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# Acute Care Surgery: Defining the Economic Burden of Emergency General Surgery



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- BACKGROUND:** Trauma centers (TCs) have been shown to provide lifesaving, but more expensive, care when compared with non-TCs (NTC). Limited data exist about the economic impact of emergency general surgery (EGS) patients on health care systems. We hypothesized that the economic burden would be higher for EGS patients managed at TCs vs NTCs.
- METHODS:** The Maryland Health Services Cost Review Commission database was queried from 2009 to 2013. The American Association for the Surgery of Trauma EGS ICD-9 codes were used to define the top 10 EGS diagnoses. Demographic characteristics, TC designation, severity of illness, and hospital charge data were collected. Differences in total charges between TCs and NTCs were analyzed by Wilcoxon test using SAS 9.3 software (SAS Institute).
- RESULTS:** A total of 435,623 patients were included. Median age was 61 years (interquartile range 47 to 76 years) and 55.9% were female. Median length of stay was 4 days; 90.3% were admitted via emergency department; and overall mortality was 5.1%. Overall median charges were \$11,081 for TC vs \$8,264 for NTC ( $p < 0.0001$ ). Minor, moderate, major, and extreme severities of illness all had higher charges at TC vs NTC with no ICU admissions, respectively (\$5,908 vs \$5,243; \$7,051 vs \$6,003; \$10,501 vs \$8,777; and \$23,997 vs \$18,381;  $p < 0.001$ ). Care at TCs was nearly twice as expensive if patients were admitted to the ICU, even when stratifying by severity of illness.
- CONCLUSIONS:** Emergency general surgery patients treated at TCs incurred increased costs compared with NTCs, independent of patient severity. These costs nearly doubled for those admitted to the ICU. As acute care surgery grows as a specialty, additional investigation is required to better understand the reasons for this cost differential. (J Am Coll Surg 2016;222:691–699. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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Acute care surgery has evolved into a new specialty incorporating trauma, emergency general surgery (EGS), and surgical critical care. The evolution of regionalized trauma care has been well studied and found to reduce mortality and length of stay (LOS).<sup>1-3</sup> However, these improvements have come with increased costs for the resources required for the care of these patients.<sup>4</sup> Several

studies have found that hospitals with a dedicated acute care surgery service have shorter LOS and decreased time to operation for common emergency surgical procedures.<sup>5-8</sup> This has led to a call for EGS regionalization as a result of improved efficiency and quality of care. Citing a lack of access to emergency care, Block and colleagues<sup>9</sup> have recommended using the regionalization of trauma care as a model for EGS patients. Diaz and colleagues<sup>10,11</sup> found that a dedicated and mature EGS service could demonstrate a decrease in mortality and LOS. However, Narayan and colleagues<sup>12</sup> found that mortality for EGS patients treated at trauma centers (TCs) vs non-trauma centers (NTCs) clearly depends on severity of illness. In fact, patients with the most extreme severity of illness had higher mortality when treated at TCs vs NTCs.

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**Abbreviations and Acronyms**

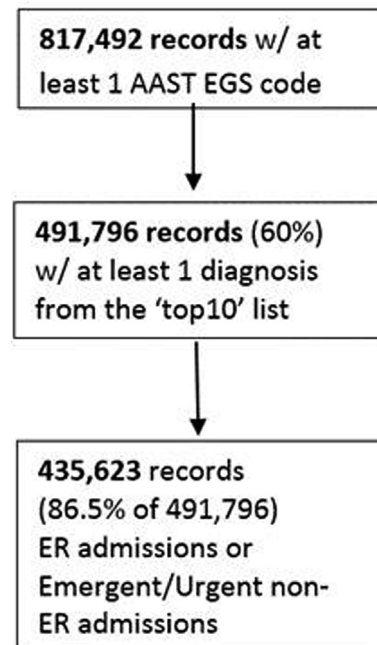
APR-SOI	= All Patients Refined Severity of Illness
CCR	= cost-to-charge ratio
ED	= emergency department
EGS	= emergency general surgery
HSCRC	= Health Services Cost Review Commission
IQR	= interquartile range
LOS	= length of stay
NTC	= non-trauma center
TC	= trauma center

Although resource use and cost data have been studied in the trauma and critical care population, little is known about the economic impact of EGS. Velopulos and colleagues<sup>13</sup> recently used the Nationwide Inpatient Sample to estimate the overall mean cost of EGS admissions. They found that the overall mean cost per EGS admission was \$9,711, leading to a national cost of approximately \$38 billion per year. Limited data exist about the economic impact of EGS on a well-defined, mature, health care delivery system. We hypothesized that the economic burden of EGS patients managed within Maryland would be higher at TCs vs NTCs.

**METHODS**

A retrospective review using the Maryland Health Services Cost Review Commission (HSCRC) database from 2009 to 2013 was performed after approval by the Health Services Cost Review Commission Review Board and confirmation of the Research Data Use Agreement. The HSCRC Inpatient Data Set that we used contains discharge medical records and billing data on each of the state's approximately 800,000 inpatient admissions annually. The HSCRC was created in the 1970s as a result of a federal government waiver exempting Maryland from national Medicare and Medicaid reimbursement principles.<sup>14,15</sup> All payers pay Maryland hospitals on the basis of the rates established by the HSCRC. Analysis was performed using hospital discharge and charge data from the HSCRC database. The University of Maryland, Baltimore Internal Review Board approved the study.

The American Association for the Surgery of Trauma EGS ICD-9 codes were used to define the top 10 EGS diagnoses in the HSCRC database.<sup>16</sup> All adult patients aged 18 years and older were included in the analysis. Additional variables collected included age, sex, race, hospital LOS, ICU LOS, emergency department (ED) admission, and All Patients Refined Severity of Illness (APR-SOI). The APR-DRG incorporates SOI subclasses. The APR-SOI is defined by the extent of physiologic



**Figure 1.** Study flow diagram. AAST, American Association for the Surgery of Trauma; EGS, emergency general surgery; ER, emergency room.

decompensation or organ system loss of function. The stratification and use of this methodology have been described previously.<sup>12,17</sup> Total charges included hospital room, operating room, drugs, radiology, laboratory, supply, therapy, and other charges.

Hospitals were broadly divided into TC vs NTC as defined by the Maryland Institute for Emergency Medical Services Systems. As we have described previously, TC designation was used as a marker for the presence of a formal acute care surgery program.<sup>12</sup> The primary end point was charges.

**Table 1.** Top 10 Emergency General Surgery Diagnoses

Diagnosis	Frequency	% of Total (N = 435,623)
Abscess	91,248	20.95
Hernias	78,792	18.09
Obstruction	66,496	15.26
Calculus	57,438	13.19
Hemorrhage	54,857	12.59
Abdominal pain	51,626	11.85
Pancreatitis	41,851	9.61
Diverticula	36,926	8.48
Appendicitis	19,823	4.55
Ulcer	17,740	4.07

Patients can have more than one diagnosis.

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