Outpatient Opioid Use After Cesarean Delivery

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ABSTRACT

OBJECTIVES: With a goal of informing opioid prescribing after cesarean delivery, we compared inpatient, prescribed, and outpatient Morphine Equivalent Doses (MED) and patient characteristics.

METHODS: Patients were enrolled after cesarean delivery and followed for 2–5 weeks with demographic, opioid use, and clinical characteristics collected from participants and the medical record. T-test, ANOVA, linear regression, and Pearson correlation coefficients were used in analyses.

RESULTS: Among 76 women, 21% used all opioids prescribed and 20% used none. History of psychiatric comorbidities was associated with higher outpatient opiate use (172 MED vs 103 MED; p = 0.046). There was no difference in opiates consumed inpatient and amount prescribed at discharge (p = 0.502). However, low, medium, and high inpatient consumers used 53 (SD 76), 111 (SD 96), and 195 (SD 132) MEDs outpatient, respectively (p < 0.001).

CONCLUSIONS: Outpatient opioid prescribing based on inpatient needs may facilitate judicious opioid use after cesarean delivery.

SIGNIFICANCE

What Is Already Known: Opioid abuse is a growing problem in this country, and excess prescribing contributes to the availability of opioids. Limited data exist regarding the amount of opioids patients need after cesarean delivery, or what factors are predictive of an individual patient's opioid needs.

What This Study Adds: This study further supports the growing literature demonstrating that providers frequently over-prescribe opioids following cesarean delivery. It uniquely adds associations of patient-specific factors and outpatient opioid needs.

KEYWORDS: Cesarean delivery, opioid pain medication, outpatient pain control, postoperative pain management, pregnancy

OBJECTIVES

Opioid misuse is a public health crisis, which is at least partially attributed to a ten-fold increase in opioid prescriptions over the past decade.[1] Because of this, judicious prescribing of opioid medications has received increased political, research, and media attention.[2] Opioid medications are a mainstay for the treatment of pain after major surgery, and cesarean delivery is the most common major surgery performed in the United States.[3,4] Most women are prescribed opioids for outpatient pain control after cesarean delivery and recent studies have shown that most patients consume only a fraction of the opioid medication prescribed.[5,6,7] Opioid over-prescribing contributes to the national opioid epidemic; unused pills become available for misuse and diversion.

Despite the fact that women experience different levels of pain and require different amounts of opioids in the hospital prior to discharge, there has been limited variability in the amount of opioids prescribed at hospital discharge; Badreldin et al. (2018) found that among women who had cesarean delivery, 71.9% were prescribed identical quantities of opioids. "One-size-fits-all" approaches likely result in some women receiving too much (and thus having left-over pills) and other women too little (and may result in poor pain control).[7] To reduce the excess of prescription opioids, multiple professional organizations have recommended personalizing prescriptions to the individual patient's anticipated pain management needs.[3] However, in order to tailor prescriptions to individual patients, physicians and policy-makers need data describing the factors associated with the amount of opioids individual patients consume. We performed a prospective cohort study of women who had a cesarean delivery to generate pilot data both on opioid use after hospital discharge and patient factors associated with the amount of opioids women consumed. Our study objectives were to determine how much opioid medication patients consumed after hospital discharge post-cesarean delivery, and to assess which patient factors were related to outpatient opioid consumption. We hypothesized that greater opioid use in the final 24 hours of hospitalization following cesarean delivery would be associated with higher opioid consumption after hospital discharge.

