Prospective Study of Colorectal Enhanced Recovery After Surgery in a Community Hospital

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IMPORTANCE Enhanced recovery after surgery (ERAS) colorectal programs have shown to be successful at reducing length of stay in many international and academic centers; however, their efficacy in a community hospital setting remains unclear.

OBJECTIVE To determine if favorable results could be reproduced in a community hospital setting using our ERAS program, which was developed using core ERAS guidelines with the goal of accelerated recovery while also addressing other important outcomes affecting patient experience and safety.

DESIGN, SETTING, AND PARTICIPANTS Prospective study of ERAS program, a multidisciplinary effort involving anesthesia, preadmission staff, nursing, and surgery staff at a community hospital. The program was initiated in 2010 and was in full practice by 2011. We assessed practice patterns and patient outcomes for all elective colon and rectal resection cases performed in 2009 (prior to ERAS implementation), 2011, and 2012.

MAIN OUTCOMES AND MEASURES Laparoscopic approach, narcotic use, length of stay, 30-day readmission, ileus (defined as reinsertion of nasogastric tube), and intra-abdominal infection and association between colorectal cancer (CRC) diagnosis and these outcomes.

RESULTS From 2009 to 2012, the use of laparoscopy increased from 57.4% to 88.8% (P < .001). Length of stay decreased significantly (6.7 days vs 3.7 days, P < .001), without an increase in 30-day readmission rate (17.6% vs 12.5%, P = .49). Use of patient-controlled narcotic analgesia and duration of use decreased (63.2% of patients vs 15%, P < .001; 67.8 hours vs 47.1 hours, P = .02). Ileus rate decreased from 13.2% to 2.5% (P = .02). Intra-abdominal infection decreased from 7.4% to 2.5% (P = .24). When comparing laparoscopic cases alone, similar results were observed. Following regression analysis, there were no statistically significant differences between CRC diagnosis and LOS, 30-day readmission rates, ileus, and intra-abdominal infection (all P's > .05). Length of stay reductions resulted in an estimated cost savings of $3202 per patient (2011) and $4803 per patient (2012).

CONCLUSIONS AND RELEVANCE Implementation of this patient care–directed enhanced recovery program is feasible in a community hospital setting, and it is associated with decreased LOS without increased readmission or morbidity, as well as significant decreases in narcotic use and cost. Improved outcomes are independent of the laparoscopic approach and CRC diagnosis.
Enhanced recovery after surgery (ERAS) or “fast-track” surgery was first introduced by Kehlet1-3 in the mid-1990s. Enhanced recovery after surgery programs were developed to improve patient care and outcomes, using a multimodal approach, decrease the surgical stress response, and reduce postoperative recovery time.4 The fundamental aspects of ERAS programs are a set of 20 guidelines that focus on patient education, optimal fluid management, minimal incision length, decreased use of tubes and drains, opioid-sparing analgesia, and early mobilization and resumption of oral intake.4-7 Enhanced recovery after surgery programs have been notably effective for reducing length of stay (LOS) after elective colorectal surgery.8-11 There is concern, however, that readmission rates may be higher using advanced recovery pathways.8,10

Multiple meta-analyses of colorectal ERAS programs have demonstrated decreased LOS without compromised patient safety.12-15 However, literature reporting results from ERAS programs mostly originates from international or specialized academic centers.8,9,11 To our knowledge, there is only 1 report of results from a community setting in the United States.16 The feasibility and efficacy of a colorectal ERAS program in a community setting is largely unknown.

In this prospective study in a community hospital setting, we sought to determine how implementation of a colorectal ERAS program affects LOS, patient outcomes, and safety. In addition, we sought to establish if this protocol could be successful in improving outcomes independent of the laparoscopic approach.

Methods

Study Participants, Design, and Setting
Legacy Good Samaritan (LGS) Medical Center is a community hospital in Portland, Oregon. It is 1 of 6 hospitals composing the Legacy Health system. Planning for a colorectal ERAS protocol at LGS began in 2010 through the existing multidisciplinary colorectal program planning group. The impetus came from surgeons, based on literature review and exposure to ERAS concepts at professional meetings. By 2011, the ERAS program was in full practice.

The protocol is based on the 20 core published guidelines.4,6 Key components of the LGS protocol include preadmission patient education, selective use of preoperative bowel preparation (only for left-sided and rectal procedures), fasting for only 2 hours prior to the procedure, locoregional anesthetic use (principally intrathecal spinal anesthetic), conservative perioperative and intraoperative fluid management, minimization of postoperative narcotic use, early resumption of oral intake, and early postoperative ambulation. Intraoperative fluid management was at the discretion of the anesthesia provider. This protocol is used for all patients undergoing elective colorectal resections.

