Impact of Enhanced Recovery After Surgery pathway for cesarean delivery on postoperative pain

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BACKGROUND: Enhanced Recovery After Surgery pathways provide evidence-based recommendations to optimize perioperative care.
OBJECTIVE: This study aimed to holistically investigate the effect of implementing an Enhanced Recovery After Surgery pathway for all cesarean deliveries on postoperative pain experience.
STUDY DESIGN: This was a prepost study comparing subjective and objective measures of postoperative pain before and after the implementation of an Enhanced Recovery After Surgery pathway for cesarean delivery. The Enhanced Recovery After Surgery pathway was developed by a multidisciplinary team and included preoperative, intraoperative, and postoperative components, with emphasis on preoperative preparation, hemodynamic optimization, early mobilization, and multimodal analgesia. All individuals undergoing cesarean delivery, whether scheduled, urgent, or emergent, were included. Demographic, delivery, and inpatient pain management data were obtained through medical record review. Of note, 2 weeks after discharge, patients were surveyed about their delivery experience, analgesic usage, and complications. The primary outcome was inpatient opioid use.
RESULTS: The study included 128 individuals, 56 in the preimplementation cohort and 72 in the Enhanced Recovery After Surgery cohort. Baseline characteristics between the 2 groups were similar. The survey response rate was 73% (94/128). Opioid use in the first 48 hours postoperatively was significantly lower in the Enhanced Recovery After Surgery group than the preimplementation group (9.4 vs 21.4 morphine milligram equivalents 0−24 hours after delivery [$P<.001$]; 14.1 vs 25.4 morphine milligram equivalents 24−48 hours after delivery [$P<.001$]) with no increase in either average or maximum postoperative pain scores. Individuals in the Enhanced Recovery After Surgery group used fewer opioid pills after discharge (10 vs 20; $P<.001$). Patient satisfaction and complication rates did not change after the implementation of an Enhanced Recovery After Surgery pathway.
CONCLUSION: The implementation of an Enhanced Recovery After Surgery pathway for all cesarean deliveries decreased both inpatient and outpatient postpartum opioid use without increasing pain scores or decreasing patient satisfaction.

Key words: cesarean delivery, Enhanced Recovery After Surgery, multimodal analgesia, opioid reduction, opioid use, perioperative care

Introduction

First introduced in colorectal surgery in 2001, Enhanced Recovery After Surgery (ERAS) pathways offer a comprehensive standardized approach to perioperative care.[1] A key principle of ERAS pathways is minimization of the physiological disturbances of surgery, through shorter preoperative fasting periods, nutrition optimization, maintenance of normothermia, early mobilization, and multimodal analgesia.[2] ERAS pathways have been successfully implemented in many surgical specialties—including benign gynecologic surgery and gynecologic oncology—with improved patient satisfaction, decreased infection rates, shorter postoperative length of stay, and cost savings.[2,3]

The adoption of ERAS principles for obstetrical procedures has lagged behind other specialties, but recent calls to action led to an increase in the use of ERAS bundles for cesarean delivery (CD) at both public and private institutions, with promising results.[4] However, data on the use of an ERAS protocol for unscheduled, intrapartum CD are lacking. The Society for Obstetric

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Why was this study conducted?

The feasibility of an Enhanced Recovery After Surgery (ERAS) protocol for unscheduled cesarean deliveries (CDs) remains unclear, and many protocols only include prelabor CD. This study was conducted to holistically compare postoperative pain experience before and after the implementation of an ERAS protocol for all CDs.

Key findings

After the implementation of an ERAS protocol, postoperative opioid use both inpatient and after discharge decreased by 50%. Despite this decrease, pain scores were unchanged, and patient satisfaction remained high.

What does this add to what is known?

Using a pathway with multiple entry points, a comprehensive ERAS protocol was successfully implemented for scheduled and urgent and emergent intrapartum CDs in a diverse population.

