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# Evaluation of readmissions due to surgical site infections: A potential target for quality improvement

Romil Shah [a], Emily Pavey [a], Mila Ju [a, b], Ryan Merkow [a, b], Ravi Rajaram [a, b], Michael W. Wandling [a, b], Mark E. Cohen [b], Allison Dahlke [a], Anthony Yang [a], Karl Bilimoria [a, b, *]

[a] *Surgical Outcomes and Quality Improvement Center (SOQIC), Department of Surgery, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA*
[b] *American College of Surgeons, Chicago, IL, USA*

A R T I C L E  I N F O

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A B S T R A C T

*Introduction:* Readmissions have become a focus of pay-for-performance programs. Surgical site infections (SSI) are the reason for most readmissions. Readmissions for SSI could be a unique target for quality improvement.
*Methods:* Readmission risk for SSI were evaluated for patients undergoing colectomies from 2013 to 2014. Hazard models were developed to examine factors associated with and hospital-level variation in risk-adjusted rates of readmission for SSI.
*Results:* Among 59,088 patients at 525 hospitals, the rate of readmissions for SSI ranged from 1.45% to 6.34%. Characteristics associated with a greater likelihood of SSI readmissions include male gender, smoking, open surgery and hospitals with increased socioeconomically-disadvantaged patients. After risk adjustment, there was little correlation between hospital performance with SSI readmission rate and performance with overall SSI or total readmission rate ($r^2 = 0.29$, $r^2 = 0.14$).
*Conclusions:* Readmission for SSI represents a unique aspect of quality beyond that offered by measuring only SSI or readmission rates alone, and may provide actionable quality improvement.


## 1. Introduction

Recent changes in pay-for-performance initiatives have resulted in an increasing focus on reducing readmissions after surgery. Surgical site infections (SSI), a potentially preventable hospital-acquired condition, were recently found to be the most frequent cause for readmissions, specifically after colectomy.[1] While 11% of all colectomies result in a readmission, 26% of those are due to SSI.[1]

However, it is unknown whether hospitals differ considerably in the rates of readmission for SSI. One may hypothesize that some hospitals may be better at dealing with SSIs in the outpatient setting (e.g., outpatient advanced services clinic where wounds can be opened and debrided and antibiotics can be started), thus avoiding a readmission. If this is the case, providing hospitals with information regarding readmissions for SSI may facilitate targeted quality improvement. Alternatively, it may be that SSIs that result in a readmission are serious and simply mandate inpatient monitoring.

The objectives of this study are to (1) investigate variation between hospitals in rates of readmissions for SSI and (2) assess patient- and hospital-level factors associated with readmissions for SSI.

## 2. Methods

### 2.1. Data source and study population

The data source for this study was the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). The sampling strategy, data abstraction process, variables collected, and outcomes measured by ACS NSQIP are described in detail elsewhere.[2–7] In brief, hospitals collect standardized and audited clinical data on patient demographics, preoperative risk

* Corresponding author. Division of Research and Optimal Patient Care, American College of Surgeons, 676 St. Clair Street, Arkes Pavilion Suite 6-650, Chicago, IL, 60611, USA
*E-mail address:* kbilimoria@facs.org (K. Bilimoria).

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factors, laboratory values, operative variables, and postoperative complications for a predefined sample of their patients.[2,6] Trained clinical data abstractors use definitions standardized for all participating institutions. Data audits are regularly performed. Patients are followed up for postoperative outcomes for 30 days after the index operation, irrespective of whether the patient is an inpatient, has been discharged to his or her home or another facility, or has been readmitted to another hospital. Patients are followed up by surgical clinical reviewers at each participating hospital who examine the medical record, query involved clinicians, and contact patients as needed to ascertain the required data elements. In 2013 and 2014, ACS NSQIP included 525 adult hospitals, accounting for approximately 10% of all hospitals and 30% of operations performed in the United States.[1]

Patients undergoing colectomy between January 1, 2013 and December 31, 2014 at ACS NSQIP hospitals in the U.S. were included in this study. Colectomies were identified by Current Procedural Terminology (CPT) codes. Patients were excluded if they were noted to have a surgical site infection preoperatively, or if they were followed less than 14 days post-discharge.

