Selective decontamination of the digestive tract in elective gastrointestinal surgery
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Citation for published version (APA):

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CHAPTER 4

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Current Application of Selective Decontamination of the Digestive Tract (SDD), Perioperative Antibiotics and Mechanical Bowel Preparation in Surgical Departments in the Netherlands

Dig Surg. 2011;28(5-6):338-44
ABSTRACT

Objective
To study the current application of selective decontamination of the digestive tract (SDD), the use of preoperative antibiotics and mechanical bowel preparation (MBP) in elective gastrointestinal (GI) surgery in surgical departments in the Netherlands.

Methods
A point prevalence survey was carried out and an online questionnaire was sent to GI surgeons of 86 different hospitals.

Results
The response rate was 74%. Only 4/64 (6.3%) of the Dutch surgical wards are currently using perioperative SDD as a prophylactic strategy to prevent postoperative infectious complications. The 4 hospitals using SDD on their surgical wards also use it on their ICUs. All hospitals make use of perioperative intravenous antibiotic prophylaxis in elective GI surgery. In most hospitals, a cephalosporin and metronidazole are applied (81.3 and 76.6%). MBP was used in 58 hospitals (90.6%) mainly in left colonic surgery.

Conclusions
Perioperative SDD is rarely used in elective GI surgery in the Netherlands. Perioperative intravenous antibiotic prophylaxis is given in all Dutch hospitals, conforming to guidelines. Although the recent literature does not recommend MBP before surgery, it is still selectively used in 90.6% of the Dutch surgical departments, mainly in open or laparoscopic left colonic surgery (including sigmoid resections).
INTRODUCTION

Reduction of postoperative infectious complications is still a challenge in gastrointestinal (GI) surgery. Surgery of the colon and rectum is associated with a high incidence of infections and morbidity. Hospital stay is often extended and there is a higher mortality due to postoperative infectious complications. Different strategies are used to prevent perioperative endotoxemia and postoperative infections. Since the introduction of oral preoperative antibiotic prophylaxis in GI surgery in the early 1970s, the rate of postoperative complications has declined from approximately 40 to 28%.\(^1\)

Dutch guidelines promote the application of perioperative antibiotics. Antibiotic prophylaxis is generally recommended for surgical procedures with relatively high postoperative infection rates and those in which the consequences of infection are serious, as in GI procedures. Studies have revealed that prophylaxis given within 2 h before surgery is most effective. Short-term, preferably single-dose prophylaxis is as effective as multiple dose prophylaxis in most procedures.\(^2\) Antibiotic prophylaxis is different from repeated doses after the operation in cases of contamination; such doses (usually during 3 or 5 days) are on a therapeutic basis. This study will not consider antibiotic therapy.

Another method to decrease postoperative infectious complications might be the perioperative administration of selective decontamination of the digestive tract (SDD).\(^3\) In 1984, SDD was introduced on the ICU by Stoutenbeek.\(^4\) In his study, a combination of tobramycin, polymyxin and amphotericin B was administered to multiple trauma patients staying in the ICU for 5 or more days and needing mechanical ventilation. The infection rate decreased from 81 to 16%.\(^4\) The inconveniences of SDD are the bad taste (bitter) and possible nausea. The antibiotic components of SDD hardly give any systemic side effects, as SDD is a topical paste which has barely any uptake in the bloodstream. Recently, we published a retrospective study on the use of SDD in colon surgery on the surgical ward. The results are promising and suggest that postoperative infectious complications can be reduced by applying SDD before and after surgery.\(^5\) In a prospective randomized controlled trial by our group, perioperative SDD did indeed decrease infectious complications, and also the rate of anastomotic leakage (accepted for publication). However, the application of SDD on surgical wards in the Netherlands is uncommon. A survey on the use of SDD on the ICU showed that SDD is used as an infection prevention strategy in 30% of Dutch ICUs. Several meta analyses, single-centre randomized studies and a multicentre trial showed that SDD improves survival of critically ill ICU patients.\(6-9\) Although the guideline of the Dutch Society of Intensive Care Medicine promotes SDD as an evidence-based strategy, 70% of the ICUs still do not follow this guideline. Ninety per cent of the ICUs applying SDD use the full regimen of oral and GI antibiotics (tobramycin 4 x 80 mg, polymyxin-B 4 x 100 mg and amphotericin 4 x 500 mg) and a short course of intravenous cefotaxime.\(10\)

