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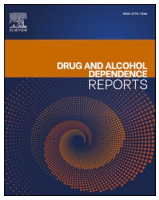

Receipt and duration of buprenorphine treatment during pregnancy and postpartum periods in a national privately-insured cohort

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HIGHLIGHTS

- About one in three privately-insured opioid-dependent birthing people were treated with buprenorphine.
- About half of buprenorphine users received treatment for at least six months.
- Hispanic and Black birthing people had lower buprenorphine use rates than white birthing people.
- Lowest buprenorphine use rate in states with punitive policies related to substance use in pregnancy.

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Opioid use disorder, Buprenorphine,
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ABSTRACT

Background: Research gaps exist on the use of medications for opioid use disorder (OUD) among birthing people.
Methods: This retrospective cohort study included people who underwent childbirth deliveries during 2017-2020 and had a diagnosis of OUD identified from a national private insurance claims database. Buprenorphine prescriptions received during the year before childbirth and the year after childbirth were obtained from pharmacy claims. Logistic regressions were used to estimate associations between receipt of buprenorphine and individual and state-level factors.
Results: Among a sample of 1,523 birthing people diagnosed with OUD, 540 (35.5 %) received buprenorphine during the pregnancy or postpartum periods. About half (51.5 %) of new recipients of buprenorphine received treatment for at least six months and, of those, one-third experienced a treatment interruption. The buprenorphine receipt rate differed significantly by race and ethnicity: 28.8 % of non-Hispanic Black birthing people with OUD and 22.8 % of Hispanic birthing people with OUD received buprenorphine treatment in contrast to 37.7 % of non-Hispanic white birthing people (aOR 0.53 [95 % CI 0.35-0.81] and 0.59 [95 % CI 0.37-0.96], respectively). The buprenorphine use rate increased over time from 29.7 % in 2017 to 42.9 % in 2020. Birthing people living in states with punitive policies related to substance use in pregnancy had the lowest buprenorphine use rate of 22.7 % as compared to 43.0 % in states with least restrictive policies.
Conclusion: In this national sample of privately-insured individuals, by 2020, 42.9 % of birthing people with OUD received buprenorphine treatment. Treatment discontinuation and interruptions were common in the period surrounding childbirth.

1. Introduction

A growing opioid crisis affects birthing people and their infants at an alarming rate in the US. The prevalence of maternal opioid-related diagnoses has increased 447 % (from 1.5 to 8.2 per 1,000 childbirth delivery hospitals) between 1999 and 2017 (Haight et al., 2018; Hirai et al., 2021). Overdose is a leading cause of maternal death in the postpartum year (Bruzelius and Martins, 2022; Pennsylvania

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Department of Health, 2020; Schiff et al., 2018).

Medications for opioid use disorder (MOUD), including methadone and buprenorphine, are approved by the Food and Drug Administration to treat opioid use disorder (OUD) by alleviating withdrawal symptoms, reducing opioid cravings, or decreasing the response to future drug use (National Academies of Sciences Engineering and Medicine, 2019). Despite the strong recommendations for these medications as standard care during pregnancy (American College of Obstetricians and Gynecologists, 2017; Substance Abuse and Mental Health Services Administration, 2018), most pregnant people with OUD do not receive any treatment with MOUD (Metz et al., 2018; Terplan et al., 2015). Among the subset of pregnant people with OUD in the US admitted to substance use treatment facilities, only half receive opioid pharmacotherapy, a percentage that has remained static over the past 20 years (Short et al., 2018).

There are several research gaps in the existing literature on the use of medications for OUD among pregnant or postpartum people. First, most research on OUD treatment utilization has been conducted on the general population; only a small number of studies have focused on pregnant and postpartum people. This special population often faces a unique constellation of complex medical, social, and structural barriers in accessing and sustaining OUD treatment, including legal issues due to the criminalization of opioid use during pregnancy and the potential loss of child custody (Grella, 1997; Krans and Patrick, 2016). Second, existing studies in this field were mostly conducted in specialty treatment settings, using data sources such as the Treatment Episode Data Set Discharges that tracks admissions into and discharges from federal-funded substance use treatment facilities (Krawczyk et al., 2017; Nguemeni Tiako et al., 2021; Short et al., 2018; Stahler and Mennis, 2018; Substance Abuse & Mental Health Data Archive, n.d.). Office-based prescribing by primary care providers is playing an increasingly important role in provision of MOUD in the US (Olfson et al., 2020). The availability of MOUD in office-based setting has broadened access to treatment, especially in areas where residents experience barriers to specialty OUD treatment programs (National Academies of Sciences Engineering and Medicine, 2019; Noe and Keller, 2020). Third, findings from previous studies may not reflect the changing scientific evidence base, clinical practice landscape, or individuals' accessibility and acceptability for OUD treatment for pregnant and postpartum people given recent changes in pharmacotherapy. Methadone was once the predominate medication used to treat OUD during pregnancy (Krans, 2022). However, restrictive regulations, such as requiring patients to be present at a treatment program daily for observed methadone administration, created barriers that hindered the accessibility to methadone treatment. New evidence now shows a lower risk of adverse neonatal outcomes associated with buprenorphine use during pregnancy, rather than methadone, likely impacting provider and individuals' acceptability of medication options for OUD during pregnancy (Suarez et al., 2022). Moreover, buprenorphine is the only opioid agonist currently approved for the treatment of OUD by prescription in an office-based setting in the US. Therefore, research focused on the use of buprenorphine for the treatment of OUD among birthing people is needed to address existing knowledge gaps.

