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Benchmarking statewide trauma mortality using Agency for Healthcare Research and Quality's patient safety indicators

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ABSTRACT

Background: Improving clinical outcomes of trauma patients is a challenging problem at a statewide level, particularly if data from the state's registry are not publicly available. Promotion of optimal care throughout the state is not possible unless clinical benchmarks are available for comparison. Using publicly available administrative data from the State Department of Health and the Agency for Healthcare Research and Quality (AHRQ) patient safety indicators (PSIs), we sought to create a statewide method for benchmarking trauma mortality and at the same time also identifying a pattern of unique complications that have an independent influence on mortality.

Methods: Data for this study were obtained from State of Florida Agency for Health Care Administration. Adult trauma patients were identified as having International Classification of Disease ninth edition codes defined by the state. Multivariate logistic regression was used to create a predictive inpatient expected mortality model. The expected value of PSIs was created using the multivariate model and their beta coefficients provided by the AHRQ. Case-mix adjusted mortality results were reported as observed to expected (O/E) ratios to examine mortality, PSIs, failure to prevent complications, and failure to rescue from death.

Results: There were 50,596 trauma patients evaluated during the study period. The overall fit of the expected mortality model was very strong at a c-statistic of 0.93. Twelve of 25 trauma centers had O/E ratios <1 or better than expected. Nine statewide PSIs had failure to prevent O/E ratios higher than expected. Five statewide PSIs had failure to rescue O/E ratios higher than expected. The PSI that had the strongest influence on trauma mortality for the state was PSI no. 9 or *perioperative hemorrhage or hematoma*. Mortality could be further substratified by PSI complications at the hospital level.

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Conclusions: AHRQ PSIs can have an integral role in an adjusted benchmarking method that screens at risk trauma centers in the state for higher than expected mortality. Stratifying mortality based on failure to prevent PSIs may identify areas of needed improvement at a statewide level.

1. Introduction

In 2014, the Florida Department of Health developed a strategic plan to decrease its higher than national average trauma mortality rate by nearly 1%. Part of the plan included identifying and establishing benchmarks or quality indicators across the continuum of our trauma system for safe, effective, and efficient trauma care [1]. However, two hurdles presented themselves: first, such benchmarks do not currently exist. Second, the statewide trauma registry has not been traditionally considered robust for quality improvement research, which makes it difficult to identify clinical measures that pertain to the state's trauma system.

To overcome these obstacles two available resources were used: the State Agency for Health Care Administration (AHCA) inpatient administrative data and clinical benchmarks developed by the Agency for Healthcare Research and Quality (AHRQ). The AHRQ has created a series of benchmarks derived from inpatient administrative data that are used to screen for clinical problems and complications, which result from a health care system. These are known as patient safety indicators (PSIs). PSIs are thought to be preventable and amenable to change at both provider and system levels [2]. At a national level, they are measures adopted by Centers for Medicare and Medicaid Services (CMS) for both quality and value-based purchasing.

We hypothesize that a novel risk adjusted model for ranking mortality among the state's trauma centers (TCs) will show differences in PSI among high performing and low performing TCs. This method should allow the state to identify benchmarks for both statewide and hospital level intervention and improve trauma mortality.

2. Methods

Data for this study were obtained from the Florida AHCA. The patient population of interest comprised trauma inpatients discharged from each of the 25 level 1 or 2 TCs in the state during calendar year Q1–Q4 2013. During this time frame, there were 50,596 patients discharged from a Florida TC who had an International Classification of Disease ninth edition (ICD-9) trauma diagnosis (specifically, 800–904.9, 925–929.9, and 940–959.9) in at least one of the 31 ICD-9 diagnosis fields contained in the AHCA inpatient administrative data. Patients aged <16 and >100 y were excluded from this analysis. Level I and II TCs were combined because both were based on Florida Administrative code and State Statute, the clinical services provided to adult trauma patients should be the same [3,4]. All data were analyzed using SAS version 9.4 (SAS Institute Inc, Cary, NC).

All numerator and denominator values were derived from the same AHCA data set and patient population. Observed mortality and PSI events were derived from the AHCA data set. Mortality is defined as inpatient mortality. PSI events are further described subsequently in the description of expected events.

Both expected values for mortality and PSIs were also derived from the AHCA data set. To create a predictive inpatient expected (E) mortality model, covariates were added to the logistic regression to adjust for confounding factors using the AHCA data set. Confounders were considered in the multivariate analysis if it was reasonable to assume or if there were published data to show that these variables had an independent effect on trauma patients in regards to mortality. This method is similar to other studies deriving expected values in failure to rescue analysis [5,6]. The c-statistic for our model was 0.93. Variables in the model include age, gender, race, ethnicity, socioeconomic status, ICD-9 Injury Severity Score (ICISS), Charlson comorbidity index, injury mechanism (blunt *versus* penetrating), and 10 hospital acquired complications. These complications were defined as the following ICD-9 or Current Procedural Terminology codes: pneumonia, 480–486; urinary tract infection, 599.0, 771.82; arrhythmias, 427.9, 427.41; sepsis, 995.91, 771.81, 995.92; reintubation, 9604 (Current Procedural Terminology); wound infection, 998.51, 998.59; cardiac arrest, 427.5, 779.85, 668.1, 668.10, 668.11, 668.12, 668.13, 668.14; deep venous thrombus, 453.4x, 453.8; coagulopathy, 286.6, 286.9; pulmonary embolus, 415.1x. To maintain anonymity, TCs are labeled in alphabetical order by rank of their overall mortality index, see Figure 1.

The expected value (E) of PSIs was derived from the multivariate logistic regression model supplied by the AHRQ [7]. The AHRQ regression model is based on administrative data and its beta coefficients were applied to the AHCA administrative data set. This method has been described and used in quality reporting when using administrative data [8]. These quality indicators were PSI no. 3 pressure ulcer, PSI no. 6 iatrogenic pneumothorax, PSI no. 7 central venous catheter-related bloodstream infections, PSI no. 8 postoperative hip fracture, PSI no. 9 postoperative hemorrhage or hematoma, PSI no. 10 postoperative physiological and metabolic derangement, PSI no. 11 postoperative respiratory failure, PSI no. 12 postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT), PSI no. 13 postoperative sepsis, PSI no. 14 postoperative wound dehiscence, and PSI no. 15 accidental puncture or laceration. PSI no. 4, death among surgical inpatients with serious treatable complications, was not included in our analysis because of the vague nature of this event and that it highly correlated with mortality itself. All hospitals had the reported PSIs. However, in the analysis of stratifying by hospitals and trauma patients, PSIs may not