Development and implementation of the program required multidisciplinary collaboration among surgeons, nursing staff, anesthesia providers, pharmacists, operating room staff, clinicians, and preadmission services. One-on-one and group discussions among health care professionals as well as presentation of the published ERAS literature were used to gain acceptance of the protocol components. A standardized ERAS protocol was developed. Key to the success of the program are clear and consistent messages about expectations for patients regarding activity, diet, and pain management before, during, and after their hospital stay. Postoperative goals are communicated each day with the patient and multidisciplinary care team, aiming for discharge by postoperative day 3, if deemed clinically safe. Discharge criteria remained unchanged from prior to program implementation: adequate pain control with oral analgesia, tolerance of a general diet, adequate fluid intake, nondistended abdomen, and either flatus or a bowel movement.

By 2011, the ERAS program was in full practice. As we continually strive to improve the protocol and enhance patient outcomes, additional measures were added in 2012. Based on literature demonstrating faster return of bowel function with use of a peripheral mu-opioid receptor antagonist in open and laparoscopic colorectal resections, alvimopan was added to our pathway in appropriate patients.17-19 Scheduled acetylsalicylic acid and gabapentin, used for multimodal pain control, were also added to the order sets for 2012.

The Legacy Institutional Review Board approved this study. Patient consent was not required by the institutional review board because the protocol was a hospital-wide, evidence-based quality improvement project and was considered standard practice. Patient information for 2011 and 2012 was prospectively gathered. Database points were patient demographics (including age, sex, smoking status, body mass index, and comorbidities), procedure performed, perioperative interventions, and outcomes. Specific clinical outcomes analyzed were laparoscopic approach, narcotic use, antiemetic use, incidence of ileus (defined as insertion of nasogastric tube), deep venous thrombosis (DVT), pulmonary embolus, myocardial infarction, pneumonia, surgical site infection, deep organ space/intra-abdominal infection, need for return to the operating room, LOS, and 30-day readmission rate. If an operation was attempted laparoscopically but converted to an open procedure, this was classified as open in our study. These data points were gathered prospectively for all elective colorectal resections in 2011 (year 1 of the protocol) and 2012 (year 2 of the protocol). Data from 2009 (prior to ERAS implementation) were gathered through retrospective medical record review and served as a baseline. The year 2010 was excluded from analysis since during this year the hospital was undergoing implementation of the program and transition to new anesthesia providers.

Data Analysis
Patient characteristics and perioperative outcomes in 2011 and 2012 were compared with those in 2009 (baseline). Length of stay in 2012 was also compared with 2011 and within 2012 comparing the cohort who received alvimopan with those who did not. Categorical variables were compared using the Fisher exact test. Continuous variables were compared using a non-parametric 2-sample Wilcoxon test (Mann-Whitney test). Analyses were performed for all cases (overall) and for the subset of laparoscopic cases. Further regression analyses were
implemented to determine whether colorectal cancer (CRC) was a significant factor in predicting our main outcome measures (LOS, 30-day readmission rate, ileus, and intra-abdominal infection). More specifically, linear regression analyses were used when outcome measures were LOS, whereas logistic regression analyses were used when outcome measures were 30-day readmission rate, ileus, and intra-abdominal infection.

Average cost per day for a postoperative colorectal resection patient at our hospital was calculated based on an average of 917 patient hospital days. This cost excluded any charges from the operating room, anesthesia, short stay unit, postoperative care unit, or emergency department. The average cost per postoperative patient day was estimated to be $1601. Cost per patient was defined as the average LOS for each year examined multiplied by the average cost per postoperative patient day. All statistical analyses were performed using R version 2.15.1.20

Results

A total of 244 patients met inclusion criteria. The number of elective colorectal resections in 2009, 2011, and 2012 were 68, 96, and 80, respectively. Patient demographics and preoperative and surgery characteristics are listed in Table 1. Years 2011 and 2012 were each compared with the baseline. The groups were statistically similar in sex, body mass index, preoperative diagnosis of diabetes, and case mix of colorectal procedures performed (P values all >.05). Patients in 2011 were younger than those in 2009 (aged 60 years vs 65 years, P = .03), a decreased percentage had CRC (53.1% vs 83.8%, P < .001), and an increased percentage had a laparoscopic approach (84.4% vs 57.4%, P < .001). In 2012, there was an increased percentage of active smokers when compared with baseline (15% vs 4.4%, P = .05), a decreased percentage of CRC (45% vs 83.8%, P < .001), and an increased percentage of the laparoscopic approach (88.8% vs 57.4%, P < .001) (Table 1).