Data from the 2013 American Hospital Association Annual Survey and from the 2015 Center for Medicare and Medicaid Services Impact Files were used to evaluate whether certain hospital characteristics were associated with unplanned readmissions. Selected hospital characteristics used in previous studies of health care quality were selected for inclusion in this study[8–12]: hospital ownership, resident-to-bed ratio, and total beds were extracted from the survey. To evaluate the relationship between a hospital's care of vulnerable populations and readmissions, we used the Medicare disproportionate hospital share index.[13]

### 2.2. Readmission variables

ACS NSQIP collects specific data about post-surgical readmissions, such as whether the readmission was planned or unplanned at the time of index discharge and what the suspected reasons are for readmissions. The accuracy of these variables have been validated against physician chart review.[14,15] The data abstractors can review inpatient and outpatient charts, contact other hospitals, and contact patients directly to ascertain whether a readmission occurred.

Readmission events were always recorded if they occurred within 30 days of the principal procedure. They were then classified as planned or unplanned. A readmission was defined as unplanned by the hospital's data abstractor if it was not part of the treatment plan at the time of the index procedure.[14–16] The analyses focused on unplanned readmissions. The primary reason for readmission was labeled as one of the standard ACS NSQIP postoperative complications (e.g., surgical site infection [SSI], myocardial infarction). The clinical data abstractor assigned the reasons for the readmission through thorough review of the medical record, by talking to the patient's care team, and even discussing the readmission directly with the patient. The readmission was then assigned a clinically abstracted ICD-9 diagnostic code.

### 2.3. Statistical analysis

We reported baseline information and readmission rates for SSIs using descriptive statistics. Because ACS NSQIP captures readmission data within 30 days from the index procedure, we used time-to-event modeling using hierarchical Cox proportional hazards models with patients clustered within hospitals to characterize the time from discharge to readmission and to evaluate variables associated with readmissions. The time-to-event interval was measured from the date of surgery to the date of readmission. Candidate variables comprised clinical covariates, including the procedure (*CPT* codes), patient demographics, health summary status variables (eg, functional status, American Society of Anesthesiologists [ASA] class), specific comorbidities (eg, heart failure, diabetes), and inpatient complications (that occurred during the index hospitalization) were included. A separate model also added hospital characteristics. The proportionality assumption was validated graphically. The association between hospital characteristics and time to readmission due to surgical site infection was estimated in random effect Cox models in order to account for hospital level clustering. The random effects model adjusts the intercept for each hospital based on either an increase or decrease in SSI readmission incidence that is not accounted for by the risk adjustment. The intercepts are used to create hospital specific hazard ratios and rank hospitals. Two more models were performed with the same covariates examining (1) 30-day risk of SSI in patients who underwent colectomy (irrespective of whether a readmission occurred) and (2) rates of total readmission in colectomies in order to investigate hospital rank with these metrics and how they correlated with readmissions for SSI.

We also performed a sensitivity analysis examining a 14-day readmission model. We used 14 day readmissions instead of 30 day readmissions to account for the decreased risk that a patient has of being readmitted 30 days post procedure if he/she has a large length of stay and is therefore followed for less time. Therefore, the model estimated 14 day readmissions in all patients who had at least 14 days post discharge to be readmitted. We included random effects at the hospital level to account for hospital clustering. As the results were generally similar, we only show the 30-day readmission for SSI Cox models.

Statistical significance was set at $P < 0.05$, and all tests were 2-tailed. All analyses were performed using SAS version 9.4 (SAS Institute). The study was approved under the Northwestern Institutional Review Board.

## 3. Results

### 3.1. Patient and hospital characteristics

There were 59,088 patients from 525 hospitals which met the inclusion and exclusion criteria in this study. Table 1 demonstrates the basic demographic and procedure data of the included patients. The overall unplanned readmission rate was 10.8%. The overall SSI rate was 3.64%. The readmission rate for SSI was 1.77% (Fig. 1). Of the patients who had an SSI after discharge, 62.0% were readmitted. As noted in methods section, the sensitivity analysis we conducted with a 14-day readmission model showed similar results so we only show the 30-day SSI Cox model here.

