Perioperative Medicine

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Length of stay after colorectal surgery in Italy: the gap between "fit for" and "actual" discharge in a prospective cohort of 4529 cases

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Abstract

Background It is common to observe a gap between the day on which the discharge criteria are reached and the actual day of discharge after colorectal surgery. The aim of this study is to understand the reasons for this difference and its clinical impact on the overall length of stay (LOS).

Methods All patients enrolled in the prospective iCral3 study were analyzed regarding any difference and reason between the "fit for discharge" (FFD) and "actual discharge" (AD) dates. The association between the gap and the LOS in the whole population was then assessed through a multivariate regression model including other confounding variables.

Results The analysis included 4529 patients, with a median [IQR] LOS of 6 [4–8] days. The median [IQR] LOS was 6 [4–8] days in the no-gap group (3,910 patients, 86.3%), significantly lower ($p < .001$) than 7 [6–10] days in the gap group (619 patients, 13.7%). Among the gap reasons, the "need for postoperative rehabilitation" compared to "not willing to return home" and "social constraints" was associated with the longest LOS (9 [6.0–12.5] days, $p < 0.001$ vs other reasons). The existence of the gap independently determined a 2.3-day lengthening of LOS.

Conclusions Among other factors, the gap between FFD and AD had an independent impact on LOS. The most frequent reasons for this gap were "not willing to return home" and "social constraint", while the "need for postoperative rehabilitation" had the greater clinical impact.

Keywords Colorectal surgery, ERAS, Length of stay, Fit for discharge, Actual discharge

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Introduction

In recent years, enhanced recovery after surgery (ERAS) pathways have been developed to improve perioperative care (Gustafsson et al. 2019). Briefly, ERAS is a multidisciplinary, patient-centered protocol in which clinical standards are implemented using evidence-based practice. A clear effect of high adherence to the ERAS pathway in reducing adverse events and shortening the overall length of stay (LOS) has been demonstrated in colorectal surgery (CRS) (Catarci et al. 2023) and in other surgical specialties (Mithany et al. 2023). LOS is one of the outcome measures, considered a proxy of in-hospital recovery because hospital discharge assumes that a minimal level of physiological and functional recovery has already been achieved (Balvardi et al. 2018).

Although current guidelines (Gustafsson et al. 2019; Ficari et al. 2019) underline the importance of fulfilling several criteria for home discharge, LOS after CRS remains highly variable (Balvardi et al. 2018). Furthermore, the definition of "fit for discharge" (FFD) remains non-homogeneous in the pertinent literature (Maessen et al. 2008), and in clinical practice, it may not be sufficient to define adequate ad hoc criteria. Therefore, actual discharge (AD) can be postponed for some causes related to local culture, surgeons' preferences, patient expectations, health systems, and insurance status (Balvardi et al. 2018). The present study aimed to measure and analyze the reasons for the gap between FFD and AD and its impact on LOS in patients enrolled in a prospective multicenter observational study of the Italian ColoRectal Anastomotic Leakage study group (iCral3 study), designed to investigate the effect of adherence to the ERAS pathway on patient-reported outcome measures and return to intended oncologic therapy after CRS (Italian ColoRectal Anastomotic Leakage (iCral3) study group 2023).

