Surgical Endoscopy (2022) 36:2653–2660
https://doi.org/10.1007/s00464-021-08514-x

2020 SAGES POSTER

High incidence of potentially preventable emergency department visits after major elective colorectal surgery

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Received: 2 November 2020 / Accepted: 17 April 2021 / Published online: 6 May 2021

Abstract

Introduction Emergency department (ED) visits after surgery represent a significant cost burden on the healthcare system. Furthermore, many ED visits are related to issues of healthcare delivery services and may be avoidable. Few studies have assessed the reasons for ED visits after colorectal surgery. The main objectives of this study were to: (1) identify the reasons why patients presented to the ED within 30 postoperative days and (2) determine if these visits were potentially preventable.

Methods A retrospective chart review was conducted on elective major colorectal surgery cases performed in a single center between 01/2017 and 07/2019. Data collected included demographics, medical history, intraoperative details, postoperative complications, ED visits within 30 postoperative days, and readmissions. Each ED visit was assessed by two reviewers and graded on a scale adapted from the New York University ED algorithm. The gradings were: (1) non-emergent, (2) emergent but treatable in an ambulatory setting, (3) emergent/ED-care required but preventable if timely outpatient care was available, and (4) emergent/ED-care required and non-preventable. Grades 1–3 were deemed potentially preventable. Logistic regression identified independent predictors of potentially preventable visits.

Results Six hundred and twenty five patients were included in the final analysis. 110 (17.6%) patients presented to the ED within 30 days. The most common cause of ED visit were ileus/small bowel obstruction (SBO) (16.4%), superficial wound infection (15.5%), genitourinary issues (10.9%), and non-infectious gastrointestinal issues (nausea, malnutrition, diarrhea, high output stomas) (10.9%). After review, 51.8% of visits were considered potentially preventable (Grade 1–3). The most common causes of preventable ED visits were superficial wound infection (24.6%), non-infectious gastrointestinal issues (19.3%), and minor bleeding (14.0%). Creation of a new stoma was the only independent risk factor for potentially preventable ED visits (OR 2.14, 95%CI 1.03–4.47).

Conclusion Approximately half of ED visits within 30 days of discharge were potentially preventable. These findings indicate a need to improve access to outpatient care to reduce preventable ED visits after elective colorectal surgery.

Keywords Colorectal · Surgery · Emergency department · Readmissions · Preventable

Inefficient use of emergency department (ED) resources is a major contributor to growing healthcare expenditures [1]. Indeed, there is a significant proportion of ED visits that are for conditions that could be treated in the outpatient setting, resulting in an estimated $38 billion in wasteful expenditures annually within the USA healthcare system [1].

Unplanned ED visits occur frequently in abdominal surgery, where 15–20% of postoperative patients will seek care within 30 days of surgery [2–4]. In colorectal surgery specifically, approximately 20% of patients will have an unplanned 30-day emergency visit, with over half of these visits not requiring readmission, suggesting that these visits may be potentially preventable [5]. Current literature has focused primarily on reasons for readmission, yet few studies have characterized the nature of non-readmission ED visits. By identifying the reasons behind these unplanned visits, we can establish targeted quality improvement initiatives to

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minimize preventable healthcare utilization and its associated cost burden.

This study aims to characterize ED resource utilization after elective colorectal surgery by: (1) identifying the reasons patients presented to the ED within 30 days of surgery and (2) determining if these visits were potentially preventable based on their usage of ED-specific resources.

Methods

After ethics approval by the McGill University Health Centre (MUHC) Institutional Review Board (IRB), a retrospective chart review was conducted on all elective inpatient major colorectal surgery cases performed in a single high-volume academic center between January 2017 and July 2019. Patient consent was not deemed required by the IRB given the retrospective nature and anonymized outcomes of the study. Major colorectal surgery includes any surgery with an intra-abdominal component (laparoscopic & open) that required bowel resection with or without anastomosis. All elective surgery patients receive standard perioperative in the context of an enhanced recovery after surgery (ERAS) pathway, which includes an active ileostomy pathway for new ileostomates. Discharge criteria included full recovery of gastrointestinal function, adequate analgesia, and ability to self-mobilize and micturition. These criteria have been previously validated [6]. Emergency surgeries, day surgeries, and surgeries without an abdominal component (transanal procedures) were excluded. Given the primary outcome was 30-day unplanned ED visits, patients with primary length of stay over 30 days were also excluded.