This current study aimed to characterize the receipt, new initiation, and duration of buprenorphine treatment episodes among pregnant or postpartum people with diagnosis of OUD, using a national private insurance claims database. Additionally, we aimed to identify individual sociodemographic, medical, and geographical factors associated with buprenorphine treatment during pregnancy and postpartum periods.

2. Methods

2.1. Data source and study sample

We used de-identified data from Optum Clinformatics® Data Mart (CDM), a product of OptumInsight, Inc. (Eden Prairie, MN). Optum CDM database aggregates enrollment data and administrative health claims data from a single large, national private payer with enrollees throughout the US. With approximately 63 million unique members, this database is representative of the commercially insured US population with respect to age, gender, and region, allowing generalizability of findings (Optum, 2017).

Patients from Optum CDM database were included in our analysis if they met all the following eligibility criteria: a) underwent vaginal or cesarean section delivery during 2017-2020; b) had a diagnosis of OUD during the year before childbirth or the year after childbirth; c) had medical and prescription insurance enrollment for at least 6 months in the year before childbirth; d) had non-missing information on race and ethnicity; e) were aged 19-50 years at the time of childbirth. A vaginal or cesarean delivery was identified by International Classification of Diseases, Tenth Revision (ICD-10) codes or Current Procedural Terminology (CPT) codes within medical claims (See Appendix A1 for a complete list of ICD-10 codes). Diagnoses of OUD were also obtained from medical claims using ICD-10 codes (See Appendix A1). The eligibility criterion on continuous insurance enrollment was made to ensure adequate capture of diagnoses of OUD and comorbidities and medication prescriptions. We included people within reproductive age range (World Health Organization, n.d.); however, adolescent birthing people (aged 15-18 years at the time of childbirth) were not included in the study sample because they may have different treatment access than adult birthing people and sample size was not sufficient to analyze them as a separate group with respect to these differences.

If a subject had multiple births that met inclusion criteria, their first childbirth during 2017-2020 was included in the analytic sample. The 24-month observation time for each person-childbirth dyad included the year before childbirth and the year after childbirth. The top part of Fig. 1 demonstrates the process of sample derivation. Sensitivity analyses were performed across varied inclusion criteria among the sample of mothers with multiple eligible births during the study observation period. Specifically, the first sensitivity analysis included all eligible births, the second sensitivity analysis restricted to births to birthing people with only one eligible birth, and the third sensitivity analysis restricted to only subsequent births to birthing people with multiple eligible births.

This study was reviewed and deemed exempt from full review by the Children's Hospital of Philadelphia Institutional Review Board because the data set was deidentified.

2.2. Measures

2.2.1. Buprenorphine prescriptions

The primary outcome of this study was any buprenorphine (at least one prescription fill) received during the year before childbirth or the year after childbirth. Prescription fills for buprenorphine were identified from pharmacy claims data using National Drug Codes (NDC) for buprenorphine formulations (See Appendix A1 for list of NDCs). The specialty type of physicians prescribing buprenorphine was obtained through linking pharmacy claims and a table that contains provider-level data such as credential, type (psychiatrist, family practitioner, internist, etc.) and state, using de-identified provider IDs. To summarize prescriber information from prescription-level to patient-level, we identified the primary prescriber type for each patient as the type of the physician who prescribed most of the buprenorphine fills for that patient. We did not examine naltrexone use in our sample because currently naltrexone is not recommended in pregnancy due to limited information on its safety and unknown fetal effects (Jones et al., 2013).

2.2.2. Duration of buprenorphine treatment among those with new prescriptions

The secondary outcome was duration of buprenorphine treatment episodes during pregnancy and postpartum periods. To ensure we captured the full course of buprenorphine treatment, when examining duration measures, we used 10-12 months before childbirth as wash-out