Methods

This was a planned secondary analysis of a prospective multicenter study conducted in Italy from October 2020 to September 2021 in 76 surgical centers participating in the iCral3 study on a voluntary basis (Italian ColoRectal Anastomotic Leakage (iCral3) study group 2023). All patients who underwent elective or delayed urgency (≥24 h from admission) CRS with anastomosis were assessed for inclusion according to explicit inclusion and exclusion criteria. The inclusion criteria were as follows: (a) patients who underwent laparoscopic/robotic/open/converted colorectal resection with anastomosis, including planned Hartmann's reversals; (b) American Society of Anesthesiologists' (ASA) class I, II, or III; c) elective or delayed urgency (≥24 h from admission) surgery; and d) patients' written acceptance to be included in the study. The exclusion criteria were as follows: (a) ASA class IV-V, (b) emergent (≤24 h from admission) surgery, (c) pregnancy, and (d) hyperthermic intraperitoneal chemotherapy for carcinomatosis. Finally, 4529 patients were enrolled (Italian ColoRectal Anastomotic Leakage (iCral3) study group 2023). Both AD and FFD were prospectively recorded for every enrolled patient by local investigators. Fitness for discharge was defined using international consensus criteria (Fiore et al. 2012): independent mobilization, adequate oral intake, stool passage, good pain control with oral analgesics, no evidence of complications, and patient consent to return home. Each participating center was defined as high volume (>4 cases) or low volume (≤4 cases) according to the median number of enrolled cases per month. The existence of an institutional enhanced recovery pathway (ERP) (having a locally implemented ERP team and protocol, supported by a specific resolution of the hospital/company strategic management) was declared by 48 out of 76 (63.1%) participating centers. The ERAS pathway was defined on 26 items derived from international guidelines (Gustafsson et al. 2019), with percentage adherence measured through explicit criteria (Supplemental Table S1) and reported as below or above the median and below/at or above the 4th quartile. Surgical procedures were categorized as standard (anterior resection, right colectomy, and left colectomy) versus non-standard (splenic flexure resection, transverse colectomy, Hartmann's reversal, subtotal and total colectomy, and other) resections. Anastomotic leakage (AL) was defined and graded according to international consensus (Rahbari et al. 2010). Nutritional status, measured using the Mini Nutritional Assessment–Short Form (MNA-SF) (Kaiser et al. 2009), was categorized as below or above 12, indicating the threshold of normal nutritional status.

Outcomes

All outcomes were calculated 60 days after surgery. Any adverse events were recorded, classified, and graded according to the Clavien-Dindo (Dindo et al. 2004) and the Japanese Clinical Oncology Group extended criteria (JCOG-EC) (Katayama et al. 2016), as well as any unplanned readmission, reoperation, and death. Overall morbidity (OM) was defined as any adverse event, while major morbidity (MM) was defined as any major adverse event (Clavien-Dindo grade > II). Thereafter, the study population was divided into two subgroups: (a) patients with no gap between FFD and AD (no-gap group); and (b) patients in which this gap was present (gap group). The primary endpoint was the effect of the gap on LOS, calculated by including any planned or unplanned readmission.

Data collection and statistical analysis

All data of the enrolled patients were prospectively recorded in a web-based database via an electronic case report form, specifically designed for the study and protected by access credentials for each center/investigator. Continuous and discrete variables related to biometric data, patient-related risk factors, indication and type of surgical procedure, adherence to ERAS pathway items, and outcomes were recorded (Supplemental Table S2). Quality control of the data for consistency, plausibility, and completeness was performed on every single record by local investigators and subsequently validated by the study coordinator, resolving any discrepancies through strict cooperation. During the perioperative period, patients were examined daily by local investigators, who were free to decide on complementary imaging and any further action according to the local criteria. Data were reported as medians (IQR) for continuous variables and numbers (percentages) for categorical variables. As most variables were not normally distributed by the Kolmogorov–Smirnov test, between-group comparisons were performed using the Mann–Whitney *U* test and the Kruskal–Wallis test for continuous variables, and the Pearson chi-square test or the Fisher exact test was used for categorical variables. Univariate and multivariate regression analyses adjusted for confounders were used to evaluate independent effects on LOS. All variables with univariate $P < 0.10$ were tested in a multivariate regression model performed using the Enter procedure. Standardized beta coefficients and model-corrected R^2 values were also determined. Collinearity diagnostics were performed to check model stability, by assessing tolerances, variance inflation factors, and condition indexes. For each variable identified as significantly associated with LOS in the multivariate analysis, we also reported the difference in LOS between the two groups identified by that variable. Statistical significance was set at P value < 0.05. All analyses were performed using SPSS (Statistical Package for Social Sciences) for Windows (version 22.0; SPSS Inc., Chicago, IL, USA).

Ethics

The study was conducted in accordance with the Declaration of Helsinki and the principles of the guidelines for good clinical practice E6 (R2). The study protocol was registered at *ClinicalTrials.gov* (*NCT04397627*) after approval by the ethics committee of the coordinating center (Marche Regional Ethics Committee-CERM 2020/192 released on 07/30/2020) and the local ethics committee of all other participating centers. Individual participant-level anonymized datasets were made available upon explicit request by contacting the study coordinator.

