

Procedure-Specific Trends in Surgical Outcomes

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- BACKGROUND:** Quality improvement efforts have generally focused on hospital benchmarking, and processes and outcomes shared among all operations. However, quality improvement could be inconsistent across different types of operations. The objective of this study was to identify operations needing additional concerted quality improvement efforts by examining their outcomes trends.
- STUDY DESIGN:** Ten procedures (colectomy, esophagectomy, hepatectomy, hysterectomy, pancreatectomy, proctectomy, total hip arthroplasty, total knee arthroplasty, thyroidectomy, and ventral hernia repair) commonly accrued into the American College of Surgeons NSQIP between 2008 and 2015 were included. Trends in risk-adjusted, standardized, smoothed rates were constructed for each procedure across 6 outcomes (mortality, pneumonia, renal failure, surgical site infection, unplanned intubation, and urinary tract infection [UTI]).
- RESULTS:** Of 1,255,575 operations analyzed, the overall unadjusted rate for mortality across all 10 procedures was 1.08%, for pneumonia 1.44%, for renal failure 0.67%, for surgical site infection 5.28%, for unplanned intubation 1.11%, and for UTI 1.86%. Hepatectomy demonstrated the greatest improvement across outcomes (4 of 6 outcomes; 362 adverse events avoided out of 10,000 procedures), and UTI demonstrated the greatest improvement across procedures (8 of 10 procedures; 989 adverse events avoided out of 10,000). For pancreatectomy, rates of mortality, unplanned intubation, and UTI improved, but surgical site infection rates were detected to have significantly increased ($p < 0.05$).
- CONCLUSIONS:** Hepatectomy was detected to have improved across the greatest number of outcomes, and UTI rates improved significantly across the greatest number of procedures. Surgical site infection rates after pancreatectomy, however, were detected to have increased, identifying an urgent need for additional concerted quality improvement efforts. (J Am Coll Surg 2017; ■:1–7. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

With an increasing emphasis on quality and safety, hospitals have made significant gains in reducing perioperative morbidity and mortality in recent years.^{1–3} The American College of Surgeons (ACS) NSQIP is one vehicle for surgical

quality improvement,⁴ and there are increasingly more clinical data registries for examining surgical quality data across specialties and geographic regions. To provide useful information, the ACS NSQIP and similar registries often compare

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Abbreviations and Acronyms

ACS = American College of Surgeons
 SSI = surgical site infection
 UTI = urinary tract infection
 VHR = ventral hernia repair

hospitals through benchmarking, which facilitates identification and dissemination of best practices.⁵ Hospitals with more complications than others can institute internal quality improvement mechanisms to improve their performance to the benefit of patients. Identifying superior performers and sharing of best practices not only potentially raises quality, but can also decrease variation among collaborating institutions.^{4,6} This pattern of continuous quality improvement through benchmarking can ultimately reassure patients of their safety in choosing any hospital, using whatever criteria they desire to use to make that decision.

During 8 years in the ACS NSQIP, the majority of hospitals were able to improve perioperative mortality (62% of hospitals), morbidity (70% of hospitals), and surgical site infections (SSIs) (65% of hospitals) for surgical patients.¹ Although overall improvement in surgical outcomes has been demonstrated using different data sources by aggregating all types of operations for benchmarking purposes,¹⁻³ this approach could mask opportunities to identify procedure-specific quality improvement initiatives. It is possible that examining certain procedures across all hospitals in different ways, such as by examining procedure-specific outcomes over time, could reveal new opportunities for improvement that are relevant and clinically meaningful to surgical specialists. The objective of this study was to examine outcomes over time for the 10 most common operations accrued in the NSQIP Procedure Targeted program: colectomy, esophagectomy, hepatectomy, hysterectomy (and myomectomy), pancreatectomy, proctectomy, total hip arthroplasty, total knee arthroplasty, thyroidectomy, and ventral hernia repair (VHR).

METHODS**Data source and study population**

Operations performed at hospitals participating in the ACS NSQIP between January 1, 2008 and December 31, 2015 were included in this cohort study. The ACS NSQIP approach to data collection has been described previously.^{4,7} Briefly, trained, dedicated, and audited surgical clinical reviewers abstract data on patient characteristics, comorbidities, operative details, and outcomes from the medical record using standardized definitions. Outcomes are tracked for 30 days from the index operation regardless of discharge status, and are regularly ascertained from discussion with

involved physicians or through direct patient contact when information is needed beyond that available in the medical record. The Chesapeake IRB deemed this study exempt from review and oversight due to the retrospective nature of this study that used pre-existing, de-identified data.

The ACS NSQIP features the ability to specifically measure, or “target,” the outcomes of certain high-volume and high-risk procedures.⁸ This study examined the 10 procedures with the highest volume and hospital participation in the Procedure Targeted Program: colectomy, esophagectomy, hepatectomy, hysterectomy (and myomectomy), pancreatectomy, proctectomy, total hip arthroplasty, total knee arthroplasty, thyroidectomy, and VHR. These procedures are also clinically diverse, with different degrees of endogenous operative risk and varying levels of perioperative care intensity. Current Procedural Terminology codes were used to identify these operations (eTable 1).

Outcomes

The following 6 outcomes, all within 30 days of operation and as defined in the ACS NSQIP, were studied: mortality; pneumonia; progressive renal insufficiency (ie rise in serum creatinine >2 mg/dL from preoperative value) or acute renal failure requiring dialysis; SSI (ie superficial, incisional, or deep/organ space SSI); unplanned intubation and mechanical ventilation; and, urinary tract infection (UTI). Although the ACS NSQIP measures additional outcomes (eg venous thromboembolism), these were selected because their definitions did not change during the period studied.¹

Risk-adjustment variables

As was the case for the outcomes studied, variables included for risk adjustment were those that did not experience definition changes during the period studied.¹ These were age, sex, body mass index, American Society of Anesthesiologists physical status classification, preoperative ventilator dependence, ascites, COPD, congestive heart failure, hypertension requiring therapy, diabetes requiring therapy, smoking status, dialysis dependence, and procedure work relative value units, all as defined in the NSQIP. Case-mix adjustment was performed using endogenous CPT code risk. Although procedures are presented as categories, operative risk was considered at the individual CPT code level, following standard ACS NSQIP case-mix adjustment processes.⁹

Statistical analyses

To examine outcomes trends for each of the 10 procedures during the study period (2008 to 2015), we adapted a methodology that has been reported previously.^{10,11} First, logistic regression models using data across all years and all risk-adjustment variables were constructed to predict each of the 6 outcomes separately. Then, for each end point by procedure

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