An International Assessment of the Adoption of Enhanced Recovery After Surgery (ERAS®) Principles Across Colorectal Units in 2019/20

The ESCP enhanced recovery collaborating group[1]

[1]European Society of Coloproctology (ESCP) Cohort Studies Committee, Department of Colorectal Surgery, University of Birmingham, Birmingham, UK

Correspondence to: Professor Thomas Pinkney, European Society of Coloproctology (ESCP) Cohort Studies Committee, Academic Department of Surgery, University of Birmingham, Heritage Building, Mindelsohn Way, Birmingham B15 2TH, UK

Thomas.pinkney@uhb.nhs.uk

ORCID: 0000-0001-7320-6673

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ABSTRACT (250/250 words)

Aim

The Enhanced Recovery After Surgery (ERAS®) Society guidelines aim to standardise perioperative care in colorectal surgery via 25 principles. We aimed to assess the variation in uptake of these principles across an international network of colorectal units.

Method

An online survey was circulated amongst European Society of Coloproctology members in 2019/20. For each ERAS® principle, respondents were asked to score how frequently the principle was implemented in their hospital, from 1 ('rarely') to 4 ('always'). Respondents were asked to recall whether practice had changed since 2017. Subgroup analyses based on hospital characteristics were conducted.

Results

Of hospitals approached, 58% responded to the survey (195/335), with 296 individual responses (some submitted multiple responses). The majority were European (163/195 [83.6%]). Overall, respondents indicated they normally or always adhered to most individual ERAS® principles (18/25 [72%]). Variability in uptake of principles was seen, with some universal uptake (e.g. prophylactic antibiotics; early mobilisation) whilst others demonstrated inconsistency between sites from 'rarely' to 'always' used (e.g. no nasogastric intubation; no preoperative fasting and carbohydrate drinks). When comparing practice to 2017, there were increases in certain principles such as prehabilitation, managing anaemia and postoperative nutrition – these differences broadly overlapped with 2018 ERAS® guideline updates.

Conclusions

Uptake of ERAS® principles varies across hospitals, and not all 25 principles are equally adhered to. Whilst some principles exhibited a high level of acceptance, others had a wide variability in uptake indicative of controversy or barriers to uptake. Further research into specific principles is required to improve ERAS® implementation.

WHAT DOES THIS PAPER ADD TO THE LITERATURE? (41/50 WORDS)

This study describes uptake of individual Enhanced Recovery After Surgery® principles in colorectal surgery across an international network, and identifies variability across centres. By better understanding the barriers to adoption, improvements in uptake may occur, leading to improved outcomes for patients.

INTRODUCTION

Colorectal resection is an important and potentially curative intervention for patients with either colorectal cancer and inflammatory bowel disease [1, 2]. However, resection is associated with a high patient burden in the short-term, in terms of length-of-stay, re-admission rates and the risk of severe complications like anastomotic leak [3, 4]. Furthermore, clinical care of patients undergoing colorectal surgery differs between hospitals and countries, with considerable variation in length-of-stay, recovery times and complication rates [5]. These factors prompted the development of a standardised enhanced recovery protocol; the Enhanced Recovery After Surgery (ERAS®) Society guidelines [5].

The first ERAS® guidelines for colorectal surgeons were published in 2005 [5]. The most recent (fourth) version was published in 2018, including the addition of guidelines for prehabilitation [6]. These latest ERAS® Society guidelines include 25 evidence-based principles designed to reduce perioperative stress, maintain physiological functioning postoperatively, and accelerate surgical recovery [6]. While there is extensive research to suggest that a multi-modal approach can reduce morbidity rates, improve recovery and shorten hospital length-of-stay after major colorectal surgery [7-10], there is limited research on the international adoption of these principles.

The effectiveness of certain principles contained within in the ERAS® guidelines are also a source of debate; for example the optimal preoperative bowel preparation regimen remains controversial [11]. Currently, the ERAS® guidelines recommend that preoperative mechanical bowel preparation should not be used routinely in colorectal surgery due to the risk of adverse events and lack of evidence for an associated benefit [12-14]. However, recent studies investigating mechanical bowel preparation alongside oral antibiotics have demonstrated an apparent benefit in the reduction of anastomotic failure [11, 15].

The objectives of this study were to assess the uptake and variation in individual ERAS® principles in 2019/20 and to assess the change in practice as compared to 2017 across international centres. By better understanding uptake and variation, patient recovery following colorectal surgery can potentially be harmonised between surgical centres in the future. This is likely to result in improved outcomes for patients.

METHOD

Study design

An online survey was circulated to all members who had actively participated in the 2017 European Society of Coloproctology (ESCP) snapshot audit of Left Colon, Sigmoid and Rectal Resections [16]. This group comprised healthcare professionals at 335 participating sites across 49 countries. The survey was in English and remained open from 21st November 2019 to 6th March 2020.

Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Birmingham, UK [17, 18].