### 3.2. Factors associated with readmission

Patients were more likely to be readmitted for SSI if men (HR 1.25; 95% CI, 1.07–1.46; $p < 0.001$), class II/III obesity (HR, 1.33; 95% CI, 1.16–1.53; $p < 0.001$), contaminated wound class (HR 1.68; 95% CI, 1.03–2.73; $p = 0.030$), ASA class III (HR, 1.22, 95% CI, 1.11–1.35, $p < 0.001$), current smoker (HR 1.22; 95% CI, 1.1–1.36, $p < 0.001$), current steroid use (HR 1.28; 95% CI, 1.10–1.49, $p < 0.001$), surgery for obstruction/perforation (HR 1.41; 95% CI, 1.17–1.69; $p < 0.001$), disseminated cancer (HR 1.46; 95% CI, 1.26–1.68; $p < 0.001$), albumin levels less than 3 g/dL (HR 1.22; 95% CI, 1.06–1.4; $p = 0.004$), progressively longer operative times (all with $p < 0.001$), open surgery, and younger patients (Table 2). Hospital factors associated with readmission for SSI included those with a large disproportionate share hospital percentage (HR, 1.43; 95% CI, 1.1–1.86; $p = 0.006$) and a lower resident-to-bed ratio (HR, 1.28; 95% CI,

**Table 1**
Patient characteristics and rates of readmission for SSI.[a]

| Patient Factors | Patients n, (%) | Readmissions for SSI n, (%) |
|---|---|---|
| Surgical Procedure | | |
| Partial Colectomy, Open | 34481 (97.6%) | 819 (2.3%) |
| Total Colectomy, Open | 1914 (98%) | 39 (1.9%) |
| Partial Colectomy, Laparoscopic | 21067 (98.3%) | 358 (1.6%) |
| Total Colectomy, Laparoscopic | 1626 (97.7%) | 38 (2.2%) |
| Indication | | |
| Diverticulitis | 10608 (98.1%) | 205 (1.8%) |
| Enteritis/Colitis | 4290 (97.1%) | 126 (2.8%) |
| Neoplasm | 26744 (97.9%) | 562 (2.0%) |
| Obstruction/Perforation | 3276 (98.1%) | 61 (1.8%) |
| Other | 14170 (97.9%) | 298 (2.0%) |
| Age | | |
| <65 | 31788 (97.5%) | 799 (2.4%) |
| 65-74 | 14256 (97.9%) | 291 (2.0%) |
| 75-84 | 9244 (98.7%) | 117 (1.2%) |
| >84 | 3800 (98.8%) | 45 (1.1%) |
| Race | | |
| White | 43595 (97.9%) | 906 (2.0%) |
| Asian | 1366 (98.5%) | 20 (1.4%) |
| African American/Black | 5546 (97.9%) | 116 (2.0%) |
| Hispanic | 2796 (97.4%) | 72 (2.5%) |
| Other/Unknown | 5785 (97.6%) | 138 (2.3%) |
| Sex | | |
| Women | 31606 (97.8%) | 679 (2.1%) |
| Men | 27482 (97.9%) | 573 (2.0%) |
| Wound Class | | |
| Clean | 638 (98.1%) | 12 (1.8%) |
| Clean/Contaminated | 42000 (97.8%) | 907 (2.1%) |
| Contaminated | 7533 (97.2%) | 216 (2.7%) |
| Dirty/Infected | 8917 (98.7%) | 117 (1.2%) |
| ASA Class | | |
| I-II: No/Mild Disturb | 25628 (98.1%) | 491 (1.8%) |
| III: Severe Disturb | 28017 (97.6%) | 680 (2.3%) |
| IV-V: Life Threat/ Moribund | 5443 (98.5%) | 81 (1.4%) |
| Diabetes | | |
| Yes | 3120 (97%) | 94 (2.9%) |
| Dyspnea | | |
| Yes | 4017 (97.8%) | 88 (2.1%) |
| COPD | | |
| Yes | 3486 (98.1%) | 64 (1.8%) |
| Hypertension | | |
| Yes | 28756 (97.9%) | 600 (2%) |
| Renal Failure | | |
| Yes | 929 (97.7%) | 21 (2.2%) |
| Current Smoker | | |
| Yes | 10669 (97.3%) | 289 (2.6%) |
| Current Steroid Use | | |
| Yes | 5634 (97.1%) | 165 (2.8%) |
| Emergency Procedure | | |
| Yes | 9698 (98.4%) | 148 (1.5%) |
| Disseminated Cancer | | |
| Yes | 4128 (97.6%) | 99 (2.3%) |
| Operative Time | | |
| <100 min | 12915 (98.4%) | 206 (1.5%) |
| 100–200 min | 29048 (98.1%) | 545 (1.8%) |
| 200–300 min | 12213 (97.4%) | 318 (2.5%) |
| >300 min | 4912 (96.4%) | 183 (3.5%) |
| Creatinine | | |
| >1.2 | 7444 (98.2%) | 131 (1.7%) |
| Platelets | | |
| >=150 | 55240 (97.9%) | 1163 (2%) |
| WBC | | |
| <4500 | 4364 (97.7%) | 101 (2.2%) |
| 4500–10,000 | 41207 (97.8%) | 890 (2.1%) |
| >10,000 | 13517 (98.1%) | 261 (1.8%) |
| Albumin | | |
| <3 | 7527 (98.1%) | 140 (1.8%) |
| >=3 | 51561 (97.8%) | 1112 (2.1%) |

