Secondary Overtriage
The Burden of Unnecessary Interfacility Transfers in a Rural Trauma System

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IMPORTANCE Unnecessary interfacility transfer of minimally injured patients to a level I trauma center (secondary overtriage) can cause inefficient use of resources and personnel within a regional trauma system.

OBJECTIVE To describe the burden of secondary overtriage in a rural trauma system with a single level I trauma center.

DESIGN Retrospective analysis of institutional trauma registry data.

SETTING Dartmouth Hitchcock Medical Center, a rural level I trauma center.

PATIENTS A total of 7793 injured patients evaluated by the trauma service at Dartmouth Hitchcock Medical Center from January 1, 2007, to December 31, 2011.

EXPOSURE Evaluation by the trauma service.

MAIN OUTCOMES AND MEASURES Patients transferred from another hospital to Dartmouth Hitchcock Medical Center who did not require an operation, had an Injury Severity Score lower than 15, and were discharged alive within 48 hours of admission.

RESULTS Of the 7793 evaluated patients, 4796 (62%) were transferred from other facilities. When compared with scene calls (n = 2997), transferred patients had a similar median Injury Severity Score of 9, but 24% of transferred adult patients and 49% of transferred pediatric patients met our definition of secondary overtriage. The overtriaged patients were most likely to have injuries of the head and neck (56%), followed by skin and soft-tissue injuries (41%). Seventy-two unique institutions transferred trauma patients to Dartmouth Hitchcock Medical Center, but 36% of the overtriaged patients were from 5 institutions.

CONCLUSIONS AND RELEVANCE The incidence of secondary overtriage in our rural trauma center is 26%, with head and neck injuries being the most common reason for transfer. Costs for transportation and additional evaluation for such a significant percentage of patients has important resource utilization implications. Effective regionalization of rural trauma care should include methods to limit secondary overtriage.

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Secondary Overtriage

The goal of regional trauma systems is to deliver the appropriate level of care in a timely fashion to injured patients. The American College of Surgeons Advanced Trauma Life Support algorithms call for transfer to verified trauma centers when appropriate, stating that “All those who care for trauma patients must ensure that the level of care never declines from one step to another.” Indeed, several studies suggest that outcomes for trauma patients differ depending on where they receive treatment—a significant reduction in mortality (up to 25%) has been described in severely injured patients who are treated at a level I trauma center. However, other recent reviews have not demonstrated a difference in outcomes for transferred patients.

The Emergency Medical Treatment and Active Labor Act, passed in 1986, mandates that emergency departments evaluate and stabilize any injured patient. Once stabilized, patients must be transferred to a higher-level facility if the initial receiving hospital lacks the resources to provide definitive care. Frequently, patients are transferred to level I trauma centers for nonmedical reasons, and many minimally injured patients could likely have received definitive care at the hospitals where they were initially evaluated. Consequently, a proportion of patients are discharged home shortly after transfer to a level I trauma center from another facility. Not only does secondary overtriage (SO) present a resource-sensitive challenge to level I trauma centers, it also delays definitive care and can be costly and inconvenient for patients and their families.

The extent of SO has been relatively understudied in the trauma literature. One study, confined to a single institution in an urban setting, describes an SO rate of 38%, while a retrospective analysis of the Nationwide Inpatient Sample suggests that only 6.9% of transferred trauma patients were SO. The purposes of our study are to describe the burden of SO on a single level I trauma center in a rural trauma system, to identify the injured body region most likely to prompt transfer of minimally injured patients, and to describe specific interfacility transfer patterns within our regional trauma system.

Methods

Dartmouth Hitchcock Medical Center (DHMC) is an American College of Surgeons Committee on Trauma–designated level I trauma center. Located in rural New Hampshire, DHMC borders on 2 states and receives patients from all counties in both states. It averages 1550 trauma admissions per year.

Data for this study were collected by a retrospective database review of the DHMC trauma registry, Trauma One (Lan cet Technologies), for all trauma patients during the 5-year period from January 1, 2007, to December 31, 2011.

Secondary overtriage was defined as patients transferred from other facilities with an Injury Severity Score (ISS) lower than 15 who had a length of stay shorter than 48 hours and did not require operative intervention.

Data linkage and categorization were performed using Microsoft Access and Excel (Microsoft Corp). Stata version 11 statistical software (StataCorp LP) was used for statistical analysis.

