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Drivers of variation in postpartum opioid prescribing across hospitals participating in a statewide maternity care quality collaborative

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Abstract

Background: We describe variation in postpartum opioid prescribing across a statewide quality collaborative and assess the proportion due to practitioner and hospital characteristics.

Methods: We assessed postpartum prescribing data from nulliparous, term, singleton, vertex births between January 2020 and June 2021 included in the clinical registry of a statewide obstetric quality collaborative funded by Blue Cross Blue Shield of Michigan. Data were summarized using descriptive statistics. Mixed effect logistic regression and linear models adjusted for patient characteristics and assessed practitioner- and hospital-level predictors of receiving a postpartum opioid prescription and prescription size. Relative contributions of practitioner and hospital characteristics were assessed using the intraclass correlation coefficient.

Results: Of 40,589 patients birthing at 68 hospitals, 3.0% (872/29,412) received an opioid prescription after vaginal birth and 87.8% (9812/11,177) received one after cesarean birth, with high variation across hospitals. In adjusted models, the strongest patient-level predictors of receiving a prescription were cesarean birth (aOR 899.1, 95% CI 752.8–1066.7) and third−/fourth-degree perineal laceration (aOR 25.7, 95% CI 17.4–37.9). Receiving care from a certified nurse-midwife (aOR 0.63, 95% CI 0.48–0.82) or family medicine physician (aOR 0.60, 95%CI 0.39–0.91) was associated with lower prescribing rates. Hospital-level predictors included receiving care at hospitals with <500 annual births (aOR 4.07, 95% CI 1.61–15.0). A positive safety culture was associated with lower prescribing rates (aOR 0.37, 95% CI 0.15–0.88). Much of the variation in postpartum prescribing was attributable to practitioners and hospitals (prescription receipt: practitioners 25.1%, hospitals 12.1%; prescription size: practitioners 5.4%, hospitals: 52.2%).

Discussion: Variation in postpartum opioid prescribing after birth is high and driven largely by practitioner- and hospital-level factors. Opioid stewardship

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efforts targeted at both the practitioner and hospital level may be effective for reducing opioid prescribing harms.

KEYWORDS
cesarean birth, dilation and curettage, pain management, quality improvement, vaginal birth

1 | INTRODUCTION

Unexplained and unwarranted variation in healthcare delivery has been identified as a target for quality improvement.[1,2] This principle has been commonly applied in maternity care to address critical issues such as the cesarean birth rate, use of episiotomy, and planned childbirth before 39 weeks of gestational age.[3–5] Identifying this variation is the first step in increasing adherence to evidence-based practices and improving the quality of care for all birthing patients and their infants.

Postpartum pain management—including opioid prescribing—is another prevalent, critical, but potentially harmful intervention in pregnancy with significant variation in practice. While opioid prescribing after childbirth (whether vaginal or cesarean) is essentially nonexistent in European countries, many postpartum patients in the United States will fill an opioid prescription after birth.[6,7] Estimates from national claims data demonstrate that 30% of patients after vaginal birth and 75% after cesarean birth fill at least one opioid prescription.[7–9] These prescriptions are not without risk. As many as one in 75 postpartum patients who fill an opioid prescription develop new persistent opioid use (persistent opioid fills) in the year after childbirth.[7,10] Thus, high-quality pain control that minimizes the potential harms of opioid prescribing after birth is critical for helping postpartum patients successfully navigate childbirth recovery and the transition to parenthood.

Prior work demonstrates significant variation in postpartum opioid prescribing rates and prescription size across regions, hospitals, and practitioners.[11] While these studies serve as an important signal of potentially inappropriate variation in prescribing, they have been performed in insurance claims databases, which may lack nuanced assessment of individual patient factors such as complications at the time of childbirth, comorbidities, or contextual factors such as culture of the labor unit. In addition, questions of opioid use after birth have never been asked in a standardized patient population. Nulliparous, term, singleton, vertex (NTSV) patients are often used for comparisons of quality measures across practitioners and hospitals, as these patients are at lower risk of maternal complications during labor and delivery.[12] Thus, we sought to describe opioid prescribing practices across hospitals and practitioners for NTSV patients cared for by hospitals participating in a statewide quality collaborative, to identify opportunities for quality improvement initiatives focused on opioid stewardship.

2 | METHODS

2.1 | Study design

We performed a retrospective cohort study using detailed registry data obtained by chart abstraction from 68 hospitals participating in a statewide obstetrics quality collaborative focused on reduction of the NTSV cesarean birth rate. The quality collaborative began collecting data on opioid prescribing in 2020; thus, we included all patients who underwent childbirth from January 2020 to June 2021. Our institution's Institutional Review Board reviewed this study and deemed it exempt from formal review and patient consent because the data set was deidentified. This cohort study followed recommended reporting guidelines as outlined by the STROBE guidelines.

2.2 | Data source

The obstetrics registry includes a sample of each hospital's annual delivery volume of NTSV patients. Hospitals with <3500 annual births submit all NTSV births to the registry. Hospitals with ≥3500 annual births submit the first 100 consecutive NTSV births per month. All data are obtained by trained clinical abstractors and are collected through 42 days after birth.

2.3 | Population

For this analysis, we identified all NTSV patients with a live birth, aged 12–55. If patients had multiple births during the study period, only the first was included. Patients who had an index hospitalization length of stay of more than 7 days, underwent surgery within 6 weeks postpartum, or were currently receiving treatment for opioid use disorders were excluded, because their postpartum course was considered different from routine care. Patients with a history of substance use without evidence of

treatment with medication for opioid use disorder were not excluded.[7]

2.4 | Exposure

Childbirth in the population of interest was the primary exposure. We evaluated vaginal birth (including spontaneous and operative birth) and cesarean birth separately, given documented differences in prescribing rates and prescription sizes.[7,8] We also included detailed characteristics of birth, including birth complications (e.g., fourth-degree laceration and postpartum hemorrhage) and maternal morbidity procedures (e.g., blood transfusion, hysterectomy, and manual removal of the placenta) to provide greater detail on factors that might influence patients' postpartum recovery.

2.5 | Outcomes

The two primary outcomes of this study were the individual hospital rates of postpartum opioid prescribing after vaginal birth and cesarean birth calculated after adjusting for patient-, practitioner-, and hospital-level characteristics using mixed effect regression models. We defined postpartum opioid prescriptions as those prescribed at the time of discharge from the birth hospitalization. Opioid prescription data were abstracted using the same methods as other registry variables. Secondary outcomes were also assessed separately for vaginal and cesarean birth and included average oral morphine equivalents prescribed per patient for each hospital (OMEs, a standardized measure that includes the number of pills prescribed times the strength of the medication) and per hospital. Finally, we assessed the patient-, practitioner-, and hospital-level factors most associated with opioid prescribing practices.

