



# Bowel decontamination before colonic and rectal surgery

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## Key clinical questions: bowel preparation before colorectal surgery

- Does bowel decontamination reduce anastomotic leaks and surgical-site complications?
- What are the potential problems with bowel decontamination?
- What does current evidence recommend?
- Should type of procedure influence bowel decontamination strategy?
- Where should future research be targeted?

Throughout the history of colorectal surgery, the use of mechanical bowel preparation has been controversial. Before the widespread adoption of enhanced recovery after surgery (ERAS) protocols, mechanical bowel preparation was used routinely in most countries before elective colorectal surgery. With the introduction of ERAS programmes, mechanical bowel preparation fell out of favour. However, more recent research questions this change in practice. The currently available evidence in this area is heterogeneous. This article summarizes the available data and provides up-to-date guidance.

## Key clinical question 1: does bowel decontamination reduce anastomotic leak and surgical-site complications?

Several recent studies, and analyses of large national databases have reported benefits from mechanical bowel preparation/antibiotics with reduced rates of surgical-site infections (SSIs); for example, risk ratio 0.48 (95 per cent c.i. 0.40 to 0.56) for oral plus intravenous *versus* intravenous antibiotics only<sup>1</sup>. The available data also suggest that anastomotic leakage may be reduced, but the weight of evidence is less strong than that for SSI; for example, 6.1 *versus* 8.7 per cent for oral plus intravenous antibiotics plus mechanical bowel preparation *versus* no preparation<sup>2</sup>. Critics argue that the heterogeneity in bowel preparation formulations and antibiotics used limits the universal acceptability of

the currently available evidence (Table 1). Emerging work on the interaction of the gut microbiome with colorectal surgical complications supports a role for mechanical bowel preparation and oral antibiotics before surgery<sup>3,4,5</sup>. It therefore seems logical that conscientiously manipulating the microbiome should influence the outcomes of surgery<sup>5,6</sup>.

### Summary: key clinical question 1

Bowel decontamination with mechanical bowel preparation and oral antibiotics can reduce surgical-site infections and probably anastomotic leakage.

## Key clinical question 2: what are the potential problems with bowel decontamination?

The human microbiota influences individual well-being based on complex interactions between the host and environmental factors. A delicate balance exists in the bowel flora, which any intervention can alter and lead to undesirable side-effects. The severity and impact of such events is multifactorial and incompletely understood. As an example, combining bowel decontamination strategies may reduce anastomotic leakage and SSIs, but at the cost of increased side-effects<sup>6</sup>. These may include low compliance, abdominal pain, nausea and vomiting, and reactions to the agents; dehydration can also occur with mechanical bowel preparation, whereas strain selection potentially leading to long-term antibiotic resistance may develop with unselected use of antibiotics.

### Summary: key clinical question 2

Bowel decontamination may result in undesired side-effects. These include low compliance, abdominal pain, nausea and vomiting, dehydration, and reactions to the agents used. Long-term antibiotic resistance may also occur.

Table 1 Reported antibiotic and mechanical bowel preparation combinations for bowel decontamination

	Class/mechanism
<b>Oral antibiotics</b>	
• Ciprofloxacin alone	
• Clindamycin alone	
• Erythromycin alone	
• Metronidazole alone	
• Neomycin alone	
• Bacitracin + neomycin, then metronidazole	
• Ciprofloxacin + metronidazole	
• Gentamicin + metronidazole	
• Kanamycin + erythromycin	
• Kanamycin + metronidazole	
• Metronidazole + levofloxacin	
• Metronidazole + neomycin	
• Neomycin + erythromycin*	
• Neomycin + metronidazole	
• Neomycin + tinidazole	
<b>Mechanical bowel preparation</b>	
• Sodium phosphate (tablets and aqueous)	• Osmotic cathartic
• Magnesium citrate	• Osmotic cathartic
• PEG (4-litre and 2-litre formulation)	• Iso osmotic
• Bisacodyl	• Contact irritant
• Sodium picosulphate/magnesium citrate	• Combination: osmotic + contact irritant
• 2-litre PEG + bisacodyl	• Combination: non-absorbable osmotic + contact irritant

Several oral antibiotic combinations have been reported so far. \*Most commonly reported combination. Polyethylene glycol (PEG) is a balanced unabsorbable solution, suitable for patients with electrolyte imbalances, congestive heart failure, ascites, and infants/children. Sodium picosulphate/magnesium citrate is also very commonly used before colonic and rectal surgery. The choice of antibiotics and bowel preparation should be made based on local policies, geographical considerations<sup>8</sup>, availability of formulation, and patient need.

