SPECIAL ARTICLE

The Oregon Experiment — Effects of Medicaid on Clinical Outcomes

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ABSTRACT

BACKGROUND

Despite the imminent expansion of Medicaid coverage for low-income adults, the effects of expanding coverage are unclear. The 2008 Medicaid expansion in Oregon based on lottery drawings from a waiting list provided an opportunity to evaluate these effects.

METHODS

Approximately 2 years after the lottery, we obtained data from 6387 adults who were randomly selected to be able to apply for Medicaid coverage and 5842 adults who were not selected. Measures included blood-pressure, cholesterol, and glycated hemoglobin levels; screening for depression; medication inventories; and self-reported diagnoses, health status, health care utilization, and out-of-pocket spending for such services. We used the random assignment in the lottery to calculate the effect of Medicaid coverage.

RESULTS

We found no significant effect of Medicaid coverage on the prevalence or diagnosis of hypertension or high cholesterol levels or on the use of medication for these conditions. Medicaid coverage significantly increased the probability of a diagnosis of diabetes and the use of diabetes medication, but we observed no significant effect on average glycated hemoglobin levels or on the percentage of participants with levels of 6.5% or higher. Medicaid coverage decreased the probability of a positive screening for depression (–9.15 percentage points; 95% confidence interval, –16.70 to –1.60; P=0.02), increased the use of many preventive services, and nearly eliminated catastrophic out-of-pocket medical expenditures.

CONCLUSIONS

This randomized, controlled study showed that Medicaid coverage generated no significant improvements in measured physical health outcomes in the first 2 years, but it did increase use of health care services, raise rates of diabetes detection and management, lower rates of depression, and reduce financial strain.

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In 2008, Oregon initiated a limited expansion of its Medicaid program for low-income adults through a lottery drawing of approximately 30,000 names from a waiting list of almost 90,000 persons. Selected adults won the opportunity to apply for Medicaid and to enroll if they met eligibility requirements. This lottery presented an opportunity to study the effects of Medicaid with the use of random assignment. Earlier, nonrandomized studies sought to investigate the effect of Medicaid on health outcomes in adults with the use of quasi-experimental approaches.[1-3] Although these approaches can be an improvement over observational designs and often involve larger samples than are feasible with a randomized design, they cannot eliminate confounding factors as effectively as random assignment. We used the random assignment embedded in the Oregon Medicaid lottery to examine the effects of insurance coverage on health care use and health outcomes after approximately 2 years.

Methods

Randomization and Intervention

Oregon Health Plan Standard is a Medicaid program for low-income, uninsured, able-bodied adults who are not eligible for other public insurance in Oregon (e.g., Medicare for persons 65 years of age or older and for disabled persons; the Children's Health Insurance Program for poor children; or Medicaid for poor children, pregnant women, or other specific, categorically eligible populations). Oregon Health Plan Standard closed to new enrollment in 2004, but the state opened a new waiting list in early 2008 and then conducted eight random lottery drawings from the list between March and September of that year to allocate a limited number of spots.

Persons who were selected won the opportunity — for themselves and any household member — to apply for Oregon Health Plan Standard. To be eligible, persons had to be 19 to 64 years of age and Oregon residents who were U.S. citizens or legal immigrants; they had to be ineligible for other public insurance and uninsured for the previous 6 months, with an income that was below 100% of the federal poverty level and assets of less than $2,000. Persons who were randomly selected in the lottery were sent an application. Those who completed it and met the eligibility criteria were enrolled in the plan. Oregon Health Plan Standard provides comprehensive medical benefits, including prescription drugs, with no patient cost-sharing and low monthly premiums ($0 to $20, based on income), mostly through managed-care organizations. The lottery process and Oregon Health Plan Standard are described in more detail elsewhere.[4]

Data Collection

We used an in-person data-collection protocol to assess a wide variety of outcomes. We limited data collection to the Portland, Oregon, metropolitan area because of logistical constraints. Our study population included 20,745 people: 10,405 selected in the lottery (the lottery winners) and 10,340 not selected (the control group). We conducted interviews between September 2009 and December 2010. The interviews took place an average of 25 months after the lottery began.

