Cost-Effectiveness of Field Trauma Triage among Injured Adults Served by Emergency Medical Services

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BACKGROUND: The American College of Surgeons Committee on Trauma sets national targets for the accuracy of field trauma triage at ≥95% sensitivity and ≥65% specificity, yet the cost-effectiveness of realizing these goals is unknown. We evaluated the cost-effectiveness of current field trauma triage practices compared with triage strategies consistent with the national targets.

STUDY DESIGN: This was a cost-effectiveness analysis using data from 79,937 injured adults transported by 48 emergency medical services agencies to 105 trauma and nontrauma hospitals in 6 regions of the western United States from 2006 through 2008. Incremental differences in survival, quality-adjusted life years (QALYs), costs, and the incremental cost-effectiveness ratio (costs per QALY gained) were estimated for each triage strategy during a 1-year and lifetime horizon using a decision analytic Markov model. We considered an incremental cost-effectiveness ratio threshold of <$100,000 to be cost-effective.

RESULTS: For these 6 regions, a high-sensitivity triage strategy consistent with national trauma policy (sensitivity 98.6%, specificity 17.1%) would cost $1,317,333 per QALY gained, and current triage practices (sensitivity 87.2%, specificity 64.0%) cost $88,000 per QALY gained, compared with a moderate sensitivity strategy (sensitivity 71.2%, specificity 66.5%). Refining emergency medical services transport patterns by triage status improved cost-effectiveness. At the trauma-system level, a high-sensitivity triage strategy would save 3.7 additional lives per year at a 1-year cost of $8.78 million, and a moderate sensitivity approach would cost 5.2 additional lives and save $781,616 each year.

CONCLUSIONS: A high-sensitivity approach to field triage consistent with national trauma policy is not cost-effective. The most cost-effective approach to field triage appears closely tied to triage specificity and adherence to triage-based emergency medical services transport practices. (J Am Coll Surg 2016;222:1125−1137. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

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Abbreviations and Acronyms

ACS COT = American College of Surgeons Committee on Trauma
EMS = emergency medical services
ICER = incremental cost-effectiveness ratio
ISS = Injury Severity Score
QALY = quality-adjusted life year

Among the 28 million emergency medical services (EMS) responses in the United States each year, the most common clinical condition is traumatic injury.[1] The decision to transport an injured patient to a major trauma center is guided by national field triage guidelines that were initially developed in 1976 by the American College of Surgeons Committee on Trauma (ACS COT) and have been updated periodically, most recently in 2011.[2,3] The triage guidelines are one of the few clinical aspects of out-of-hospital care supported by a national protocol (jointly sponsored and revised by the Centers for Disease Control and Prevention and ACS COT) and have been widely implemented into EMS and trauma systems throughout the United States. Field triage is integral to concentrating seriously injured patients in major trauma centers through the 9-1-1 emergency response system.

Important quality metrics for the triage guidelines include under- and overtriage rates, with national benchmarks set by ACS COT. Undertriage (1-sensitivity) is the proportion of seriously injured patients transported to nontrauma hospitals, a measure of reduced access to care and potentially worse outcomes[4,5] (national target $\leq$5%[6]). Conversely, overtriage (1-specificity) represents the proportion of patients without serious injuries transported to major trauma hospitals, a measure of resource waste and excess cost (national target $\leq$35%[6]). Research suggests that undertriage is as high as 34% and approximately 50% among older adults.[7-12] Revisions to the national guidelines have sought to reduce undertriage without increasing overtriage,[2] although under- and overtriage are inversely related.[13] Achieving the ACS COT benchmark of 5% undertriage would likely result in major increases in overtriage[13] and increased costs.[14] Evaluating the balance between health outcomes and costs among injured patients is important to optimizing the value of trauma systems in a resource- and cost-constrained environment. Because the survival benefit of major trauma centers appears limited to patients with serious injuries,[15-19] transporting low-risk patients to high-resource trauma centers increases costs without clear benefit.[14] Although previous research has demonstrated some of the cost implications related to field triage practices,[14,20] particularly related to differences in the cost of care between different types of hospitals,[14,21-23] there have been no formal cost-effectiveness analyses of field triage.

We sought to evaluate the cost-effectiveness of current US field trauma triage practices compared with the following alternative triage strategies meeting the national policy benchmarks: a high-sensitivity field triage strategy consistent with the $\geq$95% sensitivity target, and a moderate sensitivity approach to field triage that meets the goal for $\geq$65% specificity. We also examined the cost implications of EMS transport patterns related to the guidelines, inter-hospital transfers, and outcome differences between Level I and II trauma centers.

METHODS

Study design and setting

We developed a decision-analytic Markov model to compare the costs and outcomes of current field trauma triage practices in these 6 regions with 2 alternative approaches to field triage meeting national policy benchmarks for sensitivity and specificity (TreeAge Software, Inc). The analytical time frame lasted from the time of 9-1-1 call until death (lifetime horizon). The analysis was conducted from the health system payer's perspective with inclusion of all medical service-related costs, but exclusion of indirect societal costs (eg, transportation cost and productivity loss). We used previously collected data from a multiregion retrospective cohort of 79,937 injured patients 18 years of age or older to determine baseline patient characteristics, diagnostic test values of current triage practices in the regions (based on the national field triage guidelines), EMS transport patterns for triage-positive and triage-negative patients, 2 alternative approaches to field triage (high sensitivity and moderate sensitivity), in-hospital outcomes, and acute care costs. Patients included in the cohort were transported by 48 EMS agencies to 105 hospitals (12 Level I, 5 Level II, 3 Level III, 4 Level IV, 1 Level V, and 80 community and private hospitals) in 6 urban/suburban regions from January 1, 2006 through December 31, 2008. The regions included Portland, OR/Vancouver, WA (4 counties); King County, WA; Sacramento, CA (2 counties); San Francisco, CA; Santa Clara, CA (2 counties); and Denver County, CO. The data collection processes and methods used to construct this cohort have been described previously.[24] Inter-hospital transfers were excluded unless the patient was originally transported by EMS within the defined geographic study regions to a nontrauma hospital and subsequently transferred to a Level I or II hospital. This inclusion strategy allowed us to track all injured patients