Prescriber opioid patterns following cesarean section pre and post provider training

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Background: Opioid abuse continues to be an ongoing issue in the United States. Prescriber prescriptions play a large role in this epidemic. This study describes opioid prescribing patterns following cesarean section before and after the New York State Department of Health (NYSDOH) mandated the Opioid Prescriber Training Program in 2017. *Methods*: This is a retrospective cohort study of 1494 women hospitalized for cesarean section at a single institution in New York City between July 2016 and August 2018. We obtained patient data via chart review. *Results*: Primary outcome was total amount of opioid prescribed before and after the Opioid Prescriber Training. Secondary outcomes included outpatient opioid prescription habits by provider level, as well as outpatient opioid prescription patterns related to the amount of inpatient opioid use; and patient, surgical, and hospital-specific factors. There was a significant difference in opioids prescribed before and after training. The median dose of opioid prescribed pre and post intervention was 150 morphine milligram equivalents (MME) which is equal to 20 pills of 5 mg of oxycodone. Pre-training, 41.1% of prescriptions amounted to >150 MME, compared with 21.3% post-training (*p*-value for association <0.001). Post-training, all provider levels had reduced opioid prescriptions in the category of >150 MME. Neither inpatient opioid use, patient demographic, surgical nor hospital factors affected opioid prescriber patterns. *Conclusion*: This suggests that the NYSDOH mandated opioid training course may have contributed towards changing opioid prescribing patterns with the greatest impact noted in resident physicians.

Keywords

Opioid prescriptions; Opioids post-cesarean; Opioid provider training; Prescribing patterns; Provider training

1. Introduction

Opioid abuse in the United States has heightened to dangerous proportions in the past 15 years. According to the Centers for Disease Control and Prevention (CDC), the opioid-related death toll in the United States (US) increased five-fold from 1999 to 2016 [1]. As a result, in 2017 the US Department of Human and Health Services called this "Opioid Crisis" a state of public emergency, and subsequently is funding research and issuing strategies to combat this ongoing problem.

A major contributing factor to this epidemic is the increase in opioid prescriptions. Per the CDC, from 1999 through 2014 opioid prescription sales increased four-fold, and of the 42,000-plus opioid related deaths in 2016, 40% were attributed to a prescription opioid [1]. This rise in opioid prescriptions increases opioid availability as well as potential for abuse and misuse. A 2019 national survey in the US quoted over 10 million people taking prescription opioids for non-medical reasons, commonly using opioids not prescribed to them or using their prescription for other indications than were initially prescribed [2]. In addition, there is a correlation between prescription opioid use and future heroin abuse [3].

In response to the opioid crisis in New York State, the New York State Department of Health (NYSDOH) mandated that all providers who prescribe opioids, including resident physicians under a faculty Drug Enforcement Administration (DEA), complete a three-hour online course entitled "Opioid Prescriber Training Program" by July 1, 2017 [4]. This course describes the various options for pain management in the outpatient and palliative care setting, the physiology of opioids, evidence regarding opioid overuse and consequences of addiction. Most states have specific required coursework, lasting 1–3 hours, for opioid prescribers in this vane. However, no other state mandates resident physicians prescribing opioids to complete a mandatory online training course.

Cesarean section is the most common surgical procedure undergone by reproductive aged women. According to the CDC, there were 1,258,581 Cesarean Deliveries in the US in 2016 [1]. At our institution, Montefiore Medical Center, Weiler Campus there are approximately 4000 deliveries per year and our Cesarean Delivery rate is about 30%. According to a nationwide survey, 85% of women receive a prescription for opioids after their cesarean section [5]. At our institution, Montefiore Medical Center, all patients undergoing cesarean section receive a prescription for opioids upon discharge unless there is a medical contraindication and/or patient declines. Though most women receive an opioid prescription after cesarean section, only a small percentage of opioid naïve

women (1 in 300) become persistent opioid users [6]. The trend in new persistent opioid use over the last decade has decreased [7]. Despite this low incidence, the large number of cesarean sections performed annually translates into a significant number of newly dependent patients and hence plays a role in this serious health problem.

