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Prescription Opioid Use Patterns, Use Disorder Diagnoses, and Addiction Treatment Receipt after the 2014 Medicaid Expansion in Oregon

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ABSTRACT

Background/Aims: Evidence suggests Medicaid beneficiaries in the USA are prescribed opioids more frequently than are people who are privately-insured, but little is known about opioid prescribing patterns among Medicaid enrollees who gained coverage via the Affordable Care Act Medicaid expansions. This study compared the prevalence of receipt of opioid prescriptions and opioid-use-disorder (OUD), along with time from OUD diagnosis to medication-assisted treatment (MAT) receipt between Oregon residents who had been continuously insured by Medicaid, were newly insured after Medicaid expansion in 2014, or returned to Medicaid coverage after expansion.

Design: Cross-sectional study using inverse-propensity weights to adjust for differences among insurance groups.

Setting: Oregon.

Participants: 225,295 Oregon Medicaid adult beneficiaries insured 2014-2015 and either: 1) newly enrolled, 2) returning in 2014 after a >12-month gap, or 3) continuously insured between 2013 and 2015. We excluded patients in hospice care or with cancer diagnoses.

Measurements: Any opioid dispensed, chronic (≥90-day) and high dose (≥90 daily morphine milligram equivalence) opioid use, documented OUD diagnosis, and MAT receipt.

Findings: Compared with the continuously insured, newly and returning insured enrollees were less likely to be dispensed opioids [newly: 42.3%, 95% confidence interval (95%CI) 42.0-42.7%; returning: 49.3%, 95%CI 48.8-49.7%; continuously: 52.5%, 95%CI 52.0-53.0%], use opioids chronically (newly: 12.8%, 95%CI 12.4-13.1%; returning: 11.9%, 95%CI 11.5-12.3%, continuously: 15.8%, 95%CI 15.4-16.2%), have OUD diagnoses (newly: 3.6%, 95%CI 3.4-3.7%; returning: 3.9%, 95%CI 3.8-4.1%, continuously: 4.7%, 95%CI 4.5-4.9%), and receive MAT after OUD diagnosis [Hazard Ratio newly: 0.57, 95%CI 0.53-0.61; Hazard Ratio returning: 0.60, 95%CI 0.56-0.65 (REF: continuously)].

Conclusions: Residents of Oregon, USA who enrolled or re-enrolled in Medicaid health insurance after expansion of coverage in 2014 as a result of the Affordable Care Act were less likely than those already covered to receive opioids, use them chronically, or receive medication-assisted treatment for opioid use disorder.

Keywords: Medicaid, Affordable Care Act, opioid epidemic, prescribed opioid use, opioid-use-disorder, medication-assisted treatment

INTRODUCTION AND CONTEXT

Over the past 30 years, the role of long-term opioid therapy in managing chronic non-cancer pain has grown[1], along with rates of opioid use disorder (OUD) among patients prescribed opioids[2]. By 2011, the United States (US) Office of National Drug Control Policy declared opioid prescription abuse an epidemic[3]. Data from the US National Survey on Drug Use and Health showed that in 2016, more than 34% of individuals age 12 and older had used opioids in the prior year[4]. In 2016, over 40,000 people died from an opioid overdose[5]. Oregon's statistics mirror national trends: From 2009 to 2014, Oregon saw a sharp increase in opioid-related inpatient hospitalizations[6], and opioid-related overdose deaths in the state increased from 2,681 deaths (death rate: 2.1 per 100,000) in 2000 to 6,535 (6.5 per 100,000) in 2015[7].

Before the 2014 Affordable Care Act (ACA) Medicaid expansion patients with Medicaid insurance were prescribed opioids at twice the rate of those without Medicaid[8-9] and were on higher doses for longer periods of time[10-11]. Additionally, incidence of OUDs for Medicaid enrollees was about twice as high as in the general population[12-13], with similar trends observed in the state of Oregon[12]. It is unknown, however, how opioid prescribing patterns differed between Medicaid enrollees who gained coverage from the 2014 ACA expansion and those who were previously eligible. Medicaid also provides access to medication-assisted treatment (MAT)[13-15], which combines psychosocial therapy with Food and Drug Administration-approved medication. MAT is more effective in increasing treatment adherence in patients than either non-drug approaches[16-17] or medication alone[18], and Medicaid beneficiaries are more likely than privately-insured individuals to receive MAT[14].

As a state that experienced significant increases in Medicaid enrollment in 2014 and 2015 (due to the ACA's expansion of Medicaid coverage to non-disabled adults with incomes up to

138% of the federal poverty level)[19] and one with increasing rates of OUD, Oregon is an excellent setting to examine opioid prescriptions and OUD treatment following the 2014 Medicaid expansion. Prior research showed that, compared with individuals previously continuously insured under Medicaid, new beneficiaries used lower levels of healthcare services in 2014 and 2015[20]. Furthermore, prior to the ACA expansion, the opioid epidemic had already attracted national attention in the US, and increasing awareness of the risks of opioid therapy may have influenced opioid prescribing patterns among new enrollees.

The aim of this study was to compare the prevalence of opioid prescribing, the prevalence of OUD diagnosis, and time from OUD diagnosis to MAT treatment between three insurance groups (newly, returning, and continuously insured Oregon Medicaid enrollees) following the ACA Medicaid expansion. We also sought to understand the relationship between level of chronic and high dose opioid use and prevalence of OUD diagnosis in these insurance groups.

METHODS: DATA AND MEASURES

We obtained Oregon Medicaid enrollment (01/01/2002-12/31/2015) and administrative claims (01/01/2014-12/31/2015) data from the Oregon Health Authority that included both fee-for-service and managed care beneficiaries.

Study Population: We included adults aged 19-64 continuously insured by Oregon Medicaid from January 1, 2014 through December 31, 2015. To capture changes in utilization among enrolled individuals rather than changes in enrollment, we excluded patients with any coverage gaps during the study period. We also excluded patients with dual Medicaid and Medicare eligibility (as we did not have access to Medicare data) and patients whose 2014-

2015 eligibility was not related to the Medicaid expansion (e.g. pregnant women). Finally, we excluded those in hospice care or with a cancer diagnosis other than non-melanoma skin cancer because these patients often require intense, prolonged pain management[21] and are exempt from the Centers for Disease Prevention and Control (CDC) opioid prescribing guidelines[22]. Of 622,513 adults aged 19-64 with any Medicaid enrollment in 2014, 225,295 (36%) remained in our sample. See Appendix Exhibit A for a breakdown of exclusions.

Insurance Groups: We categorized patients in our study sample as newly, returning, or continuously insured:

1. Newly insured patients did not have any Medicaid coverage from 2002-2013 and had continuous coverage in 2014-2015;
2. Returning insured patients had no Medicaid coverage in 2013, had Medicaid coverage sometime during 2002-2012 and had continuous coverage in 2014-2015;
3. Continuously insured patients had Medicaid coverage for all of 2013 and continuous coverage in 2014-2015.