Data was collected for preoperative, intraoperative, and 30-day postoperative (calculated from the date of primary surgery) periods. Preoperative variables included patient demographics (age, sex, body mass index), comorbidities via the Charlson comorbidity index (CCI), indication for surgery, preoperative opioid use, and steroid use defined as the need for intraoperative dosing with stress-dose corticosteroids. Intraoperative data included surgery type, surgical approach (laparoscopic, open, converted), presence of a new stoma at the end of surgery, operative duration, intraoperative complications, blood loss, and the amount of administered blood products. Postoperative variables included hospital length of stay, mortality within 30 days, ED visit within 30 postoperative days, reason for ED visit, readmission, and reason for readmission. Reasons for ED visits were categorized into broad categories as follows: wound complications, organ space infections/anastomotic leak, genitourinary, cardiopulmonary, venous thromboembolism (VTE), bleeding, non-infectious gastrointestinal (which includes high output stoma, non-obstructive nausea/vomiting), issues pertaining to stoma appliances and drains, pain control, ileus/small bowel obstruction, and other.

Each ED visit was reviewed by two independent reviewers and graded on potential preventability based on ED resource utilization. Any disagreement in grading was resolved by means of a tie-breaker using a third independent reviewer. A grading scale of 1–4 was adapted from the New York University ED algorithm, depicted in Fig. 1 [7]. The gradings were: (1) non-emergent, (2) emergent but treatable in an ambulatory care setting, (3) emergent/ED-care required but preventable if timely outpatient care was available and (4) emergent/ED-care required and non-preventable. This algorithm was initially developed to classify ED utilization by the NYU Center for Health and Public Service Research. Using a panel of experts, the authors examined 6000 ED records based on several components

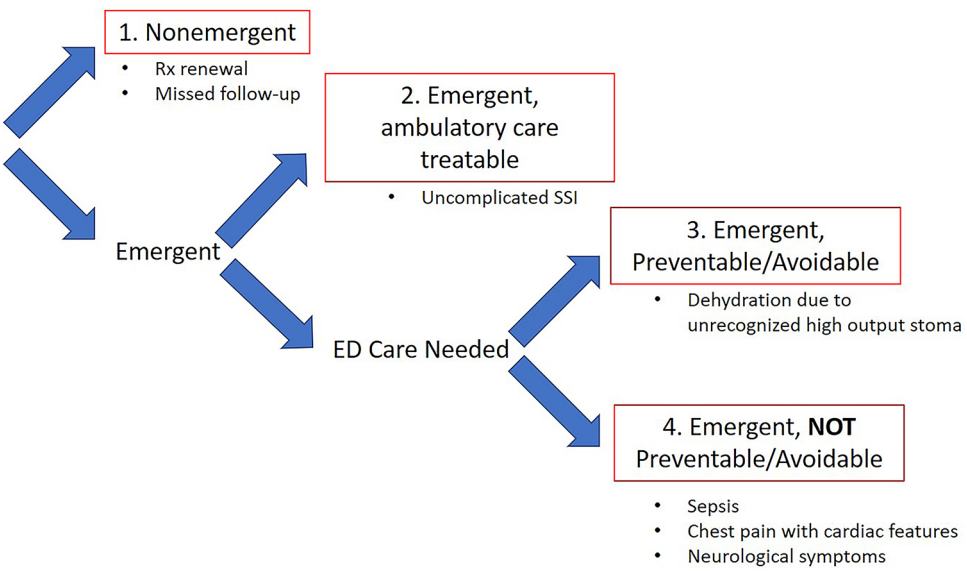

Fig. 1 Algorithm for ED visits following colorectal surgery (adapted from NYU ED Algorithm) (Rx = prescription, SSI = surgical site infection)