Perioperative outcomes for all patients who underwent laparoscopic or open surgery are summarized in Table 2. Since the ERAS protocol was put into place, patients were more likely to receive preoperative chemical DVT prophylaxis (81.3% and 79.2% vs 44.1% for 2012 [P < .001] and 2011 [P < .001] vs baseline), more likely to receive regional anesthetic (75.0% and 71.9% vs 33.9% for 2012 [P < .001] and 2011 [P < .001] vs baseline), and less likely to use patient-controlled narcotic analgesia (PCA) (15.0% and 33.3% vs 63.2% for 2012 [P < .001] and 2011 [P < .001] vs baseline). When PCA was used, the mean hours of PCA use decreased in 2012 and 2011 compared with baseline (47.1 and 43.2 vs 67.8 for 2012 [P = .02] and 2011 [P < .001] vs baseline). The percentage of patients receiving scheduled intravenous nonsteroidal anti-inflammatory drugs increased substantially after the ERAS protocol was put into place (77.5% and 72.9% vs 25.0% for 2012 [P < .001] and 2011 [P < .001] vs baseline). There was no significant difference in the percentage of patients who received antiemetics or in the mean number of doses of antiemetics used in 2012 or 2011 vs baseline. There was a statistically significant decrease in ileus (defined as reinsertion of nasogastric tube) in 2012 but not 2011 when compared with baseline (2.5% and 5.2% vs 13.2% for 2012 [P = .02] and 2011 [P = .09] vs baseline). There was no statistically significant difference in rate of DVT, pulmonary embolus, myocardial infarction, pneumonia, surgical site infection, organ space/
intra-abdominal infection, or return to the operating room in 2012 or 2011 compared with baseline. However, there was a statistically significant decrease in LOS in 2012 and 2011 compared with baseline (3.7 days and 4.7 days vs 6.7 days for 2012 [P < .001] and 2011 [P < .001] vs baseline). There was also a statistically significant decreased LOS in 2012 when compared with 2011 (P = .004). There was no difference in 30-day readmission rates in 2012 or 2011 when compared with baseline (Table 2).

For the laparoscopic cohort alone, since the ERAS protocol was put into place, patients were more likely to receive preoperative chemical DVT prophylaxis (83.1% and 75.3% vs 53.8% for 2012 [P = .002] and 2011 [P = .02] vs baseline), more likely to receive regional anesthetic (77.5% and 67.9% vs 23.1% for 2012 [P < .001] and 2011 [P < .001] vs baseline), and less likely to use a PCA (14.1% and 32.1% vs 66.7% for 2012 [P < .001] and 2011 [P < .001] vs baseline). When a PCA was used, the mean hours of PCA use were decreased in 2012 and 2011 compared with baseline (40.1 hours and 40.5 hours vs 59.2 hours for 2012 [P = .03] and 2011 [P = .001] vs baseline). When patients did not use a PCA, the mean number of total intravenous narcotic doses decreased (2.8 and 3.1 vs 6.3 for 2012 [P = .002] and 2011 [P = .01] vs baseline). The percentage of patients who received scheduled intravenous nonsteroidal anti-inflammatory drugs increased after the ERAS protocol was put into place (80.3% and 75.3% vs 30.8% for 2012 [P < .001] and 2011 [P < .001] vs baseline).

In the laparoscopic cohort, there was no difference in the percentage of patients who received antiemetics or in the mean number of doses of antiemetics used in 2012 or 2011 vs baseline. In addition, there was no statistically significant difference in rate of ileus, DVT, pulmonary embolus, myocardial infarction, pneumonia, surgical site infection, organ space/intra-abdominal infection, or return to the operating room for laparoscopic cases in 2012 or 2011 compared with baseline. There was, however, a statistically significant decrease in LOS in laparoscopic cases in 2012 and 2011 compared with baseline (3.3 days and 4.3 days vs 5.2 days for 2012 [P < .001] and 2011 [P < .001] vs baseline). There was also a statistically significant decreased LOS in 2012 when compared with 2011 (P = .01). There was no difference in 30-day readmission rates in 2012 or 2011 when compared with baseline.