The snapshot audit study database was used to extract hospital centre characteristics including geographic region, as defined by the United Nations M49 Standard [19], World Bank income status [20], type of hospital (university/tertiary versus community), and hospital capacity [16].

Participants and study evaluations

The survey included questions on each of the 25 ERAS® principles with four possible responses per question (**Supplementary Table 1**). Respondents were required to report their current practice (2019/20) and to recall their practice from 2017.

Two questions were asked per principle. The first question asked to what degree the principle was currently followed (2019/20). Respondents were able to choose 'Rarely (0–25%)', 'Sometimes (26–50%)', 'Most often (51–75%)' or 'Always (76–100%)', with percentages relating to the proportion of procedures in which the principle was believed to be implemented in their hospital. The second question queried whether practice for that principle was the same in 2017 (according to respondent recall) compared to 2019/20. Response options were 'Do not know', 'No, did it more often in 2017', 'Yes', or 'No, did it less often in 2017'.

Statistical analysis

Only respondents who provided an answer to the survey were considered in the analysis. The responses to the survey were converted to numerical values on a scale of 1–4, as found in **Table 1**. The mean for overall proportion of ERAS® principles

adhered to most often/always and the mean uptake score for each ERAS® principle in 2019/20 were calculated. The mean scores for recall of practice from 2017 were also calculated. Variation was assessed by calculating the interquartile range (IQR). Data were analysed using R Studio version 3.6.0. All analyses were descriptive with no formal statistical tests performed.

The primary analysis included all responses, even where multiple responses were provided from one centre. This ensured that variation in uptake was captured, even when this variation derived from different respondents' experience within the same hospital. A secondary analysis was performed, which only included responses from centres where one response was submitted; in this analysis responses from centres with multiple responses submitted were excluded.

Two subgroup analyses were performed on the 2019/20 responses using the primary analysis to compare the uptake of principles between groups stratified by hospital characteristics: general hospitals versus university/tertiary centres and highest versus lowest capacity (determined via bed numbers quartiles). As there were very few responses from low-income hospitals or regions outside of Europe, these hospital characteristics were not analysed to avoid biases arising from a small sample size.

RESULTS

Demographics

Eligible hospitals included all members of 2017 ESCP collaborating group (N=335; **Figure 1**). Overall, 58% of centres responded to the survey (195/335), with 70 centres submitting multiple responses, leading to a total of 296 individual responses across all centres (**Figure 1**). Of the 195 responding centres, 186 had complete characteristics data (nine centres had missing identification and so characteristics could not be extracted). The highest proportion of centres originated from Europe (Southern: 75/186 [40.3%]; Northern: 46/186 [24.7%]; Western: 22/186 [11.8%]; Eastern: 20/186 [10.8%]). Non-European centres comprised 23 (12.4%) hospitals (**Table 2**). The majority of responding hospitals were from centres rated as high income according to World Bank income status (152 [81.7%]) [20].

Practice in 2019/20

Primary analysis

Overall, respondents indicated they normally or always adhered to 18 (72%) of the 25 individual ERAS® principles. Of the individual principles, antibiotic prophylaxis had the highest mean uptake score across all responses (3.83/4), with early mobilisation (3.72), preadmission information, education and counselling (3.56), intraoperative euvolaemia (3.56) and urinary catheter (1–3 days) (3.56), together comprising the five principles with the highest implementation (**Figure 2A**). The five principles with the lowest uptake in 2019/20 were prehabilitation (2.36), no drainage (2.66), no preoperative fasting and carbohydrate drink (2.79), no sedative premedication (2.82) and no preoperative bowel preparation (2.82).

The principles where the highest number of responders reported they 'always' comply can be found in **Figure 2B**. The principles with the highest variability between responses, with a mean uptake <3, included no nasogastric intubation and no preoperative fasting and carbohydrate drink (IQR 1–4); followed by no drainage, postoperative nutrition, prehabilitation, no preoperative bowel preparation and no sedative premedication (**Figure 2C**).

Secondary analysis

The secondary analysis results, which only included hospitals that provided a single response, were largely consistent with the primary analysis. The only difference in the top five highest mean uptake scores included the addition of intraoperative normothermia in lieu of intraoperative euvolaemia. The secondary analysis included no nasogastric intubation in the lowest five adopted principles, in lieu of no sedative premedication. The mean scores for the principles were similar between the primary and secondary analyses (data not shown).

Recall of 2017 practice

For all but two principles, at least 95% of respondents indicated that they could recall their practice in 2017. The two principles where more than 5% of respondents did not recall practice in 2017 were standard anaesthetic protocol and no sedative premedication (8.8% and 5.7% did not recall 2017 practice, respectively).

Overall, the responses indicated little change in practice from 2017 to 2019/20 (**Supplementary Table 2**). There were a few notable exceptions where responders indicated an increase in compliance from 2017 to 2019/20, including the adoption of prehabilitation, managing anaemia, postoperative nutrition, minimally invasive surgery and preoperative nutrition. For these principles, 41.9%, 32.1%, 30.4%, 29.4% and 27.7% of responders, respectively, reported an increase in compliance in current practice compared with what they recalled from 2017.