including, but not limited to, diagnoses and resources used in the ED. These were then categorized into four categories, similar to those outlined here. This tool has since been validated and used in larger studies since its initial creation [8]. Visits were graded based on what resources were used, without judgment on the appropriateness in the clinical context. Any visit that required a resource specific to the ED (ex. CT scan, ultrasound, IV hydration, etc.) was assigned a Grade 3 or 4. For example, a patient coming in with acute severe abdominal pain who underwent a CT scan to rule out anastomotic leak would be considered at least a Grade 3 or 4 depending on the findings—this is in large part driven by the use of a CT scanner, which is not easily accessible in the outpatient setting and often requires ED care. Cases were considered non-preventable if the nature of the condition was unpredictable or could not have been dealt with remotely by a specialist colorectal physician (ie. unrelated to colorectal surgery, cardiopulmonary issues such as chest pain, dyspnea, palpitations etc.). For example, a patient presented with acute retrosternal chest pain 2 weeks following surgery, associated with dyspnea and palpitations. The patient underwent serial troponin testing, required an electrocardiogram and was assessed by the cardiology team in the ED—this kind of mobilization of resources require the coordination of the ED and other specialties, thus precluding it from being done in the outpatient setting. It is as such considered a Grade 4. Grades 1–3 were deemed potentially preventable.

Statistical analyses were all performed using the open-source R statistical platform. The study population was initially divided by outcome into patients who had an unplanned ED visit within 30 days and patients who did not. A weighted kappa-statistic was calculated to evaluate inter-rater reliability regarding grading of potential preventability. Univariate analysis comparing categorical variables (Sex, Opioid Use, Steroid Use, Indications for OR, Operative details, Operative approach, New Stoma, and Operative complications) was performed using a Pearson's Chi-Squared Test. Univariate analysis comparing continuous variables (Age, BMI, CCI, ASA, Operative Time, Blood loss, Length of stay) was done using a two sample t-test. Reasons for visits were tabulated by frequency of occurrence, and a percentage of total visits was calculated. A similar process was executed for potentially preventable visits. To identify potential risk factors for preventable visits, a multivariate logistical regression was fitted to model potentially preventable visits (outcome) using age, sex, ASA, indication for OR, new stoma, and operative approach as covariates. From this, 95% confidence intervals for the estimated odds ratio were calculated. Confounding factors were included based on clinical and statistical relevance, with certain factors excluded due to collinearity with included factors (ie. CCI and ASA). Factors that showed statistically significant differences between groups were included for this reason (ie. New stoma, indication for OR).

Results

A total of 625 patients underwent inpatient major colorectal surgery and were included in the final analysis. There were 110 patients (17.6%) who presented to the ED within 30 days from the date of surgery, and 515 patients who did not present to the ED. Univariate analysis between both groups demonstrates that patients who presented to the ED were younger, more likely to be treated for inflammatory bowel disease (IBD), and less likely to be treated for a neoplastic process (Table 1). The remaining preoperative and intraoperative details were similar between groups. There was no difference in ED visits between groups if the surgical procedure was separately categorized within diagnosis groups.

The most common causes of all (potentially preventable and non-preventable) ED visits were SBO/ileus and wound complications accounting for 16.36% and 15.45% respectively (Table 2). The distribution of causes for all visits are outlined in Table 2. After review of all ED visits and resource utilization, 57 (51.8%) of the visits were deemed to be potentially preventable, ie. Grades 1–3. The percent agreement was 70.9% with a Cohen's kappa score of 0.58. A third independent reviewer was used as tiebreaker for the 29.1% of disagreements. The most common causes of potentially preventable ED visits were wound complications (24.56%), non-infectious GI issues (19.3%), and bleeding (14.0%). The remaining distribution of reasons for preventable visits is outlined is outlined in Table 3. Of the patients who presented to the ED, 47 were readmitted (43.6%). The most common causes of readmission were ileus/SBO (35.4%) and organ space infection/anastomotic leak (22.9%) (Table 4).

We performed multivariate logistic regression to identify potential risk factors to identify patients likely to return to the ED for potentially preventable reasons. Potential confounders adjusted for included presence of a new stoma, age, ASA score, operative approach, and indication for OR. Creation of a new stoma was the only independent risk factor for potentially preventable ED visits with an OR of 1.86 (95%CI 1.02–3.28).