***Episodes of Opioid Prescribing*:** We grouped claims for each beneficiary into 'episodes' of consecutive opioid prescriptions. Prescriptions were considered consecutive if there was no more than a 30-day gap between the end of one and the start of another[23]. For each episode, we calculated its length, its total day supply, and its average daily dose measured in daily morphine milligram equivalents (MME). Episode length was the number of days between the date of the first claim in the episode and the date of the last plus the day supply of the last prescription. Total day supply was the day supply summed across all claims within the episode[24-25]. Average daily MME for an episode was determined by multiplying the quantity prescribed by the medication-specific strength times the conversion factor[26], summing this

value for all prescriptions within the episode, and dividing by the total day supply. If total day supply was greater than episode length, suggesting multiple concurrent prescriptions, the denominator was truncated to episode length. All episodes of opioid prescribing were categorized as low (1-30 average daily MME), medium (31-90 average daily MME), or high (>90 average daily MME). The 30 daily MME threshold was chosen because it was the median prescribed daily dose across all episodes observed[24]. The 90 daily MME threshold was based on CDC guidelines, which generally recommend keeping dosages below this amount[22]. Other studies have chosen similar dose thresholds[23-25]. Finally, we summed the number of episodes experienced by each patient over the study period, operationalizing the sum as a categorical variable with 4 levels, representing 1, 2, 3, or 4+ prescribing episodes.

Outcomes: To assess the prevalence of opioid prescribing and OUD diagnoses among Medicaid enrollees (full sample, n=225,295), we measured:

1. *Any opioid prescription filled*: A binary variable indicating whether a subject filled any prescription from the CDC's published list of opioids[26] (excluding buprenorphine, a partial opioid agonist used for treatment of OUD in primary care settings[27-28]) during the study period.
2. *Documented diagnosis of OUD*: A binary variable indicating whether a subject had a documented diagnosis of OUD, based on the presence of any international classification of diseases (ICD-9/10) codes for opioid abuse or dependence (Appendix Exhibit B1) in claims during the study period.

We also estimated the prevalence of chronic opioid use and OUD among the subset (n=105,031) of Medicaid enrollees with any opioid prescription filled. We measured:

1. *Any chronic opioid use*: a binary variable indicating the presence of any chronic episode, with an episode considered chronic when its length was >90 days and the patient was dispensed >90 days' supply during this period[23-25,29].
2. *Level of chronic opioid use*: a categorical variable with five levels: i) low/medium dose non-chronic use (≤90 average daily MME, ≤90 days); ii) high dose non-chronic use (>90 average daily MME, ≤90 days); iii) low dose chronic use (1-30 average daily MME, >90 days); iv) medium dose chronic use (31-90 average daily MME, >90 days), and v) high dose chronic use (>90 average daily MME, >90 days), with patients classified first based on their highest average dose chronic episode, then by whether they had any high dose use.
3. *Documented diagnosis of OUD.*

Among the subset of patients with OUD (n=8,637), we examined *time to receipt of MAT services after OUD diagnosis.* Receipt of MAT services was a binary variable indicating whether a subject had any procedure codes or pharmacy national drug codes indicating MAT[30] (Appendix Exhibit B2) in claims during the study period.

Independent Variables: The main independent variable was insurance group (defined above). When estimating OUD prevalence in patients with any opioid prescription, the independent variables were insurance group and episode type, representing both level of chronic use and whether they experienced a high dose episode. Episode type, a measure of length and intensity of prescribed opioid use, was operationalized as a categorical variable with the following five levels:

1. **Non-chronic use and no high dose;**
2. **Low dose chronic use and no high dose;**
3. **Non-chronic or low dose chronic use and at least one high dose;**

4. **Medium dose chronic use and no high dose;**
5. **Medium or high dose chronic use and at least one high dose.**

***Other Covariates*:** We adjusted for 'number of episodes' for all outcomes modeled in the sample of patients with any prescription (any chronic use, level of chronic use, and OUD prevalence).

METHODS: STATISTICAL ANALYSES

Propensity Score Weighting: To adjust for observable differences between the insurance groups that may have affected outcomes, we used inverse-probability of treatment weighting (IPTW)[31] via the *twang* (toolkit for weighting and analysis of nonequivalent groups)[32] package in R (version 3.4.0), implementing a generalized boosted model that included the patient's age, sex, racial and ethnic background, rural setting, zip-code-level poverty and unemployment percentiles, comorbidity level as assessed by the enhanced Charlson comorbidity index[33], and diagnoses associated with chronic pain (see Appendix Exhibit B3 for included pain categories and ICD-9/10 codes). We produced separate sets of average treatment effect weights for the full sample, the subset of patients with any opioid prescription, and the subset with OUD. For each patient characteristic included in the propensity model, we calculated absolute standardized mean differences between insurance groups before and after weighting to assess propensity score performance; standardized differences of less than 0.10 suggest good balance[34]. For all data sets, we estimated effective sample sizes (ESS), the approximate number of observations under simple random sampling that would produce variation equivalent to the weighted sample, resulting from propensity score weighting.

***Parameter Estimates and Confidence Intervals (CIs)*:** The following analyses were performed in Stata 15.1. We report point estimates and 95% CIs on all IPTW-adjusted parameter estimates (Appendix Exhibits D1-D7) from the proposed models below.

Binary Logistic Regressions: Among the full sample, we ran IPTW binary logistic regressions to estimate the likelihood of having any opioid prescription filled and OUD diagnosis prevalence by insurance group. Among the subset of patients with any opioid prescription, we estimated the likelihood of having any chronic episode by insurance group, adjusted for number of episodes, as well as OUD diagnosis prevalence by insurance group and episode type, also adjusted for number of episodes.

Multinomial Logistic Regression: We ran an IPTW multinomial logistic regression to predict the level of chronic use (low/medium dose non-chronic use, high dose non-chronic use, low dose chronic use, medium dose chronic use, or high dose chronic use) in patients with any opioid prescription by insurance group, adjusted for number of episodes.

Cox Regression: Among the subset of patients with OUD diagnosis, we used an IPTW Cox proportional hazards model to examine the relationship between insurance group and time from OUD diagnosis to MAT. For this model, we excluded patients whose MAT receipt occurred before their first OUD diagnosis during the study period, as we were unable to determine their initial date of diagnosis (3.6% of patients with OUD).

***Additional Analyses*:** To address concerns of selection bias due to opioid-related deaths among the full sample, we assessed the likelihood of having experienced an overdose event

(binary), as indicated by ICD-9/10 codes (Appendix Exhibit B4) in study period claims by insurance group using IPTW logistic regression.

RESULTS

Covariate Balance between the Insurance Groups

Full sample: Prior to weighting, the insurance groups differed on multiple demographic characteristics. Compared to returning and continuously insured enrollees, newly insured enrollees were more likely to be older, male, and Hispanic, live in an urban location, have fewer comorbidities and chronic pain-related diagnoses, and reside in zip codes with higher levels of poverty and unemployment. Balance improved for all covariates; ESS after weighting were as follows: 34,863 for continuously insured, 47,259 for returning insured, and 86,957 for newly insured, for a total ESS of 169,079. For the distribution of covariates before and after weighting, see Table 1.

Sample with any opioid dispensed: After weighting, balance improved for all covariates and the ESS were as follows: 25,832 for continuously insured, 27,607 for returning insured, and 31,332 for newly insured. See Appendix Exhibit C1 for the distribution of covariates before and after weighting. Compared to the full sample, patients with opioid prescriptions were more likely to be older, female, and white, live in a rural location, have more comorbidities and chronic-pain related diagnoses, and reside in zip codes with higher levels of unemployment.

Sample with OUD diagnosis: After weighting, balance improved for all covariates and the ESS were as follows: 2,550 for continuously insured, 2,515 for returning insured, and **2,327**

for newly insured. See Appendix Exhibit C2 for the distribution of covariates before and after weighting. Compared to the full sample, patients with OUD diagnoses were more likely to be young, male, and white, live in an urban location, and have more comorbidities and chronic pain-related diagnoses.