The secondary analysis results, which only included hospitals that provided a single response, were also consistent with the primary analysis for the recall of 2017 practice (data not shown).

Subgroup analyses

A subgroup analysis by hospital type highlighted there were minimal differences between general hospitals or university/tertiary centres. Both the ranking of principles and the mean compliance scores were broadly similar across the two hospital types (**Supplementary Table 3**). The principle with the largest difference in the mean was no drainage which had 0.43 increase in university centres compared to general hospitals. However, the ranking of this principle was not affected.

An additional subgroup analysis compared the smallest (<400 beds) and largest (≥1,000 beds) capacity hospital centres. Minimal differences between hospitals were observed in both the ranked list of principles and mean compliance scores between the smallest and largest hospital (by capacity) subgroups (**Supplementary Table 4**). No drainage had the largest difference in mean (0.43) moving from rank 24 for <400 beds to rank 21 for ≥1,000 beds.

DISCUSSION AND CONCLUSIONS

The ERAS® principles are evidence-based guidelines developed to provide a standardised protocol for perioperative care in colorectal operations in order to improve patient outcomes [6]. The aims of this study were to assess the uptake and variation in uptake of individual ERAS® principles in 2019/20 across international surgical centres as well as to evaluate changes in uptake from 2017. Overall, a high

level of compliance was reported, with 80% of ERAS® principles most often/always adhered to by respondents. Some principles, such as antibiotic prophylaxis and early mobilisation, display both a high rate of uptake in 2019/20 and a low level of variation across centres, possibly indicating a high degree of acceptance of these principles and limited barriers to uptake.

In contrast, the survey also identified a number of principles that have a high variability in uptake across centres. These principles appear to fall into two categories: those which may be considered emerging practices (prehabilitation, postoperative nutrition and no preoperative fasting and carbohydrate drink) and those where further evidence may be required to reach a consensus on their role in the colorectal surgery care pathway (no drainage, no nasogastric tube, no sedative premedication and no preoperative bowel preparation). For the latter, variation may perhaps reflect the controversial nature of these principles given conflicting evidence over recent years [11-14].

The 42% increase in uptake of prehabilitation between 2017 and 2019/20 reflects the inclusion of prehabilitation in the 2018 update of the ERAS® guidelines [6], which indicates that hospitals are aware of emerging evidence and/or changes in ERAS® recommendations, and are open to implementing changes when appropriate. It is possible that many hospitals may also be involved in or aware of recent prospective, randomised research into prehabilitation [21, 22], leading to further motivation to improve principle implementation. However, this principle is included as the only item with a weak recommendation in the latest guidelines, which may be further reflected in it being the least adopted principle in this survey. Overall, these data indicate that further research into specific principles may improve uptake with time, especially if evidence emerges of positive outcomes for patients.

In addition to prehabilitation, there were four other principles that were new in the 2018 ERAS® guidelines: preoperative nutritional care, management of anaemia, preoperative euvolaemia and postoperative euvolaemia [6]. These newly added principles largely overlap with the principles where we observed an increase in implementation from 2017 practice, with preoperative nutritional care and management of anaemia among the top five with highest uptake in 2019/20 practice. Increases in adoption of these four principles were also in line with the increase of minimally invasive surgery (which moved from a low/moderate to high

evidence grade in 2018). Minimally invasive surgery had been previously included in the 2012 recommendations; the most recent ERAS® guidelines maintained their recommendation, but with stronger quality of evidence from 2012 to 2018 [6, 14]. This indicates inclusion in the ERAS® guidelines is not the only factor driving the adoption of principles; strengthening of underpinning evidence may also be a driving force.

Limitations of the analysis

Despite this study providing insight into adoption of ERAS® principles across hospitals around the world, it is important to acknowledge the limitations of the study. Firstly, the study was only distributed amongst members of the ESCP collaborating group, leading to a strong European focus (over 83% of hospitals were within Europe). This has the potential to limit the generalisability across other regions of the world. Secondly, given the survey design, the study is subject to response bias from the self-reported nature of the surveyed questions, in addition to recall bias in terms of recalling practice back from 2017. Thirdly, although the study is well-sized to produce an informative indication of adoption across the sample, the number of respondents is insufficient to derive meaningful insights when looking at certain subgroups such as at a country level or by income status. Finally, our study highlights specific principles that have the potential for improved adoption, but it does not evaluate whether increased adoption would improve clinical outcomes. Further research is warranted for exploring the impact of driving such adoption.

Suggestions on how to standardise adoption of ERAS® principles in the future

The principles with the highest variation in adoption appear to fall into the two categories described above of emerging practices and those where further evidence may be required to reach a consensus on their benefit. For both categories, further research into the individual principles may provide an increased degree of consensus. The increase in uptake of the prehabilitation principle from 2017 practice to 2019/20, while still not adopted widely, does demonstrate that principle uptake can improve over time with increasing randomised, controlled evidence [21]. Practical insights of how best to increase implementation of emerging principles including prehabilitation, postoperative nutrition, no preoperative fasting and carbohydrate drink may be

found by engaging with the centres which responded to this survey as 'always' implementing these emerging practices.