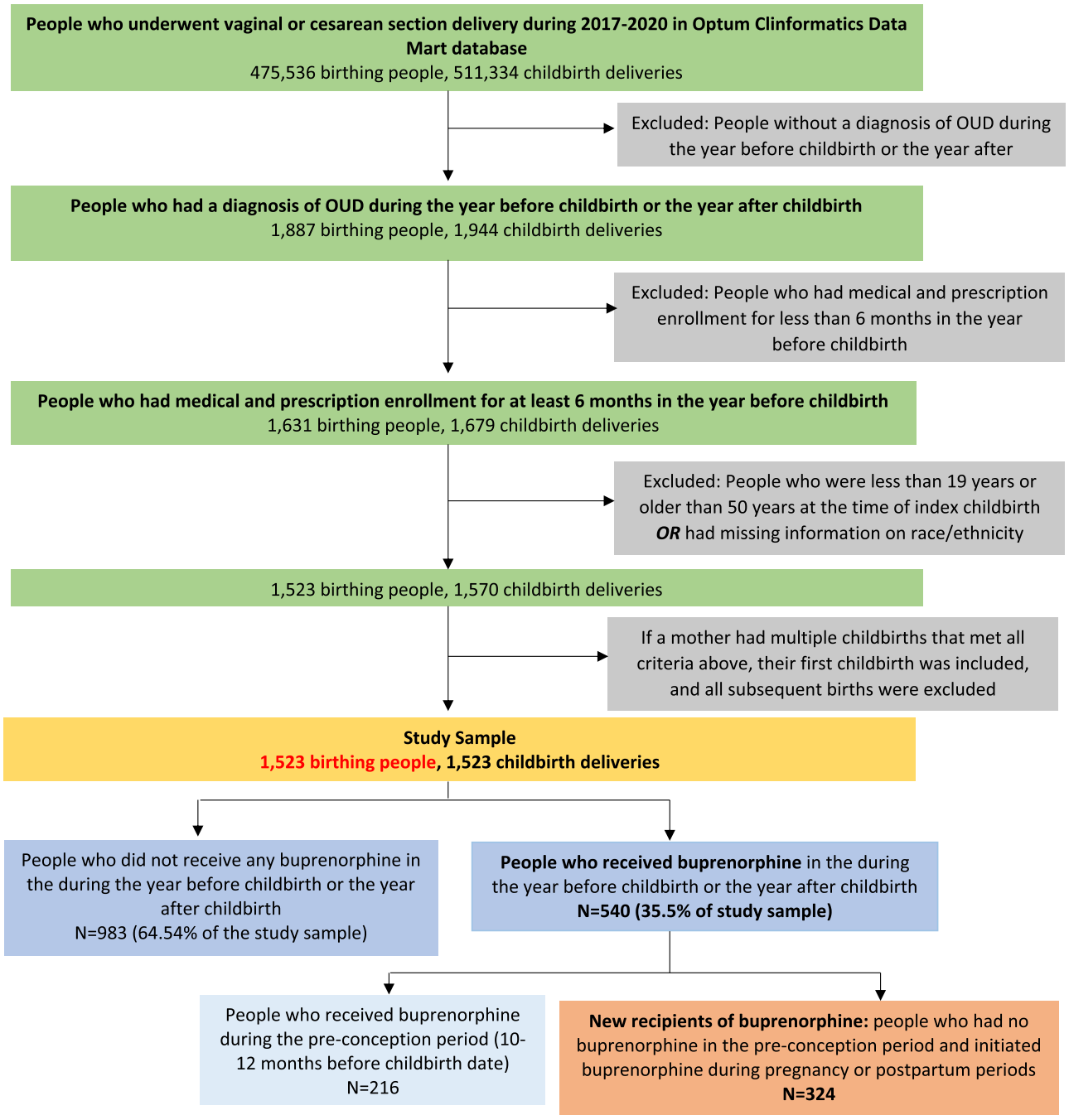

Fig. 1. Sample Derivation and Receipt of Buprenorphine in the Study Sample
Green boxes: Study target population (people who underwent childbirth deliveries and had diagnosis of opioid use disorder)
Grey boxes: People who were excluded
Yellow box: Final study sample who met all inclusion criteria
Blue boxes: Subgroups of the study sample categorized by whether they received buprenorphine treatment
Orange box: New recipients of buprenorphine who were included in the analyses on metrics of treatment duration

period and focused on individuals initiating buprenorphine in the 9-month period prior to the date of the observed birth event. That is, our analyses on duration metrics were restricted to the "new recipients of buprenorphine" who did *not* have any buprenorphine prescription fills during 10-12 months before childbirth but started the treatment during the 9 months before childbirth or postpartum period.

For each of these new recipients of buprenorphine, we consolidated their buprenorphine fills into treatment episodes. The supply end date of each prescription was first calculated as the fill date plus days of supply. The gap in supply was then calculated as difference between last prescription's end date and subsequent prescription's fill date. Discontinuation/termination of a treatment episode was defined when a patient has a gap (no buprenorphine supply on hand) for 60 or more days, informed by previous literature (Schiff et al., 2021). We also conducted a sensitivity analysis in which discontinuation was defined as the scenario in which a patient had no claims to indicate an available buprenorphine supply of 30 or more days.

We quantified the duration of each patient's first buprenorphine treatment episode in days. When individuals received overlapping buprenorphine prescriptions (i.e., a subsequent prescription's fill date

was earlier than the supply end date of an earlier prescription), we did not extend the duration of that treatment episode, an approach informed by previous literature (Saloner et al., 2017). We further defined a binary measure of retention to reflect a first treatment episode lasting for 180 days or longer. This six-month retention measure was informed by previous studies (Nguemeni Tiako et al., 2021; Saloner et al., 2017). Finally, we created a binary indicator for the presence of any treatment interruptions, defined as a gap in the treatment episode of between 14 and 60 days when an individual had no buprenorphine-naloxone supply on hand (as noted, by our definition, the episode was terminated after a gap that was longer 60 days). Treatment interruptions were only examined among individuals whose episodes lasted for 16 days or more; otherwise, a gap of 14 days or longer would be censored and impossible to observe.

2.2.3. Characteristics of patients

Individual-level data included demographic information, physical conditions, mental/behavioral co-morbidities, and polysubstance use. For demographic characteristics, we obtained information on age, education level, race and ethnicity, household income, number of adults in the household, and number of children in the household from Optum enrollment files.

The inclusion of race in this analysis was important given the pervasive and profound racial disparities in reproductive and infant health outcomes in the United States attributable to racism spanning institutional, interpersonal and internalized mechanisms. In primary analyses, non-Hispanic white was chosen as the referent category for statistical purposes because of the size of this group in this study sample. A sensitivity analysis was done as a robustness check on findings related to racial/ethnic disparities. Given the changing epidemiology of overdose fatalities and the increase in maternal morbidity and mortality attributable to overdose among Black birthing people, it is important to understand and document disparities in life-saving treatment access. The selection of non-Hispanic white as the referent group can signal a deficit-framed lens among non-white racial/ethnic groups that presupposes normative outcomes among non-Hispanic white people (Boyd et al., 2020; Elliott et al., 2022; Ramírez et al., 2005). As such, it is important to investigate comparisons that de-center white groups. We conducted a sensitivity analysis that used non-Hispanic black birth people as the referent category. This group made up the second largest population size in the sample.