2.6 | Covariates

Adjusted models accounted for patient-, practitioner-, and hospital-level factors known to affect postpartum opioid prescribing, including maternal demographics (e.g., age, race, and payer type); maternal comorbidities (e.g., prepregnancy diabetes and chronic hypertension); and maternal substance use and abuse (e.g., tobacco and alcohol).[13] These factors may influence opioid prescribing through a variety of pathways, including increased complexity of peripartum care, differing experience of pain management, and increased complexity of birth and recovery. Although all conditions potentially associated with increased pain were not available in our data set (e.g., sickle cell disease), we included opioid use in pregnancy as a proxy for complex pain.[7,8,14] Of note, race was included as an important social construct through which pain and opioid prescribing may be influenced by inequitable treatment and racism, as there are clear disparities noted in the obstetric literature on assessment and management of pain in pregnant and postpartum people of color.[15] We recognize that race is not a biologic construct, and include it as an exploratory assessment of inequitable treatment.[16] Of note, the method of collecting race data varied across hospital settings, with only some institutions using self-reported race. All maternal conditions were obtained from predefined flags in the registry data abstracted from the current prenatal record for that birth. We also included the Social Deprivation Index (SDI) to quantify individuals' socioeconomic environment and examine the relationship between environmental social determinants of health and health outcomes. The index is a composite measure that includes seven demographic characteristics collected in the American Community Survey, including income, education, employment, housing, household characteristics, transportation, and demographics. We matched individuals' zip codes to zip code tabulation area (ZCTA) SDI measures using a cross-walk to determine zip-code-level SDI.[17]

Practitioner-level characteristics were obtained by linking National Provider Identifier records to the Centers for Medicare & Medicaid Services' National Plan and Provider Enumeration System downloadable file.[18] Practitioner characteristics included gender and specialty (e.g., obstetrician–gynecologist, family medicine physician, advanced practice practitioners [certified nurse midwives, nurse practitioners]). Hospital-level characteristics were obtained from the American Hospital Association Annual Survey database and included obstetric level of care (1, 2, or 3)[19]; number of annual births; hospital teaching status (sites with at least one Accreditation Council for Graduate Medical Education accredited program)[20]; and hospital governing body (e.g., not-for-profit, for-profit). We also included the hospital's score on the patient safety domain of the Labor Culture Survey, a 10-min survey administered to evaluate the beliefs and attitudes of healthcare professionals and clinicians caring for laboring patients.[21] Survey results can be used to guide education and quality improvement efforts within the hospital. Hospitals in the quality collaborative voluntarily completed the Labor Culture Survey in 2021 as part of a pay for performance program. The patient safety subscale comprises eight questions that focus on team communication, patient advocacy, psychological safety to speak up, and hospital leadership support for changes to promote

vaginal birth and reduce unnecessary cesareans.[21] Each hospital's score on this domain was used as a proxy for its culture of general engagement in quality improvement activities related to maternity care initiatives.

2.7 | Statistical analysis

We used descriptive statistics to report the rates of postpartum opioid prescribing and prescription size by type of birth. We used multilevel regression models to account for clustering of patients within practitioners and practitioners within hospitals. For all models, we serially adjusted for patient-, then practitioner- and hospital-level characteristics known to affect other quality metrics.[22–24] In total, 80.4% (32,650/40,589) of patients in the analysis gave birth in a hospital that completed the Labor Culture Survey. Given the level of missingness on the Labor Culture Survey completion, we performed sensitivity analyses with and without hospitals that completed the survey and results were unchanged. Logistic regression was used to report the adjusted odds of receiving a postpartum opioid prescription. Multilevel linear regression was used for the size of the prescription in OMEs. The intraclass correlation coefficient (ICC), a measure of the relatedness of values within a cluster, was calculated to describe the amount of variation attributable to practitioners and hospitals after accounting for patient and practitioner variation.[25] Analyses were performed with SAS version 9.4 (SAS Institute Inc.) and Stata SE version 14 (Stata Corp.). Statistical significance was set at a p value of <0.05 with two-sided tests.

3 | RESULTS

Of the 40,589 eligible patients, 29,412 (72.5%) had a vaginal birth and 11,177 (27.5%) had a cesarean birth. The majority of cesarean births were unplanned (9958/11,177, 89.1%) and the majority of vaginal births were spontaneous, unassisted (26,585/29,412, 90.4%). Compared with patients with a vaginal birth, patients with a cesarean birth were older (cesarean: 27.8 (5.6) years; vaginal 26.0 (5.3) years; $p < 0.001$) and differed in race and insurance coverage. Patients who had a cesarean birth were more likely to have all of the comorbidities assessed and had higher rates of postpartum complications including infant neonatal intensive care unit admission (cesarean: 1141/11,177, 10.2%; vaginal: 1361/29,412, 4.6%; $p < 0.001$), postpartum hemorrhage (cesarean: 1982/11,177, 17.7%; vaginal: 1;093/29,412, 3.7%; $p < 0.001$), and procedures for maternal morbidity, including blood transfusion (cesarean: 409/11,177, 3.7%; vaginal: 351/29,412, 1.2%; $p < 0.001$). The majority of patients (32,650/40,589; 80.4%) gave birth at hospitals that completed the Labor Culture Survey in 2021.

The majority of patients were cared for by female practitioners (28,094/40,589; 69.2%) who were obstetrician–gynecologists (32,720/40589; 80.6%), followed by advanced practice practitioners (4099/40,589; 10.1%). The majority of advanced practice practitioners were midwives (3932/4099; 96.0%), with few nurse practitioners (166/4099; 4.0%) or physician's assistants (1/4099; 0.0%). Practitioner specialty differed for patients who had cesarean versus vaginal birth. Patients gave birth at hospitals of varying delivery volume, with the majority of births occurring at teaching hospitals (36,452/40,589, 89.8%) and hospitals with not-for-profit status (36,840/40,589, 90.8%). The average labor culture score for the safety subscale was 2.9 (SD 0.24; Table 1).

The overall rate of opioid prescribing was 26.3% (10,684/40,589): 87.8% (9812/11,177) for cesarean birth and 3.0% (872/29,412) for vaginal birth. The median prescription size in OMEs was 90 (IQR 75–112.5), approximately 13 tabs of 5 mg oxycodone and was higher after cesarean birth (cesarean: median 90 (IQR 75–112.5); vaginal: median 60 (IQR 45–90)). The majority of patients received only one prescription (10,661/10,684, 99.8%). The most commonly prescribed opioid was hydrocodone (6494/10,684, 60.8%) for both vaginal and cesarean birth, followed by oxycodone (3776/10,684, 35.3%) and codeine (302/10,684, 2.8%).