Anesthesia and Perinatology released a protocol for enhanced recovery after CD; however, they did not address how recommendations might be applied in an emergent situation.[5] Although the ERAS Society Cesarean Delivery Guidelines include ERAS pathways for both scheduled and unscheduled CDs, most previous studies on implementation and outcomes have included only scheduled ones.[6–14] The integration of these principles into the dynamic, often hectic, setting of intrapartum CD presents not only unique challenges but also meaningful opportunities to improve care. ERAS bundles may have many effects, but previous studies have often focused on only one or a few outcomes, potentially missing unexpected adverse effects and importantly lacking patient-reported measures.[15]

This study aimed to examine the feasibility of the implementation of an ERAS protocol for all CDs and to study its effects on postoperative pain through objective and subjective patient-reported measures. We hypothesized that the ERAS bundle could be successfully used for not only scheduled CD but also emergent CD and would decrease postoperative opioid needs and improve patient satisfaction.

Materials and Methods

We conducted a prospective cohort study evaluating the effect of an ERAS protocol for CDs at a large, public teaching hospital. We used a prepost study design, comparing data from a cohort before the implementation of an ERAS protocol with a second cohort after the implementation of an ERAS protocol at a single hospital. The ERAS protocol (Figure 1) was developed with a multidisciplinary team of physicians, nurses, staff, and administrators from obstetrics, anesthesia, labor and delivery, postpartum units, preoperative anesthesia testing unit, pharmacy, clinic, and the electronic medical record team and was based on published consensus guidelines.[6–8] The protocol included preoperative, intraoperative, and postoperative components, with emphasis on patient preparation, hemodynamic optimization, thermoregulation, early mobilization, and multimodal analgesia (Figure 1). The protocol was specifically designed to ensure that all patients undergoing CD regardless of urgency could enter the pathway at the appropriate point and receive care consistent with ERAS principles. Patients undergoing scheduled CD received bundled interventions beginning during prenatal clinic visits, including a preanesthesia consultation visit, educational materials, and an ERAS kit with chlorhexidine soap and carbohydrate drinks. Patients undergoing unscheduled or intrapartum CD received all intraoperative and postoperative interventions. This included patients who underwent emergent CD.

Before the implementation of an ERAS protocol, standard care included nothing by mouth after midnight before surgery and no standardized preoperative medications. All postoperative pain medications were ordered as needed. The implementation of an ERAS protocol was accomplished after a 3-month education and development campaign. This education was iterative and allowed for refinement of the protocol before finalizing it for implementation.

As part of the ERAS pathway, we increased patient education and emphasized multimodal analgesia. Patients received oral analgesic and antiemetic medications in the preoperative area and weight-based fluid administration. Infusion of a long-acting opioid with neuraxial anesthesia was already standard. Our ERAS protocol included incisional injection of liposomal bupivacaine intraoperatively, which was not previously available at our institution. Postoperatively, urinary catheters were removed in the recovery area in the absence of a contraindication. Patients were advanced to a clear liquid diet immediately and to a regular diet 2 hours after surgery. A new ERAS postoperative order set was developed that included scheduled acetaminophen, nonsteroidal anti-inflammatory drugs, and gabapentin, with opioid analgesics available on demand as needed.

The primary exposure was delivery after the implementation of an ERAS pathway with the control group being individuals who delivered in the preimplementation period. The baseline, or pre-ERAS, cohort included individuals who underwent CD from June 1, 2019, to June 30, 2019. The ERAS protocol was implemented over a 3-month period from October 2019 to December 2019. A 1-month washout period after full implementation of an ERAS protocol was given before the collection of data on the postimplementation group. The postimplementation, or ERAS, cohort included individuals delivering from January 6, 2020, to February 14, 2020. These timeframes were not chosen based on an a priori sample size calculation but rather based on the timing of the

