# Compliance with Centers for Disease Control and Prevention Field Triage Guidelines in an Established Trauma System

Alexis M Gage, MD, MPH, Neal Traven, PhD, Frederick P Rivara, MD, MPH, Gregory J Jurkovich, MD, FACS, Saman Arbabi, MD, MPH, FACS

**BACKGROUND:** Regionalization of trauma care reduces mortality and has clear guidelines for transport to the highest level of trauma care. Whether prehospital providers follow the CDC triage algorithm remains to be determined.

**STUDY DESIGN:** We performed a 5-year retrospective cohort analysis of linked data from Washington State's Central Region Trauma Registry (CRTR) and King County Emergency Medical Services (KCEMS). Patients were analyzed based on transport to their designated hospital, as determined by geocode mapping, or directly to the level I center (no level II center is available in this region).

**RESULTS:** Of the 12,106 patients in the study, 5,976 (49.4%) were transported directly to a level I center from the scene. Of the remaining 6,130 patients initially transported to level III to V centers, 5,024 (41.5%) remained in the respective level III to V centers and 1,106 (9.1%) were transferred to the level I center. Patients transported directly to a level I center were more likely to be male, younger, have a penetrating injury, lower scene Glasgow Coma Scale (GCS), lower scene blood pressure, and be more severely injured. Level I direct scene transport was significantly less likely for older patients. Compared with patients ages 18 to 45, the adjusted odds ratio for direct transport to the level I center was 0.7 (95% CI 0.59 to 0.83) for patients aged 46 to 55 years; 0.47 (95% CI 0.39 to 0.57) for those 56 to 65 years; 0.28 (95% CI 0.23 to 0.34) for patients 66 to 80 years; and 0.11 (95% CI 0.09 to 0.14) for those older than 81 years.

**CONCLUSIONS:** Prehospital providers follow physiologic, anatomic, and mechanistic parameters in steps 1 to 3 of the CDC field triage guidelines. However, contrary to the special considerations guideline in step 4, older age was associated with transport to the lower level of trauma care in our region. (J Am Coll Surg 2012;215:148–156. © 2012 by the American College of Surgeons)

In 2008, there were approximately 181,000 deaths and 1.8 million people hospitalized in the United States due to injury.[1] To combat this epidemic, trauma systems have been created to provide an organized approach to acutely injured patients.[2] Studies have shown that well-organized systems of trauma care have decreased mortality among all treated trauma patients by 10% to 20%.[3,4]

**Disclosure Information: Nothing to disclose.**

Presented at the Western Surgical Association 119th Scientific Session, Tucson, AZ, November 2011.

Received December 22, 2011; Revised February 19, 2012; Accepted February 20, 2012.

From the Department of Surgery, Harborview Medical Center (Gage, Jurkovich, Arbabi) and Harborview Injury Prevention and Research Center, University of Washington (Traven, Rivara), Seattle, WA.

Correspondence address: Saman Arbabi, MD, MPH, FACS, Harborview Medical Center, 325 9th Avenue, Box 359796, Seattle, WA 98104. email: sarbabi@u.washington.edu

One of the major components of a trauma system is triage and transport by emergency medical services (EMS). At any injury scene, prehospital providers determine which patients are at greatest risk for severe injury, begin medical management, and through a process of field triage, identify the most appropriate facility to which to transport the patient. The decision to transport an injured patient to the most appropriate facility can have a substantial impact on subsequent morbidity and mortality. Receiving care at a level I trauma center vs a nontrauma center can reduce the risk of death of a severely injured person by 25%.[5]

In 2006, to assist with destination transport decisions, the National Expert Panel on Field Triage, convened by the Centers for Disease Control and Prevention (CDC) and the National Highway Traffic Safety Administration, revised an algorithm first published by the American College of Surgeons-Committee on Trauma (ACS-COT) in 1986.[6] The ACS-COT Decision Scheme was revised 3 times





ISSN 1072-7515/12/$36.00
http://dx.doi.org/10.1016/j.jamcollsurg.2012.02.025

**Abbreviations and Acronyms**

AIS = Abbreviated Injury Score
CR = central region
EMS = emergency medical services
GCS = Glasgow Coma Scale
ISS = Injury Severity Score
KCEMS = King County Emergency Medical Services