Outcomes

Any opioid dispensed, any chronic opioid use, and level of chronic opioid use: Compared to the continuously insured, newly and returning insured enrollees were less likely to have any opioid dispensed, with newly insured less likely than returning insured (Table 2; Figure 1, x-axis; Appendix D1). Among patients with opioid prescriptions, the newly insured were less likely than the continuously insured to be chronic users of all types (Table 2; Appendix D2) and less likely to be dispensed either a low, medium, or high daily chronic dose (Figure 1, y-axis; Appendix D3).

OUD diagnosis and time to receipt of MAT services: Among the full sample, the continuously insured were more likely than the newly and returning insured to have an OUD diagnosis, with newly insured less likely than returning insured (Table 2; Appendix D4). Among those with an OUD diagnosis, newly insured enrollees were 43% less likely to receive MAT after OUD diagnosis than the continuously insured. Similarly, the returning insured were 40% less likely to receive MAT after OUD diagnosis than the continuously insured, with no significant differences in MAT receipt observed between newly and returning insured (Table 2; Figure 2; Appendix D5).

OUD diagnosis and episode type: Among those with any opioid dispensed, prevalence of OUD diagnosis for all insurance groups varied significantly by length and intensity of dose received during episodes. Generally, as length and intensity increased, so did prevalence of

OUD diagnosis. Patients with medium or high dose chronic use and at least one high dose were most likely to have an OUD diagnosis. Those with neither chronic use nor high dose episodes were least likely to have an OUD diagnosis (Figure 3; Appendix D6).

Among those with any opioid dispensed, after adjusting for episode type, the newly and returning insured remained at lower odds of OUD diagnosis than the continuously insured (Table 2; Appendix D7).

Additional analysis of overdose events: Among the full sample, less than half of a percent of patients with any prescribed opioid use experienced an overdose event. The continuously insured were slightly less likely than the newly and returning insured to have experienced an overdose event, with newly and returning insured similarly likely (Appendix D8).

This study evaluated the relationship between insurance group (newly, returning and continuously insured enrollees) and opioid prescriptions, OUD diagnoses, and MAT receipt among Oregon Medicaid beneficiaries after the ACA Medicaid expansion. We found that 42% of newly insured enrollees filled at least one prescription during the two-year study period, with estimates for returning (49%) and continuously insured enrollees (53%) reflecting even higher prevalences.

Among those with opioid prescriptions, relative to the continuously insured, the newly and returning insured were less likely to be chronic opioid users. This suggests that policies to decrease opioid prescribing in recent years[35] may be having their desired effect on the population of newly and returning Medicaid enrollees (in contrast with the continuously insured, who may face understandable difficulties in discontinuing long-term opioid therapy). However, differing levels of chronic and high dose opioid use may be, in part, a result of

unobserved differences in characteristics between the three groups that we were unable to control for.

Confirming other studies[24,37], we found prescribed dose and duration were both significant predictors of OUD diagnosis prevalence. Patients with medium or high dose chronic use and at least one high daily dose were roughly five times more likely to be diagnosed with OUD than those with neither chronic nor high daily dose use. Since the continuously insured were more likely to be dispensed higher doses for longer periods, the continuously insured were most likely to be diagnosed with OUD. But even after adjusting for the number of prescribing episodes and level of chronic and high dose use, the continuously insured were more likely than the newly or returning insured to have OUD diagnoses. This may be because continuously insured patients had more opportunities to receive diagnoses than new enrollees. It is also possible that individuals with existing drug dependence issues were more likely to have been continuously insured, being motivated to maintain their prescribed treatment regimens.

In addition to being more likely to be diagnosed with OUD, the continuously insured, if diagnosed, were more likely to receive MAT, possibly due to having had access to addiction treatment resources for longer. With greater access to care, these patients likely had more opportunities to initiate MAT. The length of the study period (24 months) may not have been sufficient to see comparable access to MAT among newly and returning insured enrollees. Additionally, there is evidence of a gap between treatment demand and MAT capacity, which may have impacted the newly and returning insured more than the continuously insured[38]. Thus, future research assessing long term MAT trends and capacity is necessary.

This study had limitations. Claims data did not capture self-paid prescriptions or opioids obtained through diversion. Although we adjusted for comorbidity level and chronic pain type, we were not able to measure the severity of pain experienced by patients. We were unable to determine an initial date of diagnosis for a small percent of patients with MAT before OUD diagnosis (3.6% of the sample with OUD). We were also unable to assess continuity of care by insurance status, which could impact OUD diagnosis and MAT receipt. Importantly, our data was limited to Oregon Medicaid claims and enrollment files, so we do not know if newly and returning Medicaid enrollees had other insurance (e.g. private insurance or Medicaid from another state) before 2014. Our exclusion of patients with cancer diagnosis (other than non-malignant skin cancer) may have removed cancer survivors who are not in active treatment. Our data did not have information on cancer stage and thus we were unable to identify these potential survivors to include in our analyses. Additionally, we were unable to identify enrollees who died and this may have contributed to beneficiaries with any coverage gaps during the study period being excluded; however, in our examination of enrollees with a diagnosis code indicating opioid overdose (unknown if fatal or non-fatal), we observed that less than half of a percent of patients with any prescribed opioid use experienced an overdose event. Because this percent was low and similar between insurance groups, potential for selection bias is minimal. Finally, our sample was limited to Oregon Medicaid enrollees and was not nationally representative.

CONCLUSION

Medicaid plays an important role in fighting the opioid epidemic: for low-income individuals who struggle with addiction, it is often the only affordable option for getting appropriate treatment. Opioid use in newly and returning insured enrollees after the ACA Medicaid

expansion was lower than in the continuously insured, possibly reflecting lower prescribing rates combined with difficulties in discontinuing opioids in long-term users with more stable insurance coverage; however, prescribing remains high. Lower likelihood of MAT among newly and returning insured patients with OUD relative to continuously insured patients with OUD suggests that newly eligible enrollees may not yet have established the continuity of care often needed for MAT; alternately, they may have prioritized competing healthcare needs. It is essential, therefore, that policymakers consider the importance of Medicaid continuity and primary care continuity in combating the opioid epidemic and that they continue to provide adequate access to continuous insurance.

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Table 1: Characteristics of newly, returning, and continuously insured enrollees (full sample).