Results

A total of 4,529 patients were included in this study, of which 68% received preoperative ERAS education (Supplemental Tables S1 and S2). The patients were followed for a median of 68 days (IQR 59–112). The baseline characteristics of the entire study population and subgroups are shown in Table 1. A gap between FFD and AD was recorded in 619 (13.7%) patients (gap group), and there was no gap in the remaining 3910 (86.3%) patients (no-gap group). The median (IQR; range) LOS in the entire population was 6.0 (4.0–8.0; 2–91) days; it was 6.0 (4.0–8.0; 2–91) days in the no-gap group and 7.0 (6.0–10.0; 3–79) days in the gap group ($P < 0.001$). Gap reasons were specified in 605 (97.7%) patients, the most frequent being "not willing to return home" (229 patients; 37.8%) and "social constraint" (240 patients; 39.7%). A "need for postoperative rehabilitation" was reported in 136 (22.5%) patients. It was associated with a significantly longer median [IQR] LOS of 9.0 [6.0–12.5] days, compared to the other two reasons (7.0 [6.0–9.0] days for both, $P < 0.001$) (Fig. 1). Twenty-one of 28 variables considered in the study had a significant influence on LOS in univariate analysis and were included in the multivariate regression model (Table 2). An independent increase in LOS was recorded for patients aged > 69 years and ASA class > II among patient-related variables; neo-adjuvant therapy, intra-postoperative blood transfusions, delayed urgency admission, non-standard procedure, procedure length > 180 min, associated procedures, and discharge gap among treatment-related variables; anastomotic leakage, overall morbidity, major morbidity, and reoperation among outcome-related variables. In contrast, both minimally invasive surgery and ERAS adherence > 69.2% were independently associated with a reduction of LOS. The quantitative differences with baseline LOS related to these variables are shown in Fig. 2.

Discussion

This observational study revealed the existence of a gap between FFD and AD after CRS in 13.7% of cases. This figure is lower than those reported in recent retrospective (Slieker et al. 2017) and prospective analyses (Biondi et al. 2022), where the concordance between FFD and AD barely reached one-third of the cases. This result can be attributed to several factors. In recent years, many improvements in the enhanced recovery pathway have been implemented: the return to home will probably be more anticipated by patients, they would be better prepared, and it would be easier for the treating physician to make an announcement about the discharge; surgeon-related perception of potential risks associated with early discharge that could lead to readmission and/or continued hospitalization is mitigated by the large

Table 1 Baseline characteristics of the study population and subgroups

Variables	Overall No. = 4529	No-gap group No. = 3910 (86.3%)	Gap group No. = 619 (13.7%)	*p*
Patient-related				
Age (years)	69.1 (58–77.5)	68.8 (58–78)	70.4 (61–80)	.012
Age > 69.1 years	2221 (49.0)	1888 (48.3)	333 (53.8)	.011
Male sex	2389 (52.8)	2052 (52.5)	337 (54.4)	.332
ASA class > II	1537 (33.9)	1310 (32.5)	227 (36.7)	.122
BMI (kg/m^2)	25.2 (22.7–27.9)	25.3 (22.7–27.9)	24.9 (22.3–27.7)	.133
Diabetes	630 (13.9)	537 (13.7)	93 (15.0)	.389
Chronic renal failure	195 (4.3)	170 (4.3)	25 (4.0)	.725
Dialysis	10 (0.2)	8 (0.2)	2 (0.3)	.636
Chronic liver disease	52 (1.1)	41 (1)	11 (1.8)	.114
MNA-SF > 12	2948 (65.1)	2516 (64.3)	432 (69.8)	.008
Treatment-related				
Neoadjuvant therapy	336 (7.4)	288 (7.4)	48 (7.8)	.732
Preoperative blood transfusion(s)	273 (6)	230 (5.9)	43 (6.9)	.301
Intra- and postoperative blood transfusion(s)	304 (6.7)	246 (6.3)	58 (9.4)	.005
Perioperative steroids	79 (1.7)	68 (1.7)	11 (1.8)	.947
High-volume center (> 4 cases/month)	3506 (77.4)	3048 (78)	458 (74)	.028
Institutional ERP	3001 (66.3)	2542 (65.0)	459 (74.2)	< .001
Delayed urgency admission	293 (6.5)	196 (5.0)	97 (15.7)	< .001
Non-standard procedure	712 (15.7)	613 (15.7)	96 (15.5)	.923
Procedure length (min)	180 (140–235)	180 (135–235)	185 (135–227)	.015
Associated procedures	831 (18.3)	691 (17.7)	140 (22.6)	.003
Mininvasive surgery	3862 (85.3)	3346 (85.6)	516 (83.4)	.148
ERAS adherence (%)	69.2 (53.8–80.8)	69.2 (57.2–84.2)	69.2 (61.2–80.2)	< .001
4th quartile of ERAS adherence (> 80.8%)	878 (19.3)	794 (20.3)	84 (13.6)	< .001
Outcome related				
Anastomotic leakage	199 (4.4)	163 (4.2)	36 (5.8)	.063
Overall morbidity	1214 (26.8)	1028 (26.3)	186 (30.0)	.050
Major morbidity	342 (7.6)	285 (7.3)	57 (9.2)	.093
Reoperation	233 (5.1)	190 (4.9)	43 (6.9)	.029
Readmission	174 (3.8)	154 (3.9)	20 (3.2)	.395

