# APPENDIX A. CITATION OF INCLUDED RCTS AND CCTS IN PRIOR SYSTEMATIC REVIEWS OF ENHANCED RECOVERY IN COLORECTAL SURGERY (2011-2017)

		SYSTEMATIC REVIEWS (See Footnotes for Detailed Inclusion Criteria)											
		Open or Open and Laparoscopic Surgery								Laparoscopic Surgery Only			
	Adamina 2011 <sup>5</sup>	Rawlinson 2011 <sup>13</sup>	Spanjers- berg 2011 <sup>14</sup>	Lv 2012 <sup>12</sup>	Zhuang 2013 <sup>17</sup>	Bagnall 2014 <sup>a6</sup>	Greco 2014 <sup>8</sup>	Grant 2017 <sup>7</sup>	Lau 2017 <sup>9</sup>	Launay- Savary 2017 <sup>a10</sup>	Li 2013 <sup>11</sup>	Tan 2014 <sup>15</sup>	Zhao 2014 <sup>16</sup>
RCTs Only	ü		ü	ü	ü		ü	ü	ü		ü	ü	
Required number of components	ü	ü	ü		ü				ü		ü		ü
Multiple languages allowed	ü	NR	ü	ü	ü	NR	ü			ü		ü	
OPEN SURGER	Y STUDIE	S											
Feng 2016 <sup>23</sup>													
Pappalardo 2016 <sup>31</sup>													
Jia 2014 <sup>a27</sup>						ü			ü	ü			
Nanavati 2014 <sup>30</sup>									ü				
Gouvas 2012 <sup>25</sup> (CCT) <sup>b</sup>													ü
Ren 2012 <sup>32</sup>					ü		ü		ü				
Wang 2012 <sup>b35</sup>							ü		ü		ü		ü
Yang 2012 <sup>37</sup>					ü		ü		ü				
Vlug 2011 <sup>b34</sup>				ü	ü		ü		ü		ü	ü	ü
Wang 2011 <sup>36</sup>							ü		ü		ü		

		SYSTEMATIC REVIEWS (See Footnotes for Detailed Inclusion Criteria)											
	Open or Open and Laparoscopic Surgery									Laparoscopic Surgery Only			
	Adamina 2011 <sup>5</sup>	Rawlinson 2011 <sup>13</sup>	Spanjers- berg 2011 <sup>14</sup>	Lv 2012 <sup>12</sup>	Zhuang 2013 <sup>17</sup>	Bagnall 2014 <sup>a6</sup>	Greco 2014 <sup>8</sup>	Grant 2017 <sup>7</sup>	Lau 2017 <sup>9</sup>	Launay- Savary 2017 <sup>a10</sup>	Li 2013 <sup>11</sup>	Tan 2014 <sup>15</sup>	Zhao 2014 <sup>16</sup>
lonescu 2009 <sup>26</sup>					ü		ü		ü				
Muller 2009 <sup>29</sup>	ü	ü	ü	ü	ü		ü		ü				
Šerclová 2009 <sup>33</sup>	ü	ü	ü	ü	ü		ü		ü				
Khoo 2007 <sup>28</sup>	ü	ü	ü	ü	ü		ü		ü				
Gatt 2005 <sup>24</sup>	ü	ü	ü	ü	ü		ü		ü				
Anderson 2003 <sup>22</sup>	ü	ü	ü	ü	ü		ü		ü				
LAPAROSCOPI	C SURGE	RY STUDIE	ES	•		•		•	•				
Ota 2017 <sup>42</sup> (CCT)													
Scioscia 201743													
Mari 201640													
Wang 2015 <sup>45</sup> (CCT)													
Feng 2014 <sup>38</sup>									ü				ü
Mari 201441									ü				
Gouvas 2012 <sup>25</sup> (CCT) <sup>b</sup>													ü
Wang 2012 <sup>b35</sup>							ü				ü		ü
Wang 201244					ü		ü		ü			ü	
Wang 2012 <sup>a46</sup>					ü	ü	ü			ü	ü	ü	ü
Vlug 2011 <sup>b34</sup>				ü	ü		ü				ü	ü	ü

	SYSTEMATIC REVIEWS (See Footnotes for Detailed Inclusion Criteri								ion Criteria	)			
		Open or Open and Laparoscopic Surgery							Laparoscopic Surgery Only				
	Adamina 2011 <sup>5</sup>	Rawlinson 2011 <sup>13</sup>	Spanjers- berg 2011 <sup>14</sup>	Lv 2012 <sup>12</sup>	Zhuang 2013 <sup>17</sup>	Bagnall 2014 <sup>a6</sup>	Greco 2014 <sup>8</sup>	Grant 2017 <sup>7</sup>	Lau 2017 <sup>9</sup>	Launay- Savary 2017 <sup>a10</sup>	Li 2013 <sup>11</sup>	Tan 2014 <sup>15</sup>	Zhao 2014 <sup>16</sup>
MIXED OPEN AND LAPAROSCOPIC SURGERY STUDIES													
Forsmo 2016 <sup>50</sup>													

CCT=controlled clinical trial; RCT=randomized controlled clinical trial

<sup>a</sup>Elderly (≥65 years)

<sup>b</sup> 4-arm study: open surgery with enhanced recovery, open surgery with usual care, laparoscopic surgery with enhanced recovery, and laparoscopic surgery with usual care **Systematic Review Inclusion Criteria (Literature Search Dates)** 

*Adamina 2011 (Search 1966 – June 2010):* RCT comparing ERP with traditional care (any indication for colorectal surgery); adult population; minimum 30 day follow-up; documented compliance to  $\geq 4$  of 5 key components a) patient information, b) preservation of gastrointestinal function, c) minimizing organ dysfunction; d) active pain control; e) promotion of patient's autonomy); publication in English, German, French, Spanish, or Danish

*Rawlinson 2011 (Search to February 2011):* RCT or CCT with prospective intervention group that compared enhanced recovery perioperative program with traditional care; open or laparoscopic elective colorectal surgery (any indication); adult population; documented protocol with at least 4 components of enhanced recovery covering pre-, intra-, and post-operative periods); reporting at least one outcome of interest (length of stay, complications, readmission rates, mortality); language limitation not reported

Spanjersberg 2011 (Search 1990 – 2009): RCT comparing any type of enhanced recovery strategy for resections in colorectal disease to conventional recovery strategies; open or laparoscopic surgery; at least 7 enhanced recovery items in the intervention group and no more than 2 enhanced recovery items in the conventional care group; any language *Lv 2012 (Search 1966 – April 2012)*: RCTs comparing enhanced recovery with conventional perioperative care in major colorectal surgery (resection); minimum 30 day follow-up; any language

*Zhuang 2013 (1966 – July 2012):* RCTS comparing enhanced recovery with traditional care for elective colorectal surgery; open or laparoscopic surgery; malignant or benign disease; enhanced recovery program should include at least 7 of 20 components; adult population; reporting at least one outcome of interest (length of stay, readmission rates, complications, mortality); any language

Bagnall 2014 (1947 – February 2014): any study design; evaluating enhanced recovery program in elderly (65 years or older) population undergoing colorectal surgery (or with elderly cohort as a subgroup analysis); language limitation not reported

*Greco 2014 (Search to June 2012):* RCTs comparing enhanced recovery to standard treatment in colorectal surgery; no restriction on primary or secondary outcomes; any language

*Grant 2017 (Search to June 2015):* RCTs comparing enhanced recovery to standard care for perioperative care in adults undergoing general anesthesia for abdominal and pelvic surgery; reporting healthcare-associated infection; English language

*Lau 2017 (1966 – February 2016):* RCTs comparing enhanced recovery to standard care; age range not specified; any surgery (site or approach); enhanced recovery program included at least 4 components; reporting primary clinical outcomes (length of stay, 30-day readmission, 30-day mortality, total costs); English language abstract and/or full text *Launey-Savary 2017 (2000 – 2015):* any study design; comparing feasibility of enhanced recovery in elderly (65 years or older) to younger population or to traditional management; elective colorectal surgery; reporting main endpoints (feasibility, efficacy, compliance); English or French



Li 2013 (Search to May 2013): RCTs (including abstracts) comparing laparoscopic colorectal surgery with enhanced recovery to laparoscopic colorectal surgery with conventional care; adult population; at least 7 of 17 enhanced recovery components; one month follow-up for complications and readmissions; reported at least one outcome of interest; English language

Tan 2014 (Search 1991 – February 2013): RCTs comparing enhanced recovery to traditional care in elective laparoscopic colorectal surgery; any language

*Zhao 2014 (Search to April 2014):* RCTs or CCTs comparing enhanced recovery with conventional care in laparoscopic colorectal cancer surgery; clear description of enhanced recovery protocol; applied at least 6 enhanced recovery components; reporting at least one outcome of interest (length of stay, time to first flatus, time of first bowel movement, complications, readmissions, mortality); English language

# **APPENDIX B. SEARCH STRATEGIES**

#### MEDLINE (Ovid)

1	((fast and track) or fast-track or ERAS or ERP).mp.
2	(enhanced and recovery and surg\$).mp.
3	(enhanced and recovery and program\$).mp.
4	((multimodal or enhanced or accelerated) and (optimization or management or rehabilitation or protocol or package or program or pathway)).mp.
5	1 or 2 or 3 or 4
6	(resection or surgical or surgically or surgery or laparo\$ or procedure).mp.
7	exp Colon/
8	exp Rectum/
9	exp Colon, Sigmoid/
10	(bowel or rectal or colonic or colon or colorectal or rectum or sigmoid).mp.
11	7 or 8 or 9 or 10
12	6 and 11
13	exp Colorectal Surgery/
14	exp Rectum/su [Surgery]
15	exp Colon/su [Surgery]
16	13 or 14 or 15
17	5 and 12
18	5 and 16
19	17 or 18
20	limit 19 to (english language and yr="2011 -Current")

#### CINAHL

S1	TX (fast and track) OR fast-track OR ERAS OR ERP OR (enhanced AND recovery AND (surg* OR program*)) OR ((multimodal OR enhanced OR accelerated) AND (optimization OR management OR rehabilitation OR protocol OR program OR pathway))
S2	TX (resection OR surg* OR laparo* OR procedure)
S3	TX (bowel OR rectal OR colonic OR colon OR colorectal OR rectum OR sigmoid)
S4	S3 AND S3
S5	S1 AND S4
S6	S1 AND S4 (Published Date: 20110101-20161231)
S7	S6 (English language)

# Enhanced Recovery After Surgery for Colorectal Surgery APPENDIX C. PEER REVIEW COMMENTS/AUTHOR RESPONSES

Question	Reviewer's Response	Author's Responses
Are the	Yes	Thank you
objectives,	Yes	
scope, and	Yes	
methods for this review clearly described?	Yes	
	Yes	
	Yes	
Is there any	No	Thank you
indication of	No	
bias in our	No	
synthesis of the	No	
cvidence:	No	
	No	
Are there any	No	Thank you
published or	No	
unpublished	No	
may have	No	
overlooked?	No	
	No	
Additional	None	Thank you
suggestions or	Spelling: should read Morbidity on page 32 line 4	This has been corrected.
comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.	This is a well done systematic review of ERAS and colorectal surgery. Unfortunately most of the studies were of poor quality so the conclusions are weak. One element that is important to consider is the idea of 'bundling' and standardization and the benefit that this component of ERAS may have it was included in the HICPAC guidelines.	Thank you. We agree with the reviewer's comment about the quality of the studies. We added the concept of "bundling" to the "Implications for Practice" section.
	This might not be appropriate for the purpose of this paper: My only suggestion would be that the VA could exploit the advantages of being a large system and come up with templated preadmission educational materials, CPRS notes/order sets and ways to facilitate obtaining CHO drinks preop for patients to facilitate adoption of this. These are items that I am currently working on could be adopted and edited by facilities as needed, but would help overcome a lot of the time barriers that we encounter.	Thank you for the suggestion. As the reviewer suspected, specific strategies for implementation are outside the scope of the review.

# **APPENDIX D. EVIDENCE TABLES**

### Table 1. Study Characteristics

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias					
<b>Open Surgery Stu</b>	Open Surgery Studies								
Feng 2016 <sup>23</sup> China Government funding	Inclusion: age 18-70 years; histological diagnosis of colorectal cancer; no radiotherapy or chemotherapy treatment; no severe diarrhea, liver and kidney function failure, or cardiopulmonary insufficiency; ASA I-III; BMI 18.5-30; abdominal CT with no obvious lymph node or distant metastasis Exclusion: history of abdominal surgery; endocrine or immune system dysfunction ( <i>eg</i> , diabetes, thyroid disease, multiple sclerosis, rheumatoid arthritis); recent blood transfusions; preoperative treatment with opioids, hormones, non-steroidal anti- inflammatory drugs, or other immunomodulatory substances; contraindications for epidural anesthesia	Intervention: fast-track surgery (n=121) Control: traditional care (n=120) Follow-up: 30 days Compliance: NR	N=241 (data for 230) Colorectal conditions (%): 44 colon, 56 rectum Procedures (%): NR Age (mean): 58 Gender (% male): 56 BMI: 24 Comorbidity status: ASA I (27), ASA II (50), ASA III (23)	Sequence generation: NR Allocation concealment: unclear Blinding: unclear; treatment team and patient/family not blinded; data collectors were not involved in patient management Incomplete outcome data: adequate (5% excluded from analysis due to non- compliance, ostomy surgery) Selective outcome reporting: no <i>Risk of bias:</i> medium					
Pappalardo 2016 <sup>31</sup> Italy No funding indicated	Inclusion: extraperitoneal tumor location (within 12 cm above anal verge); cT2-T4 tumors with or without positive lymph nodes, elective procedure; neoadjuvant therapy where indicated Exclusion: tumor >12 cm above anal verge, cT1 or M1, urgent procedure, ASA >3, operated on with abdominoperineal resection or Hartmann's procedure, refusing neoadjuvant therapy where indicated, refusing or unable to follow fast-	Intervention: fast-track protocol (n=25) Control: traditional care (n=25) Follow-up: 30 days Compliance: NR	N=50 Colorectal conditions (%): 100% rectal cancer Procedures (%): anterior resection (62), ultra-low anterior resection (36) Castrini technique (4) Age (mean): 67 Gender (% male): 52	Sequence generation: NR Allocation concealment: NR Blinding: adequate (outcome assessors) Incomplete outcome data: yes (mean data not reported) Selective outcome reporting: yes (data not reported at time points identified in methods)					

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
g = =		Follow-up		
	track protocol, coagulation disorder contraindicating epidural catheter insertion		BMI: 38% <25; 20% >30	<i>Risk of bias:</i> high
	NOTE: 56% of fast-track and 52% of traditional care groups received neoadjuvant therapy		Comorbidity status: ASA I (10), ASA II (42), ASA III (48)	
Jia 2014 <sup>27</sup>	Inclusion: elderly patients with colorectal carcinoma admitted for open curative	Intervention: fast-track surgery (n=120)	N=240 (all elderly, ages 70-88) (data for 233)	Sequence generation: adequate
No funding	Exclusion: history of dementia,	Control: traditional care (n=120)	Colorectal conditions (%): colon cancer (49); rectal cancer	Allocation concealment: NR
indicated	Parkinson's disease, alcohol intake of	Follow up: NP. porioporativo	(51)	Blinding: NR
	anesthesia within the past 30 days	Compliance: NR	Procedures (%): colectomy (45); Dixon (32), Miles (23) Age (mean): 75 Gender (% male): 63	Incomplete outcome data: 3% (n=7, including 3 who went to ICU) not included in analyses Selective outcome reporting: no
			BMI: NR	<i>Risk of bias:</i> medium
			Comorbidity status: NR	
Nanavati 201430	Inclusion: age 16-66 years, undergoing	Intervention: fast-track peri-	N=60	Sequence generation: NR
India No funding indicated	anastomosis anywhere distal to the ileum Exclusion: uncontrolled comorbid conditions ( <i>eg,</i> diabetes mellitus, hypertension) and emergency bowel	operative care (n=30) Control: traditional perioperative care (n=30)	Colorectal conditions (%): ileostomy closure 42 colostomy closure 28 abdominal pain 13	Allocation concealment: unclear Blinding: NR
	surgenes	Compliance: NR	other 9	Incomplete outcome data: no loss to follow-up
			Gender (% male): 53	Selective outcome reporting: no
			BMI: NR	Risk of bias: unclear
			Comorbidity status: NR	

Author, year Country Eunding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
T unuing Source		Follow-up		
Gouvas 2012 <sup>25</sup>	Inclusion: diagnosed with adenocarcinoma	Intervention: open surgery combined with fast track	N=81	Sequence generation: NA
ССТ		(n=36)	Colorectal conditions (%):	
Greece	than adenocarcinoma, distant metastases,	Control: open surgery usual	rectal cancer (100)	grouped according to
No funding	neuromuscular disability, unsuitable for epidural anesthesia; ASA IV, refusal to	care (n=45)	Age (mean): 64	surgeon's preference
indicated	consent to fast-track care or laparoscopy, different operation performed than	Follow-up: 30 days	Gender (% male): 67 (fast track 53% vs 78% usual care. P=.001	Blinding: NR
2 X 2 study (open	originally scheduled	Compliance: NR	across groups)	Incomplete outcome data: no
and fast track vs			BMI: 28	Selective outcome reporting:
usual care)			Comorbidity status (%): ASA I	
Ren 2011 <sup>32</sup>	Inclusion: age 20-80 years, single	Intervention: ERAS group	(42); ASA II (46), ASA III (12)	RISK OF DIAS: NIGN
	colorectal lesion, medically eligible for	(n=299)		adequate
China		Control: usual care (n=298)	hemicolectomy (28), left	Allocation concealment: NR
funding	synchronous resection of other organs,	Follow-up: 30 days	resection (44),	Blinding: adequate (outcomes
	affliction with a disease that would affect	Compliance: NR	(13), other (9)	assessment)
	recovery		Age (median): 59 (ERAS), 61 (control)	Incomplete outcome data: 0% (79 were randomized but then found to not meet inclusion criteria)
			Gender (% male): 62	Selective outcome reporting:
			BMI (median): 22.5	no
			Comorbidity status: ASA (mean)	Risk of bias: low
			ERAS 1.4 (0.3)	
Wang 2012 <sup>35</sup>	Inclusion: no disease of immune system,	Intervention: open surgery combined with fast track	N=86 (data for 83)	Sequence generation: NR
China	chemotherapy, no history of operation on abdominal and distant metastases, ASA	(n=42)	Colorectal conditions (%): colon cancer 100	Allocation concealment: adequate

Evidence-based Synthesis Program

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
No funding indicated	score I–III, and self-care function prior to hospitalization	Control: open surgery usual care (n=44)	Age (median): 55 (fast track),	Blinding: NR
2 X 2 study (open vs laparoscopic and fast track vs	Exclusion: association with other organ resection, conversion from laparoscopic operation to laparotomy, inability to place	Follow-up: 30 days Compliance: NR	Gender (% male): 59	Incomplete outcome data: 3% (n=3) excluded from analyses
usual care)	an epidural catheter, inability to infuse drugs, need for a stoma, and emergency		BMI: 22.5	Selective outcome reporting: no
	operation		(40), ASA II (46), ASA III (14)	Risk of bias: unclear
Yang 2012 <sup>37</sup>	Inclusion: age 18-80, diagnosed with colorectal carcinoma, no preoperative	Intervention: fast-track group (n=35)	N= 70 (data for 62)	Sequence generation: adequate
China No funding	chemotherapy or radiotherapy, ASA score I-II, BMI 17.5-27.5, preoperative serum albumin ≥30g/L, elective open colorectal	Control: conventional care (n=35)	Procedures (%): right hemicolectomy (21), left hemicolectomy (8);	Allocation concealment: adequate
indicated	resection with tracheal intubation and general anesthesia	Follow-up: 30 days	sigmoidectomy (21), Dixon operation (50)	Blinding: adequate (outcome assessment)
	Exclusion: immune-related disease, primary diabetes mellitus or impaired glucose tolerance, hiatus hernia, gastrossophagoal reflux disease (GERD)	Compliance: Use of checklists to maintain compliance. Did not report	Age (median): 57 (fast track), 60 (usual care)	Incomplete outcome data: 11% (n=8) not included in
	pregnancy, bowel obstruction, difficult airway access, drug intake that may affect bowel movement and function, failure of		BMI (median): 22	Selective outcome reporting:
	thoracic epidural catheter insertion, intraoperative blood transfusion, stoma requirement, unresectable carcinoma		Comorbidity status: NR	Risk of bias: low
Vlug 2011 <sup>34</sup> LAFA-study	Inclusion: ages 40-80 years; ASA I, II, or III; elective segmental colectomy for	Intervention: open surgery combined with fast track	N=211 (data for 191)	Sequence generation: NR
The Netherlands	histologically confirmed adenocarcinoma or adenoma; without evidence of	(n=103)	Colorectal conditions (%): colon cancer and benign	Allocation concealment: adequate
(multisite)	metastatic disease	Control: open surgery usual care (n=108)	disease 100	Blinding: patients and medical
Industry	Exclusion: prior midline laparotomy, unavailability of a laparoscopic surgeon,	Follow-up: 30 days	Procedures (%): right colectomy (45), left colectomy	statt blinded for surgical approach (laparoscopic vs
2 X 2 study (open vs laparoscopic	emergency surgery, or a planned stoma	Compliance: 15 components	(55)	open) until day of discharge
		monitored for compliance,	Aye (mean). 00	