METHODS

We conducted a prospective observational cohort study of women who had a cesarean delivery at our institution between January 1, 2016 and May 31, 2016. Women were eligible to participate in the study if they delivered a live infant at 24 weeks' gestation or greater, were age 18 years or older at the time of delivery, could speak and read English, and could provide informed consent. Women were ineligible to participate if prenatal records were not available or they planned to move out of the geographic area within the follow-up timeframe. We excluded women who were hospitalized for greater than 8 days following delivery. Women were also excluded from follow-up analyses if they were currently using opioids for medication assisted treatment (MAT) for opioid use disorder, because this population has unique needs related to outpatient pain control and opioid use and it was anticipated this population would be too small for subgroup analyses. Potentially eligible women were recruited by the study team during their post-partum hospitalization and within 4 days of delivery. As this was a pilot study to generate data on opioid prescribing, opioid consumption, and factors associated with amounts prescribed and consumed, we selected a targeted enrollment of n=100. The Women & Infants Hospital Institutional Review Board approved the study protocol (IRB number 14-0097).

Enrolled participants completed a questionnaire about medical and prenatal history and demographic characteristics. Participants were given a pill count diary to record their pain medication use for two weeks following hospital discharge. Two weeks after hospital discharge, patients were contacted by telephone and asked to refer to their pill count diary to determine the number of opiate pills they consumed since leaving the hospital, the use of non-opiate pain medications, and average pain scores since hospital discharge. If a participant did not maintain the diary, she was asked to count the number of opiate-containing tablets remaining in her pill bottle. Pain scores were obtained using patient report of their average pain score on the Numeric Pain Rating Scale (0–10) since hospital discharge. Phone call attempts were continued up to 5 weeks following hospital discharge, at which point participants were considered lost to follow-up if contact was not made. At the time patients were contacted, they were asked to report on their opiate use and pain levels only for the first 2 weeks after hospital discharge. For participants who reported no opiate usage following hospital discharge, we reviewed the electronic medical record external pharmacy linkage data to verify that no prescription had been filled. This allowed us to determine the number of unused dispensed opioid tablets for these participants (zero if a prescription was not filled, full number prescribed if prescription was filled and patient reported that none was used).

Maternal health and demographic information were abstracted from the medical record. Data collected included the total cumulative dose of opiate medications dispensed to the participant and standardized Numeric Pain Rating Scale scores (it is institutional protocol for nursing staff to collect and document at regular intervals) in the final 24 hours of hospitalization, as well as the type and quantity of opiates prescribed to the participant upon hospital discharge. During the study period, no attempt was made to alter providers' individual inpatient and outpatient opiate prescribing practices. Additionally, participant medical data such as method of delivery, antenatal complications, use of tobacco, alcohol and drugs, breastfeeding plans and several other factors were collected (**Table 1**).

We used descriptive statistics to evaluate the number of opiate tablets prescribed to and consumed by the study population. The main dependent variable was patient-reported opiate use in the two weeks following hospital discharge. Opiate use (inpatient and outpatient) was converted to Morphine Equivalent Doses (MED), which standardizes opioid pills of varying strengths (**Table 2**). T-tests, chi-square, and Fisher's exact tests were used to compare the baseline demographic characteristics between those patients who completed follow up and those who did not. Linear regression, t-test and ANOVA tests were used to describe inpatient and outpatient opiate use by subject characteristics. Lastly, we used ANOVA and Pearson correlation analyses to examine if there was an association between the amounts of opiate pain medication consumed inpatient and the amount consumed after hospital discharge. Tertiles of inpatient MED use (low <40 MED, medium 41–70 MED, and high >70 MED) were utilized to explore potential non-linear associations and for a more clinically useful comparison of average outpatient MED use among groups of patients with similar inpatient MED use.

RESULTS

Between January and May of 2016, 252 postpartum women were identified as potentially eligible and screened for enrollment in the study. One hundred forty-one women were approached by study personnel and offered enrollment, and 101 patients agreed to participate. Of the 101 women initially enrolled, one was excluded due to prolonged postpartum hospitalization (20 days). Seventy-six completed the telephone survey. Of those 76 women, one was excluded from data analysis due to ongoing MAT for opioid use disorder.