Data regarding opioid prescriptions after cesarean section has revealed that for the most part, the amount of opioids prescribed surpasses the amount consumed [8, 9]. One prospective survey study showed only half the amount of prescribed opioid tablets was reportedly consumed by patients [8]. However much of this data is prior to 2017, and there is an inadequate amount of knowledge on obstetrician prescriber habits after the NYSDOH mandated that all prescribers take an opioid course.

Our primary objective was to describe opioid prescriber practices at time of hospital discharge following cesarean section in a large cohort of women before and after the NYSDOH mandated the Opioid Prescriber Training Program. Secondary aims were to analyze opioid prescription habits by provider level as well as to identify trends in opioid prescription patterns related to the amount of inpatient opioid use as well as surgical and/or hospital specific factors.

2. Materials and methods

2.1 Population

This is a retrospective cohort analysis of women at a single high-volume academic institution who underwent a cesarean section and were discharged from the hospital. This study included all 1494 women hospitalized for cesarean delivery from July 1, 2016 to December 31, 2016 and then from January 1, 2018 to August 31, 2018, excluding women within the one year surrounding the deadline for the NYSDOH mandated Opioid Prescriber Training Program (January 1, 2017 to December 31, 2017). This tertiary center is in an urban area with a multilingual, racially, and ethnically diverse population. Over 80 attending physicians, resident physicians, and physician assistants employed by the hospital system treated these patients and were mandated to complete the online training course.

2.2 Measures

At our institution, women routinely receive neuraxial anesthesia (epidural and/or spinal) for cesarean delivery. In the post-operative period, the obstetrical team manages pain, and women generally receive multi-modal pain management including oral short-acting opioids, most commonly oxycodone or Percocet (oxycodone-acetaminophen). Discharge medications are prescribed at the individual provider's discretion. There are no current guidelines at our hospital for inpatient or outpatient opioid prescriptions. Though there is a post-Cesarean order set in our electronic medical record system Epic (Epic Systems Corporation, Verona, WI, USA), there is no discharge navigator or discharge order set that includes prescriptions.

The Institutional Review Board at Montefiore Medical Center, Albert Einstein College of Medicine approved this study on July 15th, 2019. We obtained information via chart review within EPIC. Our center's electronic medical record system includes all outpatient and inpatient records. We queried demographic information including age, race, ethnicity, and primary language. We then obtained all clinical and pharmacologic data, including patient and surgery specific characteristic as well as inpatient medications and outpatient prescriptions, directly from the electronic medical record. The data was transferred to an electronic database and double checked independently by two members of the research team. If there was missing data, it was labeled as "unknown". We used the same electronic record to see if an opioid was prescribed at discharge, and if so, we included information on the type, strength and number of pills prescribed. We converted all opioids into total morphine milligram equivalents (MME) using conversion rates from CDC.gov to compare amounts more effectively among the different opioids [10]. We obtained this value by converting each opioid dosage to MME and then multiplying by the number of pills [11]. The literature frequently uses this MME conversion to compare amounts between opioids. Our primary outcome was total MME prescribed for outpatient use. We analyzed the total outpatient MME prescribed at discharge before and after the mandated NYSDOH Opioid Prescriber Training. Secondary outcomes included analyzing outpatient opioid prescription habits by provider level. As well as identifying trends in outpatient opioid prescription patterns related to inpatient opioid use, patient (i.e., body mass index, age, race), surgical factors (surgery length, indication for cesarean, estimated blood loss, skin incision, skin closure, anesthesia) and hospital factors (length of stay, infection). Since this study was not focused on actual patient use, we did not collect information on whether the prescriptions were filled.

