



# A retrospective analysis of early discharge following minimally invasive colectomy in an enhanced recovery pathway

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Received: 18 March 2022 / Accepted: 27 November 2022 / Published online: 5 December 2022  
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## Abstract

**Background** There is increasing evidence to support discharge prior to gastrointestinal recovery following colorectal surgery. Furthermore, many patients are discharged early despite being excluded from an ambulatory colectomy pathway. The objective of this study was to determine the outcomes of patients discharged early following laparoscopic colectomy in an enhanced recovery pathway (ERP).

**Methods** A retrospective review of all adult patients undergoing elective laparoscopic colectomy at a single university-affiliated colorectal referral center (08/2017–06/2021) was performed. Patients were included if they had undergone elective laparoscopic colectomy or ileostomy closure and excluded if they had been enrolled in an ambulatory colectomy pathway. Patients were then divided into three groups: LOS =1 day, LOS 2–3 days, and LOS 4+ days. The main outcomes were 30-day emergency room (ER) visits and readmissions. Reasons for inpatient stay per post-operative day (POD) were also recorded.

**Results** A total of 497 patients were included [LOS1  $n = 63$  (13%), LOS2–3  $n = 284$  (57%), and LOS4+  $n = 150$  (30%)]. There were no differences in patient characteristics, diagnosis, or procedure between the groups. Patients were discharged with gastrointestinal recovery (GI-3) in 54% LOS1 vs. 98% LOS2–3 vs. 100% LOS4+ ( $p < 0.001$ ). Shorter procedure duration, transversus abdominus plane block, and lower opioid requirements were associated with shorter LOS ( $p < 0.001$ ). The absence of flatus was the most common reason to keep patients hospitalized: 61% on POD1, 21% on POD2, and 8% on POD3 ( $p < 0.001$ ). There were no differences in 30-day emergency visits, or readmission between the groups. In the LOS1 group, there were no differences in outcomes between patients with full return of bowel function at discharge compared to those without.

**Conclusion** Discharge on POD1 was not associated with increased emergency department use, complications, or readmissions. Importantly, full return of bowel function at discharge did not affect outcomes. There may be potential to expand eligibility criteria for ambulatory colectomy protocol.

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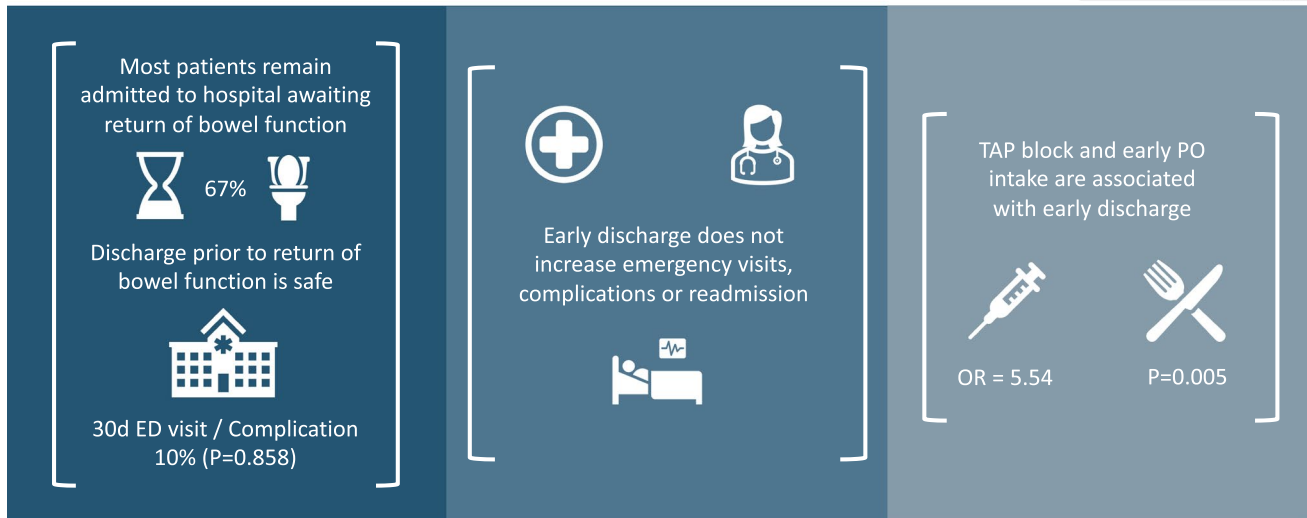
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## Graphical abstract