Unadjusted opioid prescribing practices varied widely between hospitals. After vaginal birth, hospital prescribing rates varied from 0.0% to 53.6% and median prescription size per hospital varied from 9 OMEs (IQR 9–9) to 150 OMEs (IQR 150–150)—the equivalent of approximately 1.5–20 tabs of 5 mg oxycodone. After cesarean birth, prescribing rates varied from 31.1% to 100.0% and median prescription size for patients who received an opioid prescription varied from 10 OMEs (IQR 9–10) to 495 OMEs (IQR 100–495)—the equivalent of approximately 2–65 tabs of 5 mg oxycodone (data not shown).

Variation in opioid prescribing persisted after adjusting for patient-, practitioner-, and hospital-level variables. Adjusted rates of postpartum prescribing after cesarean birth per hospital ranged from 17.9% to 98.7%. Adjusted rates of postpartum prescribing after vaginal birth per hospital ranged from 0.0% to 49.2% (Figure 1).

Several patient-, practitioner-, and hospital-level predictors of postpartum opioid prescribing rates emerged. Patient demographic factors, including non-Hispanic Black (aOR 1.23 [95% CI 1.02–1.48]) and Asian (aOR 1.48 [95% CI 1.13–1.95]) race, were associated with receipt of an opioid prescription, though age, insurance status, and SDI were not. Birth characteristics including cesarean

TABLE 1 Patients by patient, practitioner, and hospital characteristics.

Characteristic	All ($N = 40,589$)	Cesarean ($n = 11,177$)	Vaginal ($n = 29,412$)	p-Value
Patient characteristics				
Discharged with an opioid prescriptions	10,684 (26.3)	9812 (87.8)	872 (3.0)	<0.001
Opioid prescription size[a]	98.7 (139.6)	100.4 (140.0)	79.6 (133.7)	<0.001
Number of prescriptions received at discharge				
1	10,661 (99.8)	9792 (99.8)	869 (99.7)	0.392
2	23 (0.2)	20 (0.2)	3 (0.3)	
Age, years[a]	26.5 (5.4)	27.8 (5.6)	26.0 (5.3)	<0.001
Race/ethnicity				
Non-Hispanic White	27,211 (67.0)	7220 (64.6)	19,991 (68.0)	<0.001
Non-Hispanic Black	6776 (16.7)	2080 (18.6)	4696 (16.0)	
Hispanic	2252 (5.5)	652 (5.8)	1600 (5.4)	
Asian	1576 (3.9)	483 (4.3)	1093 (3.7)	
Multiracial	236 (0.6)	64 (0.6)	172 (0.6)	
Others	233 (0.6)	79 (0.7)	154 (0.5)	
Unknown	2305 (5.7)	599 (5.4)	1706 (5.8)	
Health insurance/payer				
Private	24,754 (61.0)	7034 (62.9)	17,720 (60.2)	<0.001
Medicaid	13,705 (33.8)	3609 (32.3)	10,096 (34.3)	
Other	2130 (5.2)	534 (4.8)	1596 (5.4)	
Social Deprivation Index (SDI)[a]	48.01 (28.94)	48.82 (28.98)	47.69 (28.92)	0.001
Length of stay after delivery, days[a]	1.9 (0.7)	2.4 (0.7)	1.7 (0.5)	<0.001
Maternal comorbidities				
Prepregnancy diabetes	437 (1.1)	240 (2.1)	197 (0.7)	<0.001
Gestational diabetes	3101 (7.6)	1188 (10.6)	1913 (6.5)	<0.001
Prepregnancy hypertension	1369 (3.4)	610 (5.5)	759 (2.6)	<0.001
Gestational hypertension	6610 (16.3)	2340 (20.9)	4270 (14.5)	<0.001
Asthma	6057 (14.9)	1772 (15.9)	4285 (14.6)	0.001
Alcohol use in pregnancy	1448 (3.6)	449 (4.0)	999 (3.4)	0.003
Tobacco use before/in pregnancy	7542 (18.6)	2248 (20.1)	5294 (18.0)	<0.001
Marijuana use in pregnancy	1902 (13.8)	516 (14.2)	1386 (14.7)	0.509
Opioid use in pregnancy	321 (0.8)	103 (0.9)	218 (0.7)	<0.001
Delivery complications				
Third-degree laceration	1293 (3.2)	0 (0.0)	1293 (4.4)	<0.001
Fourth-degree laceration	221 (0.5)	1 (0.0)	220 (0.7)	<0.001
NICU admission	2502 (6.2)	1141 (10.2)	1361 (4.6)	<0.001
Postpartum hemorrhage (EBL/QBL >1000)	3075 (7.6)	1982 (17.7)	1093 (3.7)	<0.001
Maternal morbidity procedures				
Blood products transfusion	760 (1.9)	409 (3.7)	351 (1.2)	<0.001
Conversion of cardiac rhythm	1 (0.0)	0 (0.0)	1 (0.0)	0.538
Drainage of abscess	54 (0.1)	34 (0.3)	20 (0.1)	<0.001
Drainage of tube placement	35 (0.1)	25 (0.2)	10 (0.0)	<0.001
Evacuation of hematoma	51 (0.1)	13 (0.1)	38 (0.1)	0.743
Exploratory laparotomy	18 (0.0)	14 (0.1)	4 (0.0)	<0.001

(Continues)

TABLE 1 (Continued)

