The American Journal of Surgery (2015) 209, 219-229

The American Journal of Surgery®

Clinical Science

Patient-specific risk factors are predictive for postoperative adverse events in colorectal surgery: an American College of Surgeons National Surgical Quality Improvement Program–based analysis

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KEYWORDS:
Colorectal surgery;
Colorectal resection;
Postoperative complications;
ACS NSQIP;
Surgical site infection;
Pay for performance

Abstract

BACKGROUND: Pay-for-performance measures incorporate surgical site infection rates into reimbursement algorithms without accounting for patient-specific risk factors predictive for surgical site infections and other adverse postoperative outcomes.

METHODS: Using American College of Surgeons National Surgical Quality Improvement Program data of 67,445 colorectal patients, multivariable logistic regression was performed to determine independent risk factors associated with various measures of adverse postoperative outcomes.

RESULTS: Notable patient-specific factors included (number of models containing predictor variable; range of odds ratios [ORs] from all models): American Society of Anesthesiologists class 3, 4, or 5 (7 of 7 models; OR 1.25 to 1.74), open procedures (7 of 7 models; OR .51 to 4.37), increased body mass index (6 of 7 models; OR 1.15 to 2.19), history of COPD (6 of 7 models; OR 1.19 to 1.64), smoking (6 of 7 models; OR 1.15 to 1.61), wound class 3 or 4 (6 of 7 models; OR 1.22 to 1.56), sepsis (6 of 7

The authors declare no conflicts of interest.

Disclosure information: All authors deny any disclosure of potential conflicts of interest, including financial interests, activities, relationships, and affiliations. The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) and the hospitals participating in the ACS NSQIP are the source of the data used here; they have not verified and are not responsible for either the statistical validity of the data analysis or the conclusions derived by the authors.

This study was presented as a podium presentation at the 2013 Annual Meeting of the Pennsylvania Society of Colon and Rectal Surgeons, The Union League, March 15, 2013, Philadelphia, PA.

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Manuscript received March 12, 2014; revised manuscript July 22, 2014

0002-9610/$ - see front matter
http://dx.doi.org/10.1016/j.amjsurg.2014.08.020

models; OR 1.14 to 1.89), corticosteroid administration (5 of 7 models; OR 1.11 to 2.24), and operation duration more than 3 hours (5 of 7 models; OR 1.41 to 1.76).

CONCLUSIONS: These findings may be used to pre-emptively identify colorectal surgery patients at increased risk of experiencing adverse outcomes.

Colorectal resection patients have higher rates of postoperative complications than all other surgical subpopulations.[1–4] Surgical site infections (SSIs) are particularly prevalent and are associated with increased postoperative length of hospitalization and higher costs of care.[3–13] As the surgical field moves toward pay-for-performance measures, SSI rates are being incorporated into reimbursement policies;[4,5,14–18] however, pay-for-performance measures do not incorporate factors predictive of SSIs and other adverse postoperative outcomes into the provider reimbursement algorithms.[5,17] Policies that fail to account for risk factors may result in negative consequences including decreased access to care for higher risk patients, discontinuation of payments to surgeons and institutions that provide care for higher risk patients, and increased racial and socioeconomic disparities in access to surgical care.[5,18,19]

Quality improvement programs have taken center stage in the surgical field as a means of quantifying patient outcomes.[1,2,20–24] The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) has been on the forefront of these efforts and has created a national tool consisting of a risk-adjusted evaluation of surgical outcomes.[2,20–24] Institutions participating in the ACS NSQIP may use risk-adjusted data to construct predictive risk models capable of offering surgeons quantifiable and objective data for assessing the clinical and socioeconomic implications of adverse outcomes in colorectal surgery. Data-driven predictive modeling provides a means for rational review of pay-for-performance algorithms, which should lead to more equitable policies for health care providers, patients, and insurance companies alike.

We undertook a large-scale population-based study to assess predictive factors associated with commonly occurring postoperative complications in colorectal resection patients. The purpose of this work was to both objectively and quantifiably delineate patient-specific independent risk factors associated with various measures of postoperative morbidity. The results provide a framework for preoperatively identifying patients at high risk of experiencing adverse postoperative outcomes and demonstrate the need to protect surgeons who choose to operate on high-risk patients.

Methods

Patient selection/inclusion criteria

We queried the 2005 to 2010 ACS NSQIP databases for elective colorectal surgery patients using primary Current Procedural Terminology coding criteria. The following procedures were included in the study (numbers in parentheses are laparoscopic and open procedures, respectively): ileocolic resection (44,205; 44,160), partial colectomy (44,204; 44,140), Hartmann's procedure (44,206; 44,143), low pelvic anastomosis (44,207 or 44,208; 44,145 or 44,146), total abdominal colectomy (44,210; 44,150), total proctocolectomy/ileal pouch anal anastomosis (44,211; 44,158), and total proctocolectomy/end ileostomy (44,212; 44,155). Laparoscopic partial colectomy (44,204) was used as the reference procedure by which all other procedures were compared against. Because patients' presurgical comorbidity status varied greatly, we excluded emergency cases. To offset the limitations posed by missing data, we eliminated patients for which data were not available for at least 90% of variables in the net analysis sample. List-wise deletion was subsequently used for addressing residual missing data. After correction for missing data, the final analysis sample consisted of approximately 89% of the initial elective colorectal population.

Variable selection

Prospective variables of interest in the study were selected based on clinical relevance and the literature.[3–13] Definition criteria for all variables included in the study are found in the 2005 to 2010 American College of Surgeons User Guides for the Participant Use Data Files.[25] Dependent outcome variables, ie, the adverse outcomes assessed by each predictive model include:

1. superficial SSI
2. deep incisional SSI
3. organ space SSI
4. any SSI (includes presence of any of the 3 aforementioned SSIs)
5. wound disruption
6. return to the operating room
7. increased length of stay

These outcome variables were evaluated against an array of predictor variables. All variables included in the study are contained in Table 1.

Statistical analysis

The queried colorectal surgery population of 67,445 patients was randomly sorted and divided into samples of 2 subpopulations: