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A retrospective cohort study of the relationship between quality indicator measurement and patient outcomes in adult trauma centers in the United States

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ABSTRACT

Background: Improving care is a key strategy for reducing the burden of injuries, but it is unknown whether the use of quality indicators (QI) is associated with patient outcomes. We sought to evaluate the association between the use of QIs by trauma centers and outcomes in adult injury patients.
Methods: We identified consecutive adult patients (n = 223,015) admitted to 233 verified trauma centers January 1, 2007 to December 31, 2010 that contributed data to the National Trauma Data Bank and participated in a survey of QI practices. Generalized Linear Mixed Models were employed to evaluate the association between the intensity (number of QIs) and nature (report cards, internal and external benchmarking) of QI use and survival to hospital discharge, adjusting for patient and hospital characteristics.
Results: There were no significant differences in the odds of survival to trauma center discharge according to the number of QIs measured (quartiles; odds ratio{OR} [95% confidence interval{CI}] 1.00 vs. 1.08 [0.90–1.31] vs. 1.00 [0.82–1.22] vs. 1.21 [0.99–1.49]), or whether centers used reports cards (OR 1.07, 95%CI 0.94–1.23), internal (OR 1.06, 95%CI 0.89–1.26) or external (OR 1.09, 95%CI 0.92–1.31) benchmarking. The duration (geometric mean) of mechanical ventilation (4.0 days), ICU stay (4.6 days), hospital stay (7.7 days) and proportion of patients with a complication (13.6%) did not significantly differ according to the intensity or nature of QI use.
Conclusions: The intensity and nature of the QIs used by trauma centers was not associated with outcomes of patient care. Alternative quality improvement strategies may be needed.
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Introduction

Around the world, injury claims the lives of 5 million people annually – ten fatalities every minute [1]. Injuries equate to 9% of global mortality and 10% of global burden of disease (time-based measure of mortality and disability) [1,2]. Tens of millions of people are hospitalized for non-fatal injuries annually, with many of them never recovering to their pre-injury health status [1,2]. For example, in the United States in 2010, injuries resulted in 57 age-adjusted fatalities, 809.7 hospitalization and 9263.3

Abbreviations: AIS, abbreviated injury score; ARDS, acute respiratory distress syndrome; CI, confidence interval; DNR, do-not-resuscitate; ED, emergency department; GCS, glasgow coma scale; GLMM, generalized linear mixed model; IQR, interquartile range; ISS, injury severity score; NTDB, National Trauma Data Bank; OR, odds ratio; QI, quality indicator; VTE, venous thromboembolism.

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emergency room visits per 100,000 population at an estimated cost of $586.8 million in medical care and lost productivity [3].

To reduce the burden of fatalities and short- and long-term disabilities resulting from injury, it is crucial to improve the organization, access and delivery of injury care across the continuum from pre-hospital to post-hospital care [1,2,4]. Professional societies (e.g., American College Surgeons Committee on Trauma), healthcare delivery organizations (e.g., Massachusetts General Hospital, Boston, MA) and accreditation bodies (e.g., Accreditation Canada) advocate for measuring the quality of injury care [5,6,7]. Quality indicators (QI) are one type of measure currently used by trauma systems to measure the quality of care and to guide quality improvement efforts [8–10]. These indicators appear in many forms, such as report cards, and have been used for both internal and external benchmarking of performance [11,12]. However, it is unknown if incorporating QIs into trauma systems improves the quality of injury care and reduces morbidity and mortality [8].

In 2011, a prospective cross-sectional survey of trauma centers reported the utilization of QIs within trauma systems in the United States, Canada and Australasia [13]. We took advantage of this data and conducted a retrospective cohort study to evaluate the relationship between the use of QIs (intensity and nature) by trauma centers and patient outcomes.

Methods

Study population

Hospital sampling frame

Our initial sampling frame was comprised of the 263 trauma centers verified by the American College of Surgeons that participated in a previous cross-sectional survey to describe the use of QIs for injury care [13]. Of these, we included those centers that contributed data to the National Trauma Data Bank (NTDB) in the three year period (2007–2010) immediately prior to survey (n = 233) [14]. The rationale for these inclusion criteria is that they allowed us to link self-reported survey data describing the use of QIs at a trauma center level to processes and outcomes of care for individual patients admitted to those trauma centers in the three years prior to the survey.

