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Original Scholarship

The Effect of Medicaid on Management of Depression: Evidence From the Oregon Health Insurance Experiment

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Policy Points:

- We take advantage of Oregon's Medicaid lottery to gauge the causal effects of Medicaid coverage on mental health care, how effectively it addresses unmet needs, and how those effects differ for those with and without a history of depression.
- Medicaid coverage reduced the prevalence of undiagnosed depression by almost 50% and untreated depression by more than 60%. It increased use of medications and reduced the share of respondents reporting unmet mental health care needs by almost 40%.
- There are likely to be substantial mental health consequences of policy decisions about Medicaid coverage for vulnerable populations.

Context: Expanding Medicaid to previously uninsured adults has been shown to increase detection and reduce the prevalence of depression, but the ways that Medicaid affects mental health care, how effectively it addresses unmet needs, and how those effects differ for those with and without a history of depression remain unclear.

Methods: We take advantage of Oregon's Medicaid lottery to gauge the causal effects of Medicaid coverage using a randomized-controlled design, drawing on both primary and administrative data sources.

Findings: Medicaid coverage reduced the prevalence of undiagnosed depression by almost 50% and untreated depression by more than 60%. It increased use of

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medications frequently prescribed to treat depression and related mental health conditions and reduced the share of respondents reporting unmet mental health care needs by almost 40%. The share of respondents screening positive for depression dropped by 9.2 percentage points overall, and by 13.1 for those with preexisting depression diagnoses, with greatest relief in symptoms seen primarily in feeling down or hopeless, feeling tired, and trouble sleeping—consistent with the increase observed not just in medications targeting depression but also in those targeting sleep.

Conclusions: Medicaid coverage had significant effects on the diagnosis, treatment, and outcomes of a population with substantial unmet mental health needs. Coverage increased access to care, reduced the prevalence of untreated and undiagnosed depression, and substantially improved the symptoms of depression. There are likely to be substantial mental health consequences of policy decisions about Medicaid coverage for vulnerable populations.

Keywords: Medicaid, insurance, depression, mental health.

Almost one-third of low-income Americans report having been diagnosed with depression—twice the rate of the nation overall.[1] Depression has been correlated with worse health and lower quality of life, along with increased health care use.[2-6] Effective treatments for depression exist, but the uninsured are less likely to have their depression treated than those with Medicaid.[7] Medicaid coverage may thus result in substantial improvements in depression and quality of life, but because of the many differences between Medicaid enrollees and the uninsured, the causal connections between insurance coverage, treatment, and outcomes are difficult to discern. At a time when policymakers are reevaluating the scope of Medicaid coverage, better information about the effects of Medicaid on mental health care and outcomes is crucial.

In 2008, Oregon allocated by random lottery a limited number of slots in its Medicaid program for low-income adults. This lottery provides a unique opportunity to study the effects of Medicaid coverage without the influence of confounding factors that otherwise plague comparisons of insured to uninsured populations. In previous analyses using the lottery, we found that Medicaid coverage increased health care use (including primary, hospital, prescription, and emergency department care); improved financial security (although had no significant effect on employment or earnings); and improved self-reported health and mental

health but had no detectable effects on several measures of physical health.[8-11] In particular, we found that Medicaid coverage decreased the probability of screening positive for depression by 9.15 percentage points (95% CI: −16.70 to −1.60; $p = .018$), a relative reduction of 30%, and found a borderline-significant increase in use of broadly related medications.[8]

Understanding the multiple pathways through which Medicaid may have affected management of depression, the nature of health needs for populations with and without depression, and the aspects of the disease that were most affected by coverage can help patients, practitioners, and policymakers better understand the implications of coverage for this widespread condition. In this paper, we explore the ways in which Medicaid coverage affected the diagnosis, treatment, and symptoms of depression and the degree to which Medicaid successfully met mental health needs. Oregon's Medicaid program covered inpatient care, outpatient care (including some psychotherapy), and psychiatric prescription drugs with no copayments. We examine the effect of insurance on the prevalence of undiagnosed and untreated depression, how the effects of insurance differed between patients with and without known diagnoses of depression, the use of different treatments and specific mental health medications, and a range of depressive symptoms.

Methods

Medicaid Lottery

Oregon held a series of lottery draws in 2008 from a waiting list of approximately 90,000 people to allocate 10,000 available slots in Oregon Health Plan (OHP) Standard. Those selected were enrolled in Medicaid if they completed the application and met eligibility requirements. OHP Standard provided benefits to low-income adults who were not categorically eligible for Oregon's traditional Medicaid program. To be eligible for OHP Standard, individuals must have been aged 19 to 64, Oregon residents, US citizens or legal immigrants, without health insurance for 6 months, and not otherwise eligible for Medicaid or other public insurance. They must have had income below the federal poverty level and less than $2,000 in assets. OHP Standard provided relatively comprehensive medical benefits (including prescription drug coverage) with no consumer cost sharing and low monthly premiums (between $0

and $20, based on income), administered mostly through managed-care organizations. The lottery process and OHP Standard, the data sources on which we draw, and the statistical methods we deploy are described in much more detail elsewhere.[8-11]

Data Sources

Lottery and Medicaid Enrollment. The state provided us with the initial lottery list and with detailed data on Medicaid enrollment for every individual on the list. The list comprises our study population, as summarized in Appendix Figure A1. We use these data to construct our primary measure of insurance coverage during the study period.

In-Person Interviews and Clinical Assessments. Between September 2009 and December 2010, we conducted a large in-person data collection effort to assess a wide variety of outcomes. The 20,745-person sample for the in-person data collection included almost all of the individuals selected in the lottery living in the Portland area and a roughly equal number of unselected controls. The collected data includes answers from the 12,229 respondents to a detailed questionnaire, including administration of the Patient Health Questionnaire depression scale (PHQ-8).[12-14]

The in-person interview also included a catalog of medications in participants' possession. Medications were categorized using a commercially available prescription drug database (First DataBank). Our medication data thus capture only medication possession at a specific point in time, not adherence or prescriptions that lapsed or went unfilled. Appendix Table A1 provides additional detail on the mental health medications possessed by study participants.