Until recently, it was assumed that preoperative mechanical bowel preparation (MBP) in combination with oral antibiotics reduced the risk of septic complications after elective colorectal surgery. Mechanical cleansing was performed routinely prior to colorectal surgery. However, several clinical trials show that there is no evidence evidence that patients benefit
from MBP and application should be reconsidered.\textsuperscript{11, 12} The present survey was performed to investigate the use of SDD, perioperative antibiotics and MBP in elective GI surgery on surgical wards in the Netherlands.

**MATERIALS AND METHODS**

This study is a point prevalence study on the use of SDD, perioperative antibiotics and MBP in surgical wards in the Netherlands. The study was conducted from June 2009 to January 2010. An online questionnaire was sent to GI surgeons at all hospitals in the Netherlands. Private clinics were excluded. The GI surgeons were contacted by email and mail in the time frame from June 2009 to March 2010. Those GI surgeons who did not respond by email or complete the online survey were contacted by mail and telephone. A paper version of the questionnaire was sent and a return envelope included.

**Questionnaire**

The survey was subdivided into 3 parts. The first part consisted of questions concerning SDD, whether SDD was currently applied as an infection prophylaxis regimen in their ICU and/or at the department of GI surgery. Details of the prescription regimen were asked: the combination and dose of the antibiotics, the times of administration, and the number of treatments. Also the indications for the use of SDD were asked. Subsequently, the pharmacy of the hospital applying SDD was contacted by email to register the exact combination and dose of SDD.

The second and third part included questions about the application of perioperative antibiotics and MBP in GI surgery. Details of the prescription regimens, times of administration and the indications were asked. The questionnaire consisted of several questions to which multiple answers were possible and there was space for free text (Figure 1).

**Data Analysis**

All data were gathered in SPSS 15.0 (SPSS, Chicago, Ill., USA) and enumerated as totals and percentages.

**RESULTS**

For this survey, Dutch GI surgeons from all 86 hospitals (8 academic centers and 78 non-academic or regional hospitals) were asked to complete the questionnaire. Those hospitals consisting of two or more locations were joined. Private clinics were excluded. The online questionnaire was successfully completed by 35 different hospitals. Another 20 hospitals responded after the paper version. A personal email to return the questionnaire was sent to the surgeons in the remaining hospitals (n = 31). Finally, the total response rate was 74%: 6 academic centers and 58 peripheral hospitals were included.
Figure 1 Questionnaire

Part one (SDD)
1. **Do you use SDD on your surgical ward and/or ICU?**
   a. Yes, only on the ICU
   b. Yes, only on the surgical ward
   c. Yes, on ICU and surgical ward
   d. No

2. **If you use SDD, what is the combination and dose of the antibiotics?**

3. **When do you start SDD?**
   a. Two days prior to surgery (8 gifts)
   b. One day prior to surgery (4 gifts)
   c. Other …*

4. **Does a patient get SDD on operation day?**
   a. Yes
   b. No
   c. Other …*

5. **Is SDD being continued if the patient goes to the ICU postoperatively?**
   a. Yes, until … days*
   b. No

6. **When do you stop SDD? (multiple choice)**
   a. One day postoperative
   b. Two days postoperative
   c. Three days postoperative
   d. Four days postoperative
   e. Five days postoperative
   f. Six days postoperative
   g. Seven days postoperative
   h. After minimal three days, or when the patient has normal bowel movement
   i. When the patient has normal bowel movement and eats
   j. When the patient does not want to take SDD
   k. Other …*

7. **Indications for SDD are: (multiple choice)**
   a. Elective surgery
   b. Laparoscopic surgery
   c. Esophageal surgery
   d. Gastric surgery
   e. Pancreatic surgery (including Whipple procedure)
   f. Liver resections
   g. All GI-related surgery with anastomosis
   h. Eliminate colostomy
   i. All left sided colonic surgery
   j. Colonic surgery with low anastomosis
   k. Total colectomies with ileo-anal or rectal anastomosis
   l. Immunocompromised patients
   m. Elderly patients (>70 years)
   n. Other …*