### Key clinical question 3: what does current evidence recommend? Bowel decontamination strategies to reduce complications

Perioperative bowel-targeted interventions that can be used to reduce anastomotic leakage and SSIs are summarized in [Table 2](#). Current evidence only unequivocally reports data on patients with colonic and rectal cancer who had surgery in the elective setting. Therefore, in different indications for surgery (such as inflammatory bowel disease), there is insufficient evidence to provide firm guidance. Use should therefore be adapted on an individual basis<sup>2,7-13</sup>. Bowel decontamination strategies should be implemented in the context of pre-established and validated multidimensional risk-reduction pathways (such as ERAS).

#### Preoperative phase

Based on the GRADE (Grading of Recommendations, Assessment, Development and Evaluations) framework, there is high-quality evidence to support the use of intravenous antibiotics before all colorectal procedures<sup>7</sup> (within 1 h of the start of surgery). The choice of intravenous antibiotics should be based on coverage of gut pathogens including Enterobacteriaceae and anaerobes.

There is high-quality GRADE evidence to support the use of oral plus intravenous antibiotics to reduce SSI after elective colonic surgery in patients without inflammatory bowel disease, compared with intravenous antibiotics alone<sup>2,8</sup>. Mechanical bowel preparation alone does not confer any advantage in reducing SSI, compared with intravenous antibiotics alone<sup>9</sup>. Even though mechanical bowel preparation does not increase postoperative complications<sup>10</sup>, its role is still debated.

As a result, comparisons between oral plus intravenous antibiotics and mechanical bowel preparation *versus* oral plus intravenous antibiotics alone are the focus of ongoing studies (such as ORALEV2, NCT04161599).

Specifically in restorative rectal surgery, the available evidence suggests that mechanical bowel preparation might safely be omitted and this may reduce the incidence of extra-abdominal complications<sup>11</sup>. Despite this, it is still common practice to use mechanical bowel preparation. SSIs are more common after rectal cancer surgery, which supports the use of oral antibiotics to reduce this morbidity<sup>12</sup>. Nuances, such as patient age and comorbidities, should be considered when preparing patients for surgery. Mechanical bowel preparation could be omitted when the risk of dehydration and/or renal failure outweighs the potential benefit, especially if non-restorative surgery is being planned.<sup>2,13</sup>

Overall, a patient-tailored approach rather than a broadly generalizable combination might be more effective in reducing anastomotic leakage after colorectal surgery. Interestingly, a study<sup>14</sup> using selective decontamination of the bowel before colorectal resections found no differences in anastomotic leakage, even though overall infectious complications were reduced with the preparation proposed.

#### Summary: key clinical question 3

The current evidence recommends microbial optimization of the bowel, before and during colorectal surgery with an expectation of reducing rates of surgical-site infection, but not anastomotic leakage.

**Table 2 Perioperative bowel decontamination and risk-reduction strategies**

Preoperative recommendations	
Elective	<ul style="list-style-type: none"> <li>• Colonic resection: oral + i.v. antibiotics; reduction in SSIs</li> <li>• Rectal resection: oral + i.v. antibiotics + MBP; reduction in SSIs and presumed reduction in anastomotic leakage</li> <li>• All patients: prehabilitation and ERAS education</li> <li>• Omit MBP in patients at significant risk of complications as a consequence of fluid shifts (overnight i.v. fluid therapy may be an appropriate alternative)</li> <li>• Targeted antibiotic prescription for patients with a history of prolonged antibiotic use</li> </ul>
Emergency	<ul style="list-style-type: none"> <li>• Stenting to allow bowel preparation and optimization</li> <li>• Enemas do not seem to add any benefit</li> </ul>
Intraoperative recommendations	
	<ul style="list-style-type: none"> <li>• Evidence does not support on-table lavage</li> <li>• Selective use of abdominal drains (can be omitted in colonic and high anterior rectal resection)</li> <li>• Adhere to SSI reduction bundles</li> <li>• Intraoperative anastomosis checking</li> </ul>

i.v., Intravenous; SSI, surgical-site infection; MBP, mechanical bowel preparation; ERAS, enhanced recovery after surgery.

