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## Disparities in opioid use disorder–related hospital use among postpartum Virginia Medicaid members

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## ABSTRACT

**Introduction:** The overdose crisis is increasingly revealing disparities in opioid use disorder (OUD) outcomes by race and ethnicity. Virginia, like other states, has witnessed drastic increases in overdose deaths. However, research has not described how the overdose crisis has impacted pregnant and postpartum Virginians. We report the prevalence of OUD-related hospital use during the first year postpartum among Virginia Medicaid members in the years preceding the COVID-19 pandemic. We secondarily assess how prenatal OUD treatment is associated with postpartum OUD-related hospital use.

**Methods:** This population-level retrospective cohort study used Virginia Medicaid claims data for live infant deliveries between July 2016 and June 2019. The primary outcome of OUD-related hospital use included overdose events, emergency department visits, and acute inpatient stays. Independent variables of interest were prenatal receipt of medication for OUD (MOUD) and receipt of non-MOUD treatment components in line with a comprehensive care approach (e.g., case management, behavioral health). Both descriptive and multivariate analyses were performed for all deliveries and stratified by White and Black non-Hispanic individuals to bring attention to the devastating impacts of the overdose crisis within communities of color.

**Results:** The study sample included 96,649 deliveries. Over a third were by Black birthing individuals ( $n = 34,283$ ). Prenatally, 2.5 % had evidence of OUD, which occurred more often among White (4 %) than Black (0.8 %) non-Hispanic birthing individuals. Postpartum OUD-related hospital use occurred in 10.7 % of deliveries with OUD, more commonly after deliveries by Black, non-Hispanic birthing individuals with OUD (16.5 %) than their White, non-Hispanic counterparts (9.7 %), and this disparity persisted in the multivariable analysis (Black AOR 1.64, 95 % CI 1.14–2.36). Postpartum OUD-related hospital events were less frequent for individuals receiving versus not receiving postpartum MOUD within 30 days prior to the event. Prenatal OUD treatment, including MOUD, was not associated with decreased odds of postpartum OUD-related hospital use in the race-stratified models.

**Conclusion:** Postpartum individuals with OUD are at high risk for mortality and morbidity, especially Black individuals not receiving MOUD after delivery. An urgent need remains to effectively address the systemic and structural drivers of racial disparities in transitions of OUD care through the one-year postpartum period.

### 1. Introduction

Addiction is a chronic disease that can manifest across the life span. Like other chronic diseases, such as diabetes and hypertension, addiction can extend into pregnancy and postpartum. Substance use disorders

(SUD) are becoming increasingly more prevalent in females (Ali et al., 2020; Gabrielson et al., 2020), and mortality related to drug and alcohol use has been rising more rapidly in females than in males (Woolf & Schoemaker, 2019). Consequently, substance use has become a leading cause of pregnancy-associated morbidity and mortality across the

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United States (Gemmill et al., 2019), with most deaths occurring during the one-year postpartum period (Goldman-Mellor & Margerison, 2019; Hall et al., 2020). In Utah and Colorado, opioids are involved in more deaths of postpartum individuals in the year after delivery than other causes (Metz et al., 2016; Smid et al., 2019). Further, drastic disparities in opioid use disorder (OUD) outcomes by race and ethnicity are increasingly being revealed, reflecting impacts of structural racism and social drivers of health that disproportionately impact people of color (ASAM, 2020). Black individuals now outpace White individuals in opioid overdose deaths (Furr-Holden et al., 2021) and unmet SUD treatment nationally (Martin et al., 2021). Not surprisingly, these racial disparities extend into pregnancy and postpartum. For example, Black pregnant (Peeler et al., 2020) and postpartum (Schiff et al., 2021) individuals in Massachusetts are significantly less likely to receive life-saving medication treatment for opioid use disorder (MOUD) than their White counterparts.

Virginia, like other states, has witnessed a 134 % increase in drug overdose deaths since 2015 (Ahmad et al., 2021), largely due to synthetic opioids like fentanyl (VDH, 2021). Given the generally higher rate of SUD prevalence and overdoses among uninsured and Medicaid populations (MACPAC, 2018), Virginia Department of Medical Assistance Services (DMAS), along with the governor and legislature, established the Addiction and Recovery Treatment Services (ARTS) benefit in April 2017. The ARTS benefit is a comprehensive Medicaid benefit package covering the full continuum of care as defined by the American Society of Addiction Medicine (ASAM, 2013). A core tenant of the ARTS benefit is to increase access to and utilization of MOUD, as MOUD is known to significantly reduce overdose risk and improve health outcomes (NIDA, 2020). Preliminary evaluations of ARTS indicate positive impacts in increasing MOUD access and improving health outcomes (Barnes et al., 2020; Cunningham et al., 2020). MOUD includes three Food and Drug Administration (FDA) approved medications for OUD: methadone, buprenorphine and naltrexone (SAMHSA, 2020). The ARTS benefit targets increasing access to MOUD and comprehensive support services (i.e., medical, psychiatric, behavioral health) by outpatient SUD programs. Additionally, a high priority population identified by DMAS in need of these targeted efforts is pregnant and parenting people given the unique challenges they face in utilizing effective SUD treatments as well as medical and psychosocial complexity. However, how the overdose crisis has impacted pregnant and postpartum Virginia Medicaid members during the transition to and initial stages of ARTS has not been described in the literature. Given variation that exists across states in OUD-related morbidity, mortality, and receipt of MOUD, reporting such state-level data focused on pregnant and postpartum people is crucial to guide timely public health interventions.