Part two (Perioperative antibiotics)

8. **Are there any preoperative, intravenous antibiotic prophylaxis be given to patients who undergo GI-surgery in which (possibly) the abdomen is contaminated?**
   a. Yes
   b. No

9. **When do you start these antibiotics (in more than 50% of the cases)?**
   a. 30-60 minutes prior to surgery
   b. In operation theatre, just before the patient is under narcosis
   c. In operation theatre, even after the patient is under narcosis
   d. In operation theatre, after incision
   e. Other …*
10. Indications for repeating antibiotic prophylaxis are: (multiple choice)
   a. Many bloodloss
   b. Operation > six hours
   c. Spill of bowel contents
   d. Necessity of placement of synthetic material
   e. Other ...

11. Which preoperative, intravenous antibiotics do you administer? (multiple choice)
   a. Cephalosporin, namely Zinacef (Cefuroxime), 1500 mg
   b. Cephalosporin, namely Zinacef (Cefuroxime), 750 mg
   c. Cephalosporin, namely Kefzol (Cephazolin) 1000 mg
   d. Flagyl (Metronidazole) 500 mg
   e. Gentamicin 3-4 mg/kg
   f. Other ...

Part three (Mechanical Bowel Preparation)

12. Do you use mechanical bowel preparation on your surgical ward? (multiple choice)
   a. No
   b. Yes, in laparoscopic colonic surgery
   c. Yes, in open left colonic surgery
   d. Yes, in esophageal resections
   e. Yes, in Whipple procedures
   f. Yes, in transanal endoscopic microsurgery (TEM)
   g. Yes, in other transanal resections
   h. Other ...

13. Do you administer one or more of the following laxatives? (multiple choice)
   a. Clear fluid diet
   b. Clean prep 2 or 4 litres
   c. Bisacodyl®
   d. Phosphoral® 2x45 ml
   e. Enema
   f. Lactulose
   g. Other ...

14. When do you start the laxative (excluding enema)?
   a. Day of admission, one day prior to surgery
   b. More than six hours before surgery
   c. Less than six hours before surgery
   d. Other ...

15. Indications for laxatives are: (indicate which of the laxatives you use: clear fluid diet, Clean prep 2 or 4 litres, Bisacodyl®, Phosphoral® 2x45 ml, enema, or other) (if your hospital does not do the mentioned procedure, indicate “not applicable”)
   a. Esophageal resections
   b. Gastric resections
   c. Liver resections
   d. Pancreatic surgery
   e. Whipple procedure
   f. Short bowel surgery
   g. Open right colonic surgery
   h. Laparoscopic right surgery
   i. Open left colonic surgery (including sigmoid)
   j. Laparoscopic left colonic surgery (including sigmoid)
   k. Open (low) anterior resections
   l. Laparoscopic (low) anterior resections
   m. Transanal endoscopic microsurgery (TEM)
   n. Other transanal resections

* there was space for free text
Selective Decontamination

Among the responding hospitals, 20 hospitals (31.1%) applied SDD exclusively in their ICUs: 2 academic centers (33.3%) and 18 peripheral hospitals (31.0%). Of this group, only 4 hospitals (6.3%) applied SDD in their surgical ward: 2 academic centers (hospitals B and D) and 2 peripheral hospitals (hospitals A and C), of which 1 was a cancer institute (Table 1). In 3 hospitals, hospitals A, B and C, perioperative SDD consists of amphotericin B, polymyxin and tobramycin (Table 2). It is administered orally 4 times daily. The SDD is started 1 or 2 days prior to surgery and is continued until there is normal bowel movement. Hospital D prescribes colistin, amphotericin B and polymyxin, 4 times daily, starting 1 day prior to surgery and continuing until the day of discharge. However, some differences exist between the indications of SDD on the surgical wards of these 4 hospitals. In hospital A perioperative SDD is applied for all GI procedures with anastomosis, while in hospital C perioperative SDD is prescribed for all GI procedures (with or without anastomosis) and when the expected duration of postoperative ventilation is more than 3 days.

