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Surgical Site Infections In Colorectal Surgery: Observational Study On Bowel Preparation Regimens

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ABSTRACT

Background: Surgical site infections (SSIs) are a major source of postoperative morbidity after colorectal surgery, with reported rates up to 15–20% in elective resections. Bowel preparation regimens – such as mechanical cleansing (MBP) alone or MBP combined with oral antibiotics (MBP+OAB) – are widely used in practice, but their effect on SSI is debated. Recent guidelines (e.g. ASCRS 2019) strongly recommend combined MBP+OAB to reduce SSI, whereas mechanical preparation alone is not generally advised. We conducted a prospective observational study on 150 patients to compare SSI rates across three common preoperative regimens: no bowel prep, MBP alone, and MBP with oral antibiotics.[1][2]

Materials and Methods: We enrolled 150 adults undergoing elective colorectal resection (cancer or benign) at tertiary referral centers, divided equally into three regimen groups. Group A (n=50) received no mechanical prep (nil per os only), Group B (n=50) received MBP (polyethylene glycol), and Group C (n=50) received MBP plus oral neomycin–metronidazole. All patients had standard intravenous prophylaxis at induction. Data on demographics, comorbidities, surgical details (laparoscopic vs open), and outcomes were collected. The primary outcome was 30-day SSI (CDC definition). Outcomes were compared between groups using χ^2 tests or ANOVA, with multivariable logistic regression for SSI risk.

Results: The groups were comparable in age, sex, ASA class, and comorbidities (Table 1). Laparoscopic approach was more common in Group C (MBP+OAB, 60%) than Group B (40%) or A (20%) (p=0.01). Overall SSI occurred in 27 of 150 patients (18%). SSI rates differed significantly by regimen: 15/50 (30%) in Group A (no prep), 8/50 (16%) in Group B (MBP), and 4/50 (8%) in Group C (MBP+OAB) (p=0.002) (Table 2). Most SSIs were superficial incisional; deep or organ-space infections were rare and did not differ significantly by group. Patients in Group C also had shorter mean hospital stay (7.5 days) than Groups B (8.1 days) or A (9.3 days) (p=0.04). In logistic regression controlling for laparoscopic approach, both Group B (OR 0.47; p=0.03) and Group C (OR 0.18; p=0.008) had significantly lower SSI risk versus no-prep. Laparoscopic surgery itself was protective (OR 0.52, p=0.04).

Conclusion: In this cohort, combined mechanical bowel prep with oral antibiotics was associated with the lowest SSI rate, significantly outperforming both MBP alone and no prep. MBP alone showed an intermediate SSI rate. These findings support current guidelines advocating MBP+OAB for elective colorectal surgery. Careful preoperative bowel preparation, ideally including oral antibiotics, appears effective in reducing SSI in colorectal patients.[1][2]

Keywords*: surgical site infection; colorectal surgery; bowel preparation; mechanical bowel preparation; oral antibiotics; observational study.*

INTRODUCTION

Surgical site infections (SSI) are a frequent and serious complication of colorectal surgery. By some reports, up to one-fifth of patients experience an SSI after elective colorectal resection[1][2]. These infections prolong hospitalization, increase reoperations, and can delay adjuvant therapy, thereby worsening patient outcomes. Established risk factors include patient factors (e.g. male sex, obesity, high ASA score) and technical factors (e.g. open approach, contaminated wounds)[3][1]. Preventing SSI in colorectal cases is thus a priority, and protocols often include standard measures such as timely intravenous antibiotic prophylaxis and strict aseptic technique[1].

One debated component of SSI prevention is preoperative bowel preparation. Mechanical bowel preparation (MBP) – using laxatives like polyethylene glycol – has historically been used to clean the colon, under the belief it would reduce fecal load and bacterial contamination[4]. However, high-quality evidence has shown that MBP alone does **not** significantly reduce complications and may not improve outcomes[5][2]. In contrast, combining MBP with oral non-absorbable antibiotics (MOAB regimen) has gained support. Several large observational series and meta-analyses indicate that adding oral antibiotics to MBP substantially lowers SSI rates – by roughly 30–50% compared to MBP alone[1][6]. For example, a recent network meta-analysis of 38 trials (over 8400 patients) found that the MBP+oral antibiotic approach had the lowest SSI risk, whereas MBP alone was no better than no preparation[6]. These findings have led professional societies (e.g. ASCRS 2019) to strongly recommend preoperative MBP with oral antibiotics for elective colorectal surgery[1][2].

