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Evaluation of a National Care Coordination Program to Reduce Utilization among High-cost, High-need Medicaid Beneficiaries with Diabetes

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Abstract

Background: Medical, behavioral, and social determinants of health are each associated with high levels of emergency department (ED) visits and hospitalizations.

Objective: To evaluate a care coordination program designed to provide combined "whole-person care," integrating medical, behavioral and social support for high-cost, high-need Medicaid beneficiaries by targeting access barriers and social determinants.

Research Design: Individual-level interrupted time series with a comparator group, using person-month as the **unit of analysis**.

Subjects: 42,214 UnitedHealthcare Medicaid beneficiaries (194,834 person-months) age ≥21 with diabetes, with Temporary Assistance to Needy Families **(TANF)**, Medicaid expansion, **Supplemental Security Income** (SSI) without Medicare, or dual Medicaid/Medicare.

Measures: Our outcome measures were any hospitalizations and any ED visits in a given month. Covariates of interest included an indicator for intervention versus comparator group and indicator and spline variables measuring changes in an outcome's time trend **after program enrollment.**

Results: Overall, 6 of the 8 examined comparisons were not statistically significant. Among SSI beneficiaries, we observed a larger projected decrease in ED visit risk among the intervention sample versus the comparator sample at 12 months post enrollment (difference-in-difference/DID: −6.6%; 95% CI: −11.2%, −2.1%). Among expansion beneficiaries, we observed a greater decrease

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in hospitalization risk among the intervention sample versus the comparator sample at 12 months post enrollment (DID: −5.8%; 95% CI: −11.4%, −0.2%).

Conclusions: A care coordination program designed to reduce utilization among high-cost, high-need Medicaid beneficiaries was associated with fewer ED visits and hospitalizations for patients with diabetes in **selected** Medicaid programs but not others.

Keywords

Medicaid; emergency department; program evaluation; utilization

Years of evidence have confirmed the importance of socioeconomic factors, often described as social determinants of health, in producing health outcomes.[1,2] Socioeconomic factors account for almost half the attributable risk of morbidity and premature mortality in the United States, compared to 30% from patient behaviors and 17% from deficits in clinical care or limited access to care.[3] Healthy People 2020 now includes objectives addressing social determinants of health, with specific targets for economic stability, education, neighborhood and built environment, and social and community context.[4]

Evidence of direct links between social determinants of health and increased utilization of high-cost health services varies by medical condition; several studies of low-income patients with diabetes demonstrate the adverse effects of unstable housing and food insecurity. Low-income patients with diabetes are at increased risk of hypoglycemia-related ED visits and hospitalizations in the last week of each month, when governmental nutrition assistance often runs out.[5,6] This concern takes on increased importance since the proportion of patients with diabetes reporting food insecurity increased by 58% from 2005 to 2014.[7] Compared to patients with diabetes and stable housing, those who report unstable housing have much higher odds of a diabetes-related ED visit or hospitalization within the prior 12 months.[8] We are not aware of existing studies evaluating the effect of interventions to address social determinants specifically among high-cost, high-need patients with diabetes.

There is no consensus on the optimal interventions to address medical, behavioral, and social determinants of health among high-cost, high-need patients. Some recent evaluations of care coordination interventions have not identified reductions in utilization.[9,10] While others have reported significant reductions in ED visit and hospitalization rates in **Medicaid** populations, these include an uncontrolled pre-post analysis[11] and a comparison to patients who declined participation in the intervention,[12] both of which are vulnerable to selection bias and therefore difficult to interpret.[13,14] These single-institution studies also have limited generalizability, since local interventions rely on referrals or connections to a specific network of partnerships, resources, and services in that particular area.[15] Given that the strength of community networks vary from place to place and since outcomes such as ED use by Medicaid beneficiaries can vary 20-fold across different communities,[16] local interventions may have entirely different results if implemented in another area or region, **particularly if the intervention delivery process is not standardized.**

