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CLINICAL PRACTICE GUIDELINES

Clinical practice guidelines for enhanced recovery after colon and rectal surgery from the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic Surgeons

Jennifer L. Irani[1] · Traci L. Hedrick[2] · Timothy E. Miller[3] · Lawrence Lee[4] · Emily Steinhagen[5] · Benjamin D. Shogan[6] · Joel E. Goldberg[1] · Daniel L. Feingold[7] · Amy L. Lightner[8] · Ian M. Paquette[9]

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Abstract

The American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) are dedicated to ensuring high-quality innovative patient care for surgical patients by advancing the science, prevention, and management of disorders and diseases of the colon, rectum, and anus as well as minimally invasive surgery. The ASCRS and SAGES society members involved in the creation of these guidelines were chosen because they have demonstrated expertise in the specialty of colon and rectal surgery and enhanced recovery. This consensus document was created to lead international efforts in defining quality care for conditions related to the colon, rectum, and anus and develop clinical practice guidelines based on the best available evidence. While not proscriptive, these guidelines provide information on which decisions can be made and do not dictate a specific form of treatment. These guidelines are intended for the use of all practitioners, healthcare workers, and patients who desire information about the management of the conditions addressed by the topics covered in these guidelines. These guidelines should not be deemed inclusive of all proper methods of care nor exclusive of methods of care reasonably directed toward obtaining the same results. The ultimate judgment regarding the propriety of any specific procedure must be made by the physician in light of all the circumstances presented by the individual patient. This clinical practice guideline represents a collaborative effort between the American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and was approved by both societies.

Keywords Enhanced recovery · Colorectal surgery · ERAS

Statement of the problem

Colorectal surgery has historically been associated with long postoperative hospital stays, high costs, and surgical site infection rates approaching 20% [1, 2]. In addition, the incidence of in-hospital perioperative nausea and vomiting (PONV) may be as high as 80% [3] and readmission rates are as high as 35% [4]. Enhanced recovery protocols (ERPs) are a set of standardized perioperative processes, the content of which may vary significantly, that are applied to patients undergoing elective surgery. In general, these protocols are not intended for non-elective cases, but components of ERPs could certainly be applied to the emergent/urgent patient [5, 6]. Also known as "fast track" or "enhanced recovery after surgery" (ERAS) protocols, enhanced recovery protocols

This publication was approved by both the ASCRS and SAGES executive council and then peer reviewed by the *Diseases of the Colon & Rectum* and *Surgical Endoscopy And Other Interventional Techniques*. The articles are identical except for minor stylistic and spelling differences in keeping with each journal's style. Either citation can be used when citing this article. In order to encourage its wide dissemination this article is freely accessible on *Surgical Endoscopy And Other Interventional Techniques* and *Diseases of the Colon & Rectum* journal web sites.

Jennifer L. Irani and Traci L. Hedrick are co-first authors.

✉ Ian M. Paquette
ian.m.paquette@gmail.com

Extended author information available on the last page of the article

are designed to improve patient outcomes [7]. Outcomes of interest include alleviating nausea and pain, achieving early return of bowel function, and decreasing rates of wound infection and length of hospital stay [8]. Although numerous perioperative protocols exist, this clinical practice guideline will evaluate the evidence in support of individual measures to improve patient outcomes after elective colon and rectal resections.

Implementation of ERPs in colorectal surgery has been shown to reduce morbidity rates and decrease length of stay without increasing readmission rates [9–13]. A 2011 Cochrane review found that ERPs were associated with reduced overall complication rates and length of stay when compared to conventional perioperative patient management [14]. Subsequent studies have shown that ERPs are associated with reduced healthcare costs, improved patient satisfaction, lower rates of complications, and reduced mortality [2, 10, 15–20]. ERPs are also associated with improved outcomes regardless of whether patients undergo laparoscopic or open surgery [21]. In addition, multiple studies have shown that ERPs are safe and efficacious in elderly patient populations [22–30]. Studies also support that ERPs should not be implemented and maintained dogmatically, but rather require ongoing compliance evaluation and continual quality improvement [31–34]. Greater adherence to ERPs is associated with decreased complications and shorter length of stay (LOS) [35–38].

There are many different preoperative, intraoperative, and postoperative components of a typical ERP and it is difficult to identify which are most beneficial within the "bundle" of simultaneously implemented measures. This clinical practice guideline will evaluate the evidence pertaining to different components of ERPs for colorectal surgery. While ostomy surgery, deep vein thrombosis (DVT) prevention, bowel preparation, and frailty are discussed in this CPG, a detailed review of these topics is beyond the scope of this Clinical Practice Guideline; these topics are addressed in depth in other ASCRS Clinical Practice Guidelines [39–42].

Methodology

The original clinical practice guidelines for enhanced recovery after colon and rectal surgery from the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal and Endoscopic surgeons were published in 2017 [43]. The present guideline was constructed using the 2017 guidelines as a platform. Compared with 2017, this guideline has 3 new recommendations and 5 statements with updated levels of evidence. All other statements have been reviewed and updated with current evidence (Table 1). A systematic search was conducted under the guidance of a librarian. The details of specific search strategies including search terms, inclusion criteria, exclusion criteria, and total number of studies identified, and tables of evidence for each statement are available in the digital supplemental materials. In brief, a systematic search from January 1, 2016 to May 1, 2022 was conducted using the Cochrane Library, EMBASE, and the MEDLINE databases utilizing a variety of key word combinations. A supplemental search was conducted using related articles and bibliographies of previously identified articles. Directed searches of the embedded references from the primary articles were also performed in certain circumstances. Prospective, randomized controlled trials (RCTs) and meta-analyses were given preference. A total of 7,712 abstracts were identified; 6,962 articles were excluded and a total of 750 full-text articles were evaluated. Of those, 547 were excluded, and along with 212 articles from the 2017 guidelines, a total of 415 articles were included in the final document (Fig. 1). The final grade of recommendation was performed using the Grading of Recommendation, Assessment, Development, and Evaluation (GRADE) system (Table 2) [44]. When agreement was incomplete regarding the evidence base or treatment guideline, consensus from the committee chair, vice chair, and 2 assigned reviewers determined the outcome. Members of the ASCRS Clinical Practice Guidelines Committee worked together with members of the SAGES Colorectal Committee from inception to publication. Recommendations formulated by the subcommittee were reviewed by the entire Clinical Practice Guidelines Committee of ASCRS and the Colorectal Committee of SAGES. The submission was approved by both the ASCRS and SAGES executive council and then peer reviewed by the *Diseases of the Colon & Rectum* and *Surgical Endoscopy*. In general, each ASCRS Clinical Practice Guideline (including joint guidelines) is updated every 5 years. No funding was received for preparing this guideline and the authors have declared no competing interests related this material. This guideline conforms to the Appraisal of Guidelines for Research and Evaluation (AGREE) checklist.