Continuous variables are reported as median (IQR); categorical variables are reported as number (percentage)

ASA American Society of Anesthesiologists, *BMI* body mass index, *MNA-SF* mini nutritional assessment–short form, *ERP* enhanced recovery pathway

body of evidence that makes discharge safe (Jones et al. 2017). In the prospective multicenter iCral1 study (Italian ColoRectal Anastomotic Leakage (iCral) Study Group. Anastomotic leakage after elective colorectal surgery: a prospective multicentre observational study on use of the Dutch leakage score, serum procalcitonin and serum C-reactive protein for diagnosis 2020), the use of clinical scores with serum biomarkers was demonstrated to have a high (< 99%) negative predictive value for anastomotic leakage already on postoperative day 2. On the other hand, a prospective French study designed to evaluate the feasibility and safety of a 3-day hospitalization after colectomy and 5-day hospitalization after proctectomy in patients enrolled in an enhanced recovery program showed that serum biomarkers above the threshold accounted for delayed discharge after CRS in 15% of cases, while patient refusal was the most common reason (Collard et al. 2020), as it was in the present analysis. Patient and caregiver education, contact information, and discharge planning are increasingly recognized as a fundamental part of surgical patient care (Biondi et al. 2022; Jones et al. 2017; Chugh et al. 2009), and improving the rate of adherence to preoperative counseling (limited to 68% of cases in the present study, Supplemental Table S2) may limit patients' refusal to return home when the criteria for safe discharge are met.

This study also reported that a median ERAS adherence of 69.2% determined a median LOS of 6 days, which