Discussion

Our study demonstrates that a significant portion of patient undergoing elective major colorectal surgery have unplanned ED visits within 30 days, with many of these not requiring readmission or ED-specific resources. This confirms the

Table 1 Preoperative and intraoperative variables comparison in patient who did or did not present to the ED within 30 days of surgery

	No ED visit ($N=515$)	ED visit ($N=110$)	p value
Age			**0.027**
Mean	62.1	58.4	
Sex			0.164
F	234 (45.4%)	42 (38.2%)	
M	281 (54.6%)	68 (61.8%)	
BMI			0.075
Mean	25.9	27	
CCI			0.281
Mean	3.95	3.65	
ASA			0.930
Mean	2.33	2.34	
Recent opioid use			0.311
No	501 (97.3%)	105 (95.5%)	
Yes	14 (2.7%)	5 (4.5%)	
Recent steroid use			0.121
No	488 (94.8%)	100 (90.9%)	
Yes	27 (5.2%)	10 (9.1%)	
Indication for OR			**0.023**
Neoplastic	324 (62.9%)	57 (51.8%)	
Stoma	78 (15.1%)	16 (14.5%)	
IBD	68 (13.2%)	27 (24.5%)	
Benign disease	45 (8.7%)	10 (9.1%)	
Operative details			0.121
Colon	287 (55.7%)	49 (44.5%)	
Colon & rectum	23 (4.5%)	9 (8.2%)	
Other	97 (18.8%)	24 (21.8%)	
Rectal	108 (21.0%)	28 (25.5%)	
Operative approach			0.212
Laparoscopic	351 (68.2%)	67 (60.9%)	
Open	129 (25.0%)	31 (28.2%)	
Converted	35 (6.8%)	12 (10.9%)	
New stoma			**0.004**
No	411 (79.8%)	74 (67.3%)	
Yes	104 (20.2%)	36 (32.7%)	
Operative time (min)			0.189
Mean	188	201	
Blood loss (mL)			0.321
Mean	191	234	
Operative complications			0.365
No	456 (88.5%)	94 (85.5%)	
Yes	59 (11.5%)	16 (14.5%)	
Length of stay (days)			0.359
Mean	4.96	4.55	

p values < 0.05 highlighted in bold

need for improved outpatient postoperative care and represents an avenue for quality improvement efforts.

Overall, this study suggests that a significant portion of potentially preventable ED visits may stem from a lack of accessibility to specialized post-operative care, with no direct access often until the standard follow-up with the surgeon several weeks later. This poses a problem with seeking appropriate medical care in the event of complications, which often arise in the first few weeks following surgery. Indeed, a qualitative study by Jones et al. reported

Table 2 Reasons for all (preventable and non-preventable) ED visits

Reason	Freq	Percent
SBO/Ileus	18	16.36
Wound complication	17	15.45
Other	13	11.82
Genitourinary	12	10.91
Noninfectious GI issues	12	10.91
Bleeding	11	10.00
Organ space infection/Anastomotic leak	11	10.00
Pain control	7	6.36
Cardiopulmonary	3	2.73
Stoma & drain issues	3	2.73
VTE	3	2.73

Table 3 Most common presentations for potentially preventable ED visits

Reason	Freq	Percent
Wound complication	14	24.56
Noninfectious GI issues	11	19.30
Bleeding	8	14.04
Other	8	14.04
Genitourinary	6	10.53
Pain control	5	8.77
Stoma & drain issues	3	5.26
SBO/Ileus	1	1.75
VTE	1	1.75