We also identified diagnoses of comorbid physical and mental/behavioral disorders that were documented in the medical claims occurred during the 24-month observation time around childbirth, including cancer, hepatitis C virus (HCV) infection, attention-deficit/hyperactivity disorder (ADHD), bipolar, conduct disorder, depression, and post-traumatic stress disorder (PTSD), using ICD-10 codes (see Appendix A1). Within our sample of people with diagnoses of OUD, we also identified their poly-substance use defined as having diagnosis of dependence or abuse of other substances, including sedative, cannabis, and cocaine using diagnoses codes from medical claims (see Appendix A1).

2.2.4. State-level policies

Because the only geographic information available in patients' enrollment file is residence division (Mid-Atlantic, Pacific, etc.) while the state of physician is available in provider table, we used the state of the provider on the medical claim for childbirth as a proxy measure for the residence state of each patient. We further linked patient residence state to state-level data on policies related to substance use treatment in pregnancy. Information on whether each state requires commercial insurers to provide coverage for medications for OUD was obtained from the Prescription Drug Abuse Policy System 2020 data (Prescription Drug Abuse Policy System, n.d.). State policies related to substance use in pregnancy was obtained from a study by Faherty and colleagues, which categorized states as having punitive policies (e.g., the state defines substance use in pregnancy as child abuse or neglect, criminalizes it, or considers it grounds for civil commitment), supportive policies (e.g., the state creates or funds targeted treatment programs for pregnant and postpartum people with substance use disorder), no policies, or mixed (both punitive and supportive) policies (Faherty et al., 2020).

2.3. Statistical analyses

We first described the number and prevalence of the primary outcome (receiving buprenorphine treatment during pregnancy and postpartum periods, yes/no) and the distribution of secondary outcome (duration of buprenorphine treatment episode). Bivariate analyses were used to further describe these outcome metrics by individual-level sociodemographic factors and state-level policy factors. We further fit a series of two-level (individuals nested in states) logistic regression models to evaluate the associations between the dependent variable of receiving buprenorphine and the characteristics of patients: Model 1 included individual-level sociodemographic factors as independent variables; Model 2 further added individuals' comorbid physical and mental/behavioral disorders and poly-substance use; and Model 3 further adjusted for state-level policy factors. Logistic regression results were presented as adjusted odds ratio (OR), 95 % confidence interval (CI), and model-predicted marginal probabilities. Similarly, we fit a logistic regression model on the binary dependent variable of retention in treatment. We also described the prevalence of comorbidities and polysubstance use in our sample, overall and by buprenorphine treatment. All analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Sample characteristics

Our study sample included 1,523 birthing people with diagnoses of OUD identified from a national private insurance claims database (Fig. 1). Table 1 describes the sociodemographic characteristics of the study sample. About one third of the sample (493, 30.9 %) were aged 19-25 years at the time of delivery. Most (1178, 73.9 %) people were non-Hispanic white and 158 (10.5 %) were non-Hispanic Black. Forty-one percent of the sample had a household income below $50,000/year. Table 1 also presents the characteristics of all (N=1887) birthing people with OUD in Optum CDM data, some of whom were excluded from our analysis for not meeting inclusion criteria on age and available race/ethnicity information. The study sample has similar distributions of sociodemographic factors, except for lower missing rate on household income and composition.

3.2. Receipt of buprenorphine prescriptions

Overall, 540 (35.5 %, 95 % CI 33.1-37.9 %) birthing people with OUD in the study sample received buprenorphine treatment during the pregnancy or postpartum period. The buprenorphine use rates obtained from sensitivity analyses across varying inclusion criteria of multiparous individuals were similar to rates obtained from the primary study sample (Appendix Table S1). Table 2 describes the unadjusted and adjusted associations between the receipt of buprenorphine and individual sociodemographic, comorbidity and poly-substance use factors, and state policy factors. The adjusted associations were similar across sequential regression models (Model 1-3). There was an age association such that the odds of receiving buprenorphine among people aged 36-50 years was 1.86 (95 % CI 1.28-2.70) times higher than that among people aged 19-25 years, after adjusting for all other covariates (Model 3). The buprenorphine use rate also differed by race and ethnicity: 28.8 % of non-Hispanic Black people with OUD and 22.8 % of Hispanic people with OUD received buprenorphine treatment in contrast to 37.7 % of non-Hispanic white birthing people. Racial/ethnic differences in

Table 1
Sociodemographic characteristics of the study sample

	All pregnant and postpartum people with OUD, in 2017-2020 Optum CDM data Total N=1887		Pregnant and postpartum people with opioid use disorder in the Study Sample Total N=1523	
	Total N=1887		Total N=1523	
	n	column %	n	column %
Age at delivery (in years)				
Below 19	15	0.8	0	0.0
19-25	546	28.9	466	30.6
26-30	475	25.2	360	23.6
31-35	512	27.1	412	27.1
36-50	334	17.7	285	18.7
Above 50	5	0.3	0	0.0
Education level				
High School Diploma or Less	531	28.1	456	29.9
Less than bachelor's degree	1008	53.4	850	55.8
Bachelor's degree Plus	229	12.1	206	13.5
Missing/Unknown	119	6.3	11	0.7
Race/ethnicity				
Asian	25	1.3	22	1.4
Non-Hispanic Black	192	10.2	170	11.2
Hispanic	155	8.2	136	8.9
Non-Hispanic white	1380	73.1	1195	78.5
Missing/Unknown	135	7.2	0	0.0
Household Income				
<$50K	718	38.1	624	41.0
$50K-$99K	515	27.3	435	28.6
$100K+	379	20.1	336	22.1
Missing/Unknown	275	14.6	128	8.4
Number of adults in the household				
1	645	34.2	524	34.4
2	630	33.4	542	35.6
3+	505	26.8	457	30.0
Missing/Unknown	107	5.7	0	0.0
Number of children in the household				
0	571	30.3	482	31.7
1	571	30.3	470	30.9
2+	638	33.8	571	37.5
Missing/Unknown	107	5.7	0	0.0
Childbirth year				
2017	534	28.3	431	28.3
2018	481	25.5	393	25.8
2019	459	24.3	373	24.5
2020	413	21.9	326	21.4