### Table 1 | Application of SDD in surgical wards and/or ICU in Dutch academic and peripheral hospitals.

<table>
<thead>
<tr>
<th></th>
<th>SDD exclusively on ICU</th>
<th>SDD on ICU and surgical ward</th>
<th>No SDD on ICU and surgical ward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Academic Hospitals N = 6</td>
<td>2 (33.3)</td>
<td>2 (33.3)</td>
<td>2 (33.3)</td>
</tr>
<tr>
<td>Number of Peripheral Hospitals N = 58</td>
<td>18 (31.0)</td>
<td>2 (3.4)</td>
<td>38 (65.5)</td>
</tr>
<tr>
<td>Total N = 64</td>
<td>20 (31.1)</td>
<td>4 (6.3)</td>
<td>40 (62.5)</td>
</tr>
</tbody>
</table>

SDD = selective decontamination. Figures represent number of hospitals (%).

### Table 2 | Four specific Dutch hospitals applying SDD on surgical wards.

<table>
<thead>
<tr>
<th></th>
<th>Hospital A</th>
<th>Hospital B</th>
<th>Hospital C</th>
<th>Hospital D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of SDD*</td>
<td>Amfotericin B 500 mg Polymyxin B sulfate 100mg Tobramycin 80mg</td>
<td>Amfotericin B 500 mg Polymyxin B sulfate 100mg Tobramycin 80mg</td>
<td>Amfotericin B 500 mg Polymyxin B sulfate 100mg Tobramycin 80mg</td>
<td>Amfotericin B 500 mg Polymyxin B sulfate 100mg Colistin sulfate 100mg</td>
</tr>
<tr>
<td>Start of SDD</td>
<td>2 days prior to surgery</td>
<td>2 days prior to surgery</td>
<td>1 day prior to surgery</td>
<td>1 day prior to surgery</td>
</tr>
<tr>
<td>Frequence of gifts</td>
<td>4 times daily</td>
<td>4 times daily</td>
<td>4 times daily</td>
<td>4 times daily</td>
</tr>
<tr>
<td>Number of gifts</td>
<td>8 before, 12 or more after surgery</td>
<td>8 before, 12 or more after surgery</td>
<td>2 before surgery, treatments after surgery depending on normal bowel passage</td>
<td>2 before surgery, treatments after surgery depending on day of discharge</td>
</tr>
<tr>
<td>Indications for SDD</td>
<td>GI surgery with anastomosis</td>
<td>HIPEC*</td>
<td>GI surgery Expected duration of ventilation &gt; 3 days</td>
<td>Liver transplantations</td>
</tr>
</tbody>
</table>

*Content of SDD in a solution of 10cc. *HIPEC = hyperthermic intraperitoneal chemotherapy.
Hospital B applies SDD primarily in hyperthermic intraperitoneal chemotherapy, while hospital D applies SDD exclusively in liver transplantations.

**Perioperative Intravenous Antibiotics**

All Dutch hospitals prescribe prophylactic intravenous antibiotics in elective GI surgery. Of these hospitals, 59.4% apply the AB approximately 30 min before incision and 40.6% administer later. The main indications for repeating antibiotics during operation were excessive blood loss (50.0%) and long duration of operation (89.1%). Different types of antibiotics were used: in most hospitals a cephalosporin and metronidazole are applied (81.3 and 76.6%; Table 3).

**Mechanical Bowel Preparation**

Among all responding hospitals, 58 (90.6%) still use MBP on their surgical wards. All these hospitals use MBP selectively. Most important indications for using MBP were open or laparoscopic left colonic surgery (including sigmoid resections; 67.2 and 69.0%), open or laparoscopic low anterior resection (96.6 and 74.1%) and trans anal procedures including trans anal endoscopic resection (75.9%). Sixty-five% of the hospitals replied that the time to give MBP was 1 day prior to surgery. Enema and Klean Prep® were the most frequently given laxatives (63.8 and 50.0%; Table 4). The questions about specific indications for applying MBP were frequently left unanswered. Some extensive procedures, such as