Preoperative interventions

Preadmission counseling

A preoperative discussion regarding clinical milestones and discharge criteria should typically be performed prior to surgery. Grade of recommendation: strong recommendation based on low-quality evidence, 1C

Preadmission counseling regarding milestones and discharge criteria are a well-established cornerstone of ERPs [7, 45–50]. Single-center case series, prospective cohort studies, systematic reviews, and RCTs have reported the benefits of using an ERP that includes preoperative education

Table 1 What is New in the 2022 ASCRS Enhanced Recovery After Colon and Rectal Surgery Clinical Practice Guidelines?

New recommendations	
Preoperative interventions Preadmission nutrition and bowel prep	5. Oral nutritional supplementation is recommended in malnourished patients prior to elective colorectal surgery. Weak recommendation based on moderate quality evidence, 2B
Perioperative interventions Intraoperative fluid management	15. Hypotension should be avoided as even short durations of MBP < 65 are associated with adverse outcomes, in particular myocardial injury, and acute kidney injury. Grade of recommendation: Strong recommendation based on moderate quality evidence, 1B
Postoperative interventions Discharge criteria	26. Early discharge prior to return of bowel function may be feasible in low-risk patients undergoing minimally invasive colectomy when coupled with close outpatient communication and follow-up. Grade of Recommendation: Weak recommendation based on moderate quality evidence, 2B
Updated recommendations	
Preadmission	6. Mechanical bowel preparation combined with preoperative oral antibiotics is typically recommended prior to elective colorectal resection. Grade of Recommendation: Strong recommendation based on moderate-quality evidence, 1B
Pain control	11. Thoracic epidural analgesia, while not recommended for routine use in laparoscopic colorectal surgery, is an option for open colorectal surgery if a dedicated acute pain team is available for postoperative management. Recommendation: Strong recommendation based on moderate-quality evidence, 1B
Fluid management	13. Fluid administration should be tailored to avoid excessive fluid administration and volume overload or undue fluid restriction and hypovolemia. Grade of Recommendation: Strong recommendation based on high-quality evidence, 1A
Fluid management	14. Balanced chloride-restricted crystalloid solutions should be used for maintenance infusions and fluid boluses in patients undergoing colorectal surgery. There is no benefit to the routine use of colloid solutions for fluid boluses. Grade of Recommendation: Strong recommendation based on moderate-quality evidence, 1B
Fluid management	16. In high-risk patients and in patients undergoing colorectal surgery with significant intravascular losses, the use of goal-directed hemodynamic therapy may be considered. Grade of Recommendation: Weak recommendation, based on moderate-quality evidence, 2B
Postoperative management	25. Urinary catheters should typically be removed within 24–48 h after mid/lower rectal resection. Grade of Recommendation: Strong recommendation based on moderate quality evidence, 1B

describing milestones and discharge criteria. [2, 51–72]. Furthermore, compliance with an ERP that includes preoperative patient education is associated with decreased length of stay and decreased complication rates [31, 73–79]. Despite the benefit, in-person preoperative counseling can be resource intensive, which may limit its widespread use; prescripted phone calls may provide sufficient counseling while saving resources [78, 79].

Patients undergoing ileostomy creation should receive stoma teaching and counseling regarding how to avoid dehydration. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

The creation of an ostomy is an independent risk factor for prolonged length of stay after colorectal surgery [50, 80–83]. Several single-center and multicenter studies as well as a systematic review have shown that structured patient stoma education significantly improves quality of life, facilitates psychosocial adjustment, and reduces hospital length of stay and hospital costs [84–94].

Ostomy education can also impact readmission rates [80, 95–97]. As dehydration is the most common cause of readmission following ileostomy creation [98, 99], counseling patients regarding dehydration avoidance is an important element of ERP [98, 99]. In a prospective study of 42 patients versus 168 historical controls, implementation of an ileostomy pathway in which patients were directly engaged in ostomy management, discharged with supplies for measuring input/output, and set up with visiting nurse services reduced the readmission rate for dehydration from 15.5 to 0% ($p = 0.02$) [4]. Others have reported similar reductions in readmission rates for dehydration when utilizing an ERP focused on ostomy education [100–102]. Gonella et al. in a retrospective study of 296 patients showed that the hospital readmission rate within 30-day postdischarge for dehydration dropped from 9 to 3.9% after protocol application [101].

Preadmission nutrition and bowel preparation

Clear liquids may be continued up to 2 h prior to general anesthesia. Grade of recommendation: strong recommendation based on high-quality evidence, 1A

Drinking clear fluids up to 2 h before induction of anesthesia, according to data from multiple RCTs, is safe and improves patients' sense of well-being [103–111]. The same RCTs have also reported that ingesting clear liquids within