Patient cohort

From the trauma centers included in the study, we included consecutive adult (age $\geq$16 years) patients admitted to hospital from January 1, 2007 to December 31, 2010 with an injury diagnosis that met the criteria for inclusion in the NTDB (i.e., patients sustaining a severe injury included in a pre-specified list of ICD 9/10 injury codes and either a hospital admission as defined by the hospital trauma registry, emergency medical services transfer from one hospital to another hospital or death). We excluded patients: 1) with injuries documented to be either minor (Injury Severity Score [ISS] of $\leq$15) or not survivable (Abbreviated Injury Score [AIS] in any body region of 6), 2) that were discharged home, or transferred to another hospital, from the Emergency Department (ED), 3) or died in the ED [15,16]. These exclusion criteria were chosen so that evaluation of the association between trauma center QI use and processes and outcomes of care would be restricted to those patients most likely to benefit from quality improvement initiatives.

Sources of data

Quality indicators

We used data previously collected through a cross-sectional survey on the current use of QIs [13]. Verified trauma centers were identified in the USA, Canada and Australasia using National Professional Trauma Associations and approached for participation (n = 330). The survey instrument was derived from a scoping and systematic review and designed to describe the characteristics of trauma centers and the QIs used [8,9]. Participants reported the intensity of QI use (number of QIs),] which were then classified into quartiles (number of quality indicators; $\leq$10, 11–25, 26–40, >40) for this study (to ensure anonymity of trauma centers after linkage of the survey data with the patient data) [13]. We also documented the nature (performance improvement initiatives) of QI use at each of the trauma centers: report cards (hospital level statistics on clinical performance initiatives and areas for improvement), internal benchmarking (within hospital comparisons of performance over time) and external or competitive benchmarking (between hospital comparisons of performance); all categorized as binary measures [12,17].

Patient data

The patient-level study data was obtained from the NTDB (American College of Surgeons, Chicago, IL), which grants researcher access to the NTDB dataset following approval from the American College of Surgeons. The NTDB is the largest trauma data repository in the United States and serves to inform healthcare systems, providers, decision makers and the public of the current state of injury care in the United States [14]. Participating centers provide the NTDB dataset with both patient-level (e.g. demographic, clinical, outcome, etc.) and hospital-level (e.g. verification level, teaching status, etc.) data.

Outcome measures

The primary outcome was patient survival to hospital discharge. We examined four secondary outcome measures: mechanical ventilation (days), intensive care unit (ICU) stay (days), hospital stay (days) and the occurrence of one or more medical complications (decubitus ulcer, venous thromboembolism [VTE], myocardial infarction, pneumonia, superficial site infection, acute renal failure, acute respiratory distress syndrome [ARDS] and stroke/cerebral vascular accident).

Statistical analyses

Descriptive statistics were used to summarize patient, injury and hospital characteristics. Categorical variables such as gender, race, comorbidities, primary method of payment, ED discharge position and injury mechanism were expressed as counts and proportions, whereas continuous variables such as age and ISS were expressed as medians with interquartile ranges (IQR). The primary outcome measure, survival to hospital discharge, and the secondary outcome measure, the occurrence of one or more medical complications, were summarized using counts and proportions. The three secondary outcome measures, mechanical ventilation, ICU stay and hospital stay had a right-skewed distribution and were summarized by geometric means. Analyses of secondary outcome measures were restricted to patients that survived to hospital discharge. A Generalized Linear Mixed Model (GLMM) was used to assess the association between the intensity (number) and nature (report cards, internal benchmarking, external benchmarking) of QI use clustered by trauma centers adjusting for covariates. For the primary outcome, survival to hospital discharge, we used a binomial distribution. For the three secondary outcome measures; mechanical ventilation, ICU stay and hospital stay, we used natural-log transformed values. Covariates, identified by literature review and expert opinion, were age in years, ISS, gender, race, primary method of payment, comorbidities, inter-facility transfer, mechanism of injury, shock

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