

# Implementation of an Enhanced Recovery After Surgery Program for Colorectal Surgery at a Community Teaching Hospital

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## ABSTRACT

**Introduction:** Perioperative programs aimed at decreasing surgical stress to colorectal patients can reduce hospital length of stay and morbidity while improving the patient's perception of the surgical experience. Our goal was to transform patient care from a perioperative platform based on individual physician and nurse choice to a standardized evidence-based Enhanced Recovery After Surgery (ERAS) protocol for all patients undergoing elective colorectal resections.

**Methods:** An institutional review board-approved retrospective review was performed for the first 12 months of ERAS protocol-driven patient care in 2014 and compared to the prior 12 months (2013) of individual choice managed care.

**Results:** Ninety-nine patients and 92 patients underwent elective colorectal surgery in the post-ERAS and pre-ERAS period, respectively. The post-ERAS group experienced a shorter length of stay ( $4.9 \pm 2.7$  vs  $6.2 \pm 4.0$  days,  $P=0.001$ ), were more likely to advance to a general diet on postoperative day 1 (72% vs 9%,  $P<0.001$ ), and had quicker return of bowel function ( $2.3 \pm 1.8$  vs  $2.8 \pm 1.1$  days,  $P<0.0001$ ) compared to the pre-ERAS group. Thirty-day complications were similar between the post-ERAS and pre-ERAS groups and included anastomotic leak (4% vs 0%,  $P=0.120$ ), surgical site infections (4% vs 8%,  $P=0.990$ ), and abscess (3% vs 3%,  $P=0.990$ ). Eleven (11%) post-ERAS patients and 7 (8%) pre-ERAS patients were readmitted within 30 days postoperative ( $P=0.410$ ).

**Conclusion:** We implemented change through a new system of care based upon standardized evidence-based ERAS protocols through the preoperative, intraoperative, and postoperative patient experience. In the first year of the ERAS program, patients experienced a reduced length of stay without a significant difference in morbidity or mortality.

## INTRODUCTION

Enhanced recovery after surgery (ERAS) protocols have been developed to improve patient care in recent years. The pri-

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mary goal of these protocols is to reduce patients' surgical stress response, decrease postoperative morbidity and mortality, decrease the length of hospital stay, and improve patients' perception of the surgical experience.<sup>1-3</sup> The development of ERAS protocols involve multimodal changes during the preoperative, intraoperative, and postoperative periods to focus on patient preoperative preparation, nutrition, fluid management, early mobilization, advancement of diet, and prevention of complications.

In patients undergoing elective colorectal surgery, implementation of the ERAS protocols have resulted in shorter hospital stays without significantly impacting morbidity and mortality.<sup>3-7</sup> Patient satisfaction scores with these protocols using validated measures have suggested increased satisfaction with postoperative pain and fatigue.<sup>8</sup> Economic evaluations of colorectal ERAS protocols have indicated a beneficial effect,

supporting their cost-effectiveness.<sup>7</sup>

Our goal was to implement a standardized ERAS pathway for all patients undergoing elective colorectal resections at our community teaching hospital based on previously published protocols, and compare patient outcomes before versus after ERAS implementation.<sup>2</sup> This would change our institution's practice pattern from a perioperative platform based on individual physician and nurse choice to a standardized evidence-based ERAS protocol. We hypothesized that, despite our previously demonstrated shorter lengths of stay<sup>9-11</sup> compared to other reports in the literature,<sup>3</sup> a further decrease in length of stay and 30-day complication rates would be observed after implementation of an ERAS protocol for patients undergoing elective colorectal resection.

**Table 1.** Practice Changes Introduced with ERAS Protocol Implementation

Preoperative	Intraoperative	Postoperative
Preadmission patient education	Intraoperative fluid management	Minimize narcotic pain management
Preoperative isovolemic bowel preparation	Active prevention of hypothermia	Early mobilization
Decreased preoperative fasting with preoperative carbohydrate loading	Prevention, treatment of postoperative nausea, vomiting	Early initiation of diet Prevention of ileus-Alvimopan
Single dose oral/IV antimicrobial prophylaxis	Laparoscopic assisted surgery Transverse incision	Early urinary catheter removal
Prevention of ileus-Alvimopan	Removal of nasogastric tubes	Chemical and mechanical VTE prophylaxis
	No peritoneal drain placement	Postoperative IV fluid restriction

Abbreviations: ERAS, enhanced recovery after surgery; IV, intravenous; VTE, venous thromboembolism.