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
and fast track vs usual care)		11.1 of 15 components successfully applied per patient in fast-track group;.5.8 components of fast track successfully applied per patient in usual care group	Gender (% male): 59 BMI: 26 Comorbidity status (%): ASA I or II (79), III (21)	Incomplete outcome data: 10% (n=20) were excluded from analyses (9 of 20 [45%] withdrew consent) Selective outcome reporting: no <i>Risk of bias:</i> medium
Wang 2011 <sup>36</sup>	Inclusion: NR	Intervention: fast-track rehabilitation (n=106)	N=230 (data for 210)	Sequence generation: NR
China Social Development Fund	Exclusion: non-selective admission, preoperative distant metastases, stoma, emergency situation, scheduled total colectomy or abdominoperineal resection, contraindications for epidural anesthesia or early ambulation	Control: conventional care (n=104) Follow-up: 30 days Compliance: NR	Colorectal condition (s)(%): colon (65), rectum (35) Procedures (%): right hemicolectomy (26), left hemicolectomy (20), sigmoid colectomy (29), anterior resection (25) Age (median): 57 (fast track), 55 (conventional care) Gender (% male): 60 BMI: NR Comorbidity status (%): ASA I (28), ASA II (55), ASA III (17)	Allocation concealment: NR Blinding: NR Incomplete outcome data: 0% Selective outcome reporting: no <i>Risk of bias:</i> unclear
Ionescu 2009 <sup>26</sup> Romania No funding indicated	Inclusion: ASA score I-III, admitted to hospital for elective open colorectal surgery for neoplasm Exclusion: previous abdominal surgery, extensive neoplasm, severe malnutrition, surgery for complications (bowel obstruction), and palliative surgical	Intervention: fast-track protocol (n=48) Control: conventional care program (n=48) Follow-up: NR (perioperative; patients asked to mention	N=96 (Data for N=96) Colorectal conditions (%): rectosigmoid (58); colon (42) Procedures: right hemicolectomy (29). left hemicolectomy (11), segmental	Sequence generation: adequate Allocation concealment: adequate Blinding: NR
	procedures			Incomplete outcome data: 0%



Author, year Country	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
Funding Source		Follow-up	Demographics	Kisk Of Blas
		inclusion in study in case of readmission)	colonic resection (1), rectosigmoidian resection (58)	Selective outcome reporting:
		Compliance: NR	Age (mean): 62	Risk of bias: low
			Gender (% male): 64	
			BMI: NR	
			Comorbidity status (%): ASA I (52), ASA II (45), ASA III (3)	
			Subgroups noted <sup>a</sup> : None	
Muller 2009 <sup>29</sup>	Inclusion: age >18, elective open colonic resection with a primary anastomosis	Intervention: fast-track program (n=76)	N= 156 (data for 151)	Sequence generation: NR
Switzerland	Exclusion: emergency situations,	Control: standard care (n=75)	Procedures (%): sigmoid resection or left hemicolectomy	Allocation concealment: unclear
indicated	scheduled total colectomy or rectum resection, preoperatively immobile	Follow-up: 30 days	colon (1), right hemicolectomy (32)	Blinding: no
		Compliance: adherence reported for intraoperative intravenous intake, first 24-	Age (median): 62 (fast track), 59 (standard care) (P=.04)	Incomplete outcome data: 3% (n=5) not included in analysis
		hour intravenous intake, effective epidural analgesia, mobilization time day 1, and oral putrition day 1 and day 4	Gender (% male): 51	Selective outcome reporting: did not report data from BADL (need for personal care) nor IADL (ability to perform
			26 (standard care)	physical activities)
		NOTE: study stopped prematurely after reaching significant difference for primary endpoint (total complications to 30 days after surgery)	Comorbidity status (%): ASA I (3), ASA II (69); ASA III (28)	<i>Risk of bias:</i> high
Šerclová 2009 <sup>33</sup> Czech Republic	Inclusion: age 18-70 years, ASA score between I or II, open intestinal resection	Intervention: fast-track group (n=53)	N= 105 (data for 103) Colorectal conditions (%):	Sequence generation: adequate

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
· analig coal co		Follow-up		
Government	Exclusion: pelvic radiation, multi-organ resections, cancer, pregnant women	Control: conventional care (n=52) Follow-up: 30 days Compliance: NR	colitis (9), familial adenomatous polyposis (5), carcinoma (7), other (2) Procedures (%): simple bowel resection (54), multiple (25), resection and stomy (20) Age (mean): 36 Gender (% male): 50 BMI (median): NR	Allocation concealment: adequate Blinding: NR Incomplete outcome data: 2% (n=2) not included in analysis Selective outcome reporting: no <i>Risk of bias:</i> low
Khao 2007 <sup>28</sup>	Inducion: clostivo curgory for coloratal	Intervention: multimodel	Comorbidity status (%): NR	Sequence generation:
UK No funding indicated	Exclusion: unable to mobilize independently over 100 meters at preoperative assessment, contraindications to thoracic epidurals, preexisting clinical depression, palliation, a joint operation involving another surgical specialty	Control: usual care (n=35) Follow-up: 10-14 days Compliance: Both arms were protocol-driven, with checklists	Colorectal conditions (%): colon cancer (67), rectal cancer (33) Age (median): 69 (multimodal), 73 (usual care) Gender (% male): 39 BMI: NR Comorbidity status (%): ASA I (11), ASA II (74), ASA III (14)	Allocation concealment: adequate Allocation concealment: adequate (telephone) Blinding: NR Incomplete outcome data: 14% (n=11 withdrawn, 7 due to metastatic disease 3 withdrew consent) Selective outcome reporting: no <i>Risk of bias:</i> medium
Gatt 2005 <sup>24</sup>	Inclusion: requiring elective colorectal surgery, living independently at home	optimization (n=19)	N=39	Sequence generation: unclear
UK No funding	Exclusion: age<18 years, pregnancy, intolerance to probiotics and/or	Control: usual care (n=20)	Colorectal conditions (%): malignant disease (69)	Allocation concealment: unclear
indicated	preantibiotics, contraindication to one or more optimization strategy,	Follow-up: 30 days	Procedures (%): right hemicolectomy (28), left	Blinding: no

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
		Follow-up		
Anderson 2003 <sup>22</sup>	contraindications to early postoperative discharge, prescribed medications that may independently prolong hospital stay ( <i>eg</i> , anticoagulants), advanced malignancy on preoperative assessment, palliative or emergency surgery, failure to perform colonic or rectal resection	Compliance: NR	hemicolectomy (5), anterior resection (38), sigmoid colectomy (5), subtotal colectomy (8), abdominoperineal resection (5), other (11) Age (median): 67 (both groups) Gender (% male): 59 BMI: medians 24 (multimodal), 27 (usual care) Comorbidity status: POSSUM score (medians) 28 (multimodal), 32 (usual care); ASA (median)=2 (both groups) N=25	Incomplete outcome data: all included in the analyses Selective outcome reporting: no <i>Risk of bias:</i> unclear Sequence generation: NR
ЛК	and required left or right hemicolectomy	optimization (n=14)	Colorectal conditions (%):	Allocation concealment:
	Exclusion: NR	Control: usual care (n=11)	malignant disease 72%	unclear
No funding indicated	dies	Follow-up: 30 days Compliance: NR	Age (medians): 64 (multimodal), 67 (usual care) Gender (% male): 44 BMI: medians 24 (multimodal), 26 (usual care) Comorbidity status: POSSUM score (median) 26 (both groups); ASA I/II 92%, III 8%	Blinding: no Incomplete outcome data: no Selective outcome reporting: no <i>Risk of bias:</i> unclear
Laparoscopic Stu	ales			
Ota 2017 <sup>42</sup> Japan	Inclusion: ASA grade I or II, elective surgery for colonic or rectosigmoid cancer in 1 of 6 hospitals, white blood cell count	Intervention: enhanced recovery after surgery (n=159)	N=320	Sequence generation: NA, not randomized



Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
CCT No funding indicated	<ul> <li>≥3000/µL, platelet count ≥100,000/µL, serum aspartate aminotransferase or alamine aminotransferase level</li> <li>≤100IU/µL, total bilirubin ≤2mg/dl, serum creatinine ≤1.5 mg/dl</li> <li>Exclusion: emergency surgery, bowel obstruction preoperatively, routine use of steroids, history of cancer treatment using irradiation or chemotherapy, previous laparotomy other than for appendectomy, oophorectomy, or caesarean section</li> </ul>	Control: conventional perioperative care (n=161) Follow-up: 30 days Compliance: average rate of compliance with each ERAS intervention in ERAS group was 85%; over 50% of ERAS components were implemented in conventional care group; improved adherence to ERAS protocol significantly associated with	Colorectal locations (%): cecum (16), ascending (29), transverse (12), descending (7), sigmoid (29), rectosigmoid (14) Age (medians): 69 (ERAS), 68 (conventional care) Gender (% male): 50 BMI: NR Comorbidity status (%): ASA I (37), ASA II (63)	Allocation concealment: NA, grouped according to hospital where operation was performed Blinding: NR Incomplete outcome data: no Selective outcome reporting: no <i>Risk of bias:</i> high
Scioscia 2017 <sup>43</sup> Italy No funding indicated	Inclusion: age >18 years, preoperative evidence of bowel endometriosis (imaging or other), primary laparoscopic approach Exclusion: surgery for reasons other than endometriosis, laparotomy or vaginal approach, endometriosis without bowel involvement, did not consent to intestinal surgery	reduced length of stay (P=.01) but not overall complications (P=.29) Intervention: fast-track care (n=62) Control: conventional care (n=165) NOTE: 1:3 ratio for randomization Follow-up: 30 days Compliance: NR	N=227 Colorectal conditions (%): bowel endometriosis (100) Procedure (%): bowel segmental resection (86) Age (mean): 35 Gender (% male): 0 BMI: 22 Comorbidity status: Barthel index (median) 100 for both groups (complete independence)	Sequence generation: unclear; based on scheduled day of surgery Allocation concealment: unclear; day of surgery assigned by secretary blind to study Blinding: surgeons and anesthetists blinded to the group assigned to them Incomplete outcome data: adequate (no loss to follow-up) Selective outcome reporting: no <i>Risk of bias:</i> medium

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
		Follow-up		
Mari 2016 <sup>40</sup> Italy No funding indicated	Inclusion: indication for major colorectal surgery, age 18-80 years, ASA I to III, autonomous for mobilization and walking, eligible for laparoscopic technique Exclusion: no additional criteria reported	Intervention: ERAS (n=70) Control: standard care (n=70) Follow-up: 5 days Compliance: 90% accordance with ERAS guidelines	N=140 Colorectal conditions (%): diverticulitis (25), adenocarcinoma (75) (left 43%, right 31%, rectal 26%) Age (mean): 66 Gender (% male): 53 BMI: 27 Comorbidity status (%): ASA I (23), ASA II (64), ASA III (14)	Sequence generation: adequate Allocation concealment: unclear Blinding: unclear Incomplete outcome data: adequate; ITT analysis, 4% (n=5) from ERAS group discharged before day 5 blood sample Selective outcome reporting: no
Wang 2015 <sup>45</sup> China CCT No funding indicated	Inclusion: underwent colonic surgery (radical resection of colonic cancer) by one surgical group (July 2012-Oct 2013) Exclusion: NR	Intervention: ERAS program (n=57) Control: usual care (n=60) Follow-up: 28 days Compliance: NR	N=117 Colorectal conditions (%): cancer 100 (right side 79%, left side 21%) Age (mean): 59 Gender (% male): 47 BMI: 24 Comorbidity status: ASA score=1 72%, ASA score=2 28%	Nisk of blas. medium         Sequence generation: NA         (CCT)         Allocation concealment: NA         (CCT)         Blinding: self-administered         questionnaire         Incomplete outcome data:         96% response rate overall         Selective outcome reporting:         no         Risk of bias: medium         Sequence generation:
Feng 2014 <sup>38</sup> China	Inclusion: age 18-75 years; diagnosed with rectal cancer based on clinical symptoms, imaging, and pathological evidence, with no findings of tumor invasion to adjacent organs, local, or distal	Intervention: fast-track surgery (n=60) Control: usual care (n=60)	N=120 (data for n=116) Colorectal condition (s): rectal cancer	Sequence generation: adequate Allocation concealment: adequate



Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
National Natural Scientific Foundation of China Laparoscopic (94%)	metastasis; no preoperative radiotherapy or chemotherapy; ASA physical status I or II Exclusion: pregnant or lactating women; primary diabetes; complete bowel obstruction; severe cardiopulmonary or immune related diseases; human immunodeficiency virus infection or acquired immunodeficiency syndrome related diseases; palliative or emergency operation; combined resection of spleen or pancreas; severe adverse events ( <i>eg</i> , cerebrovascular accident or massive hemorrhage); history of radio- chemotherapy	Follow-up: 4 weeks Compliance: NR	Procedure: radial anterior resection with TME Age (mean): 55 Gender (% male): 66 BMI: 22 Comorbidity status (%): ASA I (4), ASA II (96)	Blinding: adequate (outcomes assessment) Incomplete outcome data: 3% (n=4, unresectable tumor and withdrawal of consent) not included in analyses Selective outcome reporting: no <i>Risk of bias:</i> low
Mari 2014 <sup>41</sup> Italy No funding indicated	Inclusion: age 18-85 years, total laparoscopic high anterior resection, ASA score I-III, BMI <30, no intestinal diversion Exclusion: NR	Intervention: fast-track program (n=26) Control: usual care (n=26) Follow-up: 30 days Compliance: NR	N=52 (data for 50) Colorectal condition (s) (%): colon cancer (69), diverticular disease (31) Age (median): 66 (29-83) Gender (% male): 48 BMI: 25 Comorbidity status (%): ASA, I (67), ASA II (29), ASA III (2)	Sequence generation: NR Allocation concealment: unclear Blinding: NR Incomplete outcome data: 4% (n=2) not included in analyses Selective outcome reporting: BADL not reported <i>Risk of bias:</i> unclear
Gouvas 2012 <sup>25</sup> CCT Greece No funding indicated 2 X 2 study (open vs laparoscopic	Inclusion: diagnosed with adenocarcinoma of lower 2/3 of rectum Exclusion: emergency cases, tumor other than adenocarcinoma, distant metastases, neuromuscular disability, unsuitable for epidural anesthesia; ASA IV, refusal to consent to fast-track care or laparoscopy,	Intervention: laparoscopy combined with fast track (n=42) Control: laparoscopy usual care (n=33) Follow-up: 30 days	N=75 Colorectal conditions (%): rectal cancer (100) Age (mean): 66	Sequence generation: NA, not randomized Allocation concealment: NA, grouped according to surgeon's preference Blinding: NR



Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
and fast track vs usual care)	different operation performed than originally scheduled	Compliance: NR	Gender (% male): 44 (fast track 52% vs 33% usual care, P=.001 across groups) BMI: 28 Comorbidity status (%): ASA I (52), ASA II (36), ASA III (12)	Incomplete outcome data: no Selective outcome reporting: no <i>Risk of bias:</i> high
Wang 2012 <sup>35</sup> China No funding indicated 2 X 2 study (open vs laparoscopic and fast track vs usual care)	Inclusion: no disease of immune system, no pre-operative radiotherapy or chemotherapy, no history of operation on abdominal and distant metastases; ASA score I–III, and self-care function prior to hospitalization Exclusion: association with other organ resection, conversion from laparoscopic operation to laparotomy, inability to place an epidural catheter, inability to infuse drugs, need for a stoma, and emergency operation	Intervention: laparoscopy combined with fast track (n=42) Control: laparoscopy usual care (n=42) Follow-up: 30 days Compliance: NR	N=84, data for 80 Colorectal conditions (%): colon cancer 100 Procedures (%): right hemicolectomy (39), left hemicolectomy (34), sigmoid colectomy (28) Age (median): 56 (both groups) Gender (% male): 66 BMI: 22 Comorbidity status (%): ASA I (39), ASA II (48), ASA3 (14)	Sequence generation: NR Allocation concealment: adequate Blinding: NR Incomplete outcome data: 5% (n=4) excluded from analyses Selective outcome reporting: no <i>Risk of bias:</i> unclear
Wang 2012 <sup>44</sup> China Social Development Fund	Inclusion: no previous abdominal surgery, no preoperative chemotherapy or radiotherapy, absence of distant metastases, ASA physical status I=III Exclusion: age < 18 years, cannot take care of themselves at home, undergone conversion to laparotomy, epidural catheter could not be inserted or did not work, anastomosis performed below 12cm from the anus, or patients receiving a stoma	Intervention: fast-track rehabilitation (n=54) Control: usual care (n=54) Follow-up: 30 days Compliance: study team made rounds 3 times daily to direct care but no compliance data reported	N=107 (data for 99) Colorectal condition (s): adenocarcinoma of colon Procedures (%):right hemicolectomy (34), left hemicolectomy (26), sigmoid colectomy (39) Age (median): 54 (fast track), 53 (usual care)	Sequence generation: unclear Allocation concealment: unclear Blinding: no; groups separated into different wards; outcomes observed by all members of study team and consensus reached Incomplete outcome data: 7% (n=8, unavailable PCA pump,



Evidence-based Synthesis Program

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n)	Demographics	Risk of Bias
		Follow-up		
			Gender (% male): 60 BMI: median 22 (both groups)	conversion to laparotomy, stoma, metaptosis to pelvic floor); not included in analyses
			Comorbidity status (%): ASA I (28), ASA II (52), ASA III (20)	Selective outcome reporting: no
Mara # 004.046	lashusian ang O5 yaan diamaaa af		N 70	Risk of blas: unclear
China	colorectal cancer, undergoing laparoscopic colorectal resection Exclusion: distant metastasis involving	rehabilitation (n=40) Control: usual care (n=38)	Colorectal conditions (%): colon cancer (68), rectal cancer (32)	Allocation concealment:
indicated	Exclusion: distant metastasis involving pelvic invasion, the urethra, or iliac vessels; or were unable to undergo surgery because of poor cardiopulmonary function	Follow-up: 3-44 months Compliance: NR	Procedures (%): right hemicolectomy (17), left hemicolectomy (4), sigmoid colectomy (29), anterior resection (25) Age (median): 71 (fast track), 72 (usual care) Gender (% male): 54 BMI: NR Comorbidity status (%): ASA I	unclear Blinding: NR Incomplete outcome data: no Selective outcome reporting: no <i>Risk of bias:</i> medium
Vlug 2011 <sup>34</sup>	Inclusion: ages 40-80 years: ASA L II or	Intervention: Japaroscopy	(28), ASA II (55), ASA III (17)	Sequence generation: NR
<i>LAFA-study</i> The Netherlands (multisite)	III; elective segmental colectomy for histologically confirmed adenocarcinoma or adenoma; without evidence of metastatic disease	combined with fast track (n=106) Control: laparoscopy usual	Colorectal conditions (%): colon cancer and benign disease 100	Allocation concealment: adequate
Industry 2 X 2 study (open vs laparoscopic	Exclusion: prior midline laparotomy, unavailability of a laparoscopic surgeon, emergency surgery, or a planned stoma	care (n=110) Follow-up: 30 days Compliance: 11.2 of the 15 components successfully	Procedures (%): right colectomy (47), left colectomy (53) Age (mean): 67	Blinding: patients and medical staff blinded for surgical approach until day of discharge)

