Review Article

Preoperative instructions and postoperative care in the 21st century

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Abstract: The preoperative and postoperative management of patients undergoing right hemicolectomy for colon cancer has undergone significant change in the 20th century. From a time where a postoperative stay of 10 days was not uncommon, patients are now routinely discharged on postoperative day 2–3, and same day colectomy is also practiced in some centers. Enhanced recovery programs are standard practice and their guidelines are developed from a strong evidence base around perioperative management and recovery. The preoperative visit is increasingly important and is used to identify modifiable risk factors such as malnutrition, anemia, smoking, and alcohol abuse. Detailed counselling and preoperative education should also be undertaken so patients are psychologically prepared for their cancer surgery and have clear expectations and goals for their recovery. Nausea and vomiting postoperatively is a common cause of delayed discharge. Patients at risk should be identified preoperatively and treated prophylactically. Prehabilitation is an exciting field in colorectal surgery but its role in right hemicolectomy for colon cancer is limited due the necessary short interval between diagnosis and surgery. Patients should be fasting for the minimal amount of time preoperatively and should be allowed clear carbohydrate containing fluids up until 2 hours before surgery. The intraoperative use of opioids should be minimized and high risk patients should have goal-directed fluid therapy (GDFT). As the majority of right colectomies are performed laparoscopically, TAP blocks should be used instead of epidural analgesia for postoperative pain relief. The routine use of nasogastric tubes or abdominal drains should be avoided. Patients should be mobilized the evening after surgery and diet advanced early to prevent postoperative ileus. In modern colorectal practice, regular audits should be undertaken in the unit to ensure adherence to enhanced recovery programs and to identify areas for improvement.

Keywords: Enhanced recovery; colon cancer; right hemicolectomy

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Introduction

The perioperative management of patients undergoing right colectomy for colon cancer has undergone significant change in the past 20 years. From a historical standpoint, patients undergoing an open right colectomy would be admitted a day or two prior to surgery for inpatient bowel prepping and shaving, sometimes longer if they needed work-up, and a post-operative stay of a week to 10 days was standard, often with post-operative antibiotics for 48–72 hours and prolonged nasogastric tube decompression. In the modern era of enhanced recovery and same-day admission patients undergoing right colectomy can expect to be admitted the same day as their surgery and discharged day

1–2 post-op with a 30-day mortality risk of 1–1.5% (1,2).

The idea of enhanced recovery was first introduced in Europe by Henrik Kehlet in the late 1990's and early 2000's as a series of interventions designed to reduce the sequelae of surgical injury and physiological stress (3,4). Now common in many surgical subspecialties, enhanced recovery in colorectal surgery has been proven over the last two decades to be safe and effective and is considered the standard of care. The ERAS© Society has produced evidence based guidelines designed to reduce and mitigate perioperative stress, maintain postoperative physiological function and accelerate recovery after surgery. First published in 2005 the society has recently published its fourth guideline in 2018 and many recommendations on perioperative care that are found in this article are derived from these guidelines (5). Further guidelines have been published on enhanced recovery after colorectal surgery by the American Society of Colon and Rectal Surgeons (ASCRS) in collaboration with the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), and the American Society for Enhanced Recovery (6-8). Enhanced recovery programs in colorectal surgery has been shown to reduce length of stay (LOS), reduce morbidity, decrease hospital cost, and improve patient satisfaction (5,9-15). In this review we will outline the perioperative management of patients undergoing a right hemicolectomy for colon cancer in the 21st century; we have divided our review into three sections: preoperative, intraoperative considerations and postoperative management. We will also address specific areas of controversy such as enhanced recovery in the elderly, the use of opioid receptor blockers, prehabilitation, goal-directed fluid therapy (GDFT), and prevention of surgical site infection (SSI) with care bundles.

Preoperative

Patient education & counselling

Patient education and engagement are central tenets to modern integrated colorectal care pathways. Surgeons and nurses are involved in detailed patient education regarding what the patient should expect in the pre- and postoperative phases of their surgery. Setting patients' expectations early, particularly in relation to expected date of discharge, has a significant impact on their postoperative course. Key postoperative targets that patients are expected to obtain are outlined as well as criteria that need to be met for discharge. It has been shown that taking time with patient education may reduce perioperative anxiety and post-operative pain (16-20). A randomized controlled trial and Cochrane review has demonstrated that psychological support and detailed preoperative education has a reduction in LOS and improved postoperative outcomes (21,22). Team members included in this discussion should include the surgeon, anesthesiologist, nurses and/or advanced practice providers (23).

Addressing modifiable risk factors

Optimization of certain preoperative risk factors has been shown to have a positive impact on patient outcome (24-27). There are numerous pre-operative risk assessment tools available online and in the literature that can aid physicians in patient risk stratification (28-31). While these tools can highlight specific identifiable risk there is little evidence that these scoring systems have an impact on postoperative outcomes (28). Addressing specific modifiable risk factors such as smoking, alcohol, anemia, and nutrition has been shown to improve patient outcomes and should be sought out at the pre-operative visit.

Smoking & alcohol

Smoking is a proven risk factor for post-operative complications, particularly wound related and respiratory complications, and should be addressed at the first consultation (32). As patients with right sided colon cancer do not have the luxury of postponing their surgery for longer than a few weeks the impact of smoking cessation is limited. The minimal level of smoking cessation needed to decreased complications appears to be 4–8 weeks, but notwithstanding this figure it is intuitive that smoking should be addressed at the pre-operative visits (24,25,33).

Alcohol abuse has been shown to increase post-operative morbidity, particularly infections, but not mortality (34). A systematic review of observational studies and RCTs demonstrated that consuming more than two units per day has an impact on post-operative morbidity. Although abstinence for at least four weeks is recommended, even abstaining for shorter periods will help in the perioperative phase, particularly for patients prone to alcohol withdrawal syndromes. Addressing nutritional deficiencies in heavy alcohol users (e.g., thiamine deficiency) should also be performed at this visit.