We use these data for almost all of our outcome measures as well as to classify individuals on the basis of prelottery diagnosis of depression. Additional data sources used in ancillary analyses are described in the Appendix.

Statistical Analysis

Our analysis relies on the lottery's random assignment to generate unbiased estimates of the effect of Medicaid on outcomes. Not all adults selected in the lottery successfully enrolled in Medicaid (some selected in the lottery did not complete the Medicaid application

and some who did complete the application were ultimately deemed ineligible).

The subgroup of those selected in the lottery who went on to be enrolled is not comparable to the overall group not selected in the lottery, so simple comparisons of those actually enrolled to the control group would not provide valid causal estimates of the effects of Medicaid. Rather, we used a standard instrumental variables approach to gauge the effect of gaining Medicaid coverage through the lottery on subsequent health care use and depression outcomes. The estimates shown in Tables 2 and 3 represent the "local average treatment effect" of Medicaid coverage (or the effect of Medicaid for those people who received coverage because of the lottery, but would not have been covered otherwise), using selection in the lottery as an instrument for coverage.

The methods used here follow those of our prior quantitative analyses very closely and are detailed in the Appendix. Most analyses were prespecified and publicly archived in advance of completing any outcomes analyses; analyses that were not prespecified are marked in the tables with a carat (ˆ). In all analyses we cluster the standard errors by household since the treatment is at the household level. All analyses of outcomes from the survey data are weighted using survey weights to account for survey fielding methods.

Sample Characteristics and Insurance Coverage

A total of 12,229 individuals completed an interview by October 13, 2010 (effective response rate = 73%; see Appendix Figure A1). Table 1 describes the limited baseline demographics collected on the lottery list itself, confirming the expected balance between treatment and control groups. Just over half the study participants are women, about a quarter are ages 50-64 (the oldest eligible age group), and about 70% are white.

In addition to the full sample of in-person respondents, we also focus on those respondents who report having received a diagnosis of depression that was made prior to the lottery (34% of the sample). This categorization is based on the recollection of respondents at the time of the in-person interview. In theory, recollections about diagnoses made before the lottery could differ between those selected and those not selected (even though actual prelottery experiences should not differ because of the random selection); these recollections are, however, balanced across treatments and controls. Using the same methods as Table 1, the

Table 1. Study Population and Lottery[a]

	All Survey Respondents		Prelottery Diagnosis of Depression		No Prelottery Diagnosis of Depression	
	Control Mean (1)	Treatment Control Difference[b] (2)	Control Mean (3)	Treatment Control Difference (4)	Control Mean (5)	Treatment Control Difference (6)
Sample Characteristics (%)						
Female	56.9	−0.44	66.8	2.49	51.6	−1.74
		(0.87)		(1.58)		(1.08)
Age 19-34	36.0	−0.90	31.8	−1.95	38.3	−0.38
		(1.03)		(1.64)		(1.27)
Age 35-49	36.4	0.16	36.4	1.44	36.4	−0.53
		(1.02)		(1.67)		(1.24)
Age 50-64	27.6	0.73	31.9	0.51	25.3	0.90
		(0.94)		(1.61)		(1.11)
White	68.8	0.42	81.1	0.01	62.2	0.88
		(1.01)		(1.38)		(1.30)
Black	10.5	0.14	8.0	−0.26	11.9	0.32
		(0.61)		(0.92)		(0.78)
Other race	14.8	0.03	12.9	2.18	15.8	−1.13
		(0.80)		(1.23)		(1.03)
Hispanic	17.2	−0.19	10.0	0.11	21.1	−0.53
		(0.84)		(1.01)		(1.12)
Interviewed in English	88.2	0.25	96.6	−0.91	83.7	1.07
		(0.76)		(0.62)		(1.05)
Global test of balance, F-statistic		0.20		1.49		0.55
p-value		(0.99)		(0.15)		(0.83)
Effect of Lottery on Medicaid Coverage (%)						
Ever on Medicaid during study period	18.5	24.14	22.8	24.10	16.1	24.23
		(0.90)		(1.58)		(1.09)

[a]For each sample, the first column reports the control mean of the variable. The second column reports estimated differences between treatments and controls for the dependent variable (shown in the left-hand column), specifically the coefficient (with standard error in parentheses) on lottery based on estimating equation (1). The global test of balance rows report the pooled F-statistics and *p*-values from testing treatment-control balance on all the above variables jointly. All regressions include indicators for the number of household members on the list and adjust standard errors for household clusters. All analysis is weighted using survey weights. Samples consist of all in-person interview respondents ($n = 12{,}229$), those with a prelottery diagnosis of depression ($n = 4{,}166$) and without ($n = 8{,}063$).

[b]Results for all survey respondents were previously reported in Baicker et al (2013).[8]

difference between treatment and control groups is −0.8 percentage points; p-value of difference = .40.

The categorization of those with a prelottery diagnosis of depression captures both the individual having experienced a depressive episode in the past and the individual having had that depression recognized and diagnosed by a health care professional. Thus, given the recurrent nature of depression, this subgroup is one with a higher risk of depression during the study period. It is also likely, however, that this is a subgroup with greater connection to the health care system (as evidenced by having received a diagnosis) and willingness to discuss depressive symptoms with a health care provider.

Those with a prelottery diagnosis of depression are more likely to be female, which is consistent with the higher rates of depression in women in general.[15] They are also slightly older, more likely to be of white race, and more likely to have been interviewed in English.

