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## The Effect of an Education Plan on Nursing Intervention Compliance with Inpatient Post-Operative Colorectal Surgical Patients Using Enhanced Recovery after Surgery (ERAS) Protocols

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Running head: EFFECT OF AN EDUCATION PLAN ON NURSING INTERVENTION

The Effect of an Education Plan on Nursing Intervention Compliance with Inpatient Post-Operative Colorectal Surgical Patients Using Enhanced Recovery after Surgery (ERAS)

Protocols

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing Practice at the University of Kentucky

By

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Louisville, KY

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Abstract

**BACKGROUND:** Compliance with the enhanced recovery after surgery (ERAS) protocols for colorectal surgery patients in the post-operative inpatient setting is low, creating a gap in successful outcomes of the program.

**OBJECTIVE:** The purpose of this project is to evaluate the impact of an education plan on inpatient nursing staff. A second purpose of the study is to examine the relationship between ERAS and specific post-operative nursing interventions linked to length of stay (LOS).

**METHODS:** A prospective cohort study analyzing the effect of a knowledge to action (KTA) education plan on nursing compliance with ERAS protocols was conducted on bedside nursing staff caring for the colorectal ERAS post-operative population using a new test instrument for pre- and post-testing. Patient chart reviews were conducted on 164 pre education intervention and 19 post education intervention. Outcome measures of patient data include time to liquids, solids and mobility, pain modality used first post-operatively, length of stay and readmissions.

**RESULTS:** Nursing knowledge demonstrated post-test improvement in scores by 4.33 points with a *p* value of 0.058. There was clinical significance in process measures of time to liquids, solids and mobility which decreased by 2.8-13.9 hours from closure time. There was a slight increase in opioid-first mediated pain management which was not statistically significant. Length of stay showed clinical significance in reduction by one day, but ungeneralizable.

**CONCLUSION:** There were limitations in this study most notably small sample size affecting the ability to obtain statistically significant data. The KTA education intervention for nursing staff in areas of ERAS inpatient populations does suggest evidence of increasing compliance to order sets and ERAS initiatives.

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### **Dedication**

I would like to dedicate my final DNP project to my husband, Jerimy, and my children, Grace and Seth. Without the patience, love and support garnered from them I would not have succeeded in this amazing journey. Thank you to my husband for being a sounding block and cheerleader for the last three years, providing the motivation for me to try harder and persevere. Thank you to my children for sometimes sacrificing quality time for homework and still encouraging me to accomplish my work. I hope they will see that hard work and learning can be fun and challenging when you work on projects you believe in and find interesting and substantial.

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## Introduction

The main goals for quality healthcare are optimal patient outcomes, satisfaction, and cost effectiveness; this is true in the surgical field as it is throughout the healthcare system. Enhanced recovery after surgery (ERAS) is a structured perioperative care pathway which uses a multidisciplinary approach to minimize complications and stress to the body, improve patient outcomes and maintain cost effectiveness through patient education, optimized nutrition, volume status, pain management and early mobility (Sibbern et al., 2016). ERAS replaces traditional methods with evidence-based practice as a comprehensive process starting with the surgery consult and ending after discharge from the hospital (ERAS Society, 2016).

Compliance with ERAS protocols for colorectal surgery patients in the post-operative inpatient setting is low, creating a gap in successful outcomes of the program (Roulin, et al., 2016). Adherence is vital to the success of this complex protocol and studies support the need for 80 percent compliance as a marker for achieving desired results (Pedziwiatr et al., 2015; Cakir et al., 2013). In particular, there is room to improve adherence in the post-operative inpatient arena. Colorectal surgery patients using the ERAS protocol are directly affected by inpatient nursing staff pathway adherence. Studies show lack of proper adherence to protocols can lead to increased length of stay (LOS), subsequently increasing hospital costs and out-of-pocket costs to the patient (Cakir et al., 2013; Pedziwiatr et al., 2015). For example, reduced LOS can be compromised when pathway adherence drops from 84 percent to just 72 percent (Cakir et al., 2013). Reasons for increased LOS can be related to post-operative ileus or pneumonia, venous thromboembolism, and many other complications or simply from slow goal advancement. Therefore, it is crucial to evaluate and intervene on identified factors that influence lack of adherence.

## **Background**

Historically, surgery protocols were established by tradition rather than evidence-based practice. In fact, certain antiquated habits, such as nasogastric tube placement in colon resection patients, may not only be unnecessary but harmful and contribute to pulmonary complications (Kehlet, 1997). In the 1990s, Danish surgeon Henrik Kehlet hypothesized a multimodal approach to control and reduce organ stress and post-operative complications, thereby decreasing LOS and saving money (Kehlet, 1997). This notion did not gain popularity until the 2000s in Europe and 2010s in the United States (ASER, 2019). Dr. Kehlet originally developed ERAS for the colorectal population. However, protocols pertaining to the gastrointestinal tract present the most unique challenges for implementation and compliance due to having less structure, prior to the ERAS protocols, than other more structured surgical procedures, such as orthopedics, for example. Today, ERAS protocols are used for patients recovering from many different types of surgeries.

While ERAS is a complex, multidisciplinary mode of care, the main goals are to make sure patients drink, eat and move early after surgery to prevent complications, recoup lost body function and optimize pain control (Gan et al., 2016). This can be achieved by initiating premedication and scheduled post-medication from multi-modal pain interventions, euvolemia, eunatremia, patient education, post-op mobilization and refraining from prolonged pre-op and post-op fasting (Gan et al., 2016). The diet goal is for patients to drink as soon as they are fully awake after surgery. Once they can tolerate drinking, it is time to start a normal diet without restriction in order to decrease the risk of post-operative ileus (Gan et al., 2016). Resumption of eating and drinking stimulates all digestive reflexes, presumably stimulates gut motility and is associated with pleasure and well-being (Gan et al., 2016). The mobility goal recommends

activity within the first 24 hours to decrease risks of pulmonary infections (Gan et al., 2016).

Multi-modal analgesic options include a variety of medications such as non-opioid oral agents (acetaminophen, tramadol), NSAIDs (ibuprofen, toradol and COX-2 inhibitors), gabapentinoids, glucocorticoids, regional and local nerve blocks, alpha-2 agonists and opioids. The use of non-opioid agents is recommended first. When opioid analgesics are reserved for breakthrough pain, the associated disadvantages of nausea, vomiting, respiratory and gastric suppression, immunosuppression and urinary retention are lessened (Gan et al., 2016). In order to maintain compliance to the protocol in the post-operative setting, the goals of ERAS must be followed. Nursing staff has the ability to influence the goals of drinking, eating, moving and selection of pain modalities with the patient.

### **Purpose**

The purpose of this project was to evaluate the impact of a nursing education plan on specific patient outcomes in the ERAS colorectal surgery population. A second purpose of the study was to examine the relationship between ERAS compliance and specific post-operative nursing interventions linked to length of stay (LOS). The specific aims were:

**Aim 1:** To assess the effect of an education plan on inpatient nursing staff knowledge of the ERAS protocol.

**Aim 2:** To examine the effect of nursing compliance using a knowledge-to-action plan on ERAS order set adherence.

**Aim 3:** To evaluate if improved adherence to the ERAS order set will lead to decreased opioid use for pain management, improved time to diet initiation, and improved time to mobility.

**Aim 4:** To determine if improved compliance with the use of the ERAS order set will result in a reduction in LOS.

### **Theoretical Framework**

The best evidence-based solution for this protocol compliance problem is a knowledge to action plan (KTA). This is a conceptual framework designed to translate evidence based knowledge into practice (Graham et al., 2006). There are two main concepts in this model: knowledge creation and action. In the action phase of the plan, local champions, specific evidence-based education implementation, structured processes, audits and feedback would be implemented (see Figure 1). McLeod, et al. (2015) published results of an ERAS protocol implementation using the KTA cycle with greater than 75 percent compliance. Tailoring the KTA plan to acclimate to the culture of the units or facilities involved can increase success. The method for this KTA plan started with pre- and post-testing of nursing staff for baseline knowledge and barriers in executing the ERAS protocol properly. Next, evidence-based education started with local champions (managers and assistant nurse managers) then moved to implementation with the staff in targeted ERAS units, in a budget-neutral setting (i.e. shift huddles and on-unit in-services). Post-testing nursing staff for knowledge and barriers after the education plan implementation completed the action cycle. The final steps of the KTA cycle involve evaluation of patient process outcomes, including pain management sequencing, diet advancement and early mobility and appraisal of improvement in outcomes (Graham, et al., 2006) such as LOS, patient satisfaction and reduced complications.

Additionally, the adult learning theory was applied to this educational intervention for the ERAS protocol, as a framework for influencing adherence. This included being sensitive to the motivations of adult learners, emphasizing why they need to learn something (Curran, 2014).

Understanding experience and meaningful content facilitates learning in a collaborative way and teaching methods need to include shorter lecture periods paired with more interactive or case study assessments for knowledge saturation (Curran, 2014).

### **Literature Review**

A literature review was conducted using EBSCO Host, CINAHL, and Medline search engines for relevant research articles related to ERAS and nursing compliance to ERAS protocols. Key search phrases included: ERAS, enhanced recovery after surgery, colorectal surgery, nursing, post-operative care, quality, barriers, implementation, adherence, and compliance. Publication dates ranged from 2008-2018 with a special exception for original data from Dr. Kehlet, who created the ERAS model, and Dr. Graham, the creator of the KTA cycle. Of the 15 articles reviewed, there were two meta-analyses, one randomized controlled trial, four cohort studies, three retrospective reviews, two implementation studies and three qualitative studies. This data search was aimed at nursing compliance interventions for a targeted sample of colorectal surgery patients yielding lower-tiered studies. The data obtained were still rich with statistical significance and meaningful process measurement evaluations, including diet and mobility. There was compelling evidence to support compliance with ERAS protocols from the standpoints of cost, patient outcomes and nursing workload (see Table 1 for full review).

In 2009, there were approximately 48 million surgery cases in the United States, of which 6.1 million involved the digestive system (Stanford Medicine, 2018). The average inpatient length of stay for colorectal surgery is eight days for an open surgery and five days for the laparoscopic approach (Carmichael et al., 2017). When healthcare providers comply with the protocols, cost savings per patient can range from \$500-\$2000 using an enhanced recovery pathway over traditional methods, while still accounting for the higher costs associated with

laparoscopic surgery (Adamina, Kehlet, Tomlinson, Senagore, & Delaney, 2011). Further ERAS-related cost savings can be associated with reduced LOS (2.2 days), leading to more available patient bed days, reducing complications (up to 40 percent), and subsequently creating indirect cost savings from fewer reimbursement losses (Greco et al., 2014). This can mean yearly cost savings nationwide in the billions. Researchers have found that lack of proper adherence to protocols can lead to increased LOS, subsequently increasing hospital costs and out-of-pocket costs to the patient (Cakir et al., 2013; Pedziwiatr et al., 2015).

Lack of adherence to order sets can also negatively affect patient outcomes. Literature supports the use of structured pathways such as ERAS from the perioperative arena through discharge (Carmichael et al., 2017; Gramlich et al., 2017; Hubner et al., 2015). Failure to follow the pathway anywhere along the line may lead to a decrease in successful outcomes, but the most impactful fallout is caused by lack of compliance with the order sets on post-operative units (Cakir et al., 2013). Inconsistent physician order entry, poor nursing documentation, lack of consistent auditing and failure to follow through by leadership are all possible roadblocks to adherence. Ament et al. (2017) noted that networks and communication, unit culture, structural characteristics (including staff turnover) and adaptability were all common themes associated with sustainability of the ERAS protocol.

Colorectal surgery patients eligible for the ERAS protocol are affected by whether inpatient nurses execute the orders properly. This population, outside of ERAS, is less protocolized than other structured service lines such as orthopedics. Constructing a systematic method for colorectal surgery patients, such as ERAS, has been shown to improve outcomes, as previously discussed. Assessing fallout areas within the protocol is imperative in order to achieve continuous quality improvement. Nurse-sensitive post-operative initiatives that are critical to the

success of the protocols include pain control, diet and mobility. Additionally, improved compliance leads to added unit structure which ultimately reduces nursing workload (Hubner et al., 2015). Success with adherence is seen most when there is structure and standardization, leadership support and local champions, and follow-through with audits and feedback (McLeod et al., 2015).

There was a gap identified in this literature review surrounding staff education on ERAS protocols and implementation of them. No identified measures or tools of education were found other than the success of the KTA framework formerly mentioned. Since ERAS is still a relatively new concept over the last decade in the United States, it is not surprising there are still areas for growth within the protocol. This study aimed to fill in the staff education gap.

### **Agency Description**

This study was conducted at Norton Audubon Hospital (NAH) and Norton Women's and Children's Hospital (NWC), part of the Norton Healthcare (NHC) system in Louisville, Kentucky. Specifically, inpatient units comprising colorectal post-operative ERAS protocol patients were targeted. This healthcare organization serves the greater Louisville area and surrounding regions for acute care, surgical care and emergency care services. NAH, a 432-bed acute care hospital and NWC, a 373-bed community hospital, both have a current colorectal ERAS protocol. Norton Healthcare's mission to serve quality care to the population it serves and meet the needs of the community aligns with the goals of this education plan, to further improve the goals of ERAS and improve surgical outcomes.

The target population was divided into two categories: nursing staff and patients. Beginning with nursing staff at NAH and NWC, the sample included nursing staff, both RNs and LPNs in designated high-volume ERAS inpatient units; specifically, 6 West at NAH and 7 West at NWC.

This staff included day shift and night shift and excluded staff from preadmission testing (PAT), perioperative areas or post-anesthesia care units (PACU). The sample size for the primary colorectal ERAS units was less than originally predicted at N=62 staff members.

In the patient population at NAH and NWC, the sample included both male and female adult (aged 18-89 years) inpatient colorectal surgery patients under the ERAS protocol for chart review only. Outpatient surgeries, emergency surgeries, and those without the ERAS order sets were excluded. The patient sample size was as predicted at n=186 patients among the two hospitals being studied. Three charts were excluded, two for observation status and one for primary gynecological study, bringing the total to n=183.

The stakeholders involved in this project are vast. The administration and quality department at Norton Healthcare have a stake in the outcomes of this study for consideration of implementation within the organization. Everyone spanning the ERAS multidisciplinary team including surgeons, anesthesia, nurses, physical therapists, dietary services, and more have a stake in the outcomes of this project as it may affect their future plans of care. Inpatient nursing unit staff have a large stake, as they have directly received education through the project and how the results are received, interpreted and followed through will continue to directly affect this area. Ultimately, patients are important stakeholders as well, as the changes made as a result of this project will be directed at improving their outcomes.

### **Design**

This was a prospective cohort study analyzing the effect of a knowledge to action (KTA) education plan on nursing compliance with ERAS protocols, conducted with bedside nursing staff for the colorectal ERAS post-operative population. The study included pre- and post-testing of nursing staff related to knowledge and process of executing orders from the ERAS protocol.



The education intervention consisted of in-person rounding and shift-huddle five-minute education sessions. An educational flier was given for reinforcement. Staff members received an email prior to the education intervention for participation in a pre-test survey using Qualtrics. Then the intervention took place over a two week span, reaching over 75% of staff on day shift, night shift and weekends. The post-test with the same information was emailed after the education was complete.

From the perspective of patient outcomes, process measures of pain treatment modality, time to diet (liquids and solids), and time to activity and outcome measures of LOS effects were also evaluated. The data request spanned one year, from August 1, 2018 to July 31, 2019, and 186 charts: 166 pre-education intervention and 20 post-education.

## **Methods**

### **Nursing intervention**

Nursing staff in high volume ERAS inpatient units were included in the sample for pre- and post-testing for ERAS knowledge and order set adherence with a KTA educational intervention in between. The electronic pre- and post-testing was conducted electronically using Qualtrics, a browser-based, metadata-driven electronic data capture software for clinical research databases. The 20 question test highlighted the main objectives relative to inpatient post-operative care on colorectal ERAS surgical patients, consistent with the ERAS guidelines. Incorporating the framework of Adult Learning Theory and the reliable KTA framework, this was an original test available for validity testing in the future. See Figure 2 in the appendices for test format. The on-unit education was reinforced with an educational flier available in Figure 3.

### **Patient outcomes**

For patient outcomes a retrospective chart review meeting inclusion criteria was conducted for baseline data via electronic medical records (EMR), in full compliance with patient privacy. Table 2, inclusion and exclusion criteria, includes adult inpatients over the age of 18 with DRG codes 329, 330 or 331 with ERAS protocol initiation at NAH or NWC. Non-ERAS protocol patients with observation or outpatient status and combined (multiple DRGs) surgeries were excluded. A second chart review for new patients matching the original inclusion criteria was conducted post-intervention and variables were analyzed as described the study population. Data were reviewed on patients admitted to NAH and NWC from August 1, 2018 to July 31, 2019.

### **IRB approval**

Approval from the University of Kentucky Internal Review Board was obtained on January 14, 2019 as an expedited review with a risk level 1, not greater than minimal risk. Through the UK/Norton Healthcare higher education partnership, approval from the Norton Research office was also obtained for use of clinical data analysis and research on the grounds. Data collected were stored on a password-protected computer in a secure location on the Norton H: drive. Data will be saved for six years in compliance with the institution's policy. Data extracted included demographics and information that meets inclusion criteria for data analysis relative to the process and outcome measures. This intervention did not require direct patient contact; therefore, a waiver of informed consent for patients and a waiver of documentation of informed consent for nursing staff was obtained from the IRB prior to data extraction.

## Measures

Process outcomes of pain management, early mobility and diet advancement are integrated into protocols ordered by the provider and managed by the bedside nursing staff, therapy, dietary and ancillary staff. Pain management models can vary; however, there is a general focus on a multi-modal approach with attempts to save opioid medication administration as a last step in the post-operative setting. Patients often receive epidurals for better control in the peri-operative setting, then acetaminophen and gabapentin are used prior to narcotics, pre- and post-operatively. Early mobilization by nursing staff, physical therapy and ancillary staff can promote early return of bowel function and decrease post-op complications associated with immobility. Diet advancement should not be limited immediately post-operatively, and should begin with liquids and aspire to 1200-1500 kcal per day by the end of the first 24 hours (Carmichael et al., 2017).

The following patient measures were evaluated via pre-post testing or were extracted from the EMR for data analysis as appropriate. The nursing measures were extracted via Qualtrics and in-person rounding during the education intervention.

- 1. ERAS knowledge (nursing staff) :** This data was obtained using a structured pre-test with 12 knowledge questions covering baseline information on post-operative ERAS care and 8 demographic questions via Qualtrics. The same test was used post-education intervention and results were compared. This instrument was created for this study and has not had validity or reliability testing. No valid instruments for ERAS knowledge evaluation were identified in research for use, therefore one was created.
- 2. Pain modality (patient):** Evaluation of a multi-modal approach was assessed, including the first post-operative option of either a scheduled non-opioid medicine, as needed

(PRN) non-opioid pain medicine or prn opioid medicine. Pre/post non-opioid meds included any combination or single use of acetaminophen, celecoxib, gabapentin, toradol, carisoprodol, or glucocorticoids. These data were obtained via EMR in EPIC.

- 3. Time to liquids, solids and mobility (patient):** This was measured in hours and minutes from procedure finish time to first documentation of the outcome measure. Liquids and solids are correlated with diet order and charting in the EMR. Mobility is defined as out of bed (OOB) and up in chair or ambulating after surgery.
- 4. Length of stay (patient):** This was measured by number of days as a patient in the hospital.
- 5. Demographics (nursing):** Age, gender, years of experience, prior ERAS training and level of education was collected for nominal and ratio data.
- 6. Demographics (patient):** Age, gender, ethnicity, comorbidities and smoking status were collected for nominal and ratio data. Comorbidities examined are those considered chronic diseases including diabetes mellitus, heart failure, hypertension, chronic obstructive pulmonary disease (COPD) and kidney disease (defined as CKD stage II or greater).

### **Data analysis**

Descriptive statistics, including means and standard deviations, medians and interquartile ranges or frequency distributions were used to summarize demographic and clinical study variables. Comparisons of pre- and post- test scores and pre- and post-education time from closure to liquids, solids and mobility were assessed using the two-sample t-test. Chi-square tests of association were used to examine relationships between categorical variables and the Mann-

Whitney U test was used to evaluate differences in hospital length of stay between the two time points. All data analysis was conducted using SPSS, version 25 with an alpha of .05.

## **Results**

### **Nursing survey**

The pre- and post-test was sent via Qualtrics through email to 62 staff members at separate designated times to allow for the education intervention. There were 20 responses in total; 8 pre-test and 12 post-test yielding a less than 20 percent participation rate overall and even lower when divided into pre- and post-test participation, individually. The goal was for the same staff to take the test as a baseline evaluation, receive the education and take the test again to measure improvement. There was one nurse who did complete both tests as instructed. The nursing staff who participated in the pre- and post-test were all female. They reported having all had prior ERAS education in some format before. The age range and work experience was very evenly distributed from young and new to experienced and more senior. For more details see Table 3. The in-person education did include male nurses; however, there was no male participation on any pre- or post-testing. The results of the knowledge portion of the test instrument show evidence that were clinically significant, yielding a mean improvement of 4.33 points. The mean pre-test score was 20.75 and post-test score was 25.08 with a *p* value of .058 (see Table 4). Unfortunately, due to such a small sample size, it is difficult to deduce how meaningful this is.

Nursing staff was asked to identify barriers to ERAS compliance as a free text survey question as well as during education rounds. There were three main themes identified: pre-op patient education followed by acetaminophen use and diet orders. There were comments on the survey instrument describing the patients as uninformed about goals for multimodal pain

management, mobility and diet advancement which subjectively inhibited progress for order set compliance. This was also verbally reaffirmed during the in-person education sessions by staff. Another theme identified was concern for overuse of acetaminophen for schedule medication combined with bound-acetaminophen to hydrocodone as a PRN opioid medication. The concern is the risk of dual use of acetaminophen leads to the omission of the scheduled dose in favor of the bound narcotic, therefore breaking protocol to avoid acetaminophen toxicity limits. The third theme identified was frequent variation in diet orders among surgeons. These variations include immediate solid food diet orders, “advanced as tolerated” orders where nursing can advance automatically if the patient tolerates food in a step-wise approach and diet on a day-by-day basis beginning with NPO status. Diet ordering variation can lead to a delay in feeding patients within the goals of the ERAS protocol.

### **Patient outcomes**

There were 186 charts reviewed in total, 166 pre-intervention over an eight month period and 20 post-intervention charts reviewed over a six-week period. Three charts for excluded for not meeting criteria. Patient data outcomes were measured first by demographics including comorbidities and smoking revealed a very even pre- and post- intervention data pool. The mean age was 63 and 65, with more female than male patients at 57% and 68%. The majority were white, non-Hispanic patients at 83% and 77% while nearly all had comorbid conditions at 88% and 95% respectively. Additionally, over two-thirds of all patients were either current or former smokers. For details please see Table 5. The DRG codes were balanced among both groups, as well, see Table 6. The pre- and post-education intervention groups were evenly distributed with pre-medication and post-op multimodal pain management options, see Table 7. LOS, 7-day readmission and 30-day readmission are tallied in Table 8. Interestingly, there was evidence of

clinically significant data revealing a one day reduction LOS in the post-education patient outcome group, however the  $p$  value was .70. While this is not statistically significant, this is clinically relevant.

The next piece of data analyzed was the time to diet, stratified into liquids and solids and time to mobility; both facets were measured against procedure finish time on the anesthesia record. This was then tested for correlation to LOS. The average time to liquids in the post-education intervention group was reduced by an average of 14 hours and the time to mobility was reduced by about 7 hours, bringing the time to 23 hours after close time and meeting the mobility outcome goal (see Table 9). Again, however the sample size and  $p$  value make these data unreliable. Using Spearman's rank correlation coefficient, there was a direct positive relationship of 0.6, linking improved LOS with improved/shorter times to mobility and solid food (see Table 10).

The final piece of data examined was missing documentation. Of the 183 charts reviewed, there were 74 data points missing on one or more of the three outcomes: liquids, solids and mobility for the entirety of the post-operative period (see Table 11). Solid intake was the most commonly missed documentation with 34.8% missing in the pre-intervention group and 21% missing in the post-intervention group. Despite the small sample size in the post-intervention group, the overall improvement ranged from 3-13% in the three categories which indicated more reliable documentation.

## **Discussion**

The results yielded potential successes of some components related to the aims of the study. The effect of the education plan on inpatient nursing knowledge of the ERAS protocol was favorable, as evidenced by an improvement in post-test evaluation.

Next, the effect of nursing compliance with the KTA plan on order set adherence shows merit with an improvement in documentation noted in chart review. There were far fewer discrepancies with documentation from nursing flowsheets compared to provider notes on diet tolerance. In the pre-intervention chart review, there were a number of provider progress notes discussing diet and activity tolerance that were incongruent with nursing flowsheets for data extraction. While the data were exclusively obtained from nursing flowsheets to evaluate nursing compliance, there were discrepancies that alluded to higher compliance with the physical nursing aspects of ERAS care over documentation compliance. As part of the feedback loop associated with the KTA plan, this was communicated to nursing staff during the education intervention, possibly accounting for the improvement seen in the post-intervention chart review. The information on education rounds was well-received by staff; however, further results could be proffered by a dedicated facilitator, such as an ERAS coordinator, to follow metrics, champion units within the hospitals, follow up on learning opportunities and provide regular feedback to staff.

The subsequent aim of measuring patient outcomes yielded non-statistically significant results. *P* values did not support statistical significance, likely due to sample size, but there was clinical significance worth noting. While narcotic use was unchanged pre- and post-education intervention, the times to drink, eat and move were all shorter from close time, indicating improvement. Despite smaller size, the sample was still equal among distribution in demographics, DRG code, co-morbid conditions and smoking status. These are meaningful data that have the potential to support the KTA cycle.

Finally, the clinical significance of improved compliance did lead to a decrease in LOS, both in measurement of interquartile ranges by one day and with a direct positive correlation



coefficient linking significance among shorter time to diet and mobility with reduced LOS. Again, there was no statistical significance demonstrated among comparison groups, but decreased length of stay, and shorter times to resumption of diet and mobility were achieved. Notably, with this information, this healthcare organization is in line with aforementioned national benchmarks for LOS. This reduced LOS was further supported as meaningful, as evidenced by a zero readmission rate at 7 and 30 days. Therefore, it can be deduced that healthcare and patient dollars were saved and complications were reduced, insofar as there was less inpatient time and no readmissions. With an average decrease in LOS by one day, the direct cost savings of \$500 to \$2,000 per patient noted by Adamina, Kehlet, Tomlinson, Senagore, and Delaney (2011) could be projected at \$9,500 to \$38,000 not including indirect savings of open beds and no readmissions. This was related to a two-unit education intervention in two hospitals for zero costs.

### **Implications for Practice, Education, Policy, and Future Research**

The clinical significance in improved post-test scores, a reduced LOS, and improved charting for the post-education intervention data provides some support the use of KTA and adult learning education methods. Results could be amplified significantly by broadening the scope of the education intervention to more units, more applicable surgery pathways and more hospitals within the healthcare organization. While this study focused on education in two low-acuity, high ERAS volume surgical units, the charts reviewed were from the entire hospital, which supports the need for more educational coverage. It is important to broaden education to all inpatient units in anticipation of continued, high efficiency care.

Future research recommendations include analyzing complications such as ileus, VTE, post-op pneumonia, et cetera, as a marker of effectiveness of the ERAS protocol and to identify

future targets for quality improvement initiatives. Additionally, pain management studies could be beneficial on narcotic use if studied among ERAS versus non-ERAS protocol surgeries for better validity of opioid reduction. It is reasonable to hypothesize a significant reduction when there are multiple pain management options offered, but this would require quantifying narcotic use during the entire post-operative period, not just accounting for which option was used first as in this study. The post-anesthesia care unit (PACU) was not included in this study for narcotic use, and an evaluation of continued epidural use to decrease PACU narcotic use could be enlightening. Other areas of focus could be on surgeon routines to compare and contrast outcomes based on how the protocols vary among providers and who may have the best recipe for success. This could be useful in the continued development of clinical guidelines. Breaking down unit-specific and hospital-specific outcomes to determine if there are acuity differences or culture of care differences that affect outcomes is another option for study. Additionally, this project studied an acute hospital and a community hospital with no surgeon or anesthesia crossover. These data could be analyzed without needing to obtain new data points to extract further information.

### **Limitations**

There were significant limitations to this study, including a small sample size, especially in the post-intervention chart review. Although this project spanned one year, the post-intervention patient sample size evaluated via chart review spanned six weeks and was smaller than anticipated. Participation was low among nursing staff for pre- and post-testing. Having a single unit target per hospital further narrowed sample size, and therefore, also narrowed the results for the education intervention. Buy-in from nursing staff was not high enough from an outside party to complete the online tests. If this were a required process within the hospital

system or if there was support from multiple forces, such as administration, management, education, etc., there may have been more participation. Email as the test medium was a limitation for those staff members who do not check their email regularly. Given the time constraints faced by nurses, and the fact that they were asked to complete the survey twice while at work, participants may have had to choose between completing the survey and caring for patients; they most likely placed a greater value on patient care, which also led to lower participation.

There was potential for confounding due to system ERAS education that had taken place sporadically within NHC during the timeframe of the project pre-implementation and chart review, possibly skewing results or impeding statistical significance. As previously discussed, poor documentation in the nursing flowsheets of the EMR was a limitation that reflected decreased order set compliance within the documentation scope of care. Additionally, it is difficult to pinpoint complications in the EMR, which was larger than the scope of this project but would serve as very useful information in future.

### **Conclusion**

In conclusion, a prospective study examining the effect of an education plan on nursing adherence to ERAS order sets was conducted at two hospitals following colon surgery patients. Data analysis included nursing education evaluation via survey format after in-person education sessions with handouts. Patient chart reviews were analyzed pre- and post-education intervention, revealing potential evidence of clinically significant findings regarding an average one day reduction in length of stay. There was a clinical improvement in nursing knowledge of ERAS and an improvement in nursing documentation. There were significant limitations in this study, most notably small sample size, which affected the possibility of obtaining statistically

significant data. The KTA education intervention for nursing staff in areas of ERAS inpatient populations does suggest evidence of increasing compliance to order sets and ERAS initiatives.

**Tables and Figures**

Table 1. Literature review

#	Author/Date	Article	Design	Sample size	Main Points
1	Ament, S. M., Gilliseen, F., Moser, A., Maessen, J. M., Dirksen, C. D., von Meyenfeldt, M. F., & van der Weijden, T. (2017)	Factors associated with sustainability of 2 quality improvement programs after achieving early implementation success. A qualitative case study	Exploratory qualitative study	N=26 Two hospital ERAS programs	-Factors identified as related to sustainability included: adaptability, cost-effectiveness, structural characteristics, networks and communication, culture, patient needs and resources, external policies, characteristics of individuals and the implementation process
2	Cakir, H., van Stijn, M. M., Lopes Cardozo, A. F., Langenhorst, B. A., Schreurs, W. H., van der Ploeg, T. J., Houdijk, A. P. (2013).	Adherence to enhanced recovery after surgery and length of stay after colonic resection	Retrospective review of prospective ERAS data	N=383 Single site teaching hospital	-Mobilization within 24 hours after surgery is an independent predictor of LOS -NSAID use on POD 1 is an independent predictor of LOS -Strict adherence to ERAS protocol was associated with decreased LOS
3	Chemali, M.& Eslick, G. (2017)	A meta-analysis: Postoperative pain management in colorectal surgical patients and the effects on length of stay in an enhanced recovery after surgery (ERAS) setting	Meta-analysis	21 studies of RCTs	-Pain is a less influential impact on LOS -ERAS protocols expedite recovery after surgery -There was a statistically significant difference with vomiting in regard to LOS
4	Forsmo, H., Pfeffer, F.,	Compliance with enhanced	Randomized	N=324	-ERAS protocol was

	Rasdal, A., Ostgaard, G., Mohn, A., Korner, H., & Erichsen, C. (2016).	recovery after surgery criteria and preoperative and postoperative counseling reduces length of hospital stay in colorectal surgery: results of a randomized control trial	controlled trial	Single-center trial	associated with a significant decrease in hospital length of stay (median 3 days shorter) -Perioperative patient guidance/education was an important factor associated with the decrease in length of stay
5	Gillissen, F., Ament, S., Maessen, J., Dejong, C., Dirksen, C., van der Weijden, T. & von Meyenfeldt, M. (2014)	Sustainability of an enhanced recovery after surgery program	Retrospective observational study	N=1270 10-hospital site study	-Observed sustainability of ERAS program after 3-5 years of establishment for continuation of outcomes -There was a slight decrease in compliance, but overall goals remained achieved -Adherence of 70% yielded LOS of 6 days (up from 5.25) and functional recovery measures remained unchanged
6	Gramlich, L. M., Shappard, C. E., Wasylak, T., Gilmour, L. E., Ljungqvist, O., Basualdo-Hammond, C., & Nelson, G. (2017)	Implementation of enhanced recovery after surgery: a strategy to transform surgical care across a health system	Qualitative	N=99 6 site audit system for ERAS compliance assessment	-Barriers to compliance with ERAS include clinical practice, individual provider, organization, external environment, and patients. -Using an audit and strategy tool can improve compliance
7	Greco, M., Capretti, G., Beretta, L., Gemma, M., Pecorelli, N., & Braga,	Enhanced recovery program in colorectal surgery: A meta-analysis of	Meta-analysis	N=2,376 16 RCTs reviewed	-The ERAS protocol shortens hospital stay on average of 2.28 days