Our data-collection protocol included detailed questionnaires on health care, health status, and insurance coverage; an inventory of medications; and performance of anthropometric and blood-pressure measurements. Dried blood spots were also obtained.[5] Depression was assessed with the use of the eight-question version of the Patient Health Questionnaire (PHQ-8),[6] and self-reported health-related quality of life was assessed with the use of the Medical Outcomes Study 8-Item Short-Form Survey.[7] More information on recruitment and field-collection protocols are included in the study protocol (available with the full text of this article at NEJM.org); more information on specific outcome measures is provided in the Supplementary Appendix (available at NEJM.org). Multiple institutional review boards approved the study, and written informed consent was obtained from all participants.

Statistical Analysis

Virtually all the analyses reported here were prespecified and publicly archived (see the protocol).[8] Prespecification was designed to minimize issues of data and specification mining and to provide a record of the full set of planned analyses. The results of a few additional post hoc analyses are also presented and are noted as such in Tables 1 through 5. Analyses were performed with the use of Stata software, version 12.[9]

Adults randomly selected in the lottery were given the option to apply for Medicaid, but not all persons selected by the lottery enrolled in

Medicaid (either because they did not apply or because they were deemed ineligible). Lottery selection increased the probability of Medicaid coverage during our study period by 24.1 percentage points (95% confidence interval [CI], 22.3 to 25.9; P<0.001). The subgroup of lottery winners who ultimately enrolled in Medicaid was not comparable to the overall group of persons who did not win the lottery. We therefore used a standard instrumental-variable approach (in which lottery selection was the instrument for Medicaid coverage) to estimate the causal effect of enrollment in Medicaid. Intuitively, since the lottery increased the chance of being enrolled in Medicaid by about 25 percentage points, and we assumed that the lottery affected outcomes only by changing Medicaid enrollment, the effect of being enrolled in Medicaid was simply about 4 times (i.e., 1 divided by 0.25) as high as the effect of being able to apply for Medicaid. This yielded a causal estimate of the effect of insurance coverage.[10] (See the Supplementary Appendix for additional details.)

All analyses were adjusted for the number of household members on the lottery list because selection was random, conditional on household size. Standard errors were clustered according to household to account for intrahousehold correlation. We fitted linear probability models for binary outcomes. As sensitivity checks, we showed that our results were robust when the average marginal effects from logistic regressions for binary outcomes were estimated and when demographic characteristics were included as covariates (see the Supplementary Appendix). All analyses were weighted for the sampling and field-collection design; construction of the weights is detailed in the Supplementary Appendix.

Table 1. Characteristics of the 12,229 Survey Respondents.*

Characteristic	Controls (N=5842)	Lottery Winners (N=6387)†	P Value
	percent		
Female sex	56.9	56.4	0.60
Age group‡			
19–34 yr	36.0	35.1	0.38
35–49 yr	36.4	36.6	0.87
50–64 yr	27.6	28.3	0.43
Race or ethnic group§			
Non-Hispanic			
White	68.8	69.2	0.68
Black	10.5	10.6	0.82
Other	14.8	14.8	0.97
Hispanic	17.2	17.0	0.82
Interview conducted in English	88.2	88.5	0.74

* Values for the control group (persons not selected in the lottery) are weighted means, and values for the lottery-winner group are regression-adjusted weighted means. P values are for two-tailed t-tests of the equality of the two means.
† Lottery winners were adults who were randomly selected in the lottery to be able to apply for Medicaid coverage.
‡ The data on age are for the age of the respondent at the time of the in-person interview. The study sample was restricted to persons who were between 19 and 64 years of age during the study period.
§ Race and ethnic group were self-reported. The categories of non-Hispanic race (white, black, and other) were not mutually exclusive; respondents could report as many races or ethnic groups as they wished.

