

The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Use of Bowel Preparation in Elective Colon and Rectal Surgery

John Migaly, M.D.¹ • Andrea C. Bafford, M.D.² • Todd D. Francone, M.D., M.P.H.³
 Wolfgang B. Gaertner, M.D., M.Sc.⁴ • Cagla Eskicioglu, M.D., M.Sc., F.R.C.S.C.⁵
 Liliana Bordeianou, M.D., M.P.H.³ Daniel L. Feingold, M.D.⁶ • Scott R. Steele, M.D., M.B.A.⁷

On behalf of the Clinical Practice Guidelines Committee of the American Society of Colon and Rectal Surgeons

1 Department of Surgery, Duke University School of Medicine, Durham, North Carolina

2 Department of Surgery, University of Maryland Medical Center, Baltimore, Maryland

3 Department of Surgery, Massachusetts General Hospital, Boston, Massachusetts

4 Division of Colorectal Surgery, University of Minnesota Health, Minneapolis, Minnesota

5 Department of Surgery, Michael G. DeGroot School of Medicine, McMaster University, Hamilton, Ontario, Canada

6 Department of Surgery, Columbia University Irving Medical Center, New York, New York

7 Department of Colorectal Surgery, Cleveland Clinic, Cleveland, Ohio

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guidelines. It should be recognized that these guidelines should not be deemed inclusive of all proper methods of care or exclusive of methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding the propriety of any specific procedure must be made by the physician in light of all of the circumstances presented by the individual patient.

STATEMENT OF THE PROBLEM

Bowel preparation has been used in colon and rectal surgery for a variety of reasons. A clean colon is thought to facilitate bowel manipulation, enable passage and firing of surgical staplers, and allow for intraoperative colonoscopy, if needed. The most studied and debated aspect of bowel preparation, however, is its role in reducing surgical morbidity, namely surgical site infections (SSIs). Colon and rectal surgery has among the highest rates of SSIs reported for all types of elective surgery, with recent reviews demonstrating rates varying from 5.4% to 23.2%, with a weighted mean of 11.4%.¹ Colorectal SSI rates are of particular interest currently because US hospitals are mandated to report rates of colorectal SSIs to the National Healthcare Safety Network.

A complete description of the evolution of bowel preparation as a means to reduce SSI is beyond the scope of this clinical practice guideline. Briefly, although William Halsted introduced the concept in the late 1800s, antiseptic technique was not widely adopted until well into the 20th century. After the development of aerobic and anaerobic cell culture, it became increasingly recognized that a high bacterial count in the colon was a source of

Link to access Supplemental Digital Content 1 and 2, evidence tables, <http://links.lww.com/DCR/A794> and search strategy at <http://links.lww.com/DCR/A795>.

Funding/Support: None reported.

Financial Disclosure: None reported.

Correspondence: Scott R. Steele, M.D., M.B.A., 9500 Euclid Ave/A30, Cleveland Clinic, Cleveland, OH, 44915. E-mail: Steeles3@ccf.org

Dis Colon Rectum 2019; 62: 3–8

DOI: 10.1097/DCR.0000000000001238

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DISEASES OF THE COLON & RECTUM VOLUME 62: 1 (2019)

SSI. Mechanical bowel preparation (MBP) was used as a means of decreasing intraluminal bacterial concentration in hopes of reducing infection rates. Eventually, nonabsorbable antibiotics were added to bowel preparations to further reduce intestinal bacterial content. By the 1970s, use of an MBP with both oral and intravenous antibiotics was generally accepted.²

In the late 20th century, data emerged suggesting that elimination of MBP does not lead to increased morbidity. The majority of these studies, however, did not include oral antibiotics. Recently, there has been a general trend of reintroducing oral antibiotics into preoperative MBP. Several surgical units have published results showing reduced SSIs after introducing SSI bundles that include MBP along with oral antibiotics.³⁻⁵ This clinical practice guideline reviews the evidence for the various methods and strategies for bowel preparation in elective colon and rectal surgery. Link to access Supplemental Digital Content 1, Evidence Tables, <http://links.lww.com/DCR/A794>.