Thus, this study's primary objective is to report the prevalence of OUD-related hospital use (overdose events, emergency department (ED) visits, and acute inpatient stays) during the postpartum period from 2016 to 2019 among Virginia Medicaid members. The postpartum period has been identified as a period of particular vulnerability with high overdose rates among birthing individuals with OUD (Schiff et al., 2018). The secondary objective is to assess how prenatal treatment for OUD is associated with postpartum OUD-related hospital use; the main independent variables of interest focused on receipt of MOUD and comprehensive OUD treatment services during pregnancy in line with the unique context of the Virginia DMAS ARTS benefit. We stratify these results by White and Black non-Hispanic individuals to examine how the effects of prenatal treatment and other factors on postpartum OUD-related hospital use vary by race/ethnicity.

## 2. Methods

### 2.1. Data source and study sample

This population-level retrospective cohort study used Virginia Medicaid claims and enrollment data from Virginia DMAS for

individuals who delivered a live infant between July 2016 and June 2019. DMAS constructed a file identifying all deliveries covered by full or emergency Medicaid benefits, which also linked member IDs for the birthing individual and infants based on birth records from the Virginia Department of Health. This method allowed linkages to claims for all Medicaid covered services for the birthing individual and infants. The study used paid claims data to construct measures of diagnosed conditions, treatment, and service utilization used in the analysis (see below). The unit of analysis for the study is the delivery. Singleton births are included and treated as a single delivery and multiple gestations are treated as separate deliveries in this birthing individual-infant linked dataset. The study includes multiple deliveries from a single birthing individual (that is, having multiple pregnancies during the study period) and the study treats them as independent observations, with adjustments to standard errors and sensitivity analyses performed as discussed below. The Virginia Commonwealth University Institutional Review Board approved this study.

We restrict the sample to deliveries covered by full Medicaid benefits at the time of delivery, as emergency Medicaid covers only the hospital stay for the delivery and not care received prenatally or postpartum, to facilitate evaluation of prenatal OUD treatment support by the ARTS benefit, and to optimize consistency of available claims data through the perinatal period. Out of a total of 109,203 Medicaid-covered deliveries between July 2016 and June 2019, this study includes 96,649 who were covered by full Medicaid benefits at the time of delivery and by Virginia residents (to avoid missing claims data) (See Fig. 1).

Notably, we present all of our findings stratified by White and Black non-Hispanic individuals to bring further attention to the devastating impacts of the overdose crisis within communities of color. Given how little we know about within-group differences among Black individuals with OUD, this approach is warranted to reveal potential opportunities to bolster strengths and buffer against the systemic issues that disproportionately impact birthing individuals of color.

### 2.2. Outcome measures

The primary outcome was postpartum OUD-related hospital use by the birthing individual. This included overdose events, OUD-related ED visits and inpatient hospital stays. If an individual had a claim for at least one of these events during the 12 months after delivery, the study coded the index delivery as having the outcome. This study did not include in

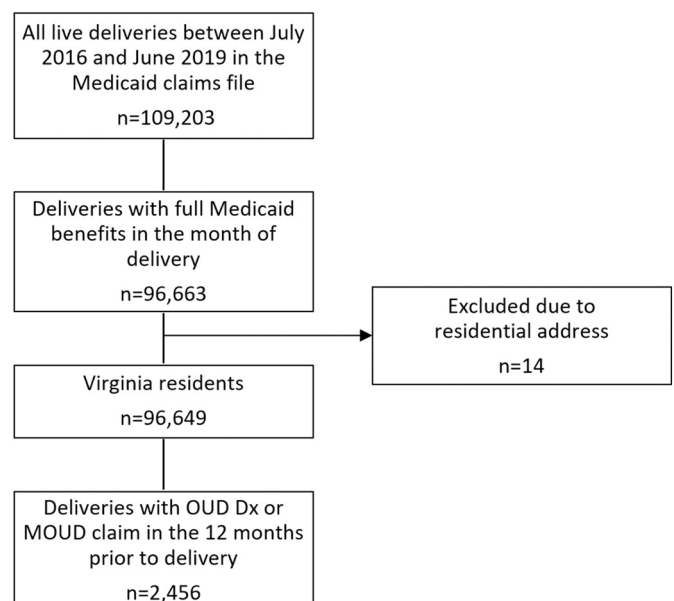


Fig. 1. Flow diagram of study sample.

our outcome overdose events that did not involve medical care with a Medicaid claim. Based on a validated method (Green et al., 2017), unique overdose events were identified by a member having a claim or group of claims with any overdose ICD-10 code (see Appendix) with at least one week separation from other overdose claims. OUD-related ED visits and inpatient stays were identified by a member having a claim or group of claims with an OUD ICD-10 diagnosis code (any primary or secondary diagnosis field; see Appendix), excluding during the two weeks before and after delivery (to mitigate conflation of the outcome by pregnancy-related hospital use). ICD-10 codes used to identify SUD and OUD diagnoses are based on codesets developed by the National Committee for Quality Assurance for claims-based measures of SUD quality of treatment (NCQA, 2020).

### 2.3. Predictors of postpartum OUD-related hospital use

The study extracted sample sociodemographic (e.g., age, race, urban/rural location), pregnancy, and OUD variables from Medicaid enrollment files and claims. Data are described for the full sample of live deliveries and stratified by race/ethnicity (Black, non-Hispanic vs. White, non-Hispanic). We defined race and ethnicity by member self-report on intake survey at the time of Virginia Medicaid enrollment (with no missing race/ethnicity values). The study included individuals self-identifying as race/ethnicity categories other than Black, non-Hispanic or White, non-Hispanic in the “Other” category. We also included individuals self-identifying as Hispanic ethnicity in the Other race/ethnicity category due to small numbers. Given the very small sample for this race/ethnicity subgroup, we do not present their data separately.