FIGURE 1
Key elements of the ERAS protocol

Preoperative elements	Intraoperative elements	Postoperative elements
Pre-anesthesia clinic consultation within 72 hours of scheduled CD	Abdominal and vaginal sterile preparation (all cases)*	Foley catheter removal in PACU
Standardized educational materials*	Use of forced air warmer, room temperature above 21°C	Advancement to regular diet within 2 hours
Chlorhexidine gluconate wash for shower evening before CD*	Vasopressor infusion to prevent neuraxial anesthesia induced hypotension	Scheduled non-opioid analgesia (acetaminophen, NSAIDs, gabapentin)
Carbohydrate drink day before and morning of CD	Infusion of long-acting opioid with neuraxial anesthesia*	Opioids available as needed on patient request*
Clear liquids up to 2 hours before CD	Blunt extension of hysterotomy cephalad-caudad*	Encourage early mobilization*
Pre-operative medications: - Antacid - H2 blocker - Acetaminophen - Gabapentin - Limited fluid preloading (15ml/kg IBW) - Prophylactic antibiotics per institutional policy*	Delayed cord clamping*	Mechanical VTE prophylaxis (pharmacologic prophylaxis as indicated by risk factors)*
	Closure of subcutaneous layer if >2cm in depth*	Standard lactation consultation and contraceptive counseling in postpartum period*
	Liposomal bupivacaine infiltration prior to skin closure	Standardized discharge instructions*

Asterisk represents components that were part of standard care before ERAS protocol implementation.

CD, cesarean delivery; *ERAS*, Enhanced Recovery After Surgery; *IBW*, ideal body weight; *NSAID*, nonsteroidal anti-inflammatory drug; *PACU*, postanesthesia care unit; *VTE*, venous thromboembolism.

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implementation. The exclusion criteria from the analysis included intrauterine or intrapartum fetal death, cesarean hysterectomy, chronic opioid use during pregnancy, and immediate use of a patient-controlled intravenous analgesia system postoperatively. All other CDs in the timeframe were included.

Demographic and clinical data were obtained via medical record review. Beginning on postoperative day 14, individuals were contacted via phone or e-mail and invited to participate in a survey about their delivery experience and analgesic usage. Non−English-speaking individuals were surveyed in their preferred language with the assistance of a phone interpreter, and no individual was excluded because of primary language. Approval as an exempt quality improvement study from the Indiana University Institutional Review Board was obtained before the initiation of the study.

