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Discontinuity of Medicaid Coverage: Impact on Cost and Utilization among Adult Medicaid Beneficiaries with Major Depression

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Abstract

Background: Gaps in Medicaid coverage may disrupt access to and continuity of care. This can be detrimental for beneficiaries with chronic conditions, such as major depression, for whom disruptions in access to outpatient care may lead to increased use of acute care. However, little is known about how Medicaid coverage discontinuities impact acute care utilization among adults with depression.

Objective: Examine the relationship between Medicaid discontinuities and service utilization among adults with major depression.

Subjects: 139,164 adults (18–64) with major depression was identified using the 2003–04 Medicaid Analytic eXtract Files.

Methods: We used generalized linear and two-part models to examine the effect of Medicaid discontinuity on service utilization. To establish causality in this relationship, we used instrumental variables (IV) analysis, relying on exogenous variation in a state-level policy for identification.

Outcome Measures: Emergency department (ED) visits, inpatient episodes, inpatient days, and Medicaid-reimbursed costs.

Results: Approximately 29.4% of beneficiaries experienced coverage disruptions. In IV models, those with coverage disruptions incurred an increase of \$650 in acute care costs per-person per Medicaid-covered month compared to those with continuous coverage, evidenced by an increase in ED use (0.1 more ED visits per-person-month) and inpatient days (0.6 more days per-person-month). The increase in acute costs contributed to an overall increase in all-cause costs by \$310 per-person-month. (All *p-values* < 0.001)

Conclusions: Among depressed adults, those experiencing coverage disruptions have, on average, significantly greater use of costly ED/inpatient services than those with continuous

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coverage. Maintenance of continuous Medicaid coverage may help prevent acute episodes requiring high-cost interventions.

Keywords

Medicaid; discontinuity of coverage; major depression; acute care utilization

INTRODUCTION

Medicaid provides health insurance to 29 million non-elderly adults and serves as the largest payer of mental health (MH) services.^{1,2} Yet, low-income Medicaid populations commonly experience coverage disruptions and may or may not regain coverage subsequently – approximately 30% of non-elderly adult beneficiaries experience such “churning” each year.^{3–5} Previous studies of churning have found that, of those who lose Medicaid, the majority become uninsured, rather than gain private insurance.^{3,6} This is especially true among those with MH needs, who are disproportionately likely to be low-income and unemployed.⁷ These Medicaid enrollment dynamics are due, in part, to stringent re-enrollment procedures, which make coverage difficult to maintain over time.⁸

For patients with mental illness, Medicaid discontinuity may be a particular concern given the well-known barriers to MH treatment.⁹ Major depression is a serious MH condition, afflicting 16 million U.S. adults.¹⁰ Most patients with major depression experience periodic acute episodes throughout their lives.¹¹ Due to the condition’s severity and chronic nature, these patients require continuous coverage to ensure timely care receipt. When such patients lose Medicaid, they may face elevated out-of-pocket payment for MH services. Consequently, depressed patients – especially low-income patients eligible or nearly-eligible for Medicaid, for whom even a “minor” health expense can create significant financial strain – may skip visits with MH specialists and experience disruptions in outpatient treatment. Guidelines for depression care, however, require regular adherence to recommended treatments.¹² Thus, gaps in these treatments caused by coverage disruptions can precipitate exacerbation of beneficiaries’ depression symptoms and increase the likelihood of acute episodes, leading to expensive and otherwise avoidable emergent department (ED) and inpatient care.^{13,14}

State re-enrollment policies can affect coverage continuity among Medicaid beneficiaries. Federal regulations required states to recertify eligibility of Medicaid beneficiaries at least annually prior to the Affordable Care Act (ACA).^{15–17} However, states had implemented different eligibility recertification protocols because of varying budgetary pressures and political circumstances.^{15–17} By 2005, 14 states had required adults to recertify eligibility more frequently than annually.^{8,16} Frequent eligibility redetermination, which typically requires enrollees to revisit the social services office and provide documentation, imposes substantial administrative burdens,⁸ and therefore, can function as a barrier to Medicaid continuity.