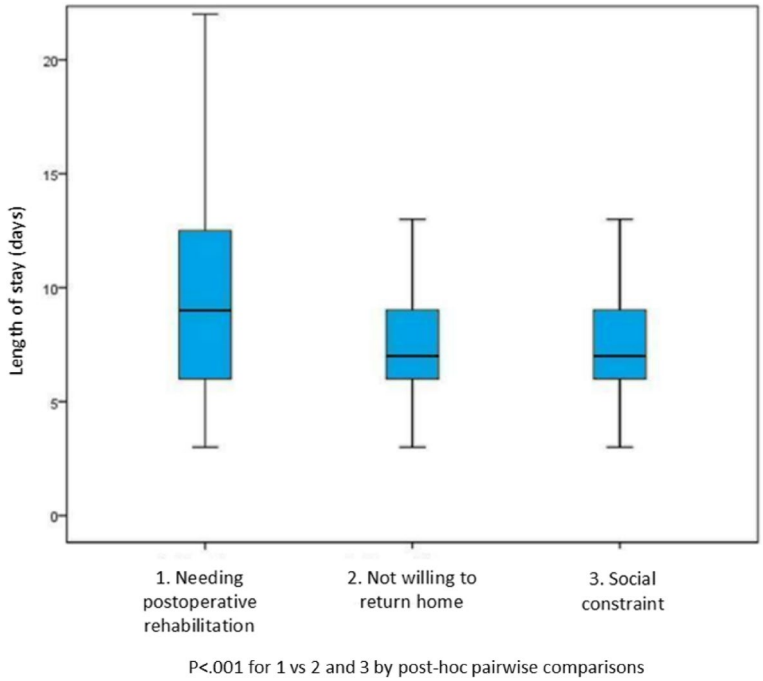

Fig. 1 Comparison of LOS based on gap causes within the gap group

is equal to the constant value reported by a nationwide study in the USA on 251,583 patients who underwent elective CRS from 2002 to 2011 (Al-Mazrou et al. 2017). This figure corresponds to a reduction of 1 day compared with the Italian nationwide LOS after laparoscopic CRS recorded in the same period (Agenzia Nazionale per i Servizi Sanitari Regionali (AGENAS) 2023). While the reduction in LOS recorded in randomized trials on ERAS generally exceeds 2 days (Greco et al. 2014), the results of the present study are not different from those achieved in population-based studies. A pre-post structured ERAS implementation study among 15 teaching hospitals in Ontario, Canada, performed on 32,612 patients who underwent CRS between 2008 and 2019 (Bayat et al. 2024), revealed a mean (95%CI) reduction of LOS at 1.05 (0.72–1.38) days. This finding confirms that complete implementation of any ERP is not an "on–off" process, as it involves deep cultural and behavioral changes in patients and healthcare providers and requires time and perseverance to reach a level of implementation (measurable through the ERP adherence rate) that can influence LOS and other outcomes. The existence of a self-declared institutional ERP by 48 out of 76 (63.1%) centers participating in the present study had no influence on LOS (Table 2), confirming that "declaring an ERAS protocol is not enough" (Maessen et al. 2007). Structured implementation and auditing processes are more important for improving program adherence and outcomes (Catarci et al. 2021).

Comparison of the no-gap and gap groups (Table 1) disclosed that the latter contains significantly more "bad performers", such as older and comorbid patients, higher rate of delayed urgency presentation, and more complex operations (longer operative time with higher rates of blood transfusions and associated procedures). This could explain the "social constraint" and "need for postoperative rehabilitation" as the reasons for the gap in two-thirds of the cases in the present study. CRS is increasingly performed in older patients with multiple comorbidities, and surgical procedures are often more complex; these factors may intuitively challenge any smooth recovery process. In this setting, anticipating the need for postoperative intensive care (Conti et al. 2023), adding a case manager nurse dedicated to ERAS programs, and implementing referral pathways for postoperative rehabilitation should be provided to improve postoperative compliance (Li et al. 2013).

Finally, the multivariate analysis for LOS in the entire cohort (Table 2) showed that any adverse event (particularly major events such as anastomotic leakage) and blood transfusions had the highest weight on the independent lengthening of LOS, as expected (Italian Colo-Rectal Anastomotic Leakage (iCral) study group 2019; Catarci et al. 2022; Italian ColoRectal Anastomotic Leakage (iCral) study group 2020; Catarci et al. 2023). While it

Table 2 Influence of patient-, treatment-, and outcome-related factors on the length of stay: univariate and multivariate regression analyses

Variable	Univariate regression analysis				Multivariate regression analysis				Difference with baseline (days)		
Patient-related	β	Lower 95% CI	Upper 95%CI	*p*	β	Lower 95% CI	Upper 95%CI	*p*	Mean	Lower 95%CI	Upper 95%CI
Age > 69 years	.068	.018	.046	< .001	.030	.002	.026	.022	1	0.6	1.4
Male sex	.043	.179	.951	.004	.002	−.280	.334	.861			
ASA class > II	.117	1227	2.036	< .001	.037	.165	.876	.004	1.6	1.2	2.1
BMI (kg/m^2)	.014	−.024	.066	.355							
Diabetes	.020	−.178	.937	.182							
Chronic renal failure	.079	1.634	3.529	< .001	.022	−.029	1.490	.059			
Dialysis	−.010	−5.540	2.679	.495							
Chronic liver disease	.006	−1.426	2.196	.667							
MNA-SF > 12	−.065	−1.310	−.502	< .001	−.020	−.603	.035	.081			
Treatment-related	β	Lower 95% CI	Upper 95% CI	*p*	β	Lower 95% CI	Upper 95% CI	*p*	Mean	Lower 95% CI	Upper 95% CI
Perioperative steroids	.010	−.968	1.979	.501							
Neoadjuvant therapy	.087	1.461	2.927	< .001	.046	.555	1.745	< .001	2.2	1.2	3.2
Preoperative blood transfusion(s)	.014	−.415	1.206	.339							
Intra- and postoperative blood transfusion(s)	.164	3.581	5.102	< .001	.053	.787	2.035	< .001	4.3	3.2	5.5
High-volume center (> 4 cases/month)	−.049	−1.232	−.311	.001	−.021	−.695	.040	.081			
No institutional ERP	−.019	−.675	.141	.200							
Delayed urgency admission	.127	2.638	4.194	< .001	.046	.605	1.873	< .001	3.4	2.3	4.5
Non-standard procedure	.080	.922	1.981	< .001	.046	.413	1.256	< .001	1.5	0.8	2.1
Procedure length > 180 (min)	.099	.929	1.698	< .001	.052	.367	1.003	< .001	1.3	0.9	1.7
Associated procedures	.080	.871	1.864	< .001	.038	.243	1.058	.002	1.4	0.9	1.8
Mininvasive surgery	−.192	−4.117	−3.049	< .001	−.082	−2.008	−1.060	< .001	-3.6	−4.3	−2.9
ERAS adherence > median (> 69.2%)	−.193	−.070	−.052	< .001	−.125	−.050	−.029	< .001	−2.2	−2.6	−1.8
4th quartile of ERAS adherence (> 80.2%)	−.149	−2.660	−1.797	< .001	−.014	−.667	.240	.356			
Outcome-related	β	Lower 95% CI	Upper 95% CI	*p*	β	Lower 95% CI	Upper 95% CI	*p*	Mean	Lower 95% CI	Upper 95% CI
Anastomotic leakage	.435	13.191	14.886	< .001	.222	6.214	8.140	< .001	14	12	16
*Overall morbidity	.252	3.344	4.187	< .001	.085	.906	1.622	< .001	3.8	3.2	4.3
**Major morbidity	.464	10.986	12.279	< .001	.259	5.519	7.482	< .001	11.6	10.2	13
Reoperation	.408	11.426	13.020	< .001	.012	−.858	1.555	.571			
Discharge gap	.308	1.166	1.396	< .001	.248	.937	1.127	< .001	2.3	1.6	2.9

