

# A Chinese Survey of Current Practice Patterns of Preoperative Bowel Preparation in Colorectal Surgery

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## Research Article

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# Abstract

## Background

Bowel preparation has long been considered as the standard preoperative management for colorectal surgery. However, there are still controversies about bowel preparation and the importance of bowel preparation gradually declined. The purpose of this study is to describe the current attitudes and practice patterns of preoperative bowel preparation among Chinese surgeons.

## Methods

An online 11-question anonymous survey was randomly assigned to Chinese surgeons. The questionnaire sought information on each surgeon's current practice of preoperative bowel preparation.

## Results

384 Chinese surgeons from 26 provincial administrative regions took part in this survey. The most common reason for choosing bowel preparation was preventing surgical site infection (SSI). Meanwhile, 74% Chinese surgeons believed bowel preparation could avoid anastomotic leakage. Only 34% thought that bowel preparation was considered to reduce risk of postoperative bleeding. In terms of bowel preparation methods, 57% Chinese surgeons preferred to choose laxatives alone. Regarding the choices of agents, Chinese surgeons were more likely to choose polyethylene glycol-electrolyte lavage solution (PEG-ELS).

## Conclusions

Surgeons choose bowel preparation mostly to avoid SSI and anastomotic leakage, and they prefer using laxatives alone. Our study shows that surgeons do not have clear guidelines that can govern their clinical practice and there are still controversies about bowel preparation. Further study is required to provide strong evidences to inform clinical and policy decisions.

## Background

Bowel preparation has long been considered as the standard preoperative management for colorectal surgery. A clean colon is thought to facilitate colorectal surgery manipulation, allowing the passage and firing of surgical staplers. On the contrary, inadequately prepared intestinal tract is considered to be an important factor leading to poor wound healing and postoperative infection, namely surgical site infection (SSI). Among all elective surgeries, colorectal surgery has the highest incidence of SSI, with a recent review showing rates ranging from 5.4–23.2% [1].

The method and practice of bowel preparation including mechanical bowel preparation (MBP) and oral antibiotics preparation (OAP) vary differently. MBP refers to the use of oral laxatives and enema to reduce intestinal contents preoperatively, so as to provide a relatively clean intestinal cavity for the surgery, decrease intraluminal bacterial concentration and reduce postoperative infections. OAP refers to the prophylactic use of antibiotics before surgery for the reduction of the bacterial load of the whole body and intestines, so as to reduce the incidence of postoperative infections and other complications.

After the ERAS (enhanced recovery after surgery) concept was proposed, the importance of bowel preparation gradually declined. A multicenter randomized trial of 1,354 patients found that it was reasonable to safely perform colorectal surgery without MBP [2]. Some meta-analyses concluded that MBP can be safely omitted in colon surgery [3], even increase the risk of SSI [4]. On the other hand, the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) indicated that the combined use of MBP and OAP was associated with a significantly lower incidence of postoperative complications compared with the use of other bowel preparation strategies [5].

The view on whether the preoperative bowel preparation is necessary remains inconclusive, how surgeons manage bowel preparation in the real life clinical practice may be beneficial to the renewal of ideas. The aim of this study is to describe the current attitudes and practice patterns of preoperative bowel preparation among Chinese surgeons.

## Methods

An online 11-question anonymous survey was randomly assigned to Chinese surgeons (Supplement 1). The participants were requested to complete the questionnaire by the end of December 2020. The questionnaire sought information on each surgeon's current practice of preoperative bowel preparation. In the questionnaire, we collected demographic information, including gender, age, working experience, medical specialty, hospital setting, hospital grade, department volume and monthly number of operations. In terms of bowel preparation, we investigated the reasons for bowel preparation, the methods of preoperative bowel preparation and the choices of agents in the participants' practice. Among the reasons, we provided options such as preventing SSI, avoiding anastomotic leakage, and reducing risk of postoperative bleeding. Options of bowel preparation methods include using laxatives, enema, OAP and their combinations. We also asked for information on the choices of laxatives, regarding polyethylene glycol-electrolyte lavage solution (PEG-ELS), sodium phosphate (NaP), magnesium sulfate ( $\text{MgSO}_4$ ) and mannitol.