buprenorphine treatment were statistically significant in adjusted logistic regression models with an OR of 0.53 (95 % CI 0.35-0.81) for non-Hispanic Black people and an OR of 0.59 (95 % CI 0.37-0.96) for Hispanic people, compared to non-Hispanic white people as reference. Sensitivity analysis also found that the odds of receiving buprenorphine treatment was 1.87 (95 % CI 1.23-2.84) times higher in non-Hispanic white people compared to non-Hispanic black birth people as the referent category (Appendix Table S2). Hispanic birthing people experienced similar odds of buprenorphine receipt as non-Hispanic black birthing people. The use rate of buprenorphine treatment increased from 29.7 % in 2017 to 42.9 % in 2020, with an adjusted OR of 1.81 (95 % CI 1.27-2.56) for birthing people in 2020 compared to those in 2017. The odds of receiving buprenorphine treatment for birthing people living in states with punitive policies related to substance use in pregnancy was 67 % (95 % CI 17-87 %) lower than that for people in states with no policy after adjustment for individual-level covariates. The regression models in Table 2 excluded people with missing values on any independent variables; as a sensitivity analysis, we fit a model including the full study sample with people having missing covariates as separate subgroups (Appendix Table S3). The subgroups with missing information on covariates (income and state policy) did not have significantly different buprenorphine use rates than their referent groups.

We also examined the characteristics of the 9117 buprenorphine prescriptions received by the 540 users during pregnancy and postpartum periods. The median quantity included in one buprenorphine prescription was 30, with an interquartile range (IQR) of 16-60. The median days of supply for one prescription was 28 (IQR 10-30). Appendix Tables S4 presents provider specialty type of buprenorphine prescribers for pregnant and postpartum people with OUD: 28.6 % of birthing people in the sample primarily received buprenorphine prescriptions from psychiatrists, 24.0 % primarily from family practitioners, and 6.4 % primarily from obstetrician-gynecologists.

3.3. Duration of buprenorphine treatment episodes among those with new prescriptions

Table 3 presents the duration of treatment among 324 people who had no buprenorphine in the pre-conception period but initiated the treatment during pregnancy or postpartum periods ("new recipients of buprenorphine"). About one third (32.1 %, 95 % CI 27.0-37.2 %) of new recipients of buprenorphine initiated the treatment 7-9 months before childbirth and 21.6 (95 % CI 17.1-26.1 %) initiated during 4-6 months before childbirth. The length of the new treatment episode had a median of 187 days (IQR 52-353 days). About half (51.5 %, 95 % CI 46.1-57.0 %) of new recipients of buprenorphine received treatment for at least six months. About one third (33.7 %, 95 % CI 28.2-39.2 %) had an interruption in buprenorphine supply (a gap between 14-60 days) within their new treatment episode.

We also explored the duration of buprenorphine treatment within subgroups by sociodemographic, clinical, and policy characteristics (Table 4). The buprenorphine treatment retention rate was lower among non-Hispanic Black birthing people (37.9 %) compared to that among non-Hispanic white birthing people (52.8 %). This difference in treatment retention was statistically significant in the adjusted logistical regression model with an OR of 0.32 (95 % CI 0.11-0.91) for non-Hispanic Black people compared to non-Hispanic white people, after accounting for other individual-level and state-level factors.

In the sensitivity analysis of a modified threshold for discontinuation of a treatment episode, defined as no buprenorphine supply on hand for 30 or more days (as compared to 60 or more days in the main analysis), the average duration of treatment episode was slightly shorter than that in the main analysis. Consequently, the retention rate was slightly lower (Appendix Table S5). However, the observed associations between individual demographic and geographic characteristic with retention rate were similar to those observed in the main analysis (Appendix Table S6).

4. Discussion

In a cohort of 1523 birthing people with opioid use disorder identified from a national privately insured cohort, one in three received buprenorphine treatment during pregnancy or postpartum periods. The use rate of buprenorphine treatment increased over time from 29.7 % in 2017 to 42.9 % in 2020. Among people who initiated buprenorphine treatment during pregnancy or postpartum periods, about half of them continued the treatment for at least six months and about one third had at least one interruption in buprenorphine receipt. Non-Hispanic Black and Hispanic birthing people in the sample had lower buprenorphine use compared to non-Hispanic white birthing people. Individuals with opioid use disorder (OUD) receiving buprenorphine had higher prevalence of mental/behavioral health services than individuals with OUD not receiving buprenorphine. Birthing people living in states with punitive policies related to substance use in pregnancy had the lowest use rate.

