An international assessment of surgeon practices in abdominal wound closure and surgical site infection prevention by the European Society for Coloproctology

2021 European Society of Coloproctology (ESCP) collaborating group

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ORIGINAL ARTICLE

An international assessment of surgeon practices in abdominal wound closure and surgical site infection prevention by the European Society for Coloproctology

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Abstract

Aim: The burden of abdominal wound failure can be profound. Recent clinical guidelines have highlighted the heterogeneity of laparotomy closure techniques. The aim of this study was to investigate current midline closure techniques and practices for prevention of surgical site infection (SSI).

Method: An online survey was distributed in 2021 among the membership of the European Society of Coloproctology and its partner societies. Surgeons were asked to provide information on how they would close the abdominal wall in three specific clinical scenarios and on SSI prevention practices.

Results: A total of 561 consultants and trainee surgeons participated in the survey, mainly from Europe ($n = 375$, 66.8%). Of these, 60.6% identified themselves as colorectal surgeons and 39.4% as general surgeons. The majority used polydioxanone for fascial closure, with small bite techniques predominating in clean-contaminated cases (74.5%, $n = 418$). No significant differences were found between consultants and trainee surgeons. For SSI prevention, more surgeons preferred the use of mechanical bowel preparation (MBP) alone over MBP and oral antibiotics combined. Most surgeons preferred 2% alcoholic chlorhexidine (68.4%) or aqueous povidone-iodine (61.1%) for skin preparation. The majority did not use triclosan-coated sutures (73.3%) or preoperative warming of the wound site (78.5%), irrespective of level of training or European/non-European practice.

Conclusion: Abdominal wound closure technique and SSI prevention strategies vary widely between surgeons. There is little evidence of a risk-stratified approach to wound

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closure materials or techniques, with most surgeons using the same strategy for all patient scenarios. Harmonization of practice and the limitation of outlying techniques might result in better outcomes for patients and provide a stable platform for the introduction and evaluation of further potential improvements.

KEYWORDS
abdominal wound, abdominal wound dehiscence, colorectal, fascial closure, incisional hernia, surgical site infection

INTRODUCTION

Wound complications are common causes of both early and late morbidity following abdominal surgery [1]. Despite increased focus, surgical site infection (SSI) remains the second most common type of healthcare-related infection and among the most preventable hospital-acquired complications [2]. In a setting of limited resources, SSI is the leading cause of infection in the general patient population. It also affects over 65% of surgical patients and frequency rates are up to nine times higher than in developed countries [3]. The additional costs to a healthcare system are profound, especially if both direct costs (hospital costs) and indirect costs (sick leave) are calculated [4].

Failure of surgical wound healing can be largely attributed to mechanical failure or to patient-related issues, and can result in SSI, dehiscence and/or incisional hernia. SSI is especially concerning after colorectal surgery, with rates around 24%; and up to 31.8% of colorectal patients develop incisional hernia 2 years after standard mass closure [5, 6]. SSI and incisional hernia have multiple causes; well-known risk factors include obesity, contamination grade, diabetes, operating time, American Society of Anesthesiologists score >3 and massive perioperative blood transfusion [7, 8].

Prevention of SSI and wound dehiscence is paramount to minimizing morbidity. Various strategies have been postulated to mitigate risk, including alternative antiseptic skin preparations [9, 10] prophylactic use of antimicrobials, varying closure techniques [11, 12] and other adjuncts (negative-pressure wound dressings, hyperbaric oxygen therapy, high-dose multivitamins etc.) [13]. Despite numerous studies, there remains no clear international consensus on 'best' practice.

Currently, The European Hernia Society recommends a continuous suture with a slowly absorbable monofilament and small bite technique with a suture-to-wound length ratio of at least 4:1 [14]. However, in clinical practice, implementation of this recommendation has not been widespread [15]. Additionally, others advocate a combination of mechanical bowel preparation (MBP) and oral antibiotics to reduce SSI and incisional hernia rates [11], but less than 10% of European surgeons routinely use preoperative oral antibiotics and MBP [16].

Despite these recommendations, the incidence of both SSI and incisional hernia remain unacceptably high and complete prevention seems an unattainable goal. Heterogeneity in clinical practice means that any large-scale study would present difficulty in control of confounders without better understanding of current variations in practice. Therefore, the aim of this study was to investigate current practice and variability in abdominal wound closure strategies at a surgeon level.

What does this paper add to the literature?

survey of general and colorectal surgeons from different backgrounds demonstrates that a broad spectrum of practice is present in abdominal wound closure and surgical site infection prevention techniques. This benchmark study will form the basis for future interventional clinical multicentre studies with the goal of improving the outcomes of abdominal surgery patients.

METHOD

Design

A cross-sectional survey was designed to capture individual surgeons' opinions and practices of abdominal wound closure and SSI prevention strategies.

Informed consent process

All participants voluntarily participated in this closed online survey in English. No incentives were offered, and institutional review board permission was not required.