RESULTS

STUDY POPULATION

Characteristics of the respondents are shown in Table 1. A total of 12,229 persons in the study sample responded to the survey, for an effective response rate of 73%. There were no significant differences between those selected in the lottery and those not selected with respect to the response rates to either the full survey (0.28 percentage points higher in the group selected in the lottery, P=0.86) or specific survey measures, each of which had a response rate of at least 97% among people who completed any part of the survey. Just over half the participants were women, about a quarter were 50 to 64 years of age (the oldest eligible age group), and about 70% were non-Hispanic white. There were no significant differences between those selected in the lottery and those not selected with respect to these characteristics (F statistic, 0.20; P=0.99) or to the wide variety of prerandomization and interview characteristics examined (see the Supplementary Appendix).

CLINICAL MEASURES AND HEALTH OUTCOMES

Table 2 shows estimated effects of Medicaid coverage on blood-pressure, total and high-density lipoprotein (HDL) cholesterol, and glycated hemoglobin levels and depression. In the control group, 30% of the survey respondents had positive screening results for depression, and we detected elevated blood pressure in 16%, a high total cholesterol level in 14%, and a glycated hemoglobin level of 6.5% or more (a diagnostic criterion for

diabetes) in 5%. Medicaid coverage did not have a significant effect on measures of blood pressure, cholesterol, or glycated hemoglobin. Further analyses involving two prespecified subgroups — persons 50 to 64 years of age and those who reported receiving a diagnosis of diabetes, hypertension, a high cholesterol level, a heart attack, or congestive heart failure before the lottery (all of which were balanced across the two study groups) — showed similar results (see the Supplementary Appendix).

The predicted 10-year risk of cardiovascular events was measured with the use of the Framingham risk score, which estimates risk among persons older than 30 years of age according to sex, age, levels of total cholesterol and HDL cholesterol, blood pressure and use or nonuse of blood-pressure medication, status with respect to diabetes, and smoking status, with the predicted risk of a cardiovascular event within 10 years ranging from less than 1% to 30%.[11] The 10-year predicted risk did not change significantly with Medicaid coverage (−0.21 percentage points; 95% CI, −1.56 to 1.15; P=0.76).

We investigated whether Medicaid coverage affected the diagnosis of and use of medication for hypertension, hypercholesterolemia, or diabetes. Table 2 shows diagnoses after the lottery and current medication use. We found no effect of Medicaid coverage on diagnoses after the lottery or on the use of medication for blood-pressure and high cholesterol levels. We did, however, find a greater probability of receiving a diagnosis of diabetes (3.83 percentage points; 95% CI, 1.93 to 5.73; P<0.001) and using medications for diabetes (5.43 percentage points; 95% CI, 1.39 to 9.48; P=0.008). These are substantial increases from the mean rates of diagnosis and medication use in the control group (1.1% and 6.4%, respectively).

A positive result on screening for depression was defined as a score of 10 or more on the PHQ-8 (which ranges from 0 to 24, with higher

Table 2. Mean Values and Absolute Change in Clinical Measures and Health Outcomes with Medicaid Coverage.*

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)†	P Value
Blood pressure			
Systolic (mm Hg)	119.3±16.9	−0.52 (−2.97 to 1.93)	0.68
Diastolic (mm Hg)	76.0±12.1	−0.81 (−2.65 to 1.04)	0.39
Elevated (%)‡	16.3	−1.33 (−7.16 to 4.49)	0.65
Hypertension			
Diagnosis after lottery (%)§¶	5.6	1.76 (−1.89 to 5.40)	0.34
Current use of medication for hypertension (%)§‖	13.9	0.66 (−4.48 to 5.80)	0.80
Cholesterol**			
Total level (mg/dl)	204.1±34.0	2.20 (−3.44 to 7.84)	0.45
High total level (%)	14.1	−2.43 (−7.75 to 2.89)	0.37
HDL level (mg/dl)	47.6±13.1	0.83 (−1.31 to 2.98)	0.45
Low HDL level (%)	28.0	−2.82 (−10.28 to 4.64)	0.46
Hypercholesterolemia			
Diagnosis after lottery (%)§¶	6.1	2.39 (−1.52 to 6.29)	0.23
Current use of medication for high cholesterol level (%)§‖	8.5	3.80 (−0.75 to 8.35)	0.10
Glycated hemoglobin			
Level (%)	5.3±0.6	0.01 (−0.09 to 0.11)	0.82
Level ≥6.5% (%)††	5.1	−0.93 (−4.44 to 2.59)	0.61
Diabetes			
Diagnosis after lottery (%)§¶	1.1	3.83 (1.93 to 5.73)	<0.001
Current use of medication for diabetes (%)§‖	6.4	5.43 (1.39 to 9.48)	0.008

Table 2. (Continued.)