Characteristic	All ($N = 40,589$)	Cesarean ($n = 11,177$)	Vaginal ($n = 29,412$)	p-Value
Hysterectomy (peripartum/postpartum)	10 (0.0)	7 (0.1)	3 (0.0)	0.003
Manual removal of the placenta	721 (1.8)	344 (3.1)	377 (1.3)	<0.001
Removal of RPOC with suction device	181 (0.4)	22 (0.2)	159 (0.5)	<0.001
Repair of complex vaginal trauma	897 (2.2)	9 (0.1)	888 (3.0)	<0.001
Repair of dehiscence	27 (0.1)	13 (0.1)	14 (0.0)	0.017
Temporary tracheostomy	0 (0.0)	0 (0.0)	0 (0.0)	N/A
Uterine artery embolization	4 (0.0)	2 (0.0)	2 (0.0)	0.315
Ventilation	8 (0.0)	5 (0.0)	3 (0.0)	0.034
Practitioner characteristics				
Sex				
Female	28,094 (69.2)	7676 (68.7)	20,418 (69.4)	0.234
Male	12,495 (30.8)	3501 (31.3)	8994 (30.6)	
Specialty				
Obstetrician–gynecologist Physician	32,720 (80.6)	9285 (83.1)	23,435 (79.7)	<0.001
Surgeon	77 (0.2)	27 (0.2)	50 (0.2)	
General practice/family medicine physician	979 (2.4)	746 (6.7)	233 (0.8)	
Midwife/nurse practitioner/physician assistant	4099 (10.1)	859 (7.7)	3240 (11.0)	
Specialist, unspecified	740 (1.8)	226 (2.0)	514 (1.7)	
Unknown	1974 (4.9)	547 (4.9)	1427 (4.9)	
Hospital characteristics				
Annual delivery volume				
≤500	4101 (10.1)	1107 (9.9)	2994 (10.2)	<0.001
501–1000	6152 (15.2)	1540 (13.8)	4612 (15.7)	
1001-2000	7589 (18.7)	2107 (18.9)	5482 (18.6)	
>2000	22,747 (56.0)	6423 (57.5)	16,324 (55.5)	
Obstetric level of care				
Level 1	7318 (18.0)	1875 (16.8)	5443 (18.5)	<0.001
Level 2	11,643 (28.7)	3199 (28.6)	8444 (28.7)	
Level 3	19,750 (48.7)	5577 (49.9)	14,173 (48.2)	
Unknown	1878 (4.6)	526 (4.7)	526 (1.8)	
Teaching hospital	36,452 (89.8)	10,041 (89.8)	26,411 (89.8)	0.906
NICU available	24,255 (59.8)	6773 (60.6)	17,482 (59.4)	0.058
Hospital governing body				
Not-for-profit	36,840 (90.8)	10,150 (90.8)	26,690 (90.7)	<0.001
For-profit	2503 (6.2)	737 (6.6)	1766 (6.0)	
Public/government-owned	1246 (3.1)	290 (2.6)	956 (3.3)	
Location				
Urban	37,156 (91.5)	10,297 (92.1)	26,859 (91.3)	<0.001
Suburban	2798 (6.9)	748 (6.7)	2050 (7.0)	
Rural	635 (1.6)	132 (1.2)	503 (1.7)	
Labor Culture Survey Safety Subscale[a,b]	2.90 (0.24)	2.90 (0.24)	2.90 (0.24)	0.527

Note: Data presented as *n* (%) unless otherwise noted.

Abbreviations: EBL, estimated blood loss; NICU, neonatal intensive care unit; QBL, quantification of blood loss; RPOC, retained products of conception.

[a]Mean (SD).

[b]32,650 out of 40,589 patients were delivered in a hospital where the survey was conducted.

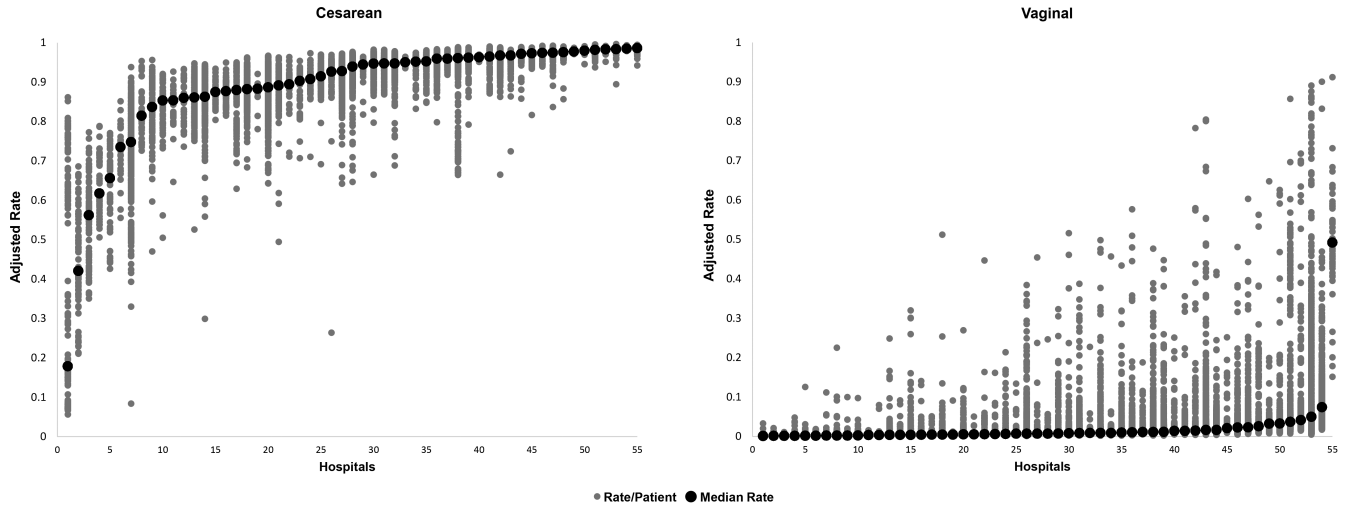

FIGURE 1 Rates of postpartum opioid prescribing after vaginal and cesarean birth at hospitals completing the Labor Culture Survey.

birth (aOR 899.1 [95% CI 752.8–1066.7]), fourth-degree perineal lacerations (aOR 25.7 [95% CI 17.4–37.9]), and some procedures for obstetric morbidity, such as uterine artery embolization (aOR 339.7 [95% CI 5.5–20899.9]) were associated with receipt of a postpartum opioid prescription. At the practitioner level, receiving care from a certified nurse-midwife (aOR 0.63 [95%CI 0.48–0.82]) or family medicine doctor (aOR 0.60 [95%CI 0.39–0.91]) was associated with a lower rate of opioid prescribing. At the hospital level, giving birth at a teaching hospital (aOR 4.07 [95% CI 1.7–9.9]) and at a hospital with <500 annual births (aOR 4.92 [95% CI 1.61–15.0]) were associated with higher rates of opioid prescribing, while giving birth in a suburban hospital (aOR 0.29 [95%CI 0.13–0.67]) was associated with lower rates of prescribing. Patients giving birth at hospitals with a high score on the safety subscale of the Labor Culture Survey were less likely to receive an opioid prescription (aOR 0.40 [95%CI 0.16–0.97]) (Table 2). Predictors remained largely unchanged when including all hospitals, not just those with an available Labor Culture Survey safety subscale score—though the hospital-level factors were no longer significant (Appendix 1).