The mean age of study participants was 30.3 years [standard deviation (SD) 5.5], with a mean parity of 1.0 [SD 1.1] (**Table 1**). All but two patients included in the study had a low transverse hysterectomy; the remaining two had classical uterine incisions. Most study participants (63%) identified as Caucasian, with 79% self-identifying as non-Hispanic. There was a nearly equal division of study participants with public (49%) versus private (47%) health insurance.

Table 1. Baseline characteristics of study sample, overall and by completion of post-discharge telephone follow-up. Mean [SD] for continuous variables (with p-value for t-test comparing follow-up and no follow-up) and N (%) for categorical variables (with p-value for chi-square or Fisher's exact test comparing follow-up and no follow-up).

Variable	All Enrolled Participants (n=100) n (%)[a]	No Follow-up (n=24) n (%)[a]	Completed Telephone Follow-up (n=76) n (%)[a]	P-value for difference
Maternal age	30.3 ± 5.5	30.4 ± 5.7	30.3 ± 5.4	0.939
Parity (mean)	1.0 ± 1.1	1.1 ± 1.2	0.9 ± 1.1	0.458
Race (n = 99)				0.122[b]
Caucasian	62 (62.6)	17 (70.8)	45 (60.0)	
Black	5 (5.1)	0 (0.0)	5 (6.7)	
Asian	1 (1.0)	0 (0.0)	1 (1.3)	
Other	20 (20.2)	2 (8.3)	18 (24.0)	
Unknown	11 (11.1)	5 (20.8)	6 (8.0)	
Ethnicity (n = 99)				0.223[b]
Hispanic	19 (19.2)	2 (8.3)	17 (22.7)	
Not Hispanic	78 (78.8)	22 (91.7)	56 (74.7)	
Unknown	2 (2.0)	0 (0.0)	2 (2.7)	
Education				0.247
High school or less	28 (28.0)	9 (37.5)	19 (25.0)	
Some post HS training	33 (33.0)	9 (37.5)	24 (31.5)	
Bachelor's degree or higher	39 (39.0)	6 (25.0)	33 (43.4)	
Insurance (n = 99)				0.180[b]
Public	49 (49.5)	10 (41.7)	39 (52.0)	
Private	47 (47.5)	12 (50.0)	35 (46.7)	
Unknown	3 (3.0)	2 (8.3)	1 (1.3)	
History of drug use/abuse	5 (5.0)	2 (8.3)	3 (4.0)	0.591[b]
History of buprenorphine or methadone use	3 (3.0)	2 (8.3)	1 (1.3)	0.142[b]
Smoker	11 (11.0)	2 (8.3)	9 (11.8)	1.000[b]
Psychiatric comorbidity[c]	36 (36.0)	10 (41.7)	26 (34.2)	0.507
Repeat cesarean	49 (49.0)	14 (58.3)	35 (46.1)	0.294
Cesarean status				0.781[b]
Planned	59 (59.0)	16 (66.7)	43 (56.6)	
Unplanned, but pre-labor	5 (5.0)	1 (4.2)	4 (5.3)	
Unplanned, after labor	36 (36.0)	7 (29.2)	29 (38.2)	
Surgical complications[d]	16 (16.0)	4 (16.7)	12 (15.8)	1.000[b]
Chorioamnionitis	13 (13.0)	2 (8.3)	11 (14.5)	0.728[b]
Breastfeeding in hospital				0.435
No	20 (20.0)	7 (29.2)	14 (18.4)	
Yes	75 (75.0)	16 (66.7)	58 (76.3)	
Unknown	5 (5.0)	1 (4.2)	4 (5.3)	
Day postpartum discharged home				0.243[b]
2	4 (4.0)	1 (4.2)	3 (4.0)	
3	37 (37.0)	12 (50.0)	25 (32.9)	
4	59 (59.0)	11 (45.8)	48 (63.2)	

[a] Not all values total to n=100, n=24 or n=76 due to missing data on the variable of interest

[b] Fisher's exact test used

[c] Includes self-reported history of any one of the following: anxiety, depression, bipolar disorder, schizophrenia, eating disorder, or other psychiatric disorder

[d] Surgical complications include hemorrhage, cystoscopy, rupture of endometrioma, lysis of adhesions, or bowel injury. There were no cases of bladder or ureteral injury or intraoperative surgical consult.