In this analysis, our team evaluated a national care coordination intervention for high-cost, high-need Medicaid beneficiaries with diabetes, implemented by UnitedHealthcare and

Optum. The goal of the intervention was to provide "whole-person care," integrating medical, behavioral and social support at a community level to address access barriers in addition to social determinants of health. Our work is part of the Natural Experiments for Translation in Diabetes 2.0 (NEXT-D2) Network, a research collaboration of eight academic centers using rigorous quasi-experimental study designs to evaluate naturally occurring experiments in healthcare policy and practice, with a focus on diabetes-related outcomes.[17] We evaluated whether a care coordination intervention to address social determinants of health changed rates of ED visits or inpatient hospitalizations among beneficiaries enrolled in the intervention as compared to a comparator group of similar Medicaid beneficiaries not offered the intervention.

METHODS

Study Design (Intervention Group versus Comparator Group)

We used an individual-level interrupted time series (ITS) with a comparator group study design. The intervention group was all Medicaid beneficiaries with diabetes who were successfully enrolled by Optum into the care coordination organization (CCO) intervention, regardless of the amount of contact with the program after initial enrollment. Beneficiaries were eligible for the CCO if they were 1) identified as high-cost, high-need (i.e., in the top 5% of Medicaid spend) based on utilization over a rolling 12-month window and predicted to be in the top 5% of spend in the following 12 months by a risk model developed by the health insurer, or 2) admitted to the hospital and flagged to be at high risk for 30-day readmission. Our comparator group was UnitedHealthcare Medicaid beneficiaries with diabetes who were CCO-eligible but never contacted for CCO enrollment because they received care in clinics within the Accountable Care Communities (ACC) program. The ACC program is a less-intensive, practice-level intervention limited to ambulatory clinical care delivery (e.g., enabling same-day scheduling, reminding providers to close care gaps by prescribing evidence-based medications, etc.) rather than addressing underlying socioeconomic issues. **An evaluation of the ACC program showed no effect on ED visits or hospital utilization for patients enrolled in ACC practices.**[18] This study was approved by University of California, Los Angeles Institutional Review Board #16-000276.

Study Population

We analyzed data from January 2013 to June 2017 for Medicaid beneficiaries age ≥21 years in 15 states that had both CCO and ACC programs (Table 1). We limited our analyses to Medicaid beneficiaries who were enrolled through one of four specific programs: 1) Temporary Assistance to Needy Families (TANF), 2) Medicaid expansion, the 3) Supplemental Security Income (SSI) program without Medicare, or 4) dual Medicaid/Medicare eligibility (simultaneously enrolled in both a Medicaid plan and a Medicare/Dual Special Needs Plan with the health insurer).

CCO Intervention

The CCO model was developed by UnitedHealthcare and Optum in response to the complexity and multifactorial needs of vulnerable members with multiple chronic conditions. The program includes services provided by behavioral health clinicians, primary

care physicians, and community-based social service organizations such as Meals on Wheels. These providers and organizations together represent the “care team” providing whole-person care to CCO enrollees. Optum subcontracts with individual community-based organizations to function as CCOs, **based on a successful record of accomplishment of providing services in a specific community. Optum provides each CCO with training and access to a standard electronic care coordination platform.** Using a claims-based algorithm, UnitedHealthcare notifies Optum of Medicaid beneficiaries who are eligible for the program, and Optum in turn works with the CCOs to perform patient outreach. The CCO typically designates a community health worker (CHW) to enroll the eligible beneficiary, administer a needs assessment survey, and connect the beneficiary with appropriate services based on their reported needs. For example, if the beneficiary reported food insufficiency, the CHW would connect him/her to local, **established** resources such as food pantries. The CHWs try to make contact with each enrolled member at least once per month to provide further assistance as needed. Approximately 26% of eligible UnitedHealthcare Medicaid beneficiaries were successfully enrolled in the CCO.