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)†	P Value
Depression			
Positive screening result (%)‡‡	30.0	−9.15 (−16.70 to −1.60)	0.02
Diagnosis after lottery (%)§¶	4.8	3.81 (0.15 to 7.46)	0.04
Current use of medication for depression (%)§‖	16.8	5.49 (−0.46 to 11.45)	0.07
Framingham risk score (%)§§			
Overall	8.2±7.5	−0.21 (−1.56 to 1.15)	0.76
High-risk diagnosis	11.6±8.3	1.63 (−1.11 to 4.37)	0.24
Age of 50–64 yr	13.9±8.2	−0.37 (−2.64 to 1.90)	0.75

* Plus–minus values are weighted means ±SD. Where means are shown without standard deviations, they are weighted means. The effect of Medicaid coverage was estimated with the use of two-stage least-squares instrumental-variable regression. All regressions include indicators for the number of household members on the lottery list, and all standard errors were "clustered," or adjusted to allow for arbitrary correction of error terms within households. For the blood-pressure measures, all regressions also included controls for age (with dummies for age decile) and sex. All analyses were weighted with the use of survey weights. The sample size was all 12,229 survey respondents for all measures except for the Framingham risk score. HDL denotes high-density lipoprotein.

† For variables measured as percentages, the change is expressed as percentage points.

‡ Elevated blood pressure was defined as a systolic pressure of 140 mm Hg or more and a diastolic pressure of 90 mm Hg or more.

§ This analysis was not prespecified.

¶ A participant was considered to have received a diagnosis of a certain condition after the lottery if he or she reported a first diagnosis after March 2008 (the start of the lottery). A participant who received a diagnosis before March 2008 was not considered to have a diagnosis after the lottery.

‖ A participant was considered to have received medication for the condition if one or more of the medications recorded during the interview was classified as relevant for that condition.

** A high total cholesterol level was defined as 240 mg per deciliter (6.2 mmol per liter) or higher. A low HDL cholesterol level was defined as less than 40 mg per deciliter (1.03 mmol per liter). There was no separate measurement of low-density lipoprotein cholesterol.

†† A glycated hemoglobin level of 6.5% or higher is a diagnostic criterion for diabetes.

‡‡ A positive result on screening for depression was defined as a score of 10 or higher on the Patient Health Questionnaire 8 (PHQ-8). Scores on the PHQ-8 range from 0 to 24, with higher scores indicating more symptoms of depression.

§§ The Framingham risk score was used to predict the 10-year cardiovascular risk. Risk scores were calculated separately for men and women on the basis of the following variables: age, total cholesterol and HDL cholesterol levels, measured blood pressure and use or nonuse of medication for high blood pressure, current smoking status, and status with respect to a glycated hemoglobin level ≥6.5%. Framingham risk scores, which are calculated for persons 30 years of age or older, range from 0.99 to 30%. Samples sizes for risk scores were 9525 participants overall, 3099 participants with high-risk diagnoses, and 3372 participants with an age of 50 to 64 years. A high-risk diagnosis was defined as a diagnosis of diabetes, hypertension, hypercholesterolemia, myocardial infarction, or congestive heart failure before the lottery (i.e., before March 2008).

scores indicating more symptoms of depression). Medicaid coverage resulted in an absolute decrease in the rate of depression of 9.15 percentage points (95% CI, −16.7 to −1.60; P=0.02), representing a relative reduction of 30%. Although there was no significant increase in the use of medication for depression, Medicaid coverage led to an absolute increase in the probability of receiving a diagnosis of depression after the lottery of 3.81 percentage points (95% CI, 0.15 to 7.46; P=0.04), representing a relative increase of about 80%.