## A retrospective analysis of early discharge following minimally-invasive colectomy in an enhanced recovery pathway



S. Robitaille *et al.* 2022, Surgical Endoscopy

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**Keywords** Early discharge · Same-day discharge · Ambulatory colectomy · Laparoscopic colectomy · Ileostomy reversal

Enhanced recovery pathways (ERP) have significantly improved outcomes after colorectal surgery, with significantly decreased length of stay (LOS), complications, and readmissions compared to conventional care [1]. However, most ERPs heavily rely on the return of gastrointestinal function as a necessary criteria for discharge [2]. Furthermore, there is emerging evidence that discharge prior to full gastrointestinal recovery within an ERP may be safe in selected patients and has not been associated with increased morbidity [3]. Considering these findings, recent studies have been successful in implementing same day discharge (SDD) protocols for minimally invasive colectomy in highly selected patients [4, 5]. These advanced ERPs and SDD protocols have the potential to bring value and limit resource utilization by allowing patients to complete their recovery at home which may ultimately contribute to increased efficiency of care and availability of hospital beds. This may be especially beneficial in situations or settings where persistently high bed occupancy rates may lead to cancellations of elective surgeries, which was seen during the recent COVID-19 pandemic [6].

Despite the potential benefits of advanced ERPs and SDD protocols, strict inclusion criteria may limit their generalizability and applicability to a wider patient population [3–5]. As a result, there may be a significant number of patients

who are excluded but would otherwise be reasonable candidates for early discharge within an established ERP or a SDD protocol.

As the data-supporting discharge prior to the return of gastrointestinal function or SDD increases, there may be potential to significantly increase enrollment in these pathways and ultimately improve value in this context. More widespread implementation of early discharge and potentially SDD would require accurate prediction of patients who are likely to experience uneventful early discharge. Therefore, the objectives of this study were (1) to characterize the reasons for post-operative hospitalization, (2) determine the outcomes of early discharge and discharge prior to the return of full gastrointestinal function, and (3) identify predictors of successful early discharge in patients undergoing elective colorectal surgery within an established ERP.

## Materials and methods

### Study population and setting

A retrospective review of all adult patients undergoing elective laparoscopic colectomy at a single high-volume university-affiliated colorectal referral center was performed

from 08/2017 to 06/2021. Patients were included if they had undergone elective laparoscopic colectomy or ileostomy closure and were admitted after surgery. They were excluded if they had been enrolled in our ambulatory colectomy pathway (SDD protocol), underwent creation of a new stoma, their procedure was open or converted to open, underwent colostomy closure, extraperitoneal rectal resection and anastomosis, multivisceral resection, were already an inpatient, or scheduled as an urgent or emergent procedure. The procedures that met inclusion criteria for this study were the same as in our SDD protocol. All patients were enrolled in our established colorectal ERP (<https://www.sages.org/enhanced-recovery/mcgill-colorectal-pathway/>) with a 3-day target LOS. Patient charts were examined by two independent reviewers. Demographic data and other clinical characteristics including principal diagnosis, procedure information (procedure, duration, blood loss), use of neuraxial anesthesia, patient controlled analgesia, and route of medication delivery, comorbidity, which was evaluated using the Charlson comorbidity index (CCI) [7], and American society of anesthesiologists score (ASA) [8]. In addition, the reason for continued hospitalization was recorded for each post-operative day (POD) starting at POD1 to POD3 and based on pre-SDD and post-SDD implementation. Included patients were then divided into three groups based on duration of admission: LOS = 1 day (early discharge), LOS 2–3 days (target LOS), and LOS 4+ days (delayed discharge). A secondary exploratory analysis was performed to evaluate patient and procedure-related factors previously associated with more complicated hospitalization. The study protocol was approved by the institutional research ethics board.