## METHODS

The implementation of a standard preoperative, intraoperative, and postoperative ERAS protocol at our medical center occurred in January 2014 after several key steps. We followed a “Plan, Do, Study, Act” model to facilitate a smooth transition from an era of patient care based on provider preference to one with a standardized protocol used by all clinicians. First, the appropriate settings, roles, and resources needed to succeed were identified. A core group of surgeons and surgical residents reviewed the available literature on ERAS, including an evidence-based care pathway from the 2009 ERAS Group Recommendations from Lassen et al.<sup>2</sup> In addition, members of a core planning committee attended a conference with presentations focused on colorectal ERAS programs.

Our institution is an integrated multispecialty health system serving 19 counties over a 3-state region. The medical center at the main campus includes a 325-bed teaching hospital. At the time of ERAS introduction, there were 18 attending surgeons, 15 general surgery residents, and 1 minimally invasive/bariatric surgery fellow within the surgery department. The entire general surgery staff and resident surgeons were educated on the ERAS approach and reported the benefits and principles of an ERAS protocol. Once the core team established a framework of ERAS principles to guide patient care preoperatively, intraoperatively, and postoperatively, it was presented within the general surgery department. A review period was allowed to address concerns with the protocol. To gain support from the Anesthesia Department, meetings also were held with the department chair. With a base from the ERAS Society, a final protocol was developed that included some areas of compromise in order to gain buy-in from the general surgery and anesthesia departments.

After support was obtained from attending surgeons and resident providers, principles were presented and education provided to general surgery clinic nurses, preoperative and postoperative

nurses, anesthesia care providers, pharmacists, nutritionists, electronic medical record personnel, and patient education services. The specific aspects of care pertinent to the different care providers were discussed. A “nurse champion” was established on the preoperative and postoperative surgical unit to help with clarifying ERAS protocols. In addition “surgical champions” – the surgeon authors – were designated for all hospital staff to approach with questions or concerns.

Updated patient education material describing the anticipated steps of ERAS was developed and given to patients at their preoperative appointment and

reviewed again by postoperative nurses each day of the patient’s hospitalization. Order sets were created and standardized in the electronic medical record system.

The protocol was implemented first in a pilot program with modifications and additional teaching completed as necessary, and we ensured buy-in of the protocol from all groups prior to full roll-out. At 3 months post implementation, areas of non-compliance were identified and addressed with the noncompliant individuals and at a system level, and changes were made. The goal of these interventions was to create a smooth transition to a standardized protocol for use in the perioperative care of elective colorectal surgery patients.

The agreed upon ERAS protocol included the initiatives presented in Table 1. All areas of change focused on reducing surgical stress and included updated patient education, decreased preoperative fasting with preoperative carbohydrate loading, intraoperative fluid restriction, active prevention of hypothermia, alvimopan administration preoperatively and postoperatively, minimization of narcotic pain medication, and early initiation of diet. Anesthesia providers were instructed to use a goal-directed administration of intravenous (IV) crystalloid based on vital signs and urine output. Alvimopan, a mu-opioid receptor antagonist, was administered in a single preoperative dose and postoperatively twice daily until return of bowel function. Alvimopan was not used with patients who were on chronic narcotics. An attempt to minimize narcotics postoperatively was made by using acetaminophen and nonsteroidal anti-inflammatory drugs, including toradol, as adjuncts.

In order to evaluate the outcomes of the ERAS protocol, Institutional Review Board approval was obtained, and a retrospective review of the medical records of all patients who underwent elective colorectal resection with or without ostomy creation (total colectomy, sigmoidectomy, transverse colon resection, right or left hemicolectomy, or cecetomy) after protocol implementation

**Table 2.** Preoperative Characteristics and Perioperative Outcomes

Variable	Pre-ERAS	Post-ERAS	P value
N	92	99	
Sex, n (%)			0.980
Female	50 (54)	54 (55)	
Male	42 (46)	45 (45)	
Mean Age, years	65.4 ± 12.6	63.1 ± 14.4	0.240
ASA Class, n (%)			0.047
I	6 (7)	7 (7)	
II	37 (40)	57 (58)	
III	48 (52)	33 (33)	
IV	1 (1)	2 (2)	
Laparoscopic approach, n (%)	59 (60)	65 (71)	0.110
Mean operative time, (minutes)	208 ± 76	206 ± 77	0.64
Pathology, n (%)			0.67
Benign	62 (67)	64 (65)	
Malignant	30 (33)	35 (35)	
Mean number of PODs	6.5 ± 4.0	5.2 ± 2.7	<0.001

Abbreviations: ERAS, enhanced recovery after surgery; ASA, American Society of Anesthesiologists; POD, postoperative day; NG, nasogastric.