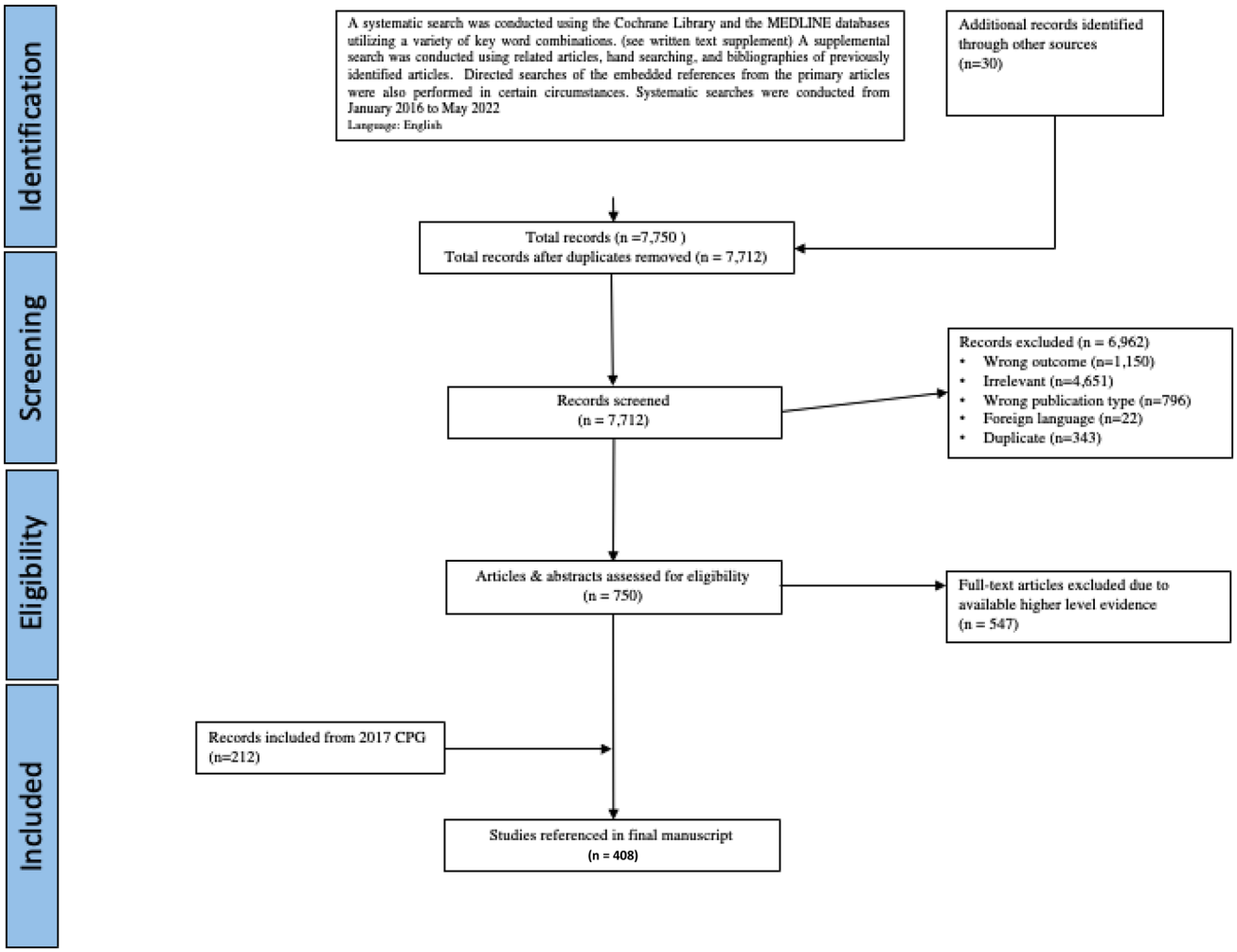

Fig. 1 PRISMA literature search flow sheet. *PRISMA* preferred reporting items for systematic reviews and meta-analysis

2–4 h of surgery versus > 4 h is associated with smaller gastric volumes and higher gastric pH at the time of surgery. The current practice guidelines of both the American Society of Anesthesiologists and the European Society of Anesthesiology support this recommendation [111–113].

Carbohydrate loading should be encouraged prior to surgery in non-diabetic patients. Grade of recommendation: weak recommendation based on moderate-quality evidence, 2B

The use of carbohydrate (CHO)-rich beverages should be encouraged to attenuate insulin resistance induced by surgery and starvation [114–116]. The focus is not on avoiding glycogen depletion, but rather on converting the patient from a fasting state to a fed stated to impact insulin resistance. A 2014 Cochrane review of 27 international trials, including 1,976 patients undergoing elective operations, concluded carbohydrate loading was associated with a 0.3-day reduction in length of hospital stay when compared with placebo or fasting (95% CI 0.56 to 0.0) but no difference in overall perioperative complications [114]. Of note, most beverages consumed in these studies contained complex carbohydrates (e.g., maltodextrin) as opposed to the monosaccharides (e.g., fructose) or disaccharides (e.g., sucrose) found in fruit juice or sports drinks. Another meta-analysis of 21 randomized studies including 1,685 patients showed no overall difference in length of stay; however, the subgroup of patients undergoing major abdominal surgery had a shorter length of stay associated with carbohydrate loading ([mean difference, 95% confidence interval: − 1.08 days (− 1.87 to − 0.29), $p = 0.007$]) [117]. Another meta-analysis including 43 RCTs with 3,110 elective surgery patients found that high-dose carbohydrate loading (≥ 45 g) was associated with a reduced length of hospital stay compared to fasting (− 1.7 days [− 3.2, − 0.1]) or placebo/water (− 1.4 days [− 2.7, − 0.1], $p < 0.05$), but there were no differences in complication rates or other secondary endpoints [118]. This

Table 2 The GRADE system—grading recommendations

Grade	Description	Benefit versus risk and burdens	Methodologic quality of supporting evidence	Implications
1A	Strong recommendation, high-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	RCTs without important limitations or overwhelming evidence from observational studies	Strong recommendation can apply to most patients in most circumstances without reservation
1B	Strong recommendation, moderate-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise) or exceptionally strong evidence from observational studies	Strong recommendation, can apply to most patients in most circumstances without reservation
1C	Strong recommendation, low- or very low-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	Observational studies or case series	Strong recommendation but may change when higher-quality evidence becomes available
2A	Weak recommendation, high-quality evidence	Benefits closely balanced with risks and burdens	RCTs without important limitations or overwhelming evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patients' or societal values
2B	Weak recommendations, moderate-quality evidence	Benefits closely balanced with risks and burdens	RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise) or exceptionally strong evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patients' or societal values
2C	Weak recommendation, low- or very low-quality evidence	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk, and burden may be closely balanced	Observational studies or case series	Very weak recommendations; other alternatives may be equally reasonable

GRADE Grades of Recommendation, Assessment, Development, and Evaluation, *RCT* randomized controlled trial. Adapted from Guyatt G, Gutermen D, Baumann MH, et al. Grading strength of recommendations and quality of evidence in clinical guidelines: report from an American College of Chest Physicians Task Force. Chest. 2006;129:174-181. Used with permission

recommendation applies to non-diabetic patients because diabetic patients were not included in the trials.

Oral nutritional supplementation is recommended in malnourished patients prior to elective colorectal surgery. Grade of recommendation: weak recommendation based on moderate-quality evidence, 2B

In malnourished patients planning elective gastrointestinal (GI) surgery, oral nutritional supplementation targeting a protein intake of 1.2–1.5 g/kg/day for a period of 1–2 weeks has been associated with reduced postoperative complications and is endorsed by several national and international guidelines [119–122]. Meanwhile, the efficacy of immunonutrition, supplementation containing immune-modulating nutrients such as arginine, fish oil (ω-3 fatty acids), nucleotides, and glutamine, over standard high-protein oral nutritional supplements remains controversial. Meta-analyses have demonstrated reduced complications and infectious complications and shortened LOS associated with preoperative immunonutrition [123, 124]. However, other studies have reported conflicting results depending on whether or not patients were malnourished, the degree of industry support (more positive results reported in industry sponsored trials) and the type of control used for comparison (standard isonitrogenous, iso-caloric non-enhancing nutritional supplement versus normal diet without any supplementation) [123–126].

Mechanical bowel preparation combined with preoperative oral antibiotics is typically recommended prior to elective colorectal resection. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

A 2011 Cochrane review of RCTs showed no benefit to mechanical bowel prep (MBP) alone in colorectal surgery in reducing anastomotic leak or complications [127]. Meanwhile, a meta-analysis of seven RCTs including 1769 patients comparing MBP with oral antibiotics to MBP alone showed a reduction in total surgical site infection (7.2% vs 16.0%, $p < 0.001$) and incisional site infection (4.6% vs 12.1%, $p < 0.001$), with no difference in the rate of organ/space infection after elective colorectal surgery [128]. These trial findings are consistent with population level data. In a retrospective analysis of a nationwide database from the USA, MBP plus oral antibiotic prep in left colon resection was associated with decreased overall morbidity, superficial surgical site infection, anastomotic leakage, and intra-abdominal infections [129]. Similar retrospective studies in different populations (Veterans Administration database [130] and a Polish hospital database [131]) have also shown a reduction in surgical site infection with the addition of OBP to MBP. The Michigan Surgical Quality Collaborative database showed reductions in surgical site infection and in postoperative C. difficile colitis in patients who received MBP and OBP versus patients who received no bowel prep [132]. These kinds of data supported the *ASCRS 2019 Clinical Practice Guideline on Bowel Preparation* recommending the use of a mechanical bowel prep combined with preoperative oral antibiotics in elective colorectal surgery [40].