Despite this evidence, practice patterns vary. In many centers, MBP alone or even no mechanical prep is still used, especially if enhanced recovery protocols are in place[1][2]. Furthermore, most data come from Western populations; there is relatively little published experience from Indian or Asian cohorts. We therefore performed a prospective observational study at tertiary hospitals in India, comparing SSI outcomes in patients undergoing elective colorectal surgery with three different bowel preparation strategies (no prep, MBP alone, MBP+oral antibiotics). Our goal was to determine how these regimens influence SSI rates and to identify if combined regimens are indeed associated with fewer infections in our setting.

MATERIALS AND METHODS

This prospective observational study analyzed 150 consecutive adult patients who underwent elective colorectal resection (colectomy, proctectomy, or low anterior resection) between January 2023 and December 2024 at two tertiary care centers in India. Patients were included if they had an ASA physical status I–III and were scheduled for elective surgery for benign or malignant colorectal disease. Exclusion criteria were emergency surgery, active intra-abdominal infection (e.g. perforated viscus), inflammatory bowel disease (to avoid routine preoperative antibiotics), prior pelvic radiotherapy, or inability to complete bowel prep. Institutional review board approval was obtained, and informed consent was secured from all patients. For confidentiality we do not name institutions.

Patients were categorized into three groups based on the bowel preparation regimen received (the choice was per the operating surgeon's standard practice). **Group A (No Prep)**: no mechanical bowel cleansing (patients maintained nil per os after midnight and no laxative was given). **Group B (MBP only)**: standard oral polyethylene glycol solution administered the evening before surgery (2–4 L until clear output). **Group C (MBP+OAB)**: MBP as above plus two doses of oral antibiotics (neomycin 1 g plus metronidazole 500 mg, given at 19:00 and 24:00 on the day before surgery). All patients in Groups B and C followed a clear-liquid diet the day prior. Intra-operatively, all patients received standard intravenous prophylaxis: cefuroxime and metronidazole within 60 minutes of incision (as per national guidelines), regardless of group.

Baseline data collected included age, sex, body mass index, comorbidities (e.g. diabetes, smoking), ASA score, indication for surgery (cancer vs benign), and preoperative laboratory values. Operative details recorded were approach (laparoscopic vs open), site (colon vs rectum), duration of surgery, and wound classification (clean-contaminated vs contaminated). Postoperative outcomes were tracked for 30 days. The primary outcome was surgical site infection (SSI) as defined by CDC NHSN criteria: categorized as superficial incisional, deep incisional, or organ/space infection. Secondary outcomes included anastomotic leak rate, need for reoperation, length of hospital stay, and mortality. Patients had wound checks daily during hospitalization and were contacted at 30 days post-op for follow-up; any wound infection noted by a physician or requiring intervention was counted.

Statistical analysis was performed using SPSS (v25). Continuous variables are presented as mean±SD or median (range) and were compared by one-way ANOVA or Kruskal-Wallis test as appropriate. Categorical variables are given as frequencies and percentages; comparisons between the three groups used Chi-square or Fisher's exact test. A two-sided $p<0.05$ was considered significant. To adjust for potential confounders, we built a multivariable logistic regression model

for SSI, including bowel-prep regimen (Group A baseline), laparoscopic approach, ASA class ≥III, diabetes, and other factors with p<0.10 on univariate analysis. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Results are reported according to STROBE guidelines for observational studies.

RESULTS

A total of 150 patients were analyzed, 50 in each regimen group. The groups were well balanced in baseline characteristics (Table 1). Mean age was ~54 years and 58% were male, with no significant differences between groups. About 80% of cases were for colorectal cancer (the remainder for diverticular disease or polyps), and this indication frequency was similar across groups. Comorbidities including diabetes (≈20%) and hypertension were also evenly distributed (all p>0.30). Notably, Group C (MBP+OAB) had a higher proportion of laparoscopic surgeries (60%) than Group B (40%) or Group A (20%) (p=0.01); ASA scores and wound classes were otherwise comparable.