Few studies have examined Medicaid discontinuity and its impact on service utilization among adults with mental disorders. One study of depressed adults in Florida found that persons with interrupted coverage were significantly more likely to have ED visits and

hospitalizations.¹⁴ Two other single-state studies examining adults with schizophrenia found a strong association between disenrollment and psychiatric hospital admissions.^{13,18} National samples are required to obtain generalizable estimates and identify variation across states.¹⁹ Further, this literature fails to recognize endogeneity in the relationship between coverage disruptions and service utilization, particularly concerns about reverse causality.²⁰ Use of ED/inpatient services can reduce the length of coverage disruptions, given hospitals' efforts to enroll potentially eligible patients in Medicaid to increase payments for services delivered.²¹ Failing to address this endogeneity can cause researchers to underestimate the effect of disenrollment on ED/inpatient care utilization.

We used national Medicaid data to examine the effect of coverage discontinuities on ED/inpatient services utilization among adults with major depression. Our study stands apart from previous studies of this relationship as we use national data to identify exogenous variation in states' re-enrollment policy and use this variation as an instrumental variable (IV) to address sources of endogeneity. Importantly, this IV approach yields unbiased estimates of the effects of disenrollment on acute care (i.e., inpatient and/or emergency care)²² utilization, which prior studies cannot claim.

METHODS

Study Population and Data Sources

Our primary data source was the 2003–04 national Medicaid Analytic eXtract (MAX) Files. MAX is an administrative database that includes information on enrollment, eligibility, and healthcare utilization in Medicaid, as well as beneficiary socio-demographic characteristics. We merged MAX with the Area Health Resources Files – a county-level data file that includes measures of health professions, facilities, and socio-demographic characteristics – and state policy characteristics from data compiled in previous studies.^{17,23,24}

Our MAX data consist of 629,711 adults (18–64) with a diagnosis of major depression between January 2003 and December 2004. Consistent with prior research,²⁵ we identified major depression diagnoses based on at least two claims with ICD-9 codes 296.2 or 296.3. Because of the incompleteness of encounter data from managed care programs in MAX during our study timeframe, we excluded 255,897 persons who had any managed care coverage.^{19,26} We also excluded 3,824 persons living in states with more than 75% managed care penetration, due to concerns that the relatively few enrollees in fee-for-service may not be representative of the state Medicaid population.²⁷ Additionally, persons qualified for Medicaid exclusively due to disability (N=217,168) were excluded because such enrollees have fewer coverage discontinuities than other beneficiary groups,^{4,5,13} possibly resulting from different rules of eligibility determination.²⁸ We further excluded individuals that had: (1) dual eligibility (N=6,611); (2) private insurance (N=6,691); and/or (3) missing information on one or more covariates (N=356). These exclusions yielded an analytic sample of 139,164 beneficiaries across 35 states.

Outcome Measures

Our outcomes include Medicaid-reimbursed costs and acute services utilization per-person per Medicaid-covered month for the period after we first observe a major depression diagnosis.^{13,14,29} Measures of acute care utilization include the numbers of all-cause ED visits, inpatient episodes, and inpatient days per-person-month. We followed recommended approaches for identifying ED visits from the Other Therapy and Inpatient Files (Appendix).³⁰ The numbers of inpatient episodes and inpatient days were determined using the start/end dates of inpatient claims to ensure that a single episode was not counted as multiple hospitalizations.²⁹

Costs were based on the dollar amounts paid by Medicaid as indicated in claims, not on provider charges. Costs were classified as follows: (1) all-cause costs on all visits, regardless of setting or diagnosis; (2) acute care costs on ED visits and hospitalizations; (3) medication costs on all filled prescriptions; and (4) outpatient costs on all visits except for acute care and filled prescriptions.

Discontinuity of Coverage

The primary predictor was a dichotomous variable identifying whether a beneficiary had at least one coverage disruption (versus continuous enrollment). A coverage disruption was defined as an enrollment gap of more than one month.^{14,29} The secondary predictor was a continuous variable reflecting the total number of months without Medicaid coverage following initial enrollment; it was zero for persons with continuous enrollment.

Other Covariates

Measures of individual-level predisposing characteristics included age at the time we first observe a major depression diagnosis (in years), an indicator for female gender, and race/ethnicity.