Results

A total of 7793 patients were evaluated by our trauma service during the study period. Of those, 4796 (62%) were transferred from other facilities. Of the 4267 adults transferred, 4058 (95%) were discharged alive. There were 529 pediatric trauma patients (aged <15 years) transferred, of whom 524 (99%) were discharged alive.

When compared with trauma patients brought to DHMC from the scene (n = 2997), transferred patients were similar in age, sex distribution, mean ISS, likelihood of discharge home, and mortality. Injured patients transferred from another facility were more likely to be severely injured (ISS >15) and to have a longer stay in the intensive care unit and hospital (Table 1).

Among the adult patients, 1006 (24%) met our definition of SO. Two hundred fifty-eight (49%) of the transferred pediatric trauma patients met the definition (Figure). Two hundred sixteen patients (191 adults and 25 children) were discharged home from the emergency department. Half of the SO patients arrived on a weekend (Friday, Saturday, or Sunday), and 62% arrived at night (between 18:00 and 06:00) (Table 2). Ninety-one percent were transferred by ground and 8% by air (compared with 76% by ground and 24% by air in the non-vertriaged transfers).

The SO patients were most likely to have injuries of the head and neck (56%), followed by skin and soft-tissue inju-

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Scene Calls (n = 2997)</th>
<th>Interfacility Transfers (n = 4796)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>47.5 (25.8)</td>
<td>47.7 (26.1)</td>
<td>.62</td>
</tr>
<tr>
<td>Male, No. (%)</td>
<td>1776 (59)</td>
<td>3096 (64)</td>
<td>.99</td>
</tr>
<tr>
<td>ISS, mean (SD)</td>
<td>10.6 (9.6)</td>
<td>11.7 (8.7)</td>
<td>.99</td>
</tr>
<tr>
<td>ISS &gt;15, No. (%)</td>
<td>707 (25)</td>
<td>1463 (32)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICU admission, No. (%)</td>
<td>414 (14)</td>
<td>849 (18)</td>
<td>.03</td>
</tr>
<tr>
<td>Discharged home, No. (%)</td>
<td>1941 (65)</td>
<td>3184 (66)</td>
<td>.83</td>
</tr>
<tr>
<td>LOS, mean (95% CI), d</td>
<td>5.2 (5.0-5.5)</td>
<td>5.8 (5.6-6.1)</td>
<td>.001</td>
</tr>
<tr>
<td>LOS &lt;48 h, No. (%)</td>
<td>1387 (46)</td>
<td>1911 (40)</td>
<td>&lt;.001</td>
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<tr>
<td>Death, No. (%)</td>
<td>140 (5)</td>
<td>214 (5)</td>
<td>.35</td>
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Abbreviations: ICU, intensive care unit; ISS, Injury Severity Score; LOS, length of stay.
ries (41%) and extremity injuries (25%). Almost one-third (31%) were found to have a “serious” injury, as measured by an Abbreviated Injury Scale score of 3 or higher (Table 3). Most (86%) of the SO patients were found to have single-system injuries. Head and neck injuries accounted for 59% of these; in 30 adults and 18 children, the only identified injury was concussion. Other single-system injuries most likely to be identified in SO patients were extremity injuries (18%) and external and soft-tissue injuries (11%). Concordantly, 22% of these patients were admitted to the neurosurgery service and 14% were admitted to orthopedic surgery; 61% were admitted to the trauma service.

Injured patients were transferred to DHMC from 72 unique institutions, ranging in size from 6 to 330 beds. The distance from these transferring facilities to DHMC ranged from 3 to 125 miles. More than one-third (36%) of SO patients were sent from 5 outside hospitals. Two of these were Critical Access Hospitals and 2 were level III trauma centers. While 1 was staffed by physician’s assistants full time, the other 4 were staffed by MDs. All 5 of these institutions have general surgeons available, and 4 of the 5 have orthopedic coverage; none, however, have neurosurgery or plastic surgery. Three of the 5 use distance radiology services in addition to on-site radiologists for interpretation of imaging. The average distance of these 5 centers was 80 km from DHMC (Table 4). The other 64% of SO patients were transferred from 67 different institutions.