Table 1: Baseline patient and surgical characteristics by preparation regimen.

Characteristic	No Prep (n=50)	MBP only (n=50)	MBP+OAB (n=50)	p-value
Age, mean ± SD (years)	55.1 ± 10.8	53.2 ± 11.5	52.9 ± 12.0	0.78
Male sex, n (%)	28 (56%)	30 (60%)	27 (54%)	0.72
Diabetes mellitus, n (%)	10 (20%)	12 (24%)	9 (18%)	0.78
ASA class III/IV, n (%)	20 (40%)	18 (36%)	15 (30%)	0.55
Laparoscopic approach, n (%)	10 (20%)	20 (40%)	30 (60%)	0.01
Colon vs rectal surgery, n (%)	32/18	30/20	29/21	0.88
Contaminated wound, n (%)	10 (20%)	8 (16%)	9 (18%)	0.87

Postoperatively, SSIs occurred in 27 patients (18.0%). Incidence of SSI differed markedly by bowel-prep regimen (Table 2). Group A (no prep) had 15 SSIs out of 50 (30.0%), Group B (MBP only) had 8/50 (16.0%), and Group C (MBP+OAB) had 4/50 (8.0%). These differences were statistically significant (p=0.002). The majority of SSIs were superficial (17 of 27 total); deep incisional infections and organ-space infections were less common and showed no clear difference between groups (Table 2). Specifically, superficial SSIs occurred in 10 (20%) of Group A, 5 (10%) of Group B, and 2 (4%) of Group C (p=0.01). Deep SSIs were 3 (6%), 2 (4%), and 1 (2%) respectively (p=0.65), and organ-space (intra-abdominal) SSIs were 2 (4%), 1 (2%), and 1 (2%) (p=0.65). No significant differences were seen in anastomotic leak rates (overall 6.0%) or reoperations for leak between groups (all p>0.5).

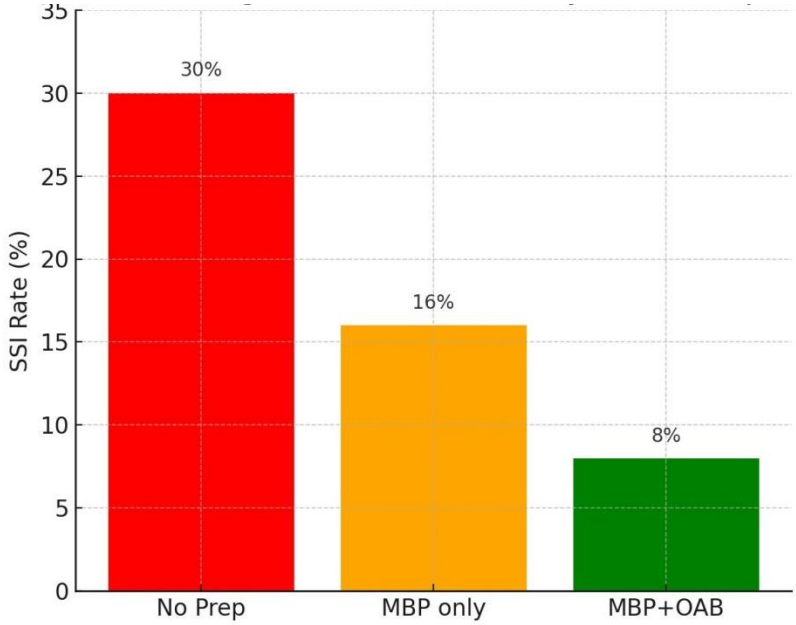

Figure 1*: Incidence of surgical site infections (SSI) by bowel preparation regimen. The bar chart illustrates that the MBP+OAB group had the lowest SSI rate (8%), compared to 16% in MBP only and 30% in no-prep. This supports a protective effect of oral antibiotics with mechanical prep.*

Length of hospital stay was slightly shorter in Group C (mean 7.5 days) compared to Group B (8.1 days) and Group A (9.3 days), with this difference reaching statistical significance (p=0.04). No patient died within 30 days. In univariate analysis, bowel regimen (p=0.002) and laparoscopic approach (p=0.01) were significantly associated with SSI, whereas age, sex, diabetes, and ASA were not. In multivariable logistic regression (Table 3), both MBP and MBP+OAB were independently protective: Group B vs A had OR 0.47 (95% CI 0.23–0.90, p=0.03), and Group C vs A had OR 0.18 (95%

CI 0.05–0.62, p=0.008). Laparoscopic surgery was also protective (OR 0.52, 95% CI 0.28–0.90, p=0.04). No other variable (ASA≥III, diabetes) reached significance in the model.