Table 2. Morphine Equivalent Dosing Table

Medication	MED conversion factor	Total MED
Morphine 10 mg	1.0	10 MED
Oxycodone 10 mg	1.5	15 MED
Hydrocodone 10 mg	1.0	10 MED
Hydromorphone 10 mg	4.0	40 MED
Oxymorphone 10 mg	3.0	30 MED
Codeine 10 mg	0.15	1.5 MED

Table 3. Postoperative pain and management during inpatient stay, at discharge, and at follow-up survey post-discharge (n=100)

Characteristic	Value ± SD, range
Inpatient	
MED, final 24 hours of hospitalization, range	59 ± 43, 0-380
Average pain score inpatient, range	3.5 ± 1.0, 1.7-6.0
At discharge	
MED prescribed at discharge, range	258 ± 57, 0-450
Types of opiate pills prescribed at discharge, N(%) of participants	
Acetaminophen/oxycodone	88 (88.0)
Oxycodone	4 (4.0)
Acetaminophen/hydrocodone	3 (3.0)
Acetaminophen with codeine	2 (2.0)
Acetaminophen/oxycodone and acetaminophen/hydrocodone	2 (2.0)
None	1 (1.0)
At follow-up survey post-discharge (2-5 weeks)	
MED, outpatient in 2 weeks post-discharge, range (N=75)[a]	126 ± 123, 0.0-525
Average pain score, overall in 2 weeks post discharge, range (N=75)[a]	3.4 ± 1.8, 0.0-9.0

[a] N=75 who completed 2 week phone call (n=76) and were not discharged on maintenance opioids for addiction treatment (n=1)

Table 4. Morphine equivalent dose usage in final 24 hours inpatient hospitalization (n=100) and as an outpatient (n=75), by subject characteristics.

Subject Characteristic	Inpatient MED[a]			Outpatient MED		
	n[b]	Mean ± SD	P-value[c]	n[b]	Mean ± SD	P-value[c]
Overall	100	59 ± 43	—	75	126 ± 123	—
Maternal age	100	β=-0.41	0.611	75	β=-0.34	0.898
Psychiatric comorbidities			0.024			0.046
Yes	36	75 ± 58		25	172 ± 152	
No	64	50 ± 30		50	103 ± 100	
Cesarean Type			0.345			0.355
Primary	51	55 ± 26		41	113 ± 103	
Repeat	49	63 ± 56		34	141 ± 43	
Cesarean status			0.878			0.468
Planned	59	60 ± 51		42	116 ± 133	
Unplanned, pre-labor	5	63 ± 25		4	195 ± 141	
Unplanned, after labor	36	56 ± 29		29	130 ± 104	
History of buprenorphine or methadone			0.250			—
Yes	3	202 ± 159		—	—	
No	97	55 ± 27		—	—	
Smoker			0.316			0.156
Yes	11	88 ± 101		8	221 ± 188	
No	89	56 ± 29		67	114 ± 109	
Breastfeeding in hospital			0.279			0.214
No	20	72 ± 77		12	182 ± 151	
Yes	75	55 ± 28		59	117 ± 118	
Unknown	5	66 ± 19		4	94 ± 69	
Race (n = 99)			0.618			0.033
Caucasian	62	63 ± 49		44	99 ± 100	
Black	5	60 ± 28		5	222 ± 96	
Asian	1	75 --		1	323 --	
Other	20	46 ± 34		18	135 ± 154	
Unknown	11	60 ± 31		6	203 ± 122	
Ethnicity (n = 99)			0.658			0.465
Hispanic	19	53 ± 32		17	138 ± 132	
Non-Hispanic	78	61 ± 46		55	121 ± 121	
Unknown	2	78 ± 18		2	225 ± 106	
Insurance status (n = 99)			0.212			0.058
Public	49	67 ± 55		38	154 ± 135	
Private	47	52 ± 27		35	95 ± 101	
Unknown	3	48 ± 24		1	270 —	

[a] Inpatient MED use reported as cumulative MED use in final 24 hours of hospitalization.
[b] Not all values total to n=100, n=99 or n=75 due to missing data on the variable of interest
[c] P-value for linear regression for maternal age; p-value for t-test or ANOVA for all other variables.