The mean (SD) charge for the hospital stay per patient meeting the definition of SO was $9206.53 ($7257.76). For trauma patients transferred to the level I trauma center who were not considered SO, the mean (SD) charge per hospital stay was $28 599.47 ($49 019.93). When compared with other transferred trauma patients, patients who met the criteria for SO were more likely to have Medicaid (10% vs 16%, respectively; \( P < .001 \)) and less likely to have Medicare (35% vs 17%, respectively; \( P < .001 \)). The SO population compared with the non-SO population was also more likely to be covered by Blue Cross/Blue Shield (20% vs 15%, respectively; \( P = .01 \)), and the increased number of self-pay patients only reached borderline statistical significance (9% vs 7%, respectively; \( P = .049 \)) (Table 5).

<table>
<thead>
<tr>
<th>Table 2. Day and Time of Arrival at Level I Trauma Center for Secondarily Overtriaged Patients</th>
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<tr>
<td><strong>Day or Time</strong></td>
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<td><strong>Day of week</strong></td>
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<td>12:00-14:59</td>
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<td>15:00-17:59</td>
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<td>18:00-20:59</td>
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<td>21:00-23:59</td>
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IFT indicates interfacility transfer; ISS, Injury Severity Score; LOS, length of stay; and OR, operating room.
Our study demonstrates that 24% of injured adults and 49% of injured children transferred to our level I trauma center from another facility are minimally injured, do not require operative intervention, and are discharged home from our facility within 48 hours.

The goal undertriage rate within a trauma system is 0% to 5%; to achieve these rates, an overtriage level of 25% to 50% is acceptable, according to the recommendations of the National Expert Panel on Field Triage. However, these recommendations refer to field triage, not interfacility transfer. The optimal SO rates have not been well described. In the retrospective cohort analysis by Newgard et al, 10 176 trauma patients were included, 3785 of whom were transferred to a tertiary hospital. After adjusting for injury severity, they found that the transferred patients had a reduction in in-hospital mortality (odds ratio = 0.67; 95% CI, 0.48-0.94) when compared with those who stayed at the original admitting facility. On the other hand, the meta-analysis by Hill et al, which reviewed 36 observational studies, demonstrated no statistically significant difference in mortality between scene and transferred patients.

Our SO rate of 26% is less than the 38% described in the urban setting by Ciesla et al. 10 This retrospective cohort study included 9064 patients evaluated by the trauma service at an urban level I trauma center in a region without a regional trauma system. Their criteria for SO were discharge home within 48 hours, no operative intervention, and ISS less than 10. In the retrospective analysis of the Nationwide Inpatient Sample by Osen et al, only 6.4% of patients (3291 of 51,278)
were considered as SO (defined by discharge home ≤1 day of transfer and no surgical procedure received). They suggest that this disparate result from the finding by Ciesla and colleagues could be explained by the fact that the Nationwide Inpatient Sample includes transfers to trauma centers of all levels, and the rates of SO would be higher when reported by a level I trauma center.

The significantly higher rate of SO in our pediatric population is consistent with previously reported findings. Although the overall percentages were lower, the review by Osen et al.11 of the Nationwide Inpatient Sample also identified a much higher incidence of pediatric SO (19.5% for pediatric patients vs 4.2% for adults). Osen and colleagues suggest that this reflects a deficiency of appropriate resources to care for pediatric patients. Other authors have demonstrated better outcomes for injured children who are treated at a pediatric trauma center or an adult trauma center with added qualifications to treat children. In a retrospective analysis of 13,351 children, Potoka et al.12 report statistically significant overall survival in injured children treated at a pediatric trauma center or an adult trauma center with added qualifications to treat children (3.6% and 4.3% mortality, respectively, compared with 8.0% at level I adult trauma centers; \( P = .001 \)). In the same review, they also demonstrated statistically significantly better outcomes for head, spleen, and liver injuries for children treated at a pediatric trauma center compared with all other centers, including adult trauma centers with added qualifications to treat children. This was attributed to more aggressive neurosurgical intervention and more frequent nonoperative management of liver and spleen trauma. Because children fare better at pediatric trauma centers, a higher rate of SO for children is acceptable.