We analyzed the data statistically based on the responses obtained. All statistical analyses were performed using STATA version 12.0. Only  $P$ -value  $< 0.05$  was considered statistically significant.

## Results

### Demographics

384 Chinese surgeons from 26 provincial administrative regions took part in this survey. The relevant demographic characteristics of the participants are presented in the Table 1. Of the 384 participants, 311 (81%) were male surgeons. Most of them were between the ages of 40–50 (46%), had more than 20 years working experience (63%) and worked in general surgery (38%). Most of the hospitals were III A general hospitals (63% and 95%) and 53% department had less than 50 beds. Among the surgeons, 61% performed less than 100 operations per month.

Table 1  
 Characteristics of surgeons

	Number	Percent (%)
Gender	311	81
Male	73	19
Female	84	22
Age	178	46
<40 years	122	32
40–50 years	35	9
>50 years	109	28
Working experience	240	63
<10 years	110	29
10–20 years	128	33
>20 years	146	38
Medical specialty	366	95
Gastrointestinal surgery	18	5
Anorectal surgery	240	63
General surgery	57	15
Hospital setting	4	1
General	74	19
Specialized	8	1
Hospital grade	1	1
III A	202	53
III B	142	37
III C	22	5
II A	18	5
II B	234	61
II C	122	32
Department volume	28	7
<50		

	Number	Percent (%)
50–100		
101–150		
>150		
Operations per month		
<100		
100–200		
>200		

## Bowel Preparation Reasons, Methods And Agents

Table 2 shows bowel preparation reasons, methods and agents. The most common reason for choosing bowel preparation was preventing SSI (312/384, 81%). Meanwhile, 74% Chinese surgeons believed bowel preparation could avoid anastomotic leakage. Only 34% thought that bowel preparation was considered to reduce risk of postoperative bleeding (Fig. 1).

Table 2  
Bowel preparation reasons, methods and agents

	Number	Percent (%)
Reasons (Multiple choice)	312	81
Preventing SSI	285	74
Avoiding anastomotic leakage	130	34
Reducing risk of postoperative bleeding	61	16
Other	217	57
Methods (Single choice)	46	12
Laxatives	79	21
Laxatives and oral antibiotics	30	8
Laxatives, oral antibiotics and enema	2	1
Enema	10	3
Oral antibiotics	349	91
Other	24	6
Agents (Multiple choice)	26	7
PEG-ELS	11	3
Mannitol	19	5
NaP		
MgSO <sub>4</sub>		
Other		

In terms of bowel preparation methods, 57% (217/384) Chinese surgeons preferred to choose laxatives alone; laxatives and oral antibiotics was used by 12%; laxatives and oral antibiotics combined with enema was used by 21%. Enema alone, oral antibiotics alone and other methods were only 8%, 1% and 3%, respectively (Fig. 2).

Regarding the choices of agents, Chinese surgeons were more likely to choose PEG-ELS (349/387, 91%). Mannitol and NaP were prescribed by 6% and 7%, respectively. MgSO<sub>4</sub> and other agents were only 3% and 5% (Fig. 3).

## Analysis Of Bowel Preparation Methods

Analysis of bowel preparation methods is summarized in Table 3. The participants' age and working experience did not show significant differences in the methods of bowel preparation ( $P$ -value > 0.05). In terms of hospitals' characteristics, there were no significant differences in the use of bowel preparation. Department volume and number of operations also did not significantly affect choosing bowel preparation.