Preadmission optimization

Multimodal prehabilitation prior to elective colorectal surgery may be considered for patients with multiple co-morbidities or significant deconditioning. Grade of recommendation: weak recommendation based on moderate-quality evidence, 2B

Prehabilitation, defined as enhancement of the patient's preoperative condition, has been proposed as a possible strategy for improving postoperative outcomes [133–135]. Several recent RCTs [136–143] and systematic reviews have demonstrated that prehabilitation improves physical function prior to colorectal or major abdominal surgery [135, 144–148]. However, whether better physical function translates into improved postoperative outcomes remains debateable [135–139, 147, 149]. A meta-analysis of 35 studies evaluating 3402 patients undergoing major abdominal surgery found that patients who received prehabilitation experienced significantly lower rates of overall complications ($p = 0.005$), pulmonary complications ($p < 0.001$), and cardiac complications ($p = 0.044$) [150]. Another meta-analysis of 8 trials with 442 patients undergoing major liver, colorectal, gastroesophageal, and general abdominal surgery demonstrated significant reductions in postoperative pulmonary complications and overall postoperative morbidity in the prehabilitation group versus controls and no differences in LOS [151]. While the available data remain limited due to many underpowered studies, patients with lower baseline functional capacity undergoing open surgery may achieve the greatest benefit from prehabilitation [137–139, 141, 142, 152].

Preadmission orders

Standardized order sets should be utilized in enhanced recovery pathways. Grade of recommendation: weak recommendation based on low-quality evidence, 2C

Comprehensive, multifaceted enhanced recovery protocols are complex and require a multidisciplinary collaboration between stakeholders including nursing teams,

anesthesiologists, social workers, and surgeons. Increased compliance with ERP components has repeatedly been associated with improved perioperative outcomes [153–156]. Dedicated order sets standardize care and are considered essential for improving compliance with ERP elements [2, 13, 157, 158]. The use of order sets has also been proven effective in reducing the risk of surgical site infection [157, 159, 160].

Perioperative interventions

Surgical site infection (SSI)

A bundle of measures should be in place to reduce surgical site infection. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Various SSI prevention bundles have been described to decrease surgical site infections in colorectal surgery. While there are many commonalities between SSI bundles, there is no universal standardization of elements and it is rare for the impact of any one component to be specifically evaluated [161–167]. Preoperative measures incorporated into bundles include a chlorhexidine shower, mechanical bowel preparation with oral antibiotics, intravenous antibiotics within one hour of incision, and standardization of the surgical field preparation with chlorhexidine/alcohol [168]. Operative measures typically found in SSI prevention bundles include the use of a wound protector, gown, and glove changes before fascial closure, using a dedicated wound closure tray, antimicrobial sutures, limiting OR traffic, and maintaining euglycemia and normothermia [169–171].

A meta-analysis evaluating SSI prevention bundles including 17,557 patients reported risk reductions of 40% in the overall SSI rate, 44% in the superficial infection rate, and 34% in the deep/organ space infection rate. This analysis also reported that utilization of sterile wound closure trays, mechanical bowel preparation with oral antibiotics, and glove changes before fascial closure were considered most important to implement [170]. Another meta-analysis of 20,701 patients found that while there was significant heterogeneity in SSI reduction bundle component elements and compliance rates (ranging from 19 to 90% in the included studies), the OR of SSI was 0.56 with a bundle compared to without [171]. Higher rates of compliance with specific bundle elements within SSI prevention bundles have repeatedly been associated with significantly lower SSI rates [159, 160].

Pain control

A multimodal, opioid-sparing, pain management plan should be implemented before the induction of anesthesia. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Multiple studies have demonstrated that minimizing opioids after colorectal surgery is associated with earlier return of bowel function and shorter length of stay [2, 31, 172]. One of the simplest techniques to limit opioid use is to schedule non-narcotic alternatives, such as acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs), rather than administering them on an as-needed basis [173–178]. There have been ongoing concerns about the postoperative safety profile of NSAIDs in this setting. However, a 2007 Cochrane review concluded that NSAIDs can cause a clinically unimportant transient reduction in renal function in the early postoperative period and should therefore not be withheld from adults with normal preoperative renal function [179]. In addition, experimental and observational clinical studies have shown that NSAIDs may increase the risk of anastomotic leak [180–183] and subsequent research has demonstrated that this potential effect on anastomotic leak appears to be molecule and class specific [184]; diclofenac has been associated with the highest risk of leak in this setting. In a retrospective cohort study of 856 patients undergoing elective colorectal surgery, the risk of anastomotic leak was 11.8% versus 6.0% ($p = 0.01$) in patients receiving diclofenac, but there was no differences in leak rates related to other nonsteroidals [185]. Additionally, two meta-analyses have demonstrated an overall increased risk of anastomotic leak with NSAIDs but no increase in the risk of anastomotic leak with the use of selective NSAIDs (such as cyclooxygenase 2 inhibitors) [180, 181]. In these studies nonselective NSAID diclofenac use was associated with an increased leak rate (OR 2.79 [1.96, 3.96], $p < 0.001$ and pooled OR 2.02, 95% CI 1.62–2.50, $p < 0.001$), while ketorolac and selective NSAIDS were not associated with anastomotic leak. In addition, a large multicenter cohort study in Europe showed no differences in anastomotic leak rate with nonselective NSAIDs [174].

Perioperative gabapentinoids, ketamine, lidocaine, magnesium, and α2-agonists have also been administered to improve analgesia and reduce opioid consumption and postoperative hyperalgesia. The role of gabapentinoids is controversial as two large database studies reported that gabapentinoid use after colorectal or orthopedic surgery was associated with increased postoperative pulmonary complications and no reduction in postoperative opioid

consumption [186, 187]. A meta-analysis evaluating the perioperative use of gabapentinoids also reported no clinically significant analgesic effect from gabapentinoid use and stated that the routine use of these medications cannot be recommended [188]. Meanwhile, a perioperative low-dose ketamine infusion can be especially useful in patients with chronic pain [189, 190]. However, psychotropic adverse effects, dizziness, and sedation may impair immediate recovery, particularly in elderly patients [191]. Magnesium either as a bolus or infusion is also associated with a decrease in postoperative opioid consumption and can be a useful adjunct [192].