Development, pretesting and design

Study data were collected and managed using REDCap (Research Electronic Data Capture) tools hosted at the University of Birmingham, United Kingdom [17, 18]. Study-specific databases were created using data dictionaries provided by the research team. Once consensus was reached by the research team on the entire data collection case report form package, the application was moved to production status for study initiation [17, 18]. The survey was constructed around three different patient scenarios that were expected to highlight differences in stratification of clinical decision making by

surgeons. Scenarios were developed and ratified by the study design team during several online meetings. In addition, surgeons' daily clinical practice of SSI prevention strategies was investigated using a list of 18 specific interventions. Usability and technical functionality of the electronic questionnaire were tested by members of the European Society of Coloproctology (ESCP) Research Committee before dissemination. Survey items were not randomized or alternated. Adaptive questioning was used for a limited number of questions to reduce complexity (e.g. type of suture or needle size). In the final online format, all 44 questions were distributed on one page without a review step before submission. All questions were marked as mandatory, and the survey could only be submitted once all questions were answered. Once submitted, there was no opportunity to change answers.

Recruitment process, sample description and survey administration

A survey announcement with a link to the REDCap website was circulated by email to European Society of Coloproctology members, CovidSurg Colorectal collaborators and Safe-anastomosis Programme in Colorectal Surgery (EAGLE) collaborators in June 2021 and to the national coloproctology societies of Hong Kong, Japan, Malaysia, Singapore South Korea, Taiwan and Thailand. Only individuals who received the email with the survey link could voluntarily access the questionnaire (see survey announcement in Appendix 1). The website was not password-protected. The survey was in English and remained open from 15 June 2021 to 17 August 2021. Reminder emails were sent on 7 July and 30 July 2021.

Survey

After completion of baseline demographics, respondents were given three clinical scenarios:

Scenario 1: A 70-year-old man with a body mass index (BMI) of 35 kg/m^2 undergoes an emergency laparotomy for perforated sigmoid diverticulitis. A Hartmann's procedure is performed through a 25 cm midline wound.

Scenario 2: A 66-year-old woman with a BMI of 22 kg/m^2 undergoes laparoscopic right hemicolectomy for a small caecal cancer. The specimen is retrieved via an 8 cm midline periumbilical wound.

Scenario 3: A 35-year-old with a history of four previous open bowel resections for Crohn's disease undergoes a fifth small bowel resection for Crohn's via a 25 cm midline wound.

For each scenario, respondents were asked questions on how they would close the abdominal incision. This involved, but was not limited to, type of closure (suture/needle combination, devices or leaving part of the wound open) and method of closure (large bites, small bites closure technique). In the second part of the survey, respondents rated their usage frequency of a series of common SSI prevention strategies for a patient undergoing an elective colorectal resection (see Appendix 2). Response options were: Never, Rarely, Sometimes, Often or Always. For comparisons, Never and Rarely responses were combined as were Often and Always responses, while responses of Sometimes were reported alone. MBP practices were presented as two options: MBP alone and MBP combined with oral antibiotics. Respondents rated each option independently, which could result in overlap. Five skin preparation solutions were presented and rated independently: 2% or 0.5% chlorhexidine gluconate (CHG) in alcohol, aqueous CHG, aqueous povidone and povidone in alcohol.

Data analysis and reporting

Only respondents who completed the survey were considered eligible for the analysis. Study reporting was planned according to The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) checklist [19]. Considering the study design and risk of selection bias, only descriptive analyses were planned for and differences between European and non-European countries and between consultants and trainee surgeons were explored with chi-square and Fisher's exact tests using SPSS 25.0 (IBM SPSS Statistics for Windows, version 25.0, Armonk, NY: IBM Corp.). *p*-values below 0.05 were considered statistically significant.

RESULTS

A total of 561 participants completed the survey, 417/561 respondents left email addresses. Of these, two-thirds were from Europe ($n = 375$, 66.8%) with the remaining being located across the globe (Figure 1).

Four hundred and seventy three (84.3%) participants were consultants and 88 (15.7%) were trainee surgeons. Most participants ($n = 381$, 67.9%) were from university or tertiary care hospitals. The rest ($n = 180$, 32.1%) were from the regional or district general hospitals. Regarding their speciality, 340 (60.6%) identified themselves as colorectal surgeons and 221 (39.4%) as general surgeons.

Abdominal wound closure

In all three scenarios (scenario 1 faecal peritonitis, scenario 2 right hemicolectomy for caecal cancer and scenario 3 repeat laparotomy for Crohn's disease), most of the surgeons stated they would use continuous suture technique (74%, 77.2% and 66.3%, respectively), small bites (59.5%, 74.5% and 58.6%) and polydioxanone as a fascial closure material (67.6%, 66.7% and 64.2%) (see Table 1).

Polyglactin sutures (e.g. VicrylTM, Polysorb™) would be used by 62 (11.1%), 92 (16.4%) and 76 (13.5%) of surgeons and barbed sutures (e.g. V-loc™, Stratafix™) by 9 (1.6%), 17 (3%) and 8 (1.4%) surgeons, respectively, for the three case scenarios. Regarding suture weight, in all three case scenarios most of the surgeons preferred