Because there was a statistically significant decrease in the rate of CRC throughout the years examined, we used regression analysis to determine there was no statistically significant association between CRC diagnosis and LOS, 30-day readmission rate, ileus, or intra-abdominal infection in all cases (all P > .05). Similarly, there was no statistically significant association between these outcomes in the laparoscopic cohort (all P > .05) (Table 3). In 2012, there was a decreased mean LOS in patients who received alvimopan (n = 54; LOS: 3.37 days) as opposed to those who did not (n = 26; LOS: 4.23 days) (P = .002). Similarly, in the laparoscopic cohort, there was also a decreased LOS with al-

Table 2. Perioperative Outcomes

<table>
<thead>
<tr>
<th>Protocol adherence outcomes</th>
<th>2009 Baseline (n = 68)</th>
<th>2011 (n = 96)</th>
<th>P Value 2011 vs Baseline</th>
<th>2012 (n = 80)</th>
<th>P Value 2012 vs Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received preoperative chemical DVT prophylaxis</td>
<td>30 (44.1)</td>
<td>76 (79.2)</td>
<td>&lt;.001</td>
<td>65 (81.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Regional anesthetic given</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrathecal</td>
<td>8 (11.8)</td>
<td>62 (64.6)</td>
<td>&lt;.001</td>
<td>60 (75.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Epidural</td>
<td>15 (22.1)</td>
<td>7 (7.3)</td>
<td>&lt;.001</td>
<td>0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>None</td>
<td>45 (66.2)</td>
<td>27 (28.1)</td>
<td>0.02</td>
<td>20 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Use of PCA</td>
<td>43 (63.2)</td>
<td>32 (33.3)</td>
<td>&lt;.001</td>
<td>12 (15.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mean PCA use (range), h</td>
<td>67.8 (8-138)</td>
<td>43.2 (17-116)</td>
<td>&lt;.001</td>
<td>47.1 (14-96)</td>
<td>.02</td>
</tr>
<tr>
<td>Patients who received scheduled IV NSAIDs</td>
<td>17 (25.0)</td>
<td>70 (72.9)</td>
<td>&lt;.001</td>
<td>62 (77.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Patients who received antiemetics</td>
<td>40 (58.8)</td>
<td>61 (63.5)</td>
<td>.63</td>
<td>38 (47.5)</td>
<td>.19</td>
</tr>
<tr>
<td>Mean No. of doses of antiemetic in 72 h (range)</td>
<td>3.0 (1-10)</td>
<td>3.7 (1-11)</td>
<td>.24</td>
<td>2.6 (1-9)</td>
<td>.45</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ileus (treated with insertion of NGT)</td>
<td>9 (13.2)</td>
<td>5 (5.2)</td>
<td>.09</td>
<td>2 (2.5)</td>
<td>.02</td>
</tr>
<tr>
<td>DVT</td>
<td>1 (1.5)</td>
<td>0</td>
<td>.41</td>
<td>0</td>
<td>.41</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>0</td>
<td>0</td>
<td>&gt;.99</td>
<td>0</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0</td>
<td>0</td>
<td>&gt;.99</td>
<td>2 (2.5)</td>
<td>.50</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1 (1.5)</td>
<td>0</td>
<td>.41</td>
<td>0</td>
<td>.41</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>3 (4.4)</td>
<td>5 (5.2)</td>
<td>&gt;.99</td>
<td>4 (5.0)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Organ space infection (intra-abdominal infection)</td>
<td>5 (7.4)</td>
<td>4 (4.2)</td>
<td>.49</td>
<td>2 (2.5)</td>
<td>.24</td>
</tr>
<tr>
<td>Hospital stay outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return to OR</td>
<td>2 (2.9)</td>
<td>3 (3.1)</td>
<td>&gt;.99</td>
<td>2 (2.5)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Mean LOS (range), d</td>
<td>6.7 (2-22)</td>
<td>4.7 (2-21)</td>
<td>&lt;.001</td>
<td>3.7 (2-12)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>30-d Readmission</td>
<td>12 (17.6)</td>
<td>15 (15.6)</td>
<td>.83</td>
<td>10 (12.5)</td>
<td>.49</td>
</tr>
</tbody>
</table>

Abbreviations: DVT, deep venous thrombosis; IV, intravenous; LOS, length of stay; NGT, nasogastric tube; NSAIDs, nonsteroidal anti-inflammatory drugs; OR, operating room; PCA, patient-controlled narcotic analgesia.
Table 3. Colorectal Cancer and Outcomes of Interesta