Analgesic blocks and wound infiltration have shown benefit in opioid reduction among patients undergoing open and laparoscopic colorectal surgery [190, 193]. There are an increasing number of block options, including but not limited to transversus abdominis plane (TAP), quadratus lumborum (QL), erector spinae, and rectus sheath blocks. Two meta-analyses of TAP blocks demonstrated decreased length of stay compared with systemic opioid use in laparoscopic colorectal surgery [193, 194]. A recent systematic review and meta-analysis demonstrated that laparoscopic-guided TAP block is safe and effective for pain management in minimally invasive surgery and seems to be as effective as US-guided TAP blocks with respect to early pain control and reducing postoperative opioid use [195]. Data remain controversial regarding the purported extended duration of benefit with long-acting local anesthetics such as liposomal bupivacaine in reducing postoperative opioid consumption [196–199].

Another option, spinal analgesia with intrathecal morphine administration, can be utilized in the perioperative setting. Studies and meta-analyses have shown that intrathecal morphine is more effective than intravenous opioids in laparoscopic surgery and is associated with lower pain scores [2, 200–202]. The concern about delayed respiratory depression related to this analgesia has not been substantiated and guidelines for postoperative monitoring have been published [203].

Thoracic epidural analgesia, while not recommended for routine use in laparoscopic colorectal surgery, is an option for open colorectal surgery if a dedicated acute pain team is available for postoperative management. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Thoracic epidural analgesia (TEA; T6–T12) has shown efficacy (versus patient controlled analgesia or simple parenteral opioids) in controlling pain and limiting opioids in patients undergoing open colorectal surgery [204, 205]. However, epidurals have no analgesic benefit over multimodal analgesia and abdominal wall blocks in laparoscopic surgery. In addition, evidence shows that the analgesic benefits provided by TEA do not translate into faster recovery in either laparoscopic or open colorectal surgery [206, 207]. In fact, TEA may actually delay hospital discharge after laparoscopic surgery [208] due to the higher incidence of hypotension and urinary tract infections that necessitate additional postoperative care [207–210].

Perioperative nausea and vomiting

Pre-emptive, multimodal anti-emetic prophylaxis reduces perioperative nausea and vomiting. Grade of recommendation: strong recommendation based on high-quality evidence, 1A

Several validated scoring systems have been developed to identify patients at higher risk for PONV [211–216]. Risk factors for developing PONV include female sex, history of PONV and/or motion sickness, nonsmoking status, young age, laparoscopic surgery, use of volatile anesthesia, prolonged operative time, and opioid analgesia. Strategies to reduce the risk of PONV include using regional anesthesia or propofol-based total intravenous anesthesia (TIVA), avoiding volatile anesthetics, and minimizing perioperative opioids by employing multimodal analgesia [207, 217–220]. Although TIVA has been associated with reduced PONV and significantly better patient satisfaction compared to volatile anesthetics, its high cost has precluded widespread adoption [221, 222].

One guideline updated in 2020 supports preoperative risk assessment in all patients undergoing anesthesia and recommends subsequent tailored multimodal therapy to prevent and treat PONV [220]. Combining risk assessment with a specific recommendation for anti-emetic intervention has been associated with significant reduction in PONV in randomized and non-randomized trials [223–226]. Given the low cost and minimal risk associated with anti-emetics, the liberal use of a multimodal anti-emetic protocol for all patients (regardless of risk) has been advocated [227, 228].

ERPs, which include multimodal PONV prophylaxis, are associated with reduced rates of PONV and readmission in colorectal surgery [229–231]. Multiple prospective and observational studies demonstrate that combination therapy using two or more anti-emetics for preventing PONV is superior over a single agent [232–269]. A description of all the available prophylactic agents is beyond the scope of this CPG. However, a common intervention for patients determined to be high risk for PONV that has been studied in randomized controlled fashion is the administration of dexamethasone and ondansetron (or other 5-hydroxytryptamine 3 (5-HT_3) antagonist) [225–270]. A meta-analysis of 9 RCTs,

including 1,089 patients, demonstrated that dexamethasone combined with other anti-emetics provided significantly better PONV prophylaxis than single anti-emetics and decreased the need for rescue therapy [271]. In addition, several meta-analyses found that dexamethasone did not increase postoperative infections or significantly impact glycemic control [272, 273].

Fluid management

Fluid administration should be tailored to avoid excessive fluid administration and volume overload or undue fluid restriction and hypovolemia. Grade of recommendation: strong recommendation based on high-quality evidence, 1A

Both intravenous fluid overload and hypovolemia can significantly impair organ function, increase postoperative morbidity, and prolong hospital stay [274, 275]. Intraoperative infusion regimens based on definitions such as liberal, restrictive, or supplemental should typically be avoided because of the variability in the volumes of fluid infused among different studies using these qualifiers [276]. However, more recently within ERP literature the term "restrictive fluid management" has gained popularity and the amount of fluid recommended with restrictive fluid management has gradually decreased. The term "zero-balance" fluid management was introduced to describe a restrictive fluid regimen aiming to avoid postoperative fluid retention (as indicated by weight gain) [277]. However, while a zero-balance approach might improve postoperative GI function, it is associated with a slightly increased risk of acute kidney injury (8.6% versus 5.0% in an RCT of 3000 patients undergoing major abdominal surgery) [278].

Based on these considerations, the overall goal of fluid management should typically be a positive fluid balance at the end of surgery of ~ 1 L. This should be sufficient to avoid hypovolemia and AKI, while limiting substantial postoperative weight gain (> 2.5 kg/days) which is associated with increased morbidity and prolonged hospital stay [279].

Balanced chloride-restricted crystalloid solutions should be used for maintenance infusions and fluid boluses in patients undergoing colorectal surgery. There is no benefit to the routine use of colloid solutions for fluid boluses. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Results from studies conducted in healthy volunteers and from meta-analyses of small RCTs indicate that balanced chloride-restricted crystalloid solutions should be preferred to normal saline to decrease the risk of hyperchloremic metabolic acidosis [280, 281]. Large propensity-matched observational studies have reported an association between the use of normal saline and an increased incidence of renal dysfunction, postoperative morbidity, and mortality in surgical patients [282, 283]. A large cluster randomized trial of 15,000 critically ill adults showed similar results, with lower rates of death and renal dysfunction attributed to the use of balanced crystalloids [284]. Based on the evidence from this trial, the current recommendation was upgraded from a 1C in 2017 to a 1B.

There is little evidence that colloids offer any benefit over crystalloids for fluid boluses, either during abdominal surgery or postoperatively in intensive care [285–289]. Meanwhile, there may be some benefit in individual cases, particularly in the setting of blood loss or when rapid resuscitation is needed [290, 291]. Colloids restore circulating volume faster than crystalloids and with a lower fluid volume (although this difference is less than traditionally taught with a ratio of around 1:1.5) [292]. Given that the evidence does not show an outcome benefit with colloids and that colloids are significantly more expensive, their routine use should be discouraged.