[a] This table only depicts baseline information on the data we used in our analysis and is without risk—adjustment. Therefore, it is solely meant to provide an overview of our data before it was incorporated into our model. It should not be used to analyze risk factors for the outcome in our study, SSI readmissions. Refer to our model in Table 2 for a risk-adjusted analysis of factors for SSI readmissions.

1.06–1.54; p = 0.010).

### 3.3. Hospital-level SSI readmission rates

There was marked variation in the adjusted risk of readmission among hospitals (Fig. 2). Risk-adjusted rates of readmission for SSI ranged from 1.45% to 6.34%. (Fig. 3). There were two hospitals (0.4%) that demonstrated significantly better than expected performance and eight hospitals (1.5%) with performance that was significantly worse than expected.

Hospitals were ranked on their performance for readmission for SSI. When comparing these rankings to overall SSI rates in patients with colectomies, the median change in rank was 62 hospitals and the correlation coefficient was poor ($r^2 = 0.29$, $P < 0.001$). When comparing the rank to the hospital rank from a model created for all unplanned readmissions (i.e., not just for SSI) in patients undergoing colectomy, the median change in rank was 76.5 hospitals and the correlation coefficient was poor ($r^2 = 0.14$, $P < 0.001$).

## 4. Discussion

The use of readmissions as a quality indicator is expanding and hospitals are working to identify opportunities to decrease readmission rates. The most frequent reason for readmissions after surgery is SSI, particularly after colectomies.[1] We found that hospital-level rates of readmissions due to SSI vary, and these rates are not correlated with the commonly reported metrics of SSI and overall readmissions. Thus, measuring readmissions for SSI may offer an opportunity to better understand differences in how hospitals address SSI in the outpatient setting.

### 4.1. Inter-hospital variability and uniqueness of the SSI readmission metric

We found that readmissions due to surgical site infections is a unique metric that was not simply a reflection of overall SSI rates or overall readmission rates. Of the 525 hospitals in this study, we ranked the different hospitals by readmission due to SSI vs. risk-adjusted overall SSI rate and overall readmission rate. We found the measures were loosely correlated ($r = 0.53$, $r = 0.38$ respectively) with large median changes in rank, demonstrating that the SSI readmission metric was capturing a unique aspect of care that is not discretely captured elsewhere.

Additionally, we found that readmission rates due to surgical site infections have variability even after risk adjustment. While most hospitals demonstrated as-expected performance with respect to SSI readmissions, we were able to identify a small group of hospitals with significantly worse-than-expected performance. These hospitals may be benefit from examining their practice regarding management of outpatient SSI. Hospitals can work to improve their performance by ensuring adherence to best practice guidelines for overall SSI reduction[17,18] and readmissions overall.