	Unweighted Sample, %				Inverse Propensity Weighted Sample, %			
	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD
Total N | ESS	108,501	59,811	56,983		86,957	47,259	34,863	
Age group								
19-29	23.3	31.6	32.4	0.1942	27.8	27.8	27.7	0.0033
30-39	22.2	26.0	29.3	0.1582	25.0	25.0	25.0	0.0005
40-64	54.5	42.4	38.4	0.3286	47.3	47.2	47.4	0.0036
Female	44.4	53.9	67.9	0.4827	52.8	53.0	53.0	0.0048
Race/Ethnicity								
Hispanic	16.0	14.7	9.0	0.218	13.9	13.9	13.8	0.0033
Non-Hisp. Non-White	8.8	9.7	8.7	0.0342	9.1	9.1	9.0	0.0022
Non-Hisp. White	51.9	69.6	75.5	0.5274	62.6	63.0	63.2	0.0148
Non-Hisp. Unknown	23.3	6.0	6.8	0.7061	14.5	14.0	13.9	0.0218
Rural Setting[2]	36.4	41.5	41.7	0.106	39.2	39.2	39.4	0.0042
ZCTA[3] Unemployment %								
0-8.09	29.5	21.9	20.5	0.2204	25.2	24.9	24.7	0.011
8.09-9.58	25.5	24.2	24.0	0.035	24.8	24.9	24.8	0.0029
9.58-11.56	23.2	26.4	27.3	0.093	25.1	25.2	25.3	0.0037
11.56-38.84	21.7	27.4	28.1	0.1435	24.8	24.9	25.1	0.0068
Unknown	0.1	0.1	0.0	0.0186	0.1	0.1	0.1	0.0088
ZCTA[3] Poverty %								
0-13.0	27.9	22.4	22.4	0.1321	25.1	25.0	25.0	0.002
13.0-17.0	26.4	25.1	23.8	0.0607	25.3	25.1	25.1	0.0044
17.0-22.6	23.9	26.3	27.6	0.0814	25.4	25.5	25.5	0.0025
22.6-100	21.8	26.2	26.3	0.1033	24.1	24.3	24.3	0.0043
Unknown	0.1	0.1	0.0	0.0206	0.1	0.1	0.0	0.0096
Co-Morbidity Index[4]								
0	45.5	37.1	31.0	0.3052	39.6	39.4	39.3	0.0061
1 to 2	20.4	17.4	20.9	0.0885	19.7	19.7	19.7	0.0019
3 to 4	19.3	25.2	24.9	0.1351	22.2	22.4	22.4	0.0046
5 to 6	9.2	12.4	13.5	0.1279	11.1	11.2	11.2	0.0014
7+	5.7	7.9	9.8	0.1422	7.4	7.4	7.4	0.0012
Migraine	4.6	6.8	10.7	0.2422	6.8	6.8	6.8	0.0014
Joint Pain	36.5	42.1	49.0	0.2533	41.2	41.3	41.4	0.0041
Osteoarthritis	8.8	8.6	10.0	0.0499	9.1	9.1	9.1	0.0011
Back Pain	24.6	30.6	38.5	0.306	29.7	29.9	29.8	0.0048
General Chronic Pain	8.4	11.1	15.8	0.2363	11.2	11.1	11.2	0.0021

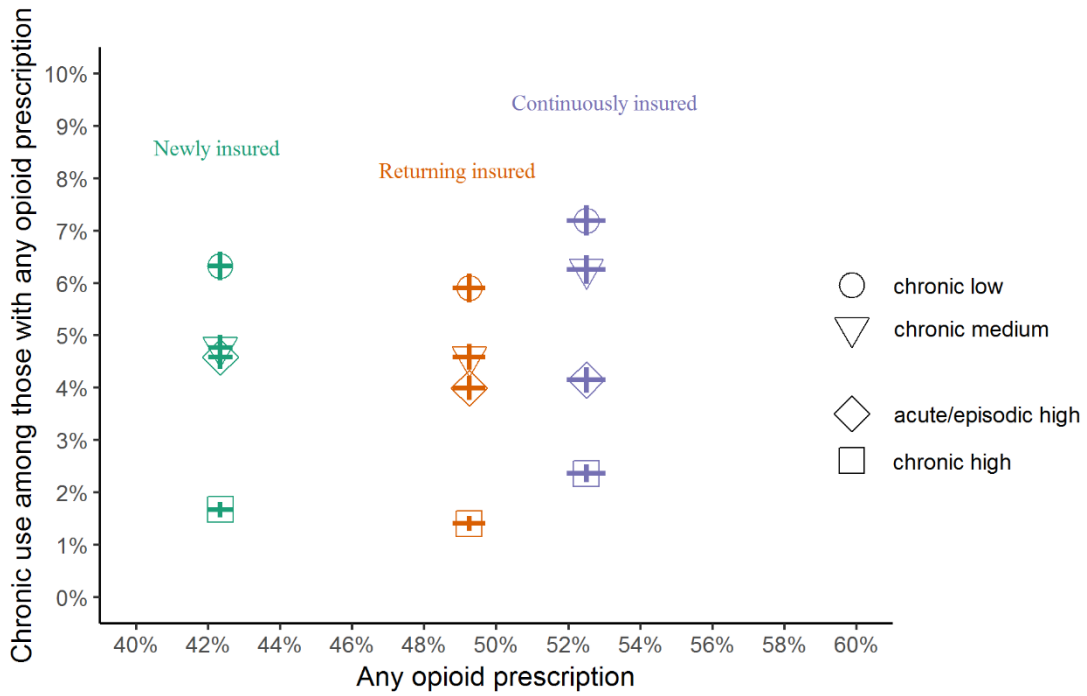
[1] Maximum absolute standardized mean difference (ASMD) across all pairwise comparisons for each level of pretreatment covariate.
[2] Rural defined by zip codes ten or more miles from the centroid of a population center of 40,000 people or more (Oregon Office of Rural Health).
[3] ZIP Code Tabulation Areas.
[4] Level of co-morbidity assessed by the enhanced Charlson comorbidity index.

Table 2: Inverse-Probability of Treatment Weighted Sample Adjusted Regression Results

Outcome	**Insurance group**	**Additional covariates**	**Adjusted Estimate**	**95%CI**
% Patients with any opioid dispensed[1] (*full sample*)	Newly insured		42.3%	42.0-42.7%
	Returning insured		49.3%	48.8-49.7%
	Continuously insured		52.5%	52.0-53.0%
% Patients with chronic opioid use[1] *(sample with any opioid dispensed)*	Newly insured	Number of episodes	12.8%	12.4-13.1%
	Returning insured		11.9%	11.5-12.3%
	Continuously insured		15.8%	15.4-16.2%
% Patients with OUD diagnosis[1] *(full sample)*	Newly insured		3.6%	3.4-3.7%
	Returning insured		3.9%	3.8-4.1%
	Continuously insured		4.7%	4.5-4.9%
Hazard Ratio, MAT receipt (*sample with OUD diagnosis*)	Newly insured (REF: Continuously insured)		0.57	0.53-0.61
	Returning insured (REF: Continuously insured)		0.60	0.56-0.65
Odds Ratio, OUD diagnosis[1] (*sample with any opioid dispensed*)	Newly insured (REF: Continuously insured)	Episode type, number of episodes	0.85	0.80-0.92
	Returning insured (REF: Continuously insured)		0.91	0.85-0.98

Note: These are a selected sample of regression results. See Appendix D for all regression results.
[1]Results from an IPT-weighted binary logistic regression model
[2]Results from an IPT-weighted Cox proportional hazards model
CI = confidence interval
OUD = opioid-use-disorder
MAT = medication-assisted treatment

Figure 1: Percent of any opioid prescribing in the overall sample and percent of low dose chronic use, medium dose chronic use, high dose **non-chronic** use, and high dose chronic use among patients with any opioid prescription by insurance group.