## Outcomes

The main outcome measures were 30-day emergency visits, complications, and readmissions. Emergency visits were then classified as (1) “not urgent,” (2) “treatable in ambulatory care setting,” (3) “emergent but appropriate for timely out-patient care,” and (4) “emergency care required” using the New-York University Emergency Department Algorithm (NYU-EDA) [9]. According to the NYU-EDA, grades 1 to 3 are considered potentially preventable. Specifically, potentially preventable visits were considered as those that could be appropriately managed by a specialist surgeon remotely or with timely follow-up (e.g.: wound issues, prescription changes, etc.), while unpreventable visits were those that needed emergency assessment and treatment (e.g., anastomotic leak, hemorrhage, etc.). Complications were classified using the Clavien–Dindo classification for severity [10]. Return of gastrointestinal function was defined as fulfillment of GI-3 criteria (tolerance of oral intake with passage of gas or stool) which is a commonly used composite score

for return of gastrointestinal function in the literature [11]. Day of the week was also evaluated as a predictor of LOS, readmission, and emergency visits.

## Statistical analysis

Continuous variables were reported as mean (SD) or median [IQR], and categorical variables were presented as frequency and percentage where appropriate. Outcome measures were analyzed using ANOVA or Kruskal–Wallis test for comparison of continuous variables and Pearson Chi Square for categorical comparisons where appropriate. A subgroup analysis comparing patients who were discharged on POD1 with versus without return of bowel function was performed. The effect of SDD implementation (03/2020) on LOS was also explored. Our secondary analysis was performed using multinomial logarithmic regression to evaluate patient and procedure factors associated with length of stay. A  $p$  value < 0.05 was considered to be statistically significant. All statistical analyses were performed using Stata software package (Stata v16.0, StataCorp, College Station, Tx).

## Results

A total of 497 patients were included out of a total of 937 elective major abdominal resections (168 excluded for a new stoma creation, 137 for open surgery, 73 for an extraperitoneal anastomosis without a stoma, 62 for other exclusion criteria). Of the 497 patients, 122 (25%) were operated on following the implementation of our institutions SDD protocol. There were 63 (13%) patients in the early discharge group (LOS = 1 day), 284 (57%) patients in the target LOS group (LOS = 2–3 days) and 150 (30%) patients in the delayed discharge group (LOS  $\geq$  4 days). Patient demographics and clinical characteristics are reported in Table 1. Overall, there were no differences in patient characteristics, indication for surgery, or procedure type between the groups. However, shorter operative time ( $p = 0.003$ ), transverse abdominis plane (TAP) block ( $p < 0.001$ ), analgesic route, and lower ASA score were associated with shorter LOS ( $p < 0.001$ ) (Table 1). Patients in the LOS1 group also had the lowest mean morphine equivalents and were the least likely to require any subcutaneous or intravenous administration of medications ( $p < 0.001$ ). There was a higher proportion of patients in the LOS1 group after SDD implementation (34% vs. 6%,  $p < 0.001$ ).