Table 3  
Analysis of bowel preparation methods

Laxatives	Laxatives and oral antibiotics	Laxatives, oral antibiotics and enema	Enema	Oral antibiotics	Other	<i>P</i> value
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	Laxatives	Laxatives and oral antibiotics	Laxatives, oral antibiotics and enema	Enema	Oral antibiotics	Other	<i>P</i> value
Age	53	5	17	8	0	1	0.326
<40 years	91	25	41	16	1	4	0.686
40–50 years	73	16	21	6	1	5	0.791
>50 years	24	1	8	1	0	1	0.308
Working experience	59	13	25	10	1	2	0.220
<10 years	134	32	46	19	1	7	0.662
10–20 years	57	15	23	12	1	2	
>20 years	77	13	28	6	0	4	
Medical specialty	83	18	28	12	1	4	
Gastrointestinal surgery	209	44	75	26	2	10	
Anorectal surgery	8	2	4	4	0	0	
General surgery	118	22	43	15	0	4	
Hospital setting	81	18	27	10	1	5	
General	11	2	4	4	0	1	
Specialized	7	4	5	1	1	0	
Department volume	142	26	44	17	1	4	
<50	60	17	28	11	1	5	
50–100	15	3	7	2	0	1	
101–150							
>150							
Operations per month							
<100							
100–200							
>200							

## Discussion

Bowel preparation has been controversial for many years, especially in necessity and methods. This survey involved currently the largest number of participants in China. In this study, the characteristics of demographic, hospital and department did not correlate with the methods of bowel preparation. Most of the reasons for bowel preparation were to prevent SSI and avoid anastomotic leakage. Surgeons preferred laxatives when it came to bowel preparation through the data we collected. In terms of laxatives selection, PEG-ELS was mostly used.

The American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommend a combination of MBP and OAP in both colonic and rectal surgery in the 2017 clinical practice guidelines [6]. Likewise, the ERAS American society guidelines recommended the same methods of bowel preparation [7]. However, some countries did not recommend either MBP or MBP + OAP, especially with the spreading of ERAS all over the world. The Canadian guidelines, based on a systematic review of 14 randomized trials and 8 meta-analyses, concluded that it was acceptable to omit MBP as it provided no advantage and might trigger discomfort among patients [8]. The British guidelines (updated in 2017 and based on Cochrane reviews) also indicated that stopping or reducing the routine use of MBP in patients undergoing elective colorectal surgery was likely to lead to improved quality of patient care, improved patient experience and productivity savings [9]. Furthermore, the French ERAS guidelines did not recommend MBP whether in colonic (strong agreement) or in rectal surgery (weak agreement) [10].

There is a continuous debate on the role of bowel preparation in colorectal surgery. Opponents of MBP argue that it can damage the intestinal mucosal barrier and destroy the endogenous microbial barrier, thereby aggravating the damage of intestinal mucosa directly or indirectly [11]. In addition, inadequate MBP caused a significantly higher incidence of peritoneal spillage and subsequent postoperative infectious complications [12]. MBP might trigger discomfort among patients, including nausea, vomiting, abdominal pain and abdominal bloating [13].

Regardless of the fact that several studies have shown no benefit from MBP in colorectal surgery, the number of cases they studied was small. The largest and most well-documented study to date came from Kiran's study [14]. They collected National Surgical Quality Improvement Program–targeted colectomy data initiated in 2012 capture information on the use/type of bowel preparation and colorectal-specific complications. Of 8442 patients, MBP with OAP was independently associated with reduced 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), compared with MBP alone and no bowel preparation. The findings of this study support the universal adoption of a simple preoperative bowel preparation regimen that combines MBP and oral antibiotics before elective colorectal resection. Bretagnol's study, the first randomized trial focused on the postoperative results after sphincter-saving rectal resection for cancer, showed that the overall and infectious morbidity rates were significantly higher in no-MBP versus MBP group, 44% versus 27%,  $P = 0.018$ , and 34% versus 16%,  $P = 0.005$ , respectively [15].