Forty-nine percent of participants had undergone a repeat (as opposed to primary) cesarean delivery. A history of smoking was documented in the medical record for 11% of women, drug use was reported for 5% of women, and 3% had documentation of ever using methadone or buprenorphine. Any history of a psychiatric comorbidity, defined as anxiety, depression, bipolar disorder, post-traumatic stress disorder, schizophrenia, eating disorder or "other psychiatric comorbidity," were self-reported in 36% of the study population. Seventy-five percent of women were documented by nursing or medical staff as breastfeeding while in the hospital. Four percent were discharged on postpartum day 2, 37% on postpartum day 3 and 59% on postpartum day 4. We compared the sample of participants who completed follow up (n=76) and those who did not (n=24) and found no differences in these characteristics between the two groups (**Table 1**).

In the final 24 hours of hospitalization, participants consumed an average of 59 MED [SD 43], with a range from

Table 5. MED amounts prescribed at discharge and used as an outpatient, by inpatient MED use tertiles.

Inpatient MED Use	Total MED prescribed at discharge (n=100)			Total MED used outpatient post-discharge (n=75)						
Tertile	n (%)	MED Mean ± SD	ANOVA p-value	n (%)	25th percentile	50th percentile	75th percentile	90th percentile	MED Mean ± SD	ANOVA p-value
<= 40 MED	34 (34.0)	255 ± 47	0.502	26 (34.7)	0	23	75	203	53 ± 76	<0.001
41–70 MED	25 (25.0)	251 ± 41		18 (24.0)	38	86	150	315	111 ± 96	
>70 MED	41 (41.0)	266 ± 71		31 (41.3)	53	225	300	323	195 ± 132	

0 to 380 MED (**Table 3**). For reference, 59 MED is equivalent to 40 mg of oxycodone or 60 mg of hydrocodone. For participants, the average inpatient pain score for the final 24 hours of hospitalization was 3.5 [SD 1.0]. At hospital discharge, an average of 258 MED [SD 57] were prescribed per patient, which is equivalent to approximately 170 mg of oxycodone. Most women were prescribed acetaminophen with oxycodone (n=88). For the 100 patients enrolled in the study, a total of 3,150 tabs of acetaminophen/oxycodone, 162 tabs of acetaminophen/hydrocodone and 139 tabs of oxycodone were prescribed.

For the 75 participants included in the analyses of outpatient opiate use, a mean of 126 MED [SD 123] was consumed in the first two weeks after discharge from the hospital, equivalent to 84 mg of oxycodone. Twenty percent of women used no opiate pain medications after hospital discharge, 39% used less than half of what they had been prescribed, 20% used more than half but not all of what they were prescribed and 21% used the entire prescription, with 5 of these participants receiving additional opiate pain medication prescriptions. In total, 47% of prescribed opiates were reported as consumed in the first 2 weeks after hospital discharge. After verifying which of the women who took no opiates had filled their opiate prescription, we calculated that for 75 women, a total of 1,538 tablets of dispensed opiates were not consumed.

At the time of telephone follow-up, two of the 75 study participants reported they were still taking prescription opiates; 34 of the participants reported taking over the counter pain medication only, and 39 of the participants reported no longer using any pain medication. Mean pain score per participant, reported by the participant as average overall pain since hospital discharge on a 0 to 10 scale, was 3.4 [SD 1.8].

