# Risk Factors for Urinary Tract Infections in Colorectal Compared with Vascular Surgery: A Need to Review Current Present-On-Admission Policy?

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**BACKGROUND:** To reduce cost, the Centers for Medicare and Medicaid Services adopted a nonpayment policy for "reasonably preventable events" including hospital acquired urinary tract infection (UTI). Type of operation a patient undergoes could be an inevitable nonmodifiable risk factor in the development of UTI.

**STUDY DESIGN:** Using Participant User File for National Surgical Quality Improvement Program (NSQIP) data from 2005 to 2007, vascular and colorectal cases were identified using CPT codes and analyzed for UTI incidence and risk factors within each group.

**RESULTS:** We identified 30,900 colorectal cases and 39,246 vascular cases with 1,289 (4.2%) colorectal and 952 (2.4%) vascular UTI cases. A multivariate analysis of the dataset revealed colorectal procedures as an independent risk factor for the development of UTI. Subset analysis revealed this significant relationship only for patients with low (<0.30) and intermediate (0.30 to 0.70) morbidity probability. Comparing only open intra-abdominal colorectal and vascular procedures revealed UTI rates of 3.9% versus 4.7%. Multivariate analysis revealed no significant difference in UTI rates in intraabdominal cases (all p values $< 0.05$). Subset analysis for the open cases revealed that colorectal procedures continued to be associated with UTI in low morbidity probability cases only.

**CONCLUSIONS:** Current policy to reward higher quality fails to differentiate between UTI that may be preventable versus one likely due to nonmodifiable risk factors. Colorectal surgery is more likely to result in higher rates of UTI in comparison with vascular surgery, which may be related to type and complexity of a procedure. Further research needs to be done to change this policy to take into account this nonmodifiable risk factor. (J Am Coll Surg 2011;212:356–361. © 2011 by the American College of Surgeons)

The cost of health care is rising at an unsustainable rate, and new incentives and cost-cutting measures have been enacted to correct some of the perceived problems in the health care system. Starting in 2008, the Centers for Medicare and Medicaid Services (CMS) adopted a policy of nonpayment for 8 preventable hospital-acquired conditions that ranged from "never events" such as retained surgical items in the operative field to "reasonably preventable events" such as catheter-associated urinary tract infection (UTI) (Table 1). CMS subsequently went on to add further hospital-acquired conditions in 2009.[1-3]

UTIs remain the leading cause of nosocomial infection in the United States, leading to a considerable increase in morbidity and mortality.[4,5] The single most important risk factor remains the length of time a transurethral drainage catheter is left in place. Rates of bacteriuria range from 3% to 10% for each day a catheter has been in place.[6,7] Other risk factors such as diabetes mellitus, age, sex, and functional dependency have been identified. Previous research regarding UTI in the postoperative period identified an overall rate of 3.5%, with a range from 3.3% in cardiac surgery to 4% in gastrointestinal surgery. Vascular surgery was associated with a 3.4% risk of UTI.[7-9]

There is general agreement on shifting incentives in the delivery of health care to reward higher quality. However, considerable controversy exists regarding the design and implementation of these plans, including the nonpayment

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**Abbreviations and Acronyms**

CMS = Centers for Medicare and Medicaid Services
NSQIP = National Surgical Quality Improvement Program
UTI = urinary tract infection

policy toward this increasing list of hospital-acquired conditions.[1,10-14] At this time, the policy fails to differentiate between a catheter-associated UTI that may have been preventable versus a catheter-associated UTI that is inevitable due to the underlying patient risk factors and hospital course. In particular, variability in the risk of UTI due to patient, disease, and procedure-related factors are not accounted for.

We postulate that the type of operation a patient undergoes and other patient-, disease-, and operation-related factors are inevitable risk factors in the development of this particular reasonably preventable event, UTI. Identification of such fixed risk factors should help guide policy. The American College of Surgeon's National Surgical Quality Improvement Program (NSQIP) prospectively collects preoperative, intraoperative, and postoperative complications of a wide range of surgical procedures. General surgery and its subspecialties such as vascular surgery are followed in both the academic and community settings. The final data are independently verified for accuracy by a third party, resulting in the gold standard for surgical clinical databases dedicated to quality improvement.

Due to previous research identifying a difference in the rates of UTI between vascular surgery and gastrointestinal surgery, these 2 groups were identified as those most likely to show a difference in UTI despite similar preoperative characteristics.[8,9,15] Also, the NSQIP database was most extensive in its coverage of general surgery and vascular surgery, offering these subsets as the largest to analyze.

## METHODS

The American College of Surgeons-NSQIP Participant User File data from 2005 through 2008 were used to identify both colorectal and vascular surgery procedures based on CPT codes for primary operations. These codes were compiled using NSQIP inclusion CPT codes that identified open and laparoscopic colorectal procedures as well as open and endovascular vascular procedures.

NSQIP requires specific criteria that define UTI. Patients must have fever >38°C, urinary urgency, urinary frequency, dysuria, or suprapubic tenderness in the setting of urine culture >100,000 colonies/mL with no more than 2 species of organisms. Alternatively, patients need to have 2 of the above symptoms and 1 of the following: dipstick positive for leukocyte esterase or nitrates, pyuria >10 WBC/mm$^3$, or >3 WBC/hpf of unspun urine, organisms seen on Gram stain of urine, 2 urine cultures with the same pathogen >100 colonies/mL, urine culture with <100,000 colonies/mL in a patient with antibiotics, and physician diagnosis.

**Table 1.** List of Hospital-Acquired Conditions

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|---|
| Not reimbursed by CMS, 2008 |
| Catheter-associated urinary tract infection |
| Retained surgical items |
| Air embolism |
| Stage III and IV decubitus ulcers |
| Surgical site infection after coronary artery bypass graft |
| Vascular catheter-associated infection |
| Fall from bed |
| Blood incompatibility |
| Added hospital acquired conditions that are not reimbursed, 2009 |
| Surgical site infection after bariatric surgery and some orthopaedic procedures |
| Deep venous thrombosis/pulmonary embolism after certain orthopaedic procedures |
| Manifestations of poor glycemic control including diabetic ketoacidosis and diabetic coma |

The vascular and colorectal groups were analyzed for differences in patient characteristics including, among others, age, sex, body mass index, and comorbid conditions such as diabetes. A multivariate model was created to analyze if colorectal surgery was an independent risk factor. To minimize differences between groups for the risk of complications, the morbidity probability was used to stratify patients into low, moderate, and high morbidity probability risk. Morbidity probability is calculated by NSQIP for each individual patient based on a logistic regression developed by NSQIP. For the purpose of this study, low, moderate, and high morbidity were defined as <0.3, .3-0.7, and >0.7, respectively.

In order to evaluate whether the complexity of surgery rather than the procedure itself was associated with the occurrence of UTI, a subgroup analysis was completed for open abdominal vascular and open colorectal procedures, again based on CPT bundling.

Chi-square and Student *t*-test were used for analysis. Statistical calculations were completed using STATA v9 (StataCorp).

## RESULTS

From 2005 through 2008, 30,900 colorectal and 39,246 vascular cases were identified, with 1,289 (4.2%) colorectal and 952 (2.4%) vascular UTI cases. Significant differences existed between the 2 patient populations, though not all