A Comparison of a Decision Tree Induction Algorithm with the ACS Guidelines for Trauma Triage

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Abstract
Triage is a key component of trauma care. Unfortunately, mistriage rates remain high. Machine learning techniques have the potential to improve triage. Our experiment showed that while decision tree induction was as accurate as the most widely accepted trauma triage guidelines, they performed differently with respect to over- and undertriage.

Introduction
Triage is the process of matching injured persons with appropriate healthcare resources. Mistrriage has a number of negative consequences including delayed access to care, misallocation of specialized trauma resources, increased health care costs, and increased death and disability.

Numerous triage decision aids exist. However, mistriage rates remain high. We believe that machine learning algorithms can assist in improving triage.

In this poster we present an early step in evaluating this hypothesis – a comparison of the performance of a widely accepted machine learning algorithm, See5[1], to that of a widely accepted trauma triage guideline [2].

Experimental Methodology
Subjects: This is a secondary data analysis from the North Carolina state trauma registry. All adult patients (15 years and older) entered into the state registry between January 1, 2002 and December 31, 2005 with complete prehospital or trauma center records are included.

Outcome Measures: Outcome measures are (1) severe injury as defined by an ISS > 16 or death prior to ICU admission and (2) need for specialized resources as defined by admission to the ICU or OR from the ED.

Statistical Evaluation: Sensitivity, specificity, accuracy, and mistriage rates were compared for ACS and See5 decision trees.

Procedure: After obtaining IRB approval, trauma registry data was reviewed and cleaned to identify patients with complete medical records in either the prehospital or trauma center settings. Of the original 85,067 patients, 23,753 (27.9%) had complete prehospital and 57,539 (67.6%) had complete trauma center records.

ACS Criteria: Each record was classified as either meeting or not meeting an ACS physiological triage criteria (systolic blood pressure, respiratory rate, and Glasgow Coma Scale score). If any of the criteria were met, the patient was classified as meeting ACS triage criteria.

Outcome Criteria: The following three different combinations of the outcome measures were used to determine diagnostic performance for ACS and See5: (1) Admission to ICU, direction admission to the OR from the ED, or death prior to admission to the ICU; (2) Admission to the ICU or death prior to admission to the ICU; and (3) ISS > 15. Three different models (one for each outcome combination) were used to compare ACS criteria to See5.

Results

Prehospital Data (n=27,142)

<table>
<thead>
<tr>
<th>Triage Method</th>
<th>Acc</th>
<th>Sen</th>
<th>Spec</th>
<th>Over-triage</th>
<th>Under-triage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS</td>
<td>.65</td>
<td>.34</td>
<td>.91</td>
<td>25%</td>
<td>38%</td>
</tr>
<tr>
<td>See5</td>
<td>.65</td>
<td>.46</td>
<td>.82</td>
<td>20%</td>
<td>50%</td>
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<tr>
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<td></td>
<td></td>
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<tr>
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<tr>
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<td>.30</td>
<td>.96</td>
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<td>20%</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>See5</td>
<td>.76</td>
<td>.31</td>
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Discussion
Overall, the accuracy of See5 was not significantly different from that of the ACS. There were, however, significant differences in other diagnostic performance measures. Neither method demonstrated overall superiority with regards to accuracy.

Conclusions and Future Work
See5 was as accurate as the ACS guidelines for trauma triage. Improvements in See5 may be achieved through expert-guided feature selection or the inclusion of misclassification costs. The use of additional artificial intelligence algorithms or subgroup discovery techniques may further develop the adaptive trauma triage process.

References
2. Resources for the Optimal Care of Injured Patients. 2006. American College of Surgeons; Chicago.