Despite strong evidence for the safety and efficacy of buprenorphine treatment during pregnancy and postpartum periods, our study identified low use rate and treatment duration of buprenorphine treatment during this time. Pregnant and postpartum people face multiple unique legal, social and structural barriers in accessing and continuing in

Table 2
Receipt of buprenorphine, overall and in subgroups of people by demographic and clinical characteristics, among pregnant and postpartum people with opioid use disorder in Optum data

	Birthing people with opioid use disorder in the study sample Number (a)	Use rate of buprenorphine during pregnancy or postpartum periods		Adjusted odds ratio (OR) for receiving any buprenorphine during pregnancy or postpartum periods [c] OR (95 % CI)		
		Number (b)	Percent (b/a)	Model 1	Model 2	Model 3
All	*1523*	*540*	*35.5 %*			
Age (in years)						
19-25	466	135	29.0 %	*Reference*	*Reference*	*Reference*
26-30	360	133	36.9 %	1.48 (1.06-2.07)	1.52 (1.07-2.15)	1.55 (1.10-2.20)
31-35	412	160	38.8 %	1.69 (1.23-2.33)	1.70 (1.22-2.39)	1.70 (1.21-2.38)
36-50	285	112	39.3 %	1.79 (1.26-2.56)	1.86 (1.28-2.70)	1.86 (1.28-2.70)
Education level						
High School Diploma or Less	456	161	35.3 %	*Reference*	*Reference*	*Reference*
Less than bachelor's degree	850	310	36.5 %	1.14 (0.85-1.53)	1.13 (0.84-1.52)	1.14 (0.85-1.53)
Bachelor's degree Plus	206	65	31.6 %	1.00 (0.64-1.55)	0.95 (0.61-1.50)	0.95 (0.60-1.49)
Race/ethnicity [b]						
Non-Hispanic Black	170	49	28.8 %	0.53 (0.35-0.80)	0.54 (0.35-0.81)	0.53 (0.35-0.81)
Hispanic	136	31	22.8 %	0.59 (0.36-0.95)	0.61 (0.37-0.98)	0.59 (0.37-0.96)
Non-Hispanic white	1195	451	37.7 %	*Reference*	*Reference*	*Reference*
Household Income [a]						
<$50K	624	224	35.9 %	0.98 (0.73-1.30)	0.96 (0.72-1.28)	0.96 (0.72-1.28)
$50K-$99K	435	168	38.6 %	*Reference*	*Reference*	*Reference*
$100K+	336	100	29.8 %	0.72 (0.51-1.01)	0.71 (0.51-1.01)	0.70 (0.50-0.99)
Childbirth year						
2017	431	128	29.7 %	*Reference*	*Reference*	*Reference*
2018	393	131	33.3 %	1.06 (0.76-1.49)	1.07 (0.76-1.50)	1.06 (0.75-1.50)
2019	373	141	37.8 %	1.36 (0.97-1.90)	1.36 (0.97-1.91)	1.35 (0.96-1.90)
2020	326	140	42.9 %	1.79 (1.26-2.52)	1.79 (1.26-2.54)	1.81 (1.27-2.56)
Mental and behavioral conditions [d]						
Externalizing disorders [e]	259	99	38.2 %	—	1.29 (0.93-1.78)	1.28 (0.93-1.77)
Mood disorders [f]	1091	396	36.3 %	—	1.11 (0.84-1.47)	1.11 (0.84-1.48)
PTSD	213	73	34.3 %	—	0.88 (0.62-1.27)	0.88 (0.61-1.26)
Physical conditions [d]						
Cancer	27	8	29.6 %	—	0.97 (0.38-2.43)	0.95 (0.38-2.38)
HCV infection	126	48	38.1 %	—	1.40 (0.90-2.17)	1.42 (0.91-2.20)
Substance dependence/abuse [d]						
Sedative	123	52	42.3 %	—	1.39 (0.87-2.22)	1.34 (0.84-2.16)
Cannabis	205	71	34.6 %	—	1.02 (0.67-1.53)	1.02 (0.68-1.54)
Cocaine	113	31	27.4 %	—	0.63 (0.36-1.09)	0.63 (0.36-1.10)
Whether residence state requires commercial insurers to provide coverage for medications for OUD [a]						
No	1215	426	35.1 %	—	—	*Reference*
Yes	209	73	34.9 %	—	—	1.03 (0.63-1.68)
Residence state's policy related to substance use in pregnancy [a]						
Punitive policy	66	15	22.7 %	—	—	0.33 (0.13-0.84)
Supportive policy	262	90	34.4 %	—	—	0.64 (0.31-1.32)
Mixed policies	1010	357	35.3 %	—	—	0.77 (0.41-1.46)
No policy	86	37	43.0 %	—	—	*Reference*

[a] 1306 people with complete information on all covariates were included in the regression analyses. People with missing values on each covariate were not included in the results for that covariate: missing education (n=11), missing income (n=128), missing residence state (n=99).

[b] Results for 22 Asian people were not included in the table due to small cell size.

[c] We fit two-level (individuals nested within states) logistic regressions on the binary outcome of receiving buprenorphine treatment during pregnancy and postpartum periods. As presented in the table, Model 1 included Individual sociodemographic factors, Model 2 further included individual clinical factors, and Model 3 further included state-level policy factors.

[d] We identified comorbid physical and mental/behavioral disorders documented in the 24-month observation time around childbirth. See Appendix for ICD codes used to identify these clinical conditions using claims data.

