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# Nationwide secondary overtriage in level 3 and level 4 trauma centers: are these transfers necessary?

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ARTICLE INFO

*Article history:*
Received 6 February 2016
Received in revised form
29 April 2016
Accepted 18 May 2016
Available online 26 May 2016

*Keywords:*
Secondary overtriage
CT scan
Triage
Trauma system
Transfers
Rural

ABSTRACT

*Background:* Secondary overtriage (SO) refers to the interfacility transfer of trauma patients who are rapidly discharged home without surgical intervention by the receiving institution. SO imposes a financial hardship on patients and strains trauma center resources. Most studies on SO have been conducted from the perspective of the receiving hospital, which is usually a level 1 trauma center. Having previously studied SO from the referring rural hospital's perspective, we sought to identify variables contributing to SO at the national level.

*Methods:* Using data from the 2008-2012 National Trauma Data Bank, we isolated patients transferred to level 1 trauma centers who were: (1) discharged home within 48 h and (2) did not undergo any surgical procedure. This population was subsequently compared with similar patients treated at and discharged directly from level 3 and 4 centers. Multivariate logistic regression analysis was used to isolate variables that independently influenced a patient's risk of undergoing SO. Injury patterns were characterized by use of subspecialty consultants.

*Results:* A total of 99,114 patients met inclusion criteria, of which 13.2% were discharged directly from level 3 or 4 trauma centers, and 86.8% of them were transferred to a level 1 trauma center before discharge. The mean Injury Severity Score of the nontransfer and transfer groups was $5.4 \pm 4.5$ and $7.3 \pm 5.7$, respectively. Multivariate regression analysis showed that Injury Severity Score $> 15$, alcoholism, smoking, drug use, and certain injury patterns involving the head, vertebra, and face were associated with being transferred. In this minimally injured population, factors protective against transfers were: age $> 65$ y, female gender, systolic blood pressure $<80$, a head computed tomography scan and orthopedic injuries.

*Conclusions:* SO results from the complex interplay of variables including patient demographics, facility characteristics, and injury type. The inability to exclude a potentially devastating neurologic injury seems to drive SO.



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http://dx.doi.org/10.1016/j.jss.2016.05.035

## Background

In the ideal trauma system, first responders stratify care such that high-acuity patients are triaged toward tertiary care trauma centers, and those without major injuries are seen locally (primary triage). According to the American College of Surgeons Committee on Trauma, a degree of overtriage (25%-35%) is accepted because undertriage can worsen patient outcomes.[1] Secondary triage occurs not at the scene of injury but in a hospital setting. Secondary overtriage (SO) therefore refers to seemingly unnecessary interfacility transfers of minimally injured trauma patients. Although usually not directly detrimental to the patient, SO imposes financial burdens (on average $5917-$12,549 per patient[2,3]) and shifts resources away from those who truly require trauma center care.[4] The annual cost of trauma care in the United States exceeds $37 billion,[5] and consequently, judicious allocation of trauma resources has become a priority. Various authors have reported SO rates of 6.9%-53%.[2-4,6,7]

Reducing the SO rate necessitates an understanding of the factors that contribute to it. Prior studies have shown that patient demographics, such as age, gender, mechanism of injury, and insurance status may affect transfer decisions and triage accuracy.[2,8-10] Provider experience may also be important, as it has been reported that appropriate triage of trauma patients by emergency room physicians correlates with the volume of moderate to severely injured patients that the physician treats,[11] and case vignette studies have suggested that emergency room physicians may be more likely to undertriage trauma patients than trauma surgeons.[12] Availability of patient care resources, such as neurosurgery services, computed tomography (CT) scanners, residents, and intensive care unit beds at the referring hospital is a third variable that has been reported to affect transfer decisions.[13,14] Thus, it appears that the interplay of patient demographics, injury patterns, and availability of hospital resources may all contribute to SO.

Although various studies have used different criteria to define SO, common elements include a lack of surgical intervention and rapid discharge by the receiving hospital.[2-4,7,15] Recently, we published a study on SO from the perspective of the rural hospitals in our state, namely the level 3 and 4 trauma centers. Most authors calculate SO rates using single-institution databases and some variant of Equation 1 (Fig. 1), which defines the SO rate as the fraction of the total transferred trauma patients who met SO criteria (Fig. 1). These definitions exclude the population of patients treated and discharged from level 3 and 4 trauma centers, however our study includes them in the denominator. We used Equation 2 of Figure 1, which compares minimally injured patients who were transferred from level 3 and 4 trauma centers with minimally injured patients discharged from a level 3 or 4 center (Fig. 1). We believe we were the first ones to directly study the decision these rural hospitals make to transfer a seemingly uninjured patient to a higher level of care.[15] Our calculated SO rate was 9.8% for our rural state.[15]

We observed that certain injury patterns, particularly those involving the head and spine, were associated with transfer to tertiary care centers. Middle of the night arrival times and the need for transfusion were also risk factors for transfer. Notably, CT scans at the initial facility were strongly protective against SO, corroborating a Canadian study which reported that nontrauma centers with CT scanners, in addition to general surgery services, had decreased overall rates of transfer to trauma centers.[13] We sought to confirm that the conclusions we reported within our previous study are applicable at the national level and to explore new factors not previously analyzed. The long-term goal of this research is to facilitate the development of targeted strategies to reduce the SO rate and thereby help alleviate the burden of SO on tertiary center resources and improve patient care.

## Methods

Data from the National Trauma Data Bank (NTDB) were combined across 2008-2012. Inclusion criteria were all trauma patients aged older than 18 y, who were discharged home within

| | *Transferred* | *Not Transferred* |
|---|---|---|
| Did not meet inclusion criteria*<br>*N = 473,081* | A<br>*N=384,730* | B<br>*N=88,351* |
| Met inclusion criteria*<br>*N = 99,114* | C<br>*N = 86,049* | D<br>*N = 13,068* |

* Inclusion criteria: Adult trauma patients discharged home within 48 hours without undergoing a surgical procedure.

**Equation 1: Historical SO Rate Calculation:**

$$SO_{rate} = \frac{C}{C + A}$$

**Equation 2: Alternate SO rate calculation:**

$$SO_{rate} = \frac{C}{C + D}$$

**Fig. 1 – Secondary overtriage rate calculation.**