An indicator for whether the birthing individual had OUD in the 12 months prior to delivery (see Appendix) was constructed based on ICD-10 diagnosis codes for OUD (any primary or secondary diagnosis field) on any claim for health services use, or a claim for MOUD treatment (based on pharmacy claims for buprenorphine or naltrexone, and procedure codes for methadone treatment). Mental health conditions included having any claim with an ICD-10 code for a mental health diagnosis in the 12 months before delivery, such as anxiety, depression, and psychosis. Comorbid SUD included if individuals had claims with diagnosis codes for disorders related to alcohol, cocaine, stimulants, cannabinoids, and use of substances other than tobacco or opioids. Preterm birth was defined as delivery before 37-week gestation. The study captured Neonatal Abstinence Syndrome (NAS) diagnosis by Medicaid claims data for the infant. Other variables likely to be correlated with postpartum experiences that were extracted from claims included having 3 or more ED visits (all cause) in the 12 months prior to delivery and whether an overdose event occurred in the 12 months prior to delivery.

We also conducted a separate analysis of the subsample of 2456 deliveries in which the birthing individual had OUD in the 12 months prior to the delivery. For this sample, the study constructed a more detailed set of OUD treatment variables. We defined prenatal MOUD receipt as having any claim for MOUD within the 12 months before delivery, and defined MOUD use at the time of birth as having a MOUD claim within 45 days before delivery. If individuals had claims for both buprenorphine and methadone during the corresponding timeframe, the study coded them as using methadone (as transitioning to methadone is a more typical clinical scenario than a transition to buprenorphine). To further report on the utilization of comprehensive OUD treatment services (in addition to MOUD receipt) reimbursed by the ARTS benefit, we devised an OUD Treatment Comprehensiveness Index based on the work of Edwards et al. (2011). DMAS provided the study team with billing codes for all addiction treatment and recovery support services. Based on definitions of “core” and “wraparound” SUD treatment services from Edwards et al., a clinician researcher with experience in addiction medicine—in consultation with the study team, which included a senior advisor of the ARTS benefit—matched billing codes to these service

categories. The index included nine service categories: peer support, case management, provider assessment, behavioral health, medication management, drug monitoring, health screening, family therapy, and psychiatric evaluation. The appendix includes a list of the billing code descriptions for each of these categories. If a member had a claim for at least one service within its category during the 12 months prior to birth, we counted that as having received that service category. OUD diagnoses were required to be primary diagnosis for each billing code except for family therapy and psychiatric evaluation. For each delivery, the study calculated the OUD Treatment Comprehensiveness Index as the total number of service categories with at least one received service (range 0 to 9).

### 2.4. Analysis

For the primary study aim, descriptive analyses include estimating rates of OUD-related hospital use across the postpartum period, based on four time periods in the 12 months after delivery. Numerators are defined based on the outcome measure—OUD-related hospital use—while the denominators for the rates are defined based on the number of deliveries that had full Medicaid coverage at any time during the particular postpartum period to account for missing claims data (which varies across the perinatal period due to Medicaid members enrolling and disenrolling at various times). Separate estimates are included for White, non-Hispanic birthing individuals and Black, non-Hispanic birthing individuals. We report these unadjusted rates of OUD-related hospital use through the 12 months after delivery per 10,000 members with full Medicaid coverage by postpartum time period, both for the full sample of deliveries and for the subsample of deliveries in which the birthing individual had OUD in the 12 months prior to the delivery.

For the secondary study aim, the study team conducted logistic regression analysis to identify factors associated with the likelihood of an OUD-related hospital event in the postpartum period for all deliveries with full Medicaid benefits at the time of delivery. The independent variable included OUD diagnosis, and covariates included sociodemographic factors, as well as diagnosis and utilization variables for the birthing individual and infant described above. The study conducted separate logistic regression analyses for all deliveries; deliveries to Black, non-Hispanic birthing individuals; and deliveries to White, non-Hispanic birthing individuals. We conducted a second set of logistic regression analyses for the subset of deliveries in which the birthing individual had OUD in the 12 months prior to delivery. Independent variables included receipt of MOUD and the OUD Treatment Comprehensiveness Index, and covariates included those from the first regression set. The study also stratified these regressions by race. Odds ratios and 95 % confidence intervals are reported for all results. All models controlled for months of Medicaid enrollment during the year postpartum as well as year of delivery. We conducted analyses in SAS and STATA.

Notably, our a priori decision to stratify our models by race was influenced by the need to evaluate within-group differences in Black individuals with OUD to inform how to best target racial maternal health disparities. In doing so, we purposely did not assess an interaction term between our independent variables and race on our outcome, since comparison of coefficients (and confidence intervals) across stratified models achieves the same purpose as interaction terms. Stratified models are in effect fully interactive models, as they allow all parameters to vary by race, and therefore are better able to reflect differences that may be driven by structural racism and discrimination. By instead stratifying our models by race, we were able to qualitatively describe meaningful within-group differences to comprehensively advance our understanding of OUD morbidity and mortality within our communities (McGuire et al., 2006; Ward et al., 2019).

Last, we performed three sensitivity analyses to assess the robustness of our results to the unit of analysis and sample inclusion criteria. First, we tested the impact of defining the unit of analysis as the birthing

individual-infant dyad by collapsing multiple gestation deliveries as single delivery events. Second, we tested the impact of including multiple gestation pregnancies in the sample by restricting the sample to only singleton deliveries. Third, we tested the inclusion of repeated deliveries from a single birthing individual over the study period by restricting the sample to only the first delivery per birthing parent. When a multiple gestation pregnancy was a birthing individual's first delivery, we included all birthing individual-infant dyads. The study team repeated the three sensitivity analyses for the primary and secondary logistic regression analyses overall and stratified them by race/ethnicity.