2.3 Statistical analysis

We computed descriptive statistics (frequencies, medians, and interquartile ranges) to summarize patient, surgical and hospital-specific factors pre and post intervention, as well as across all patients. We assessed the association between cohort (pre vs. post-intervention) and each factor via chi-square test. Due to the clustering of the data with relation to dosing, the data could not be analyzed as a continuous variable, therefore the decision was made to use MME categories. In-house opioid use was categorized as <50, 50–100, and >100 MME. Total amount of opioid prescribed at discharge was categorized as 0, <150, 150, and >150 MME. These categories were chosen for the discharge prescriptions since 150 MME (20 pills of 5 mg of oxycodone) was the median amount of opioid prescribed both pre- and post-intervention. In order to examine the association between opioid prescription patterns and patient, surgical and hospital factors, ordinal logistic regression models were estimated for both the pre- and post-intervention periods. We examined univariate and fully

adjusted models based on a set of *a priori* clinically relevant variables. Age was categorized as ≤25 years, 26–30, 31–35, 36–40, 41–45, 46–50, and >50. BMI was categorized as normal (<25), overweight (25–29.99), obese 1 (30–34.99), obese 2 (35–39.99) and obese 3 (40+). Surgical time was categorized as <30 minutes to >180 minutes in 30-minute increments. Age, surgical time, and BMI were entered into the model as ordinal variables based on the above categorization. Odds ratios (OR) and corresponding 95% confidence limits were estimated. Two-sided *p*-values less than 0.05 were considered statistically significant. All analyses were performed in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1 Demographics

Our study included 1494 patients who received a cesarean section at Montefiore Medical Center Weiler Campus between July 1, 2016 to December 31, 2016 and January 1, 2018 to August 31, 2018 and were discharged from the hospital. Of these patients, 739 had their cesarean between July 1, 2016 through December 31, 2016 before the mandated NYDOH opioid training (the "pre-intervention" group), and 755 had their cesarean between January 1, 2018 through August 31, 2018 after the mandated opioid training (the "post-intervention" group). The patient demographic and obstetric characteristics were similar between groups (Table 1a). The majority of patients were less than 35 years old, Hispanic, English-speaking and nulliparous. Most patients were overweight or obese (BMI >25; 77.8%). In addition, more than half of the patients in each group did not have any prior cesarean sections (51.3%).

The patients' hospital and surgical characteristics were similar between groups. Table 1b shows the relevant details about each cesarean section and hospital course stratified by whether the patients underwent the surgery before or after the mandated opioid training. The majority of patients in both groups had unscheduled cesarean sections (pre-intervention: 67.3%, post-intervention: 62.8%; *p*-value = 0.07). The most common indication for cesarean section was repeat procedure followed by fetal intolerance, and labor dystocia. In majority of the cases the estimated blood loss was less than 1000 cc. However, there was a statistical significance between cohorts with 71% of cases pre-intervention reporting a blood loss less than 1000 cc versus 60.7% post-intervention (*p* = 0.001). In most cases sutures were used for skin closure, but the percentage of surgeries utilizing staples significantly decreased from 9.3% pre-intervention to 5.4% post-intervention (*p*-value = 0.009). Surgical time varied significantly as well. The majority of cases in the pre-intervention group lasted between 30 to 60 minutes versus between 60 to 90 minutes in the post-intervention group (*p*-value = 0.005). For both groups, the most common length of stay in the hospital was 2–3 days. Many of the patients in both groups had horizontal skin incisions (97%) and neuraxial anesthesia (97–98%). Most had no other procedures performed at the time

of cesarean (86–88%), or in-hospital infections (89–90%). Finally, there was a statistically significant association between the level of provider prescribing the opioids and cohort (pre vs post intervention) (*p*-value = 0.001). However, within both the pre and post intervention groups, the largest percentage of opioid prescribers were first year resident physicians (pre-intervention: 66.2%, post-intervention: 72.5%).