Between the three study groups, there was no significant difference with respect to frequency of emergency visits, timing at which patients presented to the emergency department, and potential preventability of the emergency visits according to the NYU-EDA (Table 2) [9]. There was also no difference in outcomes, ED visits ( $p = 0.478$ ), readmissions

**Table 1** Cohort characteristics

	Overall cohort ( <i>n</i> = 497)	LOS 1day ( <i>n</i> = 63)	LOS 2–3 ( <i>n</i> = 284)	LOS 4+ ( <i>n</i> = 150)	<i>p</i> value
Mean age, years (SD)	64 (± 14)	63 (± 14)	63 (± 13)	66 (± 14)	0.062
Male	273 (54%)	37 (59%)	146 (51%)	90 (58%)	0.162
Mean BMI (SD)	26.8 (± 5.1)	27.2 (± 4.8)	26.7 (± 5.3)	26.9 (± 5)	0.839
Mean CCI, points (SD)					0.431
0–2	109	11 (17%)	70 (25%)	28 (18%)	
3–4	137	17 (27%)	75 (26%)	45 (29%)	
5+	257	35 (55%)	140 (49%)	82 (53%)	
ASA score					0.001
1	32 (6%)	4 (6%)	25 (9%)	3 (2%)	
2	265 (53%)	42 (66%)	148 (52%)	73 (47%)	
3+	205 (41%)	17 (27%)	108 (38%)	78 (51%)	
Indication for surgery					0.287
Neoplasm	368 (73%)	43 (68%)	211 (74%)	111 (72%)	
Diverticular disease	40 (8%)	5 (8%)	16 (6%)	15 (10%)	
IBD	33 (7%)	2 (3%)	20 (7%)	14 (9%)	
Stoma closure	61 (12%)	13 (20%)	33 (12%)	15 (10%)	
Other	5 (1%)	1 (2%)	3 (1%)	1 (1%)	
Procedure					0.121
Right/transverse colectomy	218 (43%)	27 (43%)	114 (40%)	75 (49%)	
Left/sigmoid colectomy	159 (32%)	17 (27%)	91 (32%)	50 (32%)	
Anterior resection	64 (13%)	6 (10%)	43 (15%)	14 (9%)	
Stoma closure	61 (12%)	13 (21%)	33 (12%)	15 (10%)	
Mean OR time, min (SD)	170 (± 77.8)	145 (± 63)	167 (± 69)	183 (± 94)	0.003
Median EBL, mL [IQR]	50 [100]	50 [100]	50 [100]	50 [150]	0.119
Intraoperative TAP block	163 (32%)	41 (65%)	82 (29%)	36 (23%)	<0.001
Post-operative analgesia					<0.001
Epidural	16 (3%)	0 (0%)	9 (3%)	7 (4%)	
PCA	73 (15%)	0 (0%)	26 (9%)	47 (31%)	
Oral/SC	413 (82%)	63 (100%)	250 (88%)	100 (65%)	
MME, mg (SD)					
POD0		24.3 (± 18.8)	34.1 (± 26.3)	37.6 (± 27.6)	0.003
POD1		5.14 (± 7.6)	22.4 (± 25.3)	31.7 (± 37.6)	<0.001
POD2			12.7 (± 19.8)	23.6 (± 36.7)	<0.002
POD3			7 (± 11.5)	13.6 (± 23.6)	0.003
Any SC/IV					
POD0		45 (71%)	243 (85%)	142 (92%)	<0.001
POD1		1 (1%)	59 (21%)	60 (39%)	<0.001
POD2			39 (14%)	53 (34%)	<0.002
POD3			2 (1%)	41 (27%)	<0.001

*BMI* body mass index, *CCI* Charlson comorbidity index, *ASA* American society of anesthesiology, *IBD* inflammatory bowel disease, *OR* operating room, *EBL* estimated blood loss, *TAP* transversus abdominis plane, *PCA* patient controlled analgesia, *SC* subcutaneous, *MME* mean morphine equivalents, *IV* Intravenous

( $p = 0.218$ ), or preventable visits ( $p = 0.089$ ) between the LOS1 vs. LOS2–3 groups. The early discharge group had a significantly higher rate tolerating oral intake without nausea or vomiting on POD 0 at 94% (95% CI: 88–100%) compared to 79% (95% CI: 74–84%) of those not discharged early ( $p = 0.005$ ). Furthermore, when compared specifically

to the target LOS group who tolerated oral intake 80% (95% CI: 75–85%) of the time, the results remained significant ( $p = 0.011$ ). Discharge with full gastrointestinal recovery (attainment of GI-3) occurred in 54% of patients discharged early, 98% of patients who achieved target LOS, and 100% of patients who were discharged beyond the ERP target.