In our study, most of Chinese surgeons believed that bowel preparation could prevent SSI (81%) and avoid anastomotic leakage (74%) by reducing the intraluminal bacterial counts and stool burden. In a retrospective study using data from ACS NSQIP Colectomy Targeted database from 2012 to 2015, combined MBP/OAP resulted in significantly lower rates of SSI (OR = 0.56,  $P < 0.001$ ) and anastomotic leak (OR = 0.53,  $P < 0.001$ ) than no preparation [16]. Toh et al. included in their meta-analysis 38 RCTs and 8458 patients [17]. MBP + OAP was better in terms of SSI and wound infection compared to no preparation (OR = 0.60, 95%CI:0.45–0.79 and OR = 0.67, 95%CI:0.48–0.93, respectively), and in terms of SSI and wound infection compared to MBP alone (OR = 0.71, 95%CI:0.57–0.88, and OR = 0.62, 95%CI:0.49–0.85, respectively). Nevertheless, the disruption of the host colonic microbiome and subsequent clostridium difficile infection remains a problem [18]. Kim created a propensity-matched analysis of 957 paired cases ( $n = 1914$ ) and compared patients receiving MBP + OAP with no bowel preparation [19]. MBP + OAB group was less likely to develop postoperative clostridium difficile colitis than those who received no bowel preparation (0.5% vs 1.8%;  $P = 0.01$ ). Bowel preparation should not be omitted considering the benefits above, especially in high-grade colorectal surgery.

Our results showed that Chinese surgeons preferred PEG-ELS as their first laxatives choice (91%). PEG-ELS has been widely used for colorectal surgery since 1980. Because of its isotonic and electrolyte-balanced feature, the patient's electrolytes and internal environment don't change much, and it has been shown to be highly effective and well tolerated, especially patients with renal insufficiency, congestive heart failure, and advanced liver disease [20]. In spite of its safe and adequate cleansing, large volumes of liquid required and unpleasant taste remain troubling patients [21]. Modified regimen (a lower-volume PEG formulation, for instance) and improved taste (PEG-ELS-II, for instance) enhance patients' tolerance with the progress of technology [22,23]. Mannitol and NaP are both hyperosmotic cleansing agents which not only can't be absorbed from the gastrointestinal tract, but also can attract fluid into the bowel. The disadvantage of mannitol is that it can explode by the catabolism of *Escherichia coli* [24]. The preference for NaP has reduced owing to phosphate-induced renal disease [25].

This survey had some limitations. Firstly, the questionnaire did not ask about bowel preparation in colon surgery and rectal surgery separately, which could lead to further findings. Moreover, options of bowel preparation methods should be more classified in detail, such as lack of oral antibiotics combined with enema. Finally, participants might introspect their clinical practice to avoid deviating from the most proper management.

## Conclusions

In summary, this present survey describes the current attitudes and practice patterns of preoperative bowel preparation among Chinese surgeons. Our study shows that surgeons choose bowel preparation mostly to avoid SSI and anastomotic leakage, and they prefer using laxatives alone. Surgeons do not have clear guidelines that can govern their clinical practice and there are still controversies about bowel preparation. Further study is required to provide strong evidences to inform clinical and policy decisions.

# Abbreviations

ACS NSQIP

American College of Surgeons National Surgical Quality Improvement Program; ASCRS: American Society of Colon and Rectal Surgeons; ERAS: enhanced recovery after surgery; MBP: mechanical bowel preparation;  $MgSO_4$ : magnesium sulfate; NaP: sodium phosphate; OAP: oral antibiotics preparation; PEG-ELS: polyethylene glycol-electrolyte lavage solution; SAGES: Society of American Gastrointestinal and Endoscopic Surgeons; SSI: surgical site infection.

# Declarations

## Ethics approval and consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Availability of data and materials

Please contact the author for data requests.

## Competing interests

The authors declare that they have no competing interests.

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## Authors' contributions

Yu and Zhang contributed substantially to the conception and design of the work. Liu, Yin, Chen and Li contributed substantially to the acquisition of data. Xu, Hong and Yang analyzed the data. All authors contributed to the interpretation of data. Yu and Xu drafted the work. All authors commented on and critically revised previous versions of the manuscript. All authors read and approved the final manuscript.