3.2 Outcomes

Table 2 summarizes the prescribing patterns pre and post training. A lower percentage of prescriptions post-training were >150 MME (21.3%) as opposed to prior to the training (45.1%) and a higher percent were <150 MME post-training (22.5% vs. 13.7%; *p*-value for association <0.001). The median amount prescribed remained 150 MME pre- and post-intervention. Table 3 examines prescribing patterns stratified by prescribing provider level. Pre-intervention, there was a statistically significant association between provider level and opioid prescription category (*p*-value = 0.03). Resident physicians were 1.63 times more likely to prescribe higher categories of opioids compared to physician assistants, fellows, and attendings (95% CI: (1.04, 2.54)). In an *a priori* model adjusted for age, race, body mass index (BMI), surgery time, prior cesarean section, in-house infection, in-house opioid use and whether other procedures were performed, this association remained statistically significant (OR = 3.42; 95% CI: (1.14, 10.24); data not shown). Post-training, all provider levels had reduced proportions of opioid prescriptions in the >150 MME category. We observed large reductions in opioid prescriptions >150 MME after the training period in 2nd through 4th year resident physicians such that during the pre-intervention phase, 84% and 65% of 2nd and 3–4th year resident physicians prescribed >150 MME respectively, compared to 22% and 28% post-intervention. In post-intervention univariate and adjusted models, there were no statistically significant associations between provider level and the amount category of opioids prescribed (*p*-values 0.30 and 0.65 respectively). Total in-house opioid use was observed to be associated with higher levels of opioids prescribed post-intervention in univariate analysis, however this effect was not statistically significant in the *a priori* adjusted model (OR >100 vs. ≤50 MME = 1.10, 95% CI: (0.71, 1.72)). There were no patient or surgical factors that were associated with the amount of opioids prescribed in either univariate or multivariable analysis. Therefore, with the exception of in-house opioid use, multivariable models did not yield qualitatively different results. See **Supplementary Table 1**. Table 4 summarizes univariate associations for selected patient and surgical characteristics pre and post intervention.

4. Discussion

Our study suggests that this training course may have assisted in altering prescriber practices after January 1, 2018, at our institution. Post-intervention, we found that higher amounts of opioids were prescribed less often, and lower amounts of opioids were prescribed more often; prescrip-

Table 1a. Patient demographics and characteristics pre and post intervention.

Characteristics	Pre-intervention	Post-intervention	Overall (%)	*p*-value
Age (years)				
Missing	100 (13.5%)	97 (12.8%)	197 (13.2%)	0.386
≤25	166 (22.5%)	149 (19.7%)	315 (21.1%)	
26–30	168 (22.7%)	170 (22.5%)	338 (22.6%)	
31–35	169 (22.9%)	193 (25.6%)	362 (24.2%)	
36–40	96 (13%)	103 (13.6%)	199 (13.3%)	
41–45	39 (5.3%)	37 (4.9%)	76 (5.1%)	
46–50	1 (0.1%)	4 (0.5%)	5 (0.3%)	
>50	0 (0%)	2 (0.3%)	2 (0.1%)	
Race				
Asian	53 (7.2%)	57 (7.5%)	110 (7.4%)	0.010
White	82 (11.1%)	46 (6.1%)	128 (8.6%)	
Black	203 (27.5%)	221 (29.3%)	424 (28.4%)	
Unknown	311 (42.1%)	348 (46.1%)	659 (44.1%)	
Other	90 (12.2%)	83 (11%)	173 (11.6%)	
Ethnicity				
Spanish/Hispanic/Latino	371 (50.2%)	370 (49%)	741 (49.6%)	0.110
Not Spanish/Hispanic/Latino	308 (41.7%)	342 (45.3%)	650 (43.5%)	
Unknown	60 (8.1%)	43 (5.7%)	103 (6.9%)	
English preferred language				
Yes	603 (81.6%)	594 (78.7%)	1197 (80.1%)	0.157
No	136 (18.4%)	161 (21.3%)	297 (19.9%)	
Gravida				
1	157 (21.2%)	189 (25%)	346 (23.2%)	0.010
2	189 (25.6%)	162 (21.5%)	351 (23.5%)	
3	155 (21%)	158 (20.9%)	313 (21%)	
4	119 (16.1%)	91 (12.1%)	210 (14.1%)	
>4	119 (16.1%)	155 (20.5%)	274 (18.3%)	
Parity				
0	266 (36%)	287 (38%)	553 (37%)	0.290
1	249 (33.7%)	226 (29.9%)	475 (31.8%)	
2	152 (20.6%)	147 (19.5%)	299 (20%)	
3	50 (6.8%)	59 (7.8%)	109 (7.3%)	
4	12 (1.6%)	22 (2.9%)	34 (2.3%)	
>4	10 (1.4%)	14 (1.9%)	24 (1.6%)	
Prior CS				
0	382 (51.7%)	384 (50.9%)	766 (51.3%)	0.826
1	223 (30.2%)	226 (29.9%)	449 (30.1%)	
2	106 (14.3%)	109 (14.4%)	215 (14.4%)	
>2	28 (3.8%)	36 (4.8%)	64 (4.3%)	
BMI (unit kg/m^2)				
Unknown	154 (20.8%)	106 (14%)	260 (17.4%)	0.013
<18.5	2 (0.3%)	1 (0.1%)	3 (0.2%)	
18.5–24.9	39 (5.3%)	29 (3.8%)	68 (4.6%)	
25–29.9	142 (19.2%)	167 (22.1%)	309 (20.7%)	
30–34.9	174 (23.5%)	185 (24.5%)	359 (24%)	
35–39.9	114 (15.4%)	139 (18.4%)	253 (16.9%)	
>40	114 (15.4%)	128 (17%)	242 (16.2%)	