METHODOLOGY

An organized search of MEDLINE, Embase, and the Cochrane Database of Collected Reviews was performed for the period of January 1, 1945, to March 1, 2018. The complete search strategy is included (Supplemental Digital Content 2, <http://links.lww.com/DCR/A795>). In brief, a total of 1516 unique journal titles were identified. Initial review of the search results led to the exclusion of 748 titles based on either irrelevance of the title or the journal. Secondary review resulted in the exclusion of another 441 titles considered irrelevant or outdated. A tertiary review of the remaining 307 titles included assessment of the abstract or full-length article. This led to exclusion of an additional 240 titles for which similar but higher-level evidence was available. The remaining 54 titles were considered for grading of the recommendations. A directed search of references embedded in the candidate publications was performed. Emphasis was placed on prospective trials, meta-analyses, systematic reviews, and practice guidelines. Peer-reviewed observational studies and retrospective studies were included when higher-quality evidence was insufficient. The final source material used was evaluated for the methodologic quality, the evidence base was examined, and a treatment guideline was formulated by the subcommittee for this guideline. The final grade of recommendation and level of evidence for each statement were determined using the Grades of Recommendation, Assessment, Development, and Evaluation system (Table 1).^{6,7} 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 American Society of Colon and Rectal Surgeons (ASCRS) Clinical Prac-

tice Guidelines Committee worked in joint production of these guidelines from inception to final publication. Recommendations formulated by the subcommittee were reviewed by the entire Clinical Practice Guidelines Committee. Final recommendations were approved by the ASCRS Executive Committee. In general, each ASCRS Clinical Practice Guideline is updated every 5 years.

BOWEL PREPARATIONS

1. MBP combined with preoperative oral antibiotics is typically recommended for elective colorectal resections.
Grade of Recommendation: Strong recommendation based on moderate-quality evidence, 1B.

Early studies examined the impact of preoperative enteral preparations on SSI, correlating cultures from colonic specimens and subsequent wound infections.⁸⁻¹⁰ It became evident that appropriate antibiotic coverage of gut flora would require both aerobic and anaerobic antisepsis.^{11,12} The landmark prospective, randomized controlled trial and subsequent retrospective analyses by Nichols et al^{13,14} compared MBP with MBP plus nonabsorbable oral antibiotics and demonstrated a marked decrease in SSI with combination therapy. Thus, for >3 decades the combination of antibiotics and oral purgatives described in the original article and commonly referred to as the *Nichols' prep* has been the most widely used manner of preparation before bowel surgery.^{13,14} Clarke et al¹⁵ demonstrated a reduction in postoperative complications in patients who received both enteral antibiotics and MBP not only in overall SSI but also specifically in the incidence of anastomotic leak. The findings by Nichols et al^{13,14} and Clarke et al¹⁵ were reproduced in a subsequent trial and were verified in subsequent meta-analyses.^{16,17} Multiple studies have also shown the benefit of combined MBP and oral antibiotics in reducing SSI rates, hospital length of stay, and readmission rates.¹⁸⁻²⁰

More recently, a retrospective review from the National Surgical Quality Improvement Program (NSQIP) evaluated 8415 patients who underwent elective colectomy (62.9% laparoscopic) from 2011 to 2012, comparing those with no bowel preparation (25.6%), MBP alone (44.9%), and oral antibiotics (29.5%).¹⁸ Of note, 92% of patients in the oral antibiotic bowel preparation group received both oral antibiotics and MBP. The oral antibiotic bowel preparation group had a statistically significantly lower rate of postoperative SSI (6.5% vs 14.9% with no preparation or 12% with MBP alone; $p < 0.001$), a shorter hospital length of stay (median, 4 vs 5 d; $p < 0.001$) compared with the other 2 groups, and the lowest readmission rate (8.1% vs 11.8% with no preparation or 9.3% with MBP alone; $p < 0.001$).

In a retrospective study using data from the Veterans Affairs Surgical Quality Improvement Program including

TABLE 1. The Grades of Recommendation, Assessment, Development, and Evaluation System Grading Recommendations

Label	Description	Benefit vs 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 patient 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 patient 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

Grading strength of recommendations and quality of evidence in clinical guidelines are from an American College of Chest Physicians Task Force report. Adapted with permission from Chest 2006;129:174–181.⁷

RCT = randomized controlled trial.