Anemia

Another specific modifiable risk factor that should be

addressed at the preoperative visit is anemia. This is of particular importance with right colon cancer as anemia is common and may be the only presenting sign (35). The WHO definition of anemia is a hemoglobin concentration less than 13 g/dL for men and 12 g/dL for women. The short time interval between diagnosis and surgery for right colon cancer limits the options available for normalization of hemoglobin as oral iron therapy can take weeks to take effect, and the modest increase seen with oral or IV iron therapy may be mitigated by ongoing losses. IV iron therapy may be considered in mild-moderate anemia as 1–1.5 g of iron is usually sufficient to replete iron stores and reticulocytosis occurs three to five days after infusion (5). Patients often report subjective feelings of improvement within 1–2 days. A single infusion of ferric carboxymaltose over 15 minutes was shown to increase mean hemoglobin by 0.8 g/dL over eight days (36). Severely anemic patients from an actively bleeding right colon cancer will benefit from packed RBC transfusion pre-op, although achieving a recommended pre-operative target of 13 g/dL may be unrealistic and unnecessary in this setting and a lower target should be identified to reduce the need for excessive transfusion. Autologous blood donation or acute normovolemic hemodilution is typically not used or recommended for this patient population.

Nutritional optimization

Cancer patients often present after significant weight loss and the preoperative visit should address nutritional status. It is well known that malnutrition increases postoperative morbidity and mortality and is associated with worse oncologic outcomes, particularly with unintentional weight loss of 5–10% or more (37-41). Although no singular nutritional risk assessment tool is agreed upon for patients having colorectal cancer resections, having a high Nutritional Risk Screening Score (NRS) is associated with increased risk of complications (5,42). Serum albumin levels are also associated with morbidity & mortality and can be used as a crude assessment of nutrition (43,44). Oral nutritional supplementation with high calorific drinks is usually sufficient to improve nutritional status in the short-term prior to surgery (29). The impact of immunonutrition in colorectal surgery has also been examined. Several specific nutrients such as arginine, glutamine, nucleotides and omega-3 fatty acids have been shown in laboratory and clinical studies to influence nutritional, immunological, and inflammatory parameters (45). Heyland *et al.* performed a systematic review of the evidence of immunonutrition in critically ill patients and found a reduction in infectious complication rates but no mortality advantage (45). Thornblade *et al.* examined the effect of preoperative immunonutrition on elective colorectal resection outcomes and found no difference in serious adverse events but a reduction in LOS (46). In a recent paper looking at the impact of immunonutrition on postoperative morbidity in digestive oncology surgery, Challine *et al.* found no difference in 90-day morbidity but a shorter LOS in the immunonutrition group (47). Identifying sarcopenia, visceral obesity and myosteatosis on pre-operative imaging may also be useful as they have been shown to be independent predictors of increased LOS and readmission in colorectal surgery (48).

Prevention of postoperative nausea & vomiting

One of the most debilitating symptoms for patients who undergo colonic resections is postoperative nausea and vomiting. It affects 30–50% of all surgical patients and is the leading cause of patient dissatisfaction (49). Risk factors for developing post-op nausea & vomiting include a past history of same, female gender, non-smokers, volatile anesthetic agents, nitrous oxide use, and high levels intraoperative of opioid administration (50,51). By minimizing or omitting modifiable risk factors listed above one can mitigate the severity of symptoms in those affected. There are several different classes of first line antiemetic drugs including D2 antagonists, 5HT3 antagonists, and corticosteroids. Using a multimodal treatment regimen for postoperative nausea and vomiting has a higher chance of success compared to single agent use (52). The DREAMS trial (Dexamethasone Reduces Emesis After Major Gastrointestinal Surgery) supported the use of dexamethasone for both open and laparoscopic GI surgery at a single dose of 8 mg without increased adverse events (53). According to recently published ERAS© Society guidelines patients with 1–2 risk factors for post-op nausea and vomiting should receive a two drug combination of first-line antiemetics, and patients with greater than two risk factors should receive 2–3 antiemetics from different classes (5). This observation was originally demonstrated by TJ Gan in a series of randomized controlled trials performed in the 1990's (54-56).

Prophylactic antibiotics and skin preparation

Preoperative intravenous antibiotics given within 60 minutes

prior to incision have been clearly shown to reduce SSIs. A Cochrane review on prophylactic antibiotics in 2014 demonstrated a SSI reduction from 39% to 13% (57). Antibiotic prophylaxis should be guided by local hospital policy; the standard regimen used in our institution is metronidazole combined with a third generation cephalosporin for bowel cases; with metronidazole and ciprofloxacin for penicillin-allergic patients. Skin decontamination has traditionally been performed with iodine containing solutions. Recent level one evidence on the use of chlorhexidine-alcohol solutions in colorectal patients has shown a significant advantage of these agents over traditional iodine skin preparation (58). There is limited evidence to support pre-operative antiseptic showers in colorectal surgery but is considered a 'best practice' measure and is included as part of our SSI prevention bundle (59,60). Hair that will be in the surgical field should be clipped rather than shaved and this should be performed just prior to surgery.

Mechanical bowel preparation

The use of mechanical bowel preparation in colorectal surgery has been extensively investigated and updated Cochrane reviews have consistently shown no difference rates of SSI, anastomotic leak, organ space infection, mortality, LOS, or re-operation (61). Recent large database studies however have called this into question with NSQIP data showing that adding oral antibiotics to mechanical bowel preparation reduces SSI rate, anastomotic leak rate, ileus and major morbidity (62). It appears that adding oral antibiotics to mechanical bowel prep accounts for the reduction infectious complications. A meta-analysis in 2016 of RCTs that included colorectal patients that were given mechanical bowel prep as well as oral and IV antibiotics showed a reduction in incisional SSI rate but no difference in rates of organ space SSI rate (63). There are ongoing trials in right-sided colon resections to determine if enteral antibiotics, without the mechanical prep, are adequate.

Pre-operative fasting & fluid management

The goal of modern pre-surgical planning is to have the patient as close to a euvolemic state as possible with the safest minimal fasting time permitted prior to induction. Patients undergoing a right colectomy are allowed to drink clear fluids up to two hours before surgery with a light meal six hours before. This is recommended in the most recent ERAS© guidelines and has been shown to be safe in multiple RCTs (5,64-66). Carbohydrate loading with drinks the evening before surgery and two hours before induction has been shown to reduce to catabolic response to surgery and increase gastric emptying (67). In a large RCT of preoperative carbohydrate loading *vs.* placebo in major abdominal surgery Gianotti *et al.* showed carbohydrate loading lowered insulin requirements and patients had less episodes of hyperglycemia, however there was no difference in complications or LOS (68). A Cochrane review of 27 RCTs from multiple disciplines showed carbohydrate loading resulted in a small reduction in hospital stay (mean 0.3 days) (69). There are also some data from this review showing a reduced time to flatus. There is no evidence however showing a beneficial effect of carbohydrate loading on morbidity or mortality in elective colorectal surgery.