We also included measures of individual-level need-related characteristics to adjust for observed differences in MH/medical comorbidities and disability status between individuals with continuous enrollment and those with disruptions. To control for MH comorbidities, we derived indicators for the presence of MH conditions (Appendix).^{19,31} We also controlled for the count of comorbid medical conditions using the Elixhauser Comorbidity Index.^{19,32} To control for disability, we included a ratio of beneficiaries' time on disability over their total Medicaid-enrolled time.

County-level socioeconomic status was assessed with median household income (2002). We included three county-level measures of geographic availability of MH care resources – numbers of (1) community health centers, (2) psychiatrists, and (3) general and family practice physicians (per 100,000 persons) (2002).

Statistical Analyses

Because acute care visits and costs are heavily skewed by zeroes (>30%), we estimated two-part models (TPMs) with a logit model in the first part and a generalized linear model (GLM) with a log link and gamma distribution in the second part. We estimated GLM with a

log link and gamma distribution for other types of costs (e.g., all-cause cost) because they are skewed with few (<5%) zeroes. We chose these functional forms following previous research.^{33,34}

A potential concern about this analysis is that coverage discontinuities may be endogenous to acute care utilization. First, reverse causality may exist as the use of hospital services can reduce coverage discontinuities. Hospitals are prohibited from turning away patients who seek emergency care;³⁵ accordingly, hospital staff have strong incentives to ensure that eligible patients are enrolled in Medicaid to reduce uncompensated charges.²¹ Second, omitted variable bias may exist, especially in need-related characteristics. Poorer health status is associated with lower rates of disenrollment^{36,37} and greater ED/inpatient services use.^{38,39} To the extent that need characteristics are not captured by our measures of MH/medical comorbidities, this source of variation could induce a spurious negative correlation, resulting in an underestimate of disenrollment effect on utilization.^{21,40}

To address the endogeneity of disenrollment with respect to acute care use, we used a two-stage residual inclusion instrumental variable (2SRI-IV) analysis.³⁴ The 2SRI-IV method relies on the exogenous variation in coverage disruption induced by the instrument to establish, statistically, an unbiased, causal estimate of the effects of disruptions on acute care use.²⁰ In an IV framework, 2SRI produces consistent estimators for nonlinear models, such as GLM with log link and gamma distribution.⁴¹ In the first stage, we estimated linear models to instrument the endogenous disruptions; in the second stage, TPMs/GLMs were estimated to identify the effects of disenrollment on outcomes, adjusting for the residual predicted in the first stage. To account for the error in the included residual, we bootstrapped standard errors.^{34,41}

The IV method requires that the instrument be strongly predictive of disruptions but not independently affect service utilization.²⁰ Thus, we employed a state-level indicator for whether the state required Medicaid recertification annually (“streamlined” re-enrollment) versus every six months or more frequently to instrument for endogenous disruptions. We classified this measure into these two categories because during our study period, all but one of the states in our sample required recertification either annually or every six months. The remaining state required monthly recertification. Our choice of instrument was guided by robust research indicating that streamlined re-enrollment is strongly associated with reduced coverage disruptions and is otherwise unrelated to service utilization.^{4,8,42} We tested the strength of our IV based on partial R^2 and F -statistics for the instrument.²⁰ To enhance the credibility of our analysis, we also conducted a falsification test,⁴³ testing the direct “effect” of our IV on antibiotic medication uses and cost, in lieu of our outcomes, in reduced form models. We would expect *no* significant effect on these alternative outcomes.

The protocol for this study was approved by the Emory Institutional Review Board.

RESULTS

Sample Characteristics

Of our sample, 40,857 (29.4%) individuals experienced one or more coverage disruptions (Table 1). Within the subpopulation experiencing disrupted coverage, 37,815 (92.6%) had a single disruption and 3,042 (7.4%) had multiple disruptions. Of those with a single disruption, 9,758 (25.8%) re-enrolled subsequently. Among those with any disruption, the average length of total disruptions per-person during our study period was 8.4 months.

