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Surgeon-driven variability in emergency general surgery outcomes: Does it matter who is on call? ☆

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ABSTRACT

Background: Hospital-level variation has been found to influence outcomes in emergency general surgery. However, whether the individual surgeon plays a role in this variation is unknown.

Methods: We performed an analysis of the Florida State Inpatient Database (2010–2014), which is linked to the American Hospital Association's Annual Survey Database, including patients who emergently underwent 1 or more of 7 procedures (laparotomy, adhesiolysis, small bowel resection, colectomy, repair of a perforated gastric ulcer, appendectomy, or cholecystectomy). We used multilevel random effects modeling to quantify the amount of variation in mortality, complications, and 30-day readmissions attributable to surgeons. Patient clinical and demographic factors, as well as hospital-level factors, were introduced into the model in a forward stepwise fashion, and the percent of the variation attributable to surgeons was derived.

Results: Our study included 2,149 surgeons across 224 hospitals, with a total of 569,767 emergency general surgery cases. The overall unadjusted mortality rate was 3.8%, and the complication and readmission rates were 12.7% and 27.7%, respectively. Surgeon-level variation had the greatest impact on mortality, explaining 32.77% of the overall variability in mortality risk compared with 0.08% and 2.28% for complications and readmissions, respectively. Peptic ulcer disease operations were most susceptible to surgeon-level variation in mortality and readmissions, whereas appendectomies and cholecystectomies were least susceptible to surgeon-level variation for all outcomes.

Conclusions: Surgeon-level variation contributes to a significant portion of mortality in EGS. This variation is most pronounced in surgery for peptic ulcer disease, a high-risk, low-frequency surgical condition. Programs to reduce mortality in emergency general surgery should address reducing variability in practice with attention to high-risk, low-frequency procedures.

Introduction

Emergency general surgery (EGS) encompasses a wide range of disease processes and treatments, from those conditions that are common and associated with relatively low-risk treatment modalities to the less common pathologic conditions that necessitate higher-risk interventions. EGS admissions account for at least 7% of all hospitalizations since 2001,[1] a public health burden that is expected to continue to increase in the coming years. Compared with patients undergoing elective surgery, EGS patients are at higher risk for complications, in-hospital mortality, longer hospital stays, and reoperations.[2–7] The reasons underlying this risk difference between emergent and elective surgeries are manifold. Patient factors such as comorbidities, sex, and perioperative biochemical markers have been identified as predictors of morbidity in EGS,[8] as have hospital factors, such as urban or rural

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location.[9] Factors that vary by surgeon, however, have not been examined in this context, despite the fact that practice patterns, training, and experience differ among surgeons performing EGS.

Variation in quality of care at the physician level is associated with preventable complications and extraneous costs to the health care system. Surgical specialties that routinely perform elective operations, such as surgical oncology, have sought to characterize the surgeon-level factors that could explain this variation in quality of care. Colorectal cancer lymph node examination varies at multiple levels of the care continuum, and 8.2% of this provider-level variation is attributable to differences in surgeon practice.[10] Another study found that postoperative complications among patients receiving elective colectomies vary more by surgeon than by hospital.[11] Women with breast cancer are offered different surgical treatment options depending on an assortment of surgeon-level factors.[12] The incidence of re-excision after partial mastectomy varies across surgeons,[13] although the individual surgeon does not appear to account for a significant proportion of the variability in patients' overall satisfaction with breast cancer care.[14] More than one fifth of the variation in robot-assisted radical prostatectomy costs is attributable to surgeon characteristics.[15] Surgeon factors account for 54.5% of the variation in hospital-level reoperation rates among patients receiving lumbar spinal fusion surgeries.[16]

Several of the aforementioned studies argue that efforts to improve quality in those specialties should focus on interventions at the surgeon level, rather than the hospital level. Both surgeon and hospital factors are considered modifiable, unlike patient factors, which contribute to the variability observed in these studies but are mostly beyond the health care system's ability to amend. Substantial initiatives, led by the American College of Surgeons National Surgical Quality Improvement Program, have been developed to analyze hospital processes and outcomes as metrics for quality of care in emergency and elective surgery alike. If the pattern of surgeon-level variability affecting overall outcomes holds true in EGS, quality improvement at the hospital level alone could be insufficient. We sought to quantify the amount of variability in complications, in-hospital mortality, and unplanned 30-day readmissions after EGS that is attributable to surgeon-level characteristics and determine whether this proportion of explained variation differs across disease processes and procedure types.

