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# Which transfers can we avoid: Multi-state analysis of factors associated with discharge home without procedure after ED to ED transfer for traumatic injury

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ABSTRACT

*Objective:* Among injured patients transferred from one emergency department (ED) to another, we determined factors associated with being discharged from the second ED without procedures, or admission or observation.
*Methods:* We analyzed all patients with injury diagnosis codes transferred between two EDs in the 2011 Healthcare Utilization Project State Emergency Department and State Inpatient Databases for 6 states. Multivariable hierarchical logistic regression evaluated the association between patient (demographics and clinical characteristics) and hospital factors, and discharge from the second ED without coded procedures.
*Results:* In 2011, there were a total of 48,160 ED-to-ED injury transfers, half of which (49%) were transferred to non-trauma centers, including 23% with major trauma. A total of 22,011 transfers went to a higher level of care, of which 36% were discharged from the ED without procedures. Relative to torso injuries, discharge without procedures was more likely for patients with soft tissue (OR 6.8, 95%CI 5.6–8.2), head (OR 3.7, 95%CI 3.1–4.6), facial (OR 3.8, 95%CI 3.1–4.7), or hand (OR 3.1, 95%CI 2.6–3.8) injuries. Other factors included Medicaid (OR 1.3, 95%CI 1.2–1.5) or uninsured (OR 1.3, 95%CI 1.2–1.5) status. Treatment at the receiving ED added an additional $2859 on average (95% CI $2750–$2968) per discharged patient to the total charges for injury care, not including the costs of ambulance transport between facilities.
*Conclusion:* Over a third of patients transferred to another ED for traumatic injury are discharged from the second ED without admission, observation, or procedures. Telemedicine consultation with sub-specialists might reduce some of these transfers.



## 1. Introduction

Between 1999 and 2003, the incidence of trauma transfers increased disproportionately to total trauma volumes (34% vs 6%) [1]. While several studies have described variation in transfer patterns for trauma patients [1-13], the reasons for these variations remain unknown, particularly for patients who are later determined to have only minor injuries. Prior authors have examined transfers with low injury severity who are discharged within two days of transfer without undergoing any major operating room procedures [6,8,14,15]. However, these prior studies are limited and paint an incomplete picture since all suffer from at least one of the following limitations: they are single-center [6-8,10] or single-state [4,5,15] and do not capture regional variations in trauma care, they lack data about transferring hospitals and care prior to transfer [4,6-8,10,14], and they do not include patients discharged from the emergency department (ED) prior to admission [2,9,12,14], or consider procedures performed in the ED prior to discharge. Therefore it remains unknown what happens to the majority of trauma transfer patients.

*Abbreviations:* AHA, (American Hospital Association); AIS, (Abbreviated Injury Scale); HCUP, (Healthcare Cost and Utilization Project); ISS, (Injury Severity Scale); SEDD, (State Emergency Department Database); SID, (State Inpatient Database); TIEP, (Trauma Information Exchange Program).

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Research is needed to measure the proportion and types of injured patients that are transferred to another hospital and subsequently discharged without intervention. While some patients may benefit from in-person specialized consultation or observation, when EDs transfer patients with low injury severity that ultimately do not require hospitalization or procedural intervention, it may result in higher costs of care and an additional burden on patients, physicians, and receiving hospitals. Treatment in a trauma center costs $5590 more per patient compared to treatment in a non-trauma center [16], and ambulance transport costs for interfacility trauma transfer average $1863 per patient [10]. The evaluation of all trauma patients, even those ultimately found to have minor injuries, diverts ED staff and resources, increasing wait times and morbidity for other patients in the ED during a trauma activation [17,18].

Our primary objective was to determine the factors associated with discharge home from the second ED without procedures, or observation or admission after trauma transfer. A secondary outcome was the charge for hospital care at the receiving hospital for this population.

## 2. Methods

We conducted a retrospective longitudinal cohort study of injured adult patients who were transferred between hospital EDs in six states in 2011 using data from the Healthcare Cost and Utilization Project (HCUP) State Emergency Department (SEDD) and State Inpatient (SID) Databases of the Agency for Healthcare Research and Quality (AHRQ). These databases track all acute care hospitalizations (SID) and treat-and-release ED visits (SEDD) in a state. We included data from six states—California (CA), Florida (FL), Iowa (IA), Massachusetts (MA), New York (NY), and Utah (UT). These states were chosen because they report *VisitLink*, a unique de-identified code which allows the tracking of patients across HCUP databases within a state [19]. Since this data is publicly available, the study underwent expedited review by the IRB.