tions of moderate amounts of opioids remained unchanged. Additionally, though not statistically significant on the multivariate model, there was an association noted between in-house opioid use, and the amount of opioids prescribed. Our data also suggests that amount of opioid prescribed did not correlate with patient demographics, and surgical and hospital factors.

Table 1b. Surgical and hospital characteristics pre and post intervention.

Characteristics	Pre-intervention	Post-intervention	Overall (%)	p-value
C-section scheduled				
Scheduled	242 (32.7%)	281 (37.2%)	523 (35%)	0.070
Unscheduled	497 (67.3%)	474 (62.8%)	971 (65%)	
Estimated blood loss (mL)				
≤1000	525 (71%)	458 (60.7%)	983 (65.8%)	0.001
>1000	214 (29%)	297 (39.3%)	511 (34.2%)	
Indication				
Elective Repeat	293 (39.6%)	305 (40.4%)	598 (40%)	0.078
Elective Primary*	31 (4.2%)	34 (4.5%)	65 (4.4%)	
Fetal Malpresentation	55 (7.4%)	74 (9.8%)	129 (8.6%)	
Active Herpes	3 (0.4%)	4 (0.5%)	7 (0.5%)	
Suspected Fetal Macrosomia	5 (0.7%)	6 (0.8%)	11 (0.7%)	
Fetal Intolerance of Labor	223 (30.2%)	175 (23.2%)	398 (26.6%)	
Labor Dystocia	98 (13.3%)	127 (16.8%)	225 (15.1%)	
Other†	31 (4.2%)	30 (4%)	61 (4.1%)	
Surgery time (minutes)				
Missing	23 (3.1%)	28 (3.7%)	51 (3.4%)	0.005
<30	9 (1.2%)	17 (2.3%)	26 (1.7%)	
30–60	354 (47.9%)	288 (38.1%)	642 (43%)	
60–90	267 (36.1%)	302 (40%)	569 (38.1%)	
90–120	67 (9.1%)	89 (11.8%)	156 (10.4%)	
120–150	12 (1.6%)	18 (2.4%)	30 (2%)	
150–180	4 (0.5%)	4 (0.5%)	8 (0.5%)	
>180	3 (0.4%)	9 (1.2%)	12 (0.8%)	
Length of hospital stay (days)				
2–3	325 (44%)	334 (44.2%)	659 (44.1%)	0.657
4	203 (27.5%)	218 (28.9%)	421 (28.2%)	
5	101 (13.7%)	107 (14.2%)	208 (13.9%)	
>5	110 (14.9%)	96 (12.7%)	206 (13.8%)	
In-house infection				
None	664 (89.9%)	672 (89%)	1336 (89.4%)	0.596
Infections‡	75 (10.1%)	83 (11%)	158 (10.6%)	
Skin incision				
Horizontal (Pfannenstiel/Mallard)	715 (96.7%)	738 (97.7%)	1453 (97.3%)	0.298
Midline Vertical	24 (3.2%)	17 (2.3%)	41 (2.7%)	
Skin closure				
Suture	673 (90.7%)	717 (94.6%)	1390 (92.7%)	0.009
Staples	69 (9.3%)	41 (5.4%)	110 (7.3%)	
General anesthesia				
No	718 (97.2%)	737 (97.6%)	1455 (97.4%)	0.527
Yes	21 (2.8%)	18 (2.4%)	39 (2.6%)	
Other procedures				
None	637 (86.2%)	665 (88.1%)	1302 (87.1%)	0.621
Bilateral Tubal Ligation	83 (11.2%)	77 (10.2%)	160 (10.7%)	
Cesarean Hysterectomy	6 (0.8%)	6 (0.8%)	12 (0.8%)	
Myomectomy	5 (0.7%)	2 (0.3%)	7 (0.5%)	
Other	8 (1.1%)	5 (0.7%)	13 (0.9%)	
Provider level				
No prescription given	35 (4.7%)	43 (5.7%)	78 (5.2%)	0.001
Postgraduate Year 1 (PGY1)	489 (66.2%)	547 (72.5%)	1036 (69.3%)	
Postgraduate Year 2 (PGY2)	82 (11.1%)	95 (12.6%)	177 (11.8%)	
Postgraduate Year 3 (PGY3)	39 (5.3%)	20 (2.6%)	59 (3.9%)	
Postgraduate Year 4 (PGY4)	10 (1.4%)	9 (1.2%)	19 (1.3%)	
Physician Assistant	10 (1.4%)	11 (1.5%)	21 (1.4%)	
Fellow	2 (0.3%)	0 (0%)	2 (0.1%)	
Attending	72 (9.7%)	30 (4%)	102 (6.8%)	

