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Secondary Overtriage in a Statewide Rural Trauma System

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Abstract

Background—Rural hospitals have variable degrees of involvement within the nationwide trauma system because of differences in resources and operational goals. “Secondary overtriage” refers to the patient who is discharged home shortly after being transferred from another hospital. An analysis of these occurrences is useful to determine the efficiency of the trauma system as a whole.

Materials and methods—Data was extracted from a statewide trauma registry from 2007–2012 to include those who were: 1) discharged home within 48h of arrival, and 2) did not undergo a surgical procedure. We then identified those who arrived as a transfer prior to being discharged (secondary overtriage) from those who arrived from the scene. Factors associated with transfers were analyzed using a logistic regression. Injuries were classified based on the need of a specific consultant. Time of arrival to ED was analyzed using 8-hour blocks, with the 7AM–3PM block as reference.

Results—19,319 patients fit our inclusion criteria of which 1,897 (9.8%) arrived as transfers. Descriptive analysis showed a number of differences between transfers and non-transfers due to

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our large sample size. Thus, we examined variables that had more clinical significance using logistic regression controlling for age, ISS, the type of injury, blood products given, the time of arrival to initial ER, and whether a CT scan was obtained initially. Factors associated with being transferred were ISS>15, transfusion of PRBC's, graveyard-shift arrivals, and neurosurgical, spine, and facial injuries. Patients having a CT scan were less likely to be transferred.

Conclusions—Secondary overtriage may result from the hospital's limited resources. Some of these limitations are the availability of surgical specialists, blood products, and overall coverage during the "graveyard-shift." More liberal use of the CT scan may prevent unnecessary transfers.

Keywords

secondary overtriage; CT scan; triage; trauma system; transfers; rural

Background

Rural hospitals are often the initial receiving facility for trauma patients, yet they have different degrees of involvement within the nationwide trauma system. This variability is due to the hospital's infrastructure, human resources, and operational goals. In a regionalized trauma system, efficient allocation of resources is achieved through judicious centralization of resources [1]. Level one trauma centers serve as regional referral hospitals with the resources and commitment to care for the severely injured trauma patients, yet they do not see the entire trauma population of one particular region. It is often the rural hospital's role to stabilize and triage trauma patients, a practice that is not only necessary but safe. Studies have shown that the more severely injured patients benefit from being transferred to a Level 1 trauma center for definitive treatment [2, 3], yet being initially evaluated at non-Level-1 trauma center with a subsequent transfer to one did not appear to negatively impact clinical outcome [4, 5].

The Emergency Medical Treatment and Active Labor Act (EMTALA) regulates the inter-hospital transfers whereby the initial hospital is required to stabilize prior to transfer. It also stipulates that regional tertiary referral centers may not refuse to accept the transfer of patients provided they are able to provide the care needed. However, transfers have the potential of overwhelming these regional tertiary referral centers, diverting resources from the more severely injured [6, 7]. The optimal trauma system would allow for those with mild injuries to be treated at the initial facility, while only the more severely injured patients or those requiring specialized services would be transferred to a higher level of care. However reality may be that other non-medical factors influence the decision to transfer [8].

"Secondary overtriage" is a term that has been used to describe when a patient is discharged home shortly after being transferred from another hospital. These are potentially unnecessary transfers and an analysis of these occurrences is useful to determine the efficiency of the trauma system as a whole. Few studies have addressed this phenomenon, with reported secondary overtriage rates between 39% and 6.9% [1, 9–11]. However, there has been little consensus in the methodologies and definitions for secondary overtriage. Most definitions include a discharge time within 24–48h, with or without limiting the ISS to exclude the more severe injuries, and with or without excluding patients who had an

operation. Most studies have been from single institutions comparing the rate of secondary overtriage using the total number of incoming transfers to that institution as the denominator [1, 9, 10]. An exception to the single institution studies was one done by Osen, in which selected all transferred trauma patients from the National Inpatient Sample, and they found the secondary overtriage rate to be 6.9% [11]. The only similarity between these definitions for secondary overtriage was that they all used the transfer population as a denominator.