β regression coefficients, *95%CI* confidence intervals at 95%, *ASA* American Society of Anesthesiologists, *BMI* body mass index, *MNA-SF* Mini Nutritional Assessment-Short Form

* Overall morbidity: any adverse event

** Major morbidity: any Clavien-Dindo grade > II adverse event

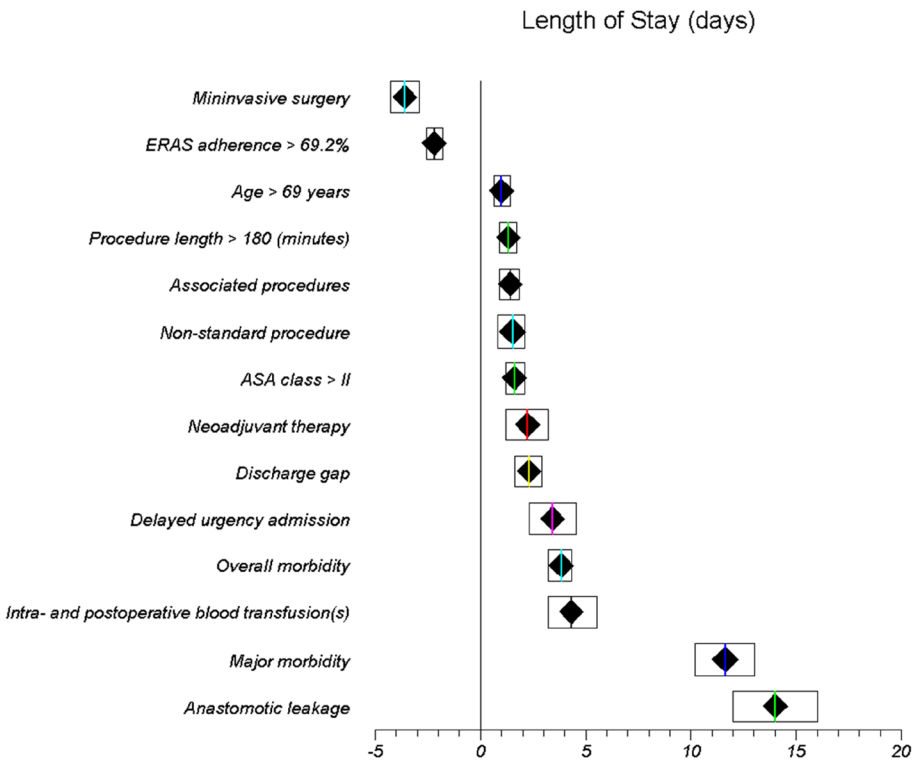

Fig. 2 Quantitative differences with baseline related to the independent predictors of LOS

appears straightforward that patient-related factors, such as older age and multiple comorbidities, and treatment-related factors, such as delayed urgency presentation, longer and associated procedures, neo-adjuvant therapy, and non-standard resections, also had an independent effect on LOS, the discharge gap independently determined a 2.3-day lengthening of LOS (Fig. 2).