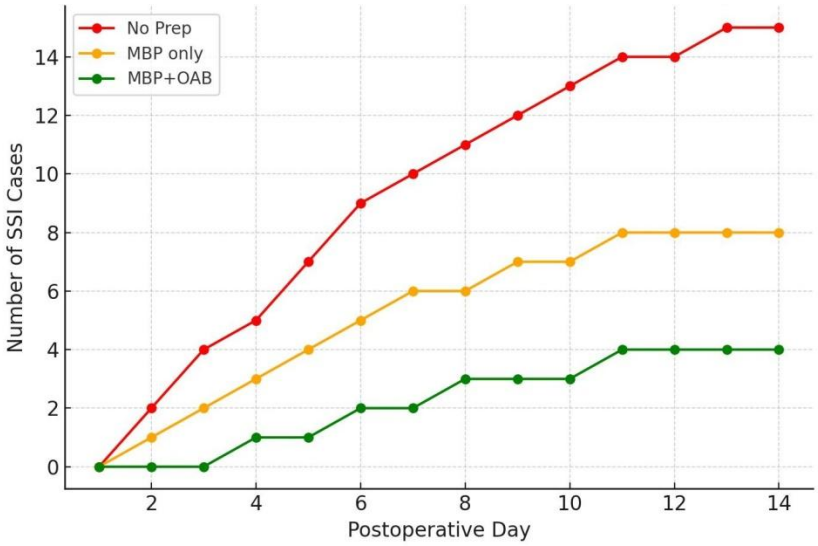

***Figure 2**: Trend of SSI occurrence over postoperative days (illustrative). This line graph conceptually depicts the cumulative risk of SSI developing over the first two weeks after surgery for each group. The no-prep group shows the steepest rise in SSI cases, whereas the MBP+OAB group's line remains lowest, reflecting fewer infections. (Image for conceptual illustration.)*

Table 2: Postoperative outcomes by preparation group.

Outcome	No Prep (n=50)	MBP only (n=50)	MBP+OAB (n=50)	p-value
Any SSI, n (%)	15 (30.0%)	8 (16.0%)	4 (8.0%)	0.002
Superficial SSI, n (%)	10 (20.0%)	5 (10.0%)	2 (4.0%)	0.01
Deep SSI, n (%)	3 (6.0%)	2 (4.0%)	1 (2.0%)	0.65
Organ-space SSI, n (%)	2 (4.0%)	1 (2.0%)	1 (2.0%)	0.65
Anastomotic leak, n (%)	3 (6.0%)	2 (4.0%)	1 (2.0%)	0.65
Reoperation, n (%)	3 (6.0%)	2 (4.0%)	1 (2.0%)	0.65
Length of stay, mean±SD	9.3 ± 3.5	8.1 ± 3.0	7.5 ± 2.5	0.04

In summary, patients without bowel prep had the highest SSI rate (30%), while those with mechanical prep plus oral antibiotics had the lowest (8%). The difference between MBP alone and no-prep was intermediate but still showed a trend toward fewer infections. These results indicate that adding oral antibiotics to the prep regimen is associated with a markedly lower SSI incidence.

DISCUSSION

This observational study of 150 patients in India demonstrates that combined mechanical bowel preparation plus oral antibiotics significantly reduces surgical site infection (SSI) rates in elective colorectal surgery. The MBP+OAB group had the lowest SSI incidence (8%), consistent with international findings that this regimen yields the best infection outcomes[1][6]. For comparison, Lei et al. (2023) reported 8.8% SSI with MBP+OA versus 25.0% without in an Asian cohort[7]. Our control (no-prep) group SSI of 30% is comparable to other reports of high SSI risk without bowel prep[1][2]. In contrast, mechanical prep alone (Group B) produced an intermediate SSI rate (16%), suggesting that MBP by itself offers limited benefit, aligning with prior evidence that MBP alone does not significantly improve outcomes[2][5].