Table 1 also shows the relationship between being selected in the lottery and being covered by Medicaid. For in-person survey responders, lottery selection increased the probability of ever being covered by Medicaid during the study period (between March 10, 2008, and the individual's interview date) among those selected relative to the control group by 24.1 percentage points. Self-reports at the time of the interview show no change in private insurance coverage. Control group Medicaid coverage rates are higher overall in the subgroup with a prelottery diagnosis of depression, but the increase in coverage generated by the lottery is not significantly different between those with and without prelottery depression diagnoses.

Limitations

There are of course several limitations to this analysis. First, while the random assignment generated by the lottery yields strong internal validity for causal estimates of the effects of Medicaid expansion, there are limits to external generalizability. Second, our measures of medication possession do not allow us to analyze adherence to medication; rather, they are a snapshot at a particular point in time. Third, we have limited information on the types of treatment for depression that the study subjects may have received. Thus, while our analyses yield strong evidence of the effects of Medicaid on a number of aspects of the care of and outcomes for depression for this population, there remain important

questions about the effects of different types of insurance coverage and specific courses of treatment.

Results

Diagnosis and Treatment of Depression

Diagnosis. Table 2, Panel A reports the impact of Medicaid on the diagnosis and treatment of depression, both overall and separately for those with and without prelottery diagnoses of depression. The top panel focuses on the diagnosis of depression among the sample that reported not having such a diagnosis before the lottery ($n = 8{,}063$). Our prior analyses had not focused on this group—one where new coverage has the opportunity to generate a new diagnosis. Medicaid increased the chance of receiving a depression diagnosis from a health care provider during the postlottery study period by 5.5 percentage points (relative to 7.4% of the control group; $p = .049$). Medicaid also decreased the prevalence of undiagnosed depression (defined as having a PHQ-8 score of 10 or higher at the time of the interview, but reporting not having received a diagnosis of depression) by 6.8 percentage points (relative to 14% of the control group; $p = .047$).

Treatment. Table 2, Panel B explores the effect of Medicaid on mental health treatments. Medicaid reduced the share of the population with untreated depression (defined as having a PHQ-8 score of 10 or higher at the time of the interview, but not reporting receiving talk therapy or having related medications)[14] by 10.5 percentage points (relative to the control group mean of 16.6; $p = .001$). It virtually eliminated untreated depression among those with a prelottery diagnosis (−17.0, relative to control group mean of 20.1; $p = .003$)—demonstrating that Medicaid drives substantial improvements in treatment independent of generating new diagnoses among depressed patients.

We have previously reported that Medicaid reduced the prevalence of unmet need for health care (defined as needing health care and not having that need fully met) by 10.7 percentage points (relative to a control group average of 39.0; $p = .004$).[8] The next rows examine unmet need for mental health care in particular. A total of 24.4% of the control group overall reported not getting all the mental health care they needed, while 45.8% of the control group with a prelottery depression diagnosis reported such unmet need. Medicaid reduced unmet need

Table 2. Diagnosis and Treatment of Depression and Mental Health Conditions[a]

	Control Mean (1)	Effect of Medicaid Coverage (2)	*P*-Value (3)
A. Diagnosis of Depression			
Among those without prelottery depression diagnosis			
Postlottery diagnosis of depression (%)	7.39	5.50	0.049
		(2.79)	
Undiagnosed depression (%)	14.01	−6.76	0.047
		(3.40)	
B. Mental Health Treatment			
Untreated depression (%)^	16.6	−10.50	0.001
		(3.05)	
Among those with prelottery depression diagnosis	20.1	−17.00	0.003
		(5.74)	
Among those without prelottery depression diagnosis	14.8	−6.80	0.053
		(3.50)	
p-value of difference			0.128
Unmet need for mental health care (%)	24.41	−9.21	0.005
		(3.29)	
Among those with prelottery depression diagnosis	45.82	−12.31	0.071
		(6.82)	
Among those without prelottery depression diagnosis	12.87	−6.19	0.041
		(3.03)	
p-value of difference			0.438
Talk therapy (%)	37.4	8.83	0.196
Among those with prelottery depression diagnosis		(6.84)	
Prescription Medications			
Any mental health medication (%)[b]	20.7	8.77	0.008
		(3.33)	
Mental health medications (#)[b]	0.335	0.14	0.025
	(0.77)	(0.06)	
Share using any (%):			
Antidepressant[c]	16.8	5.49	0.071
		(3.04)	
SSRI	9.8	4.13	0.088
		(2.42)	
Tricyclic, MAOI, or Other	7.0	3.66	0.082
		(2.10)	

Continued

Table 2. *Continued*

	Control Mean (1)	Effect of Medicaid Coverage (2)	*P*-Value (3)
Trazodone	3.4	−0.46	0.747
		(1.42)	
Anxiolytic	6.2	2.60	0.207
		(2.06)	
Bipolar	5.5	0.39	0.834
		(1.85)	
Sedative	2.9	4.13	0.004
		(1.43)	
Antipsychotic	4.0	0.80	0.629
		(1.64)	

[a]For each sample, the first column reports the control mean of the dependent variable (with standard deviation for continuous outcomes in parentheses). The second column reports the estimated local average treatment effect of Medicaid coverage (with standard error in parentheses). See Appendix for estimating equations and detail on functional form. All regressions include indicators for the number of household members on the lottery list and adjust standard errors for household clusters. All analysis is weighted using survey weights. Samples consist of all in-person interview respondents ($n = 12{,}229$), those with a prelottery diagnosis of depression ($n = 4{,}166$) and those without ($n = 8{,}063$).
[b]Trazodone and branded equivalents are excluded from these summary measures.
[c]Aggregate result for all survey respondents previously reported in Baicker et al (2013).[8]
^This analysis was not prespecified.

for mental health care by 9.2 percentage points overall ($p = .005$), by 12.3 percentage points for those with prelottery depression diagnoses (insignificant; $p = .07$), and by 6.2 percentage points for those without ($p = .04$). Appendix Table A2 shows additional detail on health care utilization based on prelottery depression diagnosis.