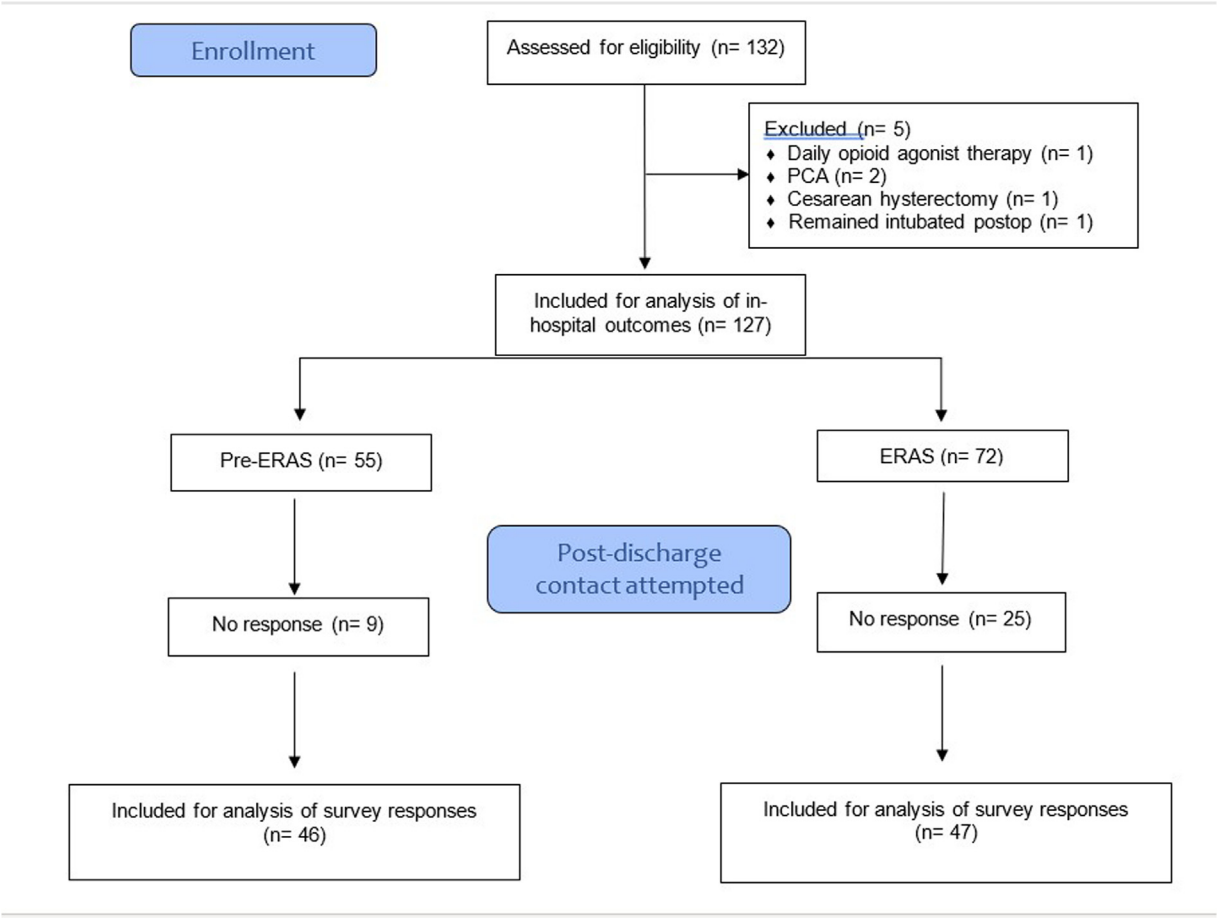
The primary outcome was inpatient postoperative opioid usage in morphine milligram equivalents (MME). All intravenous and oral opioids were converted to MME using standard conversions.[16] The secondary outcomes included opioid use after discharge, postoperative average and maximum pain scores on the visual analog scale, patient satisfaction measures, postoperative infection (defined as diagnosis of endometritis, urinary tract infection, or surgical site infection), time to urinary catheter removal, readmission, unscheduled phone calls and triage visits for pain, and breastfeeding at discharge and at time of survey completion.

Participant and delivery characteristics were compared between the pre-ERAS and ERAS groups using appropriate tests (t test, χ^2 test, or Fisher exact test). Frequencies and percentages were used to describe categorical variables. Study data were collected and managed using Research Electronic Data Capture tools hosted at Indiana University. All analyses were based on the assigned groups and completed using SAS software (version 9.4; SAS Institute, Cary, NC). We followed the Standards for QUality Improvement Reporting Excellence 2.0 guidelines for reporting quality improvement studies.[17]

Results

During pre-ERAS data collection, 59 individuals delivered via CD. Of note, 73 individuals delivered via CD during the postimplementation (ERAS) data collection time (Figure 2). Moreover, 5 patients were excluded from the analysis, 4 from the pre-ERAS cohort and 1 from the ERAS cohort. Of the patients, 1 was excluded because of cesarean hysterectomy and intrapartum fetal death, 2 were excluded for immediate use of a patient-controlled intravenous analgesia system postoperatively, 1 was excluded

FIGURE 2
Flow diagram



ERAS, Enhanced Recovery After Surgery; *PCA*, patient-controlled intravenous analgesia.

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for daily use of an opioid agonist for medication-assisted therapy of opioid use disorder, and 1 was excluded for remaining intubated postoperatively on a propofol infusion. Here, 55 individuals in the pre-ERAS cohort and 72 individuals in the ERAS cohort were included for analysis (Figure 2).