9940 patients who underwent elective colorectal resections, oral antibiotics significantly decreased the SSI rate in comparison with no bowel preparation (9.0% vs 18.1%; $p < 0.0001$). Notably, only 7.3% of patients in the oral antibiotic group did not receive MBP. MBP alone, without oral antibiotics, resulted in a similar SSI rate to that seen with no bowel preparation (20.0% vs 18.1%; $p = 0.81$).²⁰

A similar retrospective study using the Veterans Affairs Surgical Quality Improvement Program found that patients who received oral antibiotics, with or without MBP, had a significantly lower median length of stay (negative binomial regression estimate = -0.1159 ; $p < 0.0001$) and also a lower 30-day readmission rate of 12.7% for oral antibiotics with or without MBP, 15.0% for MBP only, and 16.1% with no bowel preparation ($p = 0.002$).²¹ In another randomized controlled trial of patients with ulcerative colitis undergoing proctocolectomy, the authors compared 100 patients who received MBP with oral antibiotics to 100 patients who received MBP alone and found a significantly lower SSI rate in the group that received oral antibiotics (6.1% vs 22.4%; $p = 0.001$).²²

Using data from the NSQIP, 4999 patients who underwent elective colorectal resection were evaluated based on preoperative bowel preparation. Compared with

patients who received no bowel preparation, those who received combined oral antibiotics and MBP had significantly lower rates of postoperative SSI (3.2% vs 9.0%; $p < 0.001$), anastomotic leak (2.8% vs 5.7%; $p = 0.001$), and procedure-related hospital readmission (5.5% vs 8.0%; $p = 0.03$).²³ Interestingly, there were no differences in outcomes data among those who received no bowel preparation, MBP only, or oral antibiotics only.

In an additional study using data from the NSQIP, 8442 patients were evaluated for outcomes after undergoing elective colorectal surgery. Similarly, after multivariate analysis, MBP with oral antibiotics, but not MBP alone, was independently associated with a reduced rate of anastomotic leak (OR = 0.57 (95% CI, 0.35–0.94)), SSI (OR = 0.40 (95% CI, 0.31–0.53)), and postoperative ileus (OR = 0.71 (95% CI, 0.56–0.90)).²⁴

A retrospective cohort analysis from the NSQIP targeted outcomes data set examined the impact of bowel preparation on the severity of colonic anastomotic leak and found that MBP was not associated with worse patient outcomes in those patients who go on to develop an anastomotic leak after elective colon resection with primary anastomosis.²⁵ Although the studies enumerated above demonstrate that MBP with oral antibiotics reduces

the incidence of anastomotic leak, this study implies that the addition of oral antibiotics in the preoperative bowel preparation does not reduce the severity of an anastomotic leak.

In summary, MBP, in combination with oral antibiotics, reduces the rates of SSI, anastomotic leak, readmission, and length of stay in comparison with other methods of bowel preparation. MBP with oral antibiotics should be modified or omitted in patients who have an allergy to the antibiotics or in those who have a bowel obstruction.

As a special consideration, *Clostridium difficile* colitis occurs in $\approx 1\%$ to 7% of patients after colorectal surgery.²⁶ A large observational cohort study using data from the Michigan Surgical Quality Collaborative-Colectomy Best Practices Project provides granular insight into the effect of bowel preparation on rates of *C difficile* colitis in a study population of 2475 patients. In this study, Kim et al²⁷ created a propensity-matched analysis of 957 paired cases ($n = 1914$) and compared patients receiving full bowel preparation (MBP with oral antibiotics) with patients with no bowel preparation. Patients who received oral antibiotics and MBP were actually less likely to develop postoperative *C difficile* colitis than those who received no bowel preparation (0.5% vs 1.8% ; $p = 0.01$).^{26,27} In a retrospective study of 219 patients, Yeom et al²⁸ also found no difference in rates of *C difficile* infection in patients receiving nonabsorbable antibiotics versus those who did not (7.3% vs 6.4% ; $p = 0.803$). Another small retrospective study involving 314 patients demonstrated higher *C difficile* toxin detection rates in colectomy patients who received oral antibiotics in addition to MBP (7.4%) compared with those who did not (4.2% ; $p = 0.03$).²⁹ This study was limited by the small number of patients and the retrospective methodology.