**Table 2** Primary outcomes

	LOS 1 day	LOS 2–3 days	LOS 4+ days	<i>p</i> value
In-hospital complications	0 (0%)	11 (4%)	77 (50%)	<0.001
Max Clavien-Dindo score (in hospital)				<0.001
Minor (1–2)	0 (0%)	10 (3.5%)	53 (34%)	
Major (3–4)	0 (0%)	1 (0.5%)	24 (16%)	
30-day ED visit/complication	7 (11%)	24 (8%)	15 (10%)	0.751
Max Clavien-Dindo score (out of hospital)				0.635
Minor (1–2)	5 (8%)	18 (6%)	14 (5%)	
Major (3–4)	3 (5%)	3 (1%)	2 (1%)	
Median ED timing, POD [IQR]	10.14 [± 4.26]	11.72 [± 7.29]	13.2 [± 6.32]	0.505
Preventable ED visit	3/7 (43%)	15/24 (65%)	6/15 (40%)	0.249
30-day readmission	4 (6%)	9 (3%)	8 (5%)	0.322

LOS length of stay, ED emergency department, POD post-operative day

Among patients who were discharged early, there was no difference in timing, number, or preventability of emergency visits between those with return of bowel function and those without. There was also no difference in type (e.g., wound issues, pain, ileus, leak or other) or severity of post-discharge complications or 30-day readmission rates between these two groups (Table 3). Subgroup analysis of LOS before and after the implementation of our SDD protocol revealed that prior to introduction of SDD, 6% of patients were LOS1, 60% were LOS2–3, and 34% were LOS4+ whereas, following implementation of SDD, 34% were LOS1, 48% were LOS2–3, and 18% were LOS4+. This difference represents a significant increase in early discharge following the adoption of a SDD protocol ( $p < 0.001$ ). There was also no significant association between day of surgery and LOS ( $p = 0.386$ ), overall 30-day ED visit ( $p = 0.627$ ), preventable ED visits ( $p = 0.267$ ), or readmissions ( $p = 0.566$ ).

The reason for continued hospitalization after POD 1, 2, and 3 is reported in Table 4. Awaiting gastrointestinal recovery (absence of flatus or stool) was the most common reason to keep patients hospitalized for the first two days after surgery. Other important reasons for hospitalization beyond POD 1 were nausea, vomiting, or not tolerating diet (18%), mobility issues (13%), and abnormal vital

signs (11%). Awaiting return of bowel function was documented as the main issue requiring hospitalization on POD 1 in 73% of patients prior to implementation of the SDD protocol compared 51% of those following its introduction (Table 4). The proportion of patients kept in hospital beyond POD 1 for medical monitoring increased after SDD initiation ( $p = 0.003$ ).

Using multinomial logistic regression adjusted for age, sex, ASA score, BMI, and procedure type, operative time beyond the 75th percentile for respective procedure was associated with increased LOS, whereas TAP block and neoplasia as an indication for surgery were associated with decreased LOS. Day of surgery was not associated with LOS (Table 5).