[e] Externalizing disorders: conduct disorder, ADHD

[f] Mood disorders: bipolar, depression, anxiety

Table 3
Initiation and duration of buprenorphine treatment, among pregnant and postpartum people with opioid use disorder who initiated buprenorphine treatment during pregnancy and postpartum period ("new recipients of buprenorphine") in Optum data

Initiation and duration measures	Among new buprenorphine users [a] Total N=324	
	N	Column percent (95 % CI)
Initiation time of new buprenorphine treatment episode[b]		
7-9 months *before* childbirth	104	32.1 (27.0-37.2) %
4-6 months *before* childbirth	70	21.6 (17.1-26.1) %
1-3 months *before* childbirth	53	16.4 (12.3-20.4) %
0-2 months *after* childbirth	27	8.3 (5.3-11.3) %
3-5 months *after* childbirth	28	8.6 (5.6-11.7) %
6-8 months *after* childbirth	18	5.6 (3.1-8.0) %
9-11 months *after* childbirth	24	7.4 (4.6-10.3) %
Duration of new buprenorphine treatment episode	Mean=224 days Median=187 days	SD=188 days IQR=52-353 days
Retention of the new buprenorphine treatment		
Yes (new treatment episode lasted longer than 180 days)	167	51.5 (46.1-57.0) %
No (new treatment episode lasted shorter than 180 days)	157	48.5 (43.0-53.9) %
Interruption within new treatment episode [c]		
Yes (there was a gap in buprenorphine supply between 14-60 days)	96	33.7 (28.2-39.2) %
No (there was no gap in buprenorphine supply longer than 14 days)	189	66.3 (60.8-71.8) %

[a] New recipients of buprenorphine: people who had no buprenorphine in the pre-conception period (10-12 months before childbirth date) and initiated buprenorphine during pregnancy (0-9 months before childbirth) or postpartum (0-12 months after childbirth) periods

[b] Treatment episode: We defined each person's new buprenorphine treatment episode as the date of the index fill until the first day of a gap where the patient had no buprenorphine supply for 60 or more days.

[c] Interruption was evaluated among n=285 (88 % of all new recipients of buprenorphine) those whose episode lasted for 16 days or longer.

substance use treatment (Faherty et al., 2020). Legal issues include the criminalization of opioid use during pregnancy and potential loss of child custody for birthing people with opioid use. State laws that conceptualize OUD as a criminal behavior instead of a chronic disease has been shown to prevent people from seeking evidence-based care, including MOUD (Faherty et al., 2020). Our finding that birthing people living in states with punitive policies related to substance use in pregnancy had the lowest use rate is supportive of the influence of the criminal justice environment on treatment access.

Social and structural barriers include stigma and a significant lack of specialty providers who are knowledgeable and comfortable in treating pregnant people with OUD (National Academies of Sciences Engineering and Medicine, 2019). Tailored substance treatment programs are considered to be especially needed and beneficial for pregnant and postpartum people with OUD, because they need careful monitoring when receiving medications for OUD due to changes in dose requirement for this special population (The American College of Obstetricians and Gynecologists, n.d.), and they may be more likely to achieve recovery through the counseling and referral services provided from these programs (Hadland et al., 2020). However, access to specialty provider and tailored programs is severely lacking for birthing people (Frazer et al., 2019; Patrick et al., 2019). Our current study is unable to measure some of the above-mentioned barriers. Further studies, perhaps using qualitative methods, are warranted to engage key community stakeholders, including patients, health care providers, and administrators or leadership at treatment facilities, to characterize the structural and social determinants of substance use treatment receipt for pregnant and postpartum people.

Non-Hispanic Black and Hispanic birthing people in our study sample had lower buprenorphine use rate compared to non-Hispanic white birthing people. Existing data on racial differences in access to substance use treatment are mixed. Data from the National Surveys on Drug Use and Health (Wu et al., 2016) and analysis using Medicare claims data (Barnett et al., 2023) suggest that racial minorities are treated less often for their OUD compared with white people, but a study based on the National Treatment Episode Data Base suggested that the odds of receiving opioid agonist treatment were significantly higher among Black and Hispanic patients than among white patients (Krawczyk et al., 2017). Stark racial disparities in maternal and infant health in the US have persisted for decades, and these disparities are symptoms of broader underlying social and economic inequities that are rooted in racism and discrimination (Petersen et al., 2019). A host of factors have been identified as contributors to the experience of worse standards of care and treatment outcomes, including a lack of culturally competent care, health care and insurance policies and regulations that influence accessibility, clinician attitudes and biases, and other systemic racism manifested in criminal justice and child welfare system policies and practices (Alegria et al., 2011; Schmidt et al., 2006). Examining disparities in access to buprenorphine can aid in the planning and execution of policies to promote evidence-based treatment across regions and populations affected by the opioid epidemic.

A high proportion of pregnant or postpartum people with OUD in our sample had co-occurring mental health conditions, such as depression and bipolar disorder. This finding suggests a need to improve coordination of mental health services and substance use treatment for pregnant and postpartum people. Care coordination is difficult because of the separation of mental and substance-use health care from each other and their greater separation from general health care. Complementary actions are needed from government agencies, insurers, and accrediting bodies to promote effective collaboration between mental health care, substance-use care, general health care, and other human service providers in coordinating the care of their patients (Zwarenstein et al., 2006).