Intraoperative considerations

Anesthesia

The primary aims of anesthesia are threefold: to limit the stress response to surgery, optimize fluid balance, and provide adequate analgesia (70). Recommended principles in modern colorectal anesthetic practice include avoidance of benzodiazepines, use of short acting general anesthetic agents and minimal use of intra-operative opioids. Using propofol for induction of anesthesia combined with judicious use of short acting opioids such as fentanyl, alfentanil, sufentanil or remifentanil infusions minimizes the residual effect at the end of the procedure (5). Currently there is a trend towards opiate free anesthesia (71). Maintaining body temperature with the use of nasopharyngeal assessment or an esophageal probe checked every 5 minutes helps prevent the deleterious effects of hypothermia. Even mild perioperative hypothermia has been associated with adverse events such as increased blood loss, increased transfusion rate, increased afterload, myocardial ischemia and arrhythmias, and reduction in splanchnic blood flow, increased post-operative shivering and oxygen consumption, higher rates of infection and delayed discharge (72). Methods to increase body temperature intra-operatively include warming & humidifying anesthetic gasses, warming IV fluids and irrigation fluids, using warming devices, and pre-warmed blankets. Using warmed and humidified CO_2 was associated with improved intra-operative temperature control.

Analgesia

Thoracic epidural analgesia has consistently been shown in RCTs and meta-analyses to provide superior analgesia compared to systemic opioids in open colorectal surgery (73,74). This is usually administered between the lower thoracic vertebrae from T7-T10. For laparoscopic colorectal surgery however the same analgesic benefits have not been demonstrated and some research has shown an increased LOS (75). Transversus abdominis plane (TAP) blocks using a 4-point technique under direct laparoscopic visualization just after pneumoperitoneum is established is a useful analgesia adjunct in laparoscopic cases. This is easy to perform and eliminates the time delay associated with ultrasound administered TAP blocks performed before or after the procedure. Recent evidence has also suggested that intraoperative TAP blocks performed under direct vision may be superior to US guided TAP blocks (76). TAP blocks are associated with less opioid use and faster resumption of passage of flatus and bowel movements compared to controls (77,78). The use of longer acting liposomal bupivacaine in TAP blocks for colorectal surgery is a promising area but further research is needed before recommendation based on the much higher cost compared to standard local anesthetics. There also is recent evidence to suggest that a single intrathecal injection of opioids may be superior to a TAP block in colorectal surgery with less post-operative pain and less analgesia requirements (79). Local wound infiltration of the fascia and dermis in addition to the routine use of TAP blocks can also be used.

Postoperative

Early mobilization

Early mobilization is strongly encouraged as part of an enhanced recovery program and patients are encouraged to sit out of bed and walk on the ward on the evening of their surgery; meals should be taken in the chair as well. Prolonged bed rest is associated with increased risk of deep venous thrombosis (DVT), atelectasis, and decreased muscle mass (80,81). Although the evidence for early mobilization in colorectal patients is mainly derived from other disciplines, some evidence from a recent systematic review suggests a shorter LOS in abdominal surgery (82). What is known is that prolonged bed rest after abdominal surgery is associated with a three-fold increase in pulmonary complications (83). As with the other elements of enhanced recovery programs discussed here, these interventions need to occur in tandem as inadequate pain control or failure to remove the Foley catheter will decrease the likelihood of early mobilization.

Postoperative analgesia

A multimodal post-operative pain regimen is utilized for adequate pain relief post-op. This is based on the theory that acting on multiple analgesic receptors with a lower dose will provide adequate pain control while minimizing the side effects of each drug. Regular acetaminophen, non-steroidal anti-inflammatories (NSAIDS), gabapentinoids, and short acting opioid analgesia used only for breakthrough pain are the mainstay of pain control; opioids should be "last on, and first off" (7). According to the latest ERAS© guidelines there is insufficient evidence to prove that NSAIDS are associated with anastomotic leaks and are therefore included in the guidelines (5). Using minimal or no opioids post-operatively is associated with early mobilization, quicker return of bowel function, lower morbidity and a shorter LOS (6,84).

Drains/tubes

Orogastric tubes inserted after induction of anesthesia are used for open and laparoscopic cases at our institution and are removed before the patient wakes up. These aid in gastric decompression and are helpful in laparoscopic cases by increasing operative space and reducing the risk of gastric injury. The only indication for insertion of a nasogastric draining tube that will be left in post-operatively is if a patient presented with an obstructing right colon cancer with associated small bowel dilation. The routine use of abdominal drains for right colon cancer surgery is not recommended. Foley catheters are removed early on post-operative day one to facilitate early mobilization.

IV fluids and nutrition

As part of the enhanced recovery protocol patients are allowed liquids on the evening after their surgery and are transitioned to a low residue diet quickly if this is tolerated. A delay in the resumption of diet after major surgery increases morbidity, prolongs post-operative ileus and increases and LOS (85). Dietary supplements are used to meet increased physiological and calorific requirements (86). With early resumption of diet and oral nutritional supplements, intravenous fluids are not necessary for most patients after right colectomy (6). If maintenance fluids are

required the use of excessive volumes of 0.9% saline should be avoided as this has been shown to cause hyperchloremic acidosis and interstitial fluid overload. Multiple studies have demonstrated the deleterious effects of overzealous use of 0.9% saline post-operatively (87-89).

Avoiding post-operative ileus

Postoperative ileus is the main reasons for delayed discharge in patients who have undergone a right hemicolectomy for colorectal cancer. Delayed passage of flatus and bowel movements leads to abdominal distention, nausea and vomiting and may necessitate nasogastric tube insertion. This setback coupled with the delay in resuming oral diet can lead to a delay in discharge of over a week or more. Specific measures that reduce the likelihood of ileus are therefore central to modern enhanced recovery protocols. Limiting perioperative opioid use through multimodal pain regimens, early mobilization, avoiding routine use of nasogastric tubes and abdominal drains, early removal of Foley catheter to encourage mobilization, and careful perioperative fluid and electrolyte managements are core tenets to modern perioperative care and have been shown to reduce the incidence of post-operative ileus (5,7). The use chewing gum in the post-operative period for colorectal patients has been extensively studied and is the subject of a Cochrane review (90). They have found that while it may be associated with a mild reduction of ileus the evidence is limited to poor quality studies. de Leede *et al.* recently found no benefit to gum chewing in a large RCT of patients undergoing GI surgery as part of an enhanced recovery protocol probably because the patients are already eating, and the literature supporting gum use when patients were kept NPO (91).