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Application of perioperative antibiotic prophylaxis.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timing of first treatment of antibiotics</strong></td>
<td></td>
</tr>
<tr>
<td>30-60 minutes prior to surgery</td>
<td>38 (59.4)</td>
</tr>
<tr>
<td>Prior to anaesthesia</td>
<td>17 (26.6)</td>
</tr>
<tr>
<td>After anaesthesia</td>
<td>9 (14.1)</td>
</tr>
<tr>
<td><strong>Indications for repeating antibiotics during operation</strong></td>
<td></td>
</tr>
<tr>
<td>Excessive bloodloss</td>
<td>57 (89.1)</td>
</tr>
<tr>
<td>Long duration of operation</td>
<td></td>
</tr>
<tr>
<td>Operation &gt; 6 hours</td>
<td>4 (6.3)</td>
</tr>
<tr>
<td>Operation &gt; 4 hours</td>
<td>4 (6.3)</td>
</tr>
<tr>
<td>Operation &gt; 3 hours</td>
<td>13 (20.3)</td>
</tr>
<tr>
<td>Spill of intestinal contents</td>
<td>7 (10.9)</td>
</tr>
<tr>
<td>Need to place a synthetic prosthesis</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Abscess</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Missing data</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td><strong>Types of antibiotics</strong></td>
<td></td>
</tr>
<tr>
<td>Cephalosporin</td>
<td>52 (81.3)</td>
</tr>
<tr>
<td>Zinacef 1500mg</td>
<td>14 (21.9)</td>
</tr>
<tr>
<td>Zinacef 750mg</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Kefzol 1g</td>
<td>36 (56.3)</td>
</tr>
<tr>
<td>Metronidazole (Flagyl 500mg)</td>
<td>49 (76.6)</td>
</tr>
<tr>
<td>Gentamycine 3-4mg/kg</td>
<td>4 (6.3)</td>
</tr>
<tr>
<td>Other regime</td>
<td>10 (15.6)</td>
</tr>
<tr>
<td>Missing data</td>
<td>1 (1.6)</td>
</tr>
</tbody>
</table>

Figures represent number of hospitals (%). *Multiple answers were possible.
esophagectomies, liver resections and pancreatic surgery including pancreaticoduoden-ectomies, are not performed in all hospitals, in contrast to open (extended) left-sided hemicolecotomies. In esophagectomies, gastric resections, liver resections and small bowel surgery, the majority of the Dutch surgical units do not apply MBP (Table 5).

### Table 4

<table>
<thead>
<tr>
<th>Indications for using MBP</th>
<th>Number of hospitals using MBP (n = 58)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparoscopic left colonic surgery</td>
<td>40 (69.0)</td>
</tr>
<tr>
<td>Laparoscopic right colonic surgery</td>
<td>20 (34.5)</td>
</tr>
<tr>
<td>Open left colonic surgery and sigmoidectomy</td>
<td>39 (67.2)</td>
</tr>
<tr>
<td>Open right colonic surgery</td>
<td>24 (41.4)</td>
</tr>
<tr>
<td>Esophagectomy</td>
<td>4 (6.9)</td>
</tr>
<tr>
<td>Gastric resection</td>
<td>14 (24.1)</td>
</tr>
<tr>
<td>Liver resection</td>
<td>3 (5.2)</td>
</tr>
<tr>
<td>Pancreatic surgery including Whipple</td>
<td>6 (10.3)</td>
</tr>
<tr>
<td>Small bowel surgery</td>
<td>13 (22.4)</td>
</tr>
<tr>
<td>Laparoscopic low anterior resection</td>
<td>43 (74.1)</td>
</tr>
<tr>
<td>Open low anterior resection</td>
<td>56 (96.6)</td>
</tr>
<tr>
<td>Transanal procedures including TEM</td>
<td>44 (75.9)</td>
</tr>
</tbody>
</table>

**Timing**

- One day prior to surgery: 39 (67.2)
- > 6 hours prior to surgery: 2 (3.4)
- < 6 hours prior to surgery: 7 (12.1)
- Other: 7 (12.1)
- Unknown: 3 (5.2)

**Type of laxative**

- Clear-fluid diet: 7 (12.1)
- Klean Prep 4L/2L: 29 (50.0)
- Bisacodyl®: 5 (8.6)
- Phosphoral® 2x 45ml: 14 (24.1)
- Enema: 37 (63.8)
- Lactulose: 2 (3.4)
- Unknown: 2 (3.4)