Study Months and CCO Enrollment (Real or “Synthetic”)

Because we define study time as months relative to CCO enrollment (defined as month 0), we created a “synthetic” CCO enrollment date for each beneficiary in the ACC comparator group in order to align study months between enrollees and non-enrollees, using the method described by Harvey et al.[19] With the data aligned using this approach, we then examined changes in the time trends of monthly utilization before the CCO enrollment or synthetic enrollment date (the “pre” period, months −15 through −4) versus the “post” period, months 6 through 22. We defined a “transition” period of months −3 through 5, because beneficiaries were identified as CCO-eligible approximately 3 months prior to enrollment and may have interacted with program representatives during this period, and because we estimated it would take 6 months for the program to achieve any changes in ED visits or hospitalizations.

Measures

Data included Medicaid beneficiary eligibility and demographics data, insurance claims for medical, pharmacy and laboratory services, practice-level characteristics to identify which practices were in the ACC intervention and when each ACC went online, and CCO program eligibility and enrollment information. We used the CMS Chronic Conditions Data Warehouse (CCW) definition to identify beneficiaries with diabetes, namely any of the following: 1 inpatient billing claim, 2 outpatient billing claims, an A1C value ≥ 6.5 and/or ≥1 prescription for insulin or an oral anti-hyperglycemic medication.[20] We specified that these criteria must be met within 24 calendar months of the first record of eligibility within the health plan.

We defined all outcomes at the person-month level, meaning that each observation corresponds to utilization by an individual within a given month. We made this decision given the significant number of persons who lose or gain Medicaid coverage during a given year.[21] We included all eligible person-months in the main analyses. Our outcome measures included indicators for whether an enrollee had any hospital admissions and any

emergency department visits in the given month. Covariates of interest included an indicator for treatment (CCO) versus comparator (ACC) group and indicator and spline variables that measured changes in an outcome's time trend (changes in level and slope) in the post and transition periods relative to the pre period. Indicator variables were used to measure the immediate impact of the CCO on outcomes (the change in level of the outcome at the start of the given study period). Spline variables were used to measure any gradual changes over time (the change in slope of the outcome during the given period). Specifically, a continuous variable for time in months since CCO enrollment (CCO enrollment [real or synthetic] defined as month zero) controlled for the outcome's linear pre period "baseline" time trend. The indicator variable for the post period (1 for months 6 through 22; 0 otherwise) measured the discontinuity, or immediate change in level of the outcome, at the start of the post period, relative to the level expected based on the pre period trend. The spline variable for the post period (counting months in the post period, from 1 to 17; 0 for all months in the pre and transition periods) measured changes in an outcome's slope (i.e., gradual monthly rate of change) from the pre to the post periods. We defined indicator and spline variables to account for changes in the transition period, but focused on comparisons between the pre and post periods for reasons described above.

Our estimates of interest in this interrupted time series design were the interactions between the treatment group indicator and the indicator/spline variables for each period.[22,23] For example, the difference between treatment versus comparator in the change in level from pre to post CCO (DID level) was measured by interacting the treatment indicator with the indicator for the post period; the difference between treatment versus comparator in the change in slope from pre to post CCO (DID slope) was measure by interacting the treatment group indicator with the post period spline variable.

Other covariates include sex, age group, race, language, 17 comorbidity indicators, state-by-year fixed effects, an indicator for whether a state had adopted Medicaid expansion in the given month, and seasonality.

Statistical Analyses

Segmented regression analysis models the difference between treatment and comparator in changes in an outcome's time trend between the pre and post periods, controlling for the aforementioned covarates.[24] Outcome measures were modeled using logistic regression. Each model adjusted for 3-digit zip code-level clustering using cluster-robust Huber-White standard errors, to account for the nesting of months within people with zip code.[25] We used $P < 0.05$ as our threshold for determining statistical significance. In addition to estimating the difference between treatment vs. comparator in the changes in each outcome's time trend (DID level and DID slope estimates), we used the above models to predict a counter-factual estimate of expected utilization at 12 months after enrollment (7 months after the end of the transition period) in the post period based on the pre-period time trend. The counterfactual provides an estimate of the presumed utilization if the pre period had continued and can be compared to the utilization as modeled in the post period. In addition, we estimated three sensitivity analyses, 1) restricting the analytic sample to beneficiaries with at least one month of data in the pre-period and one month of data in the post-period,

2) including patients who were CCO-eligible but not enrolled in the intervention group (intention-to-treat) and 3) restricting the analytic sample to beneficiaries in the three states with approximately 70% of the ACC practices (Arizona, Tennessee, Washington).