Intraoperative hypotension should be avoided as even short durations of MAP < 65 are associated with adverse outcomes, in particular myocardial injury and acute kidney injury. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

In a recent retrospective analysis of 4282 patients undergoing noncardiac surgery, intraoperative hypotension defined as MAP < 65 mmHg occurred in 71% of patients [293]. Approximately one-third of these hypotensive events occurred before the surgical incision. There is increasing evidence from large retrospective database reviews showing that even a short duration of hypotension is associated with myocardial injury and acute kidney injury [293–295] and that the severity of injury is associated with both the duration and degree of hypotension [294, 296]. One major prospective interventional trial showed a significant reduction in complications (38% versus 51%, $p = 0.02$) with individualized blood pressure management ($n = 147$) compared with standard pressure management ($n = 245$) [297]. In this study, patients in the intervention group had their fluid status optimized and then had a vasopressor infused to maintain their SBP within 10% of their resting blood pressure. In patients with an epidural block, crystalloid or colloid preloading does not typically prevent hypotension induced by the neuraxial blockade because total blood volume is unchanged after neuraxial blockade [298]; in these circumstances, a low dose of vasopressors, not intravenous fluids, restores colonic perfusion in normovolemic hypotensive patients [299].

In high-risk patients and in patients undergoing colorectal surgery with anticipated significant intravascular losses, the use of goal-directed hemodynamic therapy is recommended. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Objective measures of hypovolemia such as cardiac output, stroke volume, oxygen delivery, oxygen extraction, and mixed venous oxygen saturation and dynamic indices of fluid responsiveness (e.g., pulse pressure variation or stroke volume variation) can help physicians decide whether to administer intravenous fluids for purposes of resuscitation. Several meta-analyses of RCTs have shown that goal-directed fluid therapy (GDFT) reduces postoperative morbidity and length of hospital stay, especially in high-risk patients undergoing major surgery [300–302]. High-risk patients have been variably defined as patients with a history of severe cardiorespiratory illness (e.g., acute myocardial infarction, chronic obstructive pulmonary disease, stroke), a prolonged planned surgery (> 8 h), age > 70 years with limited physiologic reserve, respiratory failure, and aortic vascular disease. However, it must be acknowledged that advancements in perioperative and surgical care seem to have offset the previously demonstrated benefits of GDFT, especially in low–moderate-risk patients [303]. The largest multicenter RCT studying these issues, included 734 high-risk patients undergoing major abdominal surgery (45% colorectal surgery and the majority in the context of an ERP) and showed a decrease in complications and mortality in patients treated with GDFT though this difference did not meet statistical significance (relative risk = 0.84 [95% CI 0.71–1.01], $p = 0.07$) [304].

Recent studies have focused on goal-directed hemodynamic therapy, rather than goal-directed fluid therapy and showed an improvement in outcomes even in low–moderate-risk patients [305]. These treatment algorithms first optimize stroke volume with fluid boluses and then, if hypotension persists, add a vasopressor to maintain MBP > 65 mmHg. This management reflects the increasing evidence that perioperative hypotension is associated with harm and should be avoided [294, 296, 297].

In the absence of surgical complications or hemodynamic instability, intravenous fluids should be routinely discontinued in the early postoperative period. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

A few small, heterogeneous randomized controlled trials support discontinuation of intravenous fluids in the early postoperative period [279, 306, 307]. Traditional surgical practice recommends maintaining a minimal urine output target of 0.5 mL/kg/h in the postoperative period. However, a small prospective study of 40 low-risk patients undergoing a variety of elective colorectal resections randomized subjects to a minimum urine output target of 0.2 mL/kg/h or 0.5 mL/kg/h in the perioperative period, using intravenous fluid administration to achieve targets [308]. In this study, there were no differences in postoperative serum creatinine or other markers of acute renal tubular damage. Another RCT of patients undergoing elective colorectal surgery with an ERP evaluated the use of diuretics to achieve a euvolemic state in diuretically naïve patients and found no difference in postoperative length of stay or complications [309].

Surgical approach

A minimally invasive surgical approach should be employed when the expertise is available and when appropriate. Grade of recommendation: strong recommendation based on high-quality evidence, 1A.

High-quality evidence from RCTs and large database studies supports the use of laparoscopy in colorectal surgery. Two separate multicenter RCTs of patients with colon cancer, the ALCCaS trial from Australia and the COLOR trial from the Netherlands, showed laparoscopy to be superior to open resection regarding short-term outcomes (e.g., return of bowel function, blood loss, postoperative pain, and hospital length of stay) [310, 311]. Several other RCTs have reported improved perioperative morbidity, including total morbidity, wound morbidity, and non-surgical morbidity, following laparoscopic compared to open colonic resection [312–315]. Other RCTs showed that patients undergoing laparoscopy have decreased time to pulmonary recovery, reduced use of narcotics, and improved short-term quality of life [316–318]. These results are consistent with large, database studies that relied on data from the National Surgical Quality Improvement Program and the National Inpatient Sample which support the use of laparoscopy [319–322]. High-quality Cochrane reviews have evaluated short- and long-term outcomes as well and support the laparoscopic approach in colorectal surgery [323–325].

The use of robotics in colorectal surgery has increased exponentially over the last decade [326] and multiple studies have demonstrated the feasibility and safety of robotic colorectal surgery [326–330]. However, the benefits of the robotic approach over standard laparoscopy with regard to short- and long-term surgical outcomes have yet to be fully elucidated. Meta-analyses of RCTs suggest lower conversion rates with a robotic approach [326, 328–330]; however, operative times and costs are consistently higher with robotic surgery compared to laparoscopy, while complication rates are similar between the two approaches [327, 329]. Notably, many of the included studies in these meta-analyses and

systematic reviews were of moderate to poor methodological quality.

Combining minimally invasive surgery with an ERP is associated with optimal outcomes, as demonstrated in the 4-arm LAFA trial which randomized 427 patients to open versus laparoscopic surgery with an ERP versus a traditional care pathway. In this study, patients undergoing laparoscopic surgery within an ERP had the shortest LOS and morbidity compared to either laparoscopy within a traditional care pathway or open surgery [331]. As such, a minimally invasive approach is recommended when appropriate to optimize postoperative recovery within an ERP.

The routine use of nasogastric tubes and intra-abdominal drains for colorectal surgery should be avoided. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Small RCTs evaluating elective colorectal surgery have failed to demonstrate an impact from the routine use of nasogastric tube decompression on nausea, vomiting, time to return of bowel function or length of stay [332–334]. Alternatively, the routine use of nasogastric tube decompression delays the tolerance of oral intake by an average of two days and has been associated with significantly higher risk of associated complications, notably pharyngolaryngitis [332, 335, 336].

Similarly, there is no benefit to the routine use of intra-abdominal drains in colorectal surgery. RCTs show no significant differences in mortality, leak, or a composite of postoperative complications in patients who had drains placed [51, 337–339]. The lack of benefit from operative drains has been demonstrated across a variety of colorectal anastomoses as well as low pelvic anastomoses specifically [337, 338, 340–345]. Meanwhile, a review of the US Rectal Cancer Consortium data found a nonstatistically significant association between drains and *higher* leak rates but there was no difference in the rate of intervention for leak between patients with and without drains [346]. Notably, this was a retrospective review and drain placement was left to the discretion of the operating surgeons; drain use was likely a surrogate for patients with a higher risk for leak due to other factors. Contrary to these studies, a retrospective analysis of the Dutch TME data suggested that intra-abdominal drains in the presence of a diverting stoma may be associated with lower rates of surgical intervention in patients with anastomotic failure [347].