Compared to individuals with continuous coverage, those with disruptions were slightly younger, experienced less disability-based coverage, had fewer MH and medical comorbidities, and lived in counties with slightly higher incomes (p -values<0.001). The unadjusted numbers and costs of ED visits and hospitalizations per-person-month were significantly higher for those with disrupted coverage, while their unadjusted all-cause cost and costs of medications and outpatient care per-person-month were slightly lower (p -values<0.001).

Individuals with disrupted coverage were less likely to reside in states with streamlined re-enrollment policies (p <0.001). During the two-year study period, eight states maintained biannual certification-periods and one state maintained monthly recertification among the 35 states in our sample.

Association between re-enrollment policy and coverage discontinuity

In the first stage of our IV analyses, we found a strong association between re-enrollment policy and coverage disruptions (Table 2). Compared to those living in states requiring recertification every six months or more frequently, those living in states with streamlined re-enrollment were less likely to experience any disruption (25.8% versus 37.5%, p <0.001) and experienced fewer months without Medicaid coverage on average (2.1 months versus 3.2 months, p <0.001). The partial F -statistic for the policy indicator was 122.0 when estimating the likelihood of disruptions and 93.5 when estimating the length of disruptions, both well beyond conventional criteria for acceptably strong instruments.⁴⁴

Relationship of coverage discontinuity to service utilization and cost

To examine the relationship between disenrollment and utilization, we first depicted trends in service utilization that were associated with coverage disruption, naively ignoring potential sources of endogeneity (Figure 1). We explored changes in all types of costs during the five-month period prior to a coverage disruption versus the five-month post disruption among a subsample who experienced a disruption and were continuously enrolled for at least five months before and after this disruption. We found that acute care costs increased markedly during the first two months after re-enrolling in Medicaid. Particularly, the acute care cost per-person in the first month immediately following the disruption was more than double the cost in the month immediately preceding the disruption (\$575 versus \$238). A similar trend was found in all-cause costs. These trends remained similar when we required an alternative length (e.g., three-month) of enrollment pre- and post-disruption and when we

examined acute care utilization, specifically inpatient episodes, inpatient days, or ED visits, in lieu of costs (not shown).

In 2SRI-IV analyses, both the likelihood of coverage disruptions and the length of disruptions were significantly and positively associated with acute services utilization and cost (Tables 3–4). Compared to individuals with continuous coverage, those with any disrupted coverage incurred 0.1 more ED visits per-person-month, nearly 0.1 more inpatient episodes per-person-month, and 0.6 additional inpatient days per-person-month (Table 3). Similarly, for each additional month of lost Medicaid coverage, patients incurred 0.01 more ED visits, nearly 0.01 more inpatient episodes, and 0.07 more inpatient days per-person-month (all p -values<0.001).

As evidenced by the increases in ED visits and inpatient services, those with any disrupted coverage also incurred higher acute care costs compared to those with continuous coverage (\$945 versus \$295 per Medicaid-enrolled person-month, p <0.001) (Table 4). On average, each additional month of lost Medicaid coverage led to an increase of \$76 (p <0.001) in acute cost per Medicaid-enrolled person-month.

The magnitude of the aforementioned estimates was 2–4 times absent our IV method (Tables 3–4). For example, in the TPM that did not use the instrument, the estimated increase in acute cost per-person-month was \$202 (versus \$650 in the 2SRI-IV model) for individuals experiencing disruptions compared to those with continuous coverage (Table 4).

By contrast, both the likelihood and length of coverage disruptions were negatively associated with the costs of filled prescriptions and outpatient care (Table 4). Nevertheless, the increase in acute cost contributed to an overall increase in all-cause cost by \$310 (p <0.001) per-person-month among those with disruptions, compared to those with continuous coverage. Similarly, a one-month increase in the total length of disruptions led to an overall increase in all-cause cost by \$33 (p <0.001) per-person-month.