Our study has several limitations. First, although our data source (Optum CDM) provides a national representative sample of privately insured people (Optum, 2017), the results from our study may not be generalized to publicly insured population or uninsured population. About 42 % of mothers were covered by Medicaid at the time of birth in

Table 4
Duration of buprenorphine treatment, in subgroups of people by demographic and geographic characteristics, among pregnant and postpartum people with opioid use disorder who initiated buprenorphine treatment during pregnancy and postpartum period ("new recipients of buprenorphine") in Optum data

	All new recipients of buprenorphine [a] Number (a)	Retained for treatment: duration >180 days [b]		
		number (b)	Percent (b/a, %)	Adjusted odds ratio (OR) for retainment [e] OR (95 % CI)
All	*324*	*167*	*51.5 %*	
Age (in years)				
19-25	96	41	42.7 %	*Reference*
26-30	89	50	56.2 %	1.64 (0.77-3.50)
31-35	78	39	50.0 %	1.31 (0.60-2.83)
36-50	61	37	60.7 %	1.98 (0.89-4.39)
Education level [c]				
High School Diploma or Less	96	52	54.2 %	*Reference*
Less than bachelor's degree	185	95	51.4 %	1.33 (0.68-2.62)
Bachelor's degree Plus	42	19	45.2 %	1.07 (0.39-2.92)
Race/ethnicity [d]				
Non-Hispanic Black	29	11	37.9 %	0.32 (0.11-0.91)
Hispanic	22	14	63.6 %	1.31 (0.42-4.04)
Non-Hispanic white	269	142	52.8 %	*Reference*
Household Income [c]				
<$50K	137	79	57.7 %	1.61 (0.84-3.06)
$50K-$99K	97	47	48.5 %	0.87 (0.40-1.90)
$100K+	53	25	47.2 %	*Reference*
Childbirth year				
2017	87	42	48.3 %	*Reference*
2018	75	37	49.3 %	1.01 (0.46-2.23)
2019	84	49	58.3 %	1.43 (0.68-3.00)
2020	78	39	50.0 %	0.95 (0.46-1.98)
Mental and behavioral conditions [f]				
Externalizing disorders [g]	53	26	49.1 %	1.07 (0.51-2.23)
Mood disorders [g]	245	120	49.0 %	0.78 (0.40-1.50)
PTSD	43	19	44.2 %	0.62 (0.26-1.48)
Physical condition [f]				
HCV infection	28	13	46.4 %	0.73 (0.28-1.90)
Substance dependence/ abuse [f]				
Sedative	34	13	38.2 %	0.63 (0.23-1.72)
Cannabis	51	27	52.9 %	1.52 (0.64-3.60)
Cocaine	25	14	56.0 %	1.96 (0.63-6.04)
Whether residence state requires commercial insurers to provide coverage for medications for OUD [c]				
No	244	132	54.1 %	*Reference*
Yes	54	25	46.3 %	0.79 (0.40-1.57)
Residence state's policy related to substance use in pregnancy [c,d]				
Supportive policy	54	26	48.1 %	0.48 (0.15-1.55)
Mixed policies	212	108	50.9 %	0.47 (0.16-1.35)
No policy	24	17	70.8 %	*Reference*

[a] New recipients of buprenorphine: people who had no buprenorphine in the pre-conception period (10-12 months before childbirth date) and initiated buprenorphine during pregnancy (0-9 months before childbirth) or postpartum (0-12 months after childbirth) periods

[b] Retention of treatment: new treatment episode lasted longer than 180 days

[c] People with missing values on each covariate were not included in the results for that covariate: 1 people with missing information on educational level; 37 with missing household income; 26 with missing residence state.

[d] Results for 4 Asian people were not included in the table due to small cell size. Results for 8 people who lived in states with punitive policy were not included in this table due to small cell size.

[e] We fit a two-level (individuals nested within states) logistic regression that included all covariates in the table.

[f] We identified comorbid physical and mental/behavioral disorders documented in the 24-month observation time around childbirth. See Appendix for ICD codes used to identify these clinical conditions using claims data.

[g] Externalizing disorders: conduct disorder, ADHD. Mood disorders: bipolar, depression, anxiety

2020 (KFF, n.d.), and prior research has established that the general Medicaid population encounters inordinate barriers to substance use treatment with longer wait times (Bishop et al., 2014; Cummings et al., 2014, 2013; Guerrero, 2013; Stuart et al., 2017). Second, our analysis on treatment duration measures was restricted to a small group of patients with new buprenorphine fills and limited by small sample size. Consequently, although we detected a signal of differences in treatment duration by demographic factors such as age and race/ethnicity, the estimates within demographic subgroups were imprecise with wide confidence intervals. It is also notable that this analysis focused on new buprenorphine fills for OUD treatment and did not consider long-term buprenorphine treatment that might be used for people with chronic pain disease such as cancer. Third, about 5 % of the target population were not included in the study sample due to missing information on race/ethnicity. In future analysis when individual's residential address and surname are available, prediction methodologies, such as Bayesian Improved Surname and Geocoding, can be utilized to integrate administrative data and estimate individual race/ethnicity (Elliott et al., 2008; Imai et al., 2022). Fourth, we relied on administrative claims during the 24-month observation period to identify diagnosis of clinical conditions, which may cause under-ascertainment and impact our ability to identify the true prevalence of each of condition in this cohort.

5. Conclusions

In a national privately insured sample of birthing people with opioid use disorder, about one in three people received recommended buprenorphine treatment during pregnancy or postpartum periods, and about half of the recipients of buprenorphine had a treatment episode longer than six months. The use rate was lower among Hispanic or Black people and in states with punitive policies around substance use in pregnancy.

For programs and policies aimed at improving access and quality of evidence-based treatment for opioid use disorder during pregnancy and the postpartum period, our findings suggest that these efforts should prioritize remedying existing demographic racial, and geographic inequities, removing legal barriers, and promoting coordination of mental health services and substance use treatment services.

Credit author statement

XW, MM, KK, and RR planned and designed the study. XW, JW, DR, and AC managed and analyzed the data. XW, MM, and ZM wrote the paper. All authors have approved the final article.

Declaration of Competing Interest

The authors have no relevant financial or non-financial interests to disclose.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dadr.2023.100206.

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