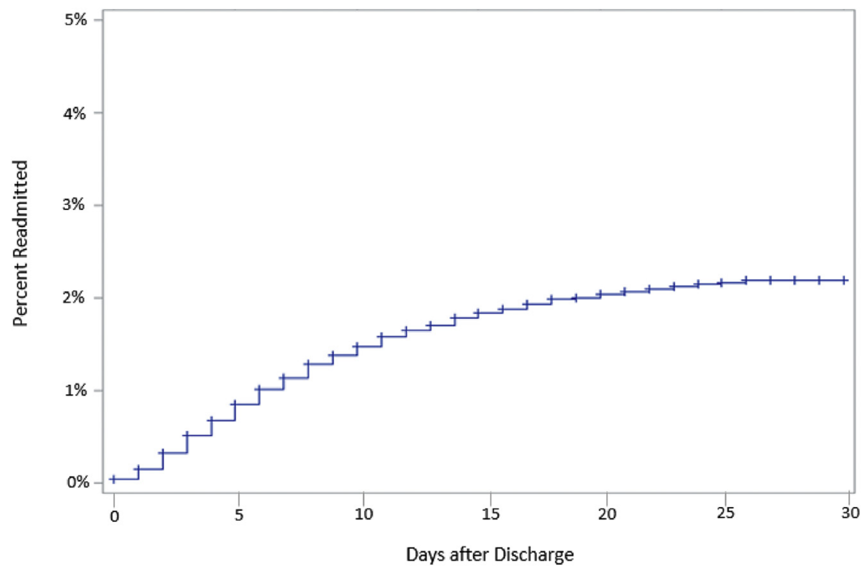


**Fig. 1.** Overall risk of readmission over time.

Specifically, past studies incorporating improved outpatient care coordination, fragmentation minimization, improved patient education/discharge instructions, and outpatient treatment have shown promise[19–21]

Additionally, telemedicine has demonstrated success in helping poor-performing hospitals reduce readmissions due to SSIs. Several studies have shown significant reductions in readmissions and mortality with telemonitoring applications.[22,23] An example of an

**Table 2**
Factors associated with readmission for SSI.

| Patient Factors | COX Time to Event Hazard Ratio | Confidence Interval | P Value |
|---|---|---|---|
| Surgical Procedure | | | |
| Partial Open | REF | | |
| Total Open | 0.95 | (0.76, 1.19) | p = 0.68 |
| Partial Laparoscopic | 0.55 | (0.5, 0.62) | p < 0.001 |
| Total Laparoscopic | 0.67 | (0.52, 0.86) | p = 0.001 |
| Indication | | | |
| Diverticulitis | 0.8 | (0.68, 0.93) | p = 0.0037 |
| Enteritis/Colitis | 1.14 | (0.94, 1.39) | p = 0.18 |
| Neoplasm | 0.93 | (0.83, 1.05) | p = 0.28 |
| Obstruction/Perforation | 1.41 | (1.17, 1.69) | p < 0.001 |
| Other | REF | | |
| Age | | | |
| <65 | REF | | |
| 65-74 | 0.81 | (0.72, 0.9) | p < 0.001 |
| 75-84 | 0.75 | (0.65, 0.87) | p < 0.001 |
| >84 | 0.66 | (0.52, 0.84) | p < 0.001 |
| Race | | | |
| White | REF | | |
| Asian | 1.16 | (0.87, 1.54) | p = 0.29 |
| African American/Black | 0.93 | (0.79, 1.08) | p = 0.36 |
| Hispanic | 0.95 | (0.78, 1.17) | p = 0.67 |
| Other/Unknown | 1.25 | (1.07, 1.46) | p = 0.0035 |
| Sex | | | |
| Female | REF | | |
| Male | 1.22 | (1.11, 1.33) | p < 0.001 |
| BMI | | | |
| Underweight | 0.97 | (0.76, 1.25) | p = 0.84 |
| Normal | REF | | |
| Overweight | 1.02 | (0.92, 1.15) | p = 0.61 |
| Class I Obesity | 1.09 | (0.96, 1.24) | p = 0.18 |
| Class II/III Obesity | 1.33 | (1.16, 1.53) | p < 0.001 |
| Wound Class | | | |
| Clean | REF | | |
| Clean/Contaminated | 1.37 | (0.85, 2.21) | p = 0.18 |
| Contaminated | 1.68 | (1.03, 2.73) | p = 0.035 |
| Dirty/Infected | 0.85 | (0.52, 1.4) | p = 0.53 |