The principles with a wide variation in uptake that fall into the category where further evidence may be required to reach a consensus include no drainage, no nasogastric tube, no sedative premedication and no preoperative bowel preparation. Some of these principles are controversial as conflicting evidence has prevented widespread acceptance of best practices [11-14]. There may be a role for further research in these key areas in order reach a consensus on whether adoption does indeed lead to improved outcomes.

Conclusions

There is variation in uptake of ERAS® principles across hospitals, with not all 25 principles adhered to in equal measure. Some principles exhibited a high degree of acceptance, whereas other principles' wide variability in uptake could signify controversy or barriers to uptake. Principles that have seen an increase of adoption in recent years appear to be those with new or strengthening evidence-based recommendations, highlighting that further research into specific principles may modify uptake in time, improving harmonisation of ERAS® practice across hospitals and ultimately resulting in better outcomes for our patients.

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Availability of data and materials

All relevant data are within the paper and its Supporting Information files.

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Conflict of interest disclosures

H Taylor, C Tong and N-D Schmitz are employees of Johnson & Johnson and therefore did not participate in the survey. <<Placeholder for author disclosures>>

Ethics approval and consent to participate

No ethical approvals were required for this study.

Authors' contributions

Study design, interpretation and writing group: Taylor H, Tong C, Schmitz N-D, Morton DG, Pinkney TD (chair)

ESCP cohort studies and audits committee: Battersby N, Bhangu A, Blackwell S, Buchs N, Chaudhri S, Dardanov D, Dulskas A, El-Hussuna A, Frasson M, Gallo G, Glasbey J, Keatley J, Kelly M, Knowles C, Li YE, McCourt V, Minaya-Bravo A, Neary P, Negoi I, Nepogodiev D, Pata F, Pellino G, Pinkney TD (chair), Poskus T, Sanchez-Guillen L, Singh B, Sivrikoz E, van Ramshorst G, Zmora O

Statistical analysis and data management: Keatley J, Magill EL, Perry R, Tong C (lead)

Collaborators: Abdalkoddus M, Abelevich A, Ábraham S, Abraham-Nordling M, Adamina M, Agalar C, Agresta F, Ahallat M, Ahmad N, Aiupov R, Akca O, Aleksic A, Aleotti F, Alías D, Allison A, Alonso J, Alonso Gonçalves S, Alonso Martín J, Alonso Poza A, Alonso-Hernández N, Alós Company R, Al-Saeedi M, Alvarez- Laso C, Alvarez-Gallego M, Amanatidis T, Americano M, Amorim E, Anandan L, Anania G, Ancans G, Andreev P, Andrejevic P, Antonacci N, Anwer M, Aonzo P, Arencibia B, Argeny S, Arieli H, Arnold S, Ashraf M, Aslam M, Atanasov B, Atif M, Atladottir J, Avital S, Awny S, Aytac B, Azahr N, Aznar-Puig S, Bailey S, Balalis D, Baldi C, Baldonedo R, Balducci G, Balestra F, Balestri R, Balfour A, Baloyiannis I, Banky B, Baral J, Baranyai Z, Barbashinov N, Bargallo J, Barišić G, Barugola G, Batashki I, Battersby N, Belev N, Belli A, Beltrán de Heredia J, Bemelman W, Benavides Buleje J, Benckert A, Bernal-Sprekelsen J, Bertocchi E, Beuran M, Bhan C, Bianco F, Bignell M, Bilali S, Bilali V, Bintintan V, Birindelli A, Birindelli A, Birsan T, Blanco Antona F, Blas J, Blasco-Segura T, Blom R, Bocchetti T, Boerma E, Bogdan M, Boland M, Bomans B, Borda N, Bowen M, Boyle K, Bradulskis S, Branagan G, Brankovic B, Brenna M, Brewer H, Broadhurst J, Bronder C, Brouwer R, Buccianti P, Buchs N, Buchwald P, Bugatti A, Bui A, Burány Á, Burcos T, Buskens C, Bustamante C, Caceres N, Cagigas Fernández C, Calero-Lillo A, Camps I, Canda A, Caravaca-García I, Carballo F, Carcoforo P, Carlander J, Carlos S, Caro A, Carpelan A, Carrasco Prats M, Carrillo López M, Carvello M, Casal E, Casoni Pattacini G, Castellvi Valls J, Castillo Diego J, Cavallesco G, Cavenaile V, Cayetano L, Ceccotti A, Cervera-Aldama J, Chabok A, Chafai N, Chandrasinghe P, Chandratreya N, Chaudhri S, Chaudhry Z, Cherdancev D,

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TABLES AND FIGURES

Table 1. Survey response codes

Answer to	Code
How often do you follow principle X in your hospital?	
Rarely (0–25%)	1
Sometimes (26–50%)	2
Most often (51–75%)	3
Always (76–100%)	4
Was your practice the same in 2017?	
Do not know	1
No, did it more often in 2017	2
Yes (no change in practice)	3
No, did it less often in 2017	4

For full survey, including the list and description of the 25 ERAS® principles, see **Supplementary Table 1**.

