Rates of Surgical Site Infections after Colon Surgery
Why Comparing Rates Between Surgeons and Hospitals is Difficult, Confusing and Sometimes Unfair

Surgical site infections (SSI) are the most common hospital acquired infection (HAI) in the United States [1]. The Center for Medicare and Medicaid Services (CMS) mandates that all hospitals that perform colon surgery report their local rates of SSI following colon surgery (COLO SSI). Medicare payment policies and rates under the inpatient prospective payment system are in turn impacted by local COLO SSI rates.

Unfortunately, currently reported data on COLO SSI rates are infrequently validated, and multiple confounders that affect local SSI rates are currently excluded from risk adjustment models. In fact, the current NHSN risk adjustment model includes only age and American Society of Anesthesiologists (ASA) risk score. We review important SSI confounders and summarize the interpretation of standardized infection ratios (SIR) below:

Confounder 1: Infections present at time of surgery

NHSN currently does not collect information on the presence or absence of bowel leaks or bowel disruptions in patients undergoing colon surgery [2]. This omission is unfortunate, as bowel perforations markedly increase the risk of developing a SSI. The NHSN does provide an option or a system in place to denote that patients with bowel perforation have this complication at the time of their primary surgery. Rather, NHSN added a new “yes/no” data field in their event reporting system to allow documentation of a new category: “infection present at the time of surgery” (PATOS) for some but not all patients who are obviously infected at the time of their primary surgical procedure.

Infection preventionists are given complicated instructions as to how to designate whether infection was or was not present at the time of surgery in the NHSN “event reporting software.” Evidence of infection or abscess must be noted and specifically documented in the operative note in order for a case to be designated as PATOS [2]. If patients meeting these criteria for an intraoperative infection later develop an intraabdominal (organ space) infection, the subsequent infection is considered PATOS. However, a patient with evidence of infection or abscess at the time of primary surgery who presents later with a superficial or deep incisional infection would NOT be considered to have PATOS, but rather would be counted as a reportable incisional SSI. These designations seem illogical and unfair to us. Further patients who are found to have a colon perforation, “necrosis,” gangrene of the bowel, fecal spillage, or inflammation without an explicit notation documenting the presence of an abscess or infection are not considered to have PATOS if they present later with an organ space or incisional SSI. Even a gunshot wound to the abdomen would not qualify as a case of PATOS unless the surgeon documents the presence of an abscess or the presence of pus at the time of the primary surgery. Although the addition of the category PATOS is an improvement over NHSN surveillance criteria prior to 2016, the current designation of PATOS is unrealistically and confusingly rigid.
rigid. For example, patients with gangrene, bowel necrosis and penetrating trauma and fecal spillage at the time of their primary surgery have an enormous and largely unpreventable postoperative risk of developing an organ space and/or deep incisional infection independent of the surgical skill of the operating surgeon.

Confounder 2: Obesity

Patients with a body mass index (BMI) >25 are at increased risk of developing SSI after colon surgery. The odds of a developing a SSI progressively increase in parallel to incremental increases in BMI beyond 25 [3].

Confounder 3: Inflammatory bowel disease (IBD)

Patients with ulcerative colitis and Crohn’s disease have a substantially higher risk of developing a SSI after undergoing colon surgery [4, 5]. Such patients are often acutely or chronically under-nourished or overtly malnourished and more likely to be taking immunosuppressive therapies at the time they undergoing colon surgery. Unfortunately, the NHSN reporting system does not make any adjustments for the proportion of patients with underlying IBD when reporting COLO SSI rates.

Confounder 4: Cancer related factors

Both disseminated cancer and perioperative radiation therapy increase risk of developing a SSI after colon surgery [3].

Summary of standardized infection ratio (SIR) interpretation

The standardized infection ratio (SIR) is a metric that compares observed infections to expected infections. Hospitals can use the SIR to trend SSI over time. The aforementioned confounders directly affect the numerator of the SIR, depending on the proportion of patients with these risk factors seeking care at your institution. Despite the confusing and complicated effect of lack of adjustment for the confounding factors described above, we agree with others that there is still utility in tracking actual rates of SSI after colon surgery for individual surgeons and in individual hospitals over time, as the “case mix” in such circumstances tends to be relatively stable over time [6]. However, we caution against inter-facility comparison of SIR, and even intra-facility comparison of the 2016 SIR to previous years because:

1) The presence of the preceding confounding factors increases the risk of a COLO SSI independent of the skill of the operating surgeon and the skill of intraoperative and postoperative team caring for these patients.

2) The proportion of patients with these risk factors often varies between individual surgeons and between hospitals of various types and sizes. Thus, the validity and fairness comparing COLO SSI SIRs between individual surgeons and hospitals is always difficult, often invalid, and frequently unfair.

3) Unfortunately, none of the 3 current NHSN data analysis methods for calculating SIR for COLO SSI include adjustment for the proportion of obese patients, underlying IBD, or cancer. The NHSN SIR calculation model currently used by CMS includes only two risk factor adjustment variables: age and ASA score. However, both the NHSN and CMS data modules for calculating SIR for SSIs are likely change in the future. For example, prior to 2016, the NHSN used old and outdated data from 2006-2009 to calculate benchmark infection rates, but beginning in August 2016, the NHSN will use 2015 data to recalculate the COLO SSI benchmark (link) [7]. Thus hospitals that have a change in their SIR from 2015 to 2016 will have difficulty in...
determining if their 2016 SIR is better, the same as, or worse than their SIR in the preceding year.

We acknowledge that it is unfortunate that the NHSN does not collect data on the proportion of patients who have several important confounding risk factors or make adjustments for the proportion of patients (“case mix”) with these risk factors when performing “risk adjustment” of reported rates. However, the SIR metric, albeit imperfect, remains an important metric for quality improvement once its pitfalls are fully understood. And, hopefully, the methodology used by NHSN and CMS to calculate SIRs will improve in the future.

References