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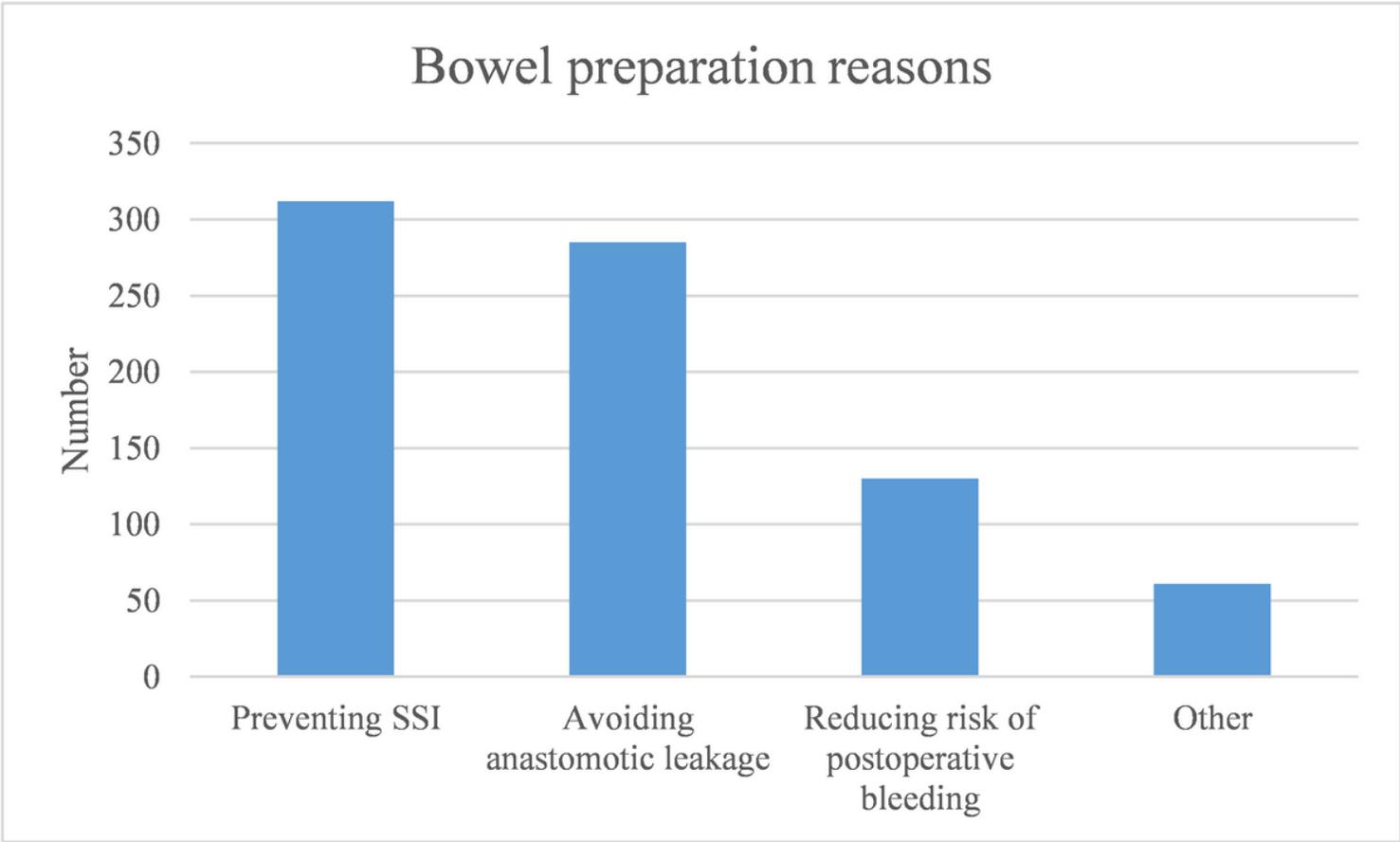
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