There was no significant difference between the groups in maternal age, body mass index (BMI) at delivery, self-identified race, gestational age at delivery, rates of nulliparity, or primary CD rate. In addition, there was no significant difference in the rates of trial of labor before undergoing CD or indication for CD (Table 1).

Opioid use in the ERAS group was significantly lower in the first 48 hours postoperatively than the pre-ERAS group (9.4±12.7 vs 21.3±14.1 MME 0−24 hours after delivery [P<.001]; 14.1±14.9 vs 25.7±14.9 MME 24−48 hours after delivery [P<.001]) (Table 2). The maximum and average postoperative pain scores were similar between the groups at all time points. In a subgroup analysis, the outcomes were not different whether the participants labored before CD or underwent prelabor scheduled CD.

The choice and quantity of discharge medications were left to the discretion of the discharging provider both before and after the implementation of an ERAS protocol. The number of opioid pills prescribed at discharge did not change after the implementation of an ERAS protocol (median: 20 pills [interquartile range (IQR), 20−30] vs 20 pills [IQR, 11−20]) (Table 2); however, individuals in the ERAS cohort reported taking fewer opioid pills after discharge (median: 10 pills [IQR, 3−16] vs 20 pills [IQR, 15−23]; P<.001) (Table 3).

After the implementation of an ERAS protocol, the most common choice of opioid prescribed at discharge changed from a combination hydrocodone-acetaminophen pill (92.9% of prescriptions in the pre-ERAS group) to oxycodone alone (72.9% of prescriptions in the ERAS group). Both the mean MME and median number of opioid pills prescribed at discharge were similar between the 2 groups (Table 2).

TABLE 1
Demographics

Characteristics	Pre-ERAS cohort (n=55)	ERAS cohort (n=72)	*P* value
Maternal age at delivery (y)	30.0±5.9	27.9±6.2	.07
BMI at delivery (kg/m^2)	34.9±6.9	34.3±6.4	.64
Race and ethnicity			.88
White	5 (9.1)	7 (9.7)	
Black	34 (61.8)	39 (54.2)	
Hispanic	14 (25.5)	23 (31.9)	
Other	2 (3.6)	3 (4.2)	
Primary language			.52
English	40 (72.7)	52 (73.6)	
Spanish	10 (18.2)	16 (22.2)	
Other	5 (9.1)	3 (4.2)	
Gestational age at delivery (wk)	38.1±1.9	38.1±2.3	.94
Nulliparous	19 (34.6)	28 (38.9)	.62
Primary CD	26 (47.3)	38 (52.8)	.48
Indication for CD[a]			.59
Previous CD	29 (52.8)	32 (44.4)	
Nonreassuring fetal heart rate tracing	11 (20.0)	16 (22.2)	
Malpresentation	5 (9.1)	4 (5.6)	
Arrest of dilation	3 (5.6)	8 (11.1)	
Arrest of descent	4 (7.3)	7 (9.7)	
Abnormal placentation	0 (0)	2 (2.8)	
Multiple pregnancy	1 (1.8)	0 (0)	
Macrosomia	0 (0)	2 (2.8)	
Other	2 (3.6)	1 (1.4)	
Trial of labor	26 (47.3)	41 (56.9)	.28
Vertical skin incision	2 (3.6)	0 (0)	<.01
Vertical hysterotomy	2 (3.6)	5 (6.9)	.70

Data are presented as mean±standard deviation or number (percentage), unless otherwise indicated. *P* values were obtained using the independent *t* test for continuous variables and the Fisher exact test for categorical variables.

BMI, body mass index; *CD*, cesarean delivery; *ERAS*, Enhanced Recovery After Surgery.

[a] Column totals may sum to >100% because of multiple indications for CD in some patients.