## Discussion

Discharge prior to the return of gastrointestinal function or even on the day of surgery may further reduce LOS and improve outcomes after minimally invasive colorectal surgery. In order to determine which patients may be candidates for early discharge, it is important to understand why patients remain admitted after surgery, and also whether

**Table 3** Early discharge cohort

	+Bowel function ( <i>n</i> = 34)	–Bowel function ( <i>n</i> = 29)	<i>p</i> value
30-day ED visit / complication	4 (12%)	3 (10%)	0.858
Max Clavien-Dindo score (out of hospital)			1.00
Minor(1–2)	3 (9%)	2 (7%)	
Major(3–4)	1 (3%)	1 (3%)	
Median ED timing, POD [IQR]	10.5 [7–14.5]	7 [6–15]	0.578
Preventable ED visit	3/4 (75%)	0/3 (0%)	0.243
30-day readmission	1 (3%)	3 (10%)	0.326

ED emergency department, POD post-operative day

**Table 4** Reason for inpatient stay by post op day and by pre/post-SDD

Reason to stay in hospital	POD1			POD2			POD3		
	Pre-SDD (n = 354)	Post-SDD (n = 80)	Total (n = 434)	Pre-SDD (n = 241)	Post-SDD (n = 37)	Total (n = 278)	Pre-SDD (n = 128)	Post-SDD (n = 21)	Total (n = 149)
Gastrointestinal function									
N/V/not tolerating PO	72 (20%)	5 (6%)*	77 (18%)	67 (28%)	7 (19%)	74 (26%)	42 (33%)	6 (29%)	48 (32%)
Not passing gas or stool	257 (73%)	41 (51%)*	298 (67%)	73 (30%)	6 (16%)	79 (28%)	17 (13%)	2 (10%)	19 (13%)
Other reasons									
Pain control	17 (5%)	7 (9%)	24 (5%)	15 (6%)	6 (16%)*	21 (7%)	8 (6%)	3 (14%)	11 (7%)
Urinary issues	7 (2%)	3 (4%)	10 (2%)	8 (3%)	2 (5%)	10 (4%)	3 (2%)	0 (0%)	3 (2%)
Mobilization issues	45 (13%)	11 (14%)	56 (13%)	24 (10%)	4 (11%)	28 (10%)	8 (6%)	4 (19%)*	12 (8%)
Social issues	0 (0%)	2 (3%)*	2 (0.5%)	3 (1%)	1 (3%)	4 (1%)	4 (3%)	1 (5%)	5 (3%)
Medical monitoring	44 (12%)	22 (28%)*	66 (15%)	50 (21%)	17 (46%)*	67 (24%)	59 (46%)	11 (52%)	70 (47%)
Abnormal or awaiting investigation	20 (6%)	11 (14%)*	31 (7%)	29 (12%)	8 (22%)	37 (13%)	30 (23%)	6 (29%)	36 (24%)
Abnormal vitals or physical exam	30 (8%)	18 (23%)*	48 (11%)	35 (15%)	12 (32%)*	47 (17%)	42 (33%)	9 (43%)	51 (34%)
Bleeding	13 (4%)	7 (9%)	20 (5%)	25 (10%)	5 (14%)	30 (11%)	9 (7%)	3 (14%)	12 (8%)
“Other”	31 (9%)	9 (11%)	40 (9%)	23 (10%)	1 (3%)	24 (9%)	9 (7%)	0 (0%)	9 (6%)

“Other” is defined as the residual categories such as, “no clear indication for admission”. *POD* post-operative day, *SDD* same-day discharge, *N/V* nausea or vomiting, *PO* per os

\*Denoting  $p < 0.05$

**Table 5** Multinomial regression

	LOS1	LOS2–3 (reference group)	LOS 4+
OR time beyond >75th percentile for procedure	0.82 (0.33, 2.04)		1.87 (1.08, 3.26)*
Body mass index >35	1.03 (0.26, 4.09)		1.12 (0.44, 2.89)
Neoplasm	0.39 (0.12, 1.27)		0.18 (0.07, 0.43)*
TAP block	5.54 (2.58, 11.92)*		0.60 (0.34, 1.06)
Thursday/Friday	1.96 (0.96, 4.00)		1.07 (0.65, 1.77)