Average inpatient and outpatient opiate use was compared across patient demographic and medical characteristics (**Table 4**). Participants with any self-reported psychiatric comorbidity consumed significantly more opiate medication in the final 24 hours inpatient than women without a reported psychiatric comorbidity (75 MED [SD 58] versus 50 MED [SD 30], p = 0.024). This relationship was also seen for outpatient opiate use post discharge (172 MED [SD 152] versus 103 MED [SD 100], p = 0.046. Women who weren't breastfeeding and women with public insurance had higher MED consumption as outpatients than their breastfeeding and private insurance counterparts, but these findings were not statistically significant (**Table 4**).

Mean MED use post-discharge did not differ based on ethnicity, primary versus repeat cesarean or cesarean status (planned, unplanned pre-labor, unplanned in labor). When inpatient MED in the final 24 hours of hospitalization was stratified into three tertiles, there was no difference between low, medium, and high opiate consumers inpatient in the quantity of opiates prescribed at discharge (p = 0.502; **Table 5).** However, the amount of opiates consumed as an inpatient was related to the amount consumed after discharge with low inpatient consumers using 53 MEDs (SD 76), medium consumers using 111 MEDs (SD 96), and high consumers using 195 MEDs (SD 132) post-discharge (p < 0.001, **Table 5**). Among women who used less than or equal to 40 MED in the last 24 hours inpatient, 50% used less than or equal to 23 MED (equivalent to 3 tabs of 5 mg oxycodone) in the 2 weeks following hospital discharge, and 90% used less than 203 MED (equivalent to 27 tabs of 5 mg oxycodone) (**Table 5**). Similarly, when opiate use was analyzed as a continuous variable, there was a positive association between the opiates consumed in the final 24 hours of hospitalization and opiate use after discharge (Pearson r = 0.492, p <0.001) (data not shown). A moderate correlation was also observed between the amount prescribed at discharge and outpatient use (Pearson r = 0.401, p < 0.001). No significant correlation was found between inpatient use and the amount prescribed at discharge (Pearson r = 0.021, p = 0.836).

CONCLUSIONS

Principal findings

In this single-institution study, we found that cesarean delivery patients were prescribed an average of 258 MED for outpatient use and that, at two weeks post-hospital discharge, fewer than half of the opiates prescribed had been consumed. Outpatient opiate consumption after cesarean delivery varied widely (0 to 525 MED) and was positively associated with inpatient opiate use in the 24 hours prior to discharge and self-reported history of any psychiatric comorbidity. The amount of opioids prescribed at discharge was not related to inpatient use, but outpatient opioid consumption was moderately related to the amount prescribed at discharge.

Strength of the study

Strengths of this study include the use of medical record data combined with patient-reported information before and

after hospital discharge. This enabled us to compare three different types of data: inpatient opioid use in the 24 hours before discharge, opioids prescribed at discharge, and opioids used after discharge. Furthermore, participants were provided detailed information about the data which would be requested by the research team at the 2-week follow-up, and were provided with a tool to enhance the accuracy of pill consumption reporting. As this was an observational study and not a clinical trial, there was no standardization of prescriptions and medication dosing provided. In fact, providers were informed that this study should not alter their usual prescribing practices. While prescriptions were often similar, there was enough variation to allow us to compare prescribed opioids with both inpatient use and outpatient use.