	M. (2014).	randomized controlled trials			without increasing readmission rate -There is a 9% reduction in non-surgical complications with the ERAS protocol
8	Hubner, M., Adder, V., Sliker, J., Griesser, A., Lecureux, E., Blanc, C., & Demartines, N. (2015).	The impact of an enhanced recovery pathway on nursing workload: A retrospective cohort study.	Retrospective cohort study	N=277 Single tertiary academic center	-The higher the compliance with ERAS, the lower the work burden for nurses.
9	Kim, B., Park, S., Park, K., & Ryoo, S. (2016)	Effects of a surgical ward care protocol following open colon surgery as part of an enhanced recovery after surgery programme	Retrospective comparative study	N=219 Single hospital setting in Korea	-Patients on ERAS protocol had shorted hospital stay, fewer complications and fewer ED visits. -ERAS care protocol was associated with increased effectiveness of clinical nursing care
10	Liu, V., Rosas, E., Hwang, J., Cain, E., Foss-Durant, A., Clopp, M., Huang, M., Lee, D., Mustille, A., Kipnis, P., & Parodi, S. (2017).	Enhanced recovery after surgery program implementation in 2 surgical populations in an integrated health care delivery system.	Pre/post implementation study	N=3,768 20-hospital study	-Decreased length of stay and postoperative complications
11	McLeod, R. S., Aarts, M., Chung, F., Edkicioglu, C., Forbes, S. S., Conn, L. G., McClusky, S., McKenzie, M., Morningstar, B., Nadier, A., Okrainec, A., Pearsall, E., Sawyer, J., Siddiqu, N., & Wood, T.	Development of an enhanced recovery after surgery guideline and implementation strategy based on the knowledge-to-action cycle.	Implementation study	N=1000 15 hospitals	-Knowledge to action cycle can be used successfully for ERAS program implementation -Increased communication, collaboration of the multidisciplinary team and patient education are key points for success -There is an associated

	(2015).				reduced length of stay, readmission rate and adverse events with the implementation of an ERAS protocol
12	Pedziwiatr, M., Kisialeuski, M., Wierdak, M., Stanek, M., Natkaniec, M., Matlok, M., Budzynski, A. (2015).	Early implementation of enhanced recovery after surgery (ERAS) protocol- Compliance improves outcomes: A prospective cohort study	Prospective cohort study	N=92 Single site tertiary medical center	-Continuous training of personnel is important in initial stages of ERAS implementation. -Use of a coordinator, frequent auditing and analysis lead to increased compliance.
13	Roulin, D., Muradbegovic, M., Addor, V., Blanc, C., Demartines, N., & Hubner, M. (2016).	Enhanced recovery after elective colorectal surgery: Reasons for non-compliance with the protocol	Cohort study	N=76 Single site center	-The lowest compliance to the ERAS protocol was in the postoperative period (63%) -Deviations from the pathway were provider mediated -Almost one-fourth of deviations were identified as amenable
14	Sibbern, T., Sellevold, V. B., Steindal, S. A., Dale, C., Watt-Watson, J., & Dihle, A. (2016).	Patient's experiences of enhanced recovery after surgery: a systematic review of qualitative studies	Qualitative systematic review	11 studies reviewed	-Themes identified regarding the patient experience concluded a desire for more consistency in information
15	Yeung, S., Hilkewich, L., Gillis, C., Heine, J., & Fenton, T. (2017).	Protein intakes are associated with reduced length of stay: a comparison between enhanced recovery after surgery (ERAS) and	Cohort study	N-115 Single site	-ERAS patients had less malnutrition going into surgery -ERAS patients still had inadequate consumption to



		conventional care after elective colorectal surgery			maintain adequate protein intake -Reduced protein intake is associated with increased PONV -Adequate protein intake of >60% of protein needs after surgery was an independent predictor of LOS
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Table 2. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Adults ≥ 18	Non-ERAS surgical patients
Colorectal surgical inpatients at NAH/NWC with DRG 329, 330, 331*	Outpatient surgery
ERAS protocol patients	Observation status
Inpatient nursing staff (RN, LPN) at NAH/NWC	Combination surgery with multiple DRGs

\*DRG 329 MAJOR SMALL & LARGE BOWEL PROCEDURES W MCC, DRG 330 MAJOR SMALL & LARGE BOWEL PROCEDURES W CC, DRG 331 MAJOR SMALL & LARGE BOWEL PROCEDURES W/O CC/MCC

Table 3. Nursing demographic and clinical characteristics of the pre- and post-educational interventional samples (N =22)

	Pre- and post-education (N=22) n (%)
Age	
21-26	15.4%
27-35	38.5%
36-45	15.4%
46-55	7.7%
55 or older	15.4%
Prefer not to answer	7.7%
Gender	
Male	0%
Female	100%
Work experience	
0-1 year	15.4%
over 1-5 years	30.8%
Over 5-10 years	30.8%
Greater than 10 years	23.1%
ERAS education	
Yes	100%
No	0%

Table 4. ERAS pre- post-test results (N=20)

	Pre-test (n=8) Mean (SD)	Post-test (n=12) Mean (SD)	<i>p</i>
Score out of 33 possible points	20.75 (5.09)	25.08 (4.42)	0.058

Table 5. Patient demographic and clinical characteristics of the pre- and post-educational interventional samples (N =183)

	Pre-education (n=164) Mean (SD) or n (%)	Post-education (n=19) Mean (SD) or n (%)	<i>p</i>
Age	63.21 (11.96)	65.74 (14.38)	0.31
Gender			0.35
Male	42.8%	31.6%	
Female	57.2%	68.4%	
Race			0.89
White	82.9%	76.5%	
Black	12.8%	17.6%	
Latino	3.7%	5.9%	
Asian	0.6%	0.0%	
Other	0.0%	0.0%	
Co-morbidities			0.40
Yes	88.4%	94.7%	
No	11.6%	5.3%	
Smoker			0.37
Current	16.9%	5.3%	
Former	45.8%	57.9%	
Never	37.3%	36.8%	

Table 6. Patient DRG codes

	Pre-education (n=164) Mean (SD) or n (%)	Post-education (n=19) Mean (SD) or n (%)
Surgery		
329*	13.9%	10.5%
330**	40.4%	52.6%
331***	45.8%	36.8%

\*DRG 329 MAJOR SMALL & LARGE BOWEL PROCEDURES W MCC

\*\*DRG 330 MAJOR SMALL & LARGE BOWEL PROCEDURES W CC

\*\*\*DRG 331 MAJOR SMALL & LARGE BOWEL PROCEDURES W/O CC/MCC

Table 7. Patient pre- and post-op pain management characteristics (N=183)

	Pre-education (n=164) n (%)	Post-education (n=19) n (%)	<i>p</i>
Pre-meds			0.45
Yes	92.2%	100%	
No	7.2%	0.0%	
Pain post op			0.69
PRN opioid	52.8%	58.8%	
PRN non-opioid	3.1%	0.0%	

Scheduled	44.2%	41.2%	
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Table 8. Patient outcomes readmission (N=183)

	Pre-education Median (IQR) or n (%)	Post-education Median (IQR) or n (%)	<i>p</i>
Length of stay	5 days (3-9)	4 days (3-7)	0.70
7-day readmission			<0.001
Yes	3%	0%	
No	97%	100%	
30-day readmission			<0.001
Yes	6%	0%	
No	94%	100%	

Table 9. Comparison of time from closure to outcomes pre- and post-education (N=183)

	Pre (n =164) Mean hours (SD)	Post (n = 19) Mean hours (SD)	<i>p</i>
Closure to liquid	25.4 (40.3)	11.5 (14.7)	0.14
Closure to solids	85.5 (64.7)	82.7 (48.3)	0.87
Closure to mobility	29.6 (36.5)	22.7 (10.8)	0.84