### Key clinical question 4: should type of procedure influence bowel decontamination strategy?

The available data, although providing limited evidence, support the use of oral and intravenous antibiotics to reduce SSI before elective colonic and rectal resections. The evidence on anastomotic leak is conflicting. Mechanical bowel preparation is currently used for rectal surgery, but mechanical bowel preparation without oral antibiotics is of questionable value (Table 3). Ongoing trials (such as MOBILE2, NCT04281667 for rectal surgery; ORALEV2, NCT04161599<sup>15</sup> for colonic surgery) will guide future practice and suggest whether adding it to oral antibiotics is of value in colonic surgery.

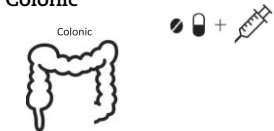
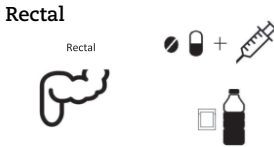
#### Summary: key clinical question 4

Oral and intravenous antibiotics should be used in all colonic and rectal surgery. The role of mechanical bowel preparation is unclear, with trials ongoing.

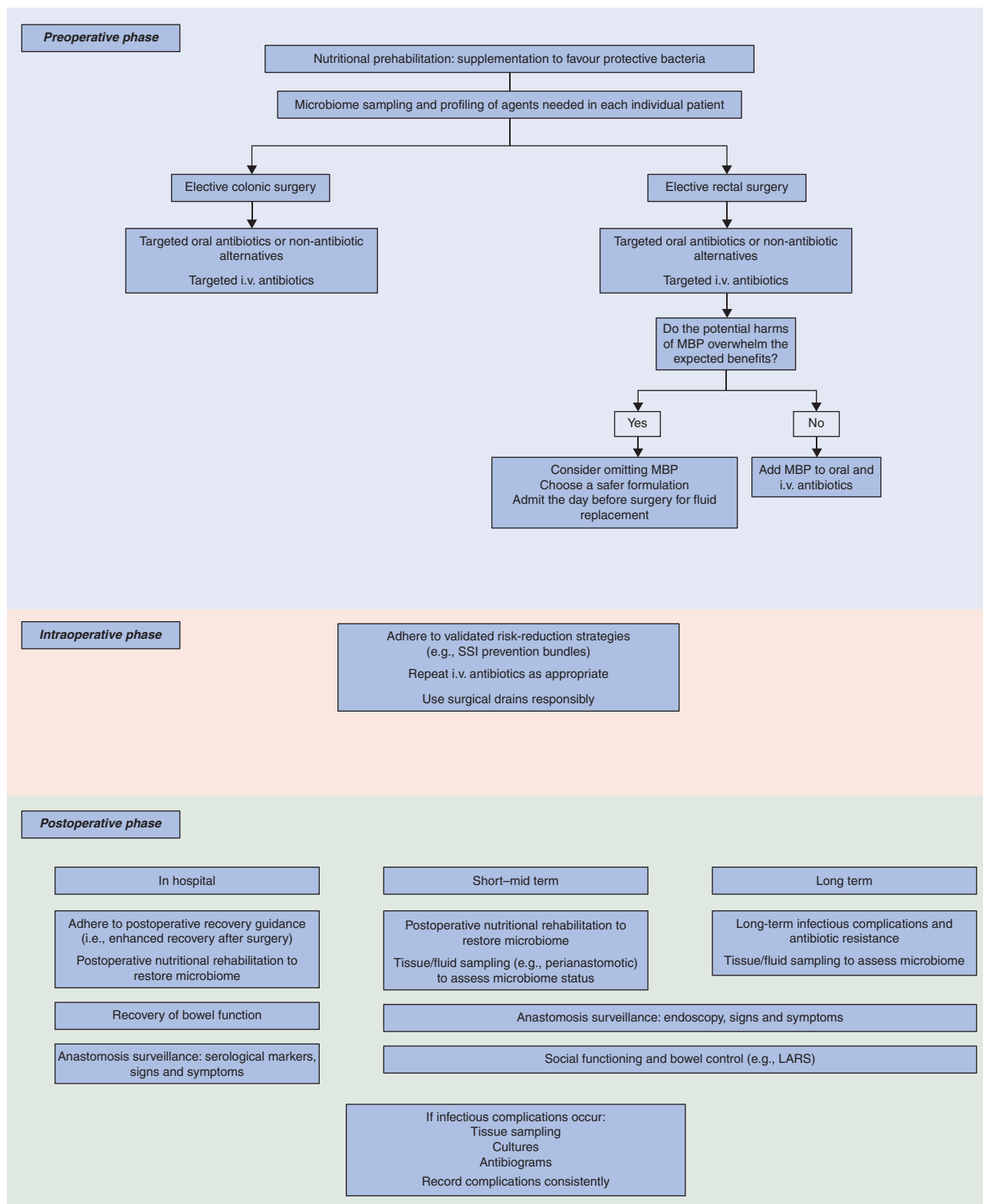
### Key clinical question 5: where should future research be targeted?