However, in a recent randomized controlled trial of 310 patients divided into 3 groups comparing the use of MBP plus preoperative probiotics only, MBP plus preoperative oral antibiotics only, and MBP only in elective colon cancer operations, there were no differences in the rates of detection of *C difficile* toxin in stool samples obtained 1 and 2 weeks postcolectomy in any of the 3 groups (7.0% vs 9.1% vs 10.5% ; $p = 0.69$).³⁰

In limited studies, bowel preparation does not appear to increase the risk of postcolectomy *C difficile* colitis. Given the benefits outlined elsewhere in this article, bowel preparation should not be omitted because of concern regarding *C difficile* infection.

2. Preoperative MBP alone, without oral antibiotics, is generally not recommended for patients undergoing elective colorectal surgery. **Grade of Recommendation: Strong recommendation based on high-quality evidence, 1A.**

A Cochrane review from 2011 evaluated 18 randomized controlled trials including 5805 patients; 2906 received

MBP alone, and 2899 had no preparation (no MBP). They also included trials comparing MBP with enema. There were no statistically significant differences in how well the 3 groups of patients (MBP alone, no MBP, and rectal enemas) did postoperatively in terms of anastomotic leak, mortality, peritonitis, need for reoperation, and wound infection.³¹

More recent evaluation using the NSQIP database also found no benefit for MBP alone.³² Of 5021 patients who underwent elective colon resection, 44.8% had MBP only. Multivariate analysis demonstrated that MBP alone was not associated with a decreased risk of postoperative complications (anastomotic leakage, superficial SSI, organ space SSI, wound disruption, deep venous thrombosis, pneumonia, unplanned intubation, ventilator dependency >48 h, pulmonary embolism, cardiac arrest requiring cardiopulmonary resuscitation, renal insufficiency, sepsis, hemorrhagic complications, return to the operating room, urinary tract infection, prolonged hospitalization >30 d, or death) after right- or left-sided colon resections. There was no association of MBP alone with mortality, morbidity, or any of the aforementioned postoperative complications. This study is consistent with multiple previous studies showing no benefit of MBP alone in colorectal surgery, and it also showed a lack of harm. It is important to note that most studies also do not show a detriment from MBP compared with no MBP.^{24,32-34}

3. Preoperative oral antibiotics alone, without mechanical preparation, are generally not recommended for patients undergoing elective colorectal surgery. **Grade of Recommendation: Weak recommendation based on low-quality evidence, 2C.**

There are no randomized trials evaluating the use of oral antibiotics independent of MBP. Retrospective studies, however, have shown that oral antibiotics alone may have similar efficacy to oral antibiotics plus MBP.^{18,19} In an NSQIP review, patients who received both oral antibiotics and MBP had a slightly lower SSI rate, although not statistically significant, when compared with those who received oral antibiotics without MBP.¹⁹ Others have shown that outcomes in patients receiving MBP alone or oral antibiotics alone did not differ significantly from those receiving no preparation at all.^{20,23}

4. Preoperative enemas alone, without MBP and oral antibiotics, are generally not recommended for patients undergoing elective colorectal surgery. **Grade of Recommendation: Weak recommendation based on moderate-quality evidence, 2B.**

A number of small studies have evaluated bowel preparation using rectal enemas alone.^{31,34-38} Alcantara Moral et al³⁵ studied 193 patients in a single-center, prospective, randomized study wherein patients were randomly as-

signed to oral MBP or cleansing enemas only. Patients in the enema group had similar morbidity (wound infection or anastomotic dehiscence) as the MBP group.³⁵ Zmora et al³⁹ randomly assigned 380 patients to an MBP group or an enema group and also found no significant difference in the rate of surgical infectious complications between the 2 groups. On the other hand, Bucher et al⁴⁰ found lower rates of overall morbidity and anastomotic leak in an enema group when 153 patients undergoing low anterior resection were randomly assigned to MBP or enemas only. Platell et al³⁷ found an increased risk of anastomotic leakage with phosphate enema preparation versus oral polyethylene glycol. These studies, however, are limited by small sample sizes and unclear methodology. The paucity of data for rectal enemas as the only mechanism of purgative cleansing and the preponderance of data favoring combined mechanical and oral antibiotic bowel preparation further bolster the recommendation of combined oral MBP with oral antibiotics.

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