For patients who received an opioid prescription, those who had a cesarean birth received prescriptions that were 37% larger in OMEs (95% CI 1.32–1.42), while those with fourth-degree lacerations received prescriptions 15% larger in OMEs (95% CI 1.04–1.28) than patients without higher order lacerations. Hospital score on the safety subscale of the Labor Culture Survey was not associated with opioid prescription size (Table 3). Predictors remained largely unchanged when including the full population (Appendix 2).

The amount of variation explained was higher at the practitioner level than at the hospital level in which practitioners were clustered for opioid prescribing rates (practitioners: 25.1%; hospitals: 12.1%) and higher at the hospital level than at the practitioner level for opioid prescription size (practitioners: 5.4%; hospitals: 52.2%) (Figure 2).

4 | DISCUSSION

In this study, we found wide variation in the rate of postpartum opioid prescribing and prescription size for vaginal and cesarean birth across NTSV individuals. A variety of patient-, practitioner-, and hospital-level factors were associated with opioid prescribing practices. A large proportion of variation in opioid prescribing practices was attributable to practitioners and hospitals, suggesting an opportunity for policies and procedures to improve opioid stewardship.

Opioid prescribing rates differed in this population when compared to prior national estimates. The opioid prescribing rate after vaginal birth was much lower—3% compared with 30% in other studies.[7–9] This difference may reflect national trends in opioid prescribing over time, with a general decline in postpartum prescribing after many procedures.[26,27] In contrast, the opioid prescribing rate after cesarean birth was higher than prior estimates—88% compared with 75% in other studies.[7–9] This difference may be explained in part by the inclusion of NTSV patients, who are less likely to have a routine scheduled cesarean birth and therefore may have higher rates of complications at the time of cesarean that influence postpartum recovery.[28] Interestingly, at some hospitals, all post-cesarean patients received a postpartum opioid prescription—suggesting universal opioid prescribing without tailoring.

Rates of opioid prescribing after childbirth differ significantly from routine practice in European nations, where postpartum prescriptions are rarely provided after either vaginal or cesarean birth.[7] While there are multiple

TABLE 2 Adjusted odds ratio for patients discharged with an opioid prescription by patient, practitioner, and hospital characteristics among hospitals completing the Labor Culture Survey.

Characteristic	Adjusted odds ratio	95% CI	*p*-Value
Patient characteristics			
Mode of delivery			
Cesarean	896.15	752.87–1066.69	<0.001
Vaginal	Ref	Ref	Ref
Age	1.01	1.00–1.02	0.137
Race/ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	1.23	1.02–1.48	0.034
Hispanic	1.11	0.87–1.42	0.412
Asian	1.48	1.13–1.95	0.005
Multiracial	1.35	0.71–2.59	0.364
Others	1.19	0.58–2.43	0.630
Unknown	1.17	0.91–1.51	0.219
Health insurance/payer			
Private	Ref	Ref	Ref
Medicaid	0.99	0.87–1.14	0.931
Other	1.28	0.84–1.95	0.244
Social Deprivation Index (SDI)	1.00	1.00–1.00	0.961
Length of stay after delivery	1.02	0.93–1.12	0.641
Maternal comorbidities			
Asthma	1.27	1.09–1.48	0.002
Alcohol use in pregnancy	1.29	0.95–1.75	0.108
Tobacco use before/in pregnancy	1.20	1.04–1.39	0.013
Opioid use in pregnancy	0.91	0.48–1.72	0.78
Delivery complications			
Third-degree laceration	6.84	5.30	<0.001
Fourth-degree laceration	25.68	17.38	<0.001
NICU admission	1.13	0.90	0.308
Postpartum hemorrhage (EBL/QBL >1000)	1.15	0.96	0.136
Maternal morbidity procedures			
Blood products transfusion	1.37	0.94–1.99	0.101
Drainage of abscess	0.22	0.08–0.64	0.005
Drainage of tube placement	2.55	0.56–11.51	0.224
Exploratory laparotomy	0.14	0.03–0.67	0.014
Hysterectomy (peripartum/postpartum)	3.13	0.26–38.25	0.372
Manual removal of the placenta	1.96	1.31–2.94	0.001
Removal of RPOC with suction device	1.22	0.53–2.79	0.635
Repair of complex vaginal trauma	1.70	1.26–2.31	0.001
Repair of dehiscence	0.31	0.08–1.13	0.076
Uterine artery embolization	339.72	5.52–20,899.91	0.006
Ventilation	1.57	0.00–1377.49	0.896
Practitioner characteristics			
Sex			
Female	Ref	Ref	Ref
Male	1.06	0.88–1.27	0.568

TABLE 2 (Continued)

Characteristic	Adjusted odds ratio	95% CI	*p*-Value
Practitioner specialty			
Obstetrician–Gynecologist physician	Ref	Ref	Ref
Surgeon	0.89	0.11–6.89	0.908
General practice/family medicine physician	0.60	0.39–0.91	0.017
Midwife/nurse practitioner/physician assistant	0.63	0.48–0.82	0.001
Specialist, unspecified	1.28	0.70–2.32	0.427
Unknown	1.09	0.72–1.66	0.679
Hospital characteristics			
Teaching hospital	4.07	1.66–9.93	0.005
Hospital annual delivery volume			
≤500	4.92	1.61–15.02	0.005
501–1000	0.93	0.46–1.86	0.832
1001–2000	Ref	Ref	Ref
>2000	1.19	0.56–2.53	0.659
Obstetric level of care			
Level 1	0.98	0.45–2.09	0.949
Level 2	1.05	0.54–2.04	0.888
Level 3	Ref	Ref	Ref
Unknown	0.37	0.11–1.30	0.12
Hospital governing body			
Not-for-profit	Ref	Ref	Ref
For-profit	2.05	0.55–7.72	0.286
Public/government-owned	0.53	0.15–1.83	0.316
Hospital location			
Urban	Ref	Ref	Ref
Suburban	0.29	0.13–0.67	0.004
Rural	0.76	0.16–3.55	0.722
Labor Culture Survey	0.40	0.16–0.97	0.042

Abbreviations: EBL, estimated blood loss; NICU, neonatal intensive care unit; QBL, quantification of blood loss; RPOC, retained products of conception.

potential drivers of differing practice, a likely driver is the overall climate of pain management in the United States, including historical pressure from professional societies, quality improvement groups, advocacy groups, and pharmaceutical companies to treat pain as the "fifth vital sign."[29] These phenomena have influenced the expectations in pain management and practice patterns across many aspects of care, including for birthing people.[30] Further work is needed to understand the differences in patient-reported outcomes and long-term outcomes across both settings.