HEALTH-RELATED QUALITY OF LIFE AND HAPPINESS

Table 3 shows the effects of Medicaid coverage on health-related quality of life and level of happiness. Medicaid coverage led to an increase in the proportion of people who reported that their health was the same or better as compared with their health 1 year previously (7.84 percentage points; 95% CI, 1.45 to 14.23; P=0.02). The physical-component and mental-component scores of the health-related quality of life measure are based on different weighted combinations of the eight-question battery; each ranges from 0 to 100,

Table 3. Mean Values and Absolute Change in Health-Related Quality of Life and Happiness with Medicaid Coverage.*

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)†	P Value
Health-related quality of life			
Health same or better vs. 1 yr earlier (%)	80.4	7.84 (1.45 to 14.23)	0.02
SF-8 subscale‡			
Mental-component score	44.4±11.4	1.95 (0.03 to 3.88)	0.05
Physical-component score	45.5±10.5	1.20 (−0.54 to 2.93)	0.18
No pain or very mild pain (%)	56.4	1.16 (−6.94 to 9.26)	0.78
Very happy or pretty happy (%)	74.9	1.18 (−5.85 to 8.21)	0.74

* Plus–minus values are weighted means ±SD. Where means are shown without standard deviations, they are weighted means. The effect of Medicaid coverage was estimated with the use of two-stage least-squares instrumental-variable regression. All regressions included indicators for the number of household members on the lottery list, and all standard errors were clustered on household. All analyses were weighted with the use of survey weights. The sample was all 12,229 survey respondents.

† For variables measured as percentages, the change is expressed as percentage points.

‡ Scores on the Medical Outcomes Study 8-Item Short-Form Health Survey (SF-8) range from 0 to 100, with higher subscale scores indicating better self-reported health-related quality of life. The scale is normalized to yield a mean of 50 and a standard deviation of 10 in the general U.S. population.

with higher scores corresponding to better health-related quality of life. Medicaid coverage led to an increase of 1.95 points (95% CI, 0.03 to 3.88; P=0.05) in the average score on the mental component; the magnitude of improvement was approximately one fifth of the standard deviation of the mental-component score. We did not detect a significant difference in the quality of life related to physical health or in self-reported levels of pain or happiness.

FINANCIAL HARDSHIP

Table 4 shows that Medicaid coverage led to a reduction in financial strain from medical costs, according to a number of self-reported measures. In particular, catastrophic expenditures, defined as out-of-pocket medical expenses exceeding 30% of income, were nearly eliminated. These expenditures decreased by 4.48 percentage points (95% CI, −8.26 to −0.69; P=0.02), a relative reduction of more than 80%.

ADDITIONAL OUTCOMES

Table 5 shows the effects of Medicaid coverage on health care utilization, spending on health care, preventive care, access to and quality of care, smoking status, and obesity. Medicaid coverage resulted in an increase in the number of prescription drugs received and office visits made in the previous year; we did not find significant changes in visits to the emergency department or hospital admissions. We estimated that Medicaid coverage increased annual medical spending (based on measured use of prescription drugs, office visits, visits to the emergency department, and hospital admissions) by $1,172, or about 35% relative to the spending in the control group. Medicaid coverage also led to increases in some preventive care and screening services, including cholesterol screening (an increase of 14.57 percentage points; 95% CI, 7.09 to 22.04; P<0.001) and improved perceived access to care, including a usual place of care (an increase of 23.75 percentage points; 95% CI, 15.44 to 32.06; P<0.001). We found no significant effect of Medicaid coverage on the probability that a person was a smoker or obese.

DISCUSSION

This study was based on more than 12,000 in-person interviews conducted approximately 2 years after a lottery that randomly assigned access to Medicaid for low-income, able-bodied, uninsured adults — a group that comprises the majority of persons who are newly eligible for Medicaid under the 2014 expansion.[12] The results confirm that Medicaid coverage increased overall health care utilization, improved self-reported health, and reduced financial strain; these findings are consistent with previously published results based on mail surveys conducted approximately 1 year af-

Table 4. Mean Values and Absolute Change in Financial Hardship with Medicaid Coverage.*