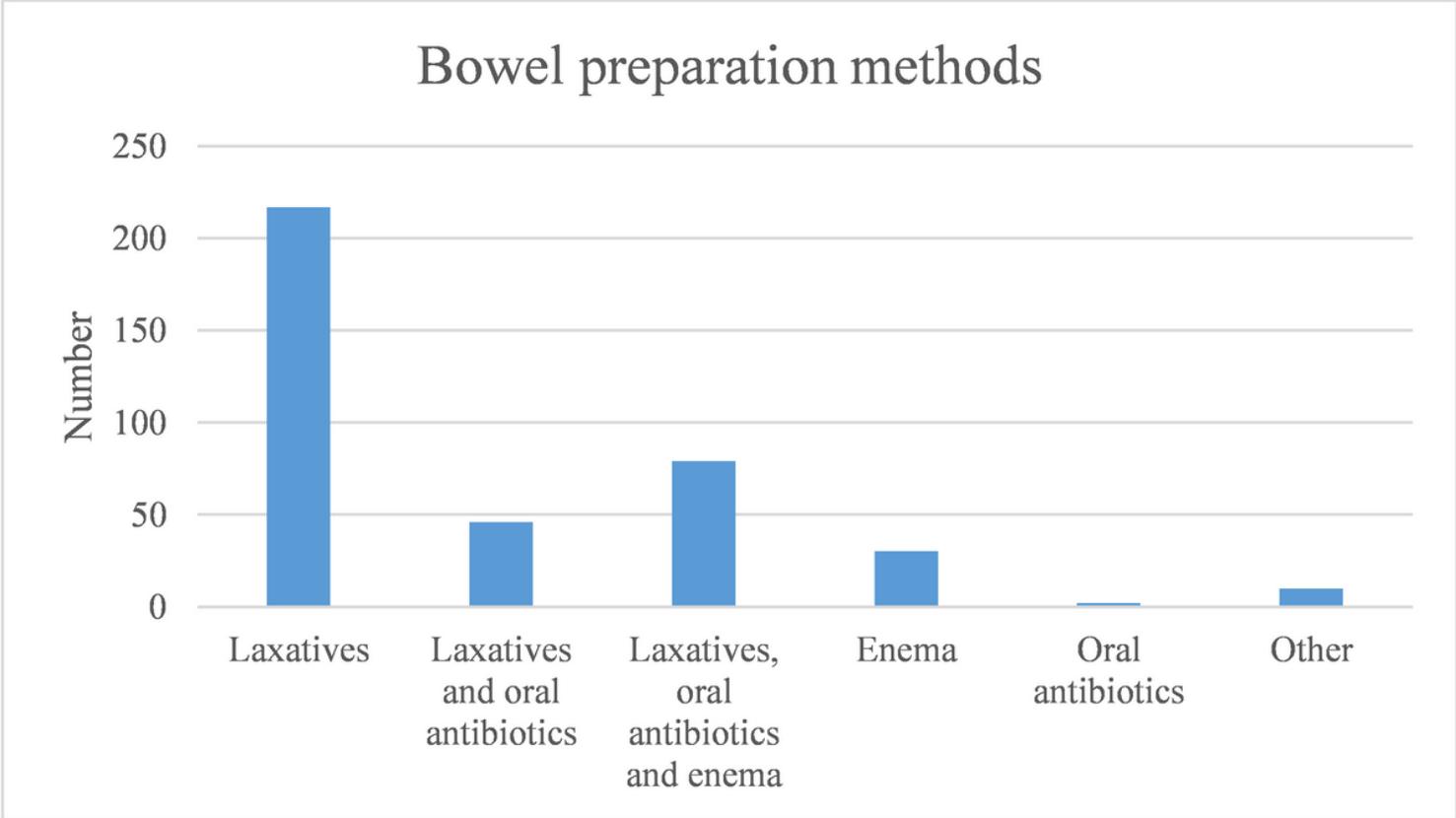
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## Figures



