Comparing Preoperative Targets to Failure-to-Rescue for Surgical Mortality Improvement

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BACKGROUND: Failure-to-rescue (FTR or death after postoperative complication) is thought to explain surgical mortality excesses across hospitals, and FTR is an emerging performance measure and target for quality improvement. We compared the FTR population to preoperatively identifiable subpopulations for their potential to close the mortality gap between lowest- and highest-mortality hospitals.

STUDY DESIGN: Patients undergoing small bowel resection, pancreatectomy, colorectal resection, open abdominal aortic aneurysm repair, lower extremity arterial bypass, and nephrectomy were identified in the 2007 to 2011 Nationwide Inpatient Sample. Lowest- and highest-mortality hospitals were defined using risk- and reliability-adjusted mortality quintiles. Five target subpopulations were established a priori: the FTR population, predicted high-mortality risk (predicted highest-risk quintile), emergency surgery, elderly (>75 years old), and diabetic patients.

RESULTS: Across the lowest mortality quintile (n = 282 hospitals, 56,893 patients) and highest-mortality quintile (282 hospitals, 45,784 patients), respectively, the size of target subpopulations varied only for the FTR population (20.2% vs 22.4%, $p = 0.002$) but not for other subpopulations. Variation in mortality rates across lowest- and highest-mortality hospitals was greatest for the high-mortality risk (7.5% vs 20.2%, $p < 0.0001$) and FTR subpopulations (7.8% vs 18.9%, $p < 0.0001$). The FTR and high-risk populations had comparable sensitivity (81% and 75%) and positive predictive value (19% and 20%, respectively) for mortality. In Monte Carlo simulations, the mortality gap between the lowest- and highest-mortality hospitals was reduced by nearly 75% when targeting the FTR population or the high-risk population, 78% for the emergency surgery population, but less for elderly (51%) and diabetic (17%) populations.

CONCLUSIONS: Preoperatively identifiable patients with high estimated mortality risk may be preferable to the FTR population as a target for surgical mortality reduction. (J Am Coll Surg 2015; 220:1096−1106. © 2015 by the American College of Surgeons)

Failure to rescue (FTR), or death after major complication, is an important metric for benchmarking quality across hospitals, and the FTR population, defined as the subpopulation of patients who have had a major complication after surgery, has become a focus of quality improvement efforts.[1] Patients in this subpopulation have a higher mortality risk that is known to vary markedly across high- and low-mortality hospitals.[2-6] This variation has fostered the idea that patients with complications in high-mortality hospitals die unnecessarily, and surgical mortality could be reduced significantly by targeting the FTR population so that high-mortality hospitals achieve the rescue rates found in low mortality hospitals. Therefore, FTR improvement efforts have emphasized both postoperative surveillance and care

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escalation strategies to coordinate rescue resources after complications are recognized.[5,7-10]

Quality improvement strategies that target the FTR population may be costly and inefficient. One inefficiency of the FTR strategy is that interventions are applied in a "wait-and-see" fashion, only after a complication has both occurred and been recognized. This encourages delay and may contribute to complication cascades.[11] Efforts to improve detection of patients in need of rescue have included enhancing the nursing workforce for all patients as well as electronic early warning systems for surveillance.[12-14] Both strategies are costly, and early warning systems have high false positive rates that result in greater inefficiencies when used to reallocate nursing and rescue resources such as engaging a rapid response team, bringing physicians to the bedside, applying more intensive nursing, or initiating transfer to a monitored or intensive care setting.[15,16]

An alternative to the FTR strategy is to preoperatively identify a target subpopulation that can be singled out for special perioperative care.[10,17,18] Rather than waiting for complications to occur and be recognized before initiating quality improvement, hospitals may identify special populations preoperatively and mark these selected patients for primary prevention, such as tailored postoperative pathways or enhanced care, which may include specific nursing care, frequent rounding, increased monitoring, or other hospital-specific strategies.[17] The potential mortality impact, or target richness, of preoperatively defined subpopulations has not been investigated or compared with the FTR population.

We aimed to evaluate preoperatively identifiable subpopulations as candidates for quality improvement, comparing them with the FTR population. For this comparison, we chose the following preoperatively identifiable subpopulations a priori: patients with high estimated mortality risk, patients having emergency surgery, patients over 75 years old, and patients with diabetes. To be valuable targets for mortality improvement, a subpopulation must share the following characteristics with the FTR population: be a reasonably small percentage of all patients, have higher mortality burdens than average, and exhibit marked mortality variation across high- and low-mortality hospitals. We assessed these features for each target subpopulation and then used Monte Carlo models to illustrate the potential mortality reduction, or potential to close the mortality gap between highest- and lowest-mortality hospitals, if patients in high-mortality hospitals were able to match the performance of low-mortality hospitals for each target subpopulation.

METHODS

This study was approved by exemption by the institutional review board at Mayo Clinic, Rochester, MN. Data were obtained from the 2007 to 2011 Nationwide Inpatient Sample (NIS), a structured 20% sample of all United States hospital admissions administered through the Healthcare Resource and Utilization Project of the Agency for Healthcare Research and Quality.[19] The Nationwide Inpatient Sample captures approximately 8 million nationally representative discharges each year.

Patient sample

We included patients undergoing the following high-risk surgical procedures: pancreatectomy, small bowel resection, colorectal resection, open abdominal aortic aneurysm repair, lower extremity bypass, and nephrectomy. We chose these operations because they are associated with relatively high mortality, as compared with other operations, are frequently the focus of quality improvement activities, and are common operations representing a diverse spectrum of surgical practice. Further, they are performed in a range of hospital environments across the United States. Patients were excluded if their information didn't include age, sex, urgency of surgical procedure, or American Hospital Association identification number. We further excluded patients older than 90 years or younger than 18 years as well as patients coded as transfers or admissions for trauma.

Determination of target subpopulations

We established 5 target populations: patients with qualifying complications (FTR population defined in detail below); patients with high estimated preoperative mortality risk; emergency surgery patients; elderly patients; and patients with diabetes.

The FTR subpopulation was defined as in previous studies as patients with a qualifying postoperative complication.[3] Using the International Classification of Diseases, Ninth Revision (ICD-9), we identified the following complications: acute myocardial infarction, pulmonary failure, pneumonia, surgical site infection, deep venous thromboembolism or pulmonary thromboembolism, postoperative hemorrhage, gastrointestinal hemorrhage, or acute renal failure. As earlier publications, these complications have been previously validated via direct comparison to medical chart review in the Complications Screening Project.[20,21]

The subpopulation of high-risk patients was identified using risk prediction models. We first established a derivation cohort composed of a random 25% sample of the total population. In this derivation cohort, we created