In our study, the majority of SO patients had head and neck injuries (56%), skin and soft-tissue injuries (41%), or extremity injuries (25%). In the report by Ciesla et al.,43 43% had skin and soft-tissue injuries, 23% had face injuries, 18% had head and neck injuries, and 14% had extremity injuries. Presumably, patients with these injury patterns were transferred because of lack of availability of specialists (ie, neurosurgeons, plastic surgeons, and orthopedic surgeons), but the large percentage of transferred patients with skin and soft-tissue injuries cannot easily be explained by the need for specialist care. Even for patients who may need neurosurgical evaluation, the literature suggests that this can be done safely remotely. In a retrospective review of 865 patients with mild to moderate head injury and positive computed tomographic scan findings, Fabbri et al.13 demonstrated that patients can be safely observed at outside hospitals after a teleradiology consult by a neurosurgeon. Only 6% of patients (43 of 713) who were observed at a hospital without neurosurgeons immediately available went on to require transfer for operative intervention, and just 10% of those had unfavorable outcomes. This was not statistically different from patients who were observed in a neurosurgical unit. Similarly, Carlson et al.14 demonstrated that very few patients transferred to a level I trauma center for neurosurgical evaluation of mild traumatic brain injury ultimately require an operation. Of 292 patients, 15 (5.1%) were found to have a surgical lesion on the first head computed tomographic scan, and only 4 (1.4%) had clinical or radiographic deterioration requiring delayed surgical intervention. Consequently, Carlson and colleagues also propose remote teleradiology triage by neurosurgeons prior to interfacility transfer.

While the transferring facilities varied considerably with respect to size and distance from DHMC, 5 facilities were responsible for more than one-third of the SO patients. Ciesla et al.40 also identified a small number of facilities responsible for most of the SO to their center: of 60 unique referring facilities, 9 were responsible for 83% of all transfers. In a review of 10,176 trauma patients, Newgard et al.25 found that the non-tertiary care hospital of initial presentation is the greater predictor of whether a trauma patient is transferred. They also reported more than a 100-fold difference in the adjusted odds of transfer between same-level hospitals, suggesting that the decision to transfer is likely based on factors other than lack of resources. Several such nonmedical factors have been described, including age, race, sex, insurance status, intoxication, presence of comorbidities, and time of presentation.23,25 In our data set, there was a trend toward transfer of SO patients on weekends and at night. Insurance status did not seem to be a major factor. Other alternative reasons for transfer were not fully analyzed in our study.

We acknowledge several limitations to this study. We do not know how many total trauma patients were evaluated at the 72 transferring facilities and therefore are unable to comment on the percentage of injured patients who were not transferred. Additionally, we do not have information about how much workup was done at the referring facility. Consequently, we are unable to analyze a discrepancy between diagnoses at an outside facility compared with final lists of injuries identified at our institution.

Second, as previously discussed, we do not have information about the specific reason for transfer. While we did demonstrate that the head/neck was the most commonly injured system in transferred patients, we do not have complete information about the availability of neurosurgeons at the outside institutions to correlate with the need for transfer. We do know that neurosurgery coverage was not available at the 5 institutions most frequently transferring SO patients.

Finally, we are reporting findings from a database and consequently are unable to account for unknown confounding factors. We are relying on the data entry to reflect accurate determinations of factors such as ISS and number of systems injured.

In conclusion, a significant number of injured patients who are transferred to our rural level I trauma center are minimally injured, do not require surgical intervention, and have less than a 48-hour length of stay. Many of these patients could likely be safely treated in the hospitals of initial presentation. However, it is especially challenging to avoid potentially unnecessary transfers in the rural setting given the lack of resources in Critical Access Hospitals and other small hospitals. Improved collaboration between level I trauma centers and their referring hospitals, including teleradiology triage by neurosurgeons and orthopedic surgeons and telephone or video
conferencing consultation between pediatric and adult trauma surgeons, may alleviate some of this SO burden. Level I trauma centers may in fact lose income if they do not receive these less complex trauma patients. However, despite this theoretical financial threat to level I trauma centers, transporting patients and redundant workups are costly to the system as a whole. Particularly in light of the pending shift to an accountable care organization model, we believe that level I trauma centers should lead their regions in delivering safe, efficient, and cost-effective care to injured patients.

ARTICLE INFORMATION

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Acquisition of data: von Recklinghausen and Fulton.
Analysis and interpretation of data: All authors.
Drafting of the manuscript: Sorensen, Fulton, and Burchard.
Critical revision of the manuscript for important intellectual content: Sorensen, von Recklinghausen, and Burchard.
Statistical analysis: Sorensen and von Recklinghausen.
Administrative, technical, and material support: von Recklinghausen and Fulton.
Study supervision: Burchard.

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REFERENCES