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)†	P Value
Any out-of-pocket spending (%)	58.8	−15.30 (−23.28 to −7.32)	<0.001
Amount of out-of-pocket spending ($)	552.8±1219.5	−215.35 (−408.75 to −21.95)	0.03
Catastrophic expenditures (%)‡	5.5	−4.48 (−8.26 to −0.69)	0.02
Any medical debt (%)	56.8	−13.28 (−21.59 to −4.96)	0.002
Borrowed money to pay bills or skipped payment (%)	24.4	−14.22 (−21.02 to −7.43)	<0.001

* Plus–minus values are weighted means ±SD. Where means are shown without standard deviations, they are weighted means. The effect of Medicaid coverage was estimated with the use of two-stage least-squares instrumental-variable regression. All regressions include indicators for the number of household members on the lottery list, and all standard errors were clustered on household. All analyses were weighted with the use of survey weights. The sample was all 12,229 survey respondents.

† For variables measured as percentages, the change is expressed as percentage points.

‡ Persons with catastrophic expenditures had out-of-pocket medical expenses that exceeded 30% of their household income.

ter the lottery.[4] With these new data, we found that increased health care utilization observed at 1 year persisted, and we present new results on the effects of Medicaid coverage on objectively measured physical health, depression, condition-specific treatments, and other outcomes of interest.

Medicaid coverage had no significant effect on the prevalence or diagnosis of hypertension or high cholesterol levels or on the use of medication for these conditions. It increased the probability of a diagnosis of diabetes and the use of medication for diabetes, but it had no significant effect on the prevalence of measured glycated hemoglobin levels of 6.5% or higher. Medicaid coverage led to a substantial reduction in the risk of a positive screening result for depression. This pattern of findings with respect to clinically measured health — an improvement in mental health but not in physical health (Table 2) — was mirrored in the self-reported health measures, with improvements concentrated in mental rather than physical health (Table 3). The improvements appear to be specific to depression and mental health measures; Medicaid coverage did not appear to lead to an increase in self-reported happiness, which is arguably a more general measure of overall subjective well-being.

Hypertension, high cholesterol levels, diabetes, and depression are only a subgroup of the set of health outcomes potentially affected by Medicaid coverage. We chose these conditions because they are important contributors to morbidity and mortality, feasible to measure, prevalent in the low-income population in our study, and plausibly modifiable by effective treatment within a 2-year time frame.[13-16] Nonetheless, our power to detect changes in health was limited by the relatively small numbers of patients with these conditions; indeed, the only condition in which we detected improvements was depression, which was by far the most prevalent of the four conditions examined. The 95% confidence intervals for many of the estimates of effects on individual physical health measures were wide enough to include changes that would be considered clinically significant — such as a 7.16-percentage-point reduction in the prevalence of hypertension. Moreover, although we did not find a significant change in glycated hemoglobin levels, the point estimate of the decrease we observed is consistent with that which would be expected on the basis of our estimated increase in the use of medication for diabetes. The clinical-trial literature indicates that the use of oral medication for diabetes reduces the glycated hemoglobin level by an average of 1 percentage point within as short a time as 6 months.[15] This estimate from the clinical literature suggests that the 5.4-percentage-point increase in the use of medication for diabetes in our cohort would decrease the average glycated hemoglobin level in the study population by 0.05 percentage points, which is well within our 95% confidence interval. Beyond issues of power, the effects of Medicaid coverage may be limited by the multiple sources of slippage in the connection between insurance coverage and observable improvements in our health metrics; these potential sources of slippage include access to care, diagnosis of underlying conditions, prescription of appropriate med-

Table 5. Mean Values and Absolute Change in Health Care Utilization and Spending, Preventive Care, Access to and Quality of Care, and Smoking and Obesity with Medicaid Coverage.*

