received greater access to novel agents than those residing in non-expansion states. Further research could elucidate the mechanisms behind these findings as well as ascertain whether increases in dispensing newer medication led to better diabetes outcomes. Additionally, longer follow-up may show increasing differences in novel agents trends between expansion and non-expansion states. US health policymakers in Medicaid non-expansion states must identify strategies to increase access to novel agents for their beneficiaries.

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