(January 2014 – December 2014) was completed. Patients in the post implementation (post-ERAS) group were compared to patients who underwent elective colorectal surgery during the year prior to ERAS implementation (January 2013 – December 2013; pre-ERAS group). Pediatric patients (<18 years of age) were excluded from the study. Statistical analysis included Wilcoxon Rank Sum and Fisher's Exact tests. A *P*-value < 0.05 was considered significant.

## RESULTS

Overall, 191 patients met inclusion criteria for this study. Ninety-two patients were included in the pre-ERAS period of individual provider preference and 99 in the post-implementation group. The patient groups were similar in age and sex but the post-implementation group had a lower American Society of Anesthesiologists (ASA) class compared to the pre-ERAS group (Table 2). There was no difference between groups for the rate of laparoscopic approach, the mean operative time, or the pathology of the colon (Table 2).

The mean intraoperative fluid volume administered was 2562 cc pre-implementation compared to 2124 cc post-implementation (*P*=0.009). In the post-ERAS group, Alvimopan was used preoperatively in 83% of patients and postoperatively in 84%, compared to only 12% and 14%, respectively, in the pre-ERAS group (*P*<0.001). In both groups, most patients received some narcotic pain medication for postoperative pain control. The post-ERAS group had reduced use of patient-controlled analgesia (PCA), which resulted in significantly less IV opioid consumption (Figure 1). This led to an overall decrease in IV narcotic use and increase in oral narcotic usage. The median oral morphine

equivalents increased from 22.5 to 45.0 in the pre-ERAS vs post-ERAS groups (*P*=0.038). Patients in whom an open approach was planned were offered an epidural; this did not change post-implementation (Figure 1).

Eighty-one percent of patients were given a liquid diet on the night of surgery, and 72% were advanced to a general diet on postoperative day 1 (Figure 2). Bowel function returned earlier in the post-ERAS group, at a mean of 2.3 ± 1.8 postoperative days vs 2.8 ± 1.1 days pre-implementation (*P*<0.001). There was no significant difference in the number of nasogastric tubes placed after surgery between the groups (16% pre-ERAS vs 8% post-ERAS; *P*=0.080). Based on early initiation of diet, use of mu-opioid antagonists, and use of nonnarcotic pain medications, the adherence to the protocol was 75%.

Post-implementation patients had a shorter postoperative length of stay than the pre-ERAS group (Table 2). There were no statistically significant differences in 30-day complications (Figure 3). The 30-day readmission rate was 8% and 11% pre-implementation and post-implementation, respectively (*P*=0.46). The reasons for readmissions in the pre-ERAS group included abscess (n=2), urinary tract infection (n=2), urinary tract infection and ileus (n=1), urinary tract infection and surgical site infection (n=1), and hematoma (n=1). In the post-ERAS group, reasons included anastomotic leak (n=4), intraabdominal abscess (n=3), perianastomotic air without a leak (n=1), failure to thrive (n=1), nausea/vomiting (n=1), and exacerbation of congestive heart failure (n=1).

## DISCUSSION

Our community teaching hospital's general surgery department developed a protocol-based care pathway for our elective colorectal surgery patients that affected all aspects of perioperative care. Through a multimodal, team-based approach, we were able to gain cooperation from all groups involved and create a culture change by transitioning from an individual provider preference pathway to a standardized, evidence-based ERAS pathway. Challenges to ERAS implementation included gaining support from anesthesia, surgical, and nursing staff. These challenges were addressed by reviewing the existing evidence for each ERAS measure while making some modifications to the protocol based on input from each group. After initial protocol implementation, feedback from participating departments was considered and addressed. While a decrease in intraoperative fluid per case was observed, we did not designate an anesthesiology champion for ERAS measures; future adopters of ERAS protocols should consider this when implementing such a protocol. Nursing time constraints to provide preoperative and postoperative education was a concern among nurses under pressure to do more work in the same patient encounter. These constraints were recognized and collaboration with nursing leadership allowed for the appropriate

support. Adherence to the ERAS protocol was approximately 75%.

Overall, integration of the protocol produced favorable results. No changes to surgical techniques were implemented; as such, surgical approach, operative times, and pathology were similar pre- and post-implementation. The protocol resulted in reduced intraoperative fluid administration, reduced PCA usage, earlier advancement of diet and return of bowel function, and a shorter hospital length of stay (LOS).