### 3. Results

A total of 96,649 live deliveries with full Medicaid coverage occurred in Virginia from July 2016 through June 2019. More than a third of these deliveries were by Black, non-Hispanic birthing individuals ( $n = 34,283$ ) (Table 1). Prenatally, 2.5 % of deliveries had evidence of an OUD diagnosis, more often among White (4 %) than Black (0.8 %) birthing individuals. Birthing individuals for these deliveries with OUD ( $N = 2456$ ) were generally young (87.4 % aged <35), living in urban areas (73.7 %), and had a comorbid mental health condition such as depression or anxiety (60.7 %). More than a third of live deliveries with OUD (37.4 %) had 3 or more ED visits in the 12 months before delivery (Table 1). Preterm births were not uncommon among deliveries with OUD (30.5 %), especially among deliveries by Black, non-Hispanic birthing individuals (White, non-Hispanic 29.0 %, Black, non-Hispanic 41.2 %). Approximately half of infants had a diagnosis for NAS, 55.2 % for White, non-Hispanic and 46.7 % for Black, non-Hispanic birthing individuals. Prenatal overdose events occurred in 1.4 % of deliveries by White, non-Hispanic and 3.4 % by Black, non-Hispanic birthing individuals with OUD. More than half of White, non-Hispanic (62.2 %) and more than a third of Black, non-Hispanic (40.2 %) deliveries to birthing individuals with OUD received MOUD prenatally with fewer deliveries receiving MOUD at the time of delivery (White, non-Hispanic 50.2 %, Black, non-Hispanic 32.0 %). In addition to MOUD, comprehensive OUD treatment receipt (receipt of at least 1 OUD treatment service category) in the prenatal period was documented for 54.6 % of White, non-Hispanic and 45.4 % of Black, non-Hispanic deliveries; receipt of treatment components across at least 4 service categories occurred in 20.2 % of White, non-Hispanic and 15.1 % Black, non-Hispanic deliveries (Table 1).

For the primary study aim, postpartum OUD-related hospital use occurred in 0.6 % of all live deliveries (White, non-Hispanic 0.8 %, Black, non-Hispanic 0.3 %) (Table 1). Focusing on deliveries with prenatal evidence of OUD, postpartum OUD-related hospital use occurred in 10.7 % of deliveries, more commonly after deliveries by Black, non-Hispanic birthing individuals (16.5 %) than their White, non-Hispanic counterparts (9.7 %) (Table 1). The prevalence of postpartum OUD-related hospital use was more than twice as high for individuals receiving prenatal MOUD (11.8 %) than those not receiving prenatal MOUD (5.4 %).

OUD-related hospital events were less frequent across the postpartum period for individuals receiving MOUD versus not receiving MOUD within 30-days prior to the postpartum event, with most events occurring among individuals not receiving postpartum MOUD (Fig. 2). However, in the multivariable analyses, duration of prenatal MOUD use was not associated with decreased odds of postpartum OUD-related hospital use for deliveries by White nor Black birthing individuals. This lack of association in the race-stratified models remained for receipt of comprehensive OUD treatment in the prenatal period (Table 2).

Interestingly, in the multivariable analysis of all live deliveries, deliveries by Black, non-Hispanic birthing individuals demonstrated lower odds of postpartum OUD-related hospital use compared to deliveries by White, non-Hispanic birthing individuals (Black, non-Hispanic AOR 0.653, 95 % CI 0.511, 0.834). However, deliveries by Black, non-

Hispanic birthing individuals with an OUD diagnosis demonstrated eleven times the odds of postpartum OUD-related hospital use (AOR 10.992, 95 % CI 5.364, 22.526) compared to Black, non-Hispanic deliveries without an OUD diagnosis. This contrasts with the odds for postpartum OUD-related hospital use for deliveries by White, non-Hispanic birthing individuals with an OUD diagnosis, which were approximately double (AOR 2.323, 95 % CI 1.735, 3.109) compared to their non-OUD diagnosis counterparts (Table 2). Similarly, in the sample of deliveries with OUD, deliveries by Black, non-Hispanic birthing individuals demonstrated higher odds of postpartum OUD-related hospital use compared to deliveries by White, non-Hispanic birthing individuals (Black, non-Hispanic AOR 1.640, 95 % CI 1.139, 2.363) (Table 2).

Last, the study team performed three sensitivity analyses: (1) collapsing multiple gestation pregnancies to single deliveries ( $n = 95,045$ ), (2) Excluding multiple gestation pregnancies ( $n = 93,465$ ), and (3) Restricting sample to only first deliveries for birthing individuals ( $n = 87,595$ ). Estimates for main independent variables of interest remained consistent in all sensitivity analyses. Specifically, among the full sample of Medicaid-covered deliveries, the association between prenatal OUD diagnosis and postpartum OUD-related hospital use remained significant for the overall and stratified samples. The sensitivity tests of the secondary analyses remained consistent in that we found no association between prenatal OUD treatment and postpartum OUD-related hospital use among the sample with an OUD diagnosis and when stratified by race/ethnicity.

### 4. Discussion

The postpartum period is an important time in the life-course for the advancement of health and wellness for parenting people and their families, yet for birthing individuals with OUD, postpartum can be a highly vulnerable time. Our study highlights the prevalence of postpartum OUD-related hospital use among Medicaid members in Virginia in the years leading up to the COVID-19 pandemic. Our results mirror those from prior reports by other states (Hall et al., 2020; Schiff et al., 2018), highlighting how OUD continues to negatively impact pregnant and parenting people in the ongoing overdose crisis. Further, we identified a higher prevalence of these postpartum overdose events and OUD-related ED visits after deliveries among Black than White parenting people for deliveries with a prenatal OUD diagnosis. Effectively addressing the systemic and structural drivers of racial and ethnic disparities in pregnancy-associated mortality and morbidity continues to be a top public health priority. Our findings contribute to the literature that highlights the need for opioid, SUD, and other behavioral health conditions to be included in public health approaches aimed at eradicating health inequities among pregnant and postpartum people.