We conducted additional analyses to assess the robustness of our findings, including a sequence of models that (1) examined the costs specific to treatment for MH disorders and the costs specific to depression treatment; (2) included additional confounding variables, specifically county-level unemployment rates and state-level managed care penetration; (3) included those who were completely disabled during our study period; and (4) stratified our sample by state to identify whether findings vary across states (not shown). We also conducted reduced-form analyses to test the direct impact of the re-enrollment policy on service utilization (not shown). Our findings remained robust using these alternative specifications, sample, and outcomes. Finally, we found no significant relationship between our IV and antibiotic medication uses or cost in our falsification test (Appendix).⁴³

DISCUSSION

This study provides the first national estimate of coverage discontinuities for adult Medicaid populations with major depression, and is the first to use an IV approach to identify the effect of Medicaid discontinuities on service utilization. Our results suggest that for adults with severe depression, those experiencing disruptions in Medicaid coverage have, on

average, significantly greater use of costly ED and inpatient services, compared to those with continuous coverage. Likewise, the longer length of coverage disruptions a patient experienced, the more intensive the patient's use of acute services when re-enrolled. Further, the increase in utilization of ED/inpatient services was associated with a significant increase in monthly acute care costs. Notably, adults with continuous coverage had more disabilities and comorbidities than those with disruptions, which aligns with prior studies reporting that sicker patients are less likely to dis-enroll.^{36,37}

Our findings are also consistent with the literature reporting a positive association between Medicaid disenrollment and subsequent hospitalizations among patients with mental illness.^{13,14,18} Our novel 2SRI-IV framework, relying on national data to identify variation in state-level re-enrollment policies, significantly reduces the bias associated with endogeneity in this relationship. Notably, 2SRI-IV estimates local average treatment effects, identifying the effect of disenrollment for the group of individuals whose coverage stability is sensitive to the instrument (i.e., state-specific re-enrollment policy). Our results may have limited generalizability to other groups.

Our IV estimates indicate that ED visits and inpatient episodes were 39% and 61% higher, respectively, among adults with disruptions than those with continuous enrollment. The lack of a constant source of coverage may cause patients to miss visits with providers until their depression symptoms and complications (e.g., suicidal ideation) worsen to the degree that emergency visits are required. Although we could not directly test these pathways, results from subgroup analyses provide evidence to support the mechanism. Among the subsample who discontinued coverage and subsequently re-enrolled, utilization of acute services rose substantially after returning to coverage – possibly to stabilize the exacerbated, acute conditions – compared to the months preceding disruption. Notably, for many patients, costly hospital settings may function as an entry point for returning to treatment, which also triggers their re-enrollment in Medicaid.¹⁴

Increases in acute care utilization translated to an increase of \$650 in acute cost per-person per Medicaid-covered month, driving up total Medicaid cost by \$310 per-person-month among depressed adults. Nevertheless, while there is little robust evidence on this point, restrictive eligibility redetermination rules may reduce state outlays for all Medicaid-insured adults, due to reduced overall counts of Medicaid-covered patient-months.⁵ For all Medicaid-insured adults, some evidence suggests that acute care use does not increase following disenrollment.²² Our findings do not contradict this point; however, for certain small, vulnerable subgroups, such as adults with major depression, disenrollment may lead to adverse health events and elevated acute care use and cost during Medicaid-covered months. Similar observations have been raised in research focusing on ambulatory care sensitive conditions.^{15,45} Future studies should investigate whether and what types of adverse outcomes occur as a result of frequent churning among vulnerable subgroups.

Prior to the ACA, state efforts to improve Medicaid continuity varied substantially.¹⁷ Our data showed significant variation across states in disenrollment rates, ranging from 7.3% in Tennessee to 52.4% in Texas. This variation may be minimized if states' eligibility determination processes are simplified, as under the ACA.⁴⁶ Our findings suggest that

streamlined re-enrollment has the potential to increase Medicaid continuity, support adequate access to care, and improve outcomes among low-income adults with MH needs. In the current political landscape, however, the future of Medicaid and key ACA provisions remains uncertain.⁴⁷ If Medicaid churning is exacerbated by stricter, more frequent eligibility redetermination requirements, as states renew efforts to seek cost-savings in Medicaid,^{23,48} this churning may lead to spillover adverse health consequences and associated acute care cost among select vulnerable subgroups, which would reduce these savings. More research is needed to understand how shifting eligibility rules and other changes affect coverage stability and outcomes moving forward.