The study data were obtained from a large multicenter prospective investigation of patients undergoing colorectal surgery, which was performed at a well-defined time-lapse in a large number of centers representing a wide sample of surgical units performing colorectal surgery in Italy. However, this study has some limitations. The nature of this study does not permit a definitive conclusion about this topic. Another limitation is the potential for residual, measured, and unmeasured confounding intrinsic to observational studies. Although data quality control was performed and repeated at various levels, we could not exclude any measurement errors from the participating investigators. Finally, the study results were obtained using a non-a priori sample structured for this topic.

In conclusion, although more studies focused on this topic are needed, our analysis pointed "not willing to return home" and "social constraint" as the most frequent reasons for the gap between FFD and AD, while "needing rehab" had the greater clinical impact. This gap, along with other variables, independently impacts LOS lengthening after CRS.

Abbreviations

AD	Actual discharge
AL	Anastomotic leakage
ASA	American Society of Anesthesiologists
CRS	Colo-Rectal Surgery
ERAS	Enhanced Recovery After Surgery
ERP	Enhanced recovery pathway
FFD	Fit for discharge
LOS	Length of stay

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13741-025-00492-1.

Supplementary Material 1: Supplemental Table S1. Definition and adherence criteria to ERAS program items. Supplemental Table S2. Categoric and continuous variables considered in the study.

Acknowledgements

* iCral3 study group investigators (collaborators) are: Maria Sole Mattei, Elena Belloni, Daniela Apa, Matteo Di Carlo, General Surgery Unit, Sandro Pertini Hospital, ASL Roma 2, Roma; Grazia Maria Attinà, General & Emergency Surgery Unit, San Camillo-Forlanini Hospital, Roma; Elisa Bertocchi, Gaia Masini, General Surgery Unit, IRCCS Sacro Cuore Don Calabria Hospital, Negrar di

Valpolicella (VR); Amedeo Altamura, Francesco Rubichi, General Surgery Unit, Cardinale G. Panico Hospital, Tricase (LE); Ferdinando Ficari, Francesco Giudici, Fabio Cianchi, General Surgery and IBD Unit, Careggi University Hospital, Firenze; Paolo Delrio, Ugo Pace, Andrea Fares Bucci, Colorectal Surgical Oncology, Istituto Nazionale per lo Studio e la Cura dei Tumori, "Fondazione Giovanni Pascale IRCCS-Italia", Napoli; Felice Pirozzi, Antonio Sciuto, General Surgery Unit, ASL Napoli 2 Nord, Pozzuoli (NA); Desirée Cianflocca, Marco Migliore, General & Oncologic Surgery Unit, Department of Surgery, Santa Croce e Carle Hospital, Cuneo; Raffaele De Luca, Michele Simone, Department of Surgical Oncology, IRCCS Istituto Tumori "Giovanni Paolo II", Bari; Alberto Patriti, Marcella Ricci, Department of Surgery, AST Marche 1, Pesaro e Fano (PU); Gianluca Garulli, Mattia Portinari, General Surgery Unit, Infermi Hospital, Rimini; Walter Siquini, Alessandro Cardinali, Massimo Sartelli, General Surgery Unit, S. 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Authors' contributions

LP, DC, PB, MC, and MS made substantial contributions to the conception of the study and to the analysis and interpretation of data. LP and DC drafted the manuscript. SR, AF, GMP, PC, MB, LAM, GR, MGV, FB, GB, MB, PM, MFA, VB, GC, AC, and GG participated in data acquisition and revised the work critically for important intellectual content. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability

Individual participant-level anonymized datasets were made available upon reasonable request by contacting the study coordinator.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and the Guideline for Good Clinical Practice E6 (R2) principles. The study protocol was approved by the coordinating center ethics committee (Comitato Etico Regionale delle Marche–C.E.R.M. #2020/192, approved on 07/30/2020) and registered at ClinicalTrials.gov (NCT04397627). Thereafter, all participating centers obtained authorization from the local institutional review board. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines for cohort studies. Individual participant-level anonymized datasets were made available upon reasonable request by contacting the study coordinator.

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 15 August 2024 Accepted: 7 January 2025
Published online: 04 February 2025

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