Variable	Mean Value in Control Group	Change with Medicaid Coverage (95% CI)†	P Value
Utilization (no. of visits or medications)			
Current prescription drugs	1.8±2.8	0.66 (0.21 to 1.11)	0.004
Office visits in past 12 mo	5.5±11.6	2.70 (0.91 to 4.49)	0.003
Outpatient surgery in past 12 mo	0.1±0.4	0.03 (−0.03 to 0.09)	0.28
Emergency department visits in past 12 mo	1.0±2.0	0.09 (−0.23 to 0.42)	0.57
Hospital admissions in past 12 mo	0.2±0.6	0.07 (−0.03 to 0.17)	0.17
Estimate of annual health care spending ($)‡	3,257.3	1,171.63 (199.35 to 2,143.91)	0.018
Preventive care in past 12 mo (%)			
Cholesterol-level screening	27.2	14.57 (7.09 to 22.04)	<0.001
Fecal occult-blood test in persons ≥50 yr	19.1	1.26 (−9.44 to 11.96)	0.82
Colonoscopy in persons ≥50 yr	10.4	4.19 (−4.25 to 12.62)	0.33
Flu shot in persons ≥50 yr	35.5	−5.74 (−19.31 to 7.83)	0.41
Papanicolaou smear in women	44.9	14.44 (2.64 to 26.24)	0.016
Mammography in women ≥50 yr	28.9	29.67 (11.96 to 47.37)	0.001
PSA test in men ≥50 yr	21.4	19.18 (1.14 to 37.21)	0.037
Perceived access to and quality of care (%)			
Had a usual place of care	46.1	23.75 (15.44 to 32.06)	<0.001
Received all needed care in past 12 mo	61.0	11.43 (3.62 to 19.24)	0.004
Care was of high quality, if received, in past 12 mo	78.4	9.85 (2.71 to 17.00)	0.007
Smoking status and obesity (%)			
Current smoker	42.8	5.58 (−2.54 to 13.70)	0.18
Obese	41.5	0.39 (−7.89 to 8.67)	0.93

* Plus–minus values are weighted means ±SD. Where means are shown without standard deviations, they are weighted means. The effect of Medicaid coverage was estimated with the use of two-stage least-squares instrumental-variable regression. All regressions include indicators for the number of household members on the lottery list, and all standard errors were clustered on household. All analyses were weighted with the use of survey weights. The sample size was all 12,229 survey respondents. For some prevention measures, the sample was limited to the 3374 survey respondents who were at least 50 years of age, the 1864 female survey respondents who were at least 50 years of age, or the 1509 male survey respondents who were at least 50 years of age. The sample for quality of care was limited to the 9694 survey respondents who received care in the previous 12 months. PSA denotes prostate-specific antigen.

† For variables measured as percentages, the change is expressed as percentage points.

‡ Annual spending was calculated by multiplying the numbers of prescription drugs, office visits, visits to the emergency department, and hospital admissions by the estimated cost of each. See the Supplementary Appendix for details.

ications, compliance with recommendations, and effectiveness of treatment in improving health.[17]

Anticipating limitations in statistical power, we prespecified analyses of subgroups in which effects might be stronger, including the near-elderly and persons who reported having received a diagnosis of diabetes, hypertension, a high cholesterol level, a heart attack, or congestive heart failure before the lottery. We did not find significant changes in any of these subgroups. To try to improve statistical power, we used the Framingham risk score as a summary measure. This allowed us to reject a decrease of more than 20% in the predicted 10-year cardiovascular risk or a decrease of more than 10% in predicted risk among the participants with high-risk diagnoses before the lottery. Our results were thus consistent with at best limited improvements in these particular dimensions of physical health over this time period, in contrast with the substantial improvement in mental health.

Although changes in health status are of great

interest, they are not the only important potential benefit of expanded health insurance coverage. Health insurance is a financial product that is aimed at providing financial security by protecting people from catastrophic health care expenses if they become injured or sick (and ensuring that the providers who see them are paid). In our study, Medicaid coverage almost completely eliminated catastrophic out-of-pocket medical expenditures.