RESULTS

The person-month demographic and clinical characteristics of the CCO-enrolled intervention sample (n=154,324 person-months) and ACC-assigned comparator sample (n=40,510) at baseline are presented in Table 1. The comparator sample included more person-months from older, Medicaid/Medicare dual eligible beneficiaries than the intervention sample (Table 1). In the pre-period the intervention and comparator groups had similar person-month risk of ED visits (22.7% vs. 20.2%) and inpatient hospitalizations (9.9% vs. 9.0%). Characteristics of the intervention and comparator samples stratified by Medicaid program type are presented in Supplemental Table 1, available online.

Among SSI Medicaid beneficiaries, we observed a larger projected decrease in ED visit risk among the intervention sample versus the comparator sample at 12 months post enrollment (Table 2, DID: −6.6%; 95% confidence interval: −11.2%, −2.1%). As shown in Figure 1, changes in both the level (−3.7%, p=0.016) and slope (−0.3%, p=0.02) for ED visits were significantly different for the intervention sample versus the comparator sample. We did not find a difference in hospitalization risk between the intervention and comparator samples of SSI Medicaid beneficiaries.

Among Medicaid expansion beneficiaries, we observed a greater decrease in hospitalization risk among the intervention sample versus the comparator sample at 12 months post enrollment (Table 2, DID: −5.8%; 95% confidence interval: −11.4%, −0.2%). As shown in Figure 2, while differences in the level change did not reach significance (−3.1%, p=0.14), there was a significant difference in the slope change for hospitalizations (−0.2, p=0.03).

We did not observe differences for the other tested comparisons at 12 months post enrollment, including no significant difference in the change of either ED visits or hospitalization for TANF beneficiaries (Figure 1) and Medicare/Medicaid dual beneficiaries. For Medicare/Medicaid duals (Figure 2), gradual monthly declines in ED visit and hospitalization risk were about half a percentage point more per month for CCO enrollees than for comparators (ED: DID slope=−0.52%, p=0.032; hospitalization: DID slope=−0.48%, p=0.027). In our sensitivity analyses limited to beneficiaries with at least one month of data in the pre-period and one month of data in the post-period, we found similar effect magnitudes for the Medicaid SSI, expansion, and Medicare/Medicaid samples to the main analysis. Analyses among TANF enrollees were limited by low sample size. **The results of our other two sensitivity analyses were consistent with the overall pattern of results, with the majority showing no statistically significant differences in outcomes between the intervention and comparison populations.**

DISCUSSION

In an evaluation of a care coordination organization (CCO) intervention for high-cost, high-need Medicaid beneficiaries with diabetes, at 12 months post-enrollment **we found no**

evidence of reduced utilization with the CCO program in six of eight comparisons. However, we observed larger reductions in the ED visit risk for beneficiaries receiving Medicaid through the SSI program and in the hospitalization risk for Medicaid expansion enrollees relative to comparators receiving a less-intensive, practice-level intervention. Strengths of this analysis include a multi-state sample with comprehensive administrative data to measure utilization outcomes, as well as a rigorous, quasi-experimental difference-in-difference design with a comparison group selected to minimize selection bias.