Postpartum OUD-related hospital use by birthing individuals was most prevalent in the late postpartum period. These findings reflect those from other states noting the 6- to 12-month period after pregnancy to be the highest risk for substance use-related deaths (Smid et al., 2019). In the overdose crisis, providers across specialties, especially OBGYN, are being called on to lead the implementation of evidence-based practices in screening and treatment for SUD (Smid et al., 2020). However, this call conflicts with the logistical reality of how perinatal care systems have historically operated, with a focus on increasing surveillance during pregnancy with limited continued support after delivery. For birthing individuals with OUD, these schisms between perinatal versus addiction care systems can generate gaps in the proper levels of psychosocial support, medical care, and evidence-based treatments. Recent ACOG postpartum care guidelines show promise in addressing this system failure for high-risk groups with their recommendation to tailor postpartum care to the individual needs of the patient, which may require ongoing multi-disciplinary care past the traditional 6-week window (ACOG, 2018). Published findings like ours bring to light the critical need to redesign how postpartum care is delivered to birthing individuals with OUD, specifically with sustained

**Table 1**

Characteristics of live deliveries for Virginia Medicaid members who had full Medicaid benefits in the month of delivery – by whether the birthing individual had OUD at any time in the 12 months prior to delivery – July 2016 to June 2019.

	All live deliveries	Deliveries for White, non-Hispanic birthing individuals	Deliveries for Black, non-Hispanic birthing individuals	All live deliveries with OUD	Deliveries for White, non-Hispanic birthing individuals with OUD	Deliveries for Black, non-Hispanic birthing individuals with OUD
<b>Total number</b>	96,649	52,520	34,283	2,456	2,110	291
<b>Sociodemographic variables</b>						
<b>Age</b>						
≤24 years	37.8%	38.2%	39.1%	18.0%	17.7%	19.6%
25-34	50.9%	50.2%	51.2%	69.3%	69.9%	65.3%
35 or older	11.3%	11.6%	9.7%	12.6%	12.5%	15.1%
<b>Residence type</b>						
Urban	84.8%	81.2%	87.8%	73.7%	71.5%	87.3%
Rural	15.2%	18.8%	12.2%	26.3%	28.5%	12.7%
<b>Mental health condition</b>	75.5%	75.3%	72.2%	60.7%	59.2%	68.4%
<b>Pregnancy variables</b>						
<b>Type of delivery</b>						
Cesarean	28.7%	27.4%	30.8%	34.9%	34.4%	40.9%
Vaginal	56.9%	58.0%	55.6%	57.1%	57.8%	50.5%
Undetermined	14.4%	14.5%	13.7%	8.0%	7.9%	8.6%
<b>3 or more ED visits in the 12 months before delivery</b>	23.2%	19.1%	32.1%	37.4%	35.6%	52.6%
<b>Preterm birth</b>	20.1%	17.8%	24.8%	30.5%	29.0%	41.2%
<b>Infant NAS diagnosis</b>	3.3%	4.4%	2.2%	54.2%	55.2%	46.7%
<b>OUD and SUD variables</b>						
<b>OUD-related hospital use in postpartum period</b>	0.6%	0.8%	0.3%	10.7%	9.7%	16.5%
<b>Evidence of OUD in 12 months prior to delivery</b>						



No OUD Dx or MOUD claim	97.5%	96.0%	99.2%	--	--	--
ODU Dx and MOUD claim	1.3%	2.5%	0.4%	--	--	--
ODU Dx with no MOUD claim	1.0%	1.5%	0.5%	--	--	--
MOUD claim with no OUD DX	0.2%	0.0%	0.0%			
<b>Overdose event in the 12 months before delivery</b>	0.05%	0.06%	0.05%	1.6%	1.4%	3.4%
<b>Co-morbid substance use disorder diagnosis</b>	9.1%	10.6%	8.5%	88.0%	88.1%	88.0%
<b>Any MOUD claim in 12 months prior to birth</b>						
Buprenorphine only	--	--	--	44.4%	47.2%	26.5%
Any Methadone	--	--	--	15.0%	15.0%	13.8%
None	--	--	--	40.6%	37.8%	59.8%
<b>MOUD receipt at delivery</b>	--	--	--			
Buprenorphine				35.2%	37.7%	20.3%
Methadone	--	--	--	12.6%	12.5%	11.7%
None	--	--	--	52.2%	49.8%	68.0%
<b>ODU Treatment Comprehensiveness Index (0-9)</b>						
0	--	--	--	46.6%	45.4%	54.6%
1	--	--	--	13.8%	13.6%	14.8%
2	--	--	--	11.2%	11.6%	8.6%
3	--	--	--	8.9%	9.2%	6.9%
4 or more	--	--	--	19.5%	20.2%	15.1%

support and personalized approaches (Martin & Parlier-Ahmad, 2021), through at least one year after delivery, as well as with appropriate reimbursement from payers for integrated, comprehensive care models.

In line with methods from studies using similar data sources (Lynch et al., 2021; Nielsen et al., 2019), we present our results both for the full sample of deliveries and for those with evidence of OUD in the prenatal period. In doing so, we unveil a significant disparity in the prevalence of postpartum OUD-related hospital use; deliveries by Black, non-Hispanic birthing individuals demonstrate a lower prevalence compared to their White, non-Hispanic counterparts in the overall full sample, but a much higher prevalence of postpartum OUD-related hospital use exists among Black, non-Hispanic birthing individuals who had been diagnosed with OUD prior to delivery. One possible explanation for our finding is that prenatal OUD is underdiagnosed and undertreated among Black, non-Hispanic birthing individuals to a greater extent than among White, non-Hispanic birthing individuals. Across pregnant and nonpregnant samples, OUD has been reported to be more prevalent among White than Black populations (Martin et al., 2019). Importantly, having a prenatal OUD diagnosis in a billing data source, like ours, necessitates that the patient presented for medical care for an OUD-related reason (e.g., OUD treatment, overdose) and/or disclosed to their provider their substance use; not surprisingly, a third of birthing individuals with an SUD do not receive a diagnosis during pregnancy (Lynch et al., 2021). Many reasons play a role in why pregnant individuals may not present to care for their opioid use during pregnancy, such as fear of discrimination due to their