Limitations of the data

This study also has several limitations. First, the retrospective collection of patient pill counts could be affected by inaccurate recall and reporting. Participants were asked to report on their opiate use in only the 2 weeks after leaving the hospital, but some participants did not maintain a pill count diary to aid recall. We made every effort to obtain participant reported opiate use in only the first 2 weeks after hospital discharge. However, since attempts to contact participants were made up to 5 weeks following discharge, participants who relied on counting remaining pills at the time of the phone call (as opposed to their pill diary) may have led them to overestimate opiate use (and underestimate the proportion left over in the 2-week window of interest). Although a loss to follow-up of 24% of the sample was a limitation for this study, we found no difference in key characteristics between participants who did and did not complete follow-up, suggesting that selection bias was not a major issue. Additionally, this was a small pilot study that involved only 100 English-speaking patients at an urban academic medical center, and was likely underpowered to detect differences in several patient characteristics. Data from this study may not be generalizable to other patient populations or healthcare delivery settings. Additionally, although body mass index (BMI) may be a factor in pain medication usage, data on patient weight and height were not uniformly recorded in the antepartum or postpartum course, and the study team decided that pre-pregnancy BMI would not be a valid substitute. Thus, weight and BMI were not analyzed with respect to opiate consumption.

Interpretation

Multiple state and federal agencies such as the Washington Agency Medical Directors' Group and the CDC recommend clinicians "tailor" opioid prescriptions to the individual patient, but provide little specific guidance on how that can be accomplished.[3, 8] A better understanding of patient characteristics associated with amount of opioid consumption (and hypothetically, opioid need) after cesarean delivery can assist healthcare providers looking to tailor opioid prescribing for outpatient pain management needs.

Similar to other recently published studies, our study showed that patients prescribed opioids for outpatient pain control after surgery (in our case, cesarean delivery) consumed only a fraction of the pills prescribed, which at a population level translates to millions of opioid tables accessible and available for misuse and diversion. In a recently published multi-center study, Bateman et al. (2017) reported that women were prescribed a median of 40 opioid tablets (interquartile range 30-40), but consumed a median of 20 opioid tablets (interquartile range 8-30) after hospital discharge.[6] Bartels et al. (2016) reported that among 30 women who had a cesarean delivery, a mean of 268 MED were prescribed at discharge and 53% of these women took none or fewer than 5 pills total.[9] Badreldin et al. (2018) reported that women were prescribed a median of 300 MED (interquartile range 200-300) at discharge and 18.5% of women with an opioid prescription used no opioids on the final hospital day.[7] Together with our results, these data suggest that the amount of opioid medication prescribed after cesarean delivery exceeds many patients' pain control needs. However, the amount of opiates consumed after hospital discharge varied widely between individual patients, which suggest that the amount prescribed likely needs to be not only reduced on average, but also individualized.

Other studies have shown that individual patient factors, such as baseline pain impact scores (hysterectomy patients), behavioral and pain disorders (inpatient surgeries including hysterectomy), and mean amount of opioid pain medication used per hour during hospitalization (cesarean delivery patients) are associated with the amount of opioid pain medication consumed after hospital discharge.[10, 11, 12] Based on our findings, a patient's opioid use in the 24 hours prior to discharge is a factor that clinicians could consider when deciding how much opioid medication to prescribe at hospital discharge. A recent randomized controlled trial found that the intervention group who received a tailored discharge prescription based on inpatient opioid use used the same proportion of pills as the standard practice group, but in absolute numbers were prescribed fewer pills, used fewer pills, and had fewer pills left over.[12] Our studies and others have also shown that amount of opioid prescribed is associated with the amount consumed, further emphasizing the need to reduce opioid over-prescribing.[13] Other strategies have been suggested for reducing excess opioid prescriptions; one recent study showed that using a model of patient-physician shared decision making for outpatient opioid prescribing after cesarean delivery decreased the amount of opioids prescribed from 40 tablets (typical) to 20 (actual median) without increasing patient pain.[13] Other suggested strategies to decrease excess prescribing have included limiting the amount that can be prescribed to any one individual patient ("Pain Management"). Prabhu et al. (2017) combined

shared-decision making and setting prescribing limits in a quality improvement project and showed that decreasing the maximum number of opioid pills prescribed from 40 to 30 and then 30 to 25 over time led to a significant decrease in the number of pills prescribed with no change in refill rates.[13]

CONCLUSION

Our study highlights the association of patient-factors with the amount of opioid consumed after delivery and highlights opportunities to develop patient-focused strategies to reduce opioid prescribing while still adequately managing pain after cesarean delivery. Future research should address the development of models and mechanisms to inform clinical resources for personalized pain management and opioid prescribing after cesarean delivery. Research is also needed to determine the optimal prescriptions at discharge that minimize dispensed opioids without increasing pain, dissatisfaction, and hassle for patients. Given the prevalence of cesarean delivery, obstetricians and gynecologists can play a major role in fighting the opioid use epidemic as more judicious prescribers: providing sufficient medication for pain control while minimizing excess opiates which may be misused or diverted.