Postoperative interventions

Patient mobilization

Early and progressive patient mobilization are associated with shorter length of stay. Grade of recommendation: strong recommendation based on low-quality evidence, 1C

Complications of prolonged immobility include skeletal muscle loss and weakness, atelectasis, insulin resistance, thromboembolic disease, and decreased exercise capacity [348, 349]. It is estimated that muscle mass decreases by 1.5–2% for every day of bedrest [350]. However, the deconditioning associated with bedrest can be minimized or avoided by engaging in physical activity. Definitions of early mobilization within a colorectal ERP vary significantly, from any mobilization at all within 24 h of operation to 8 h of activity per day by the second postoperative day [31, 351]. Compliance with mobilization targets within ERPs varies significantly between centers, but early ambulation has been associated with faster recovery and fewer complications after colorectal surgery [35, 352–354]. In a prospective cohort study of 100 patients, individuals who had a higher step count on the first postoperative day after major abdominal or thoracic surgery were more likely to have a shorter length of stay [355].

There are limited data about interventions that specifically increase mobilization with regard to their effects on postoperative outcomes. A randomized trial compared facilitated supervised mobilization ($n=49$) on postoperative days 0 to 3 versus conventional care ($n=50$) after colorectal surgery within the construct of an ERP. [356]. In this study, step counts were higher in the intervention group but there were no differences between the two groups in functional recovery, length of stay, complications, or return of gastrointestinal function. A subgroup analysis of this trial also did not find any differences in pulmonary function or postoperative pulmonary complications between the two arms [357]. These data suggest that additional resources to increase mobilization are not associated with improved outcomes within an established colorectal ERP. However, importantly, no studies have reported harm associated with early mobilization, even after perineal reconstruction following abdominoperineal resection [358].

Ileus prevention

Patients should be offered a regular diet within 24 h after elective colorectal surgery. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

A 2019 Cochrane systematic review and meta-analysis evaluated 17 RCTs that compared early feeding (i.e., within 24 h of surgery) versus "later commencement" after lower gastrointestinal surgery [359]. In this review, early feeding was associated with a two-day decrease in length of hospital stay (weighted mean difference 1.95, 95% CI 0.91–2.99). However, perioperative management strategies varied significantly within the included trials and the mean length of stay in the control group ranged from 6 to 24 days. Furthermore, the risk of complications such as anastomotic leak, wound infection, pneumonia, and mortality were not affected by early feeding. Even symptoms of nausea and vomiting were not significantly higher in the early feeding group in this review. Early enteral feeding is associated with faster return of gastrointestinal function and with shorter time to flatus and first bowel movement [360]. While there is heterogeneity between trials, the overall body of evidence supports the benefits of early feeding.

Sham feeding (i.e., chewing gum for ≥ 10 min 3–4 times daily) after colorectal surgery is safe, results in small improvements in GI recovery, and may be associated with a reduction in length of hospital stay. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Sham feeding such as gum chewing has been hypothesized to hasten recovery of gastrointestinal function through increased saliva production and vagal cholinergic stimulation that increases bowel peristalsis [361]. Eighteen RCTs have evaluated chewing gum after colorectal surgery [362]. The majority of these trials used sugar-free gum chewed for at least 5–10 min 3 times daily. However, the majority of these trials were not performed in the context of an ERP were of low quality and had a high risk of bias. A meta-analysis of all 18 randomized trials reported that chewing gum was associated with shorter time to first flatus (weighted mean difference (WMD) − 8.81 h, 95% CI − 13.45 to − 4.17), shorter time to first bowel movement (WMD − 16.43 h, 95% CI − 22.68 to − 10.19), and a reduction in length of stay (WMD − 0.89 days, 95% CI − 1.72 to − 0.07) [362]. The pooled outcome of "postoperative ileus" was also lower in the chewing gum arm (RR 0.41, 95% CI 0.23–0.73). Other outcomes, including complications, readmission, and reoperations, were not significantly different between the two groups. Subgroup analysis of laparoscopic and open approaches maintained these significant associations. However, subgroup analysis of trials performed within the context of an ERP reported that chewing gum was no longer associated with significant decreases in the time to flatus and length of stay.

In another systematic review and meta-analysis that only included ten randomized trials that were deemed "high quality," [363] the use of chewing gum was associated with a lower incidence of postoperative ileus (RR 0.55, 95% CI 0.39–0.79) and faster time to first flatus (WMD − 0.31 days, 95% CI − 0.36 to − 0.26) and bowel movement (WMD − 0.47, 95% CI − 0.60 to − 0.34), but no difference in length of stay. However, the trials included in this meta-analysis suffered from many of the same limitations pertaining to heterogeneity and variable perioperative management strategies that were present in the prior studies. Nonetheless, the overall body of literature suggests that chewing gum may only have a small effect on gastrointestinal recovery without a clear effect on length of stay but is safe and not costly.

There are even some data to support the use of coffee to facilitate gastrointestinal recovery after colorectal surgery [364–366]. Caffeine and coffee may stimulate the lower gastrointestinal tract and can potentially reduce postoperative ileus. A meta-analysis of 7 randomized trials including 606 patients reported that drinking coffee decreased the time to first bowel movement and toleration of oral intake, but did not reduce time to flatus, overall complications, or length of stay [367].

Alvimopan is recommended to hasten recovery after open colorectal surgery. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Alvimopan, an oral peripheral acting mu-opioid antagonist that minimizes the effect of opioids on postoperative gastrointestinal function, was first approved by the US Food and Drug Administration in 2008. A systematic review of all relevant studies published up to May 2020 identified 31 studies that investigated the effect of alvimopan on gastrointestinal function in colorectal surgery, of which 23 demonstrated a positive effect and 8 reported no effect [368]. Of the 6 randomized trials, 4 were positive and 2 showed no effect related to the medication.

Most of the available data supporting alvimopan in the setting of colorectal surgery is limited to open surgery. Several RCTs and pooled post hoc analyses reported accelerated time to recovery of gastrointestinal function with alvimopan 6-mg and 12-mg doses compared to placebo and a significantly shorter hospital length of stay in the alvimopan 12-mg group compared with placebo for patients undergoing open surgery [369–378]. A Cochrane review of nine studies affirmed that alvimopan was better than placebo in reversing opioid-induced increased gastrointestinal transit time and

constipation and that alvimopan was safe and efficacious in decreasing postoperative ileus, but the studies were limited to open surgery patients without an ERP in place [379].

There have been no randomized trials evaluating alvimopan after laparoscopic surgery [380–382]. Most of the non-randomized studies have shown modest benefits in favor of alvimopan for laparoscopic resection albeit within traditional care pathways [383–385]. Given the low quality of the available evidence, it may be difficult to justify the use and cost of alvimopan in laparoscopic surgery in the setting of an ERP.