(1990, 1993, 1999).[7-9] The most current 2009 Field Decision Scheme (Fig. 1) includes 4 decision steps (physiologic, anatomic, mechanism of injury, and special considerations) to help prehospital providers determine the most appropriate facility to care for the injured patient.[10]

Washington State has had an inclusive trauma system for more than 20 years based on the Statewide Emergency Services Act of 1990 (RCW 70.168). The Central Region, 1 of 8 trauma regions in the state, has jurisdiction over King County, the state's most populated county, with more than 1.9 million residents and covering 2,134 square miles (890 persons/square mile).[11] Recognizing that geographic and prehospital contextual factors may contribute to which facility an injured patient is ultimately triaged to, geocoding was used to investigate compliance with the 2009 CDC Field Triage guidelines in an established trauma system and to identify what prehospital patient characteristics dictate which trauma patients are transported directly to a level I trauma center, bypassing lower level facilities that may be closer. We hypothesized that prehospital providers in a well-established trauma system would comply with all 4 triage criteria.

## METHODS

We performed a retrospective cohort analysis of 12,106 injured patients in the Central Region (CR) of Washington State. Currently, the CR is served by 17 hospitals, 9 of which have been designated as trauma centers. There is a single level I trauma center, 3 level III trauma centers, 3 level IV trauma centers, and 1 level V trauma center, which provide a limited range of trauma services. There is no level II center in the region. The King County Emergency Medical Services (KCEMS) consists of 30 fire departments providing basic life support service and 6 paramedic agencies that provide advanced life support service in a tiered-response system. Our outcomes of interest were to determine which prehospital characteristics dictate transport to a level I center and whether CDC guidelines for field triage were being followed in an established trauma system. The Washington State Central Region Trauma Registry is a comprehensive record of the inpatient care an injured patient receives in one of the state's trauma hospitals. It contains detailed information about the injuries sustained, therapies delivered, and patient outcomes. However, the CR Trauma Registry does not contain accurate information on the geographic scene of injury location. KCEMS provides a large majority of the prehospital care of the severely injured in the county, and their database contains the incident location in addition to other prehospital information. Unfortunately, patient-identifying information is often not accurate for severely injured patients transported by EMS, and a unique consistent number or identifier does not exist to directly link a patient's EMS records with trauma registry records. To overcome this problem, the Washington State CR Trauma Registry was first used to identify all patients aged 18 or older, who were injured in King County, were assessed in the field by prehospital providers, and were transported by ambulance to a CR trauma hospital between January 1, 2004 and December 31, 2008 (Fig. 2). The patients identified in the CR registry were matched to patients in the King County EMS database using probabilistic linkage and the key identifiers of incident date, time, age, birth date, name, destination, and mechanism. Probabilistic linkage has been used successfully in similar scenarios linking trauma registries with other datasets.[12,13] Missing, incomplete, and duplicate records were identified from the database and excluded. The incident location of matched records were then geocoded (ArcGIS v9.3) to longitudinal and latitudinal coordinates.[14] A series of geocoded maps were then produced to geographically illustrate the distribution of injury locations and transport destinations across the study region. Based on proximity, specific catchment areas were defined for each trauma center. Patients were geocoded into 2 distinct cohorts: patients transported directly to a level I center (represented by black dots) and those transported to a level III to V center (centers represented each by a different colored dot) who then may have gone on to receive care at the lower level center or may have been ultimately transferred to the level I center.

Because the decision to triage to a level I center might depend on several patient characteristics that could confound the relationship between trauma center level and transport destination, stepwise multiple logistic regression analyses using the backwards method were performed to examine predictors of transport decisions. Data were analyzed using Stata version 11.0. Variables were selected for inclusion in the models based on clinical relevance and availability. As a preliminary step, we conducted univariate logistic regressions of the dependent variables on each individual predictor variable. Factors included in the regression model were age, sex, mechanism of injury, intubation at the scene, distance from the level I center, scene Glasgow