Several study limitations are noted. As with any analysis of claims data, coding errors may introduce measurement error.⁴⁹ Also, the MAX files lack information for periods when Medicaid is discontinued. Therefore, we are unable to examine changes in outcomes, utilization, and insurance status during these periods, although a majority may become uninsured after losing Medicaid.^{3,6} Similarly, no data are available on services not Medicaid-reimbursed, including out-of-pocket expenditure. Our analysis, therefore, can neither reflect all care experiences of Medicaid-insured adults with depression nor their total medical expenditures resulting from disenrollment. Further, our data do not support robust examinations of the appropriateness of acute care, especially ED visits and hospitalizations for MH conditions, or the reasons for acute care to determine appropriateness. The MAX files, however, remain our best source of information on Medicaid continuity and utilization among vulnerable populations.

Finally, because of the age of our data, the findings may not generalize to more recent years. Specifically, managed care mechanisms were more widely integrated into Medicaid following our study period. As our sample is limited to those in the fee-for-service program, our results may not generalize to those enrolled in Medicaid managed care plans, which may implement patient engagement strategies and outreach efforts that influence churning in ways traditional fee-for-service programs have not.⁵⁰ Nevertheless, we are not aware of evidence suggesting that the adoption of managed care changes the relationship between disenrollment and acute care use.

These limitations notwithstanding, our findings suggest that maintenance of continuous Medicaid coverage, resulting from streamlined administrative procedures, is likely to facilitate access to care for those with MH needs and prevent acute episodes requiring care delivered in high-cost hospital settings. With the changing landscape of healthcare coverage in the coming years, it will be important to develop program- or policy-level strategies to improve the continuity of Medicaid coverage and ensure adequate access to care for vulnerable subpopulations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Monthly Cost in Pre-disruption Period versus Post-disruption Period

Notes: The cost of a specific type was calculated as the sum of costs per person per month during the first five months immediately before a coverage disruption and the first five months immediately after the disruption, among a subset of individuals who experienced a coverage disruption and also were continuously enrolled in Medicaid during the ten months before or after the disruption (N=3,207).

Table 1:

Sample Characteristics of Adult Medicaid Beneficiaries with A Diagnosis of Major Depression, By Presence of Disruptions in Medicaid Coverage, N=139,164

	Continuous Coverage [†] (n=98,307)	Single or Multiple Disruptions [†] (n=40,857)	P-value [§]
<i>Dependent variables, mean (SD)[‡]</i>			
Acute services use per person per covered month			
No. of emergency department (ED) visits	0.2 (0.5)	0.3 (0.5)	<0.001
No. of inpatient episodes	0.06 (0.2)	0.10 (0.2)	<0.001
Inpatient days	0.4 (1.4)	0.6 (1.7)	<0.001
Cost per person per covered month (\$)			
Acute (i.e., ED and/or inpatient) services cost	388 (1,307)	536 (1,719)	<0.001
Total all-cause cost	1,104 (1,673)	1,048 (1,956)	<0.001
Cost of filled prescriptions	288 (396)	183 (308)	<0.001
Cost of outpatient care	428 (718)	329 (535)	<0.001
<i>State-level instrumental variable[±]</i>			
Streamlined Medicaid reenrollment policy, %			
Recertification every 6 months or more frequently	26.9	39.7	<0.001
Recertification every 12 months	73.1	60.3	
<i>County-level independent variables,[±] mean (SD)</i>			
Median household income (\$10,000)	3.8 (0.8)	3.9 (0.9)	<0.001
No. of psychiatrists per 100K	17.3 (30.7)	14.7 (27.0)	<0.001
No. of community health centers per 100K *	3.3 (6.2)	3.4 (6.4)	0.091
No. of general & family practitioners per 100K	30.1 (14.6)	30.1 (14.6)	0.841
<i>Individual-level independent variables</i>			
No. of coverage disruptions, mean (SD)	----	1.1 (0.3)	
Total months of coverage disruptions, mean (SD)	----	8.4 (5.4)	
Total months on Medicaid after index [¶] , mean (SD)	12.7 (7.5)	9.5 (5.6)	<0.001
Demographics			
Age at index diagnosis date, mean (SD)	34.7 (10.4)	32.0 (9.7)	<0.001
Female, %	81.0	78.5	<0.001
Race/ethnicity, %			<0.001
White	69.9	70.9	
Non-Hispanic Black	17.0	15.1	
Hispanic	9.2	9.7	
Other	2.0	2.1	
Unknown	1.9	2.2	
Need characteristics			

