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## Predictors of mortality and morbidity for acute care surgery patients



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### ABSTRACT

**Background:** As the implementation of exclusive acute care surgery (ACS) services thrives, prognostication for mortality and morbidity will be important to complement clinical management of these diverse and complex patients. Our objective is to investigate prognostic risk factors from patient level characteristics and clinical presentation to predict outcomes including mortality, postoperative complications, intensive care unit (ICU) admission and prolonged duration of hospital stay.

**Methods:** Retrospective review of all emergency general surgery admissions over a 1-year period at a large teaching hospital was conducted. Factors collected included history of present illness, physical exam and laboratory parameters at presentation. Univariate analysis was performed to examine the relationship between each variable and our outcomes with chi-square for categorical variables and the Wilcoxon rank-sum statistic for continuous variables. Multivariate analysis was performed using backward stepwise logistic regression to evaluate for independent predictors.

**Results:** A total of 527 ACS admissions were identified with 8.1% requiring ICU stay and an overall crude mortality rate of 3.04%. Operative management was required in 258 patients with 22% having postoperative complications. Use of anti-coagulants, systolic blood pressure <90, hypothermia and leukopenia were independent predictors of in-hospital mortality. Leukopenia, smoking and tachycardia at presentation were also prognostic for the development of postoperative complications. For ICU admission, use of anti-coagulants, leukopenia, leukocytosis and tachypnea at presentation were all independent predictive factors. A prolonged length of stay was associated with increasing age, higher American Society of Anesthesiologists class, tachycardia and presence of complications on multivariate analysis.

**Conclusions:** Factors present at initial presentation can be used to predict morbidity and mortality in ACS patients.

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## 1. Introduction

The emergency general surgery population forms a fundamental and often challenging subgroup within the general surgery cohort. These patients can present with an acute intra-abdominal crises with significant underlying physiological derangements because of their illness. In addition to prompt and appropriate resuscitation, the decision for operative management needs to be completed in a timely manner. Furthermore, preoperative optimization of underlying medical comorbidities is limited. Outcomes for emergency surgery have been more dismal than their nonemergent counterparts with increased risk of postoperative adverse events documented in the literature [1]. Performance variability among hospitals for common procedures such as appendectomy, cholecystectomy, and colorectal resection also demonstrate quality improvement targets [2].

Prognostication tools often used in elective surgical cases to evaluate outcomes, stratify and survey quality standards are not frequently used for acute care surgery patients. Currently, commonly used preoperative scores include the largely subjective American Society of Anesthesiologists (ASA) [3] and the Surgical Risk Scale [4], which incorporates operative variables with the ASA class. Models that take into account preoperative physiological parameters and intraoperative variables include POSSUM [5] (Physiologic and Operative Severity Score for Enumeration of Mortality and Morbidity) with Portsmouth (P-POSSUM) variation developed to include a lower baseline mortality prediction and the colorectal variation (CR-POSSUM) [6] for subspecialty use. The surgical Apgar [7], another scoring system based solely on intraoperative factors, uses blood loss, heart rate, and blood pressure during surgery to predict 30-d major complication and mortality rates. These tools, however, have mostly used elective surgical patients with some validated only in elective postoperative cohorts. The recently introduced National Surgical Quality Improvement Program calculator [8] provides a risk assessment for several end points based on a large data set; however, it is restricted to patients who undergo surgery for their condition.

Emergency or acute care general surgery patients are a unique subgroup with diverse demographics, varying surgical conditions each with a unique management technique. Therefore, our objective in this study was to investigate prognostic risk factors from patient level characteristics and clinical presentation predictive of mortality and morbidity as defined by postoperative complications, intensive care unit (ICU) admission, and prolonged duration of hospital stay in the acute care general surgery population. Identification of such prognostic factors will assist in guiding resuscitation, operative management, in estimating prognostic outcomes for effective communication, and quality assurance.

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## 2. Materials and methods

### 2.1. Patients

All general surgery admissions from the emergency room were retrospectively identified at a university affiliated

tertiary care center over a 1-y period from January–December 2010.

### 2.2. Study design

Institutional board review approval was obtained for the study protocol. For each patient, 37 factors were collected from presentation to discharge. These factors included symptoms on history of present illness, physical examination signs, and laboratory parameters at presentation, which were collected from examination of the patients' chart and study of the electronic medical records. Comorbidity burden for each patient was calculated using the Charlson comorbidity index scores [9–11]. Operative details (if applicable) were recorded on examining anesthesia, operative, and dictation records. Furthermore, efficiency parameters of patient flow were also recorded by studying time from emergency department (ED) presentation to surgical consult request, time for surgical team to establish contact with patient, and time to operating room from initial consult request.

The outcomes analyzed included in-hospital mortality, occurrence of postoperative complications, need for ICU admission, a prolonged length of hospital stay, and change in autonomous discharge disposition (i.e., discharge to a skilled care facility for patients who presented from home). Postoperative complications were categorized into cardiovascular, infectious, respiratory, neurologic, urinary, and gastrointestinal subgroups (see Appendix 1 for categorization). Prolonged hospital stay was defined as exceeding the 75th percentile of hospital stay for the entire cohort.

### 2.3. Statistical analysis

All statistical analysis was completed using Stata version 12.0 (Stata Corp, College Station, TX). Univariate analysis was performed to examine the relationship between each variable and our five primary outcomes with chi-square for categorical variables and the Wilcoxon rank-sum statistic for continuous variables. Data are presented as frequency (percentage) for categorical data and median (interquartile range [IQR]) for continuous data. Multivariate analysis for in-hospital mortality was conducted after adjusting for age and Charlson comorbidity score only, because of a small number of hospital deaths and to prevent model overfitting. Multivariate analysis for the other four outcomes was performed using backward stepwise logistic regression to evaluate for independent predictors. Statistical significance is defined as  $P$  value  $<0.05$ .

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## 3. Results

### 3.1. Patient characteristics

A total of 527 general surgery admissions were identified over a 1-y period with patient demographics illustrated in Table 1. A median age of 56 y old (IQR 36–71) and a median Charlson weighted comorbidity index of 1 (IQR 1–6) were present for the entire patient cohort with the most common admission diagnosis being appendicitis, colorectal disorders, and small

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