The early advancement of diet and quicker return of bowel function observed in the post-ERAS group may have contributed to the shorter LOS, which, in turn, may have been associated with a quicker return to normal daily activities and decreased resource utilization—an important consideration in the current era of cost-containment in health care. Aarts et al performed a multivariate logistic regression analysis of ERAS principles which indicated that preoperative counseling, intraoperative fluid restriction, laparoscopic approach, postoperative initiation of clear fluids, and early removal of the urinary catheter were independently associated with a shortened LOS.<sup>12</sup>

Thirty-day morbidity and mortality was similar pre- and post-implementation. While the pre-ERAS group is notable for an anastomotic leak rate of zero, we believe that this represents an exceptionally favorable year. Historically, our anastomotic leak rate has ranged from 0.4% to 3.2%.<sup>9-11</sup> The post-ERAS anastomotic leak rate is consistent with our institution's outcomes over the past decade.

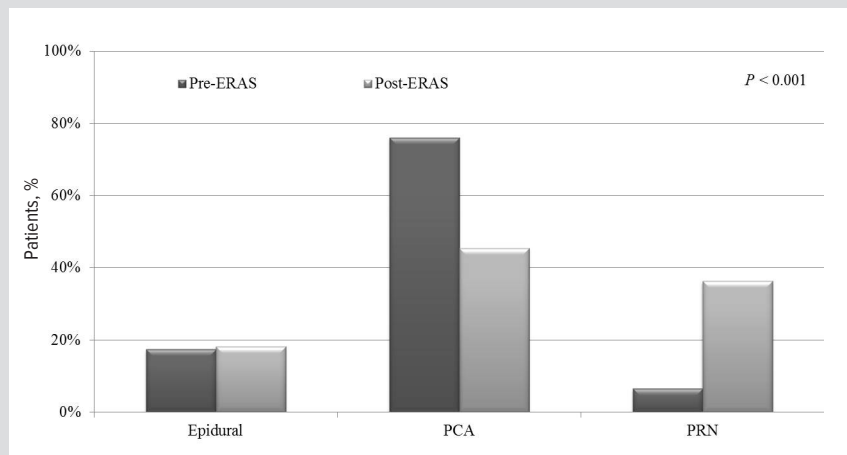
The 30-day readmission rate was slightly higher in the post-ERAS group, which may be attributable to the anastomotic leaks. In the pre-ERAS group, 4 of the 7 readmissions were for urinary tract infections (UTI). The ERAS protocol included early removal of urinary catheters, which may have prevented UTI-related readmissions. Although the difference in readmission rates pre- and post-intervention was not statistically significant, it warrants further investigation.

The outcomes of ERAS in this study were comparable to those reported in a comprehensive meta-analysis of ERAS data in the literature;<sup>3</sup> however, our outcomes were improved with respect to minor complication rates including urinary tract infections,

surgical site infections (6.1% vs 39.4%), major complication rates including sepsis, anastomotic leak, reoperation, ileus, abscess, and *C. Difficile* infection (14.3% vs 21.2%), and 30-day mortality rates (2.0% vs 1.3%), respectively. The length of stay in our series was 5.2 days, which was comparable to those reported in the literature, ranging from 4 to 7.4 days.

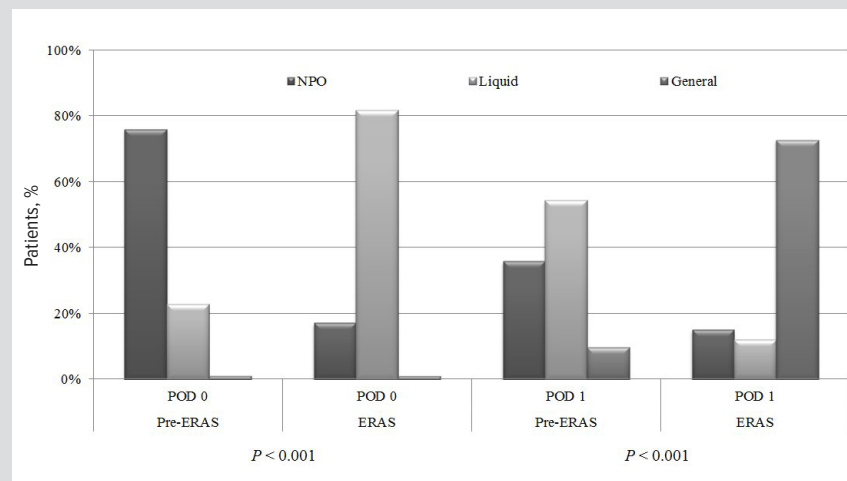
Limitations to this study include its retrospective nature, limited sample size, and single institution experience. Most of the core ERAS group recommendations were adopted; however, the practice of mechanical and antibiotic bowel preparation was continued as part of an ongoing quality improvement effort to reduce the rate of surgical site infection within our medical center. Adherence to each protocol component was encouraged, but not required, and there were no strict discharge criteria during the study period. Additionally, patient satisfaction and return to activ-