The lower rows report Medicaid's impact on treatment rates, including psychotherapy and medications. Only those with a prelottery diagnosis of depression were asked about use of psychotherapy. Of the control group, 37.4% reported receiving psychotherapy in the last year, with Medicaid increasing that share by an insignificant 8.8 percentage points ($p = .196$).

We next show use of mental health medications (with drugs and categories described in more detail in the Appendix). A total of 20.7%

of the control sample is taking at least one of these drugs, and Medicaid increases that share by 8.8 percentage points ($p = .008$). A similar pattern holds for the number of medications.

The next rows break out these medications into several categories. Examined at this level of granularity, substantial changes are evident primarily in the use of antidepressants (but only of borderline statistical significance) and sedatives. Antidepressant use is quite common overall (16.8% of control respondents), and Medicaid increases antidepressant use by 5.49 percentage points ($p = .07$), but with only marginal statistical significance, consistent with our prior findings examining a broader group of medications.[8] As shown in Appendix Table A3, this increase is statistically significant for the subset of respondents with prelottery diagnoses of depression.

Depression is often comorbid with other mental health conditions,[15] so we also examine the use of medications for anxiety, bipolar disorder, psychosis, and the use of sedatives. These other types of mental health medications are used less commonly than antidepressants, and only the use of sedatives changes significantly with Medicaid, increasing by 4.13 percentage points (relative to the control group average of 2.9; $p = .004$). As shown in Appendix Table A3, there are no statistically significant differences in the effects of Medicaid on medication use for those with versus without prelottery depression diagnoses.

Symptoms of Depression

In previous work, we found that Medicaid coverage substantially reduced the prevalence of depression.[8] In Table 3 we explore in more detail the effects of insurance on the symptoms of depression and whether the effects differ by history of depression (as measured by prelottery diagnosis).

First, we show the effect of Medicaid on screening positive for depression (PHQ-8 score of 10 or more[14]) at the time of the interview. Depressive symptoms are quite common in this population. Overall, 30% of controls screened positive for depression, compared to less than 9% nationally.[16] That rate dropped by 9.15 percentage points ($p = .02$) for those gaining Medicaid through the lottery.

The prevalence of depressive symptoms is substantially higher for individuals with a prelottery diagnosis of depression, with 52% of controls screening positive for depression, compared to 18% of controls with no prelottery diagnosis of depression. The effect of Medicaid on depression

Table 3. Presence of Depressive Symptoms[a]

	Control Mean (1)	Effect of Medicaid Coverage (2)	*P*-Value (3)
Positive Depression Screen (% with PHQ-8 ≥ 10)[b]	30.02	−9.15	0.02
		(3.85)	
Among those with prelottery depression diagnosis	52.05	−13.12	0.07
		(7.20)	
Among those without prelottery depression diagnosis	18.14	−5.26	0.19
		(3.99)	
p-value of difference			0.34
Total PHQ-8 Score	7.02	−1.18	0.02
	(6.01)	(0.50)	
Little interest/pleasure	0.83	−0.15	0.06
	(0.98)	(0.08)	
Feeling depressed	0.83	−0.26	0.00
	(0.98)	(0.08)	
Trouble sleeping or oversleeping	1.29	−0.20	0.04
	(1.17)	(0.10)	
Feeling tired	1.31	−0.26	0.00
	(1.07)	(0.09)	
Poor appetite or overeating	0.88	−0.06	0.50
	(1.10)	(0.09)	
Feeling bad about self	0.72	−0.08	0.33
	(0.99)	(0.08)	
Trouble concentrating	0.68	−0.06	0.49
	(1.02)	(0.08)	
Abnormal energy level	0.49	−0.09	0.22
	(0.87)	(0.07)	
Mental-Health-Related Quality of Life[b]	44.39	1.95	0.047
Mental Component Scale	(11.38)	(0.98)	

[a]For each sample, the first column reports the control mean of the dependent variable (with standard deviation for continuous outcomes in parentheses). The second column reports the estimated local average treatment effect of Medicaid coverage (with standard error in parentheses). See Appendix for estimating equations and detail on functional form. The third column reports the *p*-value of the estimated effects. All regressions include indicators for the number of household members on the lottery list and adjust standard errors for household clusters. All analysis is weighted using survey weights. PHQ-8 scoring: 0 is no days of symptoms, 1 is several days, 2 is more than half the days, and 3 is nearly every day. Samples consist of all in-person interview respondents ($n = 12{,}229$), those with a prelottery diagnosis of depression ($n = 4{,}166$) and those without ($n = 8{,}063$).
[b]Aggregate result previously reported in Baicker et al (2013).[8]

was not statistically significantly different for those who had received a diagnosis of depression before the lottery (−13.1; $p = .07$) versus those who had not (−5.26; $p = .19$) (p-value of difference = .34).

Next, we examine which symptoms of depression changed in response to Medicaid coverage, using the components of the PHQ-8 questionnaire.[14] Medicaid coverage significantly reduced depressive symptoms (1.18-point drop in PHQ-8 score relative to control mean of 7.02; $p = .019$), primarily through decreases in symptoms of having little interest or pleasure, feeling depressed, having sleep problems, and feeling tired. Scoring poorly on the first 2 symptoms is considered particularly important for a clinical diagnosis of depression.[12] The bottom rows report the effects of Medicaid on an alternate survey instrument—the mental health component of the 8-question Medical Outcomes Study Short-Form (SF-8), which is used to assess health-related quality of life[16]—where we also see an improvement in overall scores.

Discussion

Depression poses a major health burden to low-income populations. More than 30% of our control group of largely uninsured low-income adults screened positive for depression, and 24% reported unmet mental health needs. Amid discussion of the fate of Medicaid coverage, better information is needed about the role of Medicaid in the diagnosis, treatment, and alleviation of the symptoms of depression.