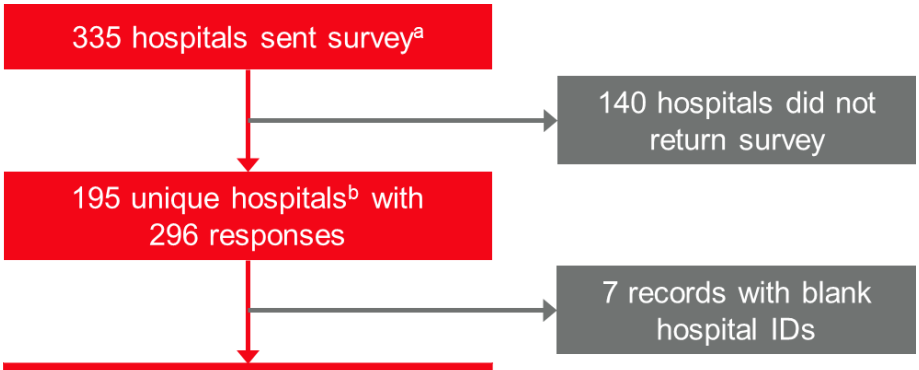
Abbreviation: **ERAS®**: Enhanced Recovery After Surgery.

Table 2. Hospital characteristics

Hospital characteristics	Overall (N[a]=186), N (%)
Hospital type	
District general hospital	50 (26.9%)
University hospital or tertiary centre	136 (73.1%)
Region[b]	
Southern Europe	75 (40.3%)
Northern Europe	46 (24.7%)
Western Europe	22 (11.8%)
Eastern Europe	20 (10.8%)
Western Asia	12 (6.5%)
Eastern Asia	2 (1.1%)
South-Eastern Asia	2 (1.1%)
Northern Africa	2 (1.1%)
South America	2 (1.1%)
Australia and New Zealand	1 (0.5%)
Northern America	1 (0.5%)
Southern Asia	1 (0.5%)
World Bank income status[c]	
High	152 (81.7%)
Upper-middle	30 (16.1%)
Lower-middle	4 (2.2%)
Number of beds[d]	
≥1,000	40 (21.6%)
650–<1,000	51 (27.6%)
400–<650	46 (24.9%)
<400	48 (25.9%)

[a]Excludes the nine hospitals missing identification. [b]Defined by the Geographic Regions of the United Nations (M49 Standard) [19]. [c]Defined by the World Bank income status [20]. [d]Missing data from one hospital and percentages calculated out of 185 hospitals.

Figure 1. Hospital responses



Responses returned	Hospitals (n)
1	124
2	52
3	13
4	4
6	1

[a]The 2017 ESCP collaborating group; [b]Includes nine unique but missing hospitals (Missing Hospital 1 through Missing Hospital 9) and seven records with blank hospital IDs.
Abbreviations: **CONSORT**: Consolidated Standards of Reporting Trials; **ESCP**: European Society of Coloproctology; **IDs**: identifications.