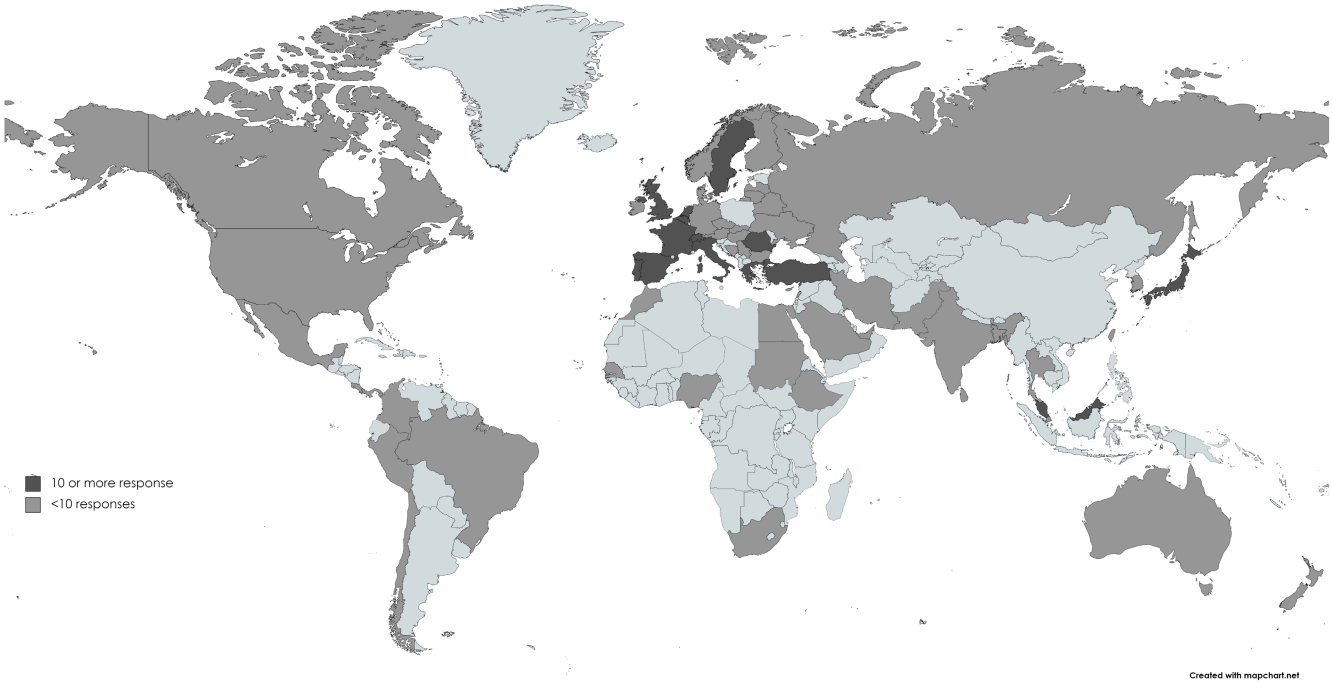

FIGURE 1 Overview of global study participation.

1, followed by 0, and 2/0 to close the fascial layer. Most opposed subcutaneous closure (73.1%, 70.9% and 71.8%). Nearly all respondents would close the skin in all scenarios (91.4%, 97.3% and 97.9%), preferably with skin staples (57%) for scenario 1 and sutures (57.2%) for scenario 2. There was an equal response regarding skin staples (47.2%) and sutures (46.7%) to close the skin for scenario 3.

Table 1 demonstrates the responses on surgeon closure technique for the abdominal incision in each scenario.

Differences in responsiveness to abdominal incision closure techniques between Europeans and non-Europeans, and between consultants and trainee surgeons

Regarding suture material, in all scenarios European surgeons preferred polydioxanone (e.g. PDS, Maxon) significantly more often (all $p < 0.001$) than non-European surgeons (73.1% vs. 56.5%, 72.8% vs. 54.3% and 69.1% vs. 54.3%) to close the fascia. On the other hand, non-European counterparts had significantly (see Tables S1–S3 for *p*-values) greater preferences for nylon (15.1% vs. 7.5%, 9.1% vs. 4% and 12.4% vs. 6.7%), polyglactin (17.2% vs. 8%, 24.2% vs. 12.5% and 19.9% vs. 10.4%) or polypropylene (9.2% vs. 4.8%, 9.1% vs. 4.5% and 12.4% vs. 6.1%) for the three respective scenarios.

For fascial closure technique, European surgeons were significantly more in favour of the small bites technique than non-Europeans (63.5% vs. 51.6%, 78.9% vs. 66.1% and 61.6% vs. 52.7%) and continuous instead of interrupted stitches (84.8% vs. 52.2%, 87.7% vs. 55.9% and 76.3% vs. 46.2%). Only seven European countries provided more than 20 respondents.

There were no significant differences in response for subcutaneous closure in both groups, but in terms of skin closure there were considerable differences between European and non-European surgeons. Significantly more European surgeons were in favour of skin closure (94.7% vs. 84.9%, 99.5% vs. 93% and 99.5% vs. 94.6%; all $p < 0.001$) in all scenarios. Significantly more European surgeons would use skin staples (67.2% vs. 36.6%, 40.8% vs. 24.2%; both $p < 0.001$) rather than suture material (26.9% vs. 47.3%, $p < 0.001$; 53.3% vs. 65.1%, $p = 0.008$) to close the skin for faecal peritonitis and right hemicolectomy for caecal cancer cases, respectively. For scenario 3 of repeat laparotomy for Crohn's disease their response was the opposite. Significantly more non-European surgeons would use skin staples (53.6% vs. 34.4%, $p < 0.001$) rather than suture skin closure (42.1% vs. 55.9%, $p = 0.002$).

The survey did not reveal significant differences in abdominal wound closure between consultants and trainee surgeons (Tables S1–S3).