Using the unique opportunity presented by the Oregon Medicaid lottery, we assess the effect of Medicaid coverage on depression care and outcomes. Medicaid coverage significantly increased the diagnosis and treatment of depression, reducing the prevalence of undiagnosed depression by almost 50% and untreated depression by more than 60%. It increased the use of medications frequently prescribed to treat depression and related mental health conditions, and reduced the share of respondents reporting unmet mental health care needs by almost 40%.

These changes are consistent with the substantial drop in depression seen in those gaining access to Medicaid through the lottery. The share of respondents in whom we observed positive depression screens dropped by 9.2 percentage points overall, and by 13.1 for those with preexisting diagnoses of depression. The greatest relief in symptoms was seen primarily in feeling depressed, feeling tired, and having trouble

sleeping—consistent with the increase observed not just in medications targeting depression but also those targeting sleep.

There are several limitations to this study. We have limited information on the nature of the health care received; we look at only the first 2 years of postinsurance outcomes; and we have little prerandomization information that can be used for subgroup analysis. There are also important limits to external generalizability of the results: our population of low-income adults in Oregon who were interested in signing up for Medicaid may not be representative of other segments of the population.

That said, the Oregon lottery allows us to examine the causal effects of Medicaid coverage on the diagnosis, treatment, and outcomes of a population with substantial unmet mental health needs. Medicaid coverage resulted in a significant increase in access to care, reducing the prevalence of untreated and undiagnosed depression and substantially improving the symptoms of depression. There are thus likely to be substantial health consequences of policy decisions about Medicaid coverage for this vulnerable population.

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Appendix

This Appendix provides additional detail on the statistical methods and data sources used in "The Effect of Medicaid on Management of Depression: Evidence From the Oregon Health Insurance Experiment," as well as additional results not reported in the main paper.

A. Methods

Randomization and Intervention

Oregon opened a waiting list for a previously closed Medicaid program (OHP Standard) in early 2008 and then conducted 8 lottery drawings from the waiting list between March and September 2008. Those selected were enrolled in Medicaid if they completed the application and met eligibility requirements.

OHP Standard (the lotteried Medicaid program) provides benefits to low-income adults who are not categorically eligible for Oregon's traditional Medicaid program. To be eligible, individuals must have been aged 19 to 64, Oregon residents, US citizens or legal immigrants,

without health insurance for 6 months, and not otherwise eligible for Medicaid or other public insurance. They must have income below the federal poverty level and have less than $2,000 in assets. OHP Standard provides relatively comprehensive medical benefits (including prescription drug coverage) with no consumer cost sharing and low monthly premiums (between $0 and $20, based on income), provided mostly through managed care organizations. The lottery process and OHP Standard are described in more detail elsewhere.[11]

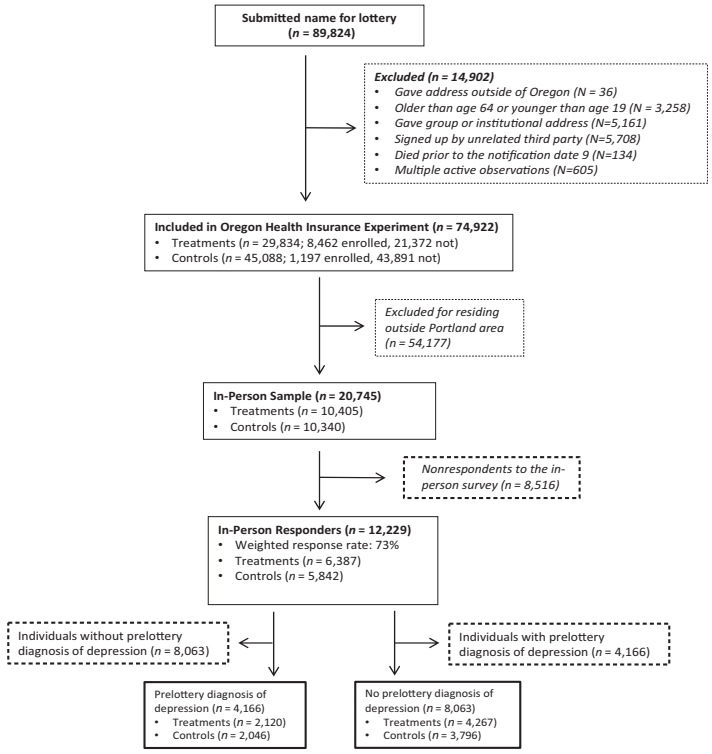
Data Sources

Lottery and Medicaid Enrollment. The state provided us with the initial lottery list and with detailed data on Medicaid enrollment for every individual on the list. We use these data to construct our primary measure of insurance coverage during the study period. These data are described in detail elsewhere.[11]

In-Person Interviews and Clinical Assessments. Between September 2009 and December 2010, we conducted a large in-person data collection effort to assess a wide variety of outcomes. The 20,745-person sample for the in-person data collection included almost all of the individuals selected in the lottery living in the Portland area and a roughly equal number of unselected controls. The collected data includes answers to a detailed questionnaire, a catalog of medications in participants' possession, anthropometric measurements, blood pressure measurements, and assays from dried blood spots. We use these data for almost all of our outcome measures as well as to classify individuals on the basis of prelottery diagnosis of depression. Receiving a prelottery diagnosis of depression required having had access to a health care provider in the past, which may explain the higher insurance rates; alternatively, it may be that those with a history of depression are more likely to seek insurance in order to obtain care for depression. These data are described in detail elsewhere.[11]

Using the medication catalog and a commercial medication database (First DataBank), we classify drugs based on primary therapeutic use for mental health conditions. We separate antidepressants into 3 subgroups: (1) SSRIs (selective serotonin reuptake inhibitors) are the most commonly prescribed class of antidepressants and are generally recommended as the first-line therapy; (2) tricyclic, monoamine oxidase inhibitors (MAOIs), and other antidepressants, all of which are older

Figure A1. Study Sample



therapies and which may be recommended for depression that does not respond to SSRIs; use of these antidepressants may reflect refinement of treatment or second-line therapy for patients not responding to SSRIs but could also reflect the use of an outdated treatment; (3) trazodone (and branded equivalents), which is commonly prescribed as a sleep aid even in the absence of depression (and is therefore excluded from our summary measures of mental health medications). Appendix Table A1 shows the most common of these medications.