Many of the patient-level factors associated with opioid prescribing in prior studies were also identified in our work, including cesarean birth, higher order perineal lacerations, tobacco use before and during pregnancy, and additional procedures at the time of childbirth.[9,11] Interestingly, non-Hispanic Black race was associated with a higher rate of opioid prescribing. This finding is in contrast to prior work demonstrating that Black and Hispanic postpartum individuals are less likely to receive assessment of their pain, are more likely to have higher pain scores, and are less likely to receive opioid medication in the hospital and at the time of discharge.[15,31,32] It is possible that higher prescribing rates for Black individuals represents an increased awareness of disparities in postpartum pain management, practitioner biases about Black postpartum individuals' pain needs, or a more complex interplay between patient-, practitioner-, and hospital-level factors. Importantly, we do not have pain scores and other patient-reported outcomes available in our data set, which limits our ability to decipher the relationship between opioid prescribing and pain experienced by the patient. Future work is needed to ensure pain management practices are

TABLE 3 Multiplicative effects for opioid prescription size by patient, practitioner, and hospital characteristics among hospitals completing the Labor Culture Survey.

Characteristic	Multiplicative Effect	95% CI	*p*-Value
Patient characteristics			
Mode of delivery			
Cesarean	1.37	1.33–1.42	<0.001
Vaginal	Ref	Ref	Ref
Age	1.00	1.00–1.00	0.894
Race/ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	0.97	0.93–1.01	0.107
Hispanic	0.99	0.97–1.01	0.364
Asian	0.97	0.94–1.00	0.085
Multiracial	1.00	0.91–1.09	0.966
Others	0.98	0.89–1.09	0.734
Unknown	1.02	0.99–1.06	0.220
Health insurance/payer			
Private	Ref	Ref	Ref
Medicaid	0.99	0.98–1.01	0.506
Other	1.01	0.95–1.07	0.821
Social Deprivation Index (SDI)	1.00	1.00–1.00	0.660
Length of stay after delivery	1.02	1.01–1.03	0.002
Maternal comorbidities			
Asthma	0.99	0.97–1.01	0.312
Alcohol use in pregnancy	1.00	0.96–1.04	0.872
Tobacco use before/in pregnancy	0.99	0.97–1.01	0.299
Opioid use in pregnancy	1.02	0.93–1.11	0.698
Delivery complications			
Third-degree laceration	1.05	0.97–1.13	0.204
Fourth-degree laceration	1.15	1.04–1.28	0.007
NICU Admission	0.97	0.95–1.00	0.065
Postpartum hemorrhage (EBL/QBL >1000)	1.02	1.00–1.04	0.088
Maternal Morbidity Procedures			
Blood products transfusion	1.01	0.97–1.05	0.705
Drainage of abscess	1.00	0.86–1.16	0.998
Drainage of tube placement	1.19	1.00–1.41	0.049
Exploratory laparotomy	1.01	0.79–1.30	0.924
Hysterectomy (peripartum/postpartum)	1.41	0.94–2.13	0.098
Manual removal of the placenta	1.01	0.95–1.08	0.756
Removal of retained products of conception with suction device	1.04	0.89–1.20	0.650
Repair of complex vaginal trauma	0.90	0.83–0.98	0.010
Repair of dehiscence	0.96	0.76–1.20	0.698
Uterine artery embolization	2.26	1.29–3.95	0.004
Ventilation	0.59	0.38–0.92	0.020
Practitioner characteristics			
Sex			
Female	Ref	Ref	Ref
Male	1.00	0.97–1.02	0.901

TABLE 3 (Continued)

Characteristic	Multiplicative Effect	95% CI	*p*-Value
Practitioner specialty			
Obstetrician–Gynecologist physician	Ref	Ref	Ref
Surgeon	1.14	0.86–1.51	0.349
General practice/family medicine physician	0.95	0.89–1.02	0.159
Midwife/nurse practitioner/physician assistant	0.95	0.92–1.00	0.031
Specialist, unspecified	1.02	0.94–1.12	0.634
Unknown	1.01	0.96–1.06	0.649
Hospital characteristics			
Teaching hospital	0.98	0.66–1.47	0.939
Hospital annual delivery volume			
≤500	1.05	0.64–1.72	0.857
501–1000	0.98	0.71–1.36	0.919
1001–2000	Ref	Ref	Ref
>2000	0.92	0.64–1.33	0.672
Obstetric level of care			
Level 1	1.22	0.85–1.74	0.274
Level 2	1.20	0.87–1.65	0.260
Level 3	Ref	Ref	Ref
Unknown	1.30	0.73–2.34	0.371
Hospital governing body			
Not-for-profit	Ref	Ref	Ref
For-profit	0.92	0.50–1.70	0.800
Public/government-owned	0.86	0.49–1.51	0.601
Hospital location			
Urban	Ref	Ref	Ref
Suburban	1.02	0.71–1.45	0.934
Rural	0.81	0.44–1.52	0.520
Labor Culture Survey	0.88	0.60–1.31	0.536

Abbreviations: EBL, estimated blood loss; NICU, neonatal intensive care unit; QBL, quantification of blood loss.

equitable across marginalized groups, and to promote postpartum recovery without increasing the harms of opioid prescribing.

We also found that patients who were cared for by a certified nurse-midwife or family medicine physician during their postpartum course were less likely to receive a postpartum opioid prescription. By promoting the normalcy of postpartum recovery and focusing on a patient-centered approach, midwives may help to improve postpartum pain control and minimize the need for opioid prescriptions.[33,34] The midwifery model of care is well-aligned with evidence-based opioid-sparing initiatives that focus on shared decision-making in pain management, minimizing unnecessary interventions, and optimizing non-opioid and non-pharmacologic strategies.[35,36] Qualitative work may be helpful in the future for further defining these successful strategies.

