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Impact of triage guidelines on prehospital triage: comparison of guidelines with a statistical model

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ABSTRACT

Background: The American College of Surgeons developed the National Field Triage Decision Scheme (NFTDS) that has been adapted by many trauma centers in the nation, but quantitative evidence of its efficacy is unclear. We compare the NFTDS and state of Ohio guidelines to the "observed" rates and with rates derived using a statistical model.

Methods: We used 4757 trauma records from 2008-2012 available from the state and calculated undertriage (UT) and overtriage (OT) rates. We then simulated the NFTDS and the state guidelines for those years and estimated the corresponding UT and OT rates. We finally compared these rates with those derived from a multivariate logistic regression model.

Results: For the state data, both NFTDS and state guidelines produced lower UT rate (~9%) compared with the observed rate (~17%), whereas the OT rates were higher (>85%) than the observed rates (~54%). The statistical model identified novel factors that were not directly available in the NFTDS; change in responsiveness (odds ratio [OR] = 1.924) and complaint in body (OR = 3.140), back (OR = 1.890), chest (OR = 3.191), head (OR = 3.878), and abdomen (OR = 2.966). Although the statistical model performed similar to observed rates, it performed considerably better than NFTDS (UT = 1.93% *versus* 9.03%; OT = 66.42% *versus* 87.52%) and state guidelines (UT = 2.18% *versus* 8.72%; OT = 64.09% *versus* 86.52%).

Conclusions: The current NFTDS and state's triage guidelines do not appear to achieve the ACS recommendation of <5% UT and <35% OT rates in the state of Ohio. Inclusion of region-specific factors may help enhance the current NFTDS guidelines and aid in the first impression or judgment of the Emergency Medical Services personnel to improve trauma care and reduce cost.

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Introduction

The question regarding trauma triage and system utilization is a complex problem that the current literature does not address effectively.[1] Previous studies have shown that improved prehospital triage methods are required to enhance trauma patient care and resource utilization. A variety of methods and scores exist in the current literature for triaging trauma patients.[1-3] However, the development of triage methods in the trauma system remains a difficult problem for most states. Consequently, the American College of Surgeons (ACS) had proposed the National Field Triage Decision Scheme (NFTDS), which was originally based largely on expert opinion.[4] The guidelines have since been revised several times to incorporate updated science and expert opinion.[5-7] The NFTDS guidelines set the benchmark of acceptable range of undertriage (UT) rates (i.e., transporting severely injured patients to a level 3/4/5 or nontrauma center [NTC]) as <5% and overtriage (OT) errors (i.e., transporting less injured patients to major trauma centers, such as a level 1 or 2) as 25%-35% for optimal trauma triage and system utilization.[7] Attempts have been made to evaluate the efficacy of NFTDS previously for trauma patients.[8-10]

Although the NFTDS guidelines have been widely adapted by many trauma centers in the nation, many regional and local guidelines also exist for trauma triage. A comparison, however, of the state and/or local guidelines with the NFTDS to identify the optimal performance criteria to minimize UT and OT rates is lacking. Further, there may exist readily available on-field patient-specific criteria that may aid in enhancing the sensitivity and specificity of a triage guideline or protocol that may aid in the Emergency Medical Services (EMS) triage decision-making process.

The primary objective of this study was to calculate UT and OT rates in the state of Ohio and compare it with the rates obtained via NFTDS or state guidelines were in use during that time period. We also developed a new model that incorporated state-specific clinical- and system-level factors to minimize UT and OT rates and evaluated it against the two guidelines.

Methods

Study design and data collection

We obtained 6796 de-identified patient records for 2008-2012 from the Ohio Department of Public Safety. This data set was derived from EMS Incident Reporting System-2 (EMSIRS-2) database that was merged with the state's Trauma Registry. In the state of Ohio, the trauma centers are designated as level 1, 2, or 3 per ACS verification standards mentioned in their reference book.[7] Injury Severity Score (ISS) method was used to identify triage errors. For example, UT rate was defined as the percentage of patients with serious injuries (ISS >15) who were *not* transported to a major trauma center (instead were transported to a level 3 or NTC) and was calculated as 1 − sensitivity.[8] Similarly, OT rate was defined as the percentage of patients with not-so-serious (minor or moderate) injuries (ISS ≤15) who were transported to a major trauma center (e.g., level 1 or 2) and was calculated as 1-specificity. The study was approved by the Wright State University's Institutional Review Board.

Comparison with national and state guidelines

For national guidelines, we used the 2011 NFTDS developed by the ACS[7] (Appendix A). For the state guidelines, we used the publicly available Ohio Prehospital Trauma Triage Decision Tree (OPTTDT)[11] (Appendix B). We first calculated the UT and OT rates for the state during the 2008-2012 time period, which we refer to as "observed" rates. We then simulated the NFTDS guidelines for each patient record as if this protocol was in use during 2008-2012 and then estimated the corresponding UT and OT rates. We repeated this process for OPTTDT. In simulating both NFTDS and OPTTDT, we matched the data fields in our data set to each criterion in those protocols and used a spreadsheet program to derive the UT and OT rates.

Comparison with a new statistical model

We also built a multiple logistic regression model to identify statistically significant factors that may have affected triage decisions using a derivation-validation approach.[12,13] Accordingly, 61% of the data (n = 2938) were used for derivation and the rest (n = 1819) for validation. The outcome was dichotomous; 1, if L1/L2 was appropriate, and 0, if L3/NTC was appropriate. For each record, the existence of OT or UT was derived by comparing the prediction from the statistical model against what actually transpired at the scene. We then compared and contrasted the NFTDS and OPTTDT with the two rates derived from the statistical model. We also evaluated the tradeoff between UT and OT rates for various threshold probability values.

Results

We identified 4757 patient records out of the original 6796 records, after excluding records with unknown or missing ISS values or clinical factors and secondary transfers. Table 1 describes the characteristics of the study population, where continuous data are summarized as median and interquartile range (IQR), and categorical data as proportions (%). Table 2 summarizes the UT and OT rates corresponding to the observed values from 2008-2012 across 4757 records. It also shows the estimated rates if either the national (NFTDS) or the state (OPTTDT) guidelines were in use during that time.

While the observed UT rate was 17.22%, either of the two guidelines would have resulted in lower rates, 9.09% for NFTDS and 9.57% with OPTTDT; both these were, however, considerably higher than the ACS recommendation of <5%. The corresponding OT rate was substantially higher for both NFTDS (87.45%) and OPTTDT (86.99%) than the observed value (54.04%) as well as the ACS-recommended range of 25%-35%.