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
and fast track vs usual care)		applied per patient; 6.0 components of fast track were successfully applied per patient in the usual care group	Gender (% male): 58 BMI: 26 Comorbidity status (%) ASA I/II	Incomplete outcome data: 3% (n=7) excluded from analyses (3 protocol violation, 2 withdrew consent) Selective outcome reporting:
			(81), III (19)Comorbidity (%): 69	no <i>Risk of bias:</i> medium
Mixed Open and L	Laparoscopic Surgery Studies	1	<u> </u>	
Forsmo 2016 <sup>50</sup> Norway Funding: Internal (University Hospital)	Inclusion: age >18 years, scheduled for elective open or laparoscopic colorectal surgery for malignant or benign disease; also included rectal cancer patients who had pelvic radiation Exclusion: multivisceral resection planned, ASA IV, pregnancy, emergency operation, impaired mental capacity making consent difficult, inability to adapt to ERAS criteria NOTE: operating surgeon decided which surgical approach should be used	Intervention: enhanced recovery after surgery (n=162) Control: standard care (n=162) Follow-up: 30 days Compliance: significant differences between groups for a) preoperative counseling (ERAS 100%), b) carbohydrate drink (night before and 2 hr before surgery (ERAS 100%), c) laxative (ERAS 100%), d) intravenous anesthesia (ERAS 99%), e) earlier and increased oral intake and decreased intravenous fluid (ERAS group), f) earlier and increased mobilization (ERAS group), g) laxative POD1 (ERAS 80%, standard 3%), h) post-op oral opiates	N=324 (data for 307) Colorectal conditions (%): colon (46), rectal (54) (overall 79% malignant) Procedures (%): right (25), left or sigmoid (21), low anterior resection (30), abdominoperineal (20), proctocolectomy (5) Age (median): 65 (ERAS), 66 (usual care) Gender (% male): 54 BMI: NR Comorbidity status (%): ASA I (21), ASA II (63), ASA III (15)	Sequence generation: adequate Allocation concealment: adequate Blinding: none Incomplete outcome data: 5% excluded after randomization (protocol violation, emergency procedure, different hospital) Selective outcome reporting: no <i>Risk of bias:</i> low



Evidence-based Synthesis Program

Author, year Country Funding Source	Inclusion/Exclusion Criteria	Intervention (n) Control (n) Follow-up	Demographics	Risk of Bias
		<ul> <li>i) post-op nasogastric tube (ERAS 3%, standard 12%),</li> <li>j) urine catheter removal (medians: ERAS POD2, standard POD4),</li> <li>k) thoracic epidural removal (medians: ERAS POD2, standard POD4)</li> </ul>		

ASA=American Society of Anesthesiologists score; BMI= body mass index; ERAS=enhanced recovery after surgery; NR=not reported; POSSUM=Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity; POD=post-operative day; TME=total mesorectal excision

## Table 2. Final Health Outcomes, Part A

Author Year Population	Length of stay, days mean (SD)		Length of stay (totalª), mean (SD)		Overall morbidity % (n/N)		Overall mortality (note timepoint) % (n/N)	
-	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Open Surgery Studi	es							
Feng 2016 <sup>23</sup> Colorectal cancer	Post-operative 7.5 (2.2) (n=116) P=001 <sup>b</sup>	Post-operative 8.6 (2.8) (n=114)	NR	NR	Surgical complications 6 (7/116) P=.03	Surgical complications 15 (17/114)	NR	NR
Pappalardo 2016 <sup>31</sup> Rectal cancer	Dischargeable <sup>c</sup> POD4 68% (17/25) POD5 20% (5/25) POD6 12% (3/25) P<.05 (overall)	Dischargeable <sup>c</sup> POD4 16% (4/25) POD5 20% (5/25) POD6 32% (8/25) POD7 or longer 28% (7/25)	NR	NR	NR	NR	0 (0/25)	0 (0/25)
Jia 2014 <sup>27</sup> Colorectal cancer (elderly)	9.0 (1.8) (n=117) P<.001	13.2 (1.3) (n=116)	NR	NR	NR	NR	Perioperative 0 (0/117)	Perioperative 0 (0/116)
Nanavati 2014 <sup>30</sup> Gastrointestinal surgery (3% cancer)	4.7 (1.3) (n=30) P=.000	7.3 (1.4) (n=30)	NR	NR	NR	NR	30 day 0 (0/30)	30 day 0 (0/30)
Gouvas 2012 <sup>25</sup> <i>CCT</i> Rectal cancer	Median 7 (range 4-13) P=.001	Median 8 (range 7-23)	Median 7 (range 4-25) P=.104	Median 8 (range 7-25)	Overall morbidity (related to complications) 39 (14/36) P=.18 <sup>b</sup>	Overall morbidity (related to complications) 56 (25/45)	30 day 3 (1/36) P=NS	30 day 0 (0/45)
Ren 2011 <sup>32</sup> Colorectal cancer	5.7 (1.6) (n=299) P<.001	6.6 (2.4) (n=298)	NR	NR	Post-op complications 9.7 (29/299) P=.90	Post-op complications 9.4 (28/298)	30 day 0 (0/299)	30 day 0 (0/298)

Author Year Population	Length of stay, days mean (SD)		Length of stay (totalª), mean (SD)		Overall morbidity % (n/N)		Overall mortality (note timepoint) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Wang 2012 <sup>35</sup> Colon cancer	NR	NR	Post-operative 6.5 (4.1) (n=41) P<.05	Post-operative 7.4 (4.2) (n=42)	Overall complications 17 (7/41) P=NS	Overall complications 24 (10/42)	30 day 0 (0/41) P=NS	30 day 2 (1/42)
Yang 2012 <sup>37</sup> Colorectal cancer	6.0 (1.0) (n=32) P<.05	11.7 (3.8) (n=30)	NR	NR	Total infectious complications 6 (2/32) Total non- infectious complications 13 (4/32) Overall P=.09 <sup>b</sup>	Total infectious complications 27 (8/30) Total non- infectious complications 13 (4/30)	NR	NR
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Postoperative Median 6 (IQR 4.5-10) P=.032	Postoperative Median 7 (IQR 6-10.5)	Postoperative Median 7 (IQR 5-11) P=NS	Postoperative Median 7 (IQR 6-13)	Overall morbidity (related to complications) 46 (43/93) P=NS	Overall morbidity (related to complications) 41 (41/98)	30 day 4 (4/93) P=NS	30 day 2 (2/98)
Wang 2011 <sup>36</sup> Colorectal cancer	Postoperative 5.1 (3.1) (n=106) P=.001	Postoperative 7.6 (4.8) (n=104)	NR	NR	Patients with complications 19 (20/106) P=.02	Patients with complications 38 (39/104)	2 (2/106) P=.57	1 (1/104)
lonescu 2009 <sup>26</sup> Rectosigmoid (58%) or colon (42%) cancer	6.4 (3.4) (n=48) P=.001	9.2 (2.7) (n=48)	NR	NR	NR	NR	NR	NR
Muller 2009 <sup>29</sup> Colon surgery (87% malignant) with primary anastomosis	Median LOS 5 (2-30) (n=76) P<.0001	Median LOS 9 (6-30) (n=75)	NR	NR	Total complications 21 (16/76) P=.001	Total complications 49 (37/75)	NR	NR

Author Year Population	Length of stay, days mean (SD)		Length of stay (totalª), mean (SD)		Overall morbidity % (n/N)		Overall mortality (note timepoint) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Šerclová 2009 <sup>33</sup> Intestinal resection (78% Crohn's disease, 7% cancer)	7.4 (1.3) (n=51) P<.001	10.4 (3.1) (n=52)	NR	NR	Total complications 22 (11/51) P=.003	Total complications 48 (25/52)	0 (0/51)	0 (0/52)
Khoo 2007 <sup>28</sup> Colon (67%) or rectal (33%) cancer	Median 5 (range 3-37) P<.001 Rectal cancer 5.5 (4-37) Colon cancer 4 (3-13)	Median 7 (range 4-63) Rectal cancer 8.5 (4-63) Colon cancer 7 (5-35)	Median 5 (range 3-37) P<.001	Median 7 (range 4-63)	NR	NR	At day 14 0 (0/35)	At day 14 6 (2/35)
Gatt 2005 <sup>24</sup> Colon surgery (69% malignant)	Median 5 (IQR 4-9) P=.03	Median 7.5 (IQR 6-10)	NR	NR	Total complications of surgery 47 (9/19) P=.08	Total complications of surgery 75 (15/20)	At day 30 5 (1/19) P=.49 <sup>b</sup>	At day 30 0 (0/20)
Anderson 2003 <sup>22</sup> Colon surgery (72% malignant)	4.0 (1.8) (n=14) Median 3 (IQR 2-7) P=.002 for both	7.0 (2.1) (n=11) Median 7 (IQR 4-10)	NR	NR	NR	NR	At day 30 0 (0/14) P=NS	At day 30 9 (1/11)
Laparoscopic Studi	es							
Ota 2017 <sup>42</sup> CCT Colorectal cancer	Postoperative Median 8.5 (5-41) P<.001	Postoperative Median 14 (7-46)	NR	NR	NR	NR	0 (0/159)	0 (0/161)
and 91% (control) had laparoscopic surgery	riteria POD3 (1-39) P<.001	riteria POD10 (7-56) P<.001						
Scioscia 2017 <sup>43</sup> Bowel endometriosis	Median 3 (3-12) P<.001	Median 7 (4-33)	NR	NR	NR	NR	NR	NR

Author Year Population	Length of mean	stay, days (SD)	Length of stay (SD	/ (totalª), mean )	Overall morbidity % (n/N)		Overall mortality (note timepoint) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Mari 2016 <sup>40</sup> Colorectal cancer (75%) or diverticular disease (25%)	Day of discharge 5.0 (2.6) P<.05	Day of discharge 7.2 (3.0)	NR	NR	Patients with complications 17 (12/70) P=NS	Patients with complications 21 (15/70)	0 (0/70)	0 (0/70)
Wang 2015 <sup>45</sup> CCT Colon cancer	Postoperative 6.1 (1.7) P<.001	Postoperative 8.7 (2.8)	NR	NR	Total morbidity 17.5% (10/57) P=.24	Total morbidity 26.7% (16/60)	0 (0/57)	0 (0/60)
Feng 2014 <sup>38</sup> Rectal cancer	Postoperative 5.1 (1.4) (n=57) P<.001	Postoperative 7.0 (2.3) (n=59)	All patients ad before o	mitted 2-3 days operation	Total complications 3 (2/59) P=.03	Total complications 17 (10/57)	0 (0/57)	0 (0/59)
Mari 2014 <sup>41</sup> Colon cancer (69%) or diverticular disease (31%)	Day of discharge 4.7 (2.4) (n=25) P<.005	Day of discharge 7.7 (2.4) (n=25)	NR	NR	No major compl gro	ications in either oup	0 (0/25)	0 (0/25)
Gouvas 2012 <sup>25</sup> <i>CCT</i> Rectal cancer	Median 4 (range 3-12) P<.001	Median 8 (range 3-18)	Median 4 (range 3-31) P<.001	Median 9 (range 3-22)	Overall morbidity (related to complications) 21 (9/42) P=.008 <sup>b</sup>	Overall morbidity (related to complications) 52 (17/33)	At day 30 2 (1/42) P=NS	At day 30 0 (0/33)
Wang 2012 <sup>35</sup> Colon cancer	NR	NR	Postoperative 5.2 (3.9) (n=40) P<.05	Postoperative 6.3 (4.7) (n=40)	Complications, overall 8 (3/40) P=.48 <sup>b</sup>	Complications, overall 15 (6/40)	At day 30 3 (1/40) P=NS	At day 30 0 (0/40)
Wang 2012 <sup>44</sup> Adenocarcinoma of the colon	NR	NR	Postoperative, median 4 (2-12) P<.01	Postoperative, median 5 (3-48)	Patients with 1 or more complications 12 (6/49) P=.30	Patients with 1 or more complications 20 (10/50)	2 (1/49) on POD3 P=.31	0 (0/50)

Evidence-based Synthesis Program

Author Year Population	Length of mear	stay, days ı (SD)	Length of stay (SD	ngth of stay (totalª), mean (SD)		Overall morbidity % (n/N)		Overall mortality (note timepoint) % (n/N)	
•	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control	
Wang 2012 <sup>46</sup> Colorectal cancer (elderly)	5.5 (5-6) P<.001 (n=40)	7.0 (6-8) (n=38)	NR	NR	Overall complications 5 (2/40) P=.045	Overall complications 21 (8/38)	1 death from he after right hen deaths from myc Groups not significant diffe gro	patic metastasis nicolectomy; 2 ocardial infarction reported; no erence between ups	
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Postoperative Median 5 (IQR 4-7) P=.020	Postoperative Median 6 (IQR 4-8.5)	Postoperative Median 5 (IQR 4-8) P=.026*	Postoperative Median 6 (IQR 4.5-9.5)	Overall morbidity (related to complications) 34 (34/100) P=NS	Overall morbidity (related to complications) 34 (37/109)	At day 30 2 (2/100) P=NS	At day 30 2 (2/109)	
Mixed Open and La	paroscopic Surg	ery Studies		•			•		
Forsmo 2016 <sup>50</sup> Colorectal cancer and benign disease	Postoperative Median 5 (IQR 2-50) P<.001	Postoperative Median 7 (IQR 2-48)	Postoperative Median 5 (IQR 2-50) P=.001	Postoperative Median 8 (IQR 2-48)	Overall morbidity 42 (65/154) P=.69 Patients with 1 or more major complications 11 (17/154) P=.33	Overall morbidity 44 (68/153) Patients with 1 or more major complications 8 (12/153)	< 30 days 2 (3/154) P=.08	< 30 days 0 (0/153)	

ASA= American Society of Anesthesiologists Index; IQR= interquartile range; NR=not reported; NS=not statistically significant; POD=Postoperative day <sup>a</sup> Initial and readmission

<sup>b</sup>Calculated (t-test or Fisher's exact test)

<sup>c</sup> Defined as meeting discharge criteria: normal oral feeding, complete canalization, abdominal drain and vesical catheter removed, no fever, no need for intravenous therapy; NOTE: one patient in traditional care group not accounted for by study authors

## Table 3. Final Health Outcomes, Part B

Author Year Population	Readmis % (	ssion rate n/N)	lleus % (n/N)		Pain score, Clinically meaningful change (note score and define)		Quality of life, Clinically meaningful change (note score and define)	
-	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Open Surgery Studie	es							
Feng 2016 <sup>23</sup> Colorectal cancer	NR	NR	1 (1/116) P=.62	2 (2/114)	NR	NR	NR	NR
Pappalardo 2016 <sup>31</sup> Rectal cancer	NR	NR	NR	NR	NR	NR	NR	NR
Jia 2014 <sup>27</sup> Colorectal cancer (elderly)	NR	NR	NR	NR	NR	NR	NR	NR
Nanavati 2014 <sup>30</sup> Gastrointestinal surgery (3% cancer)	3 (1/30) for leak P=NS	3 (1/30) for leak	3 (1/30) P=NS	10 (3/30)	NR	NR	NR	NR
Gouvas 2012 <sup>25</sup> CCT Rectal cancer	Not reported I ranged fron P=NS betwe	by group, rates n 9.5 to 15% een all groups	8 (3/36) P=.045ª	27 (12/45)	NR	NR	NR	NR
Ren 2011 <sup>32</sup> Colorectal cancer	NR	NR	NR	NR	NR	NR	NR	NR
Wang 2012 <sup>35</sup> Colon cancer	7 (3/41) P=NS	5 (2/42)	NR	NR	NR	NR	NR	NR
Yang 2012 <sup>37</sup> Colorectal cancer	0 (0/32)	0 (0/30)	NR	NR	NR	NR	NR	NR
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	8 (7/93) P=NS	7 (7/98)	Mechanical ileus requiring reoperation n=2 Prolonged postoperative	Mechanical ileus requiring reoperation n=5 Prolonged postoperative	NR	NR	NR	NR

Author Year Population	Readmis % (	ssion rate n/N)	lleus	% (n/N)	Pain score, Clinically meaningful change (note score and define)		Quality of life, Clinically meaningful change (note score and define)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
			(5 days) ileus n=5	(5 days) ileus n=5				
Wang 2011 <sup>36</sup> Colorectal cancer	4 (4/106) P=NS	9 (9/110)	NR	NR	NR	NR	NR	NR
lonescu 2009 <sup>26</sup>	0 (0/48)	0 (0/48)	NR	NR	NR	NR	NR	NR
Rectosigmoid (58%) or colon (42%) cancer	, , ,							
Muller 2009 <sup>29</sup> Colon surgery (87% malignant) with primary anastomosis	4 (3/76) P=NSª	3 (2/75)	Postoperative Ileus 4 (3/76) P=.72ª	Postoperative Ileus 5 (4/75)	NR	NR	NR	NR
Šerclová 2009 <sup>33</sup> Intestinal resection (78% Crohn's disease, 7% cancer)	0 (0/51)	0 (0/52)	NR	NR	VAS pain s Clinically impor- pain defined deviation Clinically signif for FT group vs postoperati	score (0-10) tant difference in as 1 (standard 0.5 to 1.5) ficant lower pain non-FT group for ive days 0-5	NR	NR
Khoo 2007 <sup>28</sup> Colon (67%) or rectal (33%) cancer	9 (3/35) P=.61ª	3 (1/35)	NR	NR	NR	NR	NR	NR
Gatt 2005 <sup>24</sup> Colon surgery (69% malignant)	5 (1/19) P=.17	20 (4/20)	16 (3/19) P=NSª	15 (3/20)	NR	NR	NR	NR
Anderson 2003 <sup>22</sup> Colon surgery (72% malignant)	0 (0/19)	0 (0/20)	7 (1/14) P=NS	9 (1/11)	NR	NR	NR	NR

Evidence-based Synthesis Program

Author Year Population	Readmis % (	sion rate n/N)	lleus 9	% (n/N)	Pain s Clinically mea (note score	score, ningful change and define)	Quality Clinically mea (note score	of life, ningful change and define)
-	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Laparoscopic Studi	es							
Ota 2017 <sup>42</sup> CCT Colorectal cancer	1 (2/159) P=.16	0 (0/161)	6 (10/159) P=.79	6 (9/161)	NR	NR	NR	NR
NOTE: 97% (ERAS) and 91% (control) had laparoscopic surgery								
Scioscia 2017 <sup>43</sup> Bowel endometriosis	18 (11/62) P=.69	16 (26/162)	NR	NR	NR	NR	NR	NR
Mari 2016 <sup>40</sup> Colorectal cancer (75%) or diverticular disease (25%)	NR	NR	3 (2/70) P=NS	6 (4/70)	NR	NR	NR	NR
Wang 2015 <sup>45</sup> CCT Colon cancer	NR	NR	5.2 (3/57) P=NS	8.3 (5/60)	Pain Scale QLQ-C30 <sup>b,c</sup> Change from pre-op to POD3: 24.6 P=.82 POD28: 7.9 P=.05	Pain Scale QLQ-C30 <sup>b,c</sup> Change from pre-op to POD3: 22.2 POD28: 11.1	Global Quality of Life (QLQ- C30) <sup>b,c</sup> Change from pre-op to POD3: -10.9 P=.000 POD28: 0.5 P=.11	Global Quality of Life (QLQ- C30) <sup>b,c</sup> Change <sup>s</sup> from pre-op to POD3: -18.7 POD28: -1.8
Feng 2014 <sup>38</sup> Rectal cancer	0 (0/57) P=NS	1.7 (1/59) for rectovaginal fistula	0 (0/57) P=NS	1.7 (1/59)	NR	NR	NR	NR
Mari 2014 <sup>41</sup> Colon cancer (69%) or diverticular disease (31%)	0 (0/25)	0 (0/25)	NR	NR	NR	NR	NR	NR
Gouvas 2012 <sup>25</sup> CCT	Not reported b ranged from	by group, rates 1 9.5 to 15%	7 (3/42) P=.17ª	18 (6/33)	NR	NR	NR	NR

