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Multidisciplinary approach to decrease pediatric trauma undertriage



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ABSTRACT

Background: Trauma activation and/or leveling criteria are designed to balance the potential harm to individual patients from undertriage (UT) of severe injuries versus overutilization of resources from overtriage (OT) of lesser injuries. The American College of Surgeons (ACS) recommends an acceptable UT rate $\leq 5\%$ and OT 25%-50%. To improve UT or OT, an intervention was performed to (1) improve accuracy in following established leveling criteria and (2) modify activation criteria in an evidence-based manner to better identify severely injured children.

Methods: Results from a prospective, interventional process improvement study performed at an ACS-verified level I pediatric trauma center are reported. The baseline period included all pediatric trauma patients who met registry inclusion criteria for 2010. The intervention period included two consecutive 3-mo periods in 2011-2012; phase I of the study involved moving the leveling responsibility from emergency department physicians to the nursing care team leaders. Phase II of the study implemented revised leveling criteria. Sustainability was assessed by evaluating data from 2014.

Results: In phase I, accuracy in assigned trauma activation level improved from 70% to 99%. UT decreased 10%-8%, and OT decreased 37.5%-33.3%. In phase II, UT decreased 8%-5.1%, and OT increased 33%-40%. Adherence to the activation criteria remained stable (95%). For 2014, UT was 5.3% and OT was 18.2% demonstrating sustainability.

Conclusions: Shifting trauma leveling responsibilities to nursing care team leaders improved accuracy. Revising the activation criteria to include Center for Disease Control and ACS guidelines, as well as tailoring the activation criteria to the program-specific population, further reduced UT rates in a sustainable fashion.

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Introduction

An estimated 10%-15% of all traumatically injured children sustain life-threatening injuries that require a systematic and rapid approach to their treatment.¹ When a trained trauma resuscitation team is present on the arrival of the seriously injured child, mortality can be decreased by 25%-30%.¹ Trauma team activation and leveling criteria are designed to balance the potential harm to individual patients from undertriage (UT) of severe injuries versus overutilization of systems resources from overtriage (OT) of patients with less severe injuries. The goal of balancing UT and OT is achieved through the development of appropriate, population-specific triage criteria as well as adherence to the identified criteria.

In May of 2002, the Committee on Trauma of the American College of Surgeons (ACS-COT) mandated six criteria for the highest level of activation for both adult and pediatric trauma centers.² These criteria include age-specific hypotension, respiratory compromise or obstruction, transfer patients from another hospital who are receiving blood, gunshot wound to the abdomen, neck, or chest, Glasgow Coma Scale score of ≤ 8 and deterioration of Glasgow Coma Scale score by 2. In addition, trauma centers were then encouraged to develop hospital-specific criteria that effectively captured the most severely injured patients for their region and population. The ACS recommends an acceptable UT rate of $\leq 5\%$ and OT rate of 25%-50%.²

The purpose of this study was to improve the UT and OT rates at our ACS-verified level I pediatric trauma center. We hypothesized that (1) shifting trauma leveling responsibility from emergency department (ED) physicians to ED nursing care team leaders (CTL) would improve accuracy in following established leveling criteria and that (2) modifying established activation criteria, including use of ACS-mandated criteria, to better capture injured patients would further improve accuracy. Finally, we sought to determine the sustainability of this process improvement intervention overtime.

Materials and methods

Study design

The study was designed prospectively as an interventional Quality/Process Improvement project at ACS-verified level 1 pediatric trauma center in the upper Midwest. Results are presented after institutional review board approval. Data were abstracted from a prospectively maintained institutional pediatric trauma registry which captures all pediatric trauma patients who were treated in the ED and admitted to the children's hospital and who met inclusion injury criteria using the *International Classification of Diseases, Ninth Revision*, codes 800-959.9.

Four time periods were defined for the purposes of this study. Baseline data are from calendar year 2010. Phase I (3 mo, August-October 2011) of the study involved moving the leveling responsibility from the ED physicians to the ED nursing CTL. CTL are registered nurses who are the senior team member on duty with clinical and operational

leadership responsibility. CTLs were included in all calls from prehospital providers and referring facilities to determine activation level. ED physicians retained the ability to upgrade to a higher level of activation. Individual feedback and coaching were provided by the Trauma Program Manager. Accuracy of activation leveling was assessed.

In Phase II (3 months, January-March 2012) of the intervention, a multidisciplinary group consisting of physician and nursing representatives from the ED, neurosurgery, orthopedic surgery, pediatric intensive care, pediatric trauma surgery, as well as EMS providers, drafted revised trauma activation criteria incorporating ACS recommendations² and Center for Disease Control (CDC) Field Triage recommendations.³ The emphasis of these changes focused on head injuries, the primary finding in undertriaged patients in the baseline period (Table). Finally, sustainability was assessed by evaluating data for calendar year 2014.

Cribari method for determining UT and OT

The Cribari method was used to calculate UT and OT (Fig. 1). UT is defined as the number of patients with limited or no activation with Injury Severity Score (ISS) 16-75 divided by the total patients with limited or no activation. OT is defined as the number of patients with full trauma activation with ISS 0-15 divided by the total patients with full trauma activations.

Financial impact

To determine the financial impact of our intervention, we obtained the trauma activation fee structure from our Business Planning and Development group: \$6607 for a level 1 trauma and \$3000 for a level 2 trauma. We then determined the amount in lost charges for patients with ISS 16-75 that were either activated at level 2 or received no trauma activation in the baseline and final periods. In addition, we determined the excess charges for patients with ISS 0-15 that were activated at level 1 in both periods by assuming they should have been activated at level 2.

Statistical analysis

Statistical analysis was performed using JMP Pro 12.0.1 software (SAS Institute Inc, Cary, NC). Contingency tables were constructed to compare accuracy of leveling (yes or no), patients leveled (correct or incorrect) for both UT and OT, and trauma activation charges (lost charges, appropriate charges, and OT charges) for all time periods. Chi-square analyses were performed for each comparison, and $P < 0.05$ was considered statistically significant.

Results

Accuracy of CTL leveling was assessed throughout the phases. Accuracy improved from the baseline during phase I (70%-99%, $P < 0.00001$, Fig. 2). Accuracy was stable in phase II (94%, $P = \text{NS}$ versus phase I, $P = 0.03$ versus baseline, Fig. 2). Finally,

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