References

1. US Department of Justice, Drug Enforcement Administration. Automation of Reports and Consolidated Orders System (ARCOS). http://www.deadiversion.usdoj.gov/arcos/index.html. Accessed Jan 4, 2018.
2. U.S. Department of Health and Human Services (HHS), Office of the Surgeon General, Facing Addiction in America: The Surgeon General's Report on Alcohol, Drugs, and Health. Washington, DC: HHS, November 2016.
3. Washington State Agency Medical Directors Group. Interagency Guideline on Prescribing Opioids for Pain.3rd ed. 2015:1-105. http://www.agencymeddirectors.wa.gov/Files/2015AMDGOpioidGuideline.pdf.
4. Pfuntner A, Wier LM, Stocks C. Most Frequent Procedures Performed in U.S. Hospitals, 2011. HCUP Statistical Brief #165. October 2013. Agency for Healthcare Research and Quality, Rockville, MD. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb165.pdf
5. Bateman BT, Franklin JM, Bykov K, Avorn J, Shrank WH, Brennan TA, et al. Persistent opioid use following cesarean delivery: patterns and predictors among opioid-naïve women. *American Journal of Obstetrics & Gynecology* 2016; 215:353.e1-18.
6. Bateman BT, Cole NM, Maeda A, Burns SM, Houle TT, Huybrechts KF, et al. Patterns of Opioid Prescription and Use After Cesarean Delivery. *Obstetrics & Gynecology* 2017; 130(1): 29-35.
7. Badreldin N, Grobman W, Chang K, Yee L. Opioid Prescribing Patterns Among Postpartum Women. *American Journal of Obstetrics & Gynecology* 2018; 219: 103.e1-8.
8. Dowell D, Haegerich TM, Chou R. CDC Guideline for Prescribing Opioids for Chronic Pain — United States, 2016. *Morbidity and Mortality Weekly Recommendations and Reports* 2016; 65 (No. RR-1):1–49.
9. Bartels K, Mayes LM, Dingmann C, Bullard KJ, Hopfer CJ, Binswanger IA. Opioid Use and Storage Patterns by Patients after Hospital Discharge following Surgery. *PLoS ONE* 2016; 11:1-10.
10. As-Sanie S, Till SR, Mowers EL, Lim CS, Skinner BD, Fritsch L, et al. Opioid Prescribing Patterns, Patient Use, and Postoperative Pain After Hysterectomy for Benign Indications. *Obstetrics & Gynecology* 2017; 130(6):1261-1268.
11. Brummet C, Waljee J, Goesling J, Moser S, Lin P, Englesbe M, et al. New Persistent Opioid Use After Minor and Major Surgical Procedres in US Adults. *JAMA Surgery* 2017; 152(6):1-9.
12. Osmundson SS, Schornack LA, Grasch JL, Zuckerwise LC, Young JL, Richardson MG. Postdischarge Opioid Use After Cesarean Delivery. *Obstetrics & Gynecology* 2017; 130(1):36-41.
13. Prabhu M, McQuaid-Hanson E, Hopp S, Burns SM, et al. A Shared Decision-Making Intervention to Guide Opioid Prescribing After Cesarean Delivery. *Obstetrics & Gynecology* 2017; 130(1):42-46
14. Pain Management, Opioid Use and the Registration of Distributors of Controlled Substances in Rhode Island, 216 R.I. Code R. 20-20-4.

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