Finally, practitioner- and hospital-level factors accounted for a significant proportion of the variation in postpartum opioid prescribing rates and prescription size. Notably, the Labor Culture Survey subscale assessing patient safety was associated with reduced rates of opioid prescribing across hospitals.[21] This domain—reflecting key components of patient safety including team member communication, psychological safety to speak up, and patient advocacy—was used as a proxy measure of hospital engagement in promoting quality care across all members of the maternity care team. While the Labor Culture Survey is specifically intended to measure hospital culture surrounding cesarean overuse, it is possible that an interprofessional, collaborative approach across multiple obstetric team members has spillover effects beyond specific areas of targeted quality improvement due to optimization of communication and promotion

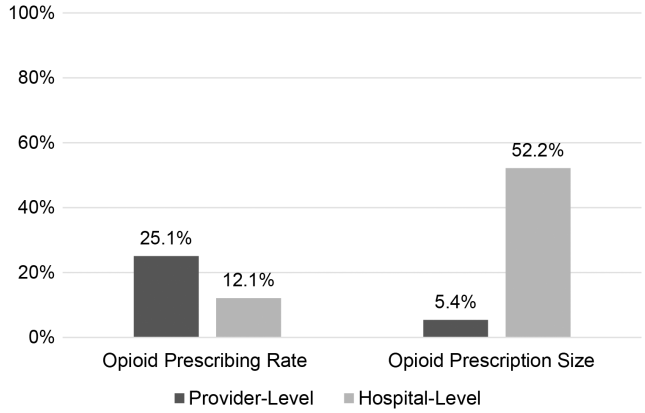

FIGURE 2 Proportion of variation in outcomes explained at the practitioner and hospital Level in hospitals completing the Labor Culture Survey.

of psychologically safe workspaces.[37] In particular, a culture that supports team-based care may contribute to better postpartum pain management that maximizes non-opioid options while prioritizing excellent pain control. Focused quality improvement activities and a positive unit culture that promotes optimal team-based care may potentially improve care across multiple domains, from reduction in unnecessary cesarean births to improved opioid stewardship.

Improving the quality of postpartum pain management requires hospital-level interventions that ensure standardization of evidence-based pain management strategies across all practitioners. Single-institution studies of cesarean birth demonstrate the effectiveness of shared decision-making for discharge opioid prescribing, opioid-sparing protocols, and institutional implementation of electronic health record prescribing support for effectively reducing opioid prescribing while maintaining excellent postpartum pain management.[38–41] In particular, tailoring opioid prescribing to individuals' pain scores and medication use in the 24 hours before discharge can significantly reduce prescription size, highlighting an opportunity for improved opioid stewardship.[38,42,43] Similar interventions after vaginal birth have been sparse, but may be particularly effective in hospitals with higher rates of opioid prescribing than their peer institutions.[44] Standardization of postoperative pain management in other specialties across statewide collaboratives has demonstrated immediate and drastic declines in postoperative opioid prescribing. These effects have "spilled over" to other procedures at target institutions, highlighting the generalizability of these pain management principles.[45] Future work, grounded in implementation science, is needed to understand the barriers and facilitators of opioid stewardship practices in the maternity care setting to design strategies that ensure every patient receives high-quality postpartum pain management that reduces their risk of opioid harms.

Our study has several strengths, including the use of detailed registry data and the incorporation of multiple patient-, practitioner-, and hospital-level factors known to influence opioid prescribing and general quality improvement efforts. We uniquely include only NTSV patients, which allows for more consistent comparisons across hospitals. We also acknowledge important limitations. Our study was completed in a single midwestern state, which may not reflect prescribing practices in other regions of the United States. We restricted our analysis to hospitals that completed the Labor Culture Survey, potentially limiting the generalizability of our findings. However, we performed sensitivity analyses demonstrating that the overarching findings of this work are similar between the group that completed the Labor Culture Survey and the full cohort. While the Labor Culture survey provides an important novel finding about the relationship between hospital culture and opioid prescribing, we cannot evaluate detailed ecological data including practitioner and organization factors (e.g., selected quality improvement initiatives) in this quantitative analysis. While there were no statewide initiatives to reduce opioid prescribing at the time of childbirth during the study period, we cannot confirm whether individual hospitals engaged in local opioid stewardship efforts. Finally, we are only able to measure whether an opioid was prescribed and the size of the prescription, not how much was consumed or if the patient consumed opioids that were not prescribed. We also cannot assess if individuals used opioid-sparing methods including pharmacologic and non-prescription medications (e.g., acetaminophen and ibuprofen), which may influence an individual's postpartum pain experience.

Opioid prescribing practices, including rates of opioid prescribing and prescription size, varied widely across NTSV patients giving birth at hospitals participating in a statewide obstetric quality collaborative. Much of this variation is driven by practitioner- and hospital-level factors, suggesting an opportunity to improve care quality through multilevel initiatives. Future work is needed to identify equitable, patient-centered practices for effectively and equitably improving postpartum pain management while minimizing the risks of opioid prescribing.

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CONFLICT OF INTEREST STATEMENT

Dr. Peahl is a paid consultant for Maven Clinic. Dr. Moniz is a paid consultant for RAND and the Society of Family Planning. The remaining authors report no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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APPENDIX 1

ADJUSTED ODDS RATIOS FOR PATIENTS DISCHARGED WITH AN OPIOID PRESCRIPTION BY PATIENT, PRACTITIONER, AND HOSPITAL CHARACTERISTICS FOR ALL HOSPITALS.[a]

Characteristic	Adjusted odds ratio	95% CI	*p*-Value
Patient characteristics			
Mode of delivery			
Cesarean	801.57	687.84–934.11	<0.001
Vaginal	Ref	Ref	Ref
Age	1.01	1.00–1.02	0.103
Race/ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	1.18	1.00–1.39	0.046
Hispanic	1.09	0.88–1.35	0.444
Asian	1.33	1.05–1.70	0.019
Multiracial	1.40	0.77–2.55	0.269
Others	1.32	0.71–2.43	0.379
Unknown	1.12	0.90–1.40	0.305

Characteristic	Adjusted odds ratio	95% CI	*p*-Value
Health insurance/payer			
Private	Ref	Ref	Ref
Medicaid	1.00	0.89–1.13	0.967
Other	1.40	1.01–1.92	0.042
Social Deprivation Index (SDI)	1.00	1.00–1.00	0.974
Length of stay after delivery	1.04	0.96–1.12	0.370
Maternal comorbidities			
Asthma	1.18	1.03–1.35	0.017
Alcohol use in pregnancy	1.18	0.91–1.54	0.220
Tobacco use before/in pregnancy	1.20	1.05–1.37	0.006
Opioid use in pregnancy	1.19	0.69–2.05	0.525
Delivery complications			
Third-degree laceration	6.09	4.85–7.64	<0.001
Fourth-degree laceration	26.32	18.64–37.17	<0.001
NICU Admission	1.14	0.95–1.38	0.162
Postpartum hemorrhage (EBL/QBL >1000)	1.16	0.98–1.37	0.079
Maternal morbidity procedures			
Blood products transfusion	1.30	0.94–1.79	0.111
Drainage of abscess	0.26	0.09–0.72	0.010
Drainage of tube placement	2.35	0.54–10.30	0.258
Exploratory laparotomy	0.18	0.04–0.79	0.023
Hysterectomy (peripartum/postpartum)	3.74	0.38–36.40	0.256
Manual removal of the placenta	1.80	1.23–2.65	0.003
Removal of RPOC with suction device	1.19	0.57–2.48	0.650
Repair of complex vaginal trauma	1.72	1.29–2.29	<0.001
Repair of dehiscence	0.30	0.08–1.10	0.069
Uterine artery embolization	264.11	4.18–16,706.27	0.008
Ventilation	0.31	0.01–8.26	0.484
Practitioner characteristics			
Sex			
Female	Ref	Ref	Ref
Male	1.04	0.89–1.21	0.647
Practitioner specialty			
Obstetrician–Gynecologist physician	Ref	Ref	Ref
Surgeon	0.96	0.16–5.88	0.964
General practice/family medicine physician	0.69	0.48–1.01	0.056
Midwife/nurse practitioner/physician assistant	0.66	0.51–0.84	0.001
Specialist, unspecified	1.41	0.82–2.42	0.215
Unknown	1.08	0.75–1.56	0.663
Hospital characteristics			
Teaching hospital	1.69	0.62–4.62	0.307
Hospital annual delivery volume			
≤500	1.72	0.52–5.70	0.373
501–1000	0.88	0.38–2.04	0.766
1001–2000	Ref	Ref	Ref
>2000	1.09	0.45–2.68	0.844