SSI prevention strategies

Usage frequency data in these three categories are presented graphically in Figures 2–5. For MBP alone, more responses were Often/Always (45.45%) versus Rarely/Never (39.8%). For MBP with oral antibiotics, most responses were Rarely/Never (51%) versus Often/Always (37.3%) (see Figure 2).

The most frequently used skin preparation solution was 2% alcohol CHG (47.9% often/always). All other solutions were rated as Never/Rarely used more than 50% of the time (range 55.5%–76.6%) (see Figure 3).

TABLE 1 Responses regarding abdominal incision closure technique per clinical scenario.

	Scenario 1 (faecal peritonitis), *n* (%)	Scenario 2 (right hemicolectomy), *n* (%)	Scenario 3 (Crohn's repeat laparotomy), *n* (%)
Fascial closure material			
Barbed suture (e.g. V-Loc, Stratafix)	9 (1.6)	17 (3)	8 (1.4)
Nylon (e.g. Ethilon, Monosof)	56 (10)	32 (5.7)	48 (8.6)
Other (e.g. Monomax)	14 (2.5)	9 (1.6)	14 (2.5)
Polydioxanone (e.g. PDS, Maxon)	379 (67.6)	374 (66.7)	360 (64.2)
Polyester (e.g. Ethibond, TiCron)	6 (1.1)	3 (0.5)	9 (1.6)
Polyglactin (e.g. Vicryl, Polysorb)	62 (11.1)	92 (16.4)	76 (13.5)
Polypropylene (e.g. Prolene, Surgipro)	35 (6.2)	34 (6.1)	46 (8.2)
Fascial closure technique			
Large bites of all abdominal wall layers	227 (40.5)	142 (25.3)	232 (41.4)
Small bites	334 (59.5)	418 (74.5)	329 (58.6)
all layers of the abdominal wall	190 (33.9)	217 (39)	185 (33)
anterior sheath only	140 (25)	192 (34.9)	139 (24.8)
Continuous	415 (74)	433 (77.2)	372 (66.3)
Interrupted	139 (24.8)	126 (22.5)	182 (32.4)
Other	7 (1.2)	2 (0.4)	7 (1.2)
Suture weight			
0	157 (28.0)	183 (32.6)	167 (29.8)
1	321 (57.2)	243 (43.3)	301 (53.7)
2/0	70 (12.5)	126 (22.5)	82 (14.6)
Other	13 (2.3)	9 (1.6)	11 (2.0)
Subcutaneous closure			
No	410 (73.1)	398 (70.9)	403 (71.8)
Yes	151 (26.9)	163 (29.1)	157 (28)
Polydioxanone (e.g. PDS, Maxon)	18 (3.2)	20 (3.6)	15 (2.7)
Polyglactin 910 (e.g. Vicryl, Polysorb)	126 (22.5)	134 (23.9)	136 (24.2)
Other	7 (1.2)	8 (1.4)	6 (1.1)
Continuous	27 (4.8)	45 (8)	36 (6.4)
Interrupted	123 (21.9)	118 (21)	121 (21.6)
Skin closure			
No	47 (8.4)	15 (2.7)	12 (2.1)
Yes	513 (91.4)	546 (97.3)	549 (97.9)
Glue/topical skin adhesive	3 (0.5)	20 (3.6)	13 (2.3)
Skin staples	320 (57)	198 (35.3)	265 (47.2)
Suture	189 (33.7)	321 (57.2)	262 (46.7)
Polypropylene (Prolene, Surgipro)	57 (10.2)	40 (7.1)	61 (10.9)
Poliglecaprone 25 (Monocryl, Biosyn)	42 (7.5)	159 (28.3)	96 (17.1)
Polydioxanone (PDS, Maxon)	26 (4.6)	52 (9.3)	42 (7.5)
Polyglactin 910 (Vicryl, Polysorb)	9 (1.6)	52 (9.3)	21 (3.7)
Other	55 (9.8)	30 (5.3)	36 (6.4)

Out of the 11 other SSI prevention interventions, six were commonly used with more than 50% Often/Always ratings (range 54.9%–78.6%) and five interventions were not commonly used with Rarely/Never ratings greater than 50% (range 62.5%–78.4%) (see Figures 4 and 5, respectively).

The most used interventions based on frequency of Often/Always ratings were clippers for hair removal (78.6%), glove change (76.3%), social cleaning (73.3%), use of wound protectors (73.3%), wound washout (70.7%) and change of instruments (54.9%). The least commonly used interventions based on

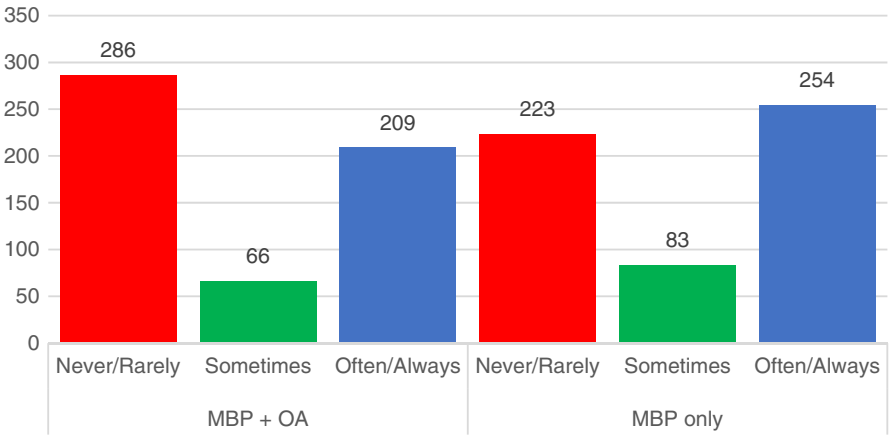

FIGURE 2 Bowel preparation practices (MBP, mechanical bowel preparation; OA, oral antibiotics).