Urinary catheters

Urinary catheters should typically be removed within 24 h of elective colonic or upper rectal resection irrespective of thoracic epidural analgesia use. Grade of recommendation: strong recommendation, based on moderate-quality evidence, 1B

Urinary catheterization is routinely used in abdominal and pelvic colorectal surgery for intraoperative bladder decompression and monitoring urinary output. Assessing whether or not to remove catheters early should consider the risk of postoperative urinary retention requiring subsequent catheter reinsertion as well as the risk of urinary tract infection (UTI) related to prolonged use of a catheter. Postoperative urinary retention is associated with decreased functional recovery (e.g., less mobility, more postoperative pain) and longer length of stay [386]. UTIs are also associated with increased morbidity, longer length of stay, and mortality [387]. However, longer duration of catheter use is associated with higher rates of UTI and in-and-out (i.e., straight catheterization) catheterization in the setting of postoperative urinary retention is not associated with an increased risk of UTI [388, 389].

Overall, the evidence suggests that early urinary catheter removal within 24 h of surgery is safe. In a large multicenter study of 2927 surgery patients (1897 colonic procedures), early catheter removal was associated with a higher incidence of catheter reinsertion compared to later removal (4.9% versus 1.9%, $p < 0.001$) but a lower rate of UTIs (0.8% versus 4.1%, $p = 0.003$) [388]. Length of stay in this study was also shorter in the early catheter removal group by 1 day and other studies have reported similar results [390, 391]. There are increasing data suggesting that catheters can be removed even earlier (e.g., within 6 h after surgery) or avoided altogether [392–394].

In the context of thoracic epidural analgesia, randomized controlled trials have investigated early urinary catheter removal compared with removal at the time of epidural discontinuation and found lower UTI rates after early catheter removal and no differences in re-catherization rates [395, 396]. In an RCT of 215 patients undergoing abdominal or thoracic surgery with a thoracic epidural that randomized patients to early catheter removal on POD 1 or following epidural removal, the incidence of recatheterization was similar between groups but the incidence of UTI was much lower in the early removal group (2% versus 24%, $p = 0.004$). [396].

Urinary catheters should typically be removed within 24–48 h after mid/lower rectal resection. Grade of recommendation: strong recommendation based on moderate-quality evidence, 1B

Retracting on the bladder and dissecting in close proximity to the lateral pelvic nerves during proctectomy may increase the risk of postoperative urinary retention. There have been 4 randomized controlled trials comparing outcomes between early and late catheter removal specifically in the setting of proctectomy [397–400]. A meta-analysis of these 4 trials examined the non-inferiority of early removal (before postoperative day 2) versus late (postoperative day 2 and after) catheter removal and concluded that the data were insufficient to conclude non-inferiority of early catheter removal after proctectomy in terms of the development of postoperative urinary retention [401]. However, this meta-analysis showed that early catheter removal decreased the risk of UTI (9.7% versus 21.1%; absolute risk difference − 11%, 95% CI − 17, − 4). Another systematic review and meta-analysis compared POD1 catheter removal versus POD3 or POD5 removal and found lower UTI rates of in the earlier removal groups [402]. There may be some subgroups of patients that were not included in the clinical trials such as pelvic exenteration patients or patients with a difficult hand-sewn coloanal anastomosis, and management of these patients is up to the best clinical judgment of the surgeon balancing the risk of urinary tract infection vs. urinary retention.

Discharge criteria

Hospital discharge prior to return of bowel function may be offered for selected patients. Grade of recommendation: weak recommendation based on moderate-quality evidence, 2B

Traditional discharge criteria following colorectal surgery include demonstrating return of bowel function along with tolerance of oral intake, adequate pain control with oral analgesia, and the ability to mobilize in the absence of complications [403]. Many patients meet these criteria by the first or second postoperative day [57, 58, 62]. However, there are increasing reports of same-day discharge which hinges on the feasibility of discharging patients prior to return of bowel function.

The concept of the "ambulatory" or "outpatient" colectomy was first introduced over a decade ago and was initially reported in small case series [62, 404, 405]. In these early reports, low-risk patients undergoing colorectal resection were successfully discharged home after an observation period of 24 h without undue complications [57, 62]. An RCT of patients undergoing minimally invasive colorectal resection for cancer randomized 30 patients to discharge on postoperative day 1 regardless of bowel function with telemedicine follow-up on postoperative day 2 versus standard postoperative care with discharge after return of bowel function (RecoverMI trial) [406]. In this study, the median LOS was 28.3 h in the study arm and 51.5 h in the control arm ($p = 0.041$) and there were no differences in adverse events or quality of life as measured by EQ-5D-5L™ between the 2 groups. Exclusion criteria included patient-reported history of severe postoperative nausea/vomiting. Patients with a serum creatinine above 1.5 ng/ml, measured within 30 days of surgery, or a history of congestive heart failure, defined as ejection fraction of 40% or less, or of more than 40% with systemic signs of heart failure were also excluded. Finally and patients requiring conversion to open surgery or in whom an ostomy was necessary at completion of the study were removed from the study and not randomized.

Other retrospective cohort studies have reported that same-day discharge after colorectal surgery was associated with low rates of readmission [128, 407]. The largest of these retrospective cohort studies included 157 consecutive patients undergoing laparoscopic right, transverse, total, or left colectomy (left colectomy accounted for the majority of cases) [407]. In this study, same-day discharge was possible in 93% of patients with an associated readmission rate of 6% [408]. These studies demonstrate that same-day discharge is feasible within an ERP in selected patients with acceptable complication rates [408]. Success of these initiatives depends on patients having adequate support at home, close outpatient surveillance, and the ability to tolerate clear liquids in the postoperative recovery unit [128]. This is an area with limited but evolving evidence. Recommendations could change as more evidence becomes available.

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Authors and Affiliations

Jennifer L. Irani[1] · Traci L. Hedrick[2] · Timothy E. Miller[3] · Lawrence Lee[4] · Emily Steinhagen[5] · Benjamin D. Shogan[6] · Joel E. Goldberg[1] · Daniel L. Feingold[7] · Amy L. Lightner[8] · Ian M. Paquette[9]

1 Department of Surgery, Division of Colorectal Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

2 Department of Surgery, University of Virginia Health System, Charlottesville, VA, USA

3 Duke University Medical Center Library, Duke University School of Medicine, Durham, NC, USA

4 Department of Surgery, McGill University, Montreal, QC, Canada

5 Department of Surgery, University Hospital Cleveland Medical Center, Cleveland, OH, USA

6 Department of Surgery, University of Chicago Pritzker School of Medicine, Chicago, IL, USA

7 Section of Colorectal Surgery, Rutgers University, New Brunswick, NJ, USA

8 Department of Colorectal Surgery, Cleveland Clinic Foundation, Cleveland Clinic, Cleveland, USA

9 Division of Colon and Rectal Surgery, University of Cincinnati College of Medicine Surgery (Colon and Rectal), 222 Piedmont #7000, Cincinnati, OH 45219, USA