Figure 2. Uptake of ERAS® principles in 2019/20

Figure 2A

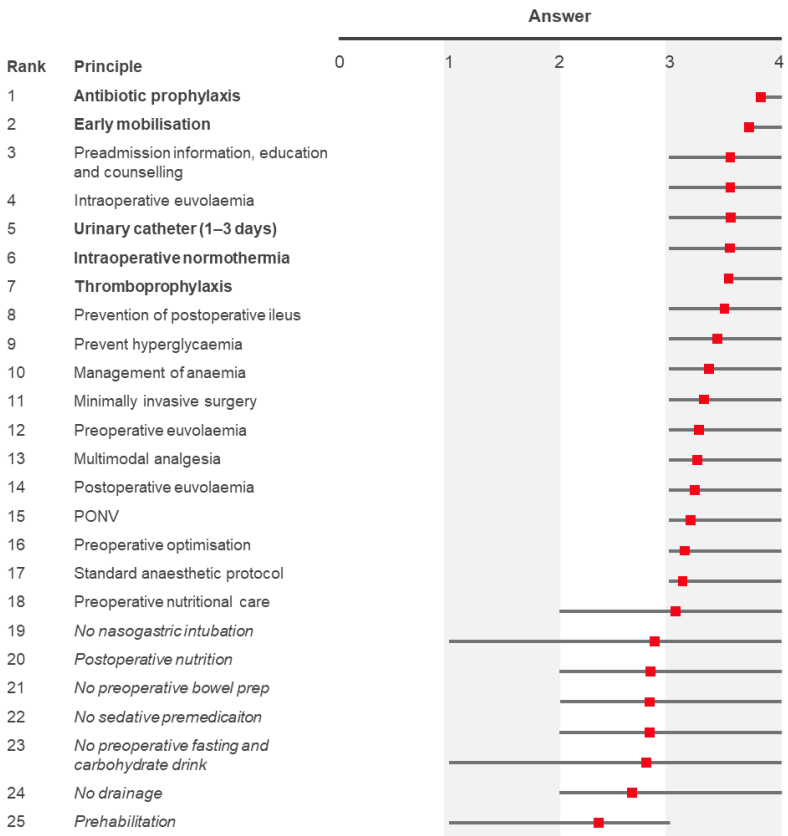


Figure 2B

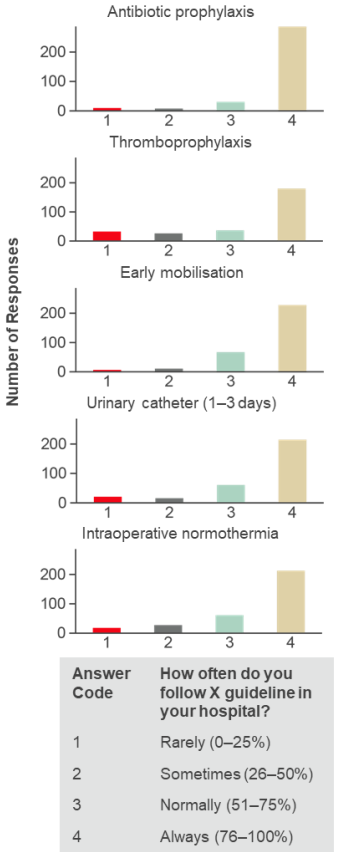
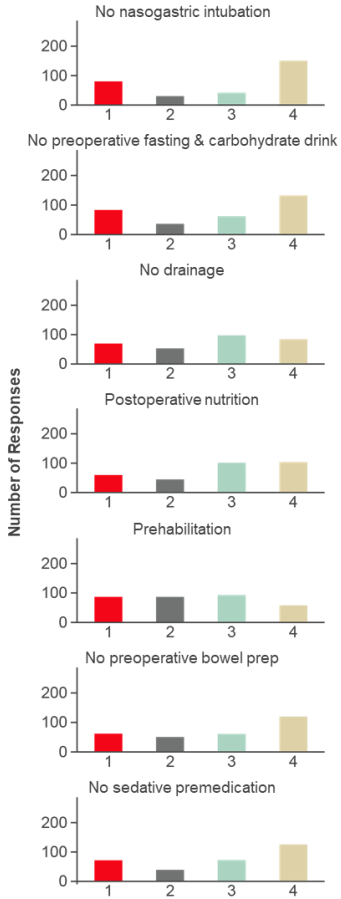


Figure 2C



(A) ERAS® principles ranked by mean uptake; squares indicate mean uptake; bars indicate variability across answers, as assessed by IQR. (B) Highlighted principles where the highest proportion of respondents answered 'always'; bolded in panel A. (C) Highlighted principles where with the highest variability of uptake across centres where the mean score is <3; italicised in panel A.

Abbreviation: **ERAS®**: Enhanced Recovery After Surgery; **IQR**: inter-quartile range.

SUPPLEMENTARY APPENDIX

Supplementary Table 1. Survey issued to respondents

Please select the approximate proportion of colorectal patients at your centre who comply with each of the following guidelines. Your responses should be guided by what is recommended at your local centre and not influenced by patient compliance**.**

	Items – Data criteria	**Recommendations**	**Answers**				**Was your practice the same in 2017?**			
Preadmission Guidelines										
1	Preoperative information, education and counselling	Patients should routinely receive dedicated preoperative counselling.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
2	Preoperative optimisation	Preoperative general medical optimisation is necessary before surgery, including stopping smoking advice.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
3	Prehabilitation	Patients who are less fit may be more likely to benefit (weak recommendation, new in 2018 guidelines).	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
4	Preoperative nutritional care[a]	Preoperative routine nutritional assessment offers the opportunity to correct malnutrition and should be offered (new in 2018 guideline).	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
5	Management of anaemia	Attempts to correct anaemia should be made prior to surgery (new in 2018 guideline).	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
Preoperative Guidelines										
6	PONV	A multimodal approach to PONV prophylaxis should be considered in all patients.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
7	Pre-anaesthetic medication *(sedative medication)* [b]	Patients should NOT routinely receive preoperative sedative medication.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know