Evidence-based Synthesis Program

Author Year Population	Readmis % (	sion rate n/N)	lleus	% (n/N)	Pain score, Clinically meaningful change (note score and define)		Quality Clinically mea (note score	/ of life, ningful change and define)
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Rectal cancer	P=NS betwe	en all groups						
Wang 2012 <sup>35</sup> Colon cancer	3 (1/40) P=NS	8 (3/40)	NR	NR	NR	NR	NR	NR
Wang 2012 <sup>44</sup> Adenocarcinoma of the colon	4 (2/49) P=.66	6 (3/50)	NR	NR	NR	NR	NR	NR
Wang 2012 <sup>46</sup> Colorectal cancer (elderly)	NR	NR	NR	NR	NR	NR	NR	NR
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	6 (6/100) P=NS <sup>a</sup>	6 (7/109)	Mechanical ileus requiring reoperation n=3 Prolonged postoperative ileus n=7	Mechanical ileus requiring reoperation n=0 Prolonged postoperative ileus n=8	NR	NR	NR	NR
Mixed Open and La	paroscopic Surg	ery Studies						•
Forsmo 2016 <sup>50</sup> Colorectal cancer and benign disease	19 (29/154) P=.23	13 (21/153)	Mechanical, requiring reoperation 0 (0/154) P=.32 Prolonged postoperative 3 (4/154) P=.35	Mechanical, requiring reoperation 1 (1/153) Prolonged postoperative 5 (7/153)	NR	NR	NR	NR

NR=not reported; NS=not statistically significant; POD=post-operative day <sup>a</sup> Calculated (Fisher's exact test)

<sup>b</sup>QLQ-C30=European Organization for Research and Treatment of Cancer Quality of Life tool (cancer-specific); QLQ-CR29=colonic cancer specific module; higher scores for function and quality of life indicate higher function and higher quality of life

<sup>c</sup> Change of 5-10 points (on 0-100 scale) denotes clinically significant change of "little better (or worse)"; change of 10-20 points denotes "moderate better (or worse)"; change of >20 points denotes "very much better (or worse)"

### Table 4. Intermediate Outcomes

Author Year Population	Gastrointest (define Mear	inal function e), days n (SD)	IV fluid adr	ninistration	Mobilization, days Mean (SD)		Pain scale s % (	core (define) n/N)
·	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
<b>Open Surgery Studi</b>	ies							
Feng 2016 <sup>23</sup> Colorectal cancer	Flatus 3.7 (1.1) P=.049 Stool passage 4.8 (1.6) P=.04 Oral intake 3.3 (1.3) P=.03	Flatus 4.3 (1.5) Stool passage 5.8 (2.1) Oral intake 5.3 (1.6)	NR	NR	First ambulation 3.7 (1.7) P=.02	First ambulation 5.4 (2.1)	NR	NR
Pappalardo 2016 <sup>31</sup> Rectal cancer	Bowel movement 52 hours P<.05	Bowel movement 19 to 33 hours later than ERAS group	NR	NR	Mobilization POD1 100 (25/25) Ambulate POD2 100 (25/25)	Mobilization POD2 68% (17/25) POD3 32% (8/25) Ambulate subsequent day for 100%	NR	NR
Jia 2014 <sup>27</sup> Colorectal cancer (elderly)	Flatus, hours 48.5 (9.6) (n=117) P<.001	Flatus, hours 77.7 (7.2) (n=116)	NR	NR	NR	NR	NR	NR
Nanavati 2014 <sup>30</sup> Gastrointestinal surgery (3% cancer)	Flatus 2.8 (n=30) Stool passage 4.0 P<.05 for both	Flatus 4.0 (n=30) Stool passage 6.2	NR	NR	NR	NR	NR	NR
Gouvas 2012 <sup>25</sup> CCT Rectal cancer	First bowel movement Median 4 (range 1-7) P<.001	First bowel movement Median 6 (range 1-12)	NR	NR	NR	NR	NR	NR
Ren 2011 <sup>32</sup>	Flatus, hours 53.7 (17.1)	Flatus, hours 63.1 (20.0)	NR	NR	NR	NR	NR	NR

Evidence-based Synthesis Program

Author Year Population	Gastrointest (define Mean	inal function ), days ı (SD)	IV fluid adı	ministration	Mobiliza Mear	tion, days າ (SD)	Pain scale score (define) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Colorectal cancer	(n=299) Bowel movement, hours 73.7 (23.7) P<.001 for both	(n=298) Bowel movement, hours 88.8 (29.5)						
Wang 2012 <sup>35</sup>	NR	NR	NR	NR	NR	NR	NR	NR
Colon cancer								
Yang 2012 <sup>37</sup> Colorectal cancer	Flatus 2 (1) (n=32) Defecation 3.8 (1.6) Soft Diet 4.0 (2.0) P<.05 for all	Flatus 4 (2) (n=30) Defecation 6.4 (2.5) Soft Diet 8.2 (2.2)	NR	NR	NR	NR	NR	NR
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Medians Tolerate solid food 1 (IQR 1–3) Flatus 1 (IQR 1–3) Stool passage 3 (IQR 2–4) Overall dis- charge criteria (including components above and mobilization) achieved significantly earlier in ERAS group versus usual care	Medians Tolerate solid food 3 (IQR 2–5) Flatus 2 (IQR 1–3) Stool passage 4 (IQR 3–6)	NR	NR	Mobilization, median minutes POD1 120 (60- 215) Mobilization as pre-operative, median days 4 (IQR 3–7)	Mobilization, median minutes POD1 20 (0- 60) Mobilization as pre-operative, median days 6 (IQR 5–8)	SF-36 Bodily Pa to baseline at 4 significant diffe gro	in score returned weeks with no erences across ups
Wang 2011 <sup>36</sup>	Flatus 2.1 (2.0)	Flatus 3.2 (2.5)	NR	NR	Walk on surgery day	Walk on surgery day	NR	NR

Evidence-based Synthesis Program

Author Year Population	Gastrointest (define Mear	inal function ), days ı (SD)	tion IV fluid administration Mean (SD)		ion, days ı (SD)	Pain scale score (define) % (n/N)		
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Colorectal cancer	(n=106) P=.001	(n=104)			35% (11/106) P=.001 Walk on day 1 53% (56/106) P=.000 Walk on day 2 85% (90/106) P=.001	0% (0/104) Walk on day 1 23% (24/104) Walk on day 2 59% (61/104)		
Ionescu 2009 <sup>26</sup> Rectosigmoid (58%) or colon (42%) cancer	Bowel function, hours 43.7 (14.9) (n=48) P=.042 Solid Food intake, hours 42.2 (12.7) P=.01 Fluid intake, hours 10.9 (8.1) P=.001	Bowel function, hours 52.02 (23.7) (n=48) Solid Food intake, hours 64.3 (23.3) Fluid intake, hours 23.5 (16.9)	NR	NR	Complete Mobilization, hours 19.6 (8.6) P=.001	Complete Mobilization, hours 37.1 (23.9)	NR	NR
Muller 2009 <sup>29</sup> Colon surgery (87% malignant) with primary anastomosis	NR	NR	NR	NR	NR	NR	NR	NR
Šerclová 2009 <sup>33</sup> Intestinal resection (78% Crohn's disease, 7% cancer)	Bowel Movement 1.3 (0.8) (n=51) Stool 2.1 (1.1) P<.001 for both Semi-solid and solid diet on Day 5 100 (51/51)	Bowel Movement 3.1 (1.0) (n=52) Stool 3.9 (1.1) Semi-solid and solid diet on Day 5 20 (10/52)	NR	NR	Day 0 64% could walk Day 1 54% walked 44% used treadmill 2% rehabilitated in sitting position only	Day 0 0% could walk Day 1 14% walked 2% used treadmill 68% rehabilitated in sitting position only	Mean daily VAS values (post-op day 0 to 5) 1.6, 1.0, 0.6, 0.3, 0, 0	Mean daily VAS values (post-op day 0 to 5) 3.2, 2.4, 1.8, 1.6, 1.2, 0.8

₩ • •

Evidence-based Synthesis Program

Author Year Population	Gastrointest (define Mean	inal function ), days ) (SD)	IV fluid administration Mobilization, days Pain scale score (d Mean (SD) % (n/N)		core (define) n/N)			
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
	P<.001					16% rehabilitated in bed		
Khoo 2007 <sup>28</sup> Colon (67%) or rectal (33%) cancer	Tolerate solid diet Median 1 (range 0-6) Stool passage/ stoma functioning 3 (range 1-5) P<.001 for both	Tolerate solid diet Median 4 (range 2-9) Stool passage/ stoma functioning 5 (range 0-23)	Median over 47 hours peri- operatively 3000 mL	Median over 47 hours peri- operatively 6263 mL	Median 2 (range 1–10) P<.001	Median 4 (range 2–32)	NR	NR
Gatt 2005 <sup>24</sup> Colon surgery (69% malignant)	Ability to tolerate diet of 3 light meals a day Median, hours approx. 50 P=.04	Ability to tolerate diet of 3 light meals a day Median, hours approx. 90	Duration of intravenous fluids from the time of surgery Median, hours approx. 35 P=.007	Duration of intravenous fluids from the time of surgery Median, hours approx. 68	No difference groups in time to to toilet una	s between the b be able to walk ided (P=.79)	ween the able to walk (P=.79) No differences between the groups in pain scores	
Anderson 2003 <sup>22</sup> Colon surgery (72% malignant)	Ability to tolerate diet of 3 light meals a day Median, hours 48 (IQR 33-55) P<.001	Ability to tolerate diet of 3 light meals a day Median, hours 76 (IQR 70- 110)	Discontinuation of supplemental intravenous fluids Median, hours 26 (IQR 24-37) P<.001	Discontinuation of supplemental intravenous fluids Median, hours 57 (IQR 42- 105)	Walk to toilet unaided Median, hours 46 (IQR 37-54) P=.04	Walk to toilet unaided Median, hours 69 (IQR 44- 121)	ilet Post-op day 1 I median pain scores at rest, on movement, and on coughing al significantly higher in usual car group versus intervention group Post-op day 7 pain on coughing remained significantly higher in usual car	
Laparoscopic Studi	es							
Ota 2017 <sup>42</sup> CCT Colorectal cancer NOTE: 97% (ERAS) and 91% (control) had laparoscopic surgery	Flatus Median 1 (1-5) P<.001 Bowel movement 2 (1-6) P<.001	Flatus Median 2 (1-5) Bowel movement 3 (1-7)	IV fluid until POD Median 1 (1-11) P<.001	IV fluid until POD Median 5 (3-35)	NR	NR	NR	NR

₩ • •

Evidence-based Synthesis Program

Author Year Population	Gastrointest (define Mear	inal function e), days ו (SD)	IV fluid adr	ministration	Mobilizat Mear	ion, days ı (SD)	Pain scale score (define) % (n/N)	
•	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
	Oral food 1 (1-31) P<.001	Oral food 3 (1-9)						
Scioscia 201743	NR	NR	NR	NR	NR	NR	NR	NR
Bowel endometriosis								
Mari 2016 <sup>40</sup> Colorectal cancer (75%) or diverticular disease (25%)	Flatus 1.6 (0.7) P<.05 Bowel movement P=NS (data NR) Solid diet 1.5 (0.9) P<.05	Flatus 2.1 (0.8) Bowel movement (data NR) Solid diet 3.0 (0.5)	NR	NR	Walk ≥100 m 1.5 (0.7) P<.05	Walk ≥100 m 2.6 (0.9)	NR	NR
Wang 2015 <sup>45</sup> CCT Colon cancer	Flatus, hours 60.9 (11.1) P=.000 Bowel movement, hours 75.1 (14.9) P=.002	Flatus, hours 74.2 (16.3) Bowel movement, hours 85.5 (19.4)	NR	NR	First time out of bed, hours 15.3 (3.6) P=.000	First time out of bed, hours 42.5 (14.7)	NR	NR
Feng 2014 <sup>38</sup> Rectal cancer	Flatus, hours 53.4 (23.6) P=.001 First defecation, hours 65.2 (22.2) P=.000 All (n=57)	Flatus, hours 67.9 (20.1) First defecation, hours 87.0 (24.9) All (n=59)	NR	NR	NR	NR	Pain (VAS) POD1 4.3 (1.0) P=.02 POD3 2.7 (1.2) P=.03 POD5 2.3 (1.5) P=.11	Pain (VAS) POD1 3.4 (1.0) POD3 1.8 (0.9) POD5 1.6 (1.2)
Mari 2014 <sup>41</sup>	First bowel movement 0.3 (0.65)	First bowel movement 1.7 (0.5)	NR	NR	Walk at least 60-meters 1.3 (0.8)	Walk at least 60-meters 3.6 (0.5)	Pain, based on Higher pain immediate poste	VAS pain scale perception in operative time in

₩ • •

Author Year Population	Gastrointest (define Mear	inal function ), days ı (SD)	IV fluid adr	ninistration	Mobilizat Mear	ion, days n (SD)	Pain scale score (define) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Colon cancer (69%) or diverticular disease (31%)	(n=25) Stool passage 1.6 (1.0) Flatus 0.9 (0.8) Solid diet 1.2 (0.4) All P<.005	(n=25) Stool passage 5 (1.8) Flatus 2.1 (0.9) Solid diet 3.8 (1.0)			(n=25) P<.005	(n=25)	ERAS group (f significant a From day 1, E referred le compared with P=	P<.05) but non- fter 5 hours; ERAS patients ass pain as control patients NS
Gouvas 2012 <sup>25</sup> CCT	First bowel movement Median	First bowel movement Median	NR	NR	NR	NR	NR	NR
Rectal cancer	2 (range 0-6) P<.001	5 (range 2-12)						
Wang 2012 <sup>35</sup>	NR	NR	NR	NR	NR	NR	NR	NR
Colon cancer								
Wang 2012 <sup>44</sup> Adenocarcinoma of the colon	Flatus, median 2 (1-6) P=.017 Semi-liquid diet 1 (1-3) P<.001 Normal diet 3 (2-5) P<.001 All (n=49)	Flatus, median 3 (1-7) Semi-liquid diet 2 (1-5) Normal diet 4 (3-7) All (n=50)	NR	NR	Autonomic mobilization 1 (1-3) P<.001	Autonomic mobilization 2 (1-3)	NR	NR
Wang 2012 <sup>46</sup> Colorectal cancer (elderly)	Flatus, median hours 31 (26-40) P=.001 Bowel movement, median hours 55 (48-63) P=.009 Fluid diet, median hours 12 (11-16)	Flatus, median hours 38 (32-51) Bowel movement, median hours 64 (51-71) Fluid diet, median hours 47 (35-50)	NR	NR	Ambulation, median hours 12 (10-14) P<.001 (n=40)	Ambulation, median hours 19 (16-24) (n=38)	NR	NR
Evidence-based Synthesis Program

Author Year Population	Gastrointestinal function (define), days Mean (SD)		IV fluid administration		Mobilization, days Mean (SD)		Pain scale score (define) % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
	P<.001 All (n=40)	All (n=38)						
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Medians Tolerate solid food 1 (IQR 1-2) Flatus 1 (IQR 1-2) Stool passage 2 (IQR 1-4) Overall dis- charge criteria (including components above and mobilization) achieved significantly earlier in ERAS group versus usual care	Medians Tolerate solid food 2 (IQR 1-3) Flatus 2 (IQR 1–3) Stool passage 3 (IQR 2-4)	NR	NR	Mobilization, median minutes POD1 120 (50- 240) Mobilization as pre-operative, median days 3 (IQR 2-5)	Mobilization, median minutes POD1 30 (15- 60) Mobilization as pre-operative, Median days 5 (IQR 4-7)	NR	NR
Mixed Open and La	paroscopic Surg	ery Studies						
Forsmo 2016 <sup>50</sup>	Flatus, median 1 (0-4)	Flatus, median 1 (1-14)	IV fluid, first 24 hrs (including	IV fluid, first 24 hrs (including	NR	NR	NR	NR
Colorectal cancer and benign disease	Bowel movement, median 1 (1-6) Both P<.001 Tolerate solid food, median 2 (0-9)	Bowel movement, 2 (1-14) Both P<.001 Tolerate solid food, median 1 (0-12)	intraoperative), L (median) 3.9 (1.9-9.0) P=.001 First 7 days 5.6 (1.9-19.2) P<.001	intraoperative), L (median) 4.4 (1.8-9.5) First 7 days 7.8 (2.8-30.1)				

 P=.61
 IQR=interquartile range; NR=not reported; NS=not statistically significant; POD=post-operative day; VAS= Visual Analogue Scale

## Table 5. Harms Associated with Enhanced Recovery, Part A

Author Year Population	Surgical complie % (n	cations (define) /N)	Need for re % (r	eoperation n/N)	Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
•	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
<b>Open Surgery Studi</b>	es							
Feng 2016 <sup>23</sup> Colorectal cancer	Anastomotic leakage 1 (1/116) P=.37 Wound infection 1 (1/116) P=.37	Anastomotic leakage 3 (3/114) Wound infection 3 (3/114)	NR	NR	Anastomotic bleeding 1 (1/116) P=.62	Anastomotic bleeding 2 (2/114)	NR	NR
Pappalardo 2016 <sup>31</sup> Rectal cancer	Anastomotic leakage 12 (3/25) (1 major) P=NS	Anastomotic leakage 8 (2/25) (1 major)	NR	NR	NR	NR	NR	NR
Jia 2014 <sup>27</sup> Colorectal cancer (elderly)	Infection of incision 5 (6/117) P=.57 Anastomotic leakage 3 (3/117) P=1.0	Infection of incision 7 (8/116) Anastomotic leakage 2 (2/116)	NR	NR	NR	NR	Intestinal obstruction 3 (4/117) P=.74	Intestinal obstruction 5 (6/116)
Nanavati 2014 <sup>30</sup> Gastrointestinal surgery (3% cancer)	Anastomotic leakage 0 (0/30) P=NS Wound infection 3 (1/30) Wound dehiscence 3 (1/30) Total 13 (4/30) P=NS	Anastomotic leakage 3 (1/30) Wound infection 0 (0/30) Wound dehiscence 0 (0/30) Total 17 (5/30)	0 (0/130)	3 (1/30) for anastomotic leak	NR	NR	NR	NR

Author Year Population	Surgical complications (define) % (n/N)		Need for reoperation % (n/N)		Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Gouvas 2012 <sup>25</sup> <i>CCT</i> Rectal cancer	Leak 11 (4/36) Wound complications 31 (11/36) P=NS for both	Leak 7 (3/45) Wound complications 38 (17/45)	Not reported b ranged from P=NS betwee	y group, rates n 4 to 15% en all groups	8 (3/36) P=.21ª	20 (9/45)	Obstruction 3 (1/36) P=NS	Obstruction 2 (1/45)
Ren 2011 <sup>32</sup>	Wound infection	Wound infection 2 (5/298)	NR	NR	NR	NR	Intestinal	Intestinal Obstruction
Colorectal cancer	Anastomotic Leaks 2 (5/299) Intestinal Perforation 0 (1/299) P=NS for all	Anastomotic Leaks 2 (5/298) Pancreatic Leakage 0 (1/298)					2 (6/299) P=NS Gastric retention 3 (10/299) P=.30 <sup>a</sup> Diarrhea 0 (1/299)	2 (7/298) Gastric retention 2 (5/298)
Wang 2012 <sup>35</sup>	"Surgical" <sup>b</sup> 7 (3/41) P–NS	"Surgical" <sup>ь</sup> 7 (3/42)	NR	NR	NR	NR	"General" <sup>b</sup> 10 (4/41) P–NS	"General" <sup>b</sup> 17 (7/42)
Yang 2012 <sup>37</sup> Colorectal cancer	Surgical site infection 3 (1/32) P=.61	Surgical site infection 7 (2/30)	NR	NR	NR	NR	Dysbiosis 3 (1/32) P=.10 <sup>a</sup>	Dysbiosis 17 (5/30)
	Anastomotic leaks 0 (0/32)	Anastomotic leaks 0 (0/30)						

Author Year Population	Surgical complications (define) % (n/N)		Need for reoperation % (n/N)		Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Major complications (including non- surgical) 20 (18/93) P=NS	Major complications (including non- surgical) 21 (21/98)	14 (13/93) P=NS	18 (18/98)	NR	NR	Minor complications (including surgical) 26 (25/93) P=NS	Minor complications (including surgical) 19 (20/98)
	Including: Anastomotic leakage n=8 (2 fatal)	Anastomotic leakage n=7 latrogenic bowel perforation n=1						
	latrogenic bowel perforation n=2	Dehiscence n=3						
	Dehiscence n=6 Wound infection 16 total	Wound infection 10 total						
Wang 2011 <sup>36</sup> Colorectal cancer	Anastomotic leakage 4 (4/106) Wound infection 4 (4/106) P=NS for both	Anastomotic leakage 2 (2/104) Wound infection 7 (7/104)	2 (2/106) for bowel obstruction	5 (5/104) for bowel obstruction	NR	NR	Bowel obstruction 2 (2/106) P=.28 Re-insertion of nasogastric tube 4 (4/106)	Bowel obstruction 5 (5/104) Re-insertion of nasogastric tube 11 (12/104)
lonescu 2009 <sup>26</sup> Rectosigmoid (58%) or colon (42%) cancer	Anastomotic leak 2 (1/48) Wound infection 8 (4/48) P=NS for both	Anastomotic leak 2 (1/48) Wound infection 10 (5/48)	0 (0/48) for anastomotic leak P=NS <sup>a</sup>	2 (1/48) for anastomotic leak	NR	NR	Post-operative nausea and vomiting 35 (17/48) P=.54	Post-operative nausea and vomiting 43 (21/48)