Methods

Data source and study cohort

The Florida State Inpatient Database was queried to establish a cohort of inpatient records from 2010 to 2014 corresponding to adult patients (older than 18 years of age) who underwent 1 or more of 7 characteristic EGS procedures as identified by a set of *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) procedure codes. According to Scott et al,[17] these 7 procedures (partial colectomy, small bowel resection, cholecystectomy, operative management of peptic ulcer disease, lysis of peritoneal adhesions, and laparotomy) account for 80% of all nontrauma emergency general surgery procedures performed nationwide. Data were restricted to only those procedures that took place under urgent or emergent conditions, which were flagged as such based on the diagnosis code associated with the record. Admissions classified as elective were excluded. We chose the Florida State Inpatient Database as our data source because it includes not only the patient clinical and demographic factors and hospital-level variables for all inpatient discharges in the state but also a random unique physician identifier that is useful for clustering observations by provider. This identifier is further categorized under the variables "MDNUMn_R," where "n" equals either 1, 2, or 3. "MDNUM2_R" refers to the operating surgeon for admissions in which an operation took place; this variable is missing in records for which no operation was performed. Each record, however, has a unique physician identifier under "MDNUM1_R," because this refers to the attending admitting physician. We restricted our analysis to only those records for which "MDNUM2_R" was not missing to allow records to be grouped by operating physician. For those records in which the physician identifier listed in "MDNUM1_R" differed from that in "MDNUM2_R," the latter was used to classify the record to ensure that the operating physician was accountable for those outcomes. We excluded EGS cases that were managed nonoperatively. Records corresponding to physicians who treated fewer than 50 patients over the 5-year study period were excluded to reduce the influence on variability of these lowest-volume outliers.

Outcomes

We focused on 3 outcomes for this analysis: in-hospital mortality, unplanned 30-day readmissions, and in-hospital complications. The latter were defined by a set of ICD-9 diagnosis codes that capture common postoperative complication such as pulmonary embolism, sepsis, myocardial infarction, acute renal failure, and cardiac arrest. These diagnosis codes have been used elsewhere to characterize common major complications that can arise after EGS and are strongly associated with mortality.[6,18,19]

Study variables

Patient factors included both demographic characteristics, such as age, sex, race, and insurance payer, and clinical characteristics, such as Charlson Comorbidity Index (CCI) score, procedure type, and diagnosis. Hospital factors included the total volume of EGS cases performed during the study period, as well as the overall EGS complication rate, mortality rate, and readmission rate. Linkage of the data set to the American Hospital Association (AHA) Annual Survey Database for 2010–2012 provided additional hospital-level variables, including trauma center designation and level, teaching status, rurality, bed size, total annual admissions, and total number of operations (both inpatient and outpatient) performed each year.

Surgeon factors included the total number of EGS cases performed during the study period (or surgeon EGS volume), as well as each surgeon's case mix, individual complication, mortality, and readmission rates. Surgeon EGS volume was coded as a dichotomous variable in which average volume surgeons managed up to 200 EGS cases per year, whereas high-volume surgeons managed greater than 200 EGS cases per year. Hospital variables were similarly dichotomized. Hospitals with high yearly EGS case volumes (greater than 5,000 cases annually) were distinguished from the rest, whereas hospitals were designated as having high overall surgical volume if greater than 10,000 procedures of any variety, including outpatient operations, were performed yearly. Total admissions and bed size were also coded as dichotomous variable for the analysis.

Statistical analysis

Summary statistics were constructed using frequencies and percentages for the categorical variables; continuous variables were recoded into categorical variables as needed. We examined the factors that were associated with mortality, complications, and readmissions separately using the χ^2 test. Multivariate logistic regression analyses were then performed to establish the relationship among each of the patient, hospital, and surgeon-level variables and the outcomes of interest, controlling for potential confounders. To understand the contribution of unobserved heterogeneity at both the surgeon and hospital level, we also incorporated random

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