Hospital Discharge Records. We obtained standard hospital discharge data for the entire state of Oregon from January 2008 through September 2009. We probabilistically matched these data to the Oregon Health

Table A1. Most Used Medications[a]

Therapeutic Use	Most Frequently Observed Medications
Antidepressant: SSRI	Citalopram
	Fluoxetine
	Sertraline
	Paroxetine
	Escitalopram
Antidepressant: Tricyclic, MAOI, or Other	Bupropion
	Amitriptyline
	Duloxetine
	Venlafaxine
	Nortriptyline
Anxiolytic	Clonazepam
	Lorazepam
	Hydroxyzine
	Alprazolam
	Diazepam
Bipolar	Quetiapine
	Lamotrigine
	Aripiprazole
	Valproic acid, sodium valproate, valproate sodium, divalproex
	Lithium
Sedative	Lorazepam
	Zolpidem
	Doxepin
	Temazepam
	Doxylamine
Antipsychotic	Quetiapine
	Aripiprazole
	Risperidone
	Olanzapine
	Ziprasidone

[a]The 5 most frequent medications per therapeutic use by generic name are listed in descending order of frequency. Medications are classified based on primary therapeutic use for mental health conditions from the First DataBank Enhanced Therapeutic Classification (ETC) system.

Insurance Experiment study population based on information provided at the time of lottery sign-up. We use these data to measure hospital use for mental health specifically. These data are described in detail elsewhere.[11]

Emergency Department Records. We obtained standard emergency department visit data for 12 hospitals in the Portland metro area from January 2007 through December 2010. We probabilistically matched these data to the Oregon Health Insurance Experiment study population based on information provided at the time of lottery sign-up. We use these data to measure emergency department use for mood disorders. These data are described in detail elsewhere.[10]

Statistical Analysis

Our analysis focuses on isolating the impact of insurance coverage itself using the exogenous variation of selection in the Medicaid lottery. This approach is detailed in Finkelstein et al.[11] We model this as follows:

$$y_{ih} = \pi_0 + \pi_1 MEDICAID_{ih} + X_{ih}\pi_2 + V_{ih}\pi_3 + v_{ih} \qquad (1)$$

where i denotes an individual and h denotes a household. MEDICAID is an indicator for whether the individual was covered by Medicaid during the course of the study.

We denote by X_{ih} the set of covariates that are correlated with treatment probability (and potentially with the outcome) and therefore must be controlled for so that estimates of β_1 give an unbiased estimate of the relationship between winning the lottery and the outcome. In all of our analyses, X_{ih} includes indicator variables for the number of household members on the lottery list; although the state randomly sampled from individuals on the list, the entire household of any selected individual was considered selected and eligible to apply for insurance. As a result, selected (treatment) individuals are disproportionately drawn from larger households. We denote by V_{ih} a second set of covariates that can be included to potentially improve power by accounting for chance differences between treatment and control groups in variables that may be important determinants of outcomes. These covariates are not needed for β_1 to give an unbiased estimate of the relationship between winning the lottery and the outcome, however, since they are not related to treatment status. Following our previous work, our primary

specification includes the prerandomization version of the outcome for data from administrative data sets (hospitalizations or emergency department visits).

We estimate Equation (1) by 2-stage least squares (2SLS), using the following first-stage equation:

$$MEDICAID_{ih} + \delta_0 + \delta_1 LOTTERY_h + X_{ih}\delta_2 + V_{ih}\delta_3 + \mu_{ih} \quad (2)$$

Here the excluded instrument is the variable *LOTTERY*, an indicator variable for whether or not household h was selected by the lottery.

We interpret the coefficient on insurance from instrumental variable estimation of Equation (1) as the local average treatment effect of insurance, or LATE.[17] In other words, our estimate of π_1 identifies the causal impact of insurance among the subset of individuals who obtain insurance upon winning the lottery but who would not obtain insurance without winning the lottery (ie, the compliers).

The LATE interpretation requires the additional identifying assumption that the only mechanism through which winning the lottery affects the outcomes studied is the lottery's impact on insurance coverage. We believe this is a reasonable approximation; in earlier work we discussed potential violations; where we could explore them we did not find cause for concern.[11]

In all of our estimates, we estimate linear models even though a number of our outcomes are binary. Because we are interested in the difference in conditional means for the treatments and controls, linear probability models would pose no concerns in the absence of covariates or in fully saturated models.[18,19] Our models are not fully saturated, however, so it is possible that results could be affected by this functional form choice—especially for outcomes with very low or very high mean probability. In prior work we have explored sensitivity to alternate specifications (such as logistic regressions) and found that linear and nonlinear models produce very similar results.

In all of our analyses we cluster the standard errors on the household identifier since the treatment is at the household level. All analyses of outcomes from the survey data are weighted using survey weights to account for the sample releases into the field and intensive follow-up of initial nonresponders; the weights are described in detail elsewhere.[11]

B. Additional Results

Health Care Utilization by Prelottery Diagnosis Status

Appendix Table A2 explores how the effect of Medicaid on health care utilization differs for those with and without prelottery diagnoses of depression. Use of all categories of health care services is higher in the controls with a prelottery diagnosis of depression than those without. The effects of Medicaid on utilization are also higher, but those increases are not concentrated in care specific to mental health conditions. We note that results for hospitalizations and emergency department use are similar (and similarly insignificant) when we use the category of "mood disorders" (shown here) or a broader category of "mental health" (which includes psychoses, etc; results not shown). We cannot interpret these differences in use as necessarily attributable to the preexisting depression itself, however; those with prelottery diagnoses of depression may differ in other dimensions and may have been more likely to interact with the health care system (increasing the probability of having their depression diagnosed).