Author Year Population	Surgical complic % (n	cations (define) /N)	Need for re % (r	Need for reoperation % (n/N)		g % (n/N)	General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Muller 2009 <sup>29</sup> Colon surgery (87% malignant) with primary anastomosis	Wound infection 5 (4/76) P=.37 <sup>a</sup> Anastomotic leaks 1 (1/76) P=.62 <sup>a</sup>	Wound infection 9 (7/75) Anastomotic leaks 3 (2/75)	NR	NR	Postoperative bleeding 1 (1/76) P=.62 <sup>a</sup>	Postoperative bleeding 3 (2/75)	"Other events" 0 (0/76) P=.12ª	"Other events" 4 (3/75)
Šerclová 2009 <sup>33</sup> Intestinal resection (78% Crohn's disease, 7% cancer)	>1 complication 0 (0/51) P=.50 <sup>a</sup> Wound complications 8 (4/51) P=.003	>1 complication 4 (2/52) Wound complications 33 (17/52)	NR	NR	NR	NR	Vomiting Day of surgery 8% POD1 16% POD2 2%* POD3 2% POD4 2% *P<.05 (P=NS all other days)	Vomiting Day of surgery 14% POD1 12% POD2 16% POD3 10% POD4 8%
Khoo 2007 <sup>28</sup> Colon (67%) or rectal (33%) cancer	Anastomotic leakage 3 (1/35) P=.61ª	Anastomotic leakage 9 (3/35)	NR	NR	NR	NR	Nasogastric tube reinsertion 9 (3/35) P=NS <sup>a</sup>	Nasogastric tube reinsertion 11 (4/35)
Gatt 2005 <sup>24</sup> Colon surgery (69% malignant)	Wound infection 0 (0/19) P=.11 <sup>a</sup>	Wound infection 20 (4/20)	NR	NR	NR	NR	Diarrhea/ nausea 5 (1/19) P=NS <sup>a</sup>	Diarrhea/ nausea 10 (2/20)
Anderson 2003 <sup>22</sup> Colon surgery (72% malignant)	Wound infection 7 (1/14) P=NS <sup>a</sup>	Wound infection 0 (0/11)	NR	NR	NR	NR	NR	NR

Author Year Population	Surgical complications (define) % (n/N)		Need for reoperation % (n/N)		Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Laparoscopic Studie	es							
Ota 2017 <sup>42</sup> CCT Colorectal cancer NOTE: 97% (ERAS) and 91% (control) had laparoscopic surgery	Surgical complications (total) 17 (27/159) P=NS Surgical site infection 3 (5/159) P=1.0 Intraperitoneal infection 0 (0/159) P=.25 Anastomotic leakage 3 (4/159) P=.99	Surgical complications (total) 16 (26/161) Surgical site infection 4 (6/161) Intraperitoneal infection 2 (3/161) Anastomotic leakage 3 (4/161)	1 (2/159) P=.16	4 (6/161)	Anastomotic bleeding 5 (8/159) P=.02 Intraperitoneal bleeding 0 (0/159) P=.08	Anastomotic bleeding 1 (1/161) Intraperitoneal bleeding 2 (3/161)	NR	NR
Scioscia 2017 <sup>43</sup> Bowel endometriosis	NR	NR	For severe complications 6.5 (4/62) P=.20	For severe complications 8.5 (14/162)	Need for transfusion 3.2 (2/62) P=.73	Need for transfusion 5.5 (9/162)	NR	NR
Mari 2016 <sup>40</sup> Colorectal cancer (75%) or diverticular disease (25%)	Wound infection 3 (2/70) Anastomotic fistula 3 (2/70) P=NS for both	Wound infection 1 (1/70) Anastomotic fistula 4 (3/70)	NR	NR	Proctorrhagia 1 (1/70) P=NS	Proctorrhagia 4 (3/70)	Vomiting 7 (5/70) P=NS	Vomiting 3 (2/70)
Wang 2015 <sup>45</sup> CCT Colon cancer	Wound infection 3.5 (2/57) Anastomotic leakage 1.8 (1/57) P=NS <sup>a</sup> for b oth	Wound infection 3.3 (2/60) Anastomotic leakage 3.3 (2/60)	NR	NR	NR	NR	Gastric retention 1.8 (1/57) P=NS <sup>a</sup>	Gastric retention 3.3 (2/60)

Author Year Population	Surgical complications (define) % (n/N)		Need for reoperation % (n/N)		Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Feng 2014 <sup>38</sup>	Change to open surgery due to	Change to open surgery due to	0 (0/57) P=NS	1.7 (1/59) for	NR	NR	Rectovaginal fistula	Rectovaginal fistula
Rectal cancer	difficulty in tumor resection (4/57) Incision Infection 0 (0/57) Anastomotic leakage 0 (0/57) Abdominal infection 0 (0/57) All P=NS	difficulty in tumor resection (3/59) Incision Infection 1.7 (1/59) Anastomotic leakage 6.8 (4/59) Abdominal infection 0 (0/59)		anastomotic leak			0 (0/57) P=NS	1.7 (1/59)
Mari 2014 <sup>41</sup> Colon cancer (69%) or diverticular disease (31%)	No anastomotic leaks	No anastomotic leaks	NR	NR	NR	NR	NR	NR
Gouvas 2012 <sup>25</sup> CCT Rectal cancer	Leak 10 (4/42) Wound complications 7 (3/42) P=NS for both	Leak 15 (5/33) Wound complications 12 (4/33)	Not reported b ranged fror P=NS betwee	y group, rates n 4 to 15% en all groups	0 (0/42)	0 (0/33)	Obstruction 0 (0/42)	Obstruction 3 (1/33)
Wang 2012 <sup>35</sup> Colon cancer	"Surgical" <sup>ь</sup> 3 (1/40) P=NS	"Surgical" <sup>ь</sup> 5 (2/40)	NR	NR	NR	NR	"General" <sup>b</sup> 5 (2/40) P=NS	"General" <sup>ь</sup> 10 (4/40)
Wang 2012 <sup>44</sup> Adenocarcinoma of the colon	Anastomotic leakage 0 (0/49) Wound infection 6 (3/49) P=NS for both	Anastomotic leakage 2 (1/50) Wound infection 4 (2/50)	None	None	NR	NR	Obstruction 0 (0/49)	Obstruction 2 (1/50)

Evidence-based Synthesis Program

Author Year Population	Surgical complie % (n	cations (define) /N)	Need for reoperation % (n/N)		Bleeding % (n/N)		General or gastrointestinal complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Wang 2012 <sup>46</sup> Colorectal cancer (elderly)	Incision infection	Incision infection 8 (3/38) (n=38) Leakage 0 (0/38)	NR	NR	NR	NR	Obstruction 0 (0/40)	Obstruction 5 (2/38)
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Anastomotic leakage n=7 Wound infection 6 total	Anastomotic leakage n=6 (1 fatal) latrogenic bowel perforation n=2 (1 patient died) Dehiscence n=3 Wound infection 8 total	10 (10/100) P=NS	10 (11/109)	NR	NR	NR	NR
Mixed Open and Lap	paroscopic Surgery	v Studies						
Forsmo 2016 <sup>50</sup> Colorectal cancer and benign disease	Anastomotic leakage <sup>c</sup> Colon: 5 (3/59) P=.45 Rectum: 12 (7/58) P=.17 Wound infection Abdominal: 7 (10/154) P=.51 Perineal: 25 (8/154) P=.81 Abdominal wall dehiscence 3 (5/154) P=.99	Anastomotic leakage <sup>c</sup> Colon: 3 (2/77) Rectum: 4 (2/45) Wound infection Abdominal: 9 (13/153) Perineal: 32 (9/153) Abdominal wall dehiscence 3 (5/153)	11 (17/154) P=.24	7 (11/153)	NR	NR	NR	NR

NR=not reported; NS=not statistically significant <sup>a</sup> Calculated (Fisher's exact test)

<sup>b</sup> Surgical complications includes wound complications, anastomotic leak, and bowel obstruction requiring re-operation; General complications includes cardiovascular, pulmonary, thromboembolic, urinary and other complications

<sup>c</sup> In patients with an anastomosis

## Table 6. Harms Associated with Enhanced Recovery, Part B

Author Year	Foley cat insertion/ot urologic compli	theter re- her renal or ications % (n/N)	Aspiration p pulmonary inf	neumonia or ection % (n/N)	Vascular or cardiovascular complications % (n/N)		Miscellaneous % (I	complications n/N)
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
<b>Open Surgery Studi</b>	ies							
Feng 2016 <sup>23</sup> Colorectal cancer	Urinary retention 2 (2/116) P=.68	Urinary retention 3 (3/114)	Pulmonary infection 1 (1/116) P=.21	Pulmonary infection 4 (4/114)	NR	NR	NR	NR
Pappalardo 2016 <sup>31</sup> Rectal cancer	Urinary complications 0 (0/25)	Urinary complications 0 (0/25)	NR	NR	Vascular complications 0 (0/25)	Vascular complications 0 (0/25)	Pulmonary complications (not specified) 0 (0/25)	Pulmonary complications 0 (0/25)
Jia 2014 <sup>27</sup> Colorectal cancer (elderly)	UTI 4 (5/117) P=.05	UTI 11 (13/116)	Pulmonary infection 5 (6/117) P=.006	Pulmonary infection 16 (19/116)	Heart failure 3 (4/117) P=.02 DVT 3 (4/117) P=.34	Heart failure 11 (13/116) DVT 6 (7/116)	Post-op delirium <sup>a</sup> 3 (4/117) P=.008	Post-op deliriumª 13 (15/116)
Nanavati 2014 <sup>30</sup> Gastrointestinal surgery (3% cancer)	NR	NR	NR	NR	NR	NR	NR	NR
Gouvas 2012 <sup>25</sup> <i>CCT</i> Rectal cancer	Urinary retention 11 (4/36) P=NS	Urinary retention 20 (9/45)	Chest infection 17 (6/36) P=.004 <sup>b</sup>	Chest infection 49 (22/45)	DVT 3 (1/36) Pulmonary embolism 3 (1/36)	DVT 16 (7/45) Pulmonary embolism 4 (2/45)	NR	NR
Ren 2011 <sup>32</sup> Colorectal cancer	NR	NR	NR	NR	Cardiovascular and cerebro- vascular complication 0 (1/299)	Cardiovascular and cerebro- vascular complication 2 (5/298)	NR	NR
Wang 2012 <sup>35</sup> Colon cancer	NR	NR	NR	NR	NR	NR	NR	NR

₩ • •

Author Year	Foley ca insertion/ot urologic compl	theter re- her renal or ications % (n/N)	Aspiration pneumonia or pulmonary infection % (n/N)		Vascular or c complication	ardiovascular ons % (n/N)	Miscellaneous complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Yang 2012 <sup>37</sup> Colorectal cancer	Urine distension 3 (1/32) P=NS	Urine distension 3 (1/30)	Pneumonia 0 (0/32) P=.48	Pneumonia 3 (1/30)	Arrhythmia 0 (0/32) P=NS	Arrhythmia 3 (1/30)	Stress ulcer 0 (0/32) P=NS	Stress ulcer 3 (1/30)
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Urine retention n=6 complications	Urine retention n=1 complication	NR	NR	None reported	CVA n=2 complications (1 fatal)	Other infectious complications n=11 Respiratory n=2 complications (1 fatal)	Other infectious complications n=14 Respiratory n=4 complications
Wang 2011 <sup>36</sup> Colorectal cancer	Catheter re- insertion 4 (4/106) $P=.06^{b}$ Urinary retention 5 (5/106) $P=.01^{b}$ Urinary tract complication 2 (2/106) P=NS	Catheter re- insertion 11 (12/104) Urinary retention 15 (16/104) Urinary tract complication 5 (5/104)	NR	NR	Cardiac complication 2 (2/106) Thrombo- embolic complication 1 (1/106) P=NS <sup>b</sup> for both	Cardiac complication 5 (5/104) Thrombo- embolic complication 3 (3/104)	Pulmonary complication (not specified) 3 (3/106) P=.13 <sup>b</sup>	Pulmonary complication 8 (8/104)
lonescu 2009 <sup>26</sup> Rectosigmoid (58%) or colon (42%) cancer	UTI 0 (0/48) Hematuria 2 (1/48) P=NS for both	UTI 6 (3/48) Hematuria 0 (0/48)	NR	NR	Pulmonary embolism 0 (0/48) P=NS	Pulmonary embolism 2 (1/48)	Postoperative hernia 0 (0/48) P=NS	Postoperative hernia 2 (1/48)
Muller 2009 <sup>29</sup> Colon surgery (87% malignant) with primary anastomosis	Urinary infection/ retention 4 (3/76) P=.49 <sup>b</sup>	Urinary infection/ retention 7 (5/75)	Pneumonia or respiratory events 1 (1/76)	Pneumonia or respiratory events 5 (4/75)	Cardiovascular events 4 (3/76) P=.08 <sup>b</sup>	Cardiovascular events 12 (9/75)	NR	NR

Evidence-based Synthesis Program

Author Year	Foley catheter re- insertion/other renal or urologic complications % (n/N)		Aspiration pneumonia or pulmonary infection % (n/N)		Vascular or cardiovascular complications % (n/N)		Miscellaneous complications % (n/N)	
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Šerclová 2009 <sup>33</sup>	NR	NR	NR	NR	NR	NR	NR	NR
Intestinal resection (78% Crohn's disease, 7% cancer)								
Khoo 2007 <sup>28</sup> Colon (67%) or rectal (33%) cancer	Re-insertion due to urinary retention 11 (4/35) P=.11 <sup>b</sup> UTI 3 (1/35) P=NS	Re-insertion due to urinary retention 0 (0/35) UTI 6 (2/35)	NR	NR	Cardio- respiratory compromise 0 (0/35) P=.11 <sup>b</sup>	Cardio- respiratory compromise 11 (4/35)	Pressure sores 0 (0/35)	Pressure sores 9 (3/35)
Gatt 2005 <sup>24</sup> Colon surgery (69% malignant)	UTI 0 (0/19) P=.49 <sup>b</sup>	UTI 10 (2/20)	Chest infection 5 (1/19) P=NS	Chest infection 0 (0/20)	DVT 10 (2/19) P=.23 <sup>b</sup>	DVT 0 (0/20)	NR	NR
Anderson 2003 <sup>22</sup> Colon surgery (72% malignant)	UTI 7 (1/14) P=.56 <sup>b</sup>	UTI 18 (2/11)	NR	NR	Atrial fibrillation 0 (0/14)	Atrial fibrillation 9 (1/11)	Respiratory depression related to patient- controlled analgesia 0 (0/14)	Respiratory depression related to patient- controlled analgesia 9 (1/11)
Laparoscopic Studi	es							
Ota 2017 <sup>42</sup> CCT Colorectal cancer	Hepatorenal complication 0 (0/159) P=.32	Hepatorenal complication 1 (1/161)	NR	NR	Cardiovascular complication 0 (0/159) P=.32 DVT	Cardiovascular complication 1 (1/161)	Respiratory complication (not specified) 0 (0/159) P= 32	Respiratory complication 1 (1/161)
and 91% (control) had laparoscopic surgery	0 (0/159)	0 (0/161			0 (0/159)	0 (0/161)	Delirium 0 (0/159) P=.25	Delirium 2 (3/161)
Scioscia 2017 <sup>43</sup> Bowel endometriosis	NR	NR	NR	NR	NR	NR	Pyrexia 14.5 (9/62) P=.83	Pyrexia 12.7 (21/162)

Evidence-based Synthesis Program

Author Year	Foley cat insertion/ot urologic compli	theter re- her renal or cations % (n/N)	Aspiration p pulmonary inf	neumonia or fection % (n/N)	eumonia or Vascular or c ection % (n/N) complicati		Miscellaneous % (I	complications n/N)
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Mari 2016 <sup>40</sup> Colorectal cancer (75%) or diverticular disease (25%)	Urinary retention 1 (1/70) P=NS	Urinary retention 4 (3/70)	Pneumonia 4 (3/70) P=NS	Pneumonia 7 (5/70)	Atrial fibrillation 0 (0/70) P=NS	Atrial fibrillation 1 (1/70)		
Wang 2015 <sup>45</sup> CCT Colon cancer	NR	NR	Pulmonary infection 1.8 (1/57) P=.62 <sup>b</sup>	Pulmonary infection 5.0 (3/60)	Cardiovascular events 3.5 (2/57) P=NS <sup>b</sup>	Cardiovascular events 3.3 (2/60)	NR	NR
Feng 2014 <sup>38</sup> Rectal cancer	Urinary retention 1.8 (1/57) Urinary infection 0 (0/57) P=NS for both	Urinary retention 3.4 (2/59) Urinary infection 0 (0/59)	Pneumonia 1.8 (1/57) P=NS	Pneumonia 1.7 (1/59)	DVT 0 (0/57)	DVT 0 (0/59)	NR	NR
Mari 2014 <sup>41</sup> Colon cancer (69%) or diverticular disease (31%)	NR	NR	NR	NR	NR	NR	Respiratory distress 4 (1/25) P=NS <sup>b</sup>	Respiratory distress 0 (0/25)
Gouvas 2012 <sup>25</sup> <i>CCT</i> Rectal cancer	Urinary retention 5 (2/42) P=.01 <sup>b</sup>	Urinary retention 24 (8/33)	Chest infection 10 (4/42) P=.20 <sup>b</sup>	Chest infection 21 (7/33)	DVT 2 (1/42) P=NS	DVT 9 (3/33)	NR	NR
Wang 2012 <sup>35</sup> Colon cancer	NR	NR	NR	NR	NR	NR	NR	NR
Wang 2012 <sup>44</sup> Adenocarcinoma of the colon	Catheter reinsertion 8 (4/49) UTI 2 (1/49) P=NS for both	Catheter reinsertion 14 (7/50) UTI 2 (1/50)	NR	NR	Cardiac complication 0 (0/49) P=.49 <sup>b</sup> Thrombo- embolic complication 0 (0/49) P=NS <sup>b</sup>	Cardiac complication 4 (2/50) Thrombo- embolic complication 2 (1/50)	Pulmonary complication (not specified) 2 (1/49) P=NS <sup>b</sup>	Pulmonary complication 4 (2/50)

₩ • •

Evidence-based Synthesis Program

Author Year	Foley ca insertion/ot urologic compl	theter re- her renal or ications % (n/N)	Aspiration p pulmonary inf	neumonia or fection % (n/N)	Vascular or c complication	ardiovascular ons % (n/N)	Miscellaneous % (	complications n/N)
	ERAS	Control	ERAS	Control	ERAS	Control	ERAS	Control
Wang 2012 <sup>46</sup> Colorectal cancer (elderly)	NR	NR	Intrapulmonary infection 3 (1/40) P=.35	Intrapulmonary infection 8 (3/38)	NR	NR	NR	NR
Vlug 2011 <sup>34</sup> Colon cancer and benign disease	Urine retention n=4 complications	Urine retention n=6 complications	NR	NR	CVA n=1 complication (fatal)	CVA n=0	Other infectious complications n=8 Respiratory n=2 complications (1 fatal)	Other infectious complications n=9 Respiratory n=2 complications
Mixed Open and La	paroscopic Surg	ery Studies						
Forsmo 2016 <sup>50</sup> Colorectal cancer and benign disease	Renal failure 5 (8/154) P=.79 Urinary retention 6 (9/154) P=.20 UTI 7 (11/154) P=.31	Renal failure 5 (7/153) Urinary retention 10 (15/153) UTI 10 (16/153)	Pneumonia 5 (7/154) P=.79 Pleural effusion requiring drainage 3 (5/154) P=.47	Pneumonia 5 (8/153) Pleural effusion requiring drainage 2 (3/153)	Cardiac arrhythmia 1 (2/154) P=.65 Pulmonary embolism 1 (2/154) P=.16	Cardiac arrhythmia 2 (3/153) Pulmonary embolism 0 (0/153)	Respiratory complications requiring ICU (not specified) 1 (2/154) P=.16 Post-operative confusion 2 (3/154) P=.99 Intra-abdominal infection 7 (11/154) P= 22	Respiratory complications requiring ICU 0 (0/153) Post-operative confusion 2 (3/153) Intra-abdominal infection 4 (6/153)