Bowel decontamination needs to be incorporated into local care bundles and be part of a holistic management strategy. Prehabilitation should be implemented with strategies to reduce SSI and anastomotic leakage after colonic and rectal

**Table 3 Recommended strategies, with advantages, disadvantages, and unresolved issues considered**

Bowel decontamination strategy	Advantages	Known disadvantages and unresolved issues
<b>Colonic</b> 	<ul style="list-style-type: none"> <li>• Demonstrated</li> <li>• Reduction in SSIs</li> <li>• Reduction in overall complications</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance with prescription</li> <li>• Long-term antibiotic resistance</li> </ul>
<b>Rectal</b> 	<p>Demonstrated</p> <ul style="list-style-type: none"> <li>• Reduction in SSIs</li> </ul> <p>Presumed or perceived</p> <ul style="list-style-type: none"> <li>• Possible reduction in anastomotic leakage</li> <li>• Easier handling, better palpation of small tumours/polyps</li> <li>• On-table colonoscopy possible</li> <li>• Reduced risk of ileus</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance with prescription</li> <li>• Dehydration and metabolic disturbances</li> <li>• Patient-targeted formulation</li> <li>• Long-term antibiotic resistance</li> <li>• Increased risk of bowel content spillage</li> </ul>

SSI, surgical-site infection.



**Fig. 1** Potential algorithm for bowel microbiome optimization in colonic and rectal surgery

i.v., Intravenous; MBP, mechanical bowel preparation; SSI, surgical-site infection; LARS, low anterior resection syndrome.

surgery, so that risk factors can be reduced. Increasingly, preoperative microbiome status is being assessed. In the future, preoperative and early postoperative microbiome manipulation with probiotics or symbiotics could be used to restore the ideal bowel flora ahead of surgery. This will require the input of coloproctologists and microbiologists, working as a multidisciplinary team<sup>5</sup>.

Effects of the gut microbiome on anastomotic healing currently represent a rapidly evolving aspect of risk-reduction strategies in colonic and rectal surgery, as well as the potential role that the microbiome might play in the restoration of bowel function following colorectal resection. 'Bowel decontamination 3.0' will likely resemble *haute couture*, an individualized formulation/strategy for each patient (Fig. 1). This would ensure that selective pressure is made on specific bowel strains, rather than performing an aggressive, one-size-fits-all elimination of the intestinal flora.

#### Summary: key clinical question 5

Individual analysis of patient microbiome composition before operation is likely to allow tailored, patient-specific approaches to bowel decontamination ahead of colorectal surgery.

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