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Is there a "weekend effect" in emergency general surgery?

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ABSTRACT

Background: Weekend admission is associated with increased mortality across a range of patient populations and health-care systems. The aim of this study was to determine whether weekend admission is independently associated with serious adverse events (SAEs), in-hospital mortality, or failure to rescue (FTR) in emergency general surgery (EGS).

Methods: An observational study was performed using the National Inpatient Sample in 2012-2013; the largest all-payer inpatient database in the United States, which represents a 20% stratified sample of hospital discharges. The inclusion criteria were all inpatients with a primary EGS diagnosis. Outcomes were SAE, in-hospital mortality, and FTR (in-hospital mortality in the population of patients that developed an SAE). Multivariable logistic regression were used to adjust for patient- (age, sex, race, payer status, and Charlson co-morbidity index) and hospital-level (trauma designation and hospital bed size) characteristics.

Results: There were 1,344,828 individual patient records (6.7 million weighted admissions). The overall rate of SAE was 15.1% (15.1% weekend, 14.9% weekday, $P < 0.001$), FTR 5.9% (6.2% weekend, 5.9% weekday, $P = 0.010$), and in-hospital mortality 1.4% (1.5% weekend, 1.3% weekday, $P < 0.001$). Within logistic regression models, weekend admission was an independent risk factor for development of SAE (adjusted odds ratio 1.08, 1.07-1.09), FTR (1.05, 1.01-1.10), and in-hospital mortality (1.14, 1.10-1.18).

Conclusions: This study found evidence that outcomes coded in an administrative data set are marginally worse for EGS patients admitted at weekends. This justifies further work using clinical data sets that can be used to better control for differences in case mix.

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Introduction

A number of studies have reported that patients admitted at the weekend have worse outcomes than those admitted during the week.[1-4] This "weekend effect" has been demonstrated across a range of different health-care systems and clinical settings.[4] Observational studies have identified such a phenomenon in Australia, the United States, Asia, the United Kingdom, and in continental Europe.[4-6] In the United States, it has been reported across many groups of patients with urgent presentations, including acute coronary syndrome,[7] intracerebral hemorrhage,[8] pulmonary embolism,[9] and lower limb vascular emergencies.[10]

Only two US studies have examined weekend outcomes in the setting of emergency general surgery (EGS), both of which were based on hospital discharge data from Florida.[11,12] They showed that weekend admission is an independent risk factor for postoperative complications, higher length of stay, and increased cost.[12] Importantly, neither study reported an association between weekend admission and mortality,[11,12] although evidence for this has been found in administrative data from the UK.[13] However, no previous study has asked whether or not there is a weekend effect for EGS patients across the US.

A number of explanations have been suggested for the weekend effects identified by previous studies. These include differences in case mix,[14,15] coding artifacts,[16] and reduced service levels provided to patients at weekends.[4] If differences in staffing and hospital resources contributed to the weekend effect, national data might be expected to show higher rates of failure to rescue (FTR) for patients admitted at weekends. FTR has been defined as "death after a treatable complication."[17] It has been widely adopted as a quality metric and is thought to reflect the ability of health-care providers to respond effectively to complications.[17,18]

In this study, we examined a national database of US hospital discharges for evidence of a weekend effect in EGS. Our aim was to test the finding from Florida that EGS outcomes are potentially compromised at weekends.[11,12]

Methods

Data source

The National Inpatient Sample (NIS) is the largest all-payer inpatient database in the US and maintained by the Healthcare Cost and Utilization Project. This study used cases between 2012 and 2013 when the NIS captured a 20% stratified sample of hospital discharges from all US hospitals. There are 5-8 million inpatient admissions within the NIS each year, which can be weighted to provide estimates for approximately 35 million hospital admissions.

Inclusion and exclusion criteria

All patients were extracted who had a primary EGS diagnosis, as per the standardized definition outlined by the American Association for the Surgery of Trauma.[19] These cases were identified using 621 distinct ICD-9-CM diagnosis codes that have previously been published.[20] Patients transferred between institutions were excluded to ensure that each record represented a single inpatient episode.

Variables and outcomes

Extracted patient-level characteristics were age, sex, race, payment source, admission source, median household income, disease severity, and weekend admission. Charlson comorbidity indices (CCIs) were calculated from International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes using the Stata ICDPIC command.[21] CCI is the most commonly used comorbidity score for secondary analysis of administrative data and has been shown to predict mortality in EGS.[22] The threshold for household income quartiles varies by year and is determined by the NIS using residential zip codes. Disease severity is also provided by the NIS according to estimated risk of mortality along a four-point scale using All Patient Refined Diagnosis Related Groups. The hospital-level characteristics were geographic region, hospital bed size, rural location, and teaching status.

The outcomes were SAEs, FTR, and total in-hospital mortality. Significant adverse events were selected for consistency with previous studies on EGS patients in the NIS that incorporated complications[20]: pneumonia, pulmonary embolus, renal failure, urinary tract infection, cerebrovascular accident, myocardial infarction, cardiac arrest, acute respiratory distress syndrome, sepsis, and septic shock. These diagnoses were discounted if coded within the NIS as present on admission.

FTR was defined as the odds of in-hospital mortality following a SAE: [mortality among patients with SAE]/[all patients with SAE].

Statistical analysis

Chi-squared tests were used to compare categorical variables and *t*-tests for continuous variables. Multivariable logistic regression models were used to adjust odds of SAE, FTR, and mortality for patient- and hospital-level factors. The covariates were determined *a priori* as age, sex, race, payer status, CCI, median household income, and hospital bed size. NIS discharge weights provided by the Healthcare Cost and Utilization Project were used to account for clustering of patients within hospitals and to determine nationally representative estimates. All results are presented as national estimates based on these discharge rates.

All analyses were conducted using Stata 13.0 (College Station, TX) with an *a priori* threshold for statistical significance set at two-tailed $P < 0.05$. The protocol was approved by our institutional review board.

Results

There were 1,344,828 individual patient records, which permitted estimates for 6.7 million weighted admissions. The mean age was 53.8. Table 1 summarizes the demographic