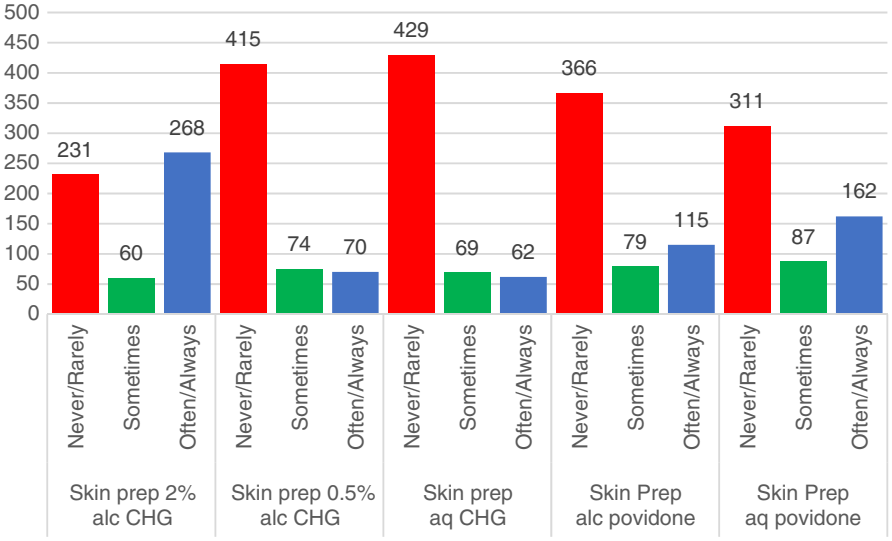

FIGURE 3 Use of skin preparation solution (alc, alcoholic; aq, aqueous; CHG, chlorhexidine gluconate).

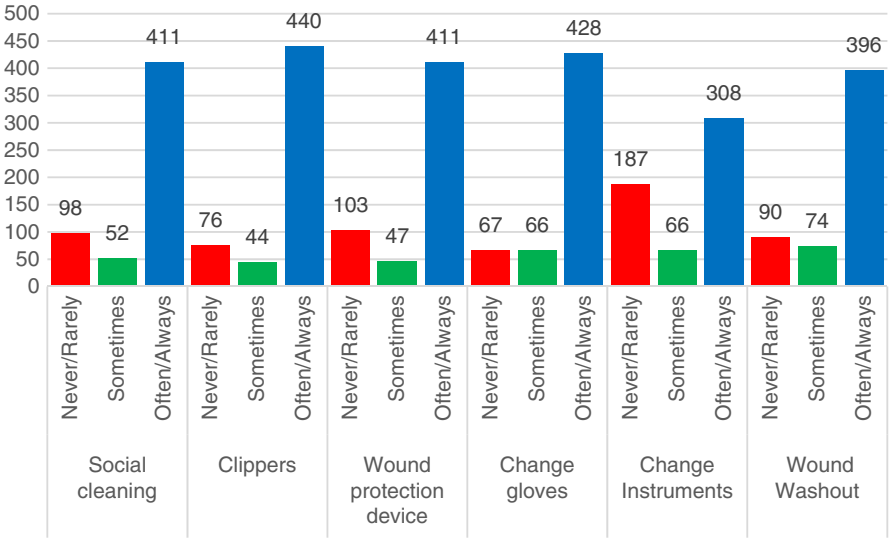

FIGURE 4 Commonly used practices for prevention of surgical site infection.

Rarely/Never ratings were wound site warming (78.4%), glue sealants (76.8%), topical negative pressure dressings (73.4%), triclosan coated sutures (73.2%) and incise drapes (62.5%) (see Table S4 for details).

DISCUSSION

This global study assessed both the techniques employed by surgeons for abdominal closure and routine SSI prevention strategies.

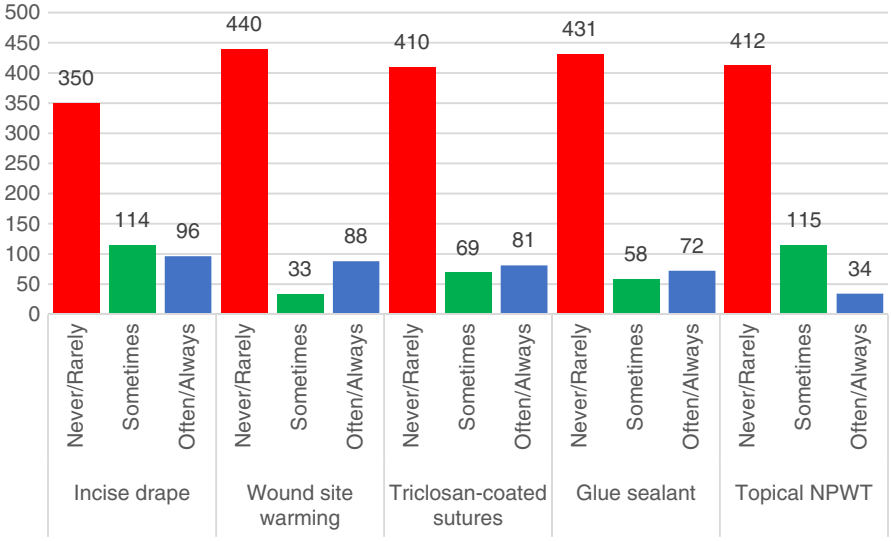

FIGURE 5 Uncommon intervention practices for surgical site infection.