Figures represent number of hospitals (%). MBP = mechanical bowel preparation. TEM = transanal endoscopic microsurgery. *Multiple answers possible.
DISCUSSION

The aim of the present study was to analyse the current application of SDD, the use of preoperative antibiotics and MBP in elective GI surgery in surgical departments in the Netherlands. The response rate on the questionnaire was high and a clear overview of the current application of the above-mentioned prophylactic bowel remedies can be provided. This survey shows that perioperative SDD in elective colorectal surgery is currently applied in only 4 (6.3%) of the Dutch surgical wards and in one third of the ICUs. The wards using SDD also use it in their ICU. SDD was originally introduced into intensive care medicine as an infection prophylaxis regimen to reduce or even eradicate aerobic potentially pathogenic...
microorganisms from the oropharynx to the rectum while leaving the normal anaerobic flora largely undisturbed. Only one study on the use of perioperative SDD with a combination of polymyxin B sulfate, tobramycin and amphotericin B in elective colorectal surgery has been published in full. This retrospective study showed that the use of perioperative SDD in elective colorectal surgery in addition to standard parenteral prophylaxis significantly decreased infectious complications. Dutch guidelines promote the application of perioperative antibiotics within 2 h before incision. In particular, it is recommended to give the antibiotics 30 min before incision to reach the best concentration in the tissue. All Dutch hospitals applied perioperative intravenous antibiotic prophylaxis in elective GI surgery and conform with guidelines (within 2 h). However, only 59.4% of the GI surgeons applied antibiotics approximately 30 min before incision. In 40.6% the antibiotics were given later, that means less than 30 min before incision or after incision. In these patients an optimal level of intravenous antibiotics is not likely to be achieved. A long duration of operation and excessive blood loss were the most frequent indications for repeating antibiotics during surgery for 50.0 and 89.1% of the responding hospitals. Dutch guidelines recommend that short-term, single-dose intravenous prophylaxis is as effective as multiple-dose prophylaxis in most procedures. Indications for repeating the antibiotic treatment during surgery are an operation of more than 3 times the half-life of the applied antibiotic, blood loss of more than 2 litres or the use of extracorporeal circulation. A Cochrane review claims that for intravenous antibiotics, it is accepted that the optimal timing is 1 h before incision, though rigorous determination of this time interval is lacking. There is no need for a second intraoperative dose or any postoperative doses when the antibiotic is being given for prophylaxis alone. Additional dosing may increase the risk of resistant organisms and *Clostridium difficile* colitis. In the present study, most hospitals used a cephalosporin and metronidazole. According to the Cochrane review, antibiotics to be given should cover both aerobic and anaerobic bacteria. If antimicrobial coverage is adequate, the actual type of antibiotic is probably not as important as the timing of administration, timing of cessation and route of administration. Although in a recently published review prophylactic MBP prior to colorectal surgery has not been proven to be valuable for patients, 90.6% of the Dutch hospitals still applied MBP in their surgical wards. It has been used mainly in left colonic surgery including sigmoid resections, low anterior resections and trans anal procedures including trans anal endoscopic microsurgery. The recent literature claims that bowel preparation is not beneficial in elective colonic surgery. Although the current literature does not advise using MBP before surgery, bowel cleansing should be considered when a surgeon needs to identify pathology or when intraoperative colonoscopy might be required. The need for cleansing for laparoscopic surgery is a matter of debate. It has been argued that it is easier to perform laparoscopic surgery if the bowel contains solid matter in order to be able to use gravity to get a better overview. On the other hand, data indicate that bowel preparation is stressful and prolongs postoperative ileus.
CONCLUSION

Perioperative SDD is rarely applied in Dutch surgical wards. Perioperative intravenous antibiotic prophylaxis is given in all Dutch hospitals, but only in 59.4% is it administered on time (i.e. 30 min before incision) and 40.6% later. Although the recent literature does not advise on the use of MBP before surgery, it is still used selectively in 90.6% of the Dutch surgical wards, mainly in open or laparoscopic left colonic surgery (including sigmoid resections).
REFERENCES