**Figure 1.** Modalities Used for Postoperative Pain Control



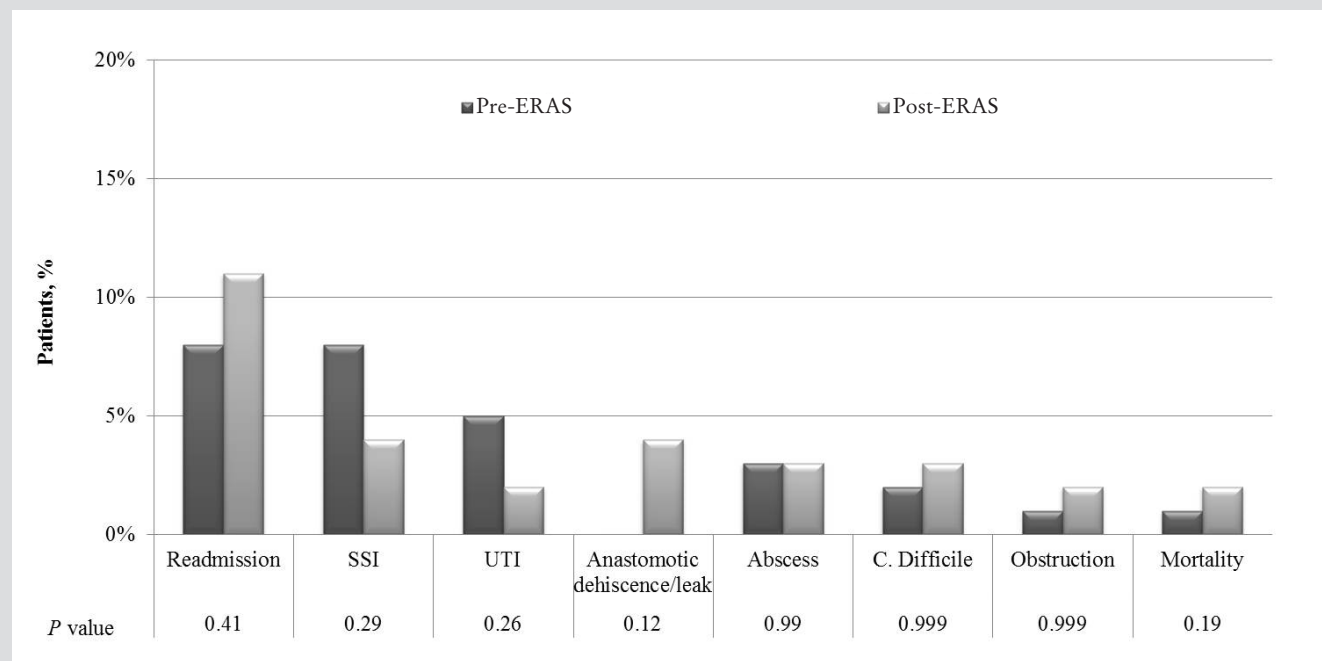
Abbreviations: PCA, patient-controlled analgesia; PRN, as needed; ERAS, enhanced recovery after surgery.

**Figure 2.** Postoperative Advancement of Diet



Abbreviations: NPO, nothing by mouth; POD, postoperative day; ERAS, enhanced recovery after surgery.

**Figure 3.** Thirty-Day Postoperative Readmission, Morbidity and Mortality



Abbreviations: SSI, surgical site infection; UTI, urinary tract infection.

ity were not evaluated. Future research on these protocols should include patients' satisfaction with their surgical experience and perceived pain control.

This study illustrates the feasibility of ERAS implementation at a community-based, integrated multispecialty health system. It also highlights the importance of multidisciplinary care and a collaborative, evidence-based approach to practice change. Despite the fact that no changes in surgical techniques occurred, patient care was positively affected by the protocol. In bringing the change full circle, we have distributed these data within our health system to provide feedback and reinforce the benefits of the change.

## CONCLUSION

An ERAS protocol for elective colorectal surgery was successfully implemented at our community teaching hospital. Implementation of the protocol led to a culture change within our medical center, and improved patient care by decreasing the length of stay, without an increase in surgical morbidity and mortality. This study highlights the importance of a multidisciplinary collaborative approach to change preoperative and postoperative patient care in order to improve patient outcomes.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

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