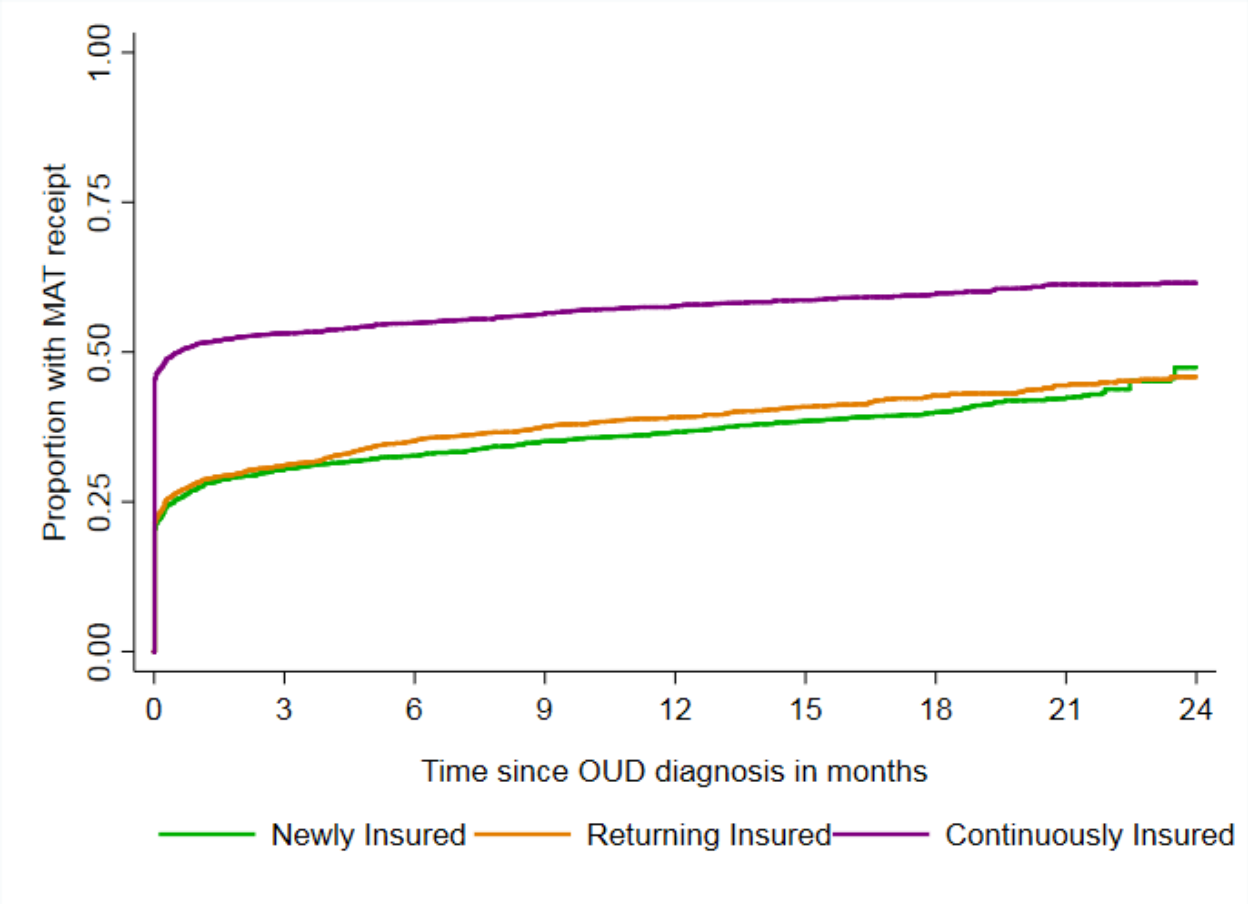


Chronic low: 1-30 average daily MME, >90 days
Chronic medium: 31-90 average daily MME, >90 days
Chronic high: >90 average daily MME, >90 days
Non-chronic high: >90 average daily MME, ≤90 days

Opioids prescribed in our sample included butorphanol, codeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, opium, oxycodone, oxymorphone, pentazocine, tapentadol, and tramadol.

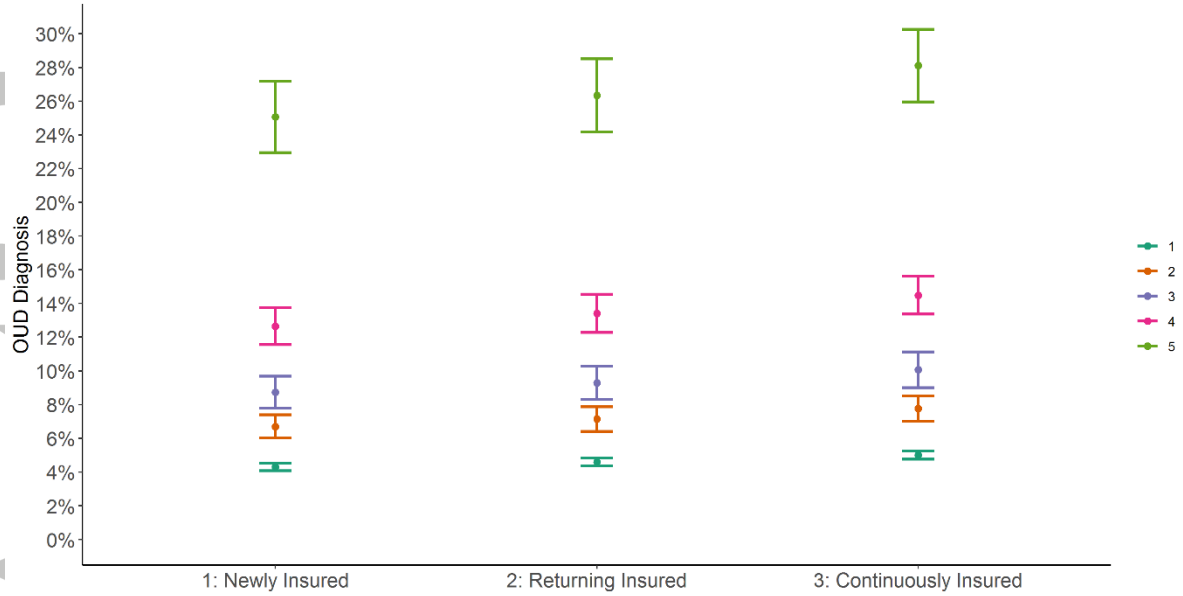
Horizontal bars indicate 95% confidence intervals for likelihood of any opioid prescription; vertical bars indicate 95% confidence intervals chronic low, chronic medium, and chronic high opioid use. These estimates and confidence intervals were produced using binary and multinomial logistic models incorporating inverse-probability of treatment weights.

Figure 2: IPT-weighted Kaplan-Meier estimates of MAT receipt among patients with OUD by insurance group.



IPT = inverse-probability of treatment
OUD = opioid-use-disorder
MAT = medication-assisted treatment

Figure 3: Percent of opioid-use-disorder diagnosis by episode type and insurance **group** among patients with any opioid prescription



OUD=opioid-use-disorder.

1: Non-chronic (≤90 day) use and no high (>90 daily MME) dose, N=86,349
2: Low (1-30 daily MME) dose chronic (>90 day) use and no high dose, N=6,649
3: Non-chronic or low dose chronic use and at least one high dose, N=4,648
4: Medium (31-90 daily MME) chronic use and no high dose, N=5,207
5: Medium or high dose chronic use and at least one high dose, N=2,178

These estimates and 95% confidence intervals were produced using binary logistic models incorporating inverse-probability of treatment weights.

Appendix for

"Prescription Opioid Use Patterns, Use Disorder Diagnoses, and Addiction Treatment Receipt after the 2014 Medicaid Expansion in Oregon"

The Appendix material contains 4 sections:

Appendix Exhibit A: Sample Exclusions

Appendix Exhibits B1-B4: Definitions

Appendix Exhibit B1: Definition of opioid use disorder (OUD) diagnosis.

Appendix Exhibit B2: Definition of receipt of medication-assisted treatment (MAT) services.

Appendix Exhibit B3: Chronic pain diagnoses.