(Continues)

APPENDIX 1 (Continued)

Characteristic	Adjusted odds ratio	95% CI	*p*-Value
OB level of care			
Level 1	0.85	0.33–2.14	0.725
Level 2	1.04	0.46–2.37	0.929
Level 3	Ref	Ref	Ref
Unknown	0.66	0.14–3.15	0.603
Hospital governing body			
Not-for-profit	Ref	Ref	Ref
For-profit	0.74	0.25–2.15	0.577
Public/government-owned	0.63	0.13–2.94	0.554
Hospital location			
Urban	Ref	Ref	Ref
Suburban	0.52	0.21–1.31	0.167
Rural	1.66	0.44–6.23	0.450

[a] Intraclass correlation coefficient (ICC): Practitioner-Level: 0.306; Hospital-Level: 0.209.

Abbreviations: EBL, estimated blood loss; NICU, neonatal intensive care unit; QBL, quantification of blood loss; RPOC, retained products of conception.

APPENDIX 2

MULTIPLICATIVE EFFECTS FOR OPIOID PRESCRIPTION SIZE BY PATIENT, PRACTITIONER, AND HOSPITAL CHARACTERISTICS FOR ALL HOSPITALS.

Characteristic	Multiplicative effect	95% CI	*p*-Value
Patient characteristics			
Mode of delivery			
Cesarean	1.38	1.33–1.42	<0.001
Vaginal	Ref	Ref	Ref
Age	1.00	1.00–1.00	0.632
Race/ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	0.98	0.95–1.01	0.194
Hispanic	0.99	0.97–1.01	0.267
Asian	0.97	0.94–1.00	0.050
Multiracial	1.01	0.93–1.11	0.778
Others	1.00	0.92–1.09	0.980
Unknown	1.03	1.00–1.06	0.080
Health insurance/payer			
Private	Ref	Ref	Ref
Medicaid	0.98	0.97–1.00	0.044
Other	1.00	0.96–1.05	0.958
Social Deprivation Index (SDI)	1.00	1.00–1.00	0.879
Length of stay after delivery	1.01	1.00–1.02	0.016
Maternal comorbidities			
Asthma	0.99	0.98–1.01	0.495
Alcohol use in pregnancy	0.99	0.96–1.03	0.722
Tobacco use before/in pregnancy	0.99	0.97–1.01	0.159
Opioid use in pregnancy	1.16	1.08–1.25	<0.001

APPENDIX 2 (Continued)

Characteristic	Multiplicative effect	95% CI	*p*-Value
Delivery complications			
Third-degree laceration	1.02	0.95–1.09	0.589
Fourth-degree laceration	1.07	0.97–1.17	0.164
NICU Admission	0.98	0.96–1.01	0.159
Postpartum hemorrhage (EBL/QBL >1000)	1.01	1.00–1.03	0.141
Maternal morbidity procedures			
Blood products transfusion	1.00	0.96–1.04	0.934
Drainage of abscess	0.98	0.85–1.14	0.797
Drainage of tube placement	1.19	1.00–1.41	0.050
Exploratory laparotomy	1.03	0.82–1.29	0.787
Hysterectomy (peripartum/postpartum)	1.30	0.92–1.83	0.144
Manual removal of the placenta	1.00	0.94–1.07	0.984
Removal of RPOC with suction device	1.03	0.89–1.18	0.724
Repair of complex vaginal trauma	0.93	0.86–1.00	0.045
Repair of dehiscence	0.96	0.76–1.22	0.762
Uterine artery embolization	1.72	1.10–2.71	0.019
Ventilation	0.67	0.45–0.99	0.042
Practitioner characteristics			
Sex			
Female	Ref	Ref	Ref
Male	0.99	0.97–1.01	0.449
Practitioner specialty			
Obstetrician–Gynecologist physician	Ref	Ref	Ref
Surgeon	1.10	0.85–1.43	0.448
General practice/family medicine physician	0.93	0.87–0.99	0.016
Midwife/nurse practitioner/physician assistant	0.96	0.92–1.00	0.036
Specialist, unspecified	1.03	0.94–1.11	0.554
Unknown	1.02	0.97–1.06	0.489
Hospital characteristics			
Teaching hospital	0.96	0.69–1.33	0.787
Hospital annual delivery volume			
≤500	0.95	0.64–1.41	0.797
501–1000	0.98	0.74–1.30	0.878
1001–2000	Ref	Ref	Ref
>2000	0.93	0.69–1.26	0.647
OB level of care			
Level 1	1.15	0.84–1.58	0.369
Level 2	1.14	0.86–1.51	0.351
Level 3	Ref	Ref	Ref
Unknown	1.32	0.78–2.24	0.297
Hospital governing body			
Not-for-profit	Ref	Ref	Ref
For-profit	0.93	0.65–1.33	0.689
Public/government-owned	0.86	0.52–1.44	0.570

(Continues)

APPENDIX 2 (Continued)

Characteristic	Multiplicative effect	95% CI	*p*-Value
Hospital location			
Urban	Ref	Ref	Ref
Suburban	1.05	0.78–1.41	0.746
Rural	0.95	0.63–1.44	0.809

Note: Intraclass correlation coefficient (ICC): Practitioner-Level: 0.053; Hospital-Level: 0.480.

Abbreviations: EBL, estimated blood loss, NICU, neonatal intensive care unit, QBL, quantification of blood loss, RPOC, retained products of conception.