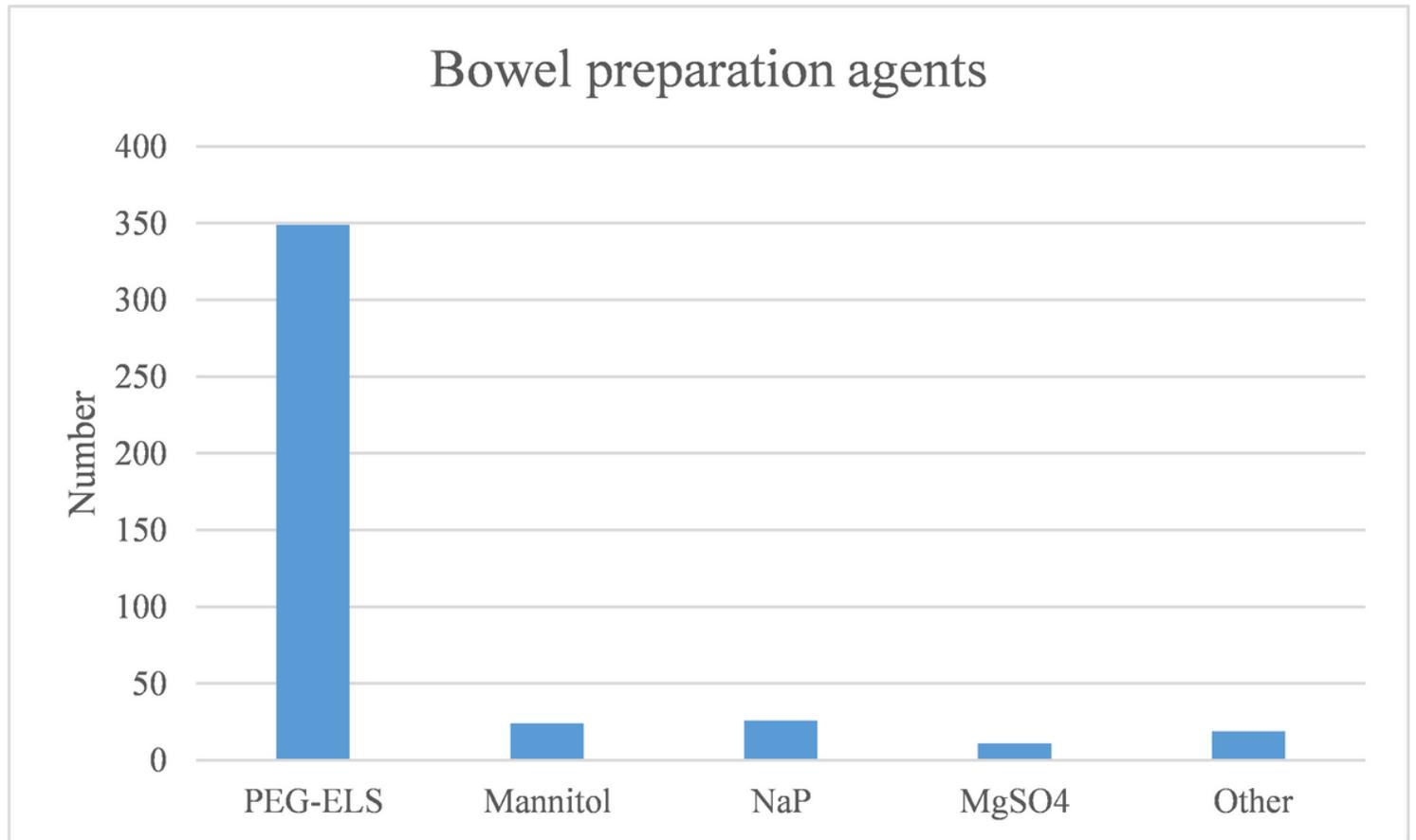
**Figure 1**

Bowel preparation reasons.



**Figure 2**

Bowel preparation methods.



**Figure 3**

Bowel preparation agents.

## Supplementary Files

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