**Table 2** (*continued* )

| Patient Factors | COX Time to Event Hazard Ratio | Confidence Interval | P Value |
|---|---|---|---|
| ASA Class | | | |
| I-II: No/Mild Disturb | REF | | |
| III: Severe Disturb | 1.22 | (1.11, 1.35) | $p < 0.001$ |
| IV-V: Life Threat/Moribund | 1.12 | (0.91, 1.36) | $p = 0.26$ |
| Diabetes | | | |
| Yes | 0.92 | (0.75, 1.12) | $p = 0.44$ |
| Dyspnea | | | |
| Yes | 1.01 | (0.84, 1.21) | $p = 0.88$ |
| COPD | | | |
| Yes | 0.97 | (0.79, 1.19) | $p = 0.80$ |
| Hypertension | | | |
| Yes | 1.03 | (0.93, 1.14) | $p = 0.49$ |
| Renal Failure | | | |
| Yes | 1.14 | (0.79, 1.65) | $p = 0.46$ |
| Current Smoker | | | |
| Yes | 1.22 | (1.1, 1.36) | $p < 0.001$ |
| Current Steroid Use | | | |
| Yes | 1.28 | (1.1, 1.49) | $p = 0.0014$ |
| Emergency Procedure | | | |
| Yes | 0.97 | (0.83, 1.13) | $p = 0.74$ |
| Disseminated Cancer | | | |
| Yes | 1.46 | (1.26, 1.68) | $p < 0.01$ |
| Operative Time | | | |
| <100 min | REF | | |
| 100–200 min | 1.23 | (1.08, 1.4) | $p = 0.0011$ |
| 200–300 min | 1.68 | (1.45, 1.94) | $p < 0.01$ |
| >300 min | 2.86 | (2.43, 3.36) | $p < 0.01$ |
| Creatinine | | | |
| <1.2 | 1 | | |
| >1.2 | 0.86 | (0.74, 1) | $p = 0.063$ |
| Platelets | | | |
| <150 | 0.91 | (0.76, 1.09) | $p = 0.33$ |
| >150 | 1 | | |
| WBC | | | |
| <4500 | 0.99 | (0.84, 1.17) | $p = 0.93$ |
| 4500–10,000 | 1 | | |
| >10,000 | 1 | (0.9, 1.13) | $p = 0.88$ |
| Albumin | | | |
| <3 | 1.22 | (1.06, 1.4) | $p = 0.0045$ |
| Non-federal Government | REF | | |
| Federal Government | 0.95 | (0.13, 6.64) | $p = 0.96$ |
| Private: Non-Profit | 0.92 | (0.84, 1.01) | $p = 0.11$ |
| Private: For-Profit | 1.01 | (0.9, 1.13) | $p = 0.79$ |
| Academic Hospital | | | |
| Yes | 0.91 | (0.77, 1.06) | $p = 0.24$ |
| Hospital Size (# of beds) | | | |
| ≤ 300 Beds | REF | | |
| 300–500 Beds | 1.02 | (0.88, 1.18) | $p = 0.74$ |
| ≥ 500 Beds | 0.97 | (0.82, 1.14) | $p = 0.72$ |
| Disproportionate Share Hospital Percentage | | | |
| ≤0.3 | REF | | |
| 0.3–0.6 | 1.05 | (0.95, 1.16) | $p = 0.28$ |
| ≥0.6 | 1.43 | (1.1, 1.86) | $p = 0.006$ |
| Resident to Bed Ratio | | | |
| ≤0.3 | REF | | |
| 0.3–0.6 | 1.05 | (0.89, 1.23) | $p = 0.54$ |
| ≥0.6 | 0.78 | (0.65, 0.94) | $p = 0.0096$ |

intervention is a phone application from the University of Washington called mPower ©, which encourages patients to send pictures and information about their wound to their care providers. It is an innovative idea that may be able to reduce readmissions by identifying SSI earlier when an outpatient intervention may be feasible, thus averting a readmission in a convenient manner.