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The overall postdischarge survey response rate was 75% (93/127). There was no difference in age, BMI, gestational age, race and ethnicity, or primary language between survey responders and nonresponders. Individuals who responded to the follow-up survey were more likely than nonresponders to be nulliparous, more likely to have undergone primary CD, and less likely to have had a trial of labor. Inpatient opioid use in the postpartum period was higher on average among responders than nonresponders (Appendix).

The satisfaction ratings were high both before and after the implementation of an ERAS protocol with no difference in patient satisfaction between groups (*P*=.44) (Table 3). Patients in both groups reported similar ratings of overall pain after discharge and comparison of pain to expectations. There was no increase in phone calls, clinic visits, or visits to triage or the emergency department for postoperative pain and no difference in the rates of opioid prescription refills.

Postoperative complication rates were assessed both through medical record review and patient report (Tables 2 and 3). The infection rates and rates of breastfeeding at discharge and at the time of follow-up survey were unchanged after the implementation of an ERAS protocol. The mean length of initial perioperative bladder catheterization significantly decreased after the implementation of an ERAS protocol (14.1±4.7 vs 8.4±9.1 hours; *P*<.001; median: 12.6 hours [IQR, 12.2−13.6] vs 3.5 hours [IQR, 2.9−14.5], respectively) (Table 2); however, the rates of acute urinary retention necessitating in-and-out catheterization or bladder catheter replacement were higher in the ERAS group (0.0% vs 10.6%; *P*=.02).

No individual in the pre-ERAS group was readmitted after delivery. However, 4 in ERAS group were readmitted in the postpartum period, 2 for new-onset preeclampsia, 1 for a wound complication, and 1 for a pulmonary embolism. There was no statistically significant difference in readmission rates (*P*=.13).

Comment

Principal findings

An ERAS pathway was successfully implemented for both scheduled and urgent CDs. Inpatient postoperative opioid use decreased by 50% after the implementation of an ERAS protocol, without an increase in postoperative pain scores. The reduction in opioid pills used persisted after discharge as well. There was no significant difference in postoperative complications or patient satisfaction.

Results in the context of what is known

We found a 50% reduction in both inpatient opioid use in the first 48 hours after delivery and opioid pills used after discharge. Previous studies have demonstrated reductions in opioid use of similar magnitude with the introduction

TABLE 2
Hospital outcomes

Outcomes	Pre-ERAS cohort (n=55)	ERAS cohort (n=72)	*P* value
MME use			
0–24 h after delivery	21.3±14.1	9.4±12.7	<.001
24–48 h after delivery	25.7±14.9	14.1±14.9	<.001
Maximum pain score			
0–24 h after delivery	7.1±2.0	6.3±2.8	.06
24–48 h after delivery	7.4±1.9	6.8±2.5	.08
Average pain score			
0–24 h after delivery	2.6±1.6	2.3±1.6	.26
24–48 h after delivery	3.7±1.6	3.4±1.8	.38
Opioid pills prescribed at discharge	20 (20–30)	20 (11–20)	.20
MME prescribed at discharge	122.9±31.3	133.6±78.1	.34
Urinary catheter in place (h)	14.1±4.7	8.4±9.1	<.001
Acute urinary retention	0 (0)	7 (10.6)	.02
Infection	2 (3.6)	4 (5.6)	.70
Triage or acute clinic visit after discharge	11 (20.0)	11 (15.3)	.49
Breastfeeding at discharge	48 (85.7)	61 (84.7)	.42
Readmission	0 (0)	4 (5.6)	.13

Data are presented as mean±standard deviation, number (percentage), or median (interquartile range), unless otherwise indicated. *P* values were obtained using the Fisher exact test for categorical variables and Chi-square test, independent t-test or Kruskal-Wallis test for continuous variables.

ERAS, Enhanced Recovery After Surgery; *MME*, morphine milligram equivalents.

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of ERAS pathways[3,10–14,18–22]; however, unlike many others, our study showed that these benefits occurred not only for scheduled deliveries but also for emergent deliveries.