 CVA=cerebral vascular accident; DVT=deep vein thrombosis; ICU=intensive care unit; UTI=urinary tract infection; NR=not reported; NS=not statistically significant

<sup>a</sup> Based on Delirium Rating Scale-Revised-98, Delirium was defined as the total score  $\geq 18$ <sup>b</sup> Calculated (Fisher's exact test)

# APPENDIX E. ERAS AND USUAL CARE COMPONENTS

Table 1. ERAS and Standard Care Protocol Components - Open Surgery Studies (SEE Appendix ETable 2 for Gouvas 2012, Wang 2012 J Gast Surg, and Vlug 2011)

Author, Year: Feng 2016 <sup>23</sup>		Reason for Surgery: Colorectal Cancer		
Phases	ERAS	Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation			
PREADMISSION	Nutritional screening/support			
	Medical optimization of chror	nic disease		
	Structured information/patier	nt and caretaker engagement	ü	
	Bowel preparation (no routin	e use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear f before surgery)	luids to 2 hours and solids to 6 hours	ü	
	Carbohydrate treatment		ü	
PREOPERATIVE	Thrombosis prophylaxis			
	Infection prophylaxis and/or a alcohol	skin preparation with chlorhexidine-	ü	
	Nausea and vomiting prophy			
	Pre-anesthetic sedative med	ication (no routine use)		
	Minimal invasive surgical tec	hniques		
	Standardized anesthesia pro blocks with local anesthetics surgery and spinal analgesia alternative to thoracic epidur	ü		
INTRAOPERATIVE	Maintain fluid balance; vasor	pressors for blood pressure control		
	Restrictive use of surgical sit	e drains	ü	
	Remove nasogastric tubes b routine use)	efore reversal of anesthesia (and no		
	Control of body temperature		ü	
	Early mobilization		ü	
	Early intake of oral fluids and	l solids	ü	
	Early removal of urinary cath	eters and intravenous fluids	ü	
POSTOPERATIVE	Chewing gum, laxatives, per	ipheral opioid-blocking agents		
	Protein and energy-rich nutri	tional supplements	ü	
	Glucose control			
	Multimodal approach to opio thoracic epidural analgesia ( (laparoscopic surgery); also	id-sparing pain control – consider open surgery) or spinal analgesia NSAIDS and paracetamol	ü	
	Multimodal approach to cont	rol of nausea and vomiting		
	Prepare for early discharge			



Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)		
	Carbohydrate treatment		
REOPERATIVE	Thrombosis prophylaxis	ü	
	Infection prophylaxis including skin preparation with chlorhexidine-alcohol	ü	
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü (epidural)	
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia		
	Control of body temperature		
	Early mobilization		
	Early intake of oral fluids and solids		
	Early removal of urinary catheters and intravenous fluids		
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
OSIOFERALIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Phases	ERAS Components	ERAS	Standard
Fliases		Protocol	Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)		
	Carbohydrate treatment	ü	
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		ü
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
POSTOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Author, Year: Nanavati 2014 <sup>30</sup>		Reason for Surgery: Colorectal Pr Closure, 17% Colostoma Closure)	ocedures (429 ; 7% Laparose	% lleostomal copic
Phases	ERAS	Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation			
PREADMISSION	Nutritional screening/suppor	rt		
	Medical optimization of chro	nic disease		
	Structured information/patie	nt and caretaker engagement		
	Bowel preparation (no routir	ne use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear hours before surgery)	fluids to 2 hours and solids to 6		
	Carbohydrate treatment		ü	
PREOPERATIVE	Thrombosis prophylaxis			
	Infection prophylaxis and/or alcohol	skin preparation with chlorhexidine-	ü	
	Nausea and vomiting prophy	ü		
	Pre-anesthetic sedative med	dication (no routine use)		
	Minimal invasive surgical tee	ü		
	Standardized anesthesia pro blocks with local anesthetics surgery and spinal analgesia alternative to thoracic epidu			
INTRAOPERATIVE	Maintain fluid balance; vaso	ü		
	Restrictive use of surgical si	ite drains	ü	
	Remove nasogastric tubes to no routine use)	ü	ü	
	Control of body temperature	)		
	Early mobilization		ü	
	Early intake of oral fluids an	d solids	ü	
	Early removal of urinary cath	heters and intravenous fluids	ü	
	Chewing gum, laxatives, per	ripheral opioid-blocking agents		
POSTOPERATIVE	Protein and energy-rich nutr	itional supplements		
	Glucose control			
	Multimodal approach to opic thoracic epidural analgesia ( (laparoscopic surgery); also	oid-sparing pain control – consider (open surgery) or spinal analgesia NSAIDS and paracetamol		
	Multimodal approach to con	trol of nausea and vomiting		
	Prepare for early discharge			

Phases	ERAS Components	ERAS Protocol	Standard Care Protoco
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol	ü	
	Nausea and vomiting prophylaxis	ü	ü
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery		
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature	ü	
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
POSTOPERATIVE	Early removal of urinary catheters and intravenous fluids	ü (early removal)	ü (early removal)
	Chewing gum, laxatives, peripheral opioid-blocking agents	ü	
	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol	ü	ü
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü (avoid long-acting opiods)	ü (avoid long-acting opiods)
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü (fluid restriction)	ü (fluid restriction)
	Restrictive use of surgical site drains	ü	ü
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature	ü	ü
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements	ü	
OSTOPERATIVE	Glucose control	ü	
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		
	Propare for early discharge		

Phases	ERAS Components	ERAS Protocol	Standard Care Protoco
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)	ü	
	Minimal invasive surgical techniques	ü	
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery		
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
POSTOPERATIVE	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

	Cancer	ERAS	Standard
Phases	ERAS Components	Protocol	Care Protoco
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	ü
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
POSTOPERATIVE	Protein and energy-rich nutritional supplements		
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge	ü	ü

Author, Year: Mulle	r 2009 <sup>29</sup> Reason for Surgery: 87% Colon Ca	ancer	
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	ü
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	<b>ü</b> (4 hrs)	<b>ü</b> (4 hrs)
	Carbohydrate treatment		
PREOPERATIVE	Thrombosis prophylaxis	ü	ü
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol	ü	ü
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	ü
	Restrictive use of surgical site drains	ü	ü
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	ü
	Control of body temperature		
	Early mobilization	ü	ü
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements	ü	
POSTOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Author, Year: Šerclová 2009 <sup>33</sup>		Reason for Surgery: 78% Crohn's Cancer, 6% Other, only ASA I-II, a	, 9% Ulcerativ verage age 35	e Colitis, 7%
Phases	ERAS	Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation			
PREADMISSION	Nutritional screening/suppor	t		
	Medical optimization of chro	nic disease		
	Structured information/patie	nt and caretaker engagement	ü	
	Bowel preparation (no routir	ne use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear hours before surgery)	fluids to 2 hours and solids to 6	ü	
	Carbohydrate treatment		ü	
PREOPERATIVE	Thrombosis prophylaxis			
	Infection prophylaxis and/or alcohol	skin preparation with chlorhexidine-		
	Nausea and vomiting prophy			
	Pre-anesthetic sedative med			
	Minimal invasive surgical teo			
	Standardized anesthesia pro blocks with local anesthetics surgery and spinal analgesia alternative to thoracic epidu			
INTRAOPERATIVE	Maintain fluid balance; vaso	pressors for blood pressure control		
	Restrictive use of surgical si	te drains	ü	
	Remove nasogastric tubes to no routine use)	ü		
	Control of body temperature	•		
	Early mobilization		ü	
	Early intake of oral fluids an	d solids	ü	
	Early removal of urinary cath	neters and intravenous fluids	ü	
	Chewing gum, laxatives, per	ripheral opioid-blocking agents		
	Protein and energy-rich nutr			
POSTOPERATIVE	Glucose control			
	Multimodal approach to opic thoracic epidural analgesia ( (laparoscopic surgery); also	oid-sparing pain control – consider (open surgery) or spinal analgesia NSAIDS and paracetamol	ü	
	Multimodal approach to con	trol of nausea and vomiting		
	Prepare for early discharge			

Phases	ERAS Components	ERAS	Standard
	Smaking/alcohol cossotion	Protocol	Care Protocol
PREADMISSION			
FREADWISSION			
	Structured information/patient and caretaker engagement		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü (3 hrs)	ü (3 hrs)
	Carbohydrate treatment		
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis	ü	
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents	ü	
POSTOPERATIVE	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	<b>ü</b> (3 hrs)	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine-alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids		
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
POSTOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Author, Year: Anderson 2003 <sup>22</sup> Reason for Surgery: 72% Colon Cancer; 28% Other (Colon)			
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine-alcohol	ü	ü
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques		
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization		
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids		
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
POSTOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Author, Year: Ota 2 surgeon's discretio implemented)	017 <sup>42</sup> (Standard Care at n; many components [*] Reason for Surgery: Colon or Laparoscopic Surgery)	re at Reason for Surgery: Colon or Rectosigmoid Cancer (90% nts [*] Laparoscopic Surgery)		
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol	
	Smoking/alcohol cessation			
PREADMISSION	Nutritional screening/support			
	Medical optimization of chronic disease			
	Structured information/patient and caretaker engagement	ü		
	Bowel preparation (no routine use of mechanical bowel prep)	ü <sup>a</sup>		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)			
PREOPERATIVE	Carbohydrate treatment	ü		
	Thrombosis prophylaxis	ü		
	Infection prophylaxis and/or skin preparation with chlorhexidine-alcohol	ü	*	
	Nausea and vomiting prophylaxis			
	Pre-anesthetic sedative medication (no routine use)			
	Minimal invasive surgical techniques	<b>ü</b> (>90%) Iaparoscopic)	ü (>90% laparoscopic)	
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient- controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü (epidural anesthesia)	* (epidural anesthesia)	
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	*	
	Restrictive use of surgical site drains	ü	*	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	*	
	Control of body temperature			
	Early mobilization	ü	*	
	Early intake of oral fluids and solids	ü		
	Early removal of urinary catheters and intravenous fluids	ü		
POSTOPERATIVE	Chewing gum, laxatives, peripheral opioid-blocking agents	ü (gum, laxative)	* (laxative)	
	Protein and energy-rich nutritional supplements	ü		
	Glucose control			
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or	ü		

## Table 2. ERAS and Standard Care Protocol Components – Laparoscopic Surgery Studies

### Evidence-based Synthesis Program

₩ 4

	spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	
	Multimodal approach to control of nausea and vomiting	
	Prepare for early discharge	

<sup>a</sup> not used for right hemicolectomy or transverse colectomy

Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
PREADMISSION	Smoking/alcohol cessation		
	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü (low residue diet)	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)		
PREOPERATIVE	Carbohydrate treatment		
	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques	ü (laparoscopic)	ü (laparoscopic
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery		
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids		
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
OSIOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia		
	(laparoscopic surgery); also NSAIDS and paracetamol		
	(laparoscopic surgery); also NSAIDS and paracetamol Multimodal approach to control of nausea and vomiting		

Author, Year: Mari 2	2016 <sup>40</sup> Reason for Surgery: Major Color 25% Diverticular Disease)	ectal Surgery (7	5% Cancer,
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment		
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine-alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques	<b>ü</b> (laparoscopic)	ü (laparoscopio
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery		
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature		
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids		
POSTOPERATIVE	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements		
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Phases	ERAS Components	ERAS Protocol	Standard Care Protoco
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol	ü	
	Nausea and vomiting prophylaxis	ü	ü
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques	ü	ü
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery		
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature	ü	
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü (early removal)	ü (early removal)
	Chewing gum, laxatives, peripheral opioid-blocking agents	ü	
POSTOPERATIVE	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

Author, rear: reng	Keason for Surgery: Kectal Cance		
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)	ü	
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)		
	Carbohydrate treatment	ü	
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques	ü	ü
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control		
	Restrictive use of surgical site drains	ü	
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)		
	Control of body temperature	ü	
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
POSTOPERATIVE	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

	Disease	EDAG	Standard
Phases	ERAS Components	Protocol	Care Protoco
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement		
	Bowel preparation (no routine use of mechanical bowel prep)		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)		
	Carbohydrate treatment	ü	
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol	ü	ü
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques	ü	ü
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	
	Control of body temperature	ü	ü
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents		
POSTOPERATIVE	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge		

₩ 4

Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)		
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
PREOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis		
	Pre-anesthetic sedative medication (no routine use)		
	Minimal invasive surgical techniques (laparoscopic arms only)	ü	ü
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü	ü
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains		
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü (removal)	
	Control of body temperature	ü	
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids		
	Chewing gum, laxatives, peripheral opioid-blocking agents		
	Protein and energy-rich nutritional supplements	ü	
POSTOPERATIVE	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	
	Multimodal approach to control of nausea and vomiting		
	Prepare for early discharge	ü	

Phases	ERAS Components	ERAS Protocol	Standard Care Protoco						
	Smoking/alcohol cessation								
PREADMISSION	Nutritional screening/support								
	Medical optimization of chronic disease								
	Structured information/patient and caretaker engagement	ü							
	Bowel preparation (no routine use of mechanical bowel prep)	ü							
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü							
	Carbohydrate treatment	ü							
PREOPERATIVE	Thrombosis prophylaxis								
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol								
	Nausea and vomiting prophylaxis								
	Pre-anesthetic sedative medication (no routine use)								
	Minimal invasive surgical techniques (laparoscopic arms only)	ü	ü						
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü							
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü							
	Restrictive use of surgical site drains	ü							
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü							
	Control of body temperature								
	Early mobilization	ü							
	Early intake of oral fluids and solids	ü							
	Early removal of urinary catheters and intravenous fluids	ü							
	Chewing gum, laxatives, peripheral opioid-blocking agents								
POSTOPERATIVE	Protein and energy-rich nutritional supplements								
	Glucose control								
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü							
	Multimodal approach to control of nausea and vomiting								
	Prepare for early discharge								
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol						
----------------	---	------------------	---------------------------	--	--	--	--	--	--
	Smoking/alcohol cessation								
PREADMISSION	Nutritional screening/support								
	Medical optimization of chronic disease								
	Structured information/patient and caretaker engagement								
	Bowel preparation (no routine use of mechanical bowel prep)	ü							
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)								
	Carbohydrate treatment	ü							
PREOPERATIVE	Thrombosis prophylaxis								
	Infection prophylaxis and/or skin preparation with chlorhexidine alcohol	-	ü						
	Nausea and vomiting prophylaxis								
	Pre-anesthetic sedative medication (no routine use)								
	Minimal invasive surgical techniques	ü	ü						
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü							
INTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü							
	Restrictive use of surgical site drains								
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü (removal)							
	Control of body temperature								
	Early mobilization	ü							
	Early intake of oral fluids and solids	ü							
	Early removal of urinary catheters and intravenous fluids	ü							
	Chewing gum, laxatives, peripheral opioid-blocking agents	ü							
	Protein and energy-rich nutritional supplements								
FUSIOFERALIVE	Glucose control								
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol								
	Multimodal approach to control of nausea and vomiting								
	Prepare for early discharge								

Author, Year: Vlug	2011 <sup>34</sup> Reason for Surgery (Open and La	paroscopic): C	olon Cancer
Phases	ERAS Components	ERAS Protocol	Standard Care Protocol
	Smoking/alcohol cessation		
PREADMISSION	Nutritional screening/support		
	Medical optimization of chronic disease		
	Structured information/patient and caretaker engagement	ü	
	Bowel preparation (no routine use of mechanical bowel prep)	ü	ü
	Pre-operative fasting (clear fluids to 2 hours and solids to 6 hours before surgery)	ü	
	Carbohydrate treatment	ü	
REOPERATIVE	Thrombosis prophylaxis		
	Infection prophylaxis and/or skin preparation with chlorhexidine- alcohol		
	Nausea and vomiting prophylaxis	ü	
	Pre-anesthetic sedative medication (no routine use)	ü	
	Minimal invasive surgical techniques (laparoscopic arms only)	ü	ü
	Standardized anesthesia protocol – may use thoracic epidural blocks with local anesthetics and low-dose opioids for open surgery and spinal analgesia or patient-controlled morphine as alternative to thoracic epidural for laparoscopic surgery	ü (and general anesthesia)	ü (and general anesthesia)
NTRAOPERATIVE	Maintain fluid balance; vasopressors for blood pressure control	ü	
	Restrictive use of surgical site drains	ü	ü
	Remove nasogastric tubes before reversal of anesthesia (and no routine use)	ü	ü
	Control of body temperature	ü	ü
	Early mobilization	ü	
	Early intake of oral fluids and solids	ü	
	Early removal of urinary catheters and intravenous fluids	ü	
	Chewing gum, laxatives, peripheral opioid-blocking agents	ü	
OSTOPERATIVE	Protein and energy-rich nutritional supplements	ü	
	Glucose control		
	Multimodal approach to opioid-sparing pain control – consider thoracic epidural analgesia (open surgery) or spinal analgesia (laparoscopic surgery); also NSAIDS and paracetamol	ü	ü
	Multimodal approach to control of nausea and vomiting		

Author, Year: Forsn	no 2016 <sup>50</sup>	Reason for Surgery: Colorectal Surgery (Malignant [79%] or Benign [21%]) (Open [60%] or Laparoscopic [40%] Surgery)						
Phases	ERAS	Components	ERAS Protocol	Standard Care Protocol				
	Smoking/alcohol cessation							
PREADMISSION	Nutritional screening/support							
	Medical optimization of chron							
	Structured information/patier	and caretaker engagement	ü					
	Bowel preparation (no routin	e use of mechanical bowel prep)						
	Pre-operative fasting (clear f before surgery)	luids to 2 hours and solids to 6 hours	ü	ü (fluids to 2 hrs)				
	Carbohydrate treatment		ü					
PREOPERATIVE	Thrombosis prophylaxis		ü	ü				
	Infection prophylaxis and/or alcohol	ü	ü					
	Nausea and vomiting prophy	laxis						
	Pre-anesthetic sedative med	ication (no routine use)	ü					
	Minimal invasive surgical tec	hniques						
	Standardized anesthesia pro blocks with local anesthetics surgery and spinal analgesia alternative to thoracic epidur	unclear	unclear					
	Maintain fluid balance; vasor	pressors for blood pressure control	ü					
INTRAOPERATIVE	Restrictive use of surgical sit	üi (no drain for colon resection)	ü (no drain for colon resection)					
	Remove nasogastric tubes b routine use)	efore reversal of anesthesia (and no	ü	ü				
	Control of body temperature		ü	ü				
	Early mobilization		ü (enforced)	ü				
	Early intake of oral fluids and	l solids	ü (enforced)	ü				
	Early removal of urinary cath	eters and intravenous fluids	ü					
	Chewing gum, laxatives, per	ipheral opioid-blocking agents	ü					
<b>POSTOPED ATIVE</b>	Protein and energy-rich nutri	tional supplements						
FOSTOFERATIVE	Glucose control							
	Multimodal approach to opio thoracic epidural analgesia ( (laparoscopic surgery); also	id-sparing pain control – consider open surgery) or spinal analgesia NSAIDS and paracetamol	ü					
	Multimodal approach to cont	rol of nausea and vomiting						
	Prepare for early discharge							

### Table 3. ERAS and Standard Care Protocol Components - Open and Laparoscopic Surgery Studies

44

126

## APPENDIX F. EVIDENCE PROFILE FOR ERAS COMPARED TO CONTROL FOR COLORECTAL **SURGERIES**

			Quality as	sessment			Nº of p	atients					
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	ERAS	Control	Relative (95% CI)	Absolute (95% CI)	Quality		
	Length of stay												
21	randomized trials	serious ª	serious <sup>b</sup>	not serious	not serious	strong association	1463	1470	-	MD <b>2.4 days lower</b> (3.1 lower to 1.8 lower)	⊕⊕⊕ MODERATE		
	Mortality												
22	randomized trials	serious ª	not serious	not serious	serious <sup>c</sup>	none	16/1619 (1.0%)	9/1636 (0.6%)	<b>OR 1.79</b> (0.81 to 3.95)	4 more per 1,000 (from 1 fewer to 16 more)	⊕⊕ LOW		
	Perioperative morbidity												
19	randomized trials	serious ª	not serious	not serious	not serious	none	299/145 6 (20.5%)	426/146 3 (29.1%)	<b>RR 0.66</b> (0.54 to 0.80)	<b>99 fewer per 1,000</b> (from 58 fewer to 134 fewer)	⊕⊕⊕ MODERATE		
						Readmissions							
19	randomized trials	serious ª	not serious	not serious	serious <sup>d</sup>	none	73/1196 (6.1%)	84/1319 (6.4%)	<b>RR 1.11</b> (0.82 to 1.50)	7 more per 1,000 (from 11 fewer to 32 more)	⊕⊕ LOW		
						Surgical site infect	ion						
17	randomized trials	serious ª	not serious	not serious	serious <sup>d</sup>	none	50/1443 (3.5%)	69/1437 (4.8%)	<b>RR 0.75</b> (0.52 to 1.07)	<b>12 fewer per 1,000</b> (from 3 more to 23 fewer)	⊕⊕ LOW		