Multinomial regression using target LOS as the reference category. Further adjusted for age, gender, ASA score and procedure type. Presented as odds ratio (95% CI). *LOS* length of stay, *OR* operating room, *TAP* transversus abdominis plane, *ASA* American society of anesthesiology

\*Denoting  $p < 0.05$

outcomes of early discharge are similar to those who remain hospitalized up to the target LOS of our ERP. We found that the main reason that patients remain hospitalized after laparoscopic colorectal resection is to await return of gastrointestinal function. Moreover, patients that were discharged before full gastrointestinal recovery did not experience increased post-discharge complications, emergency room visits, and readmissions.

In our study, patients in the early discharge group had readmission rates of 6%, which is consistent with the literature [5, 12]. These results are also comparable to readmission rates for elective laparoscopic colectomy in standard pathways [13, 14]. Moreover, no significant differences were identified in the frequency of 30-day readmissions or severity of out of hospital complications between patients who were discharged early and patients who were not. Additionally, there were no significant differences in the frequency, timing, and preventability of emergency room visits between the groups. This suggests that there is no shift in burden to the emergency after discharge. Other studies have shown similar findings; however, they included full return of bowel function as part of their discharge criteria [15].

Awaiting the return of bowel function is frequently the major criterion limiting discharge in standard ERPs with up to 47–73% of patients remaining in hospital on POD 1 awaiting the passage of flatus or stool [16]. The same was seen in our study. However, when evaluating our early discharge group, results show no significant difference in outcomes between those who had full return of gastrointestinal function and those who did not. In a recent large multicenter prospective study, discharge prior to return of bowel function was found to be safe in selected patients undergoing elective colorectal surgery [3]. These results suggest that discharge prior to recovery of gastrointestinal function is safe. Interestingly, when comparing the pre-SDD cohort to the post-SDD cohort, there were significant increases in the proportion of patients requiring further hospitalization for medical monitoring or social issues. These findings may suggest that the patients who remain hospitalized beyond POD1 are likely those who require further medical monitoring and are more frequently being identified based on other criteria such as abnormal vital signs, clinical exam, or investigations.

Patients discharged early had significantly lower ASA scores, mean operating room (OR) time, and opioid and parenteral medication use. Previous studies evaluating early discharge in elective colectomy have found that shorter operative time was associated with early discharge and have used low ASA score to evaluate eligibility for early discharge [15, 17]. Another study by Scheer et al. found that operative times greater than 270 minutes for colectomies were associated with increased complications, prolonged ileus, and longer hospital stay [18]. Notably, operative time for laparoscopic colectomy has been shown to be associated

with elevated BMI [19]. However, in our secondary analysis, when we adjusted for obesity and procedure type, we found that operative time was still a significant predictor of LOS. We suspect that operative time is a multifactorial indicator of operative difficulty, disease severity, or other technical factors. These results suggest that early discharge will likely have the highest chance of success in healthier patients undergoing uncomplicated resection.

Importantly, the patients included in this study are those that had been excluded from our institution's SDD cohort or those treated in the years just before implementation of the SDD protocol. The patients that were enrolled in the SDD protocol tended to be healthier with less extensive procedures when compared to the standard ERP [4], although 35% of patients were ASA 3+ and 15% of patients underwent extraperitoneal resections [4]. When we evaluated patients who were discharged early prior to and after the implementation of our SDD protocol, we found that significantly more patients were being discharged early (LOS = 1 day) while there was a simultaneous SDD protocol in place. We hypothesize that this pattern is likely due to increased confidence of the treating team in the safety of early discharge as a result of emerging literature supporting this practice.