While they need to be replicated in other datasets, our **limited** findings of decreased ED utilization for Medicaid SSI beneficiaries with diabetes and fewer hospitalizations for high-cost, high-need Medicaid expansion beneficiaries indicate potential benefits of care coordination interventions for these subgroups. To qualify for SSI without Medicare, adults must demonstrate that they have an impairment preventing them from performing "substantial gainful activity" for at least one year.[26] These patients may have a higher burden of behavioral and social health needs than other Medicaid beneficiaries, and often receive care in a poorly coordinated network of emergency departments, hospitals, psychiatric inpatient facilities, community clinics, jails and substance abuse clinics.[27] Analyses of high-cost, high-need Medicaid expansion beneficiaries demonstrate similar complex needs and cross-sector service use.[28] The CCO intervention may have helped provide these beneficiaries with a new, single point of initial contact with the health system. There are few studies of care coordination among high-cost, high-need Medicaid expansion beneficiaries. However, an intention-to-treat analysis of an intensive care management program among Medicaid SSI beneficiaries in Washington State found no overall effects on either ED or hospital utilization at 24-month follow-up. The investigators did identify an increase in outpatient mental health service use and prescription drug costs, outcomes not measured in the current analysis.[29]

As above, it should be noted that there was no strong, consistent pattern of evidence across all outcomes and populations that the CCO program significantly reduced high-cost healthcare events. Our results suggest that identification and enrollment of high-cost, high-need Medicaid beneficiaries into a care coordination program may not always be sufficient to result in change in ED and hospital utilization. We used a conservative study design with a comparator group who received an active although weaker practice-level intervention, and additional follow-up time may be required to assess the full effects of this type of comprehensive program. In fact, interventions based on addressing social needs may potentially increase acute care utilization and costs if supports are difficult to access elsewhere, since any weak link in the continuum of community-partnership building, resource referral, and follow-up may drive patients back to existing patterns of interaction with the larger system. As of yet, there is little consensus on the factors that make social needs interventions more likely to be broadly successful, sustainable, and scalable.[15,30]

We believe that a future "per-protocol" analysis, evaluating the impact on Medicaid beneficiaries who received the complete CCO intervention as intended, will be an important complementary assessment to the results reported here. Such an analysis will help distinguish between issues of low uptake versus modest intervention effect size, might highlight more or less effective program components for cost savings, and may help quantify

the potential impact of the intervention if recruitment and retention efforts are increased.[13] In addition, future studies examining patient perspectives on this intervention will be invaluable, since evidence suggests that high-need, high-cost patients who perceive higher levels of trust and respect from CHWs and other team members may be more engaged in changing behavior patterns.[15,31-33]

An overall limitation of the published literature evaluating interventions that target social determinants is an inability to distinguish between different categories of unmet need. For example, it is unclear whether connecting high-cost, high-need patients with housing supports, food insecurity or income support would be expected to result in similar effects. Since measured of unmet social need such as unstable housing, lack of access to nutritious food and inability to afford basic costs of living are not captured in claims data, it has been challenging to study subgroups of patients who fall into these categories. To address this issue, a working group including UnitedHealthcare and the American Medical Association proposed an additional 23 specific ICD-codes to the Centers for Medicare and Medicaid Services (CMS) to record different categories of unmet need, which are currently released for public comment.[34] If these codes are approved for use in Medicaid and Medicare, they will be enacted in fall 2020.

Our analysis has several limitations. First, since issues of unmet social need have accumulated over many years and can be slow to change, longer-term follow-up may be required to identify effects of care coordination interventions such as this one. Second, we did not match our samples for baseline utilization, and there may have been unmeasured differences between the intervention and comparison populations. However, the **interrupted time series** approach allows the intervention and comparison groups to have different intercepts and slopes in the pre period, **so the estimated intervention effects should be consistent** as long as the *changes* in intercepts and slopes from the pre-period to the post-period would have been the same for both groups in the absence of the intervention.[35] Finally, while the CCO intervention targeting high-cost, high-need beneficiaries was more intensive than the practice-level ACC intervention from which our comparison Medicaid beneficiaries were drawn, the latter group still may have received additional intervention services, **leading to a null result.**