Another potential intervention to reduce specific SSI readmissions is the use of specialized outpatient clinics. In situations where readmissions are detected early, certain less complicated surgical site infections may be able to be managed in an outpatient setting in specialized wound care clinics. These clinics would provide special services such as opening and cleaning wounds, administering antibiotic treatment, and administering PICC lines. In the past, outpatient clinics have been shown to reduce re-hospitalizations.[24] Outpatient clinics designed to deal with surgical site infections for certain high-risk procedures such as colectomies have the potential to significantly reduce costs. Another area worth investigating is emergency department visits for surgical site infections which did not result in readmissions, as this is still an inconvenience for the patient and resource consumption for a

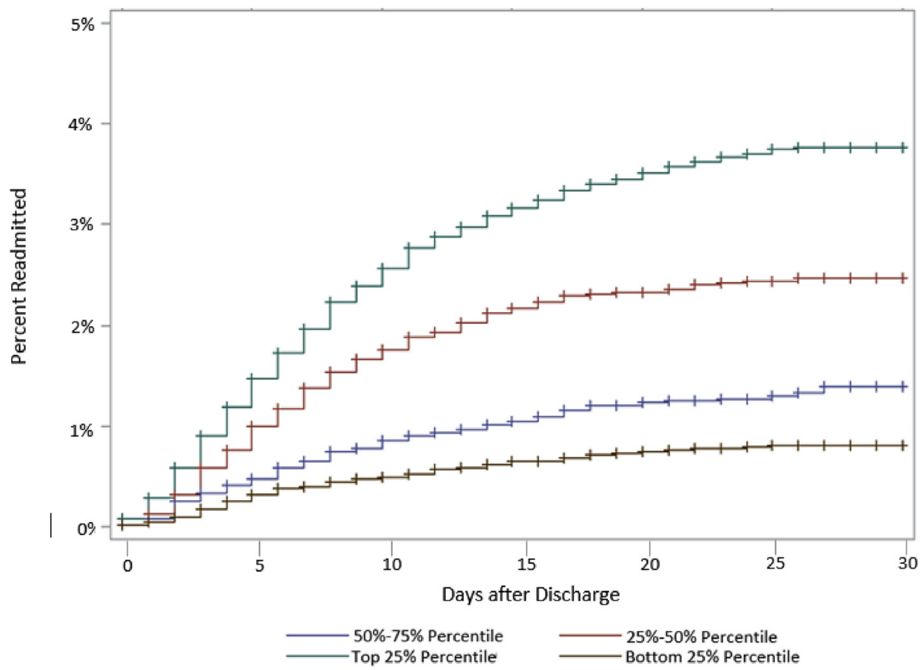


**Fig. 2.** Risk of Readmission over Time by Quartile of Hospital Performance. There are no error bars in this figure because the variation in our data is reflected by the error bars depicted for each individual hospital in Fig. 3. Fig. 2 demonstrates no time-dependent difference between poor and well performing hospitals in SSI readmissions that is not captured in total 30-day readmissions (as each quartile demonstrated above displays similar readmission trajectories). Therefore, the error bars displayed in Fig. 3 (for 30 day readmission) captures the variation which would be depicted by error bars in this figure. (Color version of figure available online.)