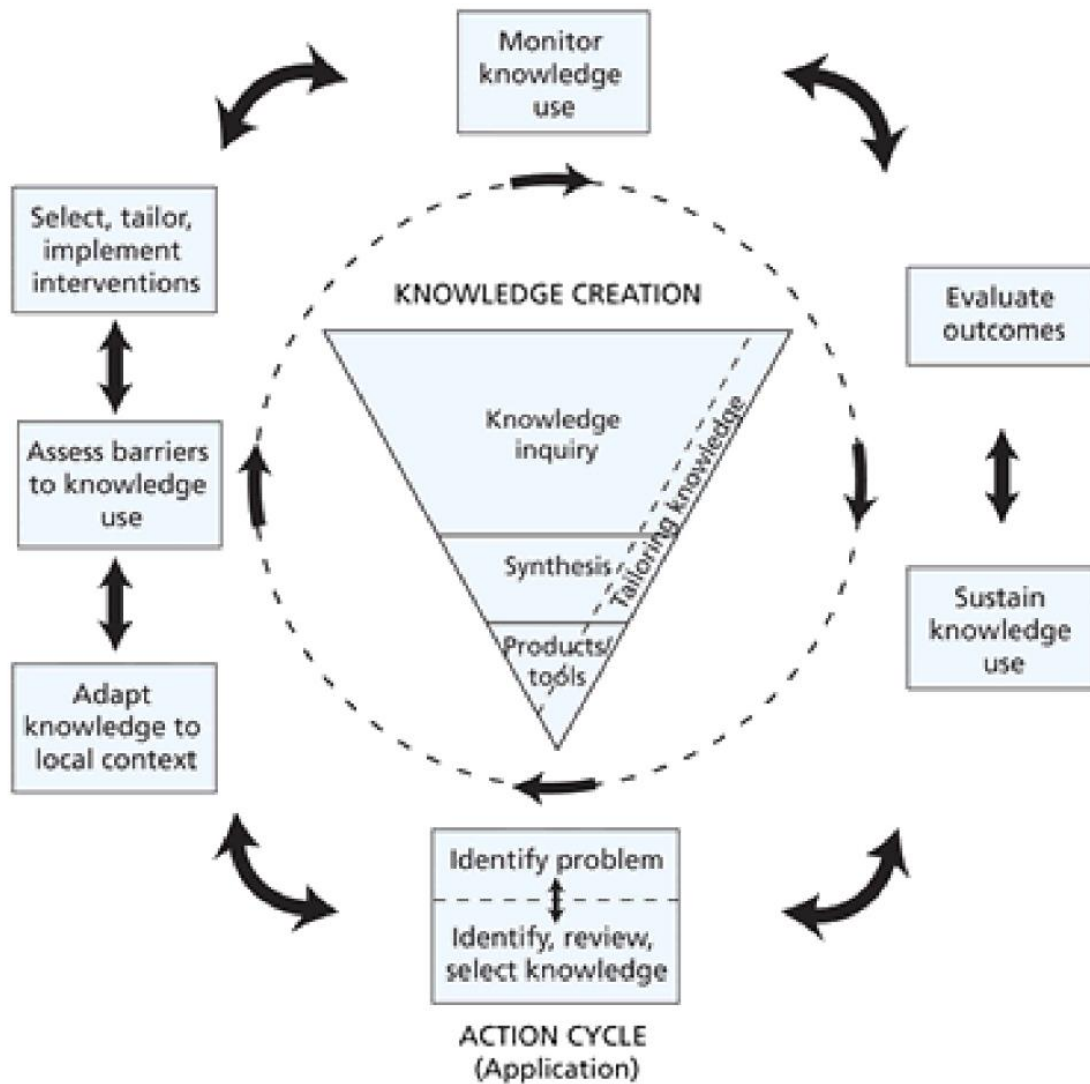
Table 10. Associations among hospital length of stay and time from closure to outcomes (N=183)

	Closure to liquid <i>rho</i> (p)	Closure to solids <i>rho</i> (p)	Closure to mobility <i>rho</i> (p)
Length of stay	0.13 (0.10)	0.62 (<0.001)	0.30 (<0.001)

Table 11. Missing documentation for patient outcomes (N=183)

Chart review	Liquids Missing unit (%)	Solids Missing unit (%)	Mobility Missing unit (%)
Pre-intervention (n=164)	7 (4.3%)	57(34.8%)	6 (3.7%)
Post-intervention (n=19)	0 (0%)	4 (21%)	0 (0%)
% difference post-intervention	-4.3%	-13.8%	-3.7%

Figure 1. Knowledge to action cycle



Knowledge to Action Framework. From Graham I, Logan J, Harrison M, Strauss S, Tetroe J, Caswell W, Robinson N: Lost in