	Items – Data criteria	Recommendations	Answers				Was your practice the same in 2017?			
8	Antibiotic prophylaxis	Routine antibiotic prophylaxis should be given within 60 minutes before surgery.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
9	Preoperative bowel preparation[c]	Mechanical bowel preparation should not be used routinely.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
10	Preoperative fluid and electrolyte therapy[d]	Patients should reach the anaesthetic room in as close a state to euvolaemia as possible and any preoperative fluid and electrolyte excesses or deficits should be corrected.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
11	Preoperative fasting and carbohydrate loading[e]	Clear fluids including carbohydrate drinks should be allowed up to 2 hours and solids up to 6 hours prior to anaesthesia.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
Intraoperative Guidelines										
12	Standard anaesthetic protocol	The use of short-acting anaesthetics, cerebral monitoring to improve recovery and reduce the risk for postoperative delirium, monitoring of the level and complete reversal of neuromuscular block is recommended.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
13	Intraoperative fluid and electrolyte therapy[f]	Aim to maintain fluid homoeostasis, avoiding fluid excess and organ hypoperfusion.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
14	Preventing intraoperative hypothermia[g]	Reliable temperature monitoring during surgery should be undertaken in all patients and methods to actively warm patients to maintain normothermia should be used routinely to keep body temperature >36ºC.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
15	Surgical access[h]	Use of a minimally invasive approach.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know

	Items – Data criteria	Recommendations	Answers				Was your practice the same in 2017?			
16	Drainage of the peritoneal cavity and pelvis[i]	Pelvic and peritoneal drains should NOT be used routinely.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
Postoperative Guidelines										
17	Nasogastric intubation[j]	Postoperative nasogastric tubes should NOT be used routinely.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
18	Postoperative analgesia[k]	Avoid opioids and apply multimodal analgesia in combination with spinal/epidural analgesia or TAP blocks when indicated.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
19	Thromboprophylaxis	Patients should routinely receive mechanical thromboprophylaxis until discharge and pharmacological prophylaxis with LMWH once daily for 28 days post-surgery.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
20	Postoperative fluid and electrolyte therapy[l]	Net "near-zero" fluid and electrolyte balance should be maintained.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
21	Urinary drainage[m]	Routine transurethral bladder drainage for 1-3 days is recommended depending on risk factors.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
22	Postoperative ileus prevention[n]	Use a multimodal approach to minimise the development of postoperative ileus including: limit opioid administration, use minimally invasive surgical techniques, postoperative nasogastric tubes should NOT be used routinely.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
23	Postoperative glycaemic control[o]	Hyperglycaemia should be avoided.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know
24	Nutritional status screening[p]	Most patients should be offered food from the day of surgery.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know

	Items – Data criteria	Recommendations	Answers				Was your practice the same in 2017?			
25	Early mobilisation	Patients should be mobilised early.	Rarely (0–25%)	Sometimes (26–50%)	Most often (51–75%)	Always (75–100%)	Yes	No, did it less often in 2017	No, did it more often in 2017	Do not know

The following principles are also described by the following alternative short descriptors: [a]Preoperative nutrition; [b]No sedative premedication; [c]No preoperative bowel preparation; [d]Preoperative euvolaemia; [e]No preoperative fasting and carbohydrate loading; [f]Intraoperative euvolaemia; [g]Intraoperative normothermia; [h]Minimally invasive surgery; [i]No drainage; [j]No nasogastric intubation; [k]Multimodal analgesia; [l]Postoperative euvolaemia; [m]Urinary catheter (1–3 days); [n]Prevention of postoperative ileus; [o]Prevent hyperglycaemia; [p]Postoperative nutrition.

Abbreviations: LMWH: Low Molecular Weight Heparin; **PONV**: prevention of nausea and vomiting; **TAP**: Transversus Abdominis Plane.

Supplementary Table 2. Recall for 2017 practice

	Rank	Principle (descending order)	Mean[a]
Five with highest uptake	1	Prehabilitation	3.31
	2	Management of anaemia	3.29
	3	Minimally invasive surgery	3.25
	4	Postoperative nutrition	3.22
	5	Preoperative nutrition	3.21
	6	Preadmission information, education and counselling	3.20
	7	Early mobilisation	3.19
	8	Postoperative euvolaemia	3.17
	9	No preoperative fasting and carbohydrate drink	3.17
	10	Preoperative optimisation	3.16
	11	Prevention of postoperative ileus	3.16
	12	Multimodal analgesia	3.13
	13	PONV	3.11
	14	Intraoperative normothermia	3.10
	15	Thromboprophylaxis	3.10
	16	Preoperative euvolaemia	3.07
	17	Intraoperative euvolaemia	3.04
	18	Prophylactic antibiotics	3.03
	19	Standard anaesthetic protocol	3.03
	20	Prevent hyperglycaemia	3.02
Five with lowest uptake	21	No nasogastric intubation	3.02
	22	Urinary catheter (1–3 days)	3.00
	23	No drainage	2.97
	24	No preoperative bowel prep	2.97
	25	No sedative premedication	2.92

[a]Mean score is based on whether practice was the same in 2017 compared to 2019/20, with the following codes: 'Do not know' (1), 'No, more often in 2017 (2), 'Yes (no change in practice)' (3) and 'No, less often in 2017' (4), as per **Table 1**.
Abbreviations: PONV: prevention of nausea and vomiting.