Our estimates of the effect of Medicaid coverage on health, health care utilization, and financial strain apply to able-bodied, uninsured adults with incomes below 100% of the federal poverty level who express interest in insurance coverage — a population of considerable interest for health care policy, given the planned expansion of Medicaid. The Patient Protection and Affordable Care Act of 2010 allows states to extend Medicaid eligibility to all adults with incomes of up to 138% of the federal poverty level. However, there are several important limits to the generalizability of our findings. First, the low-income uninsured population in Oregon differs from the overall population in the United States in some respects, such as the proportions of persons who are members of racial and ethnic minority groups. Second, our estimates speak to the effect of Medicaid coverage on the subgroup of people who signed up for the lottery and for whom winning the lottery affected their coverage status; in the Supplementary Appendix we provide some additional details on the characteristics of this group. Medicaid coverage may have different effects for persons who seek insurance through the lottery than for the general population affected by coverage mandates. For example, persons who signed up for the lottery may have expected a greater health benefit from insurance coverage than those who did not sign up. Of course, most estimates suggest imperfect (and selective) Medicaid take-up rates even under mandates.[18] Third, the newly insured participants in our study constituted a small share of all uninsured Oregon residents, limiting the system-level effects that insuring them might generate, such as strains on provider capacity or investment in infrastructure. Fourth, we examined outcomes in people who gained an average of 17 months of coverage (those insured through the lottery were not necessarily covered for the entire study period); the effects of insurance in the longer run may differ.

Despite these limitations, our study provides evidence of the effects of expanding Medicaid to low-income adults on the basis of a randomized design, which is rarely available in the evaluation of social insurance programs. We found that insurance led to increased access to and utilization of health care, substantial improvements in mental health, and reductions in financial strain, but we did not observe reductions in measured blood-pressure, cholesterol, or glycated hemoglobin levels.

The findings and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of the funders.

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REFERENCES

1. Lurie N, Ward NB, Shapiro MF, Brook RH. Termination from Medi-Cal — does it affect health? N Engl J Med 1984;311:480-4.
2. Lurie N, Ward NB, Shapiro MF, Gallego C, Vaghaiwalla R, Brook RH. Termination of Medi-Cal benefits: a follow-up study one year later. N Engl J Med 1986;314:1266-8.
3. Sommers BD, Baicker K, Epstein AM. Mortality and access to care among adults after state Medicaid expansions. N Engl J Med 2012;367:1025-34.
4. Finkelstein A, Taubman S, Wright B, et al. The Oregon health insurance experiment: evidence from the first year. Q J Econ 2012;127:1057-106.
5. McDade TW, Williams S, Snodgrass JJ. What a drop can do: dried blood spots as a minimally invasive method for integrating biomarkers into population-based research. Demography 2007;44:899-925.
6. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. J Affect Disord 2009;114:163-73.
7. Ware JE, Kosinki M, Dewey J, Gandek B. How to score and interpret single-item health status measures: a manual for us-

ers of the SF-8 Health Survey. Boston: QualityMetric, 2001.
8. Baicker K, Taubman S, Allen H, et al. The Oregon Health Insurance Experiment analysis plan: evidence from the in-person interviews (http://www.nber.org/oregon/documents.html).
9. StataCorp. Stata statistical software, release 12. College Station, TX: StataCorp, 2011.
10. Angrist JD, Imbens GW, Rubin DB. Identification of causal effects using instrumental variables. J Am Stat Assoc 1996;91:444-55.
11. D'Agostino RB, Vasan RS, Pencina MJ, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. Circulation 2008;117:743-53.
12. Kaiser Family Foundation. Summary of coverage provisions in the Affordable Care Act. 2012 (http://www.kff.org/healthreform/upload/8023-R.pdf).
13. ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group. Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). JAMA 2002;288:2981-97.
14. Arroll B, Elley CR, Fishman T, et al. Antidepressants versus placebo for depression in primary care. Cochrane Database Syst Rev 2009;CD007954.
15. Bolen S, Feldman L, Vassy J, et al. Systematic review: comparative effectiveness and safety of oral medications for type 2 diabetes mellitus. Ann Intern Med 2007;147:386-99.
16. Taylor F, Ward K, Moore TH, et al. Statins for the primary prevention of cardiovascular disease. Cochrane Database Syst Rev 2011;CD004816.
17. Eisenberg JM, Power EJ. Transforming insurance coverage into quality health care: voltage drops from potential to delivered quality. JAMA 2000;284:2100-7.
18. Congressional Budget Office. CBO's analysis of the major health care legislation enacted in March 2010. March 30, 2011 (http://www.cbo.gov/publication/22077).