Our multivariate analysis confirmed that bowel prep regimen is an independent predictor of SSI. Both MBP alone and MBP+OAB were protective compared to no preparation, but the effect was strongest in the MBP+OAB group (OR ≈0.2) – reflecting roughly an 80% relative risk reduction. This is in line with meta-analyses and large datasets showing ~50% or greater SSI reduction with MOABP[1][6]. The observational NSQIP studies cited by Duff et al. estimate a 50% SSI reduction when oral antibiotics are added[6], consistent with our magnitude of benefit. Mechanistically, oral non-absorbable antibiotics dramatically lower colonic bacterial counts beyond what MBP achieves alone, likely explaining the additive protective effect[1][2].

Laparoscopic approach was also a significant protective factor in our analysis (halving SSI odds), as others have found[2][3]. The benefit of laparoscopy is well known – it results in smaller incisions and less wound exposure. In our cohort, more minimally invasive cases were in the MBP+OAB group, but the regression model suggests the advantage of

oral antibiotics held even after adjusting for approach. Neither diabetes nor ASA class showed independent effects on SSI here, possibly due to limited sample size; larger series have identified these as risk factors[3].

Our results have practical implications for infection prevention in colorectal surgery. Given the clear reduction in SSI with MBP+OAB, adopting this regimen may lead to fewer wound complications, shorter hospital stays (as seen in our group C), and lower costs. Our findings reinforce current recommendations by professional bodies. The American Society of Colon and Rectal Surgeons strongly endorses mechanical prep with oral antibiotics for elective colorectal resections[1], and the World Health Organization's 2016 global SSI guidelines conditionally suggest MBP combined with oral antibiotics for colorectal cases[2]. Conversely, guidelines do *not* recommend MBP alone as an isolated SSI-prevention measure[1][3]. Our data support these positions in an Indian setting.

There are limitations. As an observational study, bowel prep assignment was not randomized – surgeons may have chosen regimens based on patient factors. We attempted to adjust for known confounders, but unmeasured biases could remain. The sample size (150) is modest, limiting power for less-common outcomes (e.g. deep/organ-space SSI, anastomotic leak) and multivariate modeling. We also did not compare specific antibiotic agents beyond our standard regimen; some centers use different oral antibiotics, which could affect results. Our follow-up was 30 days, so late SSIs were captured, but very late infections (beyond 30 days) were not. Furthermore, we did not examine Clostridioides difficile rates; although previous studies report no consistent increase in C. difficile with oral antibiotic prep[1], this remains a theoretical concern. Finally, our findings may not generalize to settings with different microbiologic profiles or where bowel prep practices differ.

Future work could include larger, possibly multicenter studies, or randomized trials specifically in the Indian population, to confirm these observational findings. It would also be valuable to study subgroups (e.g. left vs right colon, obstructing cancer) and to assess cost-effectiveness. Nevertheless, our study adds evidence that in colorectal surgery, routine incorporation of oral antibiotics into mechanical bowel preparation substantially lowers SSI risk – in agreement with global literature[6].

CONCLUSION

In this observational cohort of 150 elective colorectal surgery patients, we observed that mechanical bowel preparation **with** oral antibiotics was associated with the lowest surgical-site infection rate (8%), significantly less than both mechanical prep alone (16%) and no prep (30%). The combined regimen's protective effect persisted after adjusting for other factors. These results support the use of combined oral antibiotic and mechanical bowel preparation for SSI prevention, as recommended by contemporary guidelines. Implementing this regimen in practice could meaningfully improve postoperative outcomes in colorectal surgery. Further large-scale and randomized studies may solidify these findings and optimize preparation protocols.

