Which Complications Matter Most? Prioritizing Quality Improvement in Emergency General Surgery

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BACKGROUND: Because preoperative risk factor modification is generally not possible in the emergency setting, complication prevention represents an important focus for quality improvement in emergency general surgery (EGS). The objective of our study was to determine the overall impact that specific postoperative complications have in this patient population.

STUDY DESIGN: Our study sample consisted of patients from the 2012–2013 ACS-NSQIP database who underwent an EGS procedure. We used population attributable fractions (PAFs) to estimate the overall impact that each of 8 specific complications had on 30-day physiologic and resource use outcomes in our study population. The PAF represents the percentage reduction in a given outcome that would be anticipated if a complication were able to be completely prevented in our study population. Both unadjusted and risk-adjusted PAFs were calculated.

RESULTS: There were 79,183 patients included for analysis. The most common complications in these patients were bleeding (6.2%), incisional surgical site infection (SSI) (3.4%), pneumonia (2.7%), and organ/space SSI (2.6%). Bleeding was the complication with the greatest overall impact on mortality and end-organ dysfunction, demonstrating an adjusted PAF of 10.7% (95% CI 8.2%,13.1%, $p < 0.001$) and 15.9% (95% CI 13.9%, 16.7%, $p < 0.001$) for these respective outcomes. The only other complication with a sizeable impact on these outcomes was pneumonia (adjusted PAF of 7.9% for mortality and 13.2% for pneumonia). In contrast, complications such as urinary tract infection, venous thromboembolism, myocardial infarction, and incisional SSI had negligible impacts on these outcomes.

CONCLUSIONS: Our study provides a framework for the development of high-value quality initiatives in EGS. (J Am Coll Surg 2016;222:515–524. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

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Over the past decade, an increasing number of patients with emergency general surgical (EGS) disease are receiving their care under the auspices of acute care surgical services.[1-5] As the clinical management and in-hospital administration of EGS patients continues to become more centralized, it will become increasingly practical to develop and implement quality initiatives that are specifically designed to improve the outcomes of these patients. Perhaps in recognition of this evolving opportunity, the American Association for the Surgery of Trauma (AAST) and the American College of Surgeons (ACS) have created a task force of academic leaders in acute care surgery in order to develop a strategic agenda for future EGS research

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Abbreviations and Acronyms

AOR = adjusted odds ratio
EGS = emergency general surgery
EOD = end-organ dysfunction
MI = myocardial infarction
PAF = population attributable fraction
SSI = surgical site infection
UTI = urinary tract infection
VTE = venous thromboembolism

efforts.[6] Among the health policy research needs identified by this task force as meriting prioritization were the creation of metrics for measuring the quality of EGS care received, and development of public health strategies to mitigate the burden imposed by EGS.

For several reasons, postoperative complications represent an obvious initial focus for EGS-specific quality improvement efforts. First, complications occur relatively frequently in EGS patients, especially when compared with patients who undergo elective surgical procedures.[7-10] Therefore, any successful effort to curb the incidence of adverse postoperative events in EGS patients would be expected to have a disproportionate impact on the overall incidence of surgical morbidity in the United States. Second, the occurrence of postoperative complications is strongly associated with the risk of subsequent death and with the generation of considerable costs of care and excess health care resource use.[11-15] A reduction in the frequency of complications in the EGS population would therefore be anticipated to result in significant savings, both in terms of patient lives and health care expenditures. Finally, the time-sensitive nature of EGS disease will generally preclude reliance on traditional approaches to surgical quality improvement, such as preoperative risk factor modification. Perhaps by default, any attempt to improve the outcomes of patients who require emergency operation will instead need to involve either a reduction in the incidence of postoperative complications or an improvement in the timeliness and effectiveness with which such complications are recognized and managed.[9,14]

In order to maximize the benefit of EGS quality initiatives, it will first be necessary to understand which complications have the greatest overall impact on EGS patients. Previous studies of morbidity after EGS typically describe complications in terms of their incidence or their strength of association with downstream outcomes such as mortality, hospital cost, or hospital readmission.[7-16] However, simple knowledge of the prevalence of a complication or its severity is not sufficient for being able to determine that complication's overall impact on a given patient population. For example, a relatively common complication will have only a negligible population-level impact if it is unlikely to result in pathophysiologic compromise or extensive resource use. Similarly, complications that are particularly severe or costly will have a small population-level impact if they occur rarely. The objective of this study was to use an epidemiologic measure termed *population attributable fraction* in order to quantify the overall impact that specific complications have on patient and financial outcomes after EGS.

METHODS

The 2012–2013 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) Participant Use Data Files (PUFs) were used for our study.[17] Patients were included for analysis if they underwent emergency surgery by a general surgeon for a clinical condition that has been identified by the AAST as constituting the scope of EGS practice.[18] Missing information was handled in 1 of 2 ways. For variables in which a very small percentage of observations were lacking information (American Society of Anesthesiologists [ASA] Physical Status classification, operative time, length of postoperative hospitalization), patients with missing data were simply excluded from the analysis. For variables in which a larger percentage of observations were lacking information (BMI, preoperative functional status, and preoperative serum albumin), a missing indicator category was created.[19]

The primary outcomes variables for our analysis included 30-day incidence of end-organ dysfunction (EOD), 30-day mortality, hospital readmission within 30 days after index operation, and length of postoperative hospitalization. End-organ dysfunction is a composite outcome variable, and was noted to have occurred if a patient developed 1 or more of the following conditions in the first 30 days after the index procedure: need for postoperative mechanical ventilation $>$ 48 hours, coma, septic shock, or postoperative renal insufficiency (with or without the need for hemodialysis).[16] Bleeding is defined by ACS-NSQIP as the need for 1 or more units of packed red blood cells within 72 hours of the start of the index operation.

The primary predictor variables for our analysis were the presence or absence of the following index complications in the first 30 days after the index EGS operation: incisional surgical site infection (SSI, including superficial and/or deep incisional infections), bleeding, pneumonia, organ/space SSI, urinary tract infection (UTI), venous thromboembolism (VTE, including deep venous thrombosis and/or pulmonary embolism), myocardial infarction (MI), and stroke. Bleeding is defined by ACS-NSQIP as the need for 1 or more units of packed red blood cells