*Elective Primary: includes maternal request for elective cesarean, maternal request for cesarean in the setting of twins and maternal request in the setting of a history of fourth degree laceration or shoulder dystocia.

†Other: includes cesarean for placenta abruption, placenta previa, placenta accreta spectrum and history of myomectomy.

‡Infections: includes chorioamnionitis and endometritis cases.

Table 2. Total amount of narcotic prescribed pre and post intervention.

Total narcotic (MME)	Number of patients pre-intervention (%)	Number of patients post-intervention (%)	Total patients (%)	Range of narcotics prescribed (MME)
None	35 (4.7%)	42 (5.6%)	77 (5.2%)	0
<150	101 (13.7%)	170 (22.5%)	271 (18.1%)	15–140
150	307 (41.5%)	382 (50.6%)	689 (46.1%)	150
>150	296 (45.1%)	161 (21.3%)	457 (30.6%)	157.5–1800

p-value < 0.0001.

None: includes patients with no prescriptions given.

Table 3. Narcotic prescriber patterns stratified by level of prescriber pre and post intervention.

Provider levels	Prescribing patterns pre-intervention (%)			Prescribing patterns post-intervention (%)		
	<150 MME	150 MME	>150 MME	<150 MME	150 MME	>150 MME
Postgraduate Year 1	71 (14.5%)	254 (52%)	164 (33.5%)	128 (23.5%)	296 (54.2%)	122 (22.3%)
Postgraduate Year 2	2 (2.4%)	11 (13.4%)	69 (84.2%)	21 (22.1%)	53 (55.8%)	21 (22.1%)
Postgraduate Years 3–4	6 (12.2%)	11 (22.5%)	69 (65.3%)	8 (27.6%)	13 (44.8%)	8 (27.1%)
Physician Assistants, Fellows, Faculty	22 (26.2%)	31 (36.9%)	31 (36.9%)	13 (31.7%)	20 (48.8%)	8 (19.5%)

p-value (pre-intervention <0.0001; post-intervention = 0.86).