Appendix Exhibit B4: Definition of opioid overdose event.

Appendix Exhibits C1-C2: Covariate Balance Tables

Appendix Exhibit C1: Characteristics of newly, returning, and continuously insured enrollees (*sample with any opioid dispensed*)**.**

Appendix Exhibit C2: Characteristics of newly, returning and continuously insured enrollees (*sample with OUD diagnosis*).

Appendix Exhibits D1-D7: Covariate-Adjusted Parameter Estimates

Appendix Exhibit D1: Binary logistic regression with inverse-probability of treatment weights (IPTW). Marginal predicted probabilities for any opioid prescription filled (*full sample)* by insurance group.

Appendix Exhibit D2: Binary logistic regression with IPTW. Marginal predicted probabilities for any chronic episode (*sample with any opioid dispensed)* by insurance group.

Appendix Exhibit D3: Multinomial logistic regression with IPTW. Marginal predicted probabilities for level of chronic opioid use (*sample with any opioid dispensed)* by insurance group.

Appendix Exhibit D4: Binary logistic regression with IPTW. Marginal predicted probabilities for diagnosis of OUD (*full sample)* by insurance group.

Appendix Exhibit D5**:** Cox regression with IPTW. Time to receipt of MAT services after OUD diagnosis by insurance group (*sample with OUD diagnosis, excluding patients with MAT receipt before OUD diagnosis*).

Appendix Exhibit D6: Binary logistic regression with IPTW. Marginal predicted probabilities for diagnosis of OUD (*sample with any opioid dispensed)* by insurance group and episode type.

Appendix Exhibit D7: Binary logistic regression with IPTW. Odds ratios for diagnosis of OUD by insurance group (*sample with any opioid dispensed).*

Appendix Exhibit A: Sample Exclusions

Adult patients with any Medicaid enrollment in 2014 (n=622,513)		
Exclusion Criteria	*Frequency*	*Percent*
No coverage on 1/1/2014	97,005	15.6
Other Coverage Gap in Study Period	167,779	27.0
Incomplete data due to dual Medicaid/Medicare coverage	28,196	4.5
Eligibility based on pregnancy	13,376	2.1
Eligibility based on disability	37,584	6.0
Eligibility based on programs not tied to Medicaid Expansion (e.g. TANF, former Foster Care children, dialysis patients)	23,409	3.8
*Partial Coverage in 2013**	24,562	3.9
Patients in hospice care or with cancer diagnosis	5,307	0.9
Study Enrollees	225,295	36.2

*Patients with partial coverage in 2013 were not eligible for the continuously insured group, which required full coverage in 2013, or the newly or continuously insured groups, which required no coverage in 2013.

Appendix Exhibits B1-B4: Definitions

Appendix Exhibit B1: Definition of opioid use disorder (OUD) diagnosis.
This is a binary variable indicating whether a subject had a documented diagnosis of OUD during the study period. Classification was based on any of the following ICD-9 or ICD-10 diagnosis codes being present in any claims.

ICD-9: 304.00, 304.01, 304.02, 305.50, 305.51, 305.52.
ICD-10: F11.20, F11.222, F11.259, F11.281, F11.282, F11.288, F11.10, F11.159, F11.181, F11.182, F11.188.

Appendix Exhibit B2: Definition of receipt of medication-assisted treatment (MAT) services.
This is a binary variable indicating any claims with any of the following procedure codes or National Drug Codes (NDC).

Procedure Codes
H0020, H0033 with HF or HG modifier, H0016, T1502 with HF or HG modifier, J0571-J0575.

NDCs
***Buprenorphine HCl*:** 00054017613, 00054017713, 00054018813, 00054018913, 00093537856, 00093537956, 00228315303, 00228315603, 00378092393, 00378092493, 50383092493, 50383093093
***Buprenorphine-Naloxone*:** 00228315403, 00228315473, 00228315503, 00228315573, 00093572056, 00093572156, 12496120203, 12496120403, 12496120803, 12496121203, 42291017530, 50383028793, 50383029493, 65162041503, 65162041603
***Methylnaltrexone Bromide*:** 65649055102, 65649055103, 65649055107, 65649055204

Note: Methadone administered for treatment of OUD was paid using CPT codes; thus we classified methadone identified from NDCs as prescribed use for pain.

Appendix Exhibit B3: Chronic pain diagnoses.

Category	**Diagnoses included**	**ICD-9 codes**	**ICD-10 codes**
Migraine	Migraine	346	G43
Joint pain	Diffuse diseases of connective tissue; arthropathies; rheumatoid arthritis and other inflammatory polyarthropathies; polymyalgia rheumatica; peripheral enthesopathies; other disorders of synovium, tendon, and bursa; disorders of muscle, ligament, and fascia; other disorders of soft tissues.	710-714, 716-719, 725-729	M00-M02, M05, M11-M12, M14-M19, M23-M25, M35-M36, M60-M62, M65-M67, M70-M72, M75-M77
Osteoarthritis	Osteoarthritis and allied disorders; ankylosing spondylitis and other inflammatory spondylopathies.	715, 720	M15-M19, M45-M46
Back and spinal pain	Spondylosis and allied disorders; intervertebral disc disorders; other disorders of cervical region; other and unspecified disorders of back.	721-724	M43, M47-M48, M50-M54
General chronic pain	Tension headache; other pain disorders related to psychological factors; chronic pain due to trauma; chronic post-thoracotomy pain; other chronic postoperative pain; other chronic pain; chronic pain syndrome	30781, 30789, 33821, 33822, 33828, 33829, 78071	G44209, F4542, G8921, G8922, G8928, G8929, G893, G894

Appendix Exhibit B4: Definition of opioid overdose event.

	Contributing cause (ICD-10)	**Diagnosis (ICD-9)**	**External Cause of Injury (ICD-9)**
All opioid poisoning (illicit and prescription)	T400 (Poisoning by Opium), T401 (Poisoning by Heroin), T402 (Poisoning by Other Opioids), T403 (Poisoning by Methadone), T404 (Poisoning by Synthetic Narcotics)	96500 (Poisoning by Opium), 96501 (Poisoning by Heroin), 96502 (Poisoning by Methadone), 96509 (Poisoning by Other Opiates)	E8500 (Accidental Poisoning by Heroin), E8501 (Accidental Poisoning by Methadone), E8502 (Accidental Poisoning by Other Opiates)

These codes (ICD-10 Contributing Cause or ICD-9 Diagnosis or External Cause of Injury) capture both 1) non-fatal overdoses resulting in hospitalization or other medical care and 2) fatal overdoses resulting in hospitalization or other medical care.

Below is a table of raw (unadjusted) counts for patients with ≥1 opioid overdose event for all three samples by insurance group.

	Full sample		Sample with any opioid		Sample with OUD diagnosis	
Insurance Group	N	N (%) opioid overdose	N	N (%) opioid overdose	N	N (%) opioid overdose
Newly insured	108,501	244 (0.23%)	40,614	157 (0.39%)	2,941	147 (5.00%)
Returning insured	59,811	218 (0.37%)	30,164	156 (0.52%)	2,673	133 (4.98%)
Continuously insured	56,983	149 (0.26%)	34,253	131 (0.38%)	3,343	88 (2.53%)

For adjusted estimates, see Appendix D5.