Supplementary Table 3. Hospital type subgroup analysis

		General Hospitals			University/Tertiary Centres	
Overall (N[a]=186), n (%)		**50 (26.9%)**			**136 (73.1%)**	
	Rank	**Principle (descending order)**	**Mean**		**Principle (descending order)**	**Mean**
Five with highest uptake	1	Prophylactic antibiotics	3.92		Prophylactic antibiotics	3.81
	2	Early mobilisation	3.76		Early mobilisation	3.70
	3	Preadmission information, education and counselling	3.61		Intraoperative normothermia	3.59
	4	Urinary catheter (1–3 days)	3.61		Preadmission information, education and counselling	3.56
	5	Prevention of postoperative ileus	3.59		Intraoperative euvolaemia	3.56
	6	Thromboprophylaxis	3.58		Urinary catheter (1–3 days)	3.55
	7	Intraoperative euvolaemia	3.52		Thromboprophylaxis	3.54
	8	Intraoperative normothermia	3.50		Prevention of postoperative ileus	3.50
	9	Minimally invasive surgery	3.48		Prevent hyperglycaemia	3.43
	10	Prevent hyperglycaemia	3.47		Management of anaemia	3.33
	11	Management of anaemia	3.45		Minimally invasive surgery	3.28
	12	Multimodal analgesia	3.30		Preoperative euvolaemia	3.28
	13	PONV	3.27		Postoperative euvolaemia	3.26
	14	Preoperative euvolaemia	3.27		Multimodal analgesia	3.25
	15	Standard anaesthetic protocol	3.21		PONV	3.19
	16	Preoperative optimisation	3.21		Preoperative optimisation	3.13
	17	Preoperative nutrition	3.14		Standard anaesthetic protocol	3.10
	18	Postoperative euvolaemia	3.14		Preoperative nutrition	3.05
	19	Postoperative nutrition	2.97		No nasogastric intubation	2.89
	20	No preoperative fasting and carbohydrate drink	2.94		No preoperative bowel prep	2.83
Five with lowest uptake	21	No nasogastric intubation	2.83		No sedative premedication	2.83
	22	No sedative premedication	2.80		Postoperative nutrition	2.78
	23	No preoperative bowel prep	2.61		No preoperative fasting and carbohydrate drink	2.77
	24	No drainage	2.33		No drainage	2.76
	25	Prehabilitation	2.24		Prehabilitation	2.39

Abbreviations: **PONV**: prevention of nausea and vomiting.

Supplementary Table 4. Hospital bed capacity subgroup analysis

		<400 Beds			≥1,000 Beds	
Overall (N[a]=186), n (%)		**48 (25.9%)**			**40 (21.6%)**	
	Rank	**Principle (descending order)**	**Mean**		**Principle (descending order)**	**Mean**
Five with highest uptake	1	Prophylactic antibiotics	3.78		Prophylactic antibiotics	3.93
	2	Urinary catheter (1–3 days)	3.78		Urinary catheter (1–3 days)	3.78
	3	Early mobilisation	3.77		Preadmission information, education and counselling	3.71
	4	Preadmission information, education and counselling	3.67		Early mobilisation	3.69
	5	Intraoperative euvolaemia	3.59		Thromboprophylaxis	3.62
	6	Intraoperative normothermia	3.52		Intraoperative normothermia	3.59
	7	Prevention of postoperative ileus	3.51		Prevention of postoperative ileus	3.59
	8	Thromboprophylaxis	3.43		Intraoperative euvolaemia	3.57
	9	Prevent hyperglycaemia	3.41		Prevent hyperglycaemia	3.41
	10	Preoperative euvolaemia	3.36		Preoperative euvolaemia	3.41
	11	Minimally invasive surgery	3.30		Management of anaemia	3.31
	12	Management of anaemia	3.28		Minimally invasive surgery	3.31
	13	PONV	3.28		PONV	3.29
	14	Postoperative euvolaemia	3.28		Postoperative euvolaemia	3.26
	15	Multimodal analgesia	3.19		Multimodal analgesia	3.21
	16	Standard anaesthetic protocol	3.14		Standard anaesthetic protocol	3.19
	17	Preoperative nutrition	3.12		Preoperative optimisation	3.17
	18	Preoperative optimisation	3.12		Preoperative nutrition	3.09
	19	Postoperative nutrition	2.87		No nasogastric intubation	3.00
	20	No nasogastric intubation	2.84		No preoperative fasting and carbohydrate drink	2.97
Five with lowest uptake	21	No sedative premedication	2.81		No drainage	2.95
	22	No preoperative fasting and carbohydrate drink	2.78		Postoperative nutrition	2.86
	23	No preoperative bowel prep	2.68		No sedative premedication	2.84
	24	No drainage	2.52		No preoperative bowel prep	2.81
	25	Prehabilitation	2.43		Prehabilitation	2.33

Hospital capacity cut-offs determined by highest and lowest quartile.

Abbreviations: **PONV**: prevention of nausea and vomiting.