The median amount of prescribed opioid was 150 MME (20 pills of 5mg oxycodone) both pre- and post-intervention. Though 150 MME remained the median amount of opioid prescribed, we observed a decline in the percentage of prescriptions >150 MME (21.3%) post-training as opposed to (45.1%) prior to training, a reduction that was particularly apparent in resident physicians. This apparent decline of prescriptions >150 MME especially in resident physicians is important because at many academic institutions, resident physicians may be responsible for discharge prescriptions. Although many states now require an opioid training course for providers prior to prescribing opioids, New York mandates resident physician training as well.

There was a significant difference in BMI and race between the groups. We hypothesized that this was because more than 40% of the patients in the cohorts were documented as race "unknown". Therefore, it is unclear which racial groups were most affected by this category and makes it difficult to determine if the difference noted between the groups is truly significant. We are not aware of any data showing changes in the racial distribution of patients at our institution during the time period studied. Our post intervention group had a decrease in patients with BMI less than 25 and an increase in the overweight and obese categories. The BMI changes observed in the post-intervention group are consistent with the increase in obesity reported in adults living in the Bronx from 2015 to 2019 and therefore are not surprising [12]. Between the two groups there was a significant difference in surgery time, estimated blood loss and skin closure. Surgeries were longer post-intervention possibly due to an increase in new, young hires who frequently can have longer surgical times when compared to experienced faculty. The difference in estimated blood loss between groups may be explained by the implementation of "Quantitative Blood Loss" measurements where nurses cal-

culated blood loss for deliveries using a standard formula. Though we used "Estimated Blood Loss" in our study, we understand the measurement of quantitative blood loss may bias providers' estimations as well. The majority of cases were closed using sutures. Though the decrease in the use of staples post-intervention was significant, we do not believe that this is clinically relevant, and would have to perform future studies to determine a true association.

The main strength of our study is that we reviewed an extensive cohort of women in the pre, and post intervention groups and we were able to look at prescriber patterns for a large number of diverse providers of varying levels using a reliable EMR system.

This is a retrospective study with a high risk, urban patient population, which may not be generalizable of all cesarean deliveries in other states or countries. Our study only looked at our providers' prescription habits, and this may not accurately depict which prescriptions were filled by the patients and/or amount of opioid consumed. There were a variable number of providers in each level, with the largest number of prescriptions being written by resident physicians. Our total analysis did not account for prescription habits between providers of different levels. However, we do not feel that controlling for provider level would alter the effect since in general PGY1–2 in the pre-intervention group were PGY3–4 in the post-intervention group.

Another limitation is that our institution briefly piloted an Enhanced Recovery After Surgery or ERAS protocol around the same time-period that we performed our chart review. This trial included 58 patients and used an inpatient only post-operative order set. Data from the protocol demonstrated that our ERAS pilot was not associated with a reduction in postoperative opioid use compared to standard of care [13]. There was an association between in-house opioid use and prescription patterns post-intervention with the univari-

Table 4. Univariate associations of total amount of narcotic prescribed pre and post intervention.