Audit

The importance of Audit in the modern management of colorectal patients' needs to be emphasized. Many European countries perform national audits with yearly reports on crude outcomes to ensure quality control and adherence to protocol, and in the US the ACS NSQIP program collects and compares data from hundreds of hospitals. Individual hospitals or hospital groups should perform their own audits to ensure adherence to specific elements of perioperative care that are not included in national larger audits. Patients undergoing right hemicolectomy for colon cancer are looked after by many healthcare professionals, and auditing patient outcomes should include all disciplines and the results fed back to the entire group. A Cochrane review showed that audit and feedback have a significant effect on healthcare professions adherence to specific protocol (92). It has also been shown that if audit is dropped from enhanced recovery programs compliance falls back and LOS increases (93).

Controversial topics

Enhanced recovery in the elderly

There was concern in the early period of enhanced recovery programs that specific measures were too aggressive for this population and may lead to unintended morbidity (94). It is now known that this is a patient population that derives specific benefits from the program due to the serious consequences that prolonged postoperative bed rest can have on these patients. Opioids and benzodiazepines are particularly hazardous in elderly populations and are a common cause of delirium (95). Gabapentinoids are relatively contraindicated as they can cause deep somnolence. Multiple studies have now demonstrated the safety of enhanced recovery in elderly populations, including a systematic review of 5,965 patients in 16 studies performed by Bagnall *et al.* (96). Elderly patients in this study who were part of enhanced recovery programs had a shorter hospital stay compared to standard care. While it has been shown that there is a lower adherence to the elements in the program in elderly patients (such as later Foley removal, less mobilization and slower advancement of diet) and that elderly patients had increased rates of readmission, the overall benefits of enhanced recovery programs in the elderly support its use in this specific population. Slight adjustments to the protocol in elderly patients may have to be made on an individual basis due to the increased co-morbidities and polypharmacy in this group.

Opioid receptor antagonists

Opioid receptor antagonists are used in colorectal surgery to reduce the effects of post-operative ileus. These μ-opioid receptor antagonists can ameliorate opioid-induced bowel dysfunction without reversing analgesia due to their limited ability to cross the blood-brain barrier. These agents include alvimopan, methylnaltrexone, naloxone and naloxegol (5). Alvimopan is the most extensively studied in colorectal surgery and is the only agent approved for use in GI surgery by the FDA. A meta-analysis of RCTs evaluating alvimopan

showed a reduction in post-operative ileus in six of the eight RCTs with two showing no improvement (97). Alvimopan is restricted to patients who received a preoperative dose and only for open bowel resections (including laparoscopic procedures that were converted to open) with a primary anastomosis. Its use should be avoided in patients who have taken more than 7 consecutive days of therapeutic doses of opioids prior to surgery.

Prehabilitation

Poor physiological status is a known risk factor morbidity and mortality in major abdominal surgery (98). The concept of 'prehabilitation' has gained traction in recent years as a method of improving physiological reserve (99). Prehabilitation with specific aerobic targets has been shown to increase the physiological reserve in patients undergoing major surgery (100). Another study demonstrated a reduction by half in the number of post-operative complications by using a four week prehabilitation program (101). One limitation in prehabilitation programs in right colon surgery for colon cancer is the narrow window between diagnosis, staging and surgery. Nevertheless, adopting a program of smoking cessation, improved nutrition, increased aerobic capacity and resistance training are good medical practice and should be encouraged in all patients as well as those with upcoming major surgery. In the latest ERAS© guidelines prehabilitation programs are given a weak recommendation due to their lack of evidence and further research is required before considering this to be a mandatory item in an ERAS© protocol (5). There may be a role for targeting high-risk patients for customized prehabilitation programs that may result in a delay to surgery, if the benefits of prehabilitation in these individuals outweigh the delay to surgery.

GDFT

GDFT is an intraoperative IV fluid approach where fluid boluses are given to reach a near-maximal stroke volume, usually measured with a Doppler in the esophagus. This brings the heart to work at the maximal point of the Starling curve and has the theoretical benefit of improving oxygen delivery to tissues (102). Early studies showed a benefit of GDFT over conventional fluid therapy in colorectal surgery with a reduction in infectious complications, postoperative ileus and a shorter LOS (103-105). More recent studies however have failed to show a benefit of GDFT in the setting of an enhanced recovery program (106,107). As a result society guidelines have recommended the use of GDFT for high-risk patients and in patients undergoing surgery with large intravascular fluid loss (5,6).

SSI bundles

The adaption of 'bundled' care to reduce post-operative infection in colorectal surgery has increased in popularity. SSIs are associated with increased morbidity, increased LOS, higher readmission rates and increased healthcare cost (59,108-114). The rates of SSI in colorectal surgery are higher than other surgical disciplines with rates ranging from 15–30% (115-117). Evidence based practices at reducing SSI rates are laid out by the Surgical Care Improvement Project of the Centers for Medicare and Medicaid Services and include administering prophylactic antibiotics, perioperative hair clipping, and maintaining intraoperative normothermia (118). Using systematic approaches, or bundles, have been shown to increase the compliance and adherence to these recommendations. Keenan *et al.* reported their experience of implementing a preventative SSI bundle for colorectal surgery after their institution was identified by the American College of Surgeons National Quality Improvement Program as having significantly higher rates of SSI compared to peer institutions (119). The absolute reduction in the rates of SSIs following introduction of the bundle was 19.3% in unadjusted analysis and 13.6% after propensity adjustment. Implementation of the bundle was also associated with a reduced rate of postoperative sepsis. Other large database reviews have shown a reduction in SSI's when a bundled approach to SSI reduction was utilized (59,120). The core tenets of SSI reduction in bundles are also an integral part of ERAS recommendations so implementation of a bundled approach to these measures (e.g., with obligatory checks on electronic patient records) will improve compliance and is recommended.