It has identified significant variability in practice. Most respondents indicated they would use continuous, small bite, polydioxanone stitches for fascial closure, irrespective of the surgical setting, previous operations and indication for surgery. The majority of surgeons would close the subcutaneous tissue and the skin, favouring skin staples in faecal peritonitis and sutures in elective, primary colonic resections. Interestingly, there was statistically significant variability in practice in fascial closure technique between surgeons from European and non-European countries for continuous ($p < 0.0001$), small bites ($p = 0.0069$) and for subcutaneous closure by polydioxanone stitches ($p < 0.0001$) in all three scenarios.

Over recent years, robust level one evidence has been accumulating in support of the role of small bite fascial closure after laparotomy [12, 20–22]. Compared with the regular large bites closure technique, small bites closure can achieve a 48% reduction in incisional hernia rate at 12 months postoperatively (covariate adjusted odds ratio 0.52, 95% CI 0·31–0·87; $p = 0·0131$) [12] and in some studies a significant reduction in SSI was also observed [21, 23]. A continuous 2/0 polydioxanone suture with a small needle aligns with fascial healing time [24]. In the present study, most responders selected the small bites technique in all three scenarios (59.5% vs. 74.5% vs 58.6%). Considering that over 50% of these respondents declared a mass closure technique, many not reporting the use of 2/0 polydioxanone, the surgeons adopting small bites closure are more likely to range between 25% and 34.9% depending on the scenario, this being more consistent with the literature.

Among 114 laparotomies performed by 74 surgeons after a 1-year quality improvement programme on fascial closure [23] only 30.7% were performed by a small bites technique, despite all participants being aware of the technique and undergoing a multi-step programme to improve their practice [25]. In the same study, small bites closure showed a significant reduction in incisional hernias and burst abdomen compared with traditional closure. In a survey of 172 surgeons and 95 trainees from the USA and Canada [25], only 26.7% of surgeons and 28.6% trainees confirmed routine use of the small bites technique for laparotomy closure. Dogma, distrust in the technique, higher levels of obesity in the personal patient population and doubts about technical details have been identified as the main barriers to extensive adoption of the technique [26]. A multilevel approach, including the endorsement of surgical societies, organizational changes, conferences and journal clubs to extend awareness, as well hands-on courses for surgical registrars might enhance compliance and uptake of the technique [26].

SSI prevention remains relevant for laparoscopic colorectal surgery. In scenario 2, the specimen was retrieved via an 8 cm midline periumbilical wound. Benlice et al. [27] recently published a retrospective series on 2801 patients undergoing laparoscopic colorectal resection with the aim of determining the impact of the incision used for specimen extraction. The overall SSI rate was 10% (281/2801), with the highest rates being associated with periumbilical ($n = 41$; 14.6%) and the lowest rates with off midline extraction, i.e. in the right or left lower abdominal quadrant ($n = 13$, 3.3%). Interestingly, the latter increased the risk of incisional hernia by a factor of 3.6 compared with Pfannenstiel incision [27].

In our survey many of the commonly used interventions aligned with recent recommendations by the World Health Organization (WHO) and/or National Institute for Health and Care Excellence 2019 SSI prevention guidelines (social cleaning, use of clippers for hair removal, use of wound protectors, wound irrigation, alcoholic CHG skin preps) [28, 29]. Others have not been so recommended due to a lack of evidence (changing gloves and instruments before closure). More specifically, the WHO recommends the use of 2% alcoholic CHG skin preparation and triclosan-coated sutures. Several multicomponent bundles including these interventions have been reported to reduce SSI rates after colorectal surgery [28, 30–33]. In a study by Dixon et al., implementation of a SSI prevention bundle (including 2% alcoholic CHG skin preparation, triclosan-coated sutures and use of warmed carbon dioxide for laparoscopic procedures), reduced the overall SSI rate from 27.4% to 12.5% [34]. Dean et al. performed a similar study using a SSI bundle consisting of 2% alcoholic CHG skin preparation, triclosan-coated sutures, repeat-dose antibiotics after 4 h and dual-ring

wound protectors. They reported a significant reduction in SSI from 20% to 10% ($p \leq 0.0001$) [35]. In a recent web-based survey of 1105 Spanish surgeons and nurses, 57.2% reported the use of alcoholic CHG, and antimicrobial sutures were sometimes used by 20.2% [36]. In our study, more surgeons reported the use of these interventions, which may reflect selection bias. The recently published FALCON study found that the use of alcoholic CHG skin preparation and triclosan-coated sutures were not effective in reducing SSIs after abdominal surgery in low- and middle-income countries [37]. However, the study population was not limited to colorectal surgery, and included a relatively high proportion of emergency and dirty operations. Further research in colorectal patients –especially in emergency and contaminated-dirty settings, is therefore indicated to guide clinical practice.

