Effect of American College of Surgeons Trauma Center Designation on Outcomes: Measurable Benefit at the Extremes of Age and Injury

Michael D Grossman, MD, FACS, Jay A Yelon, DO, FACS, Lisa Szydiak, MS

BACKGROUND: American College of Surgeons (ACS) verification is believed to provide benefits for trauma patients, but is associated with direct costs.

STUDY DESIGN: We performed a 1-year retrospective review of the National Trauma Data Bank (NTDB) for 2012. Patients were separated into 3 age groups; Pediatric (PEDS), 0 to 14 years; adult, 15 to 65 years; and elderly (ELD), older than 65 years. We analyzed 2 injury severity cohorts, Injury Severity Score (ISS) 9 to 74 (ALL) and ISS 25 to 74 (MAJ). Multiple logistic regression to determine significance of ACS verification on mortality and major complications, controlling for age, ISS, shock, Glasgow Coma Scale, sex, age, comorbidities, and mechanism. Patients were excluded with an ISS <8 or equal to 75, dead on arrival, emergency department transfers, and burns.

RESULTS: There were 392,997 patients: 262,644 in ACS centers and 130,353 in non-ACS centers. Distribution was: PEDS 3.8%, adults 64.5%, ELD 31.7%. For ALL adults, no differences were observed for primary outcome in ACS vs non-ACS centers ($p = 0.128$ and 0.061, for mortality and complications, respectively). For ALL PEDS and ELD, complications were more likely in non-ACS centers: ($p = 0.003$, odds ratio [OR] 2.61 [95% CI 1.36 to 5.0], and $p < 0.0001$, OR 3.17 [95% CI 2.21 to 4.56]). For MAJ trauma, death was more likely in adults in ACS vs non-ACS centers ($p = 0.013$, OR 0.82 [95% CI 0.71 to 0.96]). Complications for MAJ trauma were more likely in all age groups in non-ACS centers (adult: $p = 0.028$, OR 1.48 [95% CI 1.04 to 2.1]; ELD: $p < 0.0001$, OR 2.49 [95% CI 1.7 to 3.7]; PEDS: $p < 0.0001$, OR 4.29 [95% CI 2.13 to 8.69]). Length of stay was increased for all patients with complications ($p < 0.0001$).

CONCLUSIONS: Measurable benefits in complications were observed in all age groups with MAJ trauma and in PEDS and ELD for ALL injury severity in ACS vs non-ACS trauma centers. (J Am Coll Surg 2017;225:194−199. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

The American College of Surgeons Committee on Trauma (ACS-COT) was formed in 1922 and has provided verification for trauma centers since 1987.[1] Fundamental to its mission to achieve optimal care for injured patients, the most recent edition of the optimal resource document has focused on "providing support for resource expenditure within an inclusive system of trauma care."[1] Therefore, verification can be used to provide the impetus for capital expenditures to support the personnel and process required to provide timely and appropriate care for trauma patients.

Individual hospitals may determine that the costs associated with verification are justified based on improvement in institutional quality, or they may even experience cost savings associated with decreased length of stay. On a large scale, it is less clear that verification provides measurable benefit. The question of whether ACS verification should be a national mandate is relevant given recent efforts to reduce preventable trauma deaths

Disclosure Information: Nothing to disclose.

Abstract presented at the American College of Surgeons 102nd Annual Clinical Congress, Scientific Forum, Washington, DC, October 2016.

Received February 26, 2017; Revised April 20, 2017; Accepted April 24, 2017.

From the Division of Acute Care Surgery, Southside Hospital/Northwell Health, Hofstra-Northwell School of Medicine, Bayshore, NY.

Correspondence address: Michael D Grossman, MD, FACS, Division of Acute Care Surgery, Southside Hospital/Northwell Health, Hofstra-Northwell School of Medicine, 301 East Main St, Bayshore, NY 11706. email: mgrossman4@northwell.edu

http://dx.doi.org/10.1016/j.jamcollsurg.2017.04.034
ISSN 1072-7515/17

Abbreviations and Acronyms
ACS = American College of Surgeons
COT = Committee on Trauma
ED = emergency department
ELD = elderly
GCS = Glasgow Coma Scale
ISS = Injury Severity Score
MAJ = major
OR = odds ratio
PEDS = pediatric

in the US.[2] Recent data regarding observed vs expected outcomes in Level I and II trauma centers suggested there was more variability in adverse outcomes among non-ACS Level II centers.[3] Other studies have shown outcomes differences for ACS-verified trauma centers, but only for specific complications such as acute respiratory distress syndrome[4] or comorbidities such as cirrhosis.[5] Many studies have examined the potential impact of trauma center volume on outcomes among and between different levels of designation. DiRusso[6] and others performed a systematic review of studies examining the relationship between volume and outcomes in US trauma centers and found significant heterogeneity among studies, with a slight trend toward a positive volume/outcome relationship more often observed among specific subpopulations. In order to address this question, we sought to determine if the rates of complications and mortality independent of volume are different between ACS and non-ACS centers in the US.

METHODS

We performed a 1-year retrospective review of the National Sample Program of the National Trauma Data Bank. The 2012 National Sample Program dataset was analyzed because it provides a representative model for trauma centers. We separated patients into 3 age categories: pediatric (PEDS), ages 0 to 14; adult, ages 15 to 65, and elderly (ELD), age greater than 65. We excluded patients with an Injury Severity Score (ISS) less than 8 or equal to 75, those who were dead on arrival, emergency department (ED) transfers, and those with burns. We defined death in the ED as patients arriving with signs of life, whose disposition was morgue, or not otherwise recorded as home or admitted to the hospital. We analyzed the group of patients with ISS 9 to 74 (ALL), and we separately analyzed a more severely injured cohort with ISS 25 to 74 (MAJ).

Multiple logistic regression models were used to determine the significance of ACS verification on mortality and complications across all trauma center levels. Complications were those defined by the National Trauma Data Bank as major complications and are listed in Table 1. The logistic models accounted for the National Sample Program's complex survey design that includes strata, clusters, and weights, and includes a domain analysis for the subgroups. The models controlled for age, ISS, Glasgow Coma Scale (GCS), shock, sex, comorbidities, and blunt vs penetrating mechanism. Comorbidities were those defined by the National Trauma Data Bank data dictionary and are listed in Table 2.

We analyzed both ISS and GCS as categorical variables (low, moderate, and high) because we believed these

Table 1. National Trauma Data Bank Complications

Acute kidney injury
Acute lung injury/acute respiratory distress syndrome
Cardiac arrest with CPR
Catheter related blood stream infection
Decubitus ulcer
Deep venous thrombosis/thrombophlebitis
Pulmonary embolus
Deep surgical site infection
Organ space surgical site infection
Superficial surgical site infection
Urinary tract infection
Drug or alcohol withdrawal syndrome
Extremity compartment syndrome
Graft/prosthesis/flap failure
Myocardial infarction
Osteomyelitis
Pneumonia
Severe sepsis
Stroke/cerebrovascular accident
Unplanned return to operating room/unplanned admission to ICU

Table 2. National Trauma Data Bank Comorbidities

Ascites within 30 d
Bleeding disorders (includes anticoagulation)
Cerebrovascular accident/residual neurologic deficit
Cirrhosis
Congenital anomalies
Current smoker
Current chemotherapy for cancer
Dementia
Respiratory disease
Diabetes mellitus
Drug abuse or dependence
Functionally dependent health status
Hypertension requiring medication
Major psychiatric illness
Obesity
Pre-hospital cardiac arrest with CPR
Prematurity
Steroid use