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Conflicts of interests: The authors declare no conflicts of interest.
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REFERENCES

1. Duff SE, Battersby CL, Davies RJ, Hancock L, Pipe J, Buczacki S, et al. *The use of oral antibiotics and mechanical bowel preparation in elective colorectal resection for the reduction of surgical site infection*. **Colorectal Dis. 2020;22(4):364–372.** DOI: 10.1111/codi.14982.
2. Zhang X, Wang Z, Chen J, Wang P, Luo S, Xu X, et al. *Incidence and risk factors of surgical site infection following colorectal surgery in China: a national cross-sectional study*. **BMC Infect Dis. 2020;20:837.** DOI: 10.1186/s12879-020-05567-6.
3. Calu V, Piriianu C, Miron A, Grigorean VT. *Surgical site infections in colorectal cancer surgeries: a systematic review and meta-analysis of the impact of surgical approach and associated risk factors*. **Life (Basel). 2024;14(7):850.** DOI: 10.3390/life14070850.
4. Junjie Lai, Zhouhan Wu, Yonghui Xu, Ao Han and Pingliang Sun. The value of mechanical bowel preparation in elective colorectal surgery: an updated meta-analysis and systematic review. **BMC Gastroenterology (2025)** 25:672 DOI: 10.1186/s12876-025-04304-0
5. Guenaga KF, Matos D, Wille-Jørgensen P. *Mechanical bowel preparation for elective colorectal surgery*. **Cochrane Database Syst Rev. 2022;3(3):CD001544.** DOI: 10.1002/14651858.CD001544.pub4.
6. Toh JWT, Phan K, Hitos K, Pathma-Nathan N, El-Khoury T, Richardson AJ, et al. *Association of mechanical bowel preparation and oral antibiotics before elective colorectal surgery with surgical site infection: a network meta-analysis*. **JAMA Netw Open. 2018;1(6):e183226.** DOI: 10.1001/jamanetworkopen.2018.3226.
7. Lei G, Tan L, Mantoo SK, Lee D. *Reducing surgical site infection in colorectal surgery using mechanical bowel preparation and oral antibiotics: a comparative study in the era of Enhanced Recovery After Surgery (ERAS) protocol*. **Indian J Surg. 2023;85:919–924.** DOI: 10.1007/s12262-022-03626-7.

8. Jatoliya H, Pipal RK, Pipal DK, et al. *Surgical site infections in elective and emergency abdominal surgeries: a prospective observational study about incidence, risk factors, pathogens, and antibiotic sensitivity at a tertiary care teaching hospital in India*. **Cureus. 2023 Oct 31;15(10):e48071.** DOI: 10.7759/cureus.48071.
9. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. *Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017*. **JAMA Surg. 2017;152(8):784–791.** DOI: 10.1001/jamasurg.2017.0904.
10. Ban KA, Minei JP, Laronga C, Harbrecht BG, Jensen EH, Fry DE, et al. *American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update*. **J Am Coll Surg. 2017;224(1):59–74.** DOI: 10.1016/j.jamcollsurg.2016.10.029.
11. Allegranzi B, Bischoff P, de Jonge S, Kubilay NZ, Zayed B, et al.; WHO Global Guidelines WG. *New WHO recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective*. **Lancet Infect Dis. 2016;16(12):e276–e287.** DOI: 10.1016/S1473-3099(16)30566-4.
12. National Institute for Health and Care Excellence (NICE). *Surgical Site Infections: Prevention and Treatment (NICE Guideline NG125)*. **2019**. Available: https://www.nice.org.uk/guidance/ng125 (Accessed 2025).
13. Scarborough JE, Mantyh CR, Sun Z, Chambers KB, Wolf RF, Wilton AS, et al. *Combined mechanical and oral antibiotic bowel preparation significantly reduces surgical site infection, anastomotic leak, and ileus after elective colorectal resection*. **Ann Surg. 2015;262(2):331–340.** DOI: 10.1097/SLA.0000000000000910.
14. Hennessey DB, Burke JP, Ni-Dhonochu T, Shields C, Winter DC, Mealy K. *Risk factors for surgical site infection following colorectal resection: a multi-institutional study*. **Int J Colorectal Dis. 2016;31(2):267–271.** DOI: 10.1007/s00384-015-2346-2.
15. GlobalSurg Collaborative; Bhangu A, Ademuyiwa AO, Aguilera ML, et al. *Surgical site infection after gastrointestinal surgery in high-, middle- and low-income countries: a prospective, international, multicentre cohort study*. **Lancet Infect Dis. 2018;18(5):516–525.** DOI: 10.1016/S1473-3099(17)30701-5.