In conclusion, we found that an evaluation of a national care coordination program designed by UnitedHealthcare to reduce utilization among high-cost, high-need Medicaid beneficiaries with diabetes was associated with decreased rates of ED visits and hospitalizations for some Medicaid programs but not others. Our findings are consistent with prior results from well-designed studies in this area. Given the oversized contribution of unmet social need and social determinants on health outcomes, finding effective and scalable approaches to address medical, behavioral, as well as social issues is essential in order to improve the performance of the healthcare system in the United States, particularly for high-cost, high-need patients.[36]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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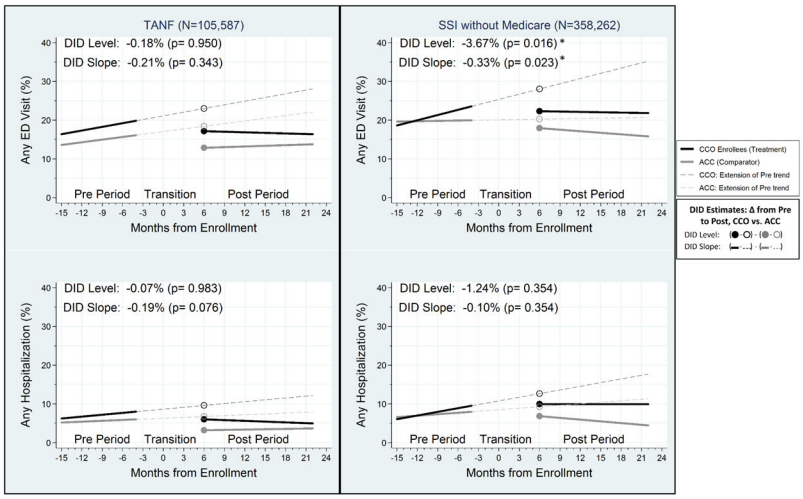

Figure 1.

Monthly ED visit and hospitalization rates for TANF and SSI without Medicare enrollees. For each sample, the figure shows the time trend of the adjusted monthly outcome for treatment (solid black line) and comparator (solid grey line). A dotted black line projects the treatment's pre period time trend forward in time, to represent what would be expected in CCO's absence (dotted grey line for comparator). Sample is person-months from 2013-2017.

Estimates from logistic regression; *denotes significance at $p < .05$. Regression covariates of interest were: Study group (treatment [CCO enrollees] vs. comparator [ACC-assigned CCO eligibles]); a linear monthly time trend counting months before and after CCO enrollment (real or synthetic; CCO enrollment defined as time zero), indicators and splines for both the transition (months −3 through 5) and post periods (months 6 and after); and the interactions between these variables and Group. Other covariates included sex, age group, race, language, 17 comorbidity indicators, state-by-year fixed effects, an indicator for whether a state had adopted the Medicaid Expansion in the given month, and seasonality. Repeated measures adjusted for using Huber-White cluster robust standard errors, clustering by 3-digit zip code. Difference-in-difference (DID) level is the difference between treatment vs. comparator in the discontinuity (change in level) at the beginning of the post period (relative to the pre period), measured using marginal effects post-estimation of the interaction between Group & an indicator for the post period. DID slope is the difference between treatment vs. comparator in the change in slope for the post period (relative to the pre period), measured using marginal effects post-estimation of the interaction between Group & a spline variable for the post period.

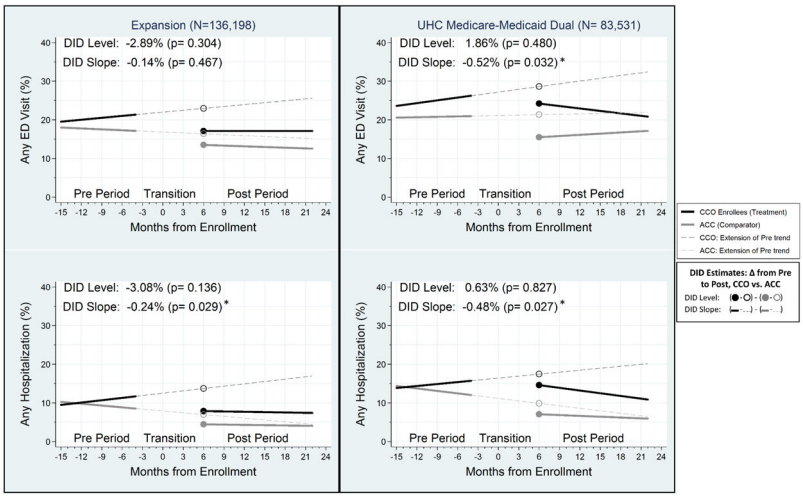

Figure 2.