Appendix Exhibits C1-C2: Covariate Balance Tables

Appendix Exhibit C1: Characteristics of newly, returning and continuously insured enrollees (*sample with any opioid dispensed*)**.**

	Unweighted Sample, %				Inverse Propensity Weighted Sample, %			
	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD
Total N | ESS	40,614	30,164	34,253		31,332	27,607	25,832	
Age group								
19-29	17.8	27.9	30.7	0.2828	24.8	24.9	24.9	0.0022
30-39	21.7	26.8	30.4	0.1939	26.0	26.0	26.0	0.0012
40-64	60.5	45.2	38.9	0.439	49.2	49.1	49.1	0.0031
Female	46.7	57.1	71.5	0.5188	57.6	57.8	57.9	0.0059
Race/Ethnicity								
Hispanic	13.6	12.0	7.5	0.2092	11.1	11.2	11.1	0.0008
Non-Hisp. Non-White	8.3	9.2	7.9	0.0468	8.4	8.4	8.3	0.0042
Non-Hisp. White	60.3	72.8	77.7	0.4042	69.7	69.8	70.1	0.0093
Non-Hisp. Unknown	17.8	6.0	7.0	0.4757	10.8	10.6	10.5	0.0115
Rural setting[2]	40.1	42.7	42.2	0.0533	41.5	41.5	41.5	0.0007
ZCTA[3] Unemployment %								
0-8.09	26.2	21.2	20.1	0.1521	22.8	22.7	22.6	0.0048
8.09-9.58	24.7	23.7	23.5	0.0278	24.1	24.1	24.0	0.0031
9.58-11.56	25.1	26.8	27.9	0.0628	26.5	26.5	26.6	0.0022
11.56-38.84	23.8	28.2	28.4	0.1014	26.6	26.5	26.8	0.0057
Unknown	0.1	0.1	0.1	0.014	0.1	0.1	0.0	0.0084
ZCTA[3] Poverty %								
0-13.0	26.5	22.2	22.3	0.1026	24.0	24.0	23.8	0.0039
13.0-17.0	25.6	25.0	24.0	0.0376	24.8	24.8	24.8	0.0005
17.0-22.6	25.8	26.9	28.1	0.0505	26.8	26.9	26.9	0.0026
22.6-100	22.0	25.8	25.7	0.0854	24.4	24.3	24.4	0.0018
Unknown	0.1	0.1	0.0	0.0174	0.1	0.1	0.0	0.0074
Co-Morbidity Index[4]								
0	23.9	21.5	19.6	0.1073	21.8	21.8	21.8	0.0023
1 to 2	22.2	17.6	20.3	0.1151	20.2	20.3	20.3	0.0025
3 to 4	26.9	30.5	28.9	0.0798	28.5	28.6	28.6	0.002
5 to 6	15.7	17.6	17.5	0.0484	16.8	16.8	16.8	0.0015
7+	11.4	12.8	13.7	0.0693	12.6	12.6	12.5	0.0018
Migraine	8.0	10.1	14.3	0.2041	10.7	10.6	10.7	0.0012
Joint Pain	58.9	59.4	62.1	0.0668	60.2	60.1	60.1	0.0033
Osteoarthritis	17.0	13.7	14.2	0.0918	15.1	15.0	15.0	0.0022
Back Pain	43.8	45.8	51.6	0.1560	46.8	46.9	46.9	0.0025

General Chronic Pain	17.9	18.7	23.2	0.1345	20.0	19.8	20.0	0.0033

[1] Maximum absolute standardized mean difference (ASMD) across all pairwise comparisons for each level of pretreatment covariate.
[2] Rural defined by zip codes ten or more miles from the centroid of a population center of 40,000 people or more (Oregon Office of Rural Health).
[3] ZIP Code Tabulation Areas.
[4] Level of co-morbidity assessed by the enhanced Charlson comorbidity index.

Appendix Exhibit C2: Characteristics of newly, returning and continuously insured enrollees (*sample with OUD diagnosis*).

	Unweighted Sample, %				Inverse Propensity Weighted Sample, %			
	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD	Newly Insured	Returning Insured	Cont. Insured	Max[1] ASMD
Total N | ESS	2,941	2,673	3,343		2,327	2,515	2,550	
Age group								
19-29	36.0	36.7	28.4	0.176	33.7	33.5	32.9	0.0176
30-39	27.9	27.9	37.1	0.1953	31.0	31.0	31.7	0.0135
40-64	36.1	35.4	34.5	0.0346	35.2	35.4	35.4	0.0041
Female	32.2	44.8	66.9	0.702	48.0	48.9	49.7	0.0327
Race/Ethnicity								
Hispanic	10.7	9.2	3.8	0.2854	7.7	7.6	7.0	0.0264
Non-Hisp. Non-White	6.5	8.1	6.0	0.0814	6.7	6.8	6.6	0.0082
Non-Hisp. White	68.0	76.8	82.3	0.357	76.3	76.7	77.7	0.0334
Non-Hisp. Unknown	14.8	6.0	7.8	0.3448	9.3	9.0	8.7	0.0229
Rural setting[2]	28.6	30.4	30.7	0.0456	29.8	30.0	29.8	0.0047
ZCTA[3] Unemployment %								
0-8.09	27.2	21.5	20.7	0.1603	23.3	23.0	22.5	0.0206
8.09-9.58	26.9	27.0	25.3	0.0388	26.4	26.5	26.7	0.0073
9.58-11.56	25.5	26.5	27.3	0.0409	26.6	26.3	26.4	0.0057
11.56-38.84	20.3	24.7	26.5	0.1421	23.5	23.9	24.2	0.0158
Unknown	0.2	0.3	0.3	0.0243	0.3	0.3	0.3	0.0031
ZCTA[3] Poverty %								
0-13.0	28.2	24.7	23.0	0.1225	25.2	25.4	25.2	0.0046
13.0-17.0	24.5	22.7	20.8	0.0889	22.5	22.7	22.3	0.0099
17.0-22.6	25.6	25.7	28.3	0.0599	26.6	26.5	26.5	0.0043
22.6-100	21.5	26.5	27.7	0.1382	25.4	25.2	25.9	0.0146
Unknown	0.2	0.3	0.3	0.0243	0.3	0.3	0.3	0.0031
Co-Morbidity Index[4]								
0	0.5	0.2	0.1	0.0885	0.3	0.2	0.3	0.023
1 to 2	0.4	0.3	0.1	0.0483	0.2	0.2	0.1	0.0328
3 to 4	44.7	41.4	40.8	0.0789	42.4	42.5	42.4	0.0019
5 to 6	29.6	31.0	29.5	0.0323	29.6	29.9	29.9	0.0064
7+	24.8	27.1	29.4	0.1025	27.5	27.2	27.4	0.0062
Migraine	6.8	9.9	13.6	0.2234	9.9	10.0	10.4	0.0162
Joint Pain	52.8	58.0	60.6	0.1583	57.2	57.2	56.8	0.0097
Osteoarthritis	12.6	12.3	14.1	0.052	13.0	12.7	13.0	0.0096
Back Pain	42.9	45.1	53.9	0.2188	47.1	47.3	47.9	0.0163

General Chronic Pain	28.7	27.8	35.1	0.1592	30.8	30.4	30.9	0.0101

[1] Maximum absolute standardized mean difference (ASMD) across all pairwise comparisons for each level of pretreatment covariate.
[2] Rural defined by zip codes ten or more miles from the centroid of a population center of 40,000 people or more (Oregon Office of Rural Health).
[3] ZIP Code Tabulation Areas.
[4] Level of co-morbidity assessed by the enhanced Charlson comorbidity index.