Table 4 Most common reasons for readmissions

Reason	Freq	Percent
SBO/Ileus	17	35.42
Organ space infection/Anastomotic Leak	11	22.92
Genitourinary	5	10.42
Noninfectious GI issues	4	8.33
Bleeding	3	6.25
Other	2	4.17
VTE	2	4.17
Wound complication	2	4.17
Cardiopulmonary	1	2.08
Pain control	1	2.08

that 68% of colorectal patients at one center were advised to seek care at the nearest ED in the event of a potential complication, highlighting a missing link in our ability to deliver quality post-operative care [9]. Based on this, several groups including our own have implemented or are currently implementing active post-discharge surveillance programs in an effort to limit unplanned ED visits and readmission [10, 11]. Indeed, Borsuk et al. demonstrated that patients benefiting from active surveillance following colorectal surgery had significantly lower odds of unplanned ED visits when compared to the control group [10]. Most interesting however, was the 22.8% of patients who despite communicating "significant clinical complaints" were successfully managed without ED involvement or readmission, a direct result of care successfully coordinated using the applications chat function [10]. Similarly, Carrier et al. demonstrated that enhanced surgeon–patient communication using a text-message based outpatient follow-up tool was associated with improved detection of postoperative complications and lower overall ED unplanned visits [11]. However, the benefit of remote follow-up may be related to the specific procedure and whether the potential complications are considered to be largely preventable or non-preventable [12]. Together, these findings highlight the many benefits of improved communication between patients and surgeon in the outpatient setting which can easily be achieved by harnessing the widespread availability of smartphone technology.

Our study defines grades of preventability solely on the utilization of ED-specific resources. This classification method, derived from the validated NYU ED algorithm [7, 8], provides a more objective measure of preventability, one that can be executed with moderate inter-rater reliability as seen by our calculated Cohen's Kappa statistic. The concept of preventability itself is highly dependent on setting-specific resources. Indeed, in our setting, access to CT scanners or providing intravenous hydration in clinic are very limited and, as such, many of our patients may be sent to the ED for these reasons. Other centers where these resources are more accessible on an outpatient basis may not need to send their patients to the ED. Therefore, while grading of preventability on ED-specific resources is objective, the definition of ED-specific resources may vary between places.

Wound-related complications were the primary reason behind potentially preventable ED visits in our cohort. This is largely in-keeping with the available literature, in which surgical site infections (SSIs) represent the most common infection in the postoperative period, accounting for over $1.6 billion in incurred costs on the healthcare system annually [13]. SSIs may be able to be managed in an ambulatory setting if identified early on. Furthermore, nearly half of patients who presented for wound-related concerns were found to have normal appearing wounds, highlighting a shortcoming in patient education with regards to the normal healing process. In the context of widespread accessibility to smartphone technology, telemedicine represents a viable solution [14]. Indeed, several studies have demonstrated that in controlled settings, remote wound monitoring is feasible and effective [15, 16]. Additionally, telemedicine-based

interventions have previously been shown to be effective in reinforcing patient education and promoting patient engagement in their recovery, which could easily be adapted to enhance patient understanding of the normal healing process [17]. As such, telemedicine represents a potential solution to managing wound-related issues by providing a simple platform for remote monitoring of wounds, while simultaneously promoting patient education on the normal recovery process.

Non-infectious gastrointestinal issues were the second most common reason for potentially preventable ED visits, largely driven by delayed recognition of high output stomas. Dehydration and electrolyte imbalances are complications of high output stomas that often affect new ostomates [18, 19]. Similar to SSIs, these complications may be able to be managed in an ambulatory setting with anti-motility agents and proper fluid intake but require early recognition. Patients may not know how to properly adjust their fluid intake or antidiarrheals when ostomy output increases, which may further exacerbate the problem. Part of this issue can be addressed by promoting patient engagement in their stoma care through educational programs, an approach that has previously be demonstrated to be effective [18]. While such a program exists in our center, the current study suggests that greater encompassing of our new ostomy patients is warranted. Addressing the issue of high-output stomas could be achieved through enhanced patient education with specific emphasis on monitoring of stoma output and simple guidelines on appropriate initial management. Much like wound related issues, stoma management could be incorporated into simple telemedicine applications that could allow patients to remotely report their stoma output to their clinical team, thus promoting patient engagement while simultaneously providing a safety net in which the clinical care team is able to identify and manage stoma-complications early in their development [10, 20].