Conclusions

The perioperative instructions for patients undergoing right hemicolectomy for colon cancer as outlined by these articles have significantly improved patient care in the 21st century. In the preoperative phase we have outlined evidenced based recommendations such as patient counselling and education, addressing modifiable risk factors such as anemia, nutrition, smoking and alcohol, pro-active prevention of postoperative

nausea and vomiting, the evidence based use of mechanical bowel preparation with oral antibiotics, careful preoperative fluid management and minimizing fasting time to reduce the physiological catabolic state. Intraoperative evidence-based recommendations include meticulous attention to normothermia, minimal use of opioids, avoiding routine use of nasogastric tubes and drains, routine use of laparoscopy and using TAP blocks for analgesia instead of epidural or PCA based opioid regimens. In the postoperative phase we have shown that early mobilization, early removal of Foley catheters, using a multimodal analgesia regimen with minimal opioid use, and minimizing the use of postoperative IV fluids contribute to optimum patient management in the era of enhanced recovery. We have also shown that enhanced recovery programs with modifications is safe in elderly populations, the use of SSI bundles should be encouraged, GDFR is useful for high-risk patients, and prehabilitation, although beneficial for elective benign colorectal surgery and rectal cancer patients who undergo chemoradiotherapy, has limited use in right colon surgery for colon cancer due to the short interval between diagnosis and surgery.

The implementation of a comprehensive perioperative care plan for patients undergoing right hemicolectomy for colon cancer requires buy-in from surgeons, anesthesiologist, nursing staff, allied healthcare professionals and the patients themselves. The rewards of such a pathway are clear however, and benefit the hospital, the healthcare professionals, and most importantly the patient.

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Footnote

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References

1. Bertelsen CA, Neuenschwander AU, Jansen JE, et al. Short-term outcomes after complete mesocolic excision compared with 'conventional' colonic cancer surgery. Br J Surg 2016;103:581-9.
2. Lawrence JK, Keller DS, Samia H, et al. Discharge within 24 to 72 hours of colorectal surgery is associated with low readmission rates when using Enhanced Recovery Pathways. J Am Coll Surg 2013;216:390-4.
3. Bardram L, Funch-Jensen P, Jensen P, et al. Recovery after laparoscopic colonic surgery with epidural analgesia, and early oral nutrition and mobilisation. Lancet (London, England) 1995;345:763-4.
4. Basse L, Madsen JL, Billesbølle P, et al. Gastrointestinal transit after laparoscopic versus open colonic resection. Surg Endosc 2003;17:1919-22.
5. Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for Perioperative Care in Elective Colorectal Surgery:Enhanced Recovery After Surgery (ERAS®) Society Recommendations: 2018. World J Surg 2019;43:659-695.
6. Carmichael JC, Keller DS, Baldini G, et al. Clinical Practice Guidelines for Enhanced Recovery After Colon and Rectal Surgery From the American Society of Colon and Rectal Surgeons and Society of American Gastrointestinal and Endoscopic Surgeons. Dis Colon Rectum 2017;60:761-84.
7. Hedrick TL, McEvoy MD, Mythen MMG, et al. American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on Postoperative Gastrointestinal Dysfunction Within an Enhanced Recovery Pathway for Elective Colorectal Surgery. Anesth Analg 2018;126:1896-907.
8. Moonesinghe SR, Grocott MPW, Bennett-Guerrero E, et al. American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative (POQI) joint consensus statement on measurement to maintain and improve quality of enhanced recovery pathways for elective colorectal surgery. Perioper Med (Lond) 2017;6:6.
9. Basse L, Hjort Jakobsen D, Billesbølle P, et al. A clinical pathway to accelerate recovery after colonic resection. Ann Surg 2000;232:51-7.
10. Basse L, Raskov HH, Hjort Jakobsen D, et al. Accelerated postoperative recovery programme after colonic resection improves physical performance, pulmonary function and body composition. Br J Surg 2002;89:446-53.
11. Khoo CK, Vickery CJ, Forsyth N, et al. A Prospective Randomized Controlled Trial of Multimodal Perioperative Management Protocol in Patients Undergoing Elective Colorectal Resection for Cancer. Ann Surg 2007;245:867-72.
12. Serclová Z, Dytrych P, Marvan J, et al. Fast-track in open