Appendix Exhibits D1-D8: Covariate-Adjusted Parameter Estimates

Appendix Exhibit D1: Binary logistic regression with IPTW. Marginal predicted probabilities for any opioid prescription filled (*full sample)* by insurance group.
Number of observations: 225,295
Dependent variable: Any opioid prescription filled
Independent variable: Insurance group
Adjusted predictions

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured	0.4234	0.0017	0.4200-0.4267
Returning insured	0.4925	0.0023	0.4880-0.4970
Continuously insured	0.5250	0.0027	0.5197-0.5303

Appendix Exhibit D2: Binary logistic regression with IPTW. Marginal predicted probabilities for any chronic episode (*sample with any opioid dispensed*) by insurance group.
Number of observations: 105,031
Dependent variable: Any chronic episode
Independent variable: Insurance group
Additional covariate: Number of episodes
Adjusted predictions

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured	0.1276	0.0019	0.1240-0.1313
Returning insured	0.1190	0.0019	0.1152-0.1227
Continuously insured	0.1581	0.0021	0.1540-0.1621

Appendix Exhibit D3: Multinomial logistic regression with IPTW. Marginal predicted probabilities for level of chronic opioid use (*sample with any opioid dispensed)* by insurance group.

Number of observations: 105,031

Dependent variable: Level of chronic opioid use (no chronic and low/medium acute, no chronic and high acute, low chronic, medium chronic, and high chronic)

Independent variables: Insurance group

Additional covariate: Number of episodes

Adjusted predictions

Insurance group	**Level of chronic opioid use**	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured	No chronic, low/medium acute (≤90 MME)	0.8265	0.0021	0.8224-0.8306
Returning insured	No chronic, low/medium acute (≤90 MME)	0.8411	0.0022	0.8369-0.8453
Continuously insured	No chronic, low/medium acute (≤90 MME)	0.8004	0.0023	0.7959-0.8050
Newly insured	No chronic, high acute (>90 MME)	0.0459	0.0012	0.0435-0.0482
Returning insured	No chronic, high acute (>90 MME)	0.0399	0.0012	0.0376-0.0422
Continuously insured	No chronic, high acute (>90 MME)	0.0415	0.0012	0.0390-0.0439
Newly insured	Low chronic (1-30 MME)	0.0633	0.0014	0.0605-0.0660
Returning insured	Low chronic (1-30 MME)	0.0590	0.0014	0.0563-0.0618
Continuously insured	Low chronic (1-30 MME)	0.0719	0.0015	0.0690-0.0748
Newly insured	Medium chronic (31-90 MME)	0.0477	0.0012	0.0453-0.0501
Returning insured	Medium chronic (31-90 MME)	0.0459	0.0013	0.0434-0.0484
Continuously insured	Medium chronic (31-90 MME)	0.0626	0.0014	0.0598-0.0653
Newly insured	High chronic (>90 MME)	0.0167	0.0007	0.0153-0.0181
Returning insured	High chronic (>90 MME)	0.0141	0.0007	0.0127-0.0154
Continuously insured	High chronic (>90 MME)	0.0236	0.0009	0.0220-0.0253

Appendix Exhibit D4: Binary logistic regression with IPTW. Marginal predicted probabilities for diagnosis of OUD (*full sample)* by insurance group.

Number of observations: 225,295

Dependent variable: Diagnosis of OUD

Independent variable: Insurance group

Adjusted predictions

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured	0.0356	0.0007	0.0342-0.0370
Returning insured	0.0392	0.0008	0.0377-0.0407
Continuously insured	0.0470	0.0009	0.0452-0.0489

Appendix Exhibit D5: Cox Regression with IPTW. Time to receipt of MAT services after OUD diagnosis by insurance group (*sample with OUD diagnosis, excluding patients with MAT receipt before OUD diagnosis*).

164 (3.7%) of 4,446 patients who received MAT did not have any diagnosis of OUD during the study period. Because we were unable to determine when, if ever, they were diagnosed with OUD, these patients were not included in the time-to-event analysis.

320 (3.6%) of 8,957 patients diagnosed with OUD in our sample received MAT before their earliest known diagnoses of OUD. These patients were excluded from the time to event analysis. In the weighted sample of patients with OUD, 2.9% of the newly insured, 2.5% of the returning insured, and 5.1% of the continuously insured were excluded from the MAT analysis for this reason.

Number of observations: 8,637

Dependent variable: Time from OUD diagnosis to MAT receipt

Independent variable: Insurance group

Adjusted hazard ratio estimates

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured (REF: Continuously insured)	0.5711	0.0222	0.5292-0.6163
Returning insured (REF: Continuously insured	0.6022	0.0224	0.5598-0.6477

Appendix Exhibit D6: Binary logistic regression with IPTW. Marginal predicted probabilities for diagnosis of OUD (*sample with any opioid dispensed)* by insurance group and episode type.

Number of observations: 105,031

Dependent variable: Diagnosis of OUD

Independent variables: Insurance group, episode type

Additional covariate: Number of episodes

Episode type:

1: No chronic opioid use and no high dose episode

2: Low chronic opioid use and no high dose episode

3: No chronic or low chronic opioid use; ≥1 high dose episode

4: Medium chronic use and no high dose episode

5: Medium or high chronic opioid use; ≥1 high dose episode

Adjusted predictions

Insurance group/Episode type	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured / 1	0.0431	0.0012	0.04076-0.0454
Returning insured / 1	0.0460	0.0012	0.04368-0.04823
Continuously insured / 1	0.0500	0.0013	0.04755-0.05254
Newly insured / 2	0.0671	0.0035	0.06016-0.07398
Returning insured / 2	0.0714	0.0037	0.06417-0.07866
Continuously insured / 2	0.0776	0.0038	0.07013-0.08507
Newly insured / 3	0.0874	0.0048	0.07791-0.0968
Returning insured / 3	0.0929	0.0051	0.0830-0.1028
Continuously insured / 3	0.1007	0.0054	0.0901-0.1113
Newly insured / 4	0.1265	0.0056	0.1156-0.1374
Returning insured / 4	0.1341	0.0058	0.1229-0.1454
Continuously insured / 4	0.1449	0.0057	0.1337-0.1561
Newly insured / 5	0.2506	0.0108	0.2295-0.2717
Returning insured / 5	0.2634	0.0111	0.2417-0.2851
Continuously insured / 5	0.2811	0.0110	0.2595-0.3026

Appendix Exhibit D7: Binary logistic regression with IPTW. Odds ratios for diagnosis of OUD (*sample with any opioid dispensed)* by insurance group.
Number of observations: 105,031
Dependent variable: Diagnosis of OUD
Independent variable: Insurance group
Additional covariates: Episode type, number of episodes

Adjusted Odds Ratios

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured (REF: Continuously insured)	0.8544	0.0310	0.7957-0.9175
Returning insured (REF: Continuously insured	0.9141	0.0318	0.8538-0.9785

Appendix Exhibit D8: Binary logistic regression with IPTW. Marginal predicted probabilities for any opioid overdose event, fatal or non-fatal, resulting in hospitalization or visit (*full sample*) by insurance status.
Number of observations: 225,295
Dependent variable: Any opioid overdose event.
Independent variable: Insurance group.
Adjusted predictions

Insurance group	**Estimate**	**Standard Error**	**95% Confidence Interval**
Newly insured	0.0031	0.0002	0.0027-0.0035
Returning insured	0.0032	0.0002	0.0024-0.0036
Continuously insured	0.0019	0.0002	0.0016-0.0023