Diagnosis and Treatment by Prelottery Diagnosis Status

Appendix Table A3 shows a more complete breakout of the results shown in Tables 2 and 3 for those with and without prelottery diagnoses of depression, as well as tests of whether the differences in the effect of Medicaid are statistically significantly different between these 2 groups. As previously reported, Medicaid insignificantly increases antidepressant use overall by 5.49 percentage points ($p = .07$); the magnitude of the effect is larger in percentage points for those with a prelottery depression diagnosis (9.87; $p = .152$) but is only statistically significant for those without (4.76; $p = .033$) and represents a larger percent increase relative to the control group rate. In general, while the differences between the 2 groups are often in the expected direction, the differences between the 2 groups in the effect of Medicaid are not statistically significant.

Table A2. Health Care Use[a]

	All Survey Respondents			Prelottery Diagnosis of Depression			No Prelottery Diagnosis of Depression			
	Control Mean (1)	Effect of Medicaid Coverage (2)	*P*-Value (3)	Control Mean (4)	Effect of Medicaid Coverage (5)	*P*-Value (6)	Control Mean (7)	Effect of Medicaid Coverage (8)	*P*-Value (9)	*P*-Value for Heterogeneity (10)
Doctor visits (12 months prior to interview)										
Any doctor visit	64.55	16.59	0.000	76.36	19.94	0.001	58.18	15.73	0.002	0.602
		(3.96)			(6.07)			(5.01)		
Number of doctor's visits[b]	5.54	2.70	0.003	8.13	4.16	0.035	4.16	2.11	0.022	0.353
	(11.58)	(0.92)		(14.33)	(1.97)		(9.51)	(0.92)		
ED visits (by September 2009)										
Any ED visit[c]	35.84	7.49	0.047	45.33	11.83	0.088	30.86	5.28	0.229	0.424
		(3.78)			(6.93)			(4.39)		
Number of ED visits[c]	0.98	0.62	0.000	1.38	1.18	0.002	0.77	0.33	0.048	0.035
	(2.41)	(0.17)		(3.04)	(0.37)		(1.98)	(0.16)		
Any ED visits for mood disorders	1.48	0.12	0.902	3.50	0.56	0.828	0.42	−0.09	0.892	0.807
		(1.00)			(2.58)			(0.69)		
Number of ED visits for mood disorders	0.03	−0.01	0.582	0.07	−0.04	0.494	0.01	0.00	0.702	0.456
	(0.32)	(0.02)		(0.53)	(0.06)		(0.10)	(0.01)		
Hospitalizations (by September 2009)										
Any hospitalization[d]	6.91	2.63	0.159	9.30	8.26	0.035	5.63	0.05	0.979	0.067
		(1.87)			(3.92)			(2.00)		

Continued

Table A2. *Continued*

	All Survey Respondents			Prelottery Diagnosis of Depression			No Prelottery Diagnosis of Depression			
	Control Mean (1)	Effect of Medicaid Coverage (2)	*P*-Value (3)	Control Mean (4)	Effect of Medicaid Coverage (5)	*P*-Value (6)	Control Mean (7)	Effect of Medicaid Coverage (8)	*P*-Value (9)	*P*-Value for Heterogeneity (10)
Number of hospitalizations[d]	0.12	0.05	0.260	0.16	0.19	0.029	0.10	−0.01	0.764	0.039
	(0.72)	(0.04)		(0.70)	(0.09)		(0.73)	(0.04)		
Any hospitalizations for mood disorders	0.81	−0.09	0.879	1.92	−1.03	0.530	0.21	0.42	0.356	0.493
		(0.62)			(1.65)			(0.45)		
Number of hospitalizations for mood disorders	0.01	0.00	0.788	0.03	−0.01	0.684	0.00	0.01	0.183	0.757
	(0.17)	(0.01)		(0.27)	(0.03)		(0.05)	(0.01)		
		(3.29)			(6.82)			(3.03)		
Overall Resource Use										
Total resource use ($)[e]	2,835	1,250.28	0.002	3,936.53	2,942.38	0.000	2,100.59	505.64	0.223	0.010
	(5,870)	(411.35)		(6,871.57)	(841.96)		(5,133.67)	(415.17)		

[a]For each sample, the first column reports the control mean of the dependent variable (with standard deviation for continuous outcomes in parentheses). The second column reports the estimated intent-to-treat effect of lottery selection (with standard error in parentheses). The third column reports the estimated local average treatment effect of Medicaid coverage (with standard error in parentheses). The fourth column reports the *p*-value of the estimated effects. See Appendix for estimating equations. All regressions include indicators for the number of household members on the lottery list and adjust standard errors for household clusters. The analyses of ED visits and hospitalizations also control for the prerandomization version of the outcome. All analysis is weighted using survey weights.

Samples for all measures except ED consist of all in-person interview respondents ($n = 12{,}229$), those with a prelottery diagnosis of depression ($n = 4{,}166$) and those without ($n = 8{,}063$). Samples for ED visits consist of the overlap between the ED sample and interview respondents ($n = 10{,}178$), and those in the overlap with a prelottery diagnosis of depression ($n = 3{,}438$) and without ($n = 6{,}740$).

[b]Results for all survey respondents previously reported in Baicker et al 2013.[8]

[c]An analysis of this outcome for the full ED sample ($n = 24{,}646$) was previously reported in Taubman et al 2014.[10] Here we report the results limiting to the overlap of the ED sample and interview respondents ($n = 10{,}178$).

