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# Independent risk factors for prolonged postoperative ileus development



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## ABSTRACT

**Background:** Postoperative ileus (POI) has a significant impact on patient wellbeing, and with a 15% incidence in colectomy patients costs US hospitals >\$1.3 billion per year. Although some causative mechanisms have been identified, little is known about what places patients at risk for ileus. We aimed to identify factors that independently influence the development of POI.

**Materials and methods:** Patients who underwent elective surgery between 2011 and 2012 were identified from the colectomy-specific American College of Surgeons National Surgical Quality Improvement Program database. Descriptive statistics were calculated, and demographics, comorbidities, preoperative treatments, and operative characteristics were evaluated as risk factors using multivariate analyses.

**Results:** A total of 9734 patients were included in this analysis; 1364 (14%) were found to have POI. Patients who developed an ileus were more likely to develop any postoperative complication, to be readmitted, and require reoperation compared with patients without POI. In addition, we identified 13 independent risk factors for POI.

**Conclusions:** Five modifiable risk factors for development of POI were identified as follows: smoking, weight loss, preoperative oral antibiotics, mechanical bowel preparation, and surgical approach. These identifications provide insight into possible targets for preoperative modification, which may lead to improvements in patients' quality of life and influence outcomes such as postoperative complications, readmission, and reoperation.

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## 1. Introduction

Regarded as inevitable by some authors [1], postoperative ileus (POI) is a period of gastrointestinal inactivity after an abdominal surgery, characterized by nausea, vomiting, and delayed passage of flatus and stool [2]. It contributes to patient discomfort and prolonged recovery times, which leads to increased hospital costs [3]. Despite much interest in reducing

POI rates, postoperative patients continue to experience POI at significant rates and incur side effects associated with POI. In fact, the incidence of POI in patients undergoing colectomy is between 10% and 15% [4–7]. The mean length of hospital stay for patients with POI is 11.5 versus 5.5 d for patients without POI [8]. Incremental costs associated with POI after abdominal surgery have been found to be \$9417, costing hospitals >\$1.3 billion per year in the United States [8].

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The causes of POI development are multifactorial. Several studies have identified contributing factors including spinal–intestinal autonomic reflexes, opioid administration, electrolyte imbalances, and inflammatory responses [9–14]. Although these studies looked at POI as an outcome, identifying predictors of POI was not the focus. Knowledge about these risk factors can lead to better preoperative risk factor management, more informed surgical treatment decisions, earlier postoperative detection, and improved treatment.

We sought to characterize preoperative and intraoperative risk factors for ileus in patients undergoing both open and laparoscopic colectomies. Our definition of ileus is that used by the American College of Surgeons National Surgery Quality Improvement Program (ACS-NSQIP) which is as follows: any nasogastric tube use or nil per os (NPO) status on postoperative day 4 or later. The study aims were to characterize colectomy patients with and without POI and identify risk factors for POI development. We hypothesized factors that increased local or systemic inflammation (e.g., open surgical approach or obesity) would be associated with POI development.

## 2. Methods

### 2.1. Data source

This was a retrospective study of patients included in the ACS-NSQIP colectomy–specific participant use data file [15]. This database is an observational cohort study of 16,981 cases from 121 participating sites between 2011 and 2012. It comprises up to 240 variables; we analyzed 27 preoperative and intraoperative factors, controlled for 19 complications, and included 4 outcome metrics.

Exclusion criteria included patients who underwent procedures defined by the ACS-NSQIP as nonelective, those who died within 30 d, those with missing data, and those with operation times of <30 min. The remaining patients were included in the analysis. This study was deemed exempt by the University of Wisconsin–Madison Health Sciences Institutional Review Board.

### 2.2. Patients

Risk factor and outcome variables were defined by the NSQIP data user guide [16] and were chosen based on clinical experience and literature review. Preoperative factors included age (with >90 coded as 90), gender, race, body mass index (BMI), surgical indication, American Society of Anesthesiologists physical status class, functional status, smoking status, steroid use, chemotherapy use, oral antibiotic use, use of mechanical bowel preparation, chronic obstructive pulmonary disease, dyspnea, congestive heart failure, hypertension, diabetes, dialysis use, ascites, weight loss, wound infection, bleeding disorder, and sepsis. Intraoperative factors included wound class, operation time, and surgical approach. The primary outcome variable of interest was the presence of POI, defined by ACS-NSQIP as a nasogastric tube or NPO on postoperative day 4 or later.

### 2.3. Statistical analysis

Descriptive analyses were performed to characterize the patients' demographic and other preoperative factors. Numerical data were categorized using clinically significant boundaries (e.g., BMI categories) when appropriate, whereas quartile cutoffs were used for variables without widely accepted clinical categories. Chi-square analyses were used to compare categorical data between groups. Continuous variables were compared using Mann–Whitney *U* tests for two group variables and Kruskal–Wallis tests for variables with more than two groups.

The multivariate model for prediction of ileus risk used binary logistic regression. The presence of complications was included in the regression to control for their interdependence. These complications included NSQIP-defined superficial wound infection, deep surgical site infection, organ space surgical site infection, wound dehiscence, pneumonia, failure to wean, reintubation, pulmonary embolism, renal insufficiency, renal failure, urinary tract infection, cerebrovascular accident, cardiac arrest, myocardial infarction, postoperative bleeding requiring a transfusion, deep vein thrombosis, sepsis, septic shock, and anastomotic leak.

P propensity scores were calculated using a logistic regression of all preoperative variables and added to the multivariate model to adjust for nonrandom assignment of treatment where appropriate. All analyses were performed with SPSS version 22 (IBM, Armonk, NY, 2013). A *P* value of <0.05 was considered significant for the purposes of this study.

## 3. Results

As demonstrated in Figure 1, the study population consisted of 9734 patients after exclusion criteria were applied. There were a total of 1364 cases (14.0%) of POI. Demographic and preoperative factors of the study population and the corresponding rates of POI are listed in Table 1. Not surprisingly, multiple

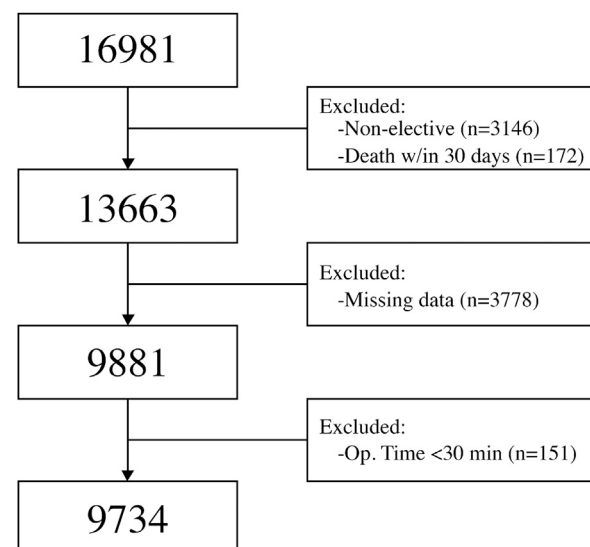


Fig. 1 – Exclusions made from NSQIP database.

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