21 Figure 2. ERAS pre- and post-test

<p>1 By completing this pre/post-test, informed consent is implied and therefore documentation of informed consent is waived.</p> <p><input type="checkbox"/> I agree</p> <p>2 Please create a unique 4-digit ID and use the same ID for each the pre- and post-test. This will be used for anonymous pairing of test results. (Suggestion: last 4 digits of SSN or house number) _____</p> <p>3 How long have you been a nurse?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Zero-1 year</li> <li><input type="radio"/> Over 1 year to 5 years</li> <li><input type="radio"/> Over 5 years to 10 years</li> <li><input type="radio"/> Greater than 10 years</li> </ul> <p>4 What is your gender?</p> <ul style="list-style-type: none"> <li><input type="radio"/> Male</li> <li><input type="radio"/> Female</li> <li><input type="radio"/> Prefer not to answer</li> </ul> <p>5 What is your age?</p> <ul style="list-style-type: none"> <li><input type="radio"/> 21-26</li> <li><input type="radio"/> 27-35</li> <li><input type="radio"/> 36-45</li> <li><input type="radio"/> 46-55</li> <li><input type="radio"/> 55 or older</li> <li><input type="radio"/> prefer not to answer</li> </ul> <p>6 Have you received prior ERAS education?</p> <ul style="list-style-type: none"> <li><input type="radio"/> No, never</li> <li><input type="radio"/> Yes, in onboarding</li> <li><input type="radio"/> Yes, in unit education</li> <li><input type="radio"/> Yes, other _____</li> </ul> <p>7 What does ERAS stand for? _____</p> <p>8 What are the goals of ERAS? Select all that apply</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Decrease body stress</li> <li><input type="checkbox"/> Promote improved recovery</li> <li><input type="checkbox"/> Decrease length of stay</li> <li><input type="checkbox"/> Cost savings for patient and healthcare industry</li> <li><input type="checkbox"/> Decrease post-op complications</li> <li><input type="checkbox"/> Stop opioid addiction</li> <li><input type="checkbox"/> Make nursing staff work harder</li> </ul> <p>9 Are there any barriers to following the ERAS protocol for the GI/colorectal population? If yes, please describe.</p> <ul style="list-style-type: none"> <li><input type="radio"/> Yes _____</li> <li><input type="radio"/> No</li> </ul> <p>10 Pre-operative teaching only includes drinking a shake right before surgery.</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul> <p>11 Fluid management is important pre, intra, and post-operatively. It is appropriate to contact the surgeon to d/c IV fluids if the patient is drinking fluids as early as possible.</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul> <p>12 Most colorectal surgery patients need NG tubes post-operatively</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul>	<p>13 It is not safe to feed a patient post-operatively until they have bowel sounds.</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul> <p>14 Strategies to reduce risk of post-op ileus include: (select all that apply)</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Minimize pre-op fasting</li> <li><input type="checkbox"/> Bedrest for at least 24 hours post-op</li> <li><input type="checkbox"/> Minimize fluid shifts</li> <li><input type="checkbox"/> Early opioid-mediated pain control</li> <li><input type="checkbox"/> NPO until flatus/bowel sounds</li> <li><input type="checkbox"/> Multimodal pain management</li> <li><input type="checkbox"/> Early post-op food by mouth</li> <li><input type="checkbox"/> Bowel prep pre-op</li> </ul> <p>15 Risks of post-op nausea and vomiting (PONV) include: (select all that apply)</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Female gender</li> <li><input type="checkbox"/> Male gender</li> <li><input type="checkbox"/> Non-smoker</li> <li><input type="checkbox"/> Smoker</li> <li><input type="checkbox"/> Post-operative opioid use</li> <li><input type="checkbox"/> Nitric oxide/inhalants</li> <li><input type="checkbox"/> Short duration of anesthesia</li> <li><input type="checkbox"/> Previous history of PONV</li> </ul> <p>16 The correct order of pain medication once oral intake has resumed is:</p> <ul style="list-style-type: none"> <li><input type="radio"/> Start with the strongest opioid immediately post-op then downgrade</li> <li><input type="radio"/> Administer based on pain rating per the order set recommendations</li> <li><input type="radio"/> Non-opioid first</li> <li><input type="radio"/> Only scheduled gabapentin</li> </ul> <p>17 Multimodal pain therapy may include: (select all that apply)</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Acetaminophen</li> <li><input type="checkbox"/> NSAIDS</li> <li><input type="checkbox"/> Gabapentin</li> <li><input type="checkbox"/> Food</li> <li><input type="checkbox"/> Chewing gum</li> <li><input type="checkbox"/> Opioids</li> <li><input type="checkbox"/> Early mobility</li> <li><input type="checkbox"/> Epidural analgesia</li> <li><input type="checkbox"/> Regional nerve block</li> <li><input type="checkbox"/> Lidocaine</li> <li><input type="checkbox"/> Tramadol</li> </ul> <p>18 I have the support I need to facilitate early mobility.</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul> <p>19 It is appropriate to mobilize stable post-op patients in the recovery room.</p> <ul style="list-style-type: none"> <li><input type="radio"/> True</li> <li><input type="radio"/> False</li> </ul> <p>20 ERAS protocols must have ____ compliance to be successful.</p> <ul style="list-style-type: none"> <li><input type="radio"/> 50%</li> <li><input type="radio"/> 95%</li> <li><input type="radio"/> 80%</li> <li><input type="radio"/> 60%</li> </ul>
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Figure 3. ERAS education flier

Post-op Care for Colorectal Surgery patients

## Enhanced Recovery after Surgery (ERAS)

*Just because the process hurts doesn't mean the results won't be beautiful. -Unknown*


The ERAS Mantra: CHEERS DREAM

Carbohydrate loaded (not hungry), Hydrated (not thirsty), Euvolemic (right amount of fluid), Eupneumatic (right amount of salt), Ready to Start to:



Goals of ERAS:

- Decrease the body's stress
- Promote improved recovery
- Decrease length of stay (LOS)
- Decrease post-op complications
- Optimal patient comfort



**Tubes and Food**

Most colorectal surgery patients do NOT need NG tubes and are commonly pulled immediately post-op. It is appropriate WITH an ORDER to feed a patient prior to return of bowel sounds. Liquids, gum chewing and diet advancement are encouraged to reduce complications.

Compliance *Eras protocols must be 80% compliant to be success with goals.*

### Pre-op and Intra-op

**Documentation**

It is of highest importance to document consistently intake and output, prn effectiveness and activity level with each intervention.

- This credits the staff for hard work.
- Establishes legal documentation of efforts made for patient care and
- Provides methods of tracking for success and feedback of the ERAS protocol

**Education:**

Preadmission testing is a staple of all ERAS patients. Examination by an LIP, surgery prep with CHG bath, pre-op shakes and analgesia (i.e. acetaminophen, gabapentin or a COX-2 inhibitor), and education for post-op pain expectations, mobility, drains and more are the start of patient readiness.

**Anesthesia:**

General anesthesia meds and gases are limited to the minimum possible amount by augmenting with nerve blocks via epidural, spinal or local. Fluid management is optimized utilizing hemodynamic monitoring tools such as an EV3000. Euvolemia and eunatremia are associated with less complications than hypo or hypervolemic states including ileus, hypotension and pulmonary edema. Fluid balance is a hallmark throughout the entire process.

### Post-op

**Multi-modal Pain interventions:**

Post-op pain is controlled starting well before the patient wakes up. As mentioned above, pre-op meds and intra-op anesthesia are already focused on promoting an enhanced recovery. Additionally, non-opioid options such as NSAIDs, acetaminophen, tramadol, lidocaine and gabapentin are used as appropriate. Gum chewing, music therapy, food, mobility, distraction techniques (tv, puzzles, rest, etc.) and pre-op expectations of minimum level of pain are aimed at decreasing opioid use. Non-opioids are expected to be tried first in ERAS patients after PACU. Reducing opioid use decreases constipation, ileus, delirium and potential dependency risks.

**Mobility:**

Early mobility can begin as early as PACU. Mobility promotes the early return of bowel function, improved rest, reduced risks of pneumonia and can reduce length of stay. Goals can vary among ERAS programs but OOB day of surgery and up to chair/ambulation TID POO 1 and beyond are typical goals. It is important to set these goals early with patients and plan rest periods and pain interventions around activity for optimal results.

### Post-op ileus/Post-op Nausea & Vomiting (PONV)

**Ileus:**

Post-op ileus is a common fear that leads to increased NG tubes and decreased early oral intake. Reduction strategies include minimizing pre-op fasting, minimizing fluid shifts, multi-modal pain mgt, and early post-op mobility and oral intake.

**PONV:**

Risks of PONV include non-smoking status, female gender, younger age, post-op opioid use, anesthesia gases such as nitric oxide, longer duration of anesthesia, abdominal surgery and previous history of PONV. Attempts to reduce PONV are similar to reducing risks of ileus. Minimization of opioids and anesthesia gases, promotion of regional blocks and fluid optimization are strategies to reduce PONV. Much of this happens intra-op and reinforces the fact that ERAS is a multi-disciplinary protocol crossing numerous departments.

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