Concerning MBP, the addition of oral antibiotics remains equivocal. Moreover, we found that more non-Europeans reported using MPB only than Europeans. Several RCTs observe that oral antibiotics are effective in reducing SSI after colonic surgery [38, 39], but adding MBP might not add benefits in this population [40–42]. The current study confirmed the variability and uncertainty of colorectal surgeons concerning preoperative bowel preparation observed in a survey of ESCP members [16]. The WHO recommends MBP plus oral antibiotics in adult elective colorectal patients, avoiding MBP alone [28], but the topic remains highly controversial [43–45].

Our study has limitations. As the survey was widely disseminated and not password-protected, the 'true' response rate cannot be accurately calculated. In addition, selection bias may occur, as interested surgeons were more likely to participate. As the survey was in English, non-native speakers may have been less likely to participate. Representation was high among participants working in academic units, which is commensurate with the society's membership, but its representation of all hospital settings is limited. Other evidence-based recommendations, such as prophylactic mesh placement in patients at high risk for developing incisional hernia have not been explored. Despite these limitations, this study provides important insight into current clinical practice from a large cohort of surgeons, and shows potential for improvement initiatives by surgical societies, such as theoretical and practical courses and quality improvement programmes to increase the potential benefit for patients.

ETHICS STATEMENT

All participants gave informed consent before engaging in the questionnaire. Data were handled according to the Declaration of Helsinki.

FUNDING INFORMATION

The study was supported by Ethicon.

CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX 1

SURVEY ANNOUNCEMENT

Dear collaborators,

The European Society of Coloproctology (ESCP) is dedicated to promoting and advancing the science, knowledge, and practice of coloproctology in Europe. We would like to invite you to complete a short survey (5–10 min to complete) designed to investigate the variety in the use of abdominal wound closure techniques and surgical site infection preventive strategies. Three clinical scenarios have been included in the survey to represent the diversity of our patient population, and insight into your personal strategies would be very much appreciated.

Midline abdominal wound closure is subject to development of surgical site infections (SSI), abdominal wound dehiscence and incisional hernia. The associated morbidity, mortality and health care costs associated with these complications challenge the surgical community to improve surgical techniques and to develop and implement preventive measures. This survey will be used to inform the next generation of ESCP studies.

You can access the questionnaire at https://redcap.link/woundclosure.

Thank you for completing the questionnaire.

James Keatley on behalf of the ESCP Cohort Studies and Audit Committee.

ESCP Project Manager.

University of Birmingham (United Kingdom).

APPENDIX 2

DISTRIBUTED SURVEY

ESCP Survey on Abdominal Wound Closure and SSI Prevention Strategies.

ESCP is investigating the variety in wound closure techniques and surgical site infection preventive strategies. We hope to gather as many individual responses as possible and would be grateful if you could complete the survey which should take no longer than 5–10 minutes.

Please feel free to share the link to the survey with your colleagues also.

For information on how the University will use any personal data we collect please click here.

Part A: Surgeon details

1. Professional role:	Consultant/attending
	Trainee/registrar
2. Speciality:	Colorectal surgery
	General surgery
	Other (please state)
3. Unit details:	University hospital/tertiary centre
	Region unit/District general hospital
4. Country (please start typing country name in box to search the list of countries)	

Part B: Abdominal wound closure practice

We will now present three clinical scenarios. Please report how you would be most likely to close the abdominal incision in these three situations.

Scenario 1: A 70-year-old man with a body mass index (BMI) of 35 kg/m^2 undergoes an emergency laparotomy for a perforated sigmoid diverticulitis with faecal peritonitis. A Hartmann's procedure is performed through a 25-cm midline wound.

1. Fascial closure suture material:	Polydiaxonone (e.g. PDS™, Maxon™) polypropylene (e.g. Prolene™, Surgipro™) nylon (e.g. Ethilon™, Monosof™)
	Polyester (e.g. Ethibond™, Ti-Cron™) polyglactin 910 (e.g. Vicryl™, Polysorb™) barbed suture (e.g. V-loc™, Stratafix™) other (please state):
Polydiaxonone (e.g. PDS™) type:	Loop/Non-loop
	Sharp needle/Blunt needle
Polydiaxonone (e.g. PDS™) type:	Loop
	Non-loop
	Sharp needle
	Blunt needle

2. Fascial closure suture weight (size):	1
	0
	2/0
	Other (please state):
3. Fascial closure technique:	Small bites
	Large bites of all abdominal wall layers
Small bites:	Anterior sheath only
	All layers/mass closure
4. Fascial suture style:	Interrupted sutures
	Continuous sutures
	Other (e.g. Hughes' technique):
5. Is the fascial suture length to wound length ratio measured and documented routinely?	Yes
	No
6. Subcutaneous tissue closure?	Yes
	No
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™)
	Polydiaxonone (e.g. PDS™, Maxon™)
	Other (please state):
Suture style:	Interrupted
	Continuous
7. Skin closure:	Yes
	No
Skin closure:	Skin staples
	Glue/Topical skin adhesive
	Suture
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™) Polydiaxonone (e.g. PDS™, Maxon™) Polypropylene (e.g. Prolene™, Surgipro™) Poliglecaprone 25 or comparable (e.g. Monocryl™, Biosyn™)
	Other (please state):
Suture style	Interrupted
	Continuous

Scenario 2: A 66-year-old woman with a BMI of 22 undergoes laparoscopic right hemicolectomy for a small caecal cancer. The specimen is retrieved via an 8 cm midline periumbilical wound.