Monthly ED visit and hospitalization rates for Medicaid Expansion and Medicare/Medicaid dual enrollees.

For each sample, the figure shows the time trend of the adjusted monthly outcome for treatment (solid black line) and comparator (solid grey line). A dotted black line projects the treatment's pre period time trend forward in time, to represent what would be expected in CCO's absence (dotted grey line for comparator). Sample is person-months from 2013-2017.

Estimates from logistic regression; *denotes significance at $p < .05$. Regression covariates of interest were: Study group (treatment [CCO enrollees] vs. comparator [ACC-assigned CCO eligibles]); a linear monthly time trend counting months before and after CCO enrollment (real or synthetic; CCO enrollment defined as time zero), indicators and splines for both the transition (months −3 through 5) and post periods (months 6 and after); and the interactions between these variables and Group. Other covariates included sex, age group, race, language, 17 comorbidity indicators, state-by-year fixed effects, an indicator for whether a state had adopted the Medicaid Expansion in the given month, and seasonality. Repeated measures adjusted for using Huber-White cluster robust standard errors, clustering by 3-digit zip code. Difference-in-difference (DID) level is the difference between treatment vs. comparator in the discontinuity (change in level) at the beginning of the post period (relative to the pre period), measured using marginal effects post-estimation of the interaction between Group & an indicator for the post period. DID slope is the difference between treatment vs. comparator in the change in slope for the post period (relative to the pre period), measured using marginal effects post-estimation of the interaction between Group & a spline variable for the post period.

Table 1.

Demographic and Clinical Characteristics of CCO Enrollees and ACC-Assigned CCO Eligible Comparators with Diabetes, averaged over the Pre Period (Months −15 to −4)

	CCO Enrollees (N=154,324 person-months)		ACC-Assigned Comparators (N=40,510 person-months)		P-Value[1]
	n	%	n	%	
Age group					
21-24	1,730	1.12	660	1.63	0.01*
25-34	7,954	5.15	2,423	5.98	0.07
35-44	19,974	12.94	5,447	13.45	0.44
45-54	49,580	32.13	11,837	29.22	0.02*
55-64	65,851	42.67	15,367	37.93	0.00*
65+	9,235	5.98	4,776	11.79	0.00*
Female	96,177	62.32	24,719	61.02	0.21
English as primary language	132,829	86.07	33,901	83.69	0.63
Race/ethnicity					
White	79,359	51.42	17,022	42.02	0.00*
African American	37,412	24.24	9,619	23.74	0.91
Latino	8,493	5.50	5,410	13.35	0.00*
Asian	5,269	3.41	592	1.46	0.01*
Other	23,791	15.42	7,867	19.42	0.01*
State of residence					
Arizona[2]	11,700	7.58	17,256	42.60	0.00*
Delaware[2]	3,011	1.95	507	1.25	0.42
Florida	10,058	6.52	1,661	4.10	0.11
Hawaii[2]	134	0.09	255	0.63	0.00*
Maryland[2]	9,673	6.27	408	1.01	0.02*
Michigan[2]	21,586	13.99	1,486	3.67	0.00*
Mississippi	9,543	6.18	2,375	5.86	0.85