We identified all patients ages 15 and above (referred to as 'adults' in this manuscript since many adult trauma hospitals will admit patients older than 14) who presented primarily to an ED with previously validated ICD-9 diagnosis codes for traumatic injury [14]. Patients who died in the ED after transfer and who were transferred a second time from the receiving hospital were excluded, as were patients from 39 receiving hospitals that did not report any procedure codes. Transfers were identified based on a disposition of "transfer to short-term hospital" from the first encounter in the SEDD followed by an encounter originating in the ED in a different hospital within one day of the first ED arrival in the SEDD (if the patient was discharged from the receiving ED without admission) or SID (if the patient was admitted to the receiving hospital). These two records were linked using *VisitLink* to create a continuous episode of care.

For our primary analyses, we only included patients who were transferred to a higher level of care, as other types of transfer are more likely to be driven by patient preferences, insurance, and health system factors [2]. Therefore in these analyses we excluded transfers to non-trauma centers (Level 4 or undesignated) and transfers to a lower level of care (for example, from a Level 1 to Level 2 or undesignated trauma center).

The primary outcome of interest was a disposition of discharge from the receiving hospital ED without a therapeutic procedure performed there after transfer ("discharge without procedures") (Fig. 1). Therapeutic procedures were coded in HCUP and included laceration repair, wound care, fracture management such as reduction, casting, or splinting, critical care procedures such as intubation, mechanical ventilation, or central line and chest tube insertion, and any operations performed in the operating room, but excluded imaging tests, laboratory tests, and medication administration. Patients who had observation services coded at either the transferring or receiving hospital were also excluded from the definition of discharge without procedure.

All patient demographic and injury characteristics were derived from the first visit in SEDD. We tabulated age, sex, race, primary payer, and the median household income of the zip code where the patient resided. ICDPIC, a validated software program, was used to map injury diagnosis codes to valid measures of injury mechanism and severity [20,21]. Injury severity included overall Injury Severity Score (ISS), Abbreviated injury scales (AIS) by body region, and pattern of most severe injury. Injury pattern was classified by the Barell injury classification by body region for the most severe injury listed [21]. In cases of patients with two or more injury diagnosis codes with equivalent severity, the first listed was used. Each Barell code was then sequentially assigned to one of nine categories based on the specialist needed to care for it: burns, eye injuries, facial injuries, hand injuries, spine injuries, or head injuries. Contusions, sprains, strains, and lacerations of any body region including the face, hand, head, or back were classified as skin and soft tissue injuries. Major internal abdominothoracic injuries such as pneumothorax, sternal fractures, diaphragmatic injuries, and injuries of the abdominal or pelvic organs were classified as torso injuries.

Hospital characteristics from the 2011 American Hospital Association (AHA) Annual Survey [22] and trauma center designation (Levels 1 through 4 or non-designated) from the 2010 American Trauma Society Trauma Information Exchange Program (TIEP) [23] were matched using the hospital's AHA identification number from the HCUP data. The driving distance and driving time between hospitals was determined based on the two hospitals' geographic latitude and longitude and using the Google Maps Application Programming Interface. We coded hospitals as metropolitan (counties in metro areas), rural-adjacent to metro (counties adjacent to a metro area), or rural (counties not adjacent to a metro area) using the hospital's county and the United States Department of Agriculture (USDA) Economic Research Service Rural-Urban Continuum Codes [14]. Hospital characteristics for the transferring and receiving hospitals included trauma center designation, annual ED visit volume, number of hospital beds, total surgical operations, metropolitan or rural location, teaching status, and total charges for each patient's care.

Descriptive statistics were used to describe the patient, injury, and hospital characteristics of the trauma transfer population, total charges for hospital care, trauma transfer patterns, and the prevalence of different types of injury and procedures. Univariate testing of explanatory variables and the outcome of discharge without procedures was tested by chi-squared or one-way ANOVA for categorical variables and *t*-tests for continuous variables.

We used a multivariable hierarchical logistic regression model to estimate the association between injury pattern and the odds of discharge without procedures adjusted for patient demographics, mechanism of injury, injury severity, and both transferring and receiving hospital characteristics. We modeled random intercepts for the transferring hospital and adjusted for state-level fixed effects. All variables included had <4% missing data. STATA software version 13.1 was used to conduct all analyses. Analytic code is included in Appendix 1.

## 3. Results

After exclusions there were 48,160 injured adult transfer patients (Fig. 1). Most (79.5%) initially presented to a non-trauma center. Of these, 48.7% were then transferred to another non-trauma center (Table 1). Only 77.0% of patients with major injuries and 62.8% of patients with moderate injuries were transferred to a designated Level 1 or 2 trauma center (Table A.1). The rates of discharge from the second ED without procedures varied by state from 28.6% in Utah to 59.3% in Massachusetts (Table A.2).

Our primary analysis cohort consisted of 22,011 transfers to a higher level of care (45.7% of all injured adult transfer patients; Fig. 1). Patients in this cohort were treated at 791 transferring hospitals and 141 receiving hospitals across 6 states. Transferring hospital trauma transfer patient volumes ranged from 1 (36 hospitals) to 214 patients (median

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