1. Fascial closure suture material:	Polydiaxonone (e.g. PDS™, Maxon™) polypropylene (e.g. Prolene™, Surgipro™) nylon (e.g. Ethilon™, Monosof™)
	Polyester (e.g. Ethibond™, Ti-Cron™) polyglactin 910 (e.g. Vicryl™, Polysorb™) barbed suture (e.g. V-loc™, Stratafix™) other (please state):
Polydiaxonone (e.g. PDS™) type:	Loop/Non-loop
	Sharp needle/Blunt needle
Polydiaxonone (e.g. PDS™) type:	Loop
	Non-loop
	Sharp needle
	Blunt needle
2. Fascial closure suture weight (size):	1
	0
	2/0
	Other (please state):
3. Fascial closure technique:	Small bites
	Large bites of all abdominal wall layers
Small bites:	Anterior sheath only
	All layers/mass closure
4. Fascial suture style:	Interrupted sutures
	Continuous sutures
	Other (e.g. Hughes' technique):
5. Is the fascial suture length to wound length ratio measured and documented routinely?	Yes
	No
6. Subcutaneous tissue closure?	Yes
	No
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™) Polydiaxonone (e.g. PDS™, Maxon™)
	Other (please state):
Suture style:	Interrupted
	Continuous
7. Skin closure:	Yes
	No
Skin closure:	Skin staples
	Glue/Topical skin adhesive
	Suture
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™) Polydiaxonone (e.g. PDS™, Maxon™) Polypropylene (e.g. Prolene™, Surgipro™) Poliglecaprone 25 or comparable (e.g. Monocryl™, Biosyn™)
	Other (please state):
Suture style	Interrupted
	Continuous

Scenario 3: A 35-year-old man with a history of four open previous bowel resections for Crohn's Disease undergoes a 5th small bowel resection for Crohn's via a 25-cm midline wound.

1. Fascial closure suture material:	Polydiaxonone (e.g. PDS™, Maxon™) polypropylene (e.g. Prolene™, Surgipro™) nylon (e.g. Ethilon™, Monosof™)
	Polyester (e.g. Ethibond™, Ti-Cron™) polyglactin 910 (e.g. Vicryl™, Polysorb™) barbed suture (e.g. V-loc™, Stratafix™) other (please state):
Polydiaxonone (e.g. PDS™) type:	Loop/Non-loop
	Sharp needle/Blunt needle
Polydiaxonone (e.g. PDS™) type:	Loop
	Non-loop
	Sharp needle
	Blunt needle
2. Fascial closure suture weight (size):	1
	0
	2/0
	Other (please state):
3. Fascial closure technique:	Small bites
	Large bites of all abdominal wall layers
Small bites:	Anterior sheath only
	All layers/mass closure
4. Fascial suture style:	Interrupted sutures
	Continuous sutures
	Other (e.g. Hughes' technique):
5. Is the fascial suture length to wound length ratio measured and documented routinely?	Yes
	No
6. Subcutaneous tissue closure?	Yes
	No
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™) Polydiaxonone (e.g. PDS™, Maxon™)
	Other (please state):
Suture style:	Interrupted
	Continuous
7. Skin closure:	Yes
	No
Skin closure:	Skin staples
	Glue/Topical skin adhesive
	Suture
Suture used:	Polyglactin 910 (e.g. Vicryl™, Polysorb™) Polydiaxonone (e.g. PDS™, Maxon™) Polypropylene (e.g. Prolene™, Surgipro™) Poliglecaprone 25 or comparable (e.g. Monocryl™, Biosyn™)
	Other (please state):
Suture style	Interrupted
	Continuous

Part C: Surgical site infection – routine prevention strategies

Please report how commonly each of the following strategies would be used for a patient undergoing an elective colorectal resection (such as a laparoscopic-assisted anterior resection) under your care:

Frequency options: NEVER/RARELY/SOMETIMES/OFTEN/ALWAYS.

Combined preoperative mechanical bowel preparation with oral antibiotics.

Preoperative mechanical bowel preparation without oral antibiotics.

Pre-operation social cleaning with bath or shower <24 h prior to surgery.

Pre-operative wound site warming.

If hair has to be removed from the operation site, this is done with electric clippers with a single-use head on the day of surgery.

Surgical skin preparation with 2% alcoholic chlorhexidine.

Surgical skin preparation with 0.5% alcoholic chlorhexidine.

Surgical skin preparation with aqueous chlorhexidine.

Surgical skin preparation with alcoholic povidone-iodine.

Surgical skin preparation with aqueous povidone-iodine.

Use of an incise drape (e.g. Ioban™).

Use of a wound-edge protection device (wound guard) in primary wound/extraction site.

Use of triclosan-coated sutures.

Change of gloves prior to wound closure.

Change of instruments prior to wound closure.

Wound irrigation/washout is performed prior to skin closure.

Use of glue as a wound sealant ('glue-as-a-dressing').

Use of topical negative pressure dressing (e.g. PICO™, Prevena™).

Part D: Interest in future participation

ESCP is considering undertaking a prospective study of wound closure techniques and surgical site infection preventive strategies in the next 12 months.

Would you be interested in participating in this study?	Yes
	No
Full name:	
Hospital (please start typing hospital name in box to search the list of hospitals)	
Email:	