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	CCO Enrollees (N=154,324 person-months)		ACC-Assigned Comparators (N=40,510 person-months)		P-Value[1]
	n	%	n	%	
New Jersey[2]	11,526	7.47	2,548	6.29	0.77
New Mexico[2]	1,117	0.72	381	0.94	0.31
New York[2]	23,514	15.24	856	2.11	0.00*
Ohio[2]	10,642	6.90	919	2.27	0.01*
Pennsylvania[2]	13,419	8.70	858	2.12	0.00*
Rhode Island[2]	5,704	3.70	265	0.65	0.00*
Tennessee	16,974	11.00	7,147	17.64	0.15
Washington[2]	5,723	3.71	3,588	8.86	0.02*
Mean Comorbidity count, IQR	6	4, 7	5	3, 7	0.00*
Medicaid category					
TANF	24,721	16.02	5,333	13.16	0.19
SSI (without Medicare)	97,555	63.21	20,036	49.46	0.00*
Expansion	20,495	13.28	8,356	20.63	0.00*
Medicare/Medicaid dual	11,553	7.49	6,785	16.75	0.00*
Utilization at baseline					
Any hospitalization	15,343	9.94	3,644	9.00	0.07
Any emergency department visit	35,076	22.73	8,182	20.20	0.02
Total person-months of data in the analyses	535,969		147,637		
Total unique people in the analyses	28,319		14,701		

1. P-values are from regressions controlling for clustering at the zip code level. All regressions were logistic regressions except in comparing the comorbidity count between treatment groups, which used gamma regression.

* p<0.05.

2. Adopted Medicaid Expansion

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Table 2.

Change in Predicted Utilization (utilization as modeled in the post period vs. utilization as expected had the pre period trend continued) for Treatment (CCO Enrollees) vs. comparator (ACC-Assigned CCO Eligibles) at 12 Month Follow-up

		Treatment Predictions		Comparator Predictions		Difference-in-Difference (DID) at 12 months: Treatment vs. Comparator, Post vs. Pre		
		A	B	C	D	DID = (A-B) – (C-D)		
Enrollment	Predicted Outcome	Under Post Trend	Under Pre Trend	Under Post Trend	Under Pre Trend	DID	95% Confidence Interval	
TANF	Any ED Visit	16.85%	25.74%	13.20%	20.38%	−1.71%	(−11.17%, 7.75%)	
	Any Hospitalization	5.58%	11.35%	3.37%	7.39%	−1.75%	(−10.73%, 7.22%)	
SSI (Without Medicare)	Any ED Visit	22.12%	32.09%	17.10%	20.43%	−6.63%	(−11.16%, −2.11%)	*
	Any Hospitalization	9.94%	17.42%	5.82%	10.51%	−2.79%	(−6.99%, 1.40%)	
Expansion	Any ED Visit	17.09%	24.15%	13.14%	15.97%	−4.22%	(−12.31%, 3.87%)	
	Any Hospitalization	7.69%	15.67%	4.29%	6.48%	−5.79%	(−11.39%, −0.19%)	+
UHC Medicare-Medicaid Dual	Any ED Visit	22.89%	30.34%	16.10%	21.55%	−1.99%	(−9.92%, 5.93%)	
	Any Hospitalization	13.07%	18.80%	6.61%	9.18%	−3.16%	(−11.30%, 4.97%)	

*(p=0.004)

+(p=0.043)

Notes: Predictions made using interrupted time series segmented regression analysis. Change in utilization at 12 months estimated by comparing (1) 12-month utilization amounts in the post period with (2) what utilization would have been at 12 months after enrollment if pre period trends had continued. Logistic regression used for utilization outcomes. Sample is person-months eligible for CCO from 2013-2017.

Regression covariates of interest were study Group (treatment [CCO enrollees] vs. control [ACC-assigned CCO eligibles]); a linear monthly time trend counting months before and after CCO enrollment (real or synthetic; CCO enrollment defined as time zero), indicators and splines for both the transition (months −3 through 5) and post periods (months 6 and after); and the interactions between these variables and Group. Other covariates included sex, age group, race, language, 17 comorbidity indicators, state-by-year fixed effects, an indicator for whether a state had adopted the Medicaid Expansion in the given month, and seasonality. Repeated measures adjusted for using generalized estimating equations (GEE), clustering by 3-digit zipcode.