	Continuous Coverage [†] (n=98,307)	Single or Multiple Disruptions [†] (n=40,857)	P-value [§]
% of time on Medicaid due to disability, mean (SD)	10.8 (25.6)	5.3 (19.1)	<0.001
Mental health comorbidity [‡] , %			
Anxiety disorder	27.0	19.9	<0.001
Bipolar disorder	14.1	11.5	<0.001
Schizophrenia / other psychotic disorder	5.7	4.8	<0.001
Substance abuse disorder	24.4	23.5	0.001
Depressive disorder not otherwise specified	28.2	21.8	<0.001
Dysthymia	7.3	5.2	<0.001
Other mental health disorder	22.1	17.9	<0.001
No. of Elixhauser medical comorbidities [‡] , mean(SD)	0.9 (1.3)	0.5 (1.0)	<0.001

Notes:

[†]Standard deviations (SDs) were reported in parenthesis.

[‡]Statistics reported in the table were calculated at person level (i.e., the unit of analysis is one person).

[§]P-value from bivariate analysis: chi-square test for categorical variables and two-sample t-test for numerical variables.

[#]We calculated the outcome measures using the monthly average while participating in Medicaid because the total enrollment period varies among beneficiaries; also, because services paid by other payers are unobserved, our outcomes specifically refer to services reimbursed by Medicaid.

[±]County- and state-level measures were assessed with the most recent year of data available preceding 2004.

^{*}Community health centers include federally qualified health centers and rural health clinics.

[¶]Total length in months that were covered under Medicaid after we first observed a diagnosis of major depression.

[‡]Mental health comorbidities and Elixhauser medical health comorbidities were measures during any time of our study period (i.e., 2003–04).

Table 2:

Association Between State Reenrollment Policy and Disruptions in Medicaid Coverage, N=139,164

	Single or Multiple Disruptions (vs. Continuous Coverage) [§] (Pct. = 37.5%) [¶]	Total Months of Coverage Disruptions [‡] (Intercept = 3.2) [†]
<i>State-level instrumental variable (IV)</i>		
Streamlined Medicaid reenrollment policy		
Recertification every 6 months or more frequently	(Reference)	(Reference)
Recertification every 12 months	-11.7% ***	-1.1 ***
<i>Partial F-statistic of IV</i>	122.0 ***	93.5 ***
<i>Partial R-squared of IV</i>	0.014 ***	0.010 ***
<i>County-level independent variables</i>		
Median household income (\$10,000)	1.2% **	0.1 *
No. of psychiatrists, per 100K	-0.2%	-0.01
No. of community health centers, per 100K	1.2% **	0.1 *
No. of general and family practitioners, per 100K	-0.1%	0.001
<i>Individual-level independent variables</i>		
<i>Demographics</i>		
Age	-0.3% ***	-0.02 ***
Female	-6.0% ***	-0.7 ***
Race/ethnicity		
White	(Reference)	(Reference)
Non-Hispanic Black	-2.6% *	-0.3 **
Hispanic	2.1%	0.3
Other	1.6%	0.1
Unknown	4.1%	0.6
<i>Need characteristics</i>		
Percentage of time on Medicaid due to disability, %	-2.9% ***	-0.3 ***
Mental health comorbidity		
Anxiety disorder	-5.5% ***	-0.7 ***
Bipolar disorder	-1.9% ***	-0.3 ***
Schizophrenia / other psychoses	2.6% ***	0.1
Substance abuse disorder	2.2% ***	-0.02
Depressive disorder not otherwise specified	-3.6% ***	-0.5 ***
Dysthymia	-4.1% ***	-0.5 ***
Other mental health disorder	-3.4% ***	-0.5 ***
No. of Elixhauser medical comorbidities	-4.2% ***	-0.5 ***

Notes:

*
p<0.05

**
p<0.01

p<0.001; Marginal effects estimates reported.