Factor	Group	Pre-intervention OR (95% CI)	Post-intervention OR (95% CI)
Age*	Ordinal	0.98 (0.87, 1.11)	1.05 (0.94, 1.19)
Race	Asian	0.89 (0.48, 1.66)	1.03 (0.49, 2.15)
	Black	1.16 (0.73, 1.85)	0.96 (0.52, 1.76)
	Unknown	0.99 (0.63, 1.54)	0.92 (0.51, 1.66)
	Other	1.14 (0.66, 1.99)	0.86 (0.43, 1.72)
	Ref: white		
Ethnicity	Spanish/Hispanic/Latino	0.93 (0.7, 1.23)	0.92 (0.69, 1.21)
	Unknown	1.19 (0.72, 1.98)	0.94 (0.51, 1.73)
	Ref: NOT S/H/L		
Prior CS	Ordinal	0.92 (0.78, 1.08)	0.96 (0.82, 1.12)
BMI*	Ordinal	1.01 (0.95, 1.08)	1.05 (0.98, 1.13)
CS	Unscheduled	0.85 (0.64, 1.13)	1.21 (0.92, 1.6)
	Ref: Scheduled		
Surgery time*	Ordinal	1.08 (0.92, 1.28)	1.1 (0.95, 1.27)
In-house infection	Infections§	0.98 (0.62, 1.54)	0.97 (0.63, 1.51)
	Ref: none		
Skin Incision	Midline Vertical	1.12 (0.71, 1.77)	1.08 (0.63, 1.87)
	Ref: Horizontal		
Skin closure	Suture	0.86 (0.39, 1.91)	1.09 (0.6, 1.97)
	Ref: Staples		
General anesthesia	Yes	1.84 (0.77, 4.39)	0.88 (0.36, 2.16)
	Ref: No		
In-house narcotics prescribed	50–100 MME	1.10 (0.73, 1.66)	1.74 (1.13, 2.68)
	>100 MME	1.28 (0.88, 1.89)	1.58 (1.08, 2.3)
	Ref: <50 MME		
Other procedures performed	Yes	1.46 (0.97, 2.19)	0.73 (0.29, 1.83)
	Ref: No		
Prescribing provider level‖	Ordinal	1.15 (1, 1.32)	0.94 (0.79, 1.12)
	Resident physicians	1.63 (1.04, 2.54)	1.38 (0.75, 2.54)
	Ref: PA, fellow, faculty		

*Categories for Age: ≤25, 26–30, 31–35, 36–40, 41–45, 46–50, and >50 years, BMI: <25, 25–29.99, 30–34.99, 35–39.99, 40+ kg/m^2; Surgical time: <30, 30–59.9, 60–89.9, 90–119.9, 120–149.9, 150–179.9, 180+ minutes.

§Infections includes chorioamnionitis, endometritis, surgical site infections and other related infections.

‖Excludes cases where no narcotics were prescribed.

S/H/L: Spanish/Hispanic/Latino.

ate analysis and since ERAS was aimed to specifically decrease opioid use post-operatively there is the possibility it impacted our outcome.

5. Implications for practice and/or policy

Our study suggests a role in provider training and education in altering prescribing practices as a means of addressing the opioid epidemic. The positive shift in prescribing patterns in resident physicians supports that they be included in interventions to improve hospital practices and patient care. Opioid education should be included as part of the residency curriculum. This is especially significant since resident physicians will move on to become prescribing physicians themselves.

6. Conclusions

It is important to note that the observed changes in provider practices may not be solely related to this single intervention, but could be a combination of effects including the intervention as well as an overall increase in awareness through the media, news etc. Further studies would be needed to confirm causality.

There was an association between in house opioid use and prescribing patterns in the post-intervention group. Surprisingly, this association failed to be significant in the multivariate analysis. One would expect the amount of opioid use in-house to predict use at home in the immediate post-operative setting, and therefore would be influential. More studies are needed to better elucidate this data. Patient demographic,

surgical or hospital factors did not influence opioid prescriptions. Next steps would include a prospective study looking at the percentage of patients that filled their opioid prescriptions and actual patient consumption upon discharge.

Author contributions

TB was the primary investigator on this project. This author was involved in initial conceptualization and project planning. She supervised the initiation and progress of the entire project. She played a major role in writing final paper and was responsible for final review and editing. AC was involved in conceptualization of project with primary investigator. This author carried out the data research and recording in database. She played a large role in writing the original draft and in subsequent revisions. MF was the statistician on the project. This author provided formal statistical analysis and interpretation and wrote the statistical portions of the paper. GN assisted in data collection and input into the database. This author collaborated in writing the original draft. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and the protocol was approved by the Institutional Review Board at Montefiore Medical Center, Albert Einstein College of Medicine on July 15th, 2019. This was a chart review without direct patient contact, hence individual patient consent was not required. Institutional review board number is 2018-9111.

Conflict of interest

The authors declare no conflict of interest.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at https://ceog.imrpress.com/EN/10.31083/j.ceog4806227.

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