addiction and punitive child welfare reporting policies (Frazer et al., 2019; Schempf & Strobino, 2009; Stone, 2015). These barriers to disclosure and treatment-seeking can be further amplified for Black birthing individuals due to systemic and structural racism (Komaromy et al., 2021; Santoro & Santoro, 2018), such as in the context of prior patient experiences with criminalization due to drug use (Poland et al., 1993) and provider bias (Mays et al., 2017). Thus, the degree of underdiagnosing OUD may be greater for our deliveries by Black than White birthing individuals. The advancement of systems that support nonjudgmental, evidence-based substance use screening and treatment linkage approaches tailored for birthing individuals of color are not only urgently needed (Terplan & Minkoff, 2017) but also could serve as a potentially effective avenue to eradicate racial disparities in pregnancy-associated mortality.

Additionally, our finding of a higher prevalence of postpartum OUD-related hospital use among Black, non-Hispanic than White, non-Hispanic deliveries with OUD could be a reflection of evolving trends in OUD morbidity and mortality. The opioid epidemic, which once disproportionately impacted White populations, has shifted, now with opioid-related deaths among Black individuals superseding those among White individuals (Furr-Holden et al., 2021). Prior studies have reported higher rates of OUD-related hospitalizations among White than Black postpartum patients, largely using data from prior to 2014 (Kern-Goldberger et al., 2020; Wen et al., 2019). In a recent study by Furr-Holden et al., opioid overdose deaths in the United States decreased

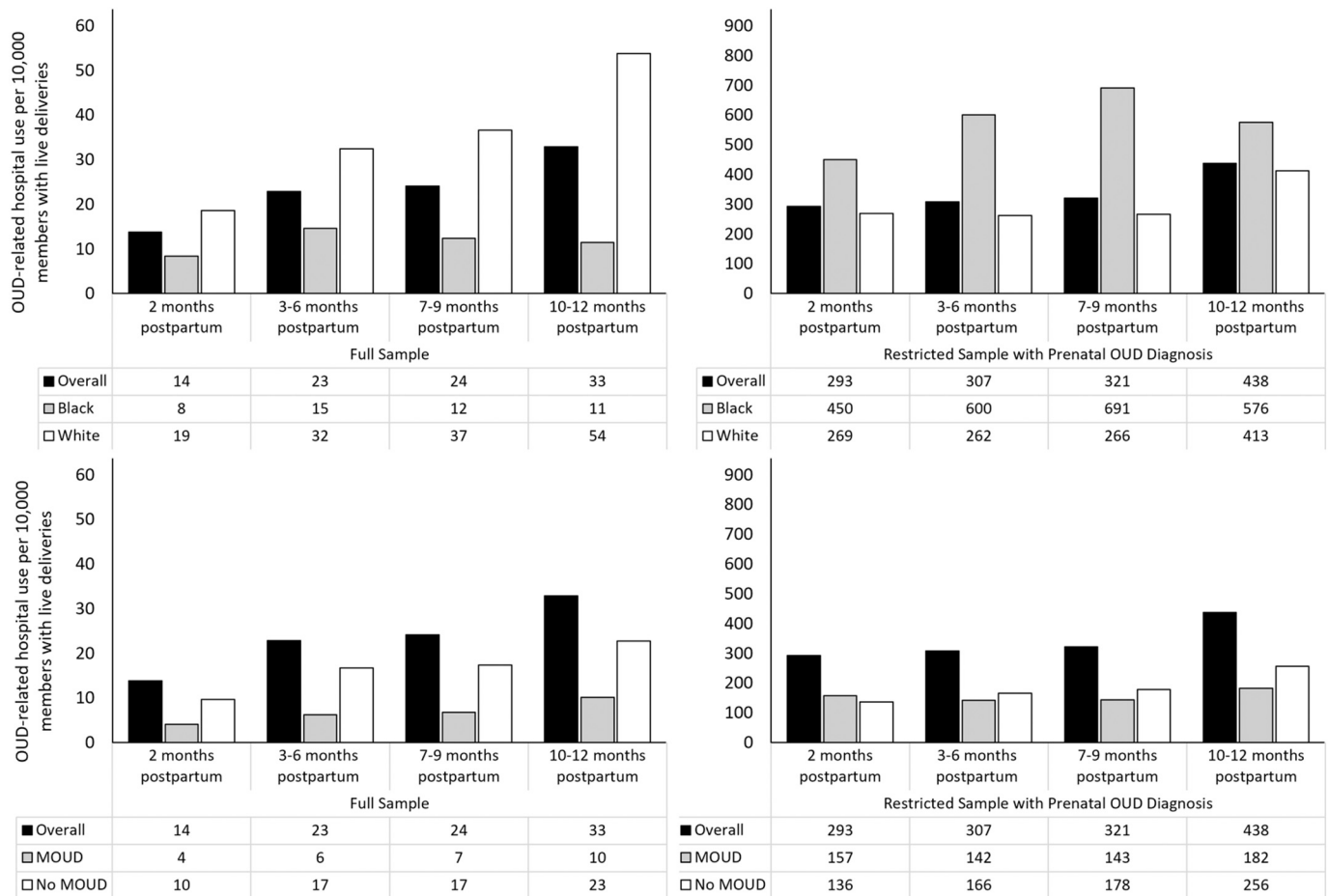


Fig. 2. OUD-related hospital use during the postpartum period by Virginia Medicaid members from July 2016 through June 2019.

for White individuals between 2016 and 2018, but the significant, rapid acceleration in opioid overdose deaths that Black individuals started witnessing in 2012 continued to persist through 2018 (Furr-Holden et al., 2021). With our study timeframe of 2016 through 2019, our finding of a racial disparity in postpartum OUD-related hospital use among the OUD diagnosis sample may represent how the opioid epidemic that is now increasingly harming people of color is also extending into the perinatal period. As research advances the evidence base for targeting the overdose crisis, it must incorporate a life-course perspective (Cleveland et al., 2020) to ensure that pregnant and postpartum populations, especially those within communities of color, are not excluded from emerging public health initiatives.