<table>
<thead>
<tr>
<th>Variables</th>
<th>2009 Estimate (95% CI)</th>
<th>2011 Estimate (95% CI)</th>
<th>2012 Estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All cases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay</td>
<td>-0.84 (-3.44 to 1.77)</td>
<td>0.69 (-0.45 to 1.83)</td>
<td>0.48 (-0.28 to 1.25)</td>
</tr>
<tr>
<td>30-d Readmission</td>
<td>0.87 (-1.29 to 3.03)</td>
<td>-0.31 (-1.41 to 0.80)</td>
<td>0.23 (-1.10 to 1.56)</td>
</tr>
<tr>
<td>Ileus</td>
<td>-0.46 (-2.19 to 1.26)</td>
<td>0.30 (-1.54 to 2.13)</td>
<td>0.21 (-2.60 to 3.01)</td>
</tr>
<tr>
<td>Intra-abdominal infection</td>
<td>-0.28 (-2.57 to 2.01)</td>
<td>1.01 (-1.29 to 3.31)</td>
<td>17.52 (-5809.44 to 5774.40) &gt;.99</td>
</tr>
<tr>
<td><strong>Laparoscopic cases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay</td>
<td>1.58 (-0.33 to 3.49)</td>
<td>1.04 (-0.11 to 2.19)</td>
<td>0.13 (-0.36 to 0.62)</td>
</tr>
<tr>
<td>30-d Readmission</td>
<td>16.55 (-5700.79 to 5731.90) &gt;.99</td>
<td>-0.41 (-1.69 to 0.87)</td>
<td>0.35 (-1.12 to 1.83)</td>
</tr>
<tr>
<td>Ileus</td>
<td>15.79 (-5701.55 to 5733.14) &gt;.99</td>
<td>0.54 (-1.90 to 2.98)</td>
<td>1.01 (-1.29 to 3.31)</td>
</tr>
<tr>
<td>Intra-abdominal infection</td>
<td>16.07 (-9410.24 to 9442.38) &gt;.99</td>
<td>17.95 (-5695.16 to 5731.07) &gt;.99</td>
<td>17.60 (-6362.33 to 6327.14) &gt;.99</td>
</tr>
</tbody>
</table>

a There is no statistically significant effect of colorectal cancer on outcomes of interest.

Discussion

We have demonstrated that a colorectal ERAS program can be successfully implemented in a community hospital. With the adoption of this program, we have decreased LOS without increasing readmission rate, with continued patient safety and improved health care cost savings. In addition, use of the protocol demonstrated improvements beyond those attributed to laparoscopy alone.

We successfully implemented this program using core guidelines initially established by Kehlet1-3 and delineated by consensus review.6 Most of the literature reporting results with ERAS programs stems from either non-US countries or specialized academic centers in the United States.8,10,11 To our knowledge, there is only 1 report of outcomes of a fast-track colorectal surgery program within a community hospital in the United States.16 With this prospective study, we have demonstrated that this type of program can be developed and implemented and is efficacious in the community setting. Moreover, we have shown that in this setting, data assessment can be successfully executed to report and self-evaluate outcomes.

Despite literature supporting that increased compliance with ERAS protocol improves outcomes, many studies do not measure this.15,21 We demonstrated compliance with the program, with a statistically significant increase in use of the laparoscopic approach, preoperative DVT prophylaxis, and regional anesthetics, with a complementary decreased narcotic use. Because of the well-known effects of narcotics on postoperative bowel functional recovery,22 we focused attention on this aspect of the protocol. We implemented regional techniques of pain control in attempt to decrease narcotic use. We demonstrated not only the ability to decrease PCA use rates, but also hours of use when PCA is needed. Furthermore, we demonstrated that withholding use of PCA does not increase use of intravenous narcotic doses in the laparoscopic cohort.

Decrease in surgical morbidity using an ERAS protocol has been described in the literature.8,10,11,13 We demonstrate a statistically significant reduced incidence of ileus overall within year 2 when compared with baseline. This decrease does not hold significance when only the laparoscopic cases are examined. There was also a decrease in organ space infection from 7% to 3% within our study. This change did not reach statistical significance because of the infrequency of the complication within our limited patient cohort.

In concordance with the literature, our LOS decreased overall from 6.7 days prior to the protocol to 3.7 days in 2012.22-24 The reduction in LOS was also notably observed within patients who underwent a laparoscopic procedure (decreasing from 5.2 days in 2009 to 3.3 days in 2012). Though some authors report that their decreased LOS comes at a cost of increased readmissions,8,10 in our study, there was no significant difference in readmission rates throughout the study period.