CI: Confidence interval; MD: Mean difference; RR: Risk ratio; OR: Odds ratio

Explanations

a. Mostly moderate, high, or unclear RoBb. I-square indicated substantial statistical heterogeneity

c. Wide confidence intervals and very few events

d. Wide confidence intervals

# APPENDIX G. POOLED ANALYSES BY PROCEDURE AND COLORECTAL CONDITION

#### Figure 1. Length of Stay by Procedure<sup>a</sup>

	E	RAS		C	ontrol			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.2.1 Open procedure									
Yang 2012 (37)	6	1	32	11.7	3.8	30	4.2%	-5.70 [-7.10, -4.30]	
Jia 2014 (27)	9	1.8	117	13.2	1.3	116	5.2%	-4.20 [-4.60, -3.80]	-
Muller 2009 (29)	6.7	4.8	76	10.3	4.9	75	4.0%	-3.60 [-5.15, -2.05]	
Serclová 2009 (33)	7.4	1.3	51	10.4	3.1	52	4.7%	-3.00 [-3.92, -2.08]	- <b>-</b>
Anderson 2003 (22)	4	1.8	14	7	2.1	11	4.0%	-3.00 [-4.56, -1.44]	
lonescu 2009 (26)	6.4	3.4	48	9.2	2.7	48	4.4%	-2.80 [-4.03, -1.57]	_ <b>-</b>
Nanavati 2014 (30)	4.7	1.3	30	7.3	1.4	30	5.0%	-2.60 [-3.28, -1.92]	
Wang 2011 (36)	5.1	3.1	106	7.6	4.8	104	4.6%	-2.50 [-3.60, -1.40]	<u> </u>
Gatt 2005 (24)	6.6	4.4	19	9	4.6	20	2.6%	-2.40 [-5.22, 0.42]	
Khoo 2007 (28)	5	8.5	35	7	14.8	35	1.0%	-2.00 [-7.65, 3.65]	
Feng 2016 (23)	7.5	2.2	116	8.6	2.8	114	5.0%	-1.10 [-1.75, -0.45]	
Gouvas 2012-CCT open (25)	7	2.25	36	8	4	45	4.2%	-1.00 [-2.38, 0.38]	
Ren 2011 (32)	5.7	1.6	299	6.6	2.4	298	5.2%	-0.90 [-1.23, -0.57]	+
Vlug 2011 open (34)	7	4.4	93	7	5.2	98	4.2%	0.00 [-1.36, 1.36]	
Subtotal (95% CI)			1072			1076	58.3%	-2.50 [-3.44, -1.56]	◆
Heterogeneity: Tau² = 2.63; Chi	<sup>2</sup> = 212.4	49, df=	= 13 (P	< 0.000	01); I²	= 94%			
Test for overall effect: Z = 5.23 (	P < 0.00	001)							
1.2.2 Laparoscopic procedure									
Ota 2017-CCT (42)	8.5	6	159	14	6.5	161	4.2%	-5.50 [-6.87, -4.13]	
Scioscia 2017 (43)	3	2.3	62	7	4.8	165	4.7%	-4.00 [-4.93, -3.07]	
Gouvas 2012-CCT lap (25)	4	2.3	42	8	3.8	33	4.1%	-4.00 [-5.47, -2.53]	
Mari 2014 (41)	4.7	2.4	25	7.7	2.4	25	4.3%	-3.00 [-4.33, -1.67]	
Wang 2015 (CCT)	6.1	1.7	57	8.7	2.8	60	4.8%	-2.60 [-3.43, -1.77]	
Mari 2016 (40)	5	2.6	70	7.2	3	70	4.7%	-2.20 [-3.13, -1.27]	
Feng 2014 (38)	5.1	1.4	57	7	2.3	59	5.0%	-1.90 [-2.59, -1.21]	
Wang 2012 (46)	5.5	1	40	7	1.8	38	5.0%	-1.50 [-2.15, -0.85]	
Vlug 2011 lap (34)	5	2.9	100	6	2.9	109	4.9%	-1.00 [-1.79, -0.21]	
Subtotal (95% CI)			612			720	41.7%	-2.76 [-3.58, -1.93]	<b>•</b>
Heterogeneity: Tau <sup>2</sup> = 1.33; Chi	<b>²</b> = 58.06	6, df =	8 (P < (	0.00001	); <b>I²</b> = 8	36%			
Test for overall effect: Z = 6.54 (	P < 0.00	001)							
Total (95% CI)			1684			1796	100.0%	-2.62 [-3.25, -1.98]	•
Heterogeneity: $Tau^2 = 2.00$ : Obi	= 270 s	81 df=	: 22 (P	< 0 000	01): 17	= 92%			
Test for overall effect: 7 = 8.06 (	P < 0.00	0011	22 (1	0.000	01/11	5270			-4 -2 0 2 4
Test for subgroup differences: (	Chi²=0	16. df:	= 1 (P =	= 0.69)	² = 0%				Favors ERAS Favors control

#### Figure 2. Length of Stay by Condition

	E	RAS		Co	ontrol			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
1.3.1 Benign									
Scioscia 2017 (43)	3	2.3	62	7	4.8	165	4.6%	-4.00 [-4.93, -3.07]	- <b>-</b>
Serclová 2009 (33)	7.4	1.3	51	10.4	3.1	52	4.6%	-3.00 [-3.92, -2.08]	<u> </u>
Nanavati 2014 (30)	4.7	1.3	30	7.3	1.4	30	4.8%	-2.60 [-3.28, -1.92]	
Subtotal (95% CI)			143			247	13.9%	-3.16 [-3.97, -2.34]	◆
Heterogeneity: Tau² = 0.34; Chi	i <sup>z</sup> = 5.68	df=	2 (P = 0	0.06); I <sup>z</sup> =	= 65%				
Test for overall effect: Z = 7.59 (	(P < 0.00	0001)							
1.3.2 Colorectal cancer	_								
Yang 2012 (37)	6	1	32	11.7	3.8	30	4.0%	-5.70 [-7.10, -4.30]	
Ota 2017-CCT (42)	8.5	6	159	14	6.5	161	4.1%	-5.50 [-6.87, -4.13]	
Jia 2014 (27)	9	1.8	117	13.2	1.3	116	5.0%	-4.20 [-4.60, -3.80]	-
Ionescu 2009 (26)	6.4 C.4	3.4	48	9.2	2.7	48	4.2%	-2.80 [-4.03, -1.57]	
Wang 2015 (CCT)	6.1	1.7	57	8.7	2.8	60	4.7%	-2.60 [-3.43, -1.77]	
Wang 2011 (36)	5.1	3.1	106	7.6	4.8	104	4.4%	-2.50 [-3.60, -1.40]	
KN00 2007 (28)	5	8.5	35	1	14.8	35	1.0%	-2.00 [-7.65, 3.65]	
(Vang 2012 (46)	5.5	22	40		1.8	38	4.8%	-1.50 [-2.15, -0.85]	
Ferig 2016 (23)	1.5	2.2	200	0.0	2.8	200	4.8%	-1.10[-1.70,-0.40]	
Subtotal (95% CI)	5.7	1.0	1009	0.0	2.4	1004	0.0% 42.0%	-0.90 [-1.23, -0.57] -2.88 [-4.03, -1.73]	
Heterogeneity: Tau <sup>2</sup> - 2.96: Chi	<b>≥</b> - 218	83 H	- 9 /P	< 0.000	01\·I≊	- 06%	4210 /0	-2.00 [-1.00, -1.10]	•
Test for overall effect: 7 = 4 92 (	′ — ∠10. ′P < ∩ ∩ſ	00, 41 1001)	- 5 (i	~ 0.0000	517,1	- 30 %			
	, 0.00	,,							
1.3.3 Colorectal cancer/benigr	n								
Muller 2009 (29)	6.7	4.8	76	10.3	4.9	75	3.9%	-3.60 [-5.15, -2.05]	
Anderson 2003 (22)	4	1.8	14	7	2.1	11	3.9%	-3.00 [-4.56, -1.44]	<u> </u>
Mari 2014 (41)	4.7	2.4	25	7.7	2.4	25	4.1%	-3.00 [-4.33, -1.67]	
Gatt 2005 (24)	6.6	4.4	19	9	4.6	20	2.5%	-2.40 [-5.22, 0.42]	
Mari 2016 (40)	5	2.6	70	7.2	3	70	4.6%	-2.20 [-3.13, -1.27]	
Forsmo 2016 (50)	5	8	154	7	7.6	153	3.6%	-2.00 [-3.75, -0.25]	
Vlug 2011 lap (34)	5	2.9	100	6	2.9	109	4.7%	-1.00 [-1.79, -0.21]	
Vlug 2011 open (34)	7	4.4	93	7	5.2	98	4.1%	0.00 [-1.36, 1.36]	•
Subtotal (95% CI)			551			561	31.3%	-2.07 [-2.91, -1.22]	<b>•</b>
Heterogeneity: Tau <sup>2</sup> = 0.94; Chi	F= 22.1	4, df =	= 7 (P =	0.002);	I <b>²</b> = 68	3%			
Test for overall effect: $Z = 4.79$ (	(P < 0.00	JUU1)							
1.3.4 Rectal cancer									
Gouvas 2012-CCT lan (25)	4	23	42	8	3.8	33	4 በ%	-4 00 [-5 47 -2 53]	
Feng 2014 (38)	5.1	1.4	57	7	2.3	59	4.8%	-1.90 [-2.59, -1.21]	_ <b>_</b>
Gouvas 2012-CCT open (25)	7	2.3	36	8	4	45	4.1%	-1.00 [-2.39, 0.39]	<b>_</b> _
Subtotal (95% CI)			135	-		137	12.8%	-2.25 [-3.69, -0.81]	◆
Heterogeneity: Tau <sup>2</sup> = 1.24; Chi	r <b>≃</b> = 9.12,	df=	2 (P = (	0.01); I <sup>2</sup> =	= 78%				
Test for overall effect: Z = 3.06 (	(P = 0.00	)2)							
T-4-1 (05%) OB			4000			40.40	400.05	0.001.000 4.000	
Total (95% CI)			1838			1949	100.0%	-2.59 [-3.22, -1.97]	. ▼.
Heterogeneity: Tau+ = 1.97; Chi	r= 270. m + 0.00	86, di	= 23 (F	- < 0.001	UU1); I	r= 929	D		-4 -2 0 2 4
Test for overall effect: $Z = 8.19$ (	(⊢ < 0.00 ⊖⊳:z - ≎	1001) - az	6 - 0 m	- 0.00	17 - 0	0.4.00			Favors ERAS Favors control
i est for subgroup differences:	Cnif = 3	.76, d	T= 3 (P	= 0.29),	if = 2	0.1%			

₩ 4

#### Figure 3. Mortality by Procedure<sup>a</sup>

	ERA	S	Cont	ol		Peto Odds Ratio	Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	Peto, Fixed, 95% Cl	Peto, Fixed, 95% CI
1.10.1 Open porcedure							
Pappalardo 2016 (31)	0	25	0	25		Not estimable	
Serclová 2009 (33)	0	51	0	52		Not estimable	
Ren 2011 (32)	0	299	0	298		Not estimable	
Jia 2014 (27)	0	117	0	116		Not estimable	
Nanavati 2014 (30)	0	30	0	30		Not estimable	
Anderson 2003 (22)	0	14	1	11	4.5%	0.10 [0.00, 5.34]	
Khoo 2007 (28)	0	35	2	35	9.1%	0.13 [0.01, 2.14]	
Wang 2012 open (35)	0	41	1	42	4.6%	0.14 [0.00, 6.99]	
Wang 2011 (36)	2	106	1	104	13.7%	1.92 [0.20, 18.69]	
Vlug 2011 open (34)	4	93	2	98	26.9%	2.09 [0.41, 10.60]	
Gatt 2005 (24)	1	19	0	20	4.6%	7.79 [0.15, 393.02]	
Gouvas 2012-CCT open (25)	1	36	0	45	4.6%	9.49 [0.18, 489.97]	
Subtotal (95% CI)		866		876	68.1%	1.17 [0.42, 3.25]	<b>•</b>
Total events	8		7				
Heterogeneity: Chi <sup>2</sup> = 7.60, df =	6 (P = 0.2	7); l² =	21%				
Test for overall effect: Z = 0.30 (	P = 0.76)						
1.10.2 Laparoscopic procedur	e						
Ota 2017-CCT (42)	0	159	0	161		Not estimable	
Wang 2015 (CCT)	0	57	0	60		Not estimable	
Mari 2014 (41)	0	25	0	25		Not estimable	
Feng 2014 (38)	0	57	0	59		Not estimable	
Mari 2016 (40)	0	70	0	70		Not estimable	
Vlug 2011 lap (34)	2	100	2	109	18.2%	1.09 [0.15, 7.87]	
Gouvas 2012-CCT lap (25)	1	42	0	33	4.5%	5.96 [0.12, 309.26]	
Wang 2012 lap (35)	1	40	0	40	4.6%	7.39 [0.15, 372.38]	
Wang 2012 (44)	1	49	0	50	4.6%	7.54 [0.15, 380.14]	
Subtotal (95% CI)		599		607	31.9%	2.42 [0.55, 10.75]	
Total events	5		2				
Heterogeneity: Chi <sup>2</sup> = 1.46, df =	3 (P = 0.6	9); I² =	0%				
Test for overall effect: Z = 1.16 (	P = 0.24)						
Total (95% CI)		1465		1483	100.0%	1.48 [0.64, 3.43]	•
Total events	13		a				-
Heterogeneity: Chi <sup>2</sup> = 9.69 df =	10 (P = 0	47) <sup>,</sup> I≩:	= 0%				+ + + + +
Test for overall effect: 7 = 0.91 (	P = 0.36		5.0				0.002 0.1 1 10 500
Test for subgroup differences: (	. ⊑0.00) Chi≅=0.61	2 df='	1 (P = 0 4	.3) I≧=	0%		Favors ERAS Favours control
ar = 1 1 $r = -0.1 < 50$	···· = 0.0.	-, or	1.1		~~.	``	

#### Figure 4. Mortality by Condition

	ERA	S	Contr	ol		Peto Odds Ratio	Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	Peto, Fixed, 95% Cl	Peto, Fixed, 95% CI
1.11.1 Colorectal cancer							
Jia 2014 (27)	0	117	0	116		Not estimable	
Ota 2017-CCT (42)	0	159	0	161		Not estimable	
Ren 2011 (32)	0	299	0	298		Not estimable	
Wang 2015 (CCT)	0	57	0	60		Not estimable	
Khoo 2007 (28)	0	35	2	35	8.0%	0.13 [0.01, 2.14]	<b>_</b>
Wang 2012 open (35)	0	41	1	42	4.1%	0.14 [0.00, 6.99]	
Wang 2011 (36)	2	106	1	104	12.1%	1.92 [0.20, 18.69]	<b>_</b>
Wang 2012 lap (35)	1	40	0	40	4.1%	7.39 [0.15, 372.38]	
Wang 2012 (44)	1	49	0	50	4.1%	7.54 [0.15, 380.14]	
Subtotal (95% CI)		903		906	32.2%	1.00 [0.25, 4.01]	-
Total events	4		4				
Heterogeneity: Chi <sup>2</sup> = 5.34, df =	4 (P = 0.2)	25); I <sup>z</sup> =	25%				
Test for overall effect: Z = 0.00 (I	P = 1.00)						
1.11.2 Benign conditions							
Nanavati 2014 (30)	0	30	0	30		Not estimable	
Serclová 2009 (33)	0	51	0	52		Not estimable	
Subtotal (95% CI)		81		82		Not estimable	
Total events	0		0				
Heterogeneity: Not applicable							
Test for overall effect: Not applic	able						
1.11.3 Combined colorectal ca	ncer and	l benigi	1 conditio	on			
Mari 2014 (41)	0	25	0	25		Not estimable	
Mari 2016 (40)	0	70	0	70		Not estimable	
Anderson 2003 (22)	0	14	1	11	4.0%	0.10 [0.00, 5.34]	•
Vlug 2011 lap (34)	2	100	2	109	16.0%	1.09 [0.15, 7.87]	
Vlug 2011 open (34)	4	93	2	98	23.7%	2.09 [0.41, 10.60]	
Forsmo 2016 (50)	3	154	0	153	12.1%	7.44 [0.77, 72.04]	
Gatt 2005 (24)	1	19	0	20	4.1%	7.79 [0.15, 393.02]	
Subtotal (95% CI)		475		486	59.8%	2.03 [0.73, 5.64]	-
Total events	10		5				
Heterogeneity: Chi <sup>2</sup> = 4.28, df =	4 (P = 0.0	37); I <b>z</b> =	6%				
Test for overall effect: Z = 1.36 (	P = 0.17)						
1.11.4 Rectal cancer							
Feng 2014 (38)	0	57	0	59		Not estimable	
Pappalardo 2016 (31)	0	25	0	25		Not estimable	
Gouvas 2012-CCT lap (25)	1	42	0	33	4.0%	5.96 [0.12, 309.26]	
Gouvas 2012-CCT open (25)	1	36	0	45	4.0%	9.49 [0.18, 489.97]	
Subtotal (95% CI)	_	160		162	8.0%	7.52 [0.46, 122.56]	
Total events	2		0				
Heterogeneity: Chi <sup>2</sup> = 0.03, df =	1 (P = 0.8	37); I² =	0%				
Test for overall effect: Z = 1.42 (	P = 0.16)						
		4640		4620	400.05	4 70 10 04 2 051	
Total (95% CI)		1619	-	1636	100.0%	1.79 [0.81, 3.95]	-
l otal events	16		9				
Heterogeneity: Chi# = 11.40, df=	= 11 (P =	U.41); P	-= 4%				0.005 0.1 1 10 200
lest for overall effect: Z = 1.45 (	P = 0.15)				~~		Favors ERAS Favors control
lest for subgroup differences: (	⊃ni* = 1.7	5, df = 3	2 (P = 0.4	·2), I* =	0%		