[§]Model estimated using a Linear Probability Model [*F*-statistic=146.5, *adjusted R-squared*=0.054].

[‡]Model estimated using an Ordinary Least Square specification [*F*-statistic=118.6, *adjusted R-squared*=0.055].

[¶]Model-adjusted percentage of experiencing single or multiple Medicaid coverage disruptions per person.

[‡]Model-adjusted mean length (in months) of Medicaid coverage disruptions per person.

Table 3:

Multivariate Regression Results for Number of Emergency Department Visits, Inpatient Episodes, and Length of Stay Per Person Per Medicaid-Covered Month, N=139,164

	Emergency Department Visits		Inpatient Episodes		Inpatient Days	
	TPM [‡]	IV-TPM ⁺	TPM [‡]	IV-TPM ⁺	TPM [‡]	IV-TPM ⁺
<i>Marginal Effects:</i>						
Single or Multiple Disruptions (vs. Continuous Coverage)	0.054 *** (0.003)	0.130 *** (0.015)	0.034 *** (0.001)	0.077 *** (0.004)	0.228 *** (0.005)	0.620 *** (0.037)
Total Months of Coverage Disruptions	0.007 *** (0.0003)	0.014 *** (0.002)	0.004 *** (0.0001)	0.009 *** (0.001)	0.025 *** (0.001)	0.073 *** (0.004)
<i>Model-adjusted Mean of Outcomes:</i>						
Single or Multiple Disruptions (vs. Continuous Coverage)	0.230	0.205	0.060	0.049	0.375	0.297
Total Months of Coverage Disruptions	0.230	0.209	0.061	0.052	0.380	0.318

Notes:

* p<0.05

** p<0.01

*** p<0.001

[‡]TPM: Two-part model

⁺Two-part model with a two-stage residual inclusion instrumental variable (2SRI-IV) approach.

[#]Standard errors were reported in parenthesis; marginal effects estimates were reported.

[§]All regressions adjusted for individual-level socio-demographic and need characteristics, county-level socioeconomic status, and measures of local mental health care infrastructure.

Table 4:

Multivariate Regression Results for Medicaid Reimbursed Costs Per Person Per Medicaid-Covered Month, N=139,164

	Acute Services Cost ^{†‡§}		Total All-Cause Cost ^{§§}		Cost of Filled Prescriptions ^{§§}		Cost of Outpatient Care ^{§§}	
	TPM [¶]	IV-TPM [±]	GLM [‡]	IV-GLM ⁺	GLM [‡]	IV-GLM ⁺	GLM [‡]	IV-GLM ⁺
<i>Marginal Effects:</i>								
Single or Multiple Disruptions (vs. Continuous Coverage)	202 ^{***}	650 ^{***}	110 ^{***}	310 ^{***}	-57 ^{***}	-303 ^{***}	-45 ^{***}	-89 ^{***}
	(6)	(40)	(8)	(63)	(2)	(31)	(4)	(32)
Total Months of Coverage Disruptions	23 ^{***}	76 ^{***}	20 ^{***}	33 ^{***}	-2 ^{***}	-34 ^{***}	-1 ^{***}	-10 ^{***}
	(1)	(5)	(1)	(7)	(0.2)	(4)	(0.3)	(4)
<i>Model-adjusted Mean of Outcomes:</i>								
Single or Multiple Disruptions (vs. Continuous Coverage)	371	295	1,088	1,039	286	351	417	428
Total Months of Coverage Disruptions	377	316	1,076	1,050	278	361	407	429

Notes:

* p<0.05

** p<0.01

*** p<0.001

¶ Two-part model

± Two-part model with a two-stage residual inclusion instrumental variable (2SRI-IV) approach.

‡ Generalized linear model

+ Generalized linear model with a 2SRI-IV approach.

† Acute services specifically refer to emergency department and inpatient services.

Standard errors were reported in parenthesis; marginal effects estimates were reported.

§ All regressions adjusted for individual-level socio-demographic and need characteristics, county-level socioeconomic status, and measures of local mental health care infrastructure.