When comparing year 1 of the protocol with year 2, there was a continued improvement in LOS with a statistically significant decrease overall and within the laparoscopic cohort. The changes to the protocol in year 2 included addition of scheduled acetaminophen and gabapentin and use of alvimopan. When comparing those who received alvimopan with those who did not, patients who received the medication had a significant reduction in LOS overall (decreasing from 4.2 days to 2.3 days) and in the laparoscopic cohort (decreasing from 4.0 days to 3.0 days). This reflects that, within the ERAS protocol, additional improvements can enhance recovery for all colorectal resections and also independently within the laparoscopic cohort.

We have demonstrated significant reductions in LOS with implementation of the ERAS protocol, resulting in substantial cost savings for the hospital system. Based on our surg-
cal volume in 2012, for instance, of 80 patients, this represents an overall cost savings of $384 240 per year.

There are certain limitations to this study. This is a study based in a single community hospital. Our patient population and hospital setting may not reflect other patient settings such as academic centers. Nonetheless, given the paucity of literature from community hospitals reporting data from ERAS programs, this is a useful study that clearly demonstrates reproducibility of this internationally pioneered ERAS program within a community center. Since implementation of the program at our facility with increasing multidisciplinary awareness of improved outcomes, there has been a noticeable increase in referrals to a more limited number of colorectal specialists. This shift in care may have affected outcomes. An additional important limitation is that our superficial wound infection rates are likely underrepresented. Many superficial wound infections can occur after discharge, which our study did not capture. At our community hospital, the inpatient electronic medical record is not linked to individual surgeon outpatient clinic records. In the literature, laparoscopic wound infection rates range from 4% to 6% and open, from 15% to 25%. Despite increased use of laparoscopy throughout the study, wound infection rates were not significantly different.

In our efforts to continually evolve and improve the program with an evidence-based approach, we have adopted additional elements subsequent to this report. We have implemented preoperative support and interventions for nutrition (using arginine-based supplements), emphasis on smoking cessation, and improvements in glycemic control.

Conclusions
We have demonstrated with this study that a colorectal ERAS program can be effectively applied to and integrated within a community hospital setting. The program can successfully speed patient recovery without increasing postoperative morbidity or readmission rates. These effects are validated in the overall elective colorectal resection patient population as well as within the laparoscopic approach cohort. Our results validate use of ERAS programs to include community hospital care settings.

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Author Contributions: Dr Geltzeiler had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Whitehead, Frankhouse. Acquisition, analysis, or interpretation of data: Geltzeiler, Rotramel, Wilson, Deng, Whitehead, Frankhouse. Drafting of the manuscript: Geltzeiler, Rotramel, Wilson, Frankhouse. Critical revision of the manuscript for important intellectual content: Geltzeiler, Rotramel, Wilson, Deng, Whitehead, Frankhouse. Statistical analysis: Deng. Administrative, technical, or material support: Geltzeiler, Rotramel, Wilson, Whitehead, Frankhouse. Study supervision: Rotramel, Whitehead, Frankhouse.

Conflict of Interest Disclosures: None reported.
Previous Presentation: This study was presented at the 85th Annual Meeting of the Pacific Coast Surgical Association; February 15, 2014; Dana Point, California.

REFERENCES


CORRECTION

Missing Initial in Author Name: In the article titled “Diffusion of Surgical Innovations, Patient Safety, and Minimally Invasive Radical Prostatectomy,” published in the August issue of JAMA Surgery (doi:10.1001/jamasurg.2014.31), a middle initial was missing from an author’s name. The name should have been listed as Sean P. Stroup. This article was corrected online.

Incorrect Author Affiliation: In the article titled “Department of Veterans Affairs Cooperative Studies Program Network of Dedicated Enrollment Sites: Implications for Surgical Trials,” published online March 19, 2014, and in the June print issue of JAMA Surgery (doi:10.1001/jamasurg.2013.4150), the second author’s affiliation was incorrect. Dr. Reda’s affiliation should have been listed as Hines Cooperative Studies Program Coordinating Center, Hines, Illinois. This article was corrected online.

Errors in Subtitle: In the article titled “Vein Graft Preservation Solutions, Patency, and Outcomes After Coronary Artery Bypass Graft Surgery: Follow-up From PREVENT IV Randomized Clinical Trial,” published online June 18, 2014, and in the August print issue of JAMA Surgery (doi:10.1001/jamasurg.2014.87), the subtitle should have been given as “Follow-up From the PREVENT IV Randomized Clinical Trial.” This article was corrected online.