₩ 4

#### Figure 5. Morbidity by Procedure<sup>a</sup>

	ERA	S	Contr	ol		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% CI
1.6.1 Open procedure							
Feng 2016 (23)	7	116	17	114	4.3%	0.40 [0.17, 0.94]	<b>-</b>
Muller 2009 (29)	16	76	37	75	7.8%	0.43 [0.26, 0.70]	
Serclová 2009 (33)	11	51	25	52	6.5%	0.45 [0.25, 0.81]	
Yang 2012 (37)	6	32	12	30	4.3%	0.47 [0.20, 1.09]	
Wang 2011 (36)	20	106	39	104	8.1%	0.50 [0.32, 0.80]	
Gatt 2005 (24)	9	19	15	20	7.2%	0.63 [0.37, 1.08]	
Gouvas 2012-CCT open (25)	14	36	25	45	7.8%	0.70 [0.43, 1.14]	
Wang 2012 open (35)	7	41	10	42	4.2%	0.72 [0.30, 1.70]	
Ren 2011 (32)	29	299	28	298	7.7%	1.03 [0.63, 1.69]	
Vlug 2011 open (34)	43	93	41	98	10.2%	1.11 [0.80, 1.52]	
Subtotal (95% CI)		869		878	68.1%	0.63 [0.49, 0.83]	◆
Total events	162		249				
Heterogeneity: Tau <sup>2</sup> = 0.10; Chi <sup>2</sup>	<sup>2</sup> = 20.92,	df = 9	(P = 0.01)	); I <sup>z</sup> = 51	7%		
Test for overall effect: Z = 3.37 (I	P = 0.000	8)					
		-					
1.6.2 Laparoscopic procedure							
Mari 2014 (41)	0	25	0	25		Not estimable	
Feng 2014 (38)	2	59	10	57	1.8%	0.19 [0.04, 0.84]	<b>←</b>
Wang 2012 (46)	2	40	8	38	1.8%	0.24 [0.05, 1.05]	<b>←</b>
Gouvas 2012-CCT lap (25)	9	42	17	33	5.8%	0.42 [0.21, 0.81]	
Wang 2012 lap (35)	3	40	6	40	2.2%	0.50 [0.13, 1.86]	
Wang 2015 (CCT)	10	57	16	60	5.4%	0.66 [0.33, 1.33]	
Mari 2016 (40)	12	70	15	70	5.6%	0.80 [0.40, 1.58]	
Vlug 2011 lap (34)	34	100	37	109	9.3%	1.00 [0.69, 1.46]	
Subtotal (95% CI)		433		432	31.9%	0.59 [0.39, 0.90]	◆
Total events	72		109				
Heterogeneity: Tau <sup>2</sup> = 0.13; Chi <sup>2</sup>	<sup>2</sup> = 11.44,	df = 6	(P = 0.08)	); l <sup>2</sup> = 48	B%		
Test for overall effect: Z = 2.46 (I	P = 0.01)						
Total (95% CI)		1302		1310	100.0%	0.63 [0.51, 0.78]	◆
Total events	234		358				
Heterogeneity: Tau <sup>2</sup> = 0.09; Chi <sup>2</sup>	<sup>2</sup> = 32.34,	df = 18	i (P = 0.0	09); I <sup>z</sup> =	51%		
Test for overall effect: Z = 4.26 (I	P < 0.000	1)					U.Z U.S I Z S Eavors ERAs Eavours control
Test for subaroup differences: (	Chi <b>²</b> = 0.0	7. df = 1	1 (P = 0.7	'9), I <sup>z</sup> =	0%		

#### Figure 6. Morbidity by Condition

	ERA	s	Contr	ol		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
1.7.1 Benign conditions							
Serclová 2009 (33)	11	51	25	52	5.8%	0.45 [0.25, 0.81]	<b>_</b>
Subtotal (95% CI)		51		52	5.8%	0.45 [0.25, 0.81]	◆
Total events	11		25				
Heterogeneity: Not applicable							
Test for overall effect: Z = 2.64 (	P = 0.008	)					
1.7.2 Colorectal cancer							
Wang 2012 (46)	2	40	0	20	1 6 06	0.24/0.05/1.051	
Fond 2016 (22)	2	116	17	114	20%	0.24 [0.03, 1.03]	
Yang 2010 (23)	à	22	12	30	2.2%	0.40 [0.17, 0.34]	
Wang 2012 (37)	3	40	6	40	1 0 %	0.47 [0.20, 1.09]	
Wang 2012 1ap (33)	20	106	20	104	73%	0.50 [0.13, 1.00]	
Wang 2011 (30)	10	57	16	60	4 9%	0.66 (0.33, 1.33)	
Wang 2013 (001)	7	41	10	42	3.7%	0.72 [0.30, 1.30]	
Ren 2011 (32)	- 20	200	28	742	7.0%	1 03 00 63 1 60	
Subtotal (95% CI)	23	731	20	726	34.1%	0.61 [0.46, 0.80]	•
Total events	84		136				•
Heterogeneity: Tau <sup>2</sup> = 0.02; Chi	<sup>2</sup> = 8.11. d	lf = 7 (F	P = 0.32);	$ ^2 = 14^{\circ}$	%		
Test for overall effect: Z = 3.50 (	P = 0.000	5)	,1				
1.7.3 Combined colorectal can	icer and b	enign	conditio	IS			
Mari 2014 (41)	0	25	0	25		Not estimable	
Muller 2009 (29)	16	76	37	75	7.0%	0.43 [0.26, 0.70]	_ <b></b>
Gatt 2005 (24)	9	19	15	20	6.5%	0.63 [0.37, 1.08]	
Mari 2016 (40)	12	70	15	70	5.0%	0.80 [0.40, 1.58]	
Forsmo 2016 (50)	65	154	68	153	10.1%	0.95 [0.74, 1.23]	
Vlug 2011 lap (34)	34	100	37	109	8.4%	1.00 [0.69, 1.46]	
Vlug 2011 open (34)	43	93	41	98	9.2%	1.11 [0.80, 1.52]	
Subtotal (95% CI)	470	537	24.2	550	40.3%	0.82 [0.63, 1.07]	-
Hotorogonoity: Touã - 0.06: Chi	179 7-1264	df – E	213 /P = 0.02	V 1 <b>2</b> – GI	n ox.		
Test for overall effect: 7 – 1.47 (	P = 0.14	ui – 0	(F = 0.03)	), 1 – 0	0.70		
Testion overall ellect. Z = 1.47 (	r = 0.14)						
1.7.4 Rectal cancer							
Feng 2014 (38)	2	59	10	57	1.6%	0.19 [0.04, 0.84]	•
Gouvas 2012-CCT lap (25)	9	42	17	33	5.2%	0.42 [0.21, 0.81]	
Gouvas 2012-CCT open (25)	14	36	25	45	7.1%	0.70 [0.43, 1.14]	
Subtotal (95% CI)		137		135	13.8%	0.48 [0.27, 0.88]	
Total events	25		52				
Heterogeneity: Tau <sup>2</sup> = 0.13; Chi	²= 3.78, d	lf = 2 (F	P = 0.15);	l² = 47	%		
Test for overall effect: Z = 2.38 (	P = 0.02)						
Total (95% CI)		1456		1463	100.0%	0.66 [0.54, 0.80]	•
Total events	299		426				
Heterogeneity: Tau² = 0.09; Chi	<sup>2</sup> = 36.88,	df = 17	7 (P = 0.0	03); l² =	54%		
Test for overall effect: Z = 4.12 (	P < 0.000	1)					Eavors ERAS Eavors control
Test for subgroup differences:	Chi² = 5.5	7. df=	3 (P = 0.1	3), l² =	46.2%		

#### Figure 7. Readmissions by Procedure<sup>a</sup>

	ERA	S	Contr	ol		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
1.13.1 Open procedure							
Anderson 2003 (22)	0	19	0	20		Not estimable	
Serclová 2009 (33)	0	51	0	52		Not estimable	
lonescu 2009 (26)	0	48	0	48		Not estimable	
Yang 2012 (37)	0	32	0	30		Not estimable	
Gatt 2005 (24)	1	19	4	20	3.3%	0.26 [0.03, 2.15]	
Wang 2011 (36)	4	106	9	110	11.0%	0.46 [0.15, 1.45]	
Nanavati 2014 (30)	1	30	1	30	1.9%	1.00 [0.07, 15.26]	
Vlug 2011 open (34)	7	93	7	98	14.2%	1.05 [0.38, 2.89]	
Muller 2009 (29)	3	76	2	75	4.7%	1.48 [0.25, 8.61]	
Wang 2012 open (35)	3	41	2	42	4.8%	1.54 [0.27, 8.73]	
Khoo 2007 (28)	3	35	1	35	2.9%	3.00 [0.33, 27.46]	
Subtotal (95% CI)		550		560	42.8%	0.89 [0.50, 1.59]	-
Total events	22		26				
Heterogeneity: Tau <sup>2</sup> = 0.0	00; Chi <b>²</b> =	: 4.53, (	df = 6 (P =	= 0.61);	I <sup>z</sup> = 0%		
Test for overall effect: Z =	= 0.39 (P =	= 0.69)					
4 42 0 Lanaraa aania ar	o o o duro						
1.15.2 Laparoscopic pro	ocedure						
Mari 2014 (41)	U	25	U	25		Not estimable	
Feng 2014 (38)	U	57	1	59	1.4%	0.34 [0.01, 8.29]	
Wang 2012 (44)	2	49	3	50	4./%	0.68 [0.12, 3.90]	
Viug 2011 lap (34)	6	100		109	12.9%	0.93 [0.32, 2.69]	
Scioscia 2017 (43)	11	62	26	162	35.1%	1.11 [0.58, 2.10]	
wang 2012 lap (35)	1	40	0	40	1.4%	3.00 [0.13, 71.51]	
Subtotal (95% CI)	2	159	U	101	1.0%	5.06 [0.24, 104.62]	
Total events	22	452	37	000	51.2.10	100 [0.04, 1.10]	Ť
Hotorogonoity: Tou² – 0 (	 00∵∩hi≅–	2.24	4f – 5 (P -	- 0.91)-	I≊ – 0%		
Test for overall effect: 7 =	= 0.23 (P :	- 2.24, ( = 0.82)	a - 5 (i -	- 0.017,	1 - 0 /0		
100 In overall energy Z	0.20 (1 -	0.02)					
Total (95% CI)		1042		1166	100.0%	0.98 [0.67, 1.44]	<b>•</b>
Total events	44		63				
Heterogeneity: Tau <sup>2</sup> = 0.0	00; Chi <b>²</b> =	6.97, (	df = 12 (P	= 0.86	); I <sup>z</sup> = 0%		
Test for overall effect: Z =	= 0.08 (P =	= 0.94)					U.US U.Z 1 5 2U
Test for subgroup differe	ences: Ch	i² = 0.2	0, df = 1	(P = 0.6	65), I <sup>2</sup> = 0°	%	

#### Figure 8. Readmissions by Condition

	ERA	s	Contr	ol		Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
1.14.1 Benign condition	S						
Serclová 2009 (33)	0	51	0	52		Not estimable	
Nanavati 2014 (30)	1	30	1	30	1.3%	1.00 (0.07, 15,26)	
Scioscia 2017 (43)	11	62	26	162	22.7%	1.11 [0.58, 2.10]	<b>_</b>
Subtotal (95% CI)		143		244	24.0%	1.10 [0.59, 2.05]	-
Total events	12		27				
Heterogeneity: Tau <sup>2</sup> = 0.	00; Chi <b>²</b> =	0.00, 0	df = 1 (P =	: 0.94);	l² = 0%		
Test for overall effect: Z =	= 0.30 (P =	= 0.77)					
1.14.2 Colorectal cance	er						
Yang 2012 (37)	0	32	0	30		Not estimable	
Ionescu 2009 (26)	Ň	48	ñ	48		Not estimable	
Wang 2011 (36)	4	106	ğ	110	7.1%	0.46 (0.15, 1.45)	<b>_</b>
Wang 2012 (44)	2	49	3	50	3.1%	0.68 [0.12, 3.90]	
Wang 2012 open (35)	3	41	2	42	3.1%	1.54 [0.27, 8.73]	
Wang 2012 lap (35)	1	40	- 0	40	0.9%	3.00 [0.13, 71,51]	
Khon 2007 (28)	3	35	1	35	1.9%	3 00 [0.33, 27, 46]	
Ota 2017-CCT (42)	2	159	O	161	1.0%	5.06 [0.24, 104, 62]	<b>_</b>
Subtotal (95% CI)	-	510	-	516	17.1%	0.97 [0.46, 2.02]	-
Total events	15		15				
Heterogeneity: Tau <sup>2</sup> = 0.	00; Chi <sup>z</sup> =	4.69, 0	df = 5 (P =	: 0.45);	I² = 0%		
Test for overall effect: Z =	= 0.09 (P =	- 0.93)					
1.14.3 Combined colore	ectal cano	er and	l benian (	conditi	on		
Mori 2014 (41)		26	n beingin (	26		Not actimable	
Mail 2014 (41) Anderson 2003 (22)	0	10	0	20		Not estimable	
Gatt 2005 (24)	1	10	4	20	2.1%		
Vlug 2003 (24)	, 8	100	7	100	2.1%	0.20 (0.00, 2.10)	
Vlug 2011 Jap (34) Vlug 2011 open (34)	7	00	7	903	0.4% 0.7%	1 05 [0.32, 2.03]	
Foremo 2016 (50)	, 20	154	21	153	35.2%		<b>_</b>
Muller 2009 (29)	23	76	21	75	3.0%	1 48 [0 25 8 61]	
Subtotal (95% CI)		486	-	500	58.0%	1.18 [0.79, 1.76]	•
Total events	46		41				-
Heterogeneity: Tau <sup>2</sup> = 0.	00: Chi <sup>2</sup> =	2.61. 0	df=4 (P=	= 0.63);	I² = 0%		
Test for overall effect: Z =	= 0.79 (P =	= 0.43)		,			
1 14 4 Rectal cancer							
Feng 2014 (38)	ο	57	1	60	U 0 0%	0341001 820	·
Subtotal (95% CI)	0	57		59	0.9%	0.34 [0.01, 8.29]	
Total events	0		1				
Heterogeneity: Not appli	cable						
Test for overall effect: Z =	= 0.66 (P :	= 0.51)					
Total (95% CI)		1196		1319	100.0%	1.11 [0.82, 1.50]	◆
Total events	73		84				
Heterogeneity: Tau <sup>2</sup> = 0.	00; Chi <b>²</b> =	8.01, 0	df = 13 (P	= 0.84	); I <sup>z</sup> = 0%		
Test for overall effect: Z =	= 0.65 (P =	= 0.52)					Eavors ERAS Eavors control
Test for subgroup differe	ences: Ch	i² = 0.7	3, df = 3 i	(P = 0.8	87), I <sup>2</sup> = 01	%	

4

#### Figure 9. Surgical Site Infections by Procedure<sup>a</sup>

	ERA	S	Contr	ol		Risk Ratio	Risk Ratio			
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl			
1.16.1 Open procedur	е									
Gatt 2005 (24)	0	19	4	20	2.0%	0.12 [0.01, 2.03]	· · · · · · · · · · · · · · · · · · ·			
Feng 2016 (23)	1	116	3	114	3.2%	0.33 [0.03, 3.10]				
Yang 2012 (37)	1	32	2	30	2.9%	0.47 [0.04, 4.91]				
Wang 2011 (36)	4	106	7	104	11.3%	0.56 [0.17, 1.86]				
Muller 2009 (29)	4	76	7	75	11.5%	0.56 [0.17, 1.85]				
Jia 2014 (27)	6	117	8	116	15.4%	0.74 [0.27, 2.08]				
lonescu 2009 (26)	4	48	5	48	10.3%	0.80 [0.23, 2.80]				
Ren 2011 (32)	5	299	5	298	10.7%	1.00 [0.29, 3.41]				
Anderson 2003 (22)	1	14	0	11	1.7%	2.40 [0.11, 53.77]				
Nanavati 2014 (30)	1	30	0	30	1.6%	3.00 [0.13, 70.83]				
Subtotal (95% CI)		857		846	70.6%	0.68 [0.42, 1.10]	-			
Total events	27		41							
Heterogeneity: Tau² =	0.00; Chi <sup>a</sup>	²= 4.12	:, df = 9 (F	P = 0.90	)); I² = 0%					
Test for overall effect: 2	Z = 1.55 (ł	P = 0.10	2)							
1 16 2 Lanarosconic I	arocodur	•								
Work 2012 (46)	JUCEUUI	40	-	20	2.200	0 22 00 02 2 041				
(Varig 2012 (46) Ferra 2014 (20)	1	40	3	38	3.370 4.000	0.32 [0.03, 2.91]				
Ferig 2014 (38) Oto 2017 COT (42)	U 6	150		104	1.0%	0.34 [0.01, 8.29]	,			
Uta 2017-CCT (42)	5	109	0	101	11.9%	0.84 [0.26, 2.71]				
Wang 2015 (CCT)	2	37	2	50	4.470 5.00	1.00 [0.10, 7.22]				
Wang ZUTZ Mari 2016 (40)	ა ე	49	2	20	0.370	1.00 [0.27, 0.77]				
Subtotal (95% CI)	2	432	1	438	2.9%	2.00 [0.19, 21.56] 0.90 [0.43, 1.90]				
Total events	10	452	15	450	20.470	0.00 [0.40, 1.00]				
Hotorogonoity: Tou <sup>2</sup> -	тэ 0.00-сый	- 2 02	U df = 676	- n o/	N IZ = 000					
Tect for overall effect: 3	0.00, Cili 7 – 0.27 /8	- 2.03 2 - 0 79	, ui – 5 (r 9)	- 0.04	9,1 - 0%					
Testion overall effect. 2	L = 0.27 (i	- 0.71	0)							
Total (95% CI)		1289		1284	100.0%	0.74 [0.50, 1.11]	◆			
Total events	40		56							
Heterogeneity: Tau <sup>2</sup> =	0.00; Chi <sup>a</sup>	<sup>2</sup> = 6.53	, df = 15	(P = 0.9	97); I <b>²</b> = 09	%				
Test for overall effect: 2	Z = 1.45 (F	P = 0.19	5)			U.UZ U.1 1 1U 5U Eavors ERAS Eavors control				
Test for subgroup differences: Chi <sup>2</sup> = 0.38, df = 1 (P = 0.54), l <sup>2</sup> = 0%										

#### Figure 10. Surgical Site Infections by Condition

	ERA	S	Control			Risk Ratio	Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% CI
1.17.1 Benign							
Vanavati 2014 (30)	1	30	0	30	1.3%	3.00 [0.13, 70.83]	
Subtotal (95% CI)		30		30	1.3%	3.00 [0.13, 70.83]	
otal events	1		0				
leterogeneity: Not app	licable						
est for overall effect: 2	Z = 0.68 (I	P = 0.5	0)				
.17.2 Colorectal cand	cer						
Vang 2012 (46)	1	40	3	38	2.6%	0.32 [0.03, 2.91]	
eng 2016 (23)	1	116	3	114	2.5%	0.33 [0.03, 3.10]	
ang 2012 (37)	1	32	2	30	2.3%	0.47 [0.04, 4.91]	
Vang 2011 (36)	4	106	7	104	9.0%	0.56 [0.17, 1.86]	
ia 2014 (27)	6	117	8	116	12.2%	0.74 [0.27, 2.08]	
onescu 2009 (26)	4	48	5	48	8.2%	0.80 [0.23, 2.80]	
ta 2017-CCT (42)	5	159	6	161	9.5%	0.84 [0.26, 2.71]	
Ren 2011 (32)	5	299	5	298	8.5%	1.00 [0.29, 3.41]	
Vang 2015 (CCT)	2	57	2	60	3.5%	1.05 [0.15, 7.22]	<b>-</b>
Vang 2012	3	49	2	50	4.2%	1.53 [0.27, 8.77]	
ubtotal (95% CI)		1023		1019	62.6%	0.75 [0.48, 1.18]	◆
otal events	32		43				
leterogeneity: Tau <sup>2</sup> = (	0.00; Chi <sup>a</sup>	<sup>2</sup> = 2.50	, df = 9 (F	P = 0.98	3); I <b>²</b> = 0%		
est for overall effect: 2	Z = 1.24 (I	P = 0.23	2)				
.17.3 Colorectal cano	cer/benig	In					
∋att 2005 (24)	0	19	4	20	1.6%	0.12 [0.01, 2.03]	·
tuller 2009 (29)	4	76	7	75	9.2%	0.56 [0.17, 1.85]	
orsmo 2016 (50)	10	154	13	153	20.5%	0.76 [0.35, 1.69]	
1ari 2016 (40)	2	70	1	70	2.3%	2.00 [0.19, 21.56]	
nderson 2003 (22)	1	14	0	11	1.3%	2.40 [0.11, 53.77]	
ubtotal (95% CI)		333		329	34.8%	0.72 [0.39, 1.32]	
otal events	17		25				
leterogeneity: Tau <sup>z</sup> = (	0.00; Chi <sup>a</sup>	<b>²</b> = 3.06	i, df = 4 (F	P = 0.59	5); I² = 0%		
est for overall effect: 2	Z = 1.05 (I	P = 0.2	9)				
.17.4 Rectal cancer							
eng 2014 (38)	0	57	1	59	1.3%	0.34 [0.01, 8.29]	
ubtotal (95% CI)		57		59	1.3%	0.34 [0.01, 8.29]	
otal events	0		1				
leterogeneity: Not app	licable						
est for overall effect: Z	Z = 0.66 (I	P = 0.51	1)				
otal (95% CI)		1443		1437	100.0%	0.75 [0.52, 1.07]	◆
otal events	50		69				
łeterogeneity: Tau <sup>z</sup> = (	0.00; Chi <sup>a</sup>	<sup>2</sup> = 6.53	, df = 16	(P = 0.9)	38); I <sup>2</sup> = 09	6	
est for overall effect: Z	Z = 1.60 (I	P = 0.1	1)				U.UZ U.1 1 1U 50
est for subaroup diffe	rences: (	Chi²=0	.98. df=	3 (P = (	).81), I² = (	0%	Favors ERAS Favors control