Continued

Table A2. *Continued*

[d]An analysis of this outcome for the full Oregon Health Insurance Experiment sample ($n = 74{,}922$) was previously reported in Finkelstein et al 2012.[11] Here we report the results limiting to survey respondents ($n = 12{,}229$).
[e]An analysis of this outcome for the full Oregon Health Insurance Experiment sample ($n = 74{,}922$) was previously reported in Finkelstein et al 2012.[11] Here we report the results limiting to survey respondents ($n = 12{,}229$). To calculate the implied annual spending effects associated with the estimated utilization effects we use data from the 2002-2007 (pooled) Medical Expenditure Panel Survey (MEPS) on expenditures of all nonelderly (19-64) adults below 100% of poverty who are publicly insured. This gives us a total sample of over 7,500 individuals. We use their expenditures (all inflated with the CPI-U to 2007 dollars) to calculate average expenditures per outpatient visit, average expenditures per ED visit, and average expenditures per inpatient visit (for visits not related to childbirth). For medications, we calculate average spending per prescription drug by dividing total annual prescription drug costs by the total number of prescription drugs taken over the course of the year. All spending numbers are based on total expenditures (ie, not just expenditures among the insured or covered by insurance). The underlying costs are $150 per outpatient visit, $435 per ED visit, $7,523 per inpatient visit, and $312 per prescription drug. For each type of use (office visit, ED visit, inpatient visit, and prescription drug), we multiply the estimated annual change in number by the cost estimated in the MEPS.

Table A3. Diagnosis and Treatment of Depression and Mental Health Conditions[a]

	All Survey Respondents			With Prelottery Diagnosis of Depression			Without Prelottery Diagnosis of Depression			*p*-Value for Difference Between (7) and (11)
	Control Mean (1)	Effect of Medicaid Coverage (2)	*p*-Value (3)	Control Mean (4)	Effect of Medicaid Coverage (5)	*p*-Value (6)	Control Mean (7)	Effect of Medicaid Coverage (8)	*p*-Value (9)	(10)
Diagnosis of depression										
Postlottery diagnosis of depression (%)	N/A			N/A			7.39	5.50 (2.79)	0.049	
Undiagnosed depression (%)	N/A			N/A			14.01	−6.76 (3.40)	0.047	
Treatment										
Talk therapy (%)	N/A			37.4	8.83 (6.84)	0.196	N/A			
Prescription medications										
Any mental health medication (%)[b]	20.7	8.77 (3.33)	0.008	44.8	14.53 (7.10)	0.041	7.7	7.58 (2.67)	0.005	0.362

Continued

Table A3. *Continued*

	All Survey Respondents			With Prelottery Diagnosis of Depression			Without Prelottery Diagnosis of Depression			*p*-Value for Difference Between (7) and (11)
	Control Mean (1)	Effect of Medicaid Coverage (2)	*p*-Value (3)	Control Mean (4)	Effect of Medicaid Coverage (5)	*p*-Value (6)	Control Mean (7)	Effect of Medicaid Coverage (8)	*p*-Value (9)	(10)
Mental health medications (#)[b]	0.335	0.14	0.025	0.771	0.28	0.077	0.099	0.11	0.004	0.301
	(0.77)	(0.06)		(1.07)	(0.16)		(0.38)	(0.04)		
Share using any (%):										
Antidepressant[c]	16.8	5.49	0.071	37.5	9.87	0.152	5.7	4.76	0.033	0.484
		(3.04)			(6.88)			(2.23)		
SSRI	9.8	4.13	0.088	22.6	8.45	0.157	2.9	2.96	0.069	0.376
		(2.42)			(5.96)			(1.62)		
Tricyclic, MAOI, or Other	7.0	3.66	0.082	15.8	6.32	0.227	2.3	2.87	0.051	0.529
		(2.10)			(5.23)			(1.47)		
Trazodone	3.4	−0.46	0.747	7.4	−2.70	0.457	1.2	0.96	0.342	0.329
		(1.42)			(3.62)			(1.01)		
Anxiolytic	6.2	2.60	0.207	14.1	7.11	0.171	2.0	0.81	0.553	0.242
		(2.06)			(5.20)			(1.37)		
Bipolar	5.5	0.39	0.834	12.8	1.89	0.690	1.5	−0.77	0.523	0.584
		(1.85)			(4.73)			(1.21)		

Continued

Table A3. *Continued*

	All Survey Respondents			With Prelottery Diagnosis of Depression			Without Prelottery Diagnosis of Depression			*p*-Value for Difference Between (7) and (11) (10)
	Control Mean (1)	Effect of Medicaid Coverage (2)	*p*-Value (3)	Control Mean (4)	Effect of Medicaid Coverage (5)	*p*-Value (6)	Control Mean (7)	Effect of Medicaid Coverage (8)	*p*-Value (9)	
Sedative	2.9	4.13	0.004	6.1	6.95	0.045	1.2	2.94	0.013	0.274
		(1.43)			(3.47)			(1.18)		
Antipsychotic	4.0	0.80	0.629	9.8	−0.61	0.887	0.8	1.81	0.075	0.582
		(1.64)			(4.28)			(1.02)		
Untreated depression (%)[d]	16.6	−10.50	0.001	20.1	−17.00	0.003	14.8	−6.80	0.053	0.128
		(3.05)			(5.74)			(3.50)		
Unmet need for mental health care (%)	24.41	−9.21	0.005	45.82	−12.31	0.071	12.87	−6.19	0.041	0.438
		(3.29)			(6.82)			(3.03)		

[a]For each sample, the first column reports the control mean of the dependent variable (with standard deviation for continuous outcomes in parentheses). The second column reports the estimated local average treatment effect of Medicaid coverage (with standard error in parentheses). See Appendix for estimating equation. All regressions include indicators for the number of household members on the lottery list and adjust standard errors for household clusters. The final column reports the *p*-value for a test for treatment effect heterogeneity by prelottery diagnosis of depression. All analysis is weighted using survey weights. Samples consist of all in-person interview respondents ($n = 12{,}229$), those with a pre-lottery diagnosis of depression ($n = 4{,}166$) and those without ($n = 8{,}063$).

[b]Trazodone and branded equivalents are excluded from these summary measures.

[c]Aggregate result for all survey respondents previously reported in Baicker et al 2013.[8]

[d]This analysis was not prespecified.