Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Society of Asian Academic Surgeons

The impact of individual physicians on outcomes after trauma: is it the system or the surgeon?

N. Rhea Udyavar, MD,[a,*] *Ali Salim, MD,*[b] *Joaquim M. Havens, MD,*[a,b] *Zara Cooper, MD,*[a,b] *Edward E. Cornwell III, MD,*[c] *Stuart R. Lipsitz, ScD,*[a,b] *John W. Scott, MD, MPH,*[b] *and Adil H. Haider, MD, MPH*[a,b]

[a] *Center for Surgery and Public Health, Brigham and Women's Hospital, Boston, Massachusetts*
[b] *Department of Surgery, Brigham and Women's Hospital, Boston, Massachusetts*
[c] *Department of Surgery, Howard University Hospital, Washington, District of Columbia*

ARTICLE INFO

Article history:
Received 19 December 2017
Received in revised form
29 January 2018
Accepted 23 February 2018
Available online 16 April 2018

Keywords:
Trauma quality
Individual surgeon effects
Random effects
Trauma systems

ABSTRACT

Background: Benchmarking of mortality outcomes across the country has revealed major differences in survival based on the trauma center at which a patient receives care. The role of the individual surgeon in determining trauma outcomes is unknown. Most believe that differences in outcomes are primarily driven by system- and process-based variations. Our objective was to determine if variation in individual surgeon outcomes could help explain difference in survival after trauma.

Methods: Analysis of trauma patients in the Florida State Inpatient Database from 2010 to 2014. The presence of unique physician identifiers, in addition to hospital identifiers, rendered this data set ideal for performance of multilevel analysis. The amount of the variation attributable to surgeon-level variation was calculated using multilevel random-effects models controlling for patient clinical factors (such as injury severity and comorbidities/age) and hospital-level factors, such as case mix and bed size.

Results: There were 31 hospitals, 175 surgeons, and 65,706 admissions. The overall mortality rate was 5.6%. The average mortality rate across surgeons ranged from 0% to 17.4% (mean 0.4%, standard deviation 1.85). At the individual surgeon level, when controlling for clinical and hospital-level factors, 9% of this variation was attributable solely to the surgeon.

Conclusions: At the state level, we found that differences in outcomes among trauma centers are impacted by individual surgeon-level variation. Implementation of protocolized, system-based trauma care is useful for improving the overall quality of care for injured patients but does not entirely negate surgeon-specific variations in management.

Portions of this research were presented at the Society for Asian Academic Surgeons 2017 Plenary Session in Birmingham, AL.

* *Corresponding author*. Center for Surgery and Public Health, 1620 Tremont Street 4-020, Boston, MA 02120. Tel.: +1 443 401 4052; fax: +1 617 525 7723.
E-mail address: nudyavar@bwh.harvard.edu (N.R. Udyavar).

0022-4804/$ – see front matter © 2018 Elsevier Inc. All rights reserved.
https://doi.org/10.1016/j.jss.2018.02.051

Introduction

Substantial variations in risk-adjusted mortality following traumatic injury have been well documented at the institutional level.[1] The establishment of trauma systems, which categorize hospitals based on resources available to care for injured patients, has resulted in improvements in survival and functional outcomes for those treated at designated trauma centers.[2-5] However, it is not known which specific components of the entity we define as a "trauma system" are responsible for this improved care. Adherence to evidence-based guidelines and protocols, for example, reduces the variability associated with clinical decision-making and represents an integral aspect of the ethos of trauma systems. Concentrating the care of injured patients at hospitals that possess the infrastructure and organizational commitment to adhere to these protocols has been cited as a driving force behind the improvement of the quality of trauma care, but the role of the individual surgeon in achieving this improvement remains controversial.

This uncertainty is compounded by the broad range of training, experience, and allocation of time devoted to the care of trauma patients that characterizes the workforce of surgeons who staff trauma services throughout the United States.[6,7] Although fellowships in trauma and acute care surgery exist, additional training is not a prerequisite for surgeons providing trauma care at most medical centers. The sheer volume and wide geographic distribution of trauma patients necessitate an expansive pool of surgeons to meet the needs of the population. Trauma surgeon characteristics, such as experience and case volume, have been examined in single-institution studies to assess their effect on mortality, demonstrating divergent results. Haut *et al.*[8] reported that any potential adverse effects of individual trauma surgeons' relative inexperience were surmounted by the positive effects of an organized trauma system and the availability of more senior trauma faculty to provide guidance in the care of injured patients. Mortality similarly does not appear to differ according to surgeon case volume within level I trauma centers, although Sava *et al.*[9,10] did find a trend toward higher mortality for lower-volume surgeons. Conversely, surgeon-specific characteristics such as having an attending surgeon in-house and present during the initial resuscitation of severely injured patients or having a "full-time" trauma surgeon instead of a surgeon who only covers trauma "part-time" appear to be associated with improved survival. This indicates that so-called "surgeon effects" do have a measurable impact on outcomes such as mortality and readmissions within trauma centers, particularly among the most critically injured patients.[6,11]

Quantifying this relationship and conceptualizing its effect within the greater context of the regionalization of trauma care are challenging. We hypothesized that, when comparing surgeons across multiple trauma centers, individual surgeon-specific variation would contribute to overall in-hospital mortality variation, even after controlling for hospital effects. Through this study, we sought to delineate whether outcomes are influenced by the individual surgeon overseeing the care of the injured patient within the protocolized constraints of a trauma system.

Methods

We used the Florida State Inpatient Database (SID) from 2010 to 2014 to extract inpatient trauma records for which the primary diagnoses corresponded to one or more of the *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis codes 800-959. The Florida SID is an administrative data set that contains all inpatient discharge information, translated into a uniform set of variables. It is unique among other SIDs in that it links each discharge record to a specific attending physician or billing fellow. Since 2010, Florida has provided two distinct identifiers for each physician, housed under the variable name "MDNUMn_R", with *n* equal to 1, 2, or 3. The operating surgeon is provided in "MDNUM2_R" for admissions in which an operating room procedure took place, while the attending physician is provided in "MDNUM1_R". For some records, no operative physician was designated, and for others, these two entries are identical.[12] For those with distinct attending and operating physicians, we attributed the record to the operating physician. Because this analysis involved the use of publicly available data without any personal identifying information, Institutional Review Board deemed it to be exempt.

Study sample

Patients 18 y or older with the aforementioned *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis codes, receiving both operative and nonoperative management for traumatic injuries, were included. We restricted our study population to patients who were treated by relatively higher-volume physicians, defined as those who had 100 or more inpatient records for which they were either the operating or attending physician to reduce the influence of low-volume outliers on the overall variability. Records for which either a physician identifier or hospital identifier was missing were excluded.

Statistical analysis

Our outcome of interest was in-hospital mortality. We first generated descriptive statistics for patients' demographic and clinical characteristics (mechanism of injury, race, primary insurance payer, age, length of stay, comorbidities, Injury Severity Score [ISS], whether an operation took place during the admission, and, if so, the type of procedure) as well as surgeon and hospital characteristics (total patient volume and total operative volume). New variables were generated to describe both surgeons' caseload and hospital caseload, as well as complication rates and 30-d readmission rates as an indicator of overall quality. To assess the distribution of the patients' demographic and clinical characteristics across the surgeons, we first calculated the overall mean for continuous variables and the mean proportion for dichotomous variables,