Furthermore, patients who were discharged early were more likely to tolerate their diet on POD 0 than those who were not. Early tolerance of feeding has been associated with decreased complications and failure of early tolerance of feeding can serve as an early indicator of more complicated hospital admissions [20]. These findings solidify the inclusion of early oral intake as a discharge criterion in both SDD and early discharge in an ERP. When considering modes of analgesia, previous studies have found TAP blocks to be associated with decreased opioid use, earlier resumption of diet, and shorter hospital admission [21]. Similarly, we found TAP block to be associated with early discharge, whereas use of parenteral medication on POD 0 and increased opioid use were associated with increased LOS. Given these findings, we suspect that patients who require parenteral medications are more likely to have nausea, intolerance to oral intake, or significant pain not sufficiently relieved by oral analgesia.

Interestingly, day of surgery was not associated with LOS or any other primary outcome despite reports of its association with LOS and mortality in other contexts [22, 23]. These findings are likely an indication of a robust and consistent discharge practice throughout the course of the week and supports early discharge on the weekends.

## Limitations

This study is limited by its retrospective nature, and findings should be interpreted in this context. Specifically, there is potential for unmeasured confounding such as

patient activation or health literacy, which has been associated with post-discharge resource utilization after surgery [24]. There may also have been socioeconomic factors that affected discharge, such as available social support at home or even distance to the hospital, although this was recorded as ‘social reasons’ for delayed discharge. Furthermore, due to the retrospective nature, it was difficult to determine on occasion the exact reason for keeping patients in hospital, especially when there were discrepancies between the nursing and physician notes. In such cases, the physician notes were given priority. We were also limited to variables available in patient charts and, therefore, could not gather data on potentially relevant variables such as pain scores that may affect readiness for discharge. We used opioid consumption as a proxy measure for pain scores, as we hypothesized that pain that was not controllable with opioid-free analgesia would be a contraindication for discharge. Further, we excluded procedures with fewer than  $n = 5$  cases such as reversal of loop colostomy. Therefore, generalizability to less commonly performed procedures is unknown. Lastly, unplanned patient interactions by phone call or e-mail were not recorded. As a result, additional administrative workload could not be determined for these tasks.

Increased emergency visits and 30-day readmission rates are unfavorable outcomes of early discharge as they are costly and can affect patient satisfaction [25, 26]. Conversely, unnecessary inpatient admission is associated with inefficient hospital resource utilization, and in situations with high bed occupancy may lead to limitations or cancellations of elective procedures. In summary, our study found that (1) the main reason to remain hospitalized after elective laparoscopic colorectal resection was to await the return of gastrointestinal function, and that (2) early discharge, even without full recovery of gastrointestinal function, was not associated with worse outcomes. Lastly, (3) there were several factors that were associated with successful early discharge such as, lower ASA scores, shorter operative times, tolerance of oral intake on POD 0, oral route for medications and hydration on POD 0, use of TAP block, and avoidance of PCA or epidural. These results suggest that a greater proportion of patients, especially those who meet these criteria and have no other contraindication for discharge, may be candidates for early discharge even without return of gastrointestinal function. This approach has the potential of further reduce length of stay, costs, and unnecessary use of valuable inpatient resources.

**Funding** Canadian Institutes of Health Research-Frederick Banting and Charles Best Canada Graduate Scholarship-Master’s (CGS M).

## Declarations

**Disclosures** S Robitaille is supported by a Bursary Award for Master’s Training for Applicants with a Professional Degree from the Canadian Institutes of Health Research (Frederick Banting and Charles Best Canada Graduate Scholarship-Master’s (CGS M)), LS Feldman reports an investigator-initiated grant from TheatOR, and speaker fees from Abbott and Merck. JF Fiore Jr reports an investigator-initiated grant from Merck and consulting fees from Shionogi. AS Liberman is on the advisory board for Novadaq, Merck, and Servier, and receives speaker fees from Ippen. L Lee is supported by a Career Development Award from the American Society of Colon & Rectal Surgeons (CDA-019). L Lee also reports an investigator-initiated operating grant from Johnson & Johnson and speaker fees from Stryker. A Wang, P Charlebois, and B Stein have no disclosures to report.

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