The third most common reason for potentially preventable ED visits was bleeding per rectum. While major bleeding is often a concern in any perioperative scenario, most bleeding presentations following colorectal surgery are minor hematochezia, with less than 1% of presentations representing severe bleeds that require reintervention [21, 22]. In the current study, 12 patients presented for bleeding, of which 8 were discharged with reassurance (these were considered potentially preventable). Three were readmitted for monitoring and resolved without further intervention. One patient underwent a colonoscopic exam which found no active bleed but some granulation tissue at the level of the anastomosis, on which a clip was applied. Those readmitted did not contribute to the potentially preventable ED visits. Very few bleeding presentations require ED-specific resources such as endoscopic intervention, suggesting that with adequate follow-up and access to specialized care, this presentation could be monitored in the outpatient setting. We aim to answer this question in our prospective study assessing remote patient follow-up using a telemedicine application in the future.

This study is subject to limitations. Our center is a high-volume referral center that treats patients in the entirety of Quebec. Due to lack of a provincial central electronic medical record (EMR), our patient records are limited to ED visits within our center thus potentially missing any patients who presented to the ED at other centers in the province, or patients who presented at their local clinic. As such, we are likely underestimating the true proportion of unplanned healthcare visits. Second, the retrospective nature of the study limits the collection of information to the accuracy and completeness of medical records. However, to account for this we elected to grade preventability using an objective measure of "ED-specific resources" in an effort to minimize bias that would have occurred had we elected to judge the "appropriateness" of specific interventions during the visit. Lastly, the retrospective nature of the study limits our ability to control for certain confounding factors, such as health literacy and socioeconomic status. Previous studies have demonstrated that health literacy is intimately linked with healthcare utilization, with lower health literacy being associated with increased healthcare utilization [23]. Furthermore, the literature demonstrates that low socioeconomic status is a driving factor behind low health literacy [24]. The retrospective nature of the current study precludes our ability to identify the associated socioeconomic demographics of our patient population, which may be a contributing factor to our ED visit rate. However, our rate of return is consistent with other studies done in North America which shows a 15–20% rate of readmission after elective colorectal surgery [2–4]. While this may suggest that our surgical population is in-keeping with the North American literature, certain aspects of generalizability should be addressed. First, the population in Montreal, Canada is very diverse, with immigrants accounting for nearly 25% of the greater metropolitan region [25]. Within this population, patients from Africa, Europe, Asia, and South America are nearly equally represented. Studies in North America have demonstrated that immigrants are generally less likely to access healthcare resources, a finding which could affect our ED visit rate [26]. Second, our access to specialized postoperative clinics in Quebec and Canada remains poor, with most patients advised to present to the ED in the event of a concern or complication [8]. As such, our rate of ED visits may be inflated and the results not applicable to centers that have better accesibility for postoperative patients.

In conclusion, we demonstrate that a significant portion of ED visits following elective colorectal surgery are potentially preventable. Reasons underlying these visits are potentially the result of incomplete patient education,

compounded by a lack of accessibility to specialized outpatient care. Smartphone technology represents an avenue via which we could combine enhanced patient education with simple remote monitoring tools to improve patient outcomes in the 30 days following surgery. With this in mind, we are currently assessing the ability of a mobile-based application to reduce unplanned and potentially preventable ED visits in a prospective study.

Acknowledgements This research was in part funded by a research bursary award from the Fonds de la Recherche en Santé du Quebec (FRSQ). The authors would also like to acknowledge Dr. Sender Liberman, Dr. Patrick Charlebois, and Dr. Barry Stein, whose cases and patients were included in this study.

Funding Bursary Award for Masters Training for Applicants with a Professional Degree—Fonds de la Recherche en Sante du Quebec (FRSQ)—2019–2021 Award# 273257.

Declarations

Disclosures Dr Fiore reported receiving research funding from Merck and receiving honorarium as a research consultant to Shionogi. Dr Feldman reported receiving research funding from Theator, Merck and Johnson & Johnson and an educational grant from Medtronic. Dr Lee reported receiving research funding from Johnson & Johnson and is a consultant for Stryker. Dr. Eustache, Dr. Hopkins, Dr. Trepanier, M. Kaneva have no conflicts of interest or financial ties to disclose.

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