In addition, our protocol included several analgesic components not present in other published protocols; specifically, we used scheduled gabapentin both preoperatively and postoperatively and incisional injection of liposomal bupivacaine. We feel that these interventions represent safer modalities for pain control than opioid medications, and we hope to study them separately and in bundles in future studies.

A shorter postoperative length of stay is a commonly touted benefit of ERAS pathways, both in obstetrics and in other surgical specialties. Previous studies of ERAS for CD have inconsistently demonstrated decreases in postoperative length of stay.[10,11,19–21,23–25] We did not include this outcome in our study because we could not accurately determine the precise time of discharge from the review of the electronic medical record. In addition, discharge timing after CD is multifactorial, often dependent on both maternal and neonatal factors, and any difference in length of stay would likely be confounded by multiple factors outside of ERAS interventions.

Clinical implications

We assessed pain control comprehensively, using inpatient pain scores and analgesic usage after discharge and patient-reported perceptions of pain control. We found no difference in pain scores or patient satisfaction despite a significant reduction in opioid use, demonstrating that ERAS pathways may offer an effective method to reduce opioid use without compromising postoperative pain control. In a subgroup analysis, these results were not different whether patients underwent scheduled or unscheduled intrapartum CD. On average, individuals in the ERAS group used 10 less opioid pills after discharge than those in the pre-ERAS cohort. If these results are generalizable, the use of an ERAS pathway for all CDs in the United States could result in a decrease in outpatient opioid use of more than 10 million pills annually.

An unintended consequence of the introduction of the ERAS pathway was a change in the most commonly prescribed opioid at discharge from a combination opioid-acetaminophen pill to an opioid-only pill. This shift likely occurred because providers favored prescribing the same opioid individuals received while inpatient, and the ERAS order set included scheduled acetaminophen with oxycodone 5 mg as needed. Although this was not an outcome we predicted, prescribing a decoupled opioid pill facilitates multimodal analgesia and continuation of regular dosing of acetaminophen after discharge, in alignment with the American Pain Society guidelines for postoperative pain management.[26]

Research implications

The recently published guidelines for ERAS for CD offer guiding principles for the design of an ERAS protocol, but with few specific recommendations.[6–8] As such, although the areas of emphasis of ERAS protocols are largely similar, from our anecdotal discussions with practitioners in other hospitals and review of published protocols, specific components vary widely among institutions. Future studies are needed to identify and optimize specific components of ERAS pathways that may be the most crucial for improved outcomes and to examine cost-effectiveness.

In our study, catheters were removed at a median of 3 hours after surgery. Understandably, there was a higher rate of acute urinary retention in the ERAS group. The benefits of early catheter removal to facilitate early postoperative mobilization may outweigh the downsides of an increase in the need for intermittent in-and-out catheterization

TABLE 3
Postdischarge follow-up survey responses

Variables	Pre-ERAS cohort (n=46)[a]	ERAS cohort (n=47)[a]	*P* value
Overall satisfaction[b]	+3.8±2.3	+4.1±1.6	.44
Overall pain[c]	4.5±2.9	4.3±2.6	.65
How would you describe your pain from your cesarean delivery?			.73
More than what I expected	16 (34.8)	17 (36.2)	
What I expected	17 (37.0)	14 (29.8)	
Less than what I expected	13 (28.3)	16 (34.0)	
Number of opioid pills taken after discharge	20 (15–23)	10 (3–16)	<.001
Number of unused opioid pills	1 (0–8)	6 (0–13)	.15
Took all opioid pills prescribed	23 (53.5)	18 (45.0)	.44
Breastfeeding	28 (60.9)	34 (72.3)	.24
Since leaving the hospital, have you called or seen a doctor because of pain?	Yes: 8 (17.4) No: 38 (82.6)	Yes: 5 (10.6) No: 42 (89.4)	.35
Since leaving the hospital, have you gone to the emergency room for any reason?	Yes: 2 (4.4) No: 44 (95.7)	Yes: 3 (6.4) No: 44 (93.6)	1.00

Data are presented as mean±standard deviation, number (percentage), or median (interquartile range), unless otherwise indicated. *P* values were obtained using the Fisher exact test for categorical variables and the chi-square test, independent *t* test, or Kruskal-Wallis test for continuous variables.