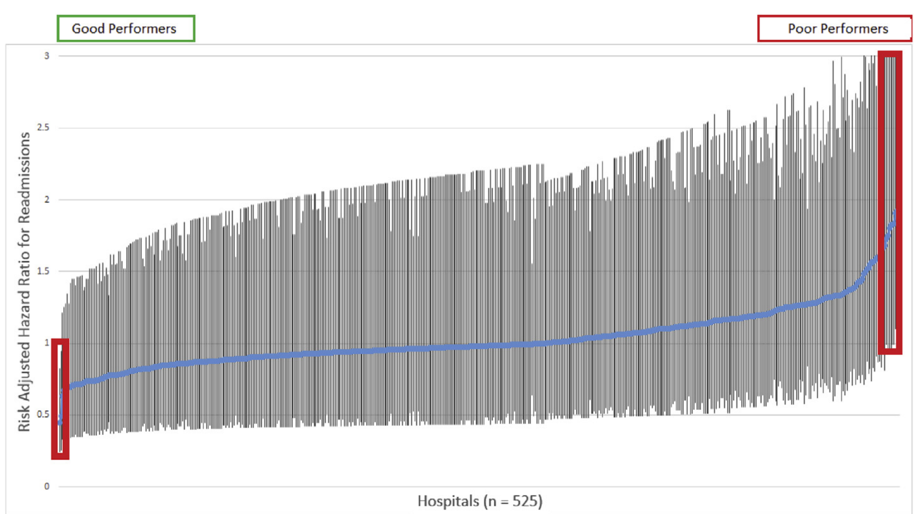


**Fig. 3.** Hospital-level variation.

hospital. Unfortunately, this event is not recorded in the database that we used. It is possible that the different ways that hospitals deal with SSIs in the emergency department may affect their readmission rate.

### *4.2. Hospital- and patient-level risk factors*

Prior studies have shown that a number of patient factors are associated with a higher risk of surgical site infections including alcohol and smoking abuse, larger operative times, and open approach surgeries.[25,26] Risk factors for unplanned readmissions in colectomies include disability, steroid use and weight loss.[1] Similarly, we found that disability, larger operative times and steroid use are associated with readmissions for SSI. We also found lower albumin levels and male sex to be risk factors. Even though older age is associated with higher readmission risk, we found that the reason for that readmission is also less likely due to be a surgical site infection, suggesting different interventions for preventing readmissions based on age.

Prior studies show that the socioeconomic status as well as the Medicare/Medicaid insurance status of a hospital population are associated with readmission.[27] In our study, we found that similarly a larger disproportionate share hospital percentage is associated with an increased risk of readmissions due to surgical site infections. This may be because socioeconomically-disadvantaged patients may lack the social supports necessary to care for SSIs at home. These patients may in fact benefit from staying longer in the inpatient setting initially. We also found that a lower resident-to-bed ratio was also a risk factor for increased readmissions. The mechanism for this is unclear but may be due to increased wound examination by having more trainees available or more thorough discharge instructions being offered.

### 4.3. Limitations

This study has certain limitations that should be considered. First, the reason for readmission may be difficult to ascertain consistently; ACS NSQIP is rare in that it provides information on the reasons for readmissions[14,15] that has been validated against physician panel chart reviews.[1] Second, it is also important to note that the readmission variable we used were not 30 days post discharge, but instead 30 days post-operation. Therefore, the readmission risk is dependent on patient length of stay. We tried to account for this risk through a Cox proportional hazards time-to-event modeling, but a large assumption of the Cox model is that censoring is non-informative; that is, that the reason that patients were not followed up for the same amount of time post discharge is not dependent on prognostic reasons.[28] This may not have been accurate because a patient's length of stay may have been due to prognostic covariates. We examined this bias by excluding patients who were not followed for at least 14 days from our sample post discharge. We also addressed this concern in our 14-day readmission model by only including patients who were followed for 14 days and calculating 14 day readmission risk. The results were qualitatively similar irrespective of approach. Finally, we did not split our analyses by type of Surgical Site Infection (deep, superficial, or organ space). It is plausible that there are different covariates affecting each of these subgroups.

## 5. Conclusions

Surgical Site Infections are clearly a meaningful and prevalent marker in colectomies. This study was an exploratory investigation into SSI readmissions with the intent to allow hospitals to analyze their performance and attempt to improve. Readmissions due to surgical site infections may be an actionable metric which would allow hospitals to improve quality and patient satisfaction, while reducing costs.

## Conflicts of interest

None of the authors have any financial or personal relationships with people or organizations which may inappropriately bias this work.

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