Postpartum OUD-related hospital use was rare among individuals with a recent MOUD claim through the year after delivery. MOUD is highly effective at reducing hospitalization (Ahrens et al., 2021) and overdose risk in nonpregnant populations (Wakeman et al., 2020) as well as during pregnancy and postpartum (Krans et al., 2021). In our sample, duration of MOUD receipt during pregnancy was not associated with a reduced risk of postpartum OUD-related hospital use, contrary to findings from a recent study of Pennsylvania Medicaid members from 2009 to 2017 (Krans et al., 2021). This discrepancy may be due to our smaller sample size, a tradeoff to our selection of the most recent study timeframe available in our dataset. Nonetheless, we found MOUD use to be approximately 20 % less common for deliveries by Black than White, non-Hispanic birthing individuals with OUD. This racial disparity in prenatal MOUD utilization is consistent with reports from other states (Krans et al., 2019; Peeler et al., 2020; Schiff et al., 2020). These studies have also highlighted how Black birthing individuals are less likely to continue MOUD through one year after delivery than their White

counterparts (Schiff et al., 2021). Further, we found that fewer deliveries by Black, non-Hispanic birthing individuals received comprehensive OUD treatment services prenatally in addition to MOUD through the Virginia DMAS ARTS benefit. These disparities across the OUD treatment cascade may reflect disproportionate levels of stigma related to engaging in OUD treatment experienced by Black compared to White individuals, combined with the lag commonly seen in the uptake of new treatment component options by people of color (Schuler et al., 2021) due to the persistence of racism in health systems (Entress, 2021). Overall, more work needs to elucidate bias-free, person-centered approaches to increase OUD treatment utilization beyond the pregnancy window, to encompass the entire postpartum period and beyond. These future investigations need to be inclusive of provider, system, and societal factors impacting OUD postpartum, such as racial discrimination in health care, punitive policies against pregnant people who use drugs, and the role of child welfare.

While we utilized data that are by far the most extensive and detailed patient-level data available for Virginia specific to SUD, our study findings should be interpreted within the inherent limitations of data from billing databases not originally developed for research. Medicaid claims capture all SUD-related diagnoses and treatment services that providers bill to Medicaid. However, some SUD recovery services are not paid for by Medicaid, such as self-help groups and counseling services sponsored by nonprofit organizations, limiting our generalizability. Similarly, overdose events for which the member received medical care is captured in our outcome; we do not capture overdoses where the member did not receive medical care (e.g., in the field). Further, some people with SUD do not seek medical care, and when they do, they may not disclose their substance use, leading to underdiagnosis of SUD by a

**Table 2**

Multivariable analysis of factors associated with postpartum OUD-related hospital use among Virginia Medicaid members with live deliveries – by having an OUD diagnosis in 12 months prior to delivery – July 2016 to June 2019<sup>a</sup>.

	All live deliveries	Deliveries for White, non-Hispanic birthing individuals	Deliveries for Black, non-Hispanic birthing individuals	All live deliveries with OUD	Deliveries for White, non-Hispanic birthing individuals with OUD	Deliveries for Black, non-Hispanic birthing individuals with OUD
<b>Total number</b>	<b>96,649</b>	<b>52,520</b>	<b>34,283</b>	<b>2,456</b>	<b>2,110</b>	<b>291</b>
<b>Sociodemographic variables</b>						
<b>Age</b>						
≤24 years	0.793 (0.633, 0.994)	0.786 (0.602, 1.025)	0.826 (0.520, 1.310)	0.786 (0.538, 1.146)	0.761 (0.492, 1.177)	.891 (.355, 2.235)
25-34	1	1	1	1	1	1
35 or older	.992 (.743, 1.324)	0.982 (0.710, 1.356)	1.157 (.581, 2.304)	1.028 (0.701, 1.506)	1.177 (0.774, 1.796)	0.664 (0.266, 1.653)
<b>Race</b>						
White, non-Hispanic	1	--	--	1	--	--
Black, non-Hispanic	0.653 (0.511, 0.834)	--	--	1.640 (1.139, 2.363)	--	--
Other	0.950 (0.612, 1.476)	--	--	2.399 (1.180, 4.879)	--	--
<b>Residence type</b>						
Urban	1	1	1	1	1	1
Rural	0.576 (0.448, 0.740)	0.586 (0.447, 0.768)	.619 (.300, 1.277)	0.605 (0.429, 0.853)	0.662 (0.461, 0.952)	0.213 (0.034, 1.330)
<b>Mental health condition</b>						
Yes	.903 (.740, 1.101)	.894 (.711, 1.125)	.927 (.584, 1.471)	.916 (.685, 1.222)	.866 (.626, 1.197)	1.138 (0.493, 2.263)
No	1	1	1	1	1	1
<b>Pregnancy variables</b>						
<b>Type of delivery</b>						
Cesarean	1.178 (0.967, 1.434)	1.089 (0.867, 1.369)	1.512 (.971, 2.355)	1.208 (0.905, 1.611)	1.184 (0.852, 1.646)	1.459 (0.701, 3.038)
Vaginal	1	1	1	1	1	1
Undetermined	1.078 (0.777, 1.497)	0.924 (0.620, 1.376)	1.469 (.773, 2.792)	.883 (0.515, 1.514)	0.768 (0.401, 1.470)	1.509 (.433, 5.263)
<b>3 or more ED visits in the 12 months before delivery</b>						
Yes	1.526 (1.255, 1.855)	1.571 (1.256, 1.916)	1.649 (1.065, 2.553)	1.823 (1.367, 2.431)	2.051 (1.493, 2.816)	1.444 (0.647, 3.218)



No	1	1	1	1	1	1
<b>Preterm birth</b>						
Yes	1.371(1.113, 1.665)	1.328 (1.059, 1.665)	1.337 (0.879, 2.036)	1.496 (1.130, 1.980)	1.418 (1.029, 1.953)	1.342 (0.675, 2.667)
No	1	1	1	1	1	1
<b>Infant NAS diagnosis</b>						
Yes	1.876 (1.468, 2.396)	1.685 (1.292, 2.199)	3.035 (1.692, 5.445)	1.527 (1.134, 2.058)	1.574 (1.123, 2.205)	1.749 (0.779, 3.924)
No	1	1	1	1	1	1
<b>SUD variables prior to delivery</b>						
<b>ODD diagnosis in 12 months prior to delivery</b>						
No OUD Dx or MOUD claim	1	1	1	--	--	--
ODD Dx and MOUD claim	3.156 (2.370, 4.202)	2.323 (1.735, 3.109)	10.992 (5.364, 22.526)	--	--	--
ODD Dx with no MOUD claim	3.004 (2.212, 4.079)	1.940 (1.385, 2.718)	11.609 (6.041, 21.308)	--	--	--
<b>Overdose event in the 12 months before delivery</b>						
Yes	1.963 (.905, 4.258)	2.537 (1.036, 6.212)	0.802 (0.127, 5.081)	1.464 (0.630, 3.402)	1.959 (.763, 5.024)	0.418 (0.063, 2.776)
No	1	1	1	1	1	1
<b>Co-morbid SUD in 12 months prior to delivery</b>						
Yes	19.722 (14.547, 26.739)	28.434 (19.226, 42.051)	6.774 (3.899, 11.769)	--	--	--
No	1	1	1	--	--	--
<b>Co-morbid substance use disorder diagnosis</b>						
Yes	--	--	--	7.837 (2.857, 21.501)	7.767 (2.436, 24.762)	7.999 (0.864, 74.029)
No	--	--	--	1	1	1
<b>Prenatal OUD treatment variables</b>						
<b>MOUD claim in 12 months prior to birth</b>						
None	--	--	--	1	1	1
1-4 months	--	--	--	1.478 (1.024, 2.134)	1.137 (0.897, 2.095)	1.623 (0.669, 3.936)
5-8 months	--	--	--	1.132 (0.715, 1.794)	1.166 (0.703, 1.934)	0.777 (0.151, 3.991)
9-12 months	--	--	--	1.326 (0.804, 2.186)	1.230 (0.701, 2.132)	2.941 (0.565, 15.398)
<b>ODD Treatment Comprehensive Index (0-9)</b>						
0	--	--	--	1	1	1
1	--	--	--	.832 (0.536, 1.292)	.875 (0.527, 1.452)	1.046 (0.388, 2.819)
2	--	--	--	.802 (0.498, 1.291)	.915 (0.537, 1.559)	.552 (0.154, 1.987)
3	--	--	--	.941 (0.560, 1.582)	1.156 (0.662, 2.020)	0.297 (0.059, 1.507)
4 or more	--	--	--	.963 (0.644, 1.442)	1.147 (0.736, 1.790)	0.377 (0.104, 1.363)

<sup>a</sup> Models control for number of months enrolled in Medicaid postpartum and year of delivery.

health care provider (and thus lack of ICD-10 code in the Medicaid billing database). Yet Medicaid claims data encompass the most complete information on SUD treatment outcomes that are typically unavailable in other sources, including those that do account for lack of clinician SUD diagnosis, such as the National Survey on Drug Use and Health (SAMHSA, 2019). In addition, results from this study may not generalize to Medicaid members in other states, nor individuals with non-Medicaid insurance or no insurance. Specifically, many Medicaid members disenroll or have lapses in their coverage due to loss of eligibility, relocations outside of the state, or other reasons. Although the study included postpartum Medicaid enrollment as a covariate in all multivariable models, the study did not observe care utilization that occurs during these lapses of coverage. Last, the observational study design precludes our ability to fully assess causation between treatment variables and OUD outcomes.

OUD-related hospital use during the postpartum period has been rapidly increasing (Kern-Goldberger et al., 2020), disproportionately among Medicaid members and populations living in impoverished areas (Wen et al., 2019). Our results indicate that OUD is likely substantially underdiagnosed in the prenatal period, disproportionately among Black birthing individuals. This differential may be masking important racial disparities in health outcomes related to OUD, such as postpartum overdose and hospitalizations, and further exacerbating OUD treatment disparities between Black and White birthing individuals. Prioritizing approaches to increase MOUD utilization, especially during pregnancy and postpartum, is of utmost importance. Bold and decisive action is urgently needed to eradicate barriers to long-term MOUD receipt for all, such as MOUD insurance coverage (Bachireddy & Terplan, 2021), addiction stigma, and systemic and structural racism. Without such comprehensive interventions, these significant health disparities will continue, especially for people of color and postpartum individuals.

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Caitlin E. Martin: Conceptualization, Funding acquisition, Investigation; Methodology, Supervision, Project administration; Roles/Writing - original draft; Writing - Review & Editing

Erin Britton: Conceptualization; Data curation; Formal analysis; Methodology; Validation; Visualization; Writing - review & editing

Hannah Shadowen: Data curation; Formal analysis; Visualization; Writing - review & editing

Chethan Bachireddy: Resources; Writing - review & editing

Ashley Harrell: Methodology; Resources; Writing - review & editing

Peter Cunningham: Conceptualization, Funding acquisition, Investigation; Methodology, Supervision, Project administration; Roles/Writing - original draft; Writing - Review & Editing

## Declaration of competing interest

None.

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