ERAS, Enhanced Recovery After Surgery.

[a] Number values vary for each question, as not all survey respondents responded to each question; [b] Participants were asked to rate overall satisfaction on a Likert scale from −5 (extremely dissatisfied) to +5 (extremely satisfied); [c] Participants were asked to rate overall pain since discharge on a scale from 0 (no pain) to 10 (worst pain imaginable).

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(10.6%), but further investigation is needed to determine the ideal timing of catheter removal to balance these factors. There was no difference in the rates of postoperative urinary tract infection between groups, but our study was underpowered for that outcome.

Strengths and limitations

Most previously published studies regarding the implementation of an ERAS protocol for CD have only included scheduled CD or low-risk individuals, but we included all patients undergoing CD, regardless of the urgency of delivery, trial of labor, indication, primary language, or comorbidities. Our study population was diverse (58% Black, 29% Hispanic, and 27% non-English speaking). We assessed outcomes both objectively through the review of the electronic health record and subjectively through patient surveys and included patient satisfaction markers and postdischarge follow-up, which we believe offers a uniquely comprehensive view of the effects of this quality improvement initiative.

Inherent to a prepost study design, we cannot rule out the possibility that other unmeasured factors, Hawthorne effects, or personnel or practice changes that occurred during the study period may have contributed to the observed results. As with any quality improvement bundle, it is difficult to determine which components of the pathway drove the outcomes. We had an overall high survey response rate, although the response rate was higher in the pre-ERAS group than in the ERAS group, likely because of the ability to make more attempts at contact when summer research students were present. More patients in the pre-ERAS group had a previous CD than in the ERAS group, and although this difference did not reach statistical significance, this may have contributed to differences in postoperative pain. Infection and readmission rates were low in both groups, and this study was underpowered to detect potential differences between groups in these relatively rare outcomes. We did not record the training level of the primary surgeon as all CDs at our facility are performed by residents under the direct supervision of attending obstetricians and all were trained on the ERAS protocol. As techniques of procedures were relatively standard regardless of which level of resident performed the surgery with the attending, we did not believe this would affect opioid use postoperatively, the primary outcome.

Conclusions

The introduction of an ERAS pathway for all CDs was associated with decreased opioid use both inpatient and after discharge with no associated change in pain scores or patient satisfaction in a diverse population. ■

Appendix

	Survey responders (n=94)	Survey non-responders (n=33)	P-value
Maternal age at delivery (y)	28.9 ± 6.0	28.6 ± 6.7	0.80
BMI (kg/m^2)	34.4 ± 7.0	35.0 ± 5.3	0.70
Race/ethnicity			0.87
White	8 (8.5)	4 (12.1)	
Black	56 (59.6)	17 (51.5)	
Hispanic	26 (27.7)	11 (33.3)	
Other	4 (4.2)	1 (3.1)	
Primary language			0.11
English	73 (77.7)	20 (60.6)	
Spanish	17 (18.1)	9 (27.3)	
Other	4 (4.3)	4 (12.1)	
Gestational age at delivery (wk)	38.0 ± 2.2	38.2 ± 1.9	0.80
Nulliparous	40 (42.6)	7 (21.1)	0.03
Primary CD	53 (56.4)	11 (33.3)	0.03
Trial of labor	55 (58.5)	12 (36.4)	0.03
MME use			
0-24h postpartum	16.7 ± 15.0	8.5 ± 11.2	<0.01
24-48h postpartum	21.3 ± 16.5	13.0 ± 12.4	0.01

CD, cesarean delivery. BMI, body mass index

Data are mean ± SD or n (%).

P-values obtained from Fishers' exact test for categorical variables and Chi-square test or independent t-test for continuous variables.

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