intestinal surgery: Prospective randomized study (Clinical Trials Gov Identifier no. NCT00123456). Clin Nutr 2009;28:618-24.
13. Awad S, Varadhan KK, Ljungqvist O, et al. A meta-analysis of randomised controlled trials on preoperative oral carbohydrate treatment in elective surgery. Clin Nutr 2013;32:34-44.
14. Wind J, Polle SW, Fung Kon Jin PH, et al. Systematic review of enhanced recovery programmes in colonic surgery. Br J Surg 2006;93:800-809.
15. Li D, Jensen C. Patient Satisfaction and Quality of Life with Enhanced Recovery Protocols. Clin Colon Rectal Surg 2019;32:138-44.
16. Ayyadhah Alanazi A. Reducing anxiety in preoperative patients: a systematic review. Br J Nurs 2014;23:387-93.
17. Gan TJ, Habib AS, Miller TE, et al. Incidence, patient satisfaction, and perceptions of post-surgical pain:results from a US national survey. Curr Med Res Opin 2014;30:149-60.
18. Hounsome J, Lee A, Greenhalgh J, et al. A systematic review of information format and timing before scheduled adult surgery for peri-operative anxiety. Anaesthesia 2017;72:1265-72.
19. Wilson CJ, Mitchelson AJ, Tzeng TH, et al. Caring for the surgically anxious patient: a review of the interventions and a guide to optimizing surgical outcomes. Am J Surg 2016;212:151-9.
20. Ziehm S, Rosendahl J, Barth J, et al. Psychological interventions for acute pain after open heart surgery. Cochrane database Syst Rev 2017;7:CD009984.
21. Forsmo HM, Pfeffer F, Rasdal A, et al. Compliance with enhanced recovery after surgery criteria and preoperative and postoperative counselling reduces length of hospital stay in colorectal surgery: results of a randomized controlled trial. Colorectal Dis 2016;18:603-11.
22. Powell R, Scott NW, Manyande A, et al. Psychological preparation and postoperative outcomes for adults undergoing surgery under general anaesthesia. Cochrane Database Syst Rev 2016;(5):CD008646.
23. Aasa A, Hovbäck M, Berterö CM. The importance of preoperative information for patient participation in colorectal surgery care. J Clin Nurs 2013;22:1604-12.
24. Mills E, Eyawo O, Lockhart I, et al. Smoking cessation reduces postoperative complications: a systematic review and meta-analysis. Am J Med 2011;124:144-154.e8.
25. Wong J, Lam DP, Abrishami A, et al. Short-term preoperative smoking cessation and postoperative complications: a systematic review and meta-analysis. Can J Anaesth 2012;59:268-79.
26. Shabanzadeh DM, Sørensen LT. Alcohol consumption increases post-operative infection but not mortality: a systematic review and meta-analysis. Surg Infect (Larchmt) 2015;16:657-68.
27. Oppedal K, Møller AM, Pedersen B, et al. Preoperative alcohol cessation prior to elective surgery. Cochrane database Syst Rev 2012;(7):CD008343.
28. Cohen ME, Liu Y, Ko CY, et al. An Examination of American College of Surgeons NSQIP Surgical Risk Calculator Accuracy. J Am Coll Surg 2017;224:787-795.e1.
29. Jie B, Jiang Z-M, Nolan MT, et al. Impact of preoperative nutritional support on clinical outcome in abdominal surgical patients at nutritional risk. Nutrition 2012;28:1022-7.
30. Kristensen SD, Knuuti J, Saraste A, et al. 2014 ESC/ESA Guidelines on non-cardiac surgery. Eur J Anaesthesiol 2014;31:517-73.
31. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489-95.
32. Bluman LG, Mosca L, Newman N, et al. Preoperative smoking habits and postoperative pulmonary complications. Chest 1998;113:883-9.
33. Thomsen T, Villebro N, Møller AM. Interventions for preoperative smoking cessation. Cochrane Database Syst Rev 2014;(3):CD002294.
34. US Preventive Services Task Force, Bibbins-Domingo K, Grossman DC, et al. Screening for Colorectal Cancer:US Preventive Services Task Force Recommendation Statement. JAMA 2016;315:2564-75.
35. Muñoz M, Gómez-Ramírez S, Martín-Montañez E, et al. Perioperative anemia management in colorectal cancer patients: A pragmatic approach. World J Gastroenterol 2014;20:1972.
36. Froessler B, Palm P, Weber I, et al. The Important Role for Intravenous Iron in Perioperative Patient Blood Management in Major Abdominal Surgery. Ann Surg 2016;264:41-6.
37. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003;22:235-9.
38. Norman K, Pichard C, Lochs H, et al. Prognostic impact of disease-related malnutrition. Clin Nutr 2008;27:5-15.
39. Pacelli F, Bossola M, Rosa F, et al. Is malnutrition still a risk factor of postoperative complications in gastric cancer

surgery? Clin Nutr 2008;27:398-407.
40. Pressoir M, Desné S, Berchery D, et al. Prevalence, risk factors and clinical implications of malnutrition in French Comprehensive Cancer Centres. Br J Cancer 2010;102:966-71.
41. Bozzetti F, Gianotti L, Braga M, et al. Postoperative complications in gastrointestinal cancer patients: The joint role of the nutritional status and the nutritional support. Clin Nutr 2007;26:698-709.
42. Schwegler I, von Holzen A, Gutzwiller JP, et al. Nutritional risk is a clinical predictor of postoperative mortality and morbidity in surgery for colorectal cancer. Br J Surg 2010;97:92-7.
43. Gibbs J, Cull W, Henderson W, et al. Preoperative serum albumin level as a predictor of operative mortality and morbidity: results from the National VA Surgical Risk Study. Arch Surg 1999;134:36-42.
44. Hennessey DB, Burke JP, Ni-Dhonochu T, et al. Preoperative Hypoalbuminemia is an Independent Risk Factor for the Development of Surgical Site Infection Following Gastrointestinal Surgery. Ann Surg 2010;252:325-9.
45. Heyland DK, Novak F, Drover JW, et al. Should immunonutrition become routine in critically ill patients? A systematic review of the evidence. JAMA 2001;286:944-53.
46. Thornblade LW, Varghese TK, Shi X, et al. Preoperative Immunonutrition and Elective Colorectal Resection Outcomes. Dis Colon Rectum 2017;60:68-75.
47. Challine A, Rives-Langes C, Danoussou D, et al. Impact of Oral Immunonutrition on Postoperative Morbidity in Digestive Oncologic Surgery. Ann Surg 2019. [Epub ahead of print].
48. Martin L, Hopkins J, Malietzis G, et al. Assessment of Computed Tomography (CT)-Defined Muscle and Adipose Tissue Features in Relation to Short-Term Outcomes After Elective Surgery for Colorectal Cancer: A Multicenter Approach. Ann Surg Oncol 2018;25:2669-80.
49. Gan TJ, Diemunsch P, Habib AS, et al. Consensus Guidelines for the Management of Postoperative Nausea and Vomiting. Anesth Analg 2014;118:85-113.
50. Apfel CC, Philip BK, Cakmakkaya OS, et al. Who is at risk for postdischarge nausea and vomiting after ambulatory surgery? Anesthesiology 2012;117:475-86.
51. Apfel CC, Läärä E, Koivuranta M, et al. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anesthesiology 1999;91:693-700.
52. Eberhart LHJ, Mauch M, Morin AM, et al. Impact of a multimodal anti-emetic prophylaxis on patient satisfaction in high-risk patients for postoperative nausea and vomiting. Anaesthesia 2002;57:1022-7.
53. DREAMS Trial Collaborators and West Midlands Research Collaborative. Dexamethasone versus standard treatment for postoperative nausea and vomiting in gastrointestinal surgery: randomised controlled trial (DREAMS Trial). BMJ 2017;357:j1455.
54. Gan TJ, Collis R, Hetreed M. Double-blind comparison of ondansetron, droperidol and saline in the prevention of postoperative nausea and vomiting. Br J Anaesth 1994;72:544-7.
55. Gan TJ, Ginsberg B, Grant AP, et al. Double-blind, randomized comparison of ondansetron and intraoperative propofol to prevent postoperative nausea and vomiting. Anesthesiology 1996;85:1036-42.
56. Gan TJ, El-Molem H, Ray J, et al. Patient-controlled antiemesis: a randomized, double-blind comparison of two doses of propofol versus placebo. Anesthesiology 1999;90:1564-70.
57. Nelson RL, Gladman E, Barbateskovic M. Antimicrobial prophylaxis for colorectal surgery. Cochrane Database Syst Rev 2014;(5):CD001181.
58. Darouiche RO, Wall MJ, Itani KMF, et al. Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis. N Engl J Med 2010;362:18-26.
59. Gorgun E, Rencuzogullari A, Ozben V, et al. An Effective Bundled Approach Reduces Surgical Site Infections in a High-Outlier Colorectal Unit. Dis Colon Rectum 2018;61:89-98.
60. Ploegmakers IB, Olde Damink SW, Breukink SO. Alternatives to antibiotics for prevention of surgical infection. Br J Surg 2017;104:e24-e33.
61. Rollins KE, Javanmard-Emamghissi H, Lobo DN. Impact of mechanical bowel preparation in elective colorectal surgery: A meta-analysis. World J Gastroenterol 2018;24:519-36.
62. Garfinkle R, Abou-Khalil J, Morin N, et al. Is There a Role for Oral Antibiotic Preparation Alone Before Colorectal Surgery? ACS-NSQIP Analysis by Coarsened Exact Matching. Dis Colon Rectum 2017;60:729-37.
63. Chen M, Song X, Chen L, et al. Comparing Mechanical Bowel Preparation With Both Oral and Systemic Antibiotics Versus Mechanical Bowel Preparation and Systemic Antibiotics Alone for the Prevention of Surgical Site Infection After Elective Colorectal Surgery. Dis Colon Rectum 2016;59:70-8.

64. Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration. Anesthesiology 2017;126:376-93.
65. Brady M, Kinn S, Ness V, et al. Preoperative fasting for preventing perioperative complications in children. Cochrane Database Syst Rev 2009;(4):CD005285.
66. Brady M, Kinn S, Stuart P. Preoperative fasting for adults to prevent perioperative complications. Cochrane Database Syst Rev 2003;(4):CD004423.
67. Nygren J. The metabolic effects of fasting and surgery. Best Pract Res Clin Anaesthesiol 2006;20:429-38.
68. Gianotti L, Biffi R, Sandini M, et al. Preoperative Oral Carbohydrate Load Versus Placebo in Major Elective Abdominal Surgery (PROCY). Ann Surg 2018;267:623-30.
69. Smith MD, McCall J, Plank L, et al. Preoperative carbohydrate treatment for enhancing recovery after elective surgery. Cochrane Database Syst Rev 2014;(8):CD009161.
70. Levy BF, Scott MJP, Fawcett WJ, et al. Optimizing patient outcomes in laparoscopic surgery. Colorectal Dis 2011;13:8-11.
71. Keller DS, Zhang J, Chand M. Opioid-free colorectal surgery: a method to improve patient & financial outcomes in surgery. Surg Endosc 2019;33:1959-66.
72. Rajagopalan S, Mascha E, Na J, et al. The effects of mild perioperative hypothermia on blood loss and transfusion requirement. Anesthesiology 2008;108:71-7.
73. Block BM, Liu SS, Rowlingson AJ, et al. Efficacy of Postoperative Epidural Analgesia. JAMA 2003;290:2455-63.
74. Werawatganon T, Charuluxanun S. Patient controlled intravenous opioid analgesia versus continuous epidural analgesia for pain after intra-abdominal surgery. Cochrane Database Syst Rev 2005;(1):CD004088.
75. Hübner M, Blanc C, Roulin D, et al. Randomized Clinical Trial on Epidural Versus Patient-controlled Analgesia for Laparoscopic Colorectal Surgery Within an Enhanced Recovery Pathway. Ann Surg 2015;261:648-53.
76. Zaghiyan KN, Mendelson BJ, Eng MR, et al. Randomized Clinical Trial Comparing Laparoscopic Versus Ultrasound-Guided Transversus Abdominis Plane Block in Minimally Invasive Colorectal Surgery. Dis Colon Rectum 2019;62:203-10.
77. Walter CJ, Maxwell-Armstrong C, Pinkney TD, et al. A randomised controlled trial of the efficacy of ultrasound-guided transversus abdominis plane (TAP) block in laparoscopic colorectal surgery. Surg Endosc 2013;27:2366-72.
78. Tikuisis R, Miliauskas P, Lukoseviciene V, et al. Transversus abdominis plane block for postoperative pain relief after hand-assisted laparoscopic colon surgery: a randomized, placebo-controlled clinical trial. Tech Coloproctol 2016;20:835-44.
79. Colibaseanu DT, Osagiede O, Merchea A, et al. Randomized clinical trial of liposomal bupivacaine transverse abdominis plane block versus intrathecal analgesia in colorectal surgery. Br J Surg 2019;106:692-9.
80. BED REST, thrombosis, and embolism. Lancet 1958;1:465-6.
81. Brower RG. Consequences of bed rest. Crit Care Med 2009;37:S422-8.
82. Castelino T, Fiore JF, Niculiseanu P, et al. The effect of early mobilization protocols on postoperative outcomes following abdominal and thoracic surgery: A systematic review. Surgery 2016;159:991-1003.
83. Haines KJ, Skinner EH, Berney S, et al. Association of postoperative pulmonary complications with delayed mobilisation following major abdominal surgery: an observational cohort study. Physiotherapy 2013;99:119-25.
84. Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery. JAMA Surg 2017;152:292-8.
85. Lewis SJ, Andersen HK, Thomas S. Early Enteral Nutrition Within 24 h of Intestinal Surgery Versus Later Commencement of Feeding: A Systematic review and Meta-analysis. J Gastrointest Surg 2009;13:569-75.
86. Smedley F, Bowling T, James M, et al. Randomized clinical trial of the effects of preoperative and postoperative oral nutritional supplements on clinical course and cost of care. Br J Surg 2004;91:983-90.
87. Shaw AD, Bagshaw SM, Goldstein SL, et al. Major complications, mortality, and resource utilization after open abdominal surgery. Ann Surg 2012;255:821-9.
88. Yunos NM, Bellomo R, Hegarty C, et al. Association between a chloride-liberal vs chloride-restrictive intravenous fluid administration strategy and kidney injury in critically ill adults. JAMA 2012;308:1566-72.
89. Shaw AD, Schermer CR, Lobo DN, et al. Impact of intravenous fluid composition on outcomes in patients with systemic inflammatory response syndrome. Crit Care 2015;19:334.
90. Short V, Herbert G, Perry R, et al. Chewing gum for postoperative recovery of gastrointestinal function. Cochrane Database Syst Rev 2015;(2):CD006506.
91. de Leede EM, van Leersum NJ, Kroon HM, et al. Multicentre randomized clinical trial of the effect of chewing gum after abdominal surgery. Br J Surg 2018;105:820-8.

92. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional practice and healthcare outcomes. Cochrane Database Syst Rev 2012;(6):CD000259.
93. Gillissen F, Ament SMC, Maessen JMC, et al. Sustainability of an Enhanced Recovery After Surgery Program (ERAS) in Colonic Surgery. World J Surg 2015;39:526-33.
94. Lee GC, Hodin RA. Applying Enhanced Recovery Pathways to Unique Patient Populations. Clin Colon Rectal Surg 2019;32:134-7.
95. By the 2019 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2019 Updated AGS Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults. J Am Geriatr Soc 2019;67:674-94.
96. Bagnall NM, Malietzis G, Kennedy RH, et al. A systematic review of enhanced recovery care after colorectal surgery in elderly patients. Colorectal Dis 2014;16:947-56.
97. Schwenk ES, Grant AE, Torjman MC, et al. The Efficacy of Peripheral Opioid Antagonists in Opioid-Induced Constipation and Postoperative Ileus. Reg Anesth Pain Med 2017;42:767-77.
98. Wilson RJ, Davies S, Yates D, et al. Impaired functional capacity is associated with all-cause mortality after major elective intra-abdominal surgery. Br J Anaesth 2010;105:297-303.
99. Silver JK, Baima J. Cancer Prehabilitation. Am J Phys Med Rehabil 2013;92:715-27.
100. Gillis C, Li C, Lee L, et al. Prehabilitation versus Rehabilitation. Anesthesiology 2014;121:937-47.
101. Barberan-Garcia A, Ubré M, Roca J, et al. Personalised prehabilitation in high-risk patients undergoing elective major abdominal surgery: a randomized blinded controlled trial. Ann Surg 2018;267:50-6.
102. Brandstrup B, Svendsen PE, Rasmussen M, et al. Which goal for fluid therapy during colorectal surgery is followed by the best outcome: near-maximal stroke volume or zero fluid balance? Br J Anaesth 2012;109:191-9.
103. Wakeling HG, McFall MR, Jenkins CS, et al. Intraoperative oesophageal Doppler guided fluid management shortens postoperative hospital stay after major bowel surgery. Br J Anaesth 2005;95:634-42.
104. Noblett SE, Snowden CP, Shenton BK, et al. Randomized clinical trial assessing the effect of Doppler-optimized fluid management on outcome after elective colorectal resection. Br J Surg 2006;93:1069-76.
105. Conway DH, Mayall R, Abdul-Latif MS, et al. Randomised controlled trial investigating the influence of intravenous fluid titration using oesophageal Doppler monitoring during bowel surgery. Anaesthesia 2002;57:845-9.
106. Gómez-Izquierdo JC, Trainito A, Mirzakandov D, et al. Goal-directed Fluid Therapy Does Not Reduce Primary Postoperative Ileus after Elective Laparoscopic Colorectal Surgery. Anesthesiology 2017;127:36-49.
107. Srinivasa S, Taylor MHG, Singh PP, et al. Randomized clinical trial of goal-directed fluid therapy within an enhanced recovery protocol for elective colectomy. Br J Surg 2013;100:66-74.
108. Holubar SD, Hedrick T, Gupta R, et al. American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative (POQI) joint consensus statement on prevention of postoperative infection within an enhanced recovery pathway for elective colorectal surgery. Perioper Med (Lond) 2017;6:4.
109. Coello R, Charlett A, Wilson J, et al. Adverse impact of surgical site infections in English hospitals. J Hosp Infect 2005;60:93-103.
110. de Lissovoy G, Fraeman K, Hutchins V, et al. Surgical site infection: Incidence and impact on hospital utilization and treatment costs. Am J Infect Control 2009;37:387-97.
111. Kaye KS, Anderson DJ, Sloane R, et al. The Effect of Surgical Site Infection on Older Operative Patients. J Am Geriatr Soc 2009;57:46-54.
112. Kirkland KB, Briggs JP, Trivette SL, et al. The Impact of Surgical-Site Infections in the 1990s: Attributable Mortality, Excess Length of Hospitalization, And Extra Costs. Infect Control Hosp Epidemiol 1999;20:725-30.
113. Wick EC, Hirose K, Shore AD, et al. Surgical site infections and cost in obese patients undergoing colorectal surgery. Arch Surg 2011;146:1068-72.
114. Broex ECJ, van Asselt ADI, Bruggeman CA, et al. Surgical site infections: how high are the costs? J Hosp Infect 2009;72:193-201.
115. Kobayashi M, Mohri Y, Inoue Y, et al. Continuous follow-up of surgical site infections for 30 days after colorectal surgery. World J Surg 2008;32:1142-6.
116. Smith RL, Bohl JK, McElearney ST, et al. Wound infection after elective colorectal resection. Ann Surg 2004;239:599-605; discussion 605-7.
117. Wick EC, Vogel JD, Church JM, et al. Surgical Site Infection in a High Outlier Institution: are Colorectal Surgeons to Blame? Dis Colon Rectum 2009;52:374-9.
118. Bratzler DW, Hunt DR. Healthcare Epidemiology: The Surgical Infection Prevention and Surgical Care Improvement Projects: National Initiatives to Improve Outcomes for Patients Having Surgery. Clin Infect Dis

2006;43:322-30.
119. Keenan JE, Speicher PJ, Thacker JK, et al. The preventive surgical site infection bundle in colorectal surgery. JAMA Surg 2014;149:1045-52.
120. Stulberg JJ, Delaney CP, Neuhauser DV, et al. Adherence to Surgical Care Improvement Project Measures and the Association With Postoperative Infections. JAMA 2010;303:2479-85.

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