None of the studies we encountered examined the minimally injured population that is seen and treated at the initial receiving facility and gets discharged home. We intend to focus on this population because we believe that comparing them to those who end up transferred will yield new insight into the rate and the reasons for transfer. Particularly important in the rural setting, we believe that studying this population will help understand the capabilities of the non-tertiary referral hospitals and their contributions to the trauma system as a whole. To our knowledge no study has compared the secondary overtriage population to those who don't get transferred and are discharged directly from the initial facility.

Methods

The statewide West Virginia trauma registry contains data from all state designated ACS Levels 1, 2, 3 and 4 trauma centers. Adult trauma patients over the age of 18 seen at a West Virginia trauma center between years 2012–2007 at a non-Level-one trauma center were identified if they met the following inclusion criteria: 1) they were discharged home within 48h, 2) did not undergo a surgical procedure. Patients who came from or were discharged to a SNF, a nursing home, or a rehabilitation facility were excluded. This population was further divided into those who were discharged from the initial receiving facility and those who were transferred prior to their discharge from the accepting facility. Data points queried included (from both transferring/accepting facilities if transferred): age, gender, race/ethnicity, Injury Severity Score (ISS), SBP, HR, temperature, GCS, detection of blood alcohol, transfusion of blood products, injuries by ICD-9 code, mechanism of injury, time of day, day of week, month, imaging studies obtained at referring/accepting facilities, time to transport, and procedures performed. Injuries were further divided based on whether a specific consultant was required for evaluation and treatment and included: Neurosurgical, Orthopedic, Spine, Facial, and all remaining injuries categorized as "Other". Time of arrival to ED was categorized into 8-hour blocks: Morning (7AM to <3PM), Afternoon (3PM to <11PM), and Night (11PM to <7AM). Comparison between those who were transferred and those who were not transferred was performed to identify differences between the two groups. Clinically important factors associated with transfers were analyzed using a logistic regression controlling for age, ISS, the type of injury, blood products given, the time of arrival to initial ER, and whether a CT scan was obtained initially.

All variables were compared between those transferred and not transferred using either Chi Square tests for association or two-sample t-tests. A multivariable logistic regression was performed to calculate the odds of being transferred for each variable controlling for all others. All analyses were performed in SAS 9.4.

Results

A total of 23,760 trauma patients were seen in a state designated ACS Level 1, 2, 3 or 4 trauma center for their initial presentation who fit our inclusion criteria, of which 19,319 were adults and 4,441 were <18 years old. Of the adults, 1,897 (9.8%) adult trauma patients were transferred (Figure 1). The majority of the transfers came from a rural Level 3 or Level 4 Trauma Center (96.5%). Although the majority of the transfers came by ambulance (87%), some came by helicopter (10%). Descriptive analysis showed a number of statistically significant differences between adults who were transferred and those who were not transferred due to our large sample size (Table 1).

Mean Injury Severity Score (ISS) was higher in transfers (6.6 ± 5 vs. 3.8 ± 3.4 non-transfers; $p < 0.0001$), and there was also a higher proportion of transfers with an ISS > 15 , (7.7% vs. 1.7% non-transfers; $p < 0.0001$). There were no differences in mean systolic blood pressure (SBP) measured at the scene, incidence of hypotension (SBP < 90) or mean weight between the two groups. Although the lower Mean SBP measured at the initial ED for those transferred was statistically significantly, this small difference is not clinically significant (140.2 ± 23.4 vs. 138.3 ± 21.3 ; $p < 0.0007$). The use of blood products in this population was uncommon, but those who were transferred were more likely to received blood products (1.4% vs. 0.4%, $p < 0.0001$), including packed red blood cells (1.1% vs. 0.3%, $p < 0.0001$), fresh frozen plasma (4% vs. 0.1%, $p < 0.005$), and platelets (0.03% vs 1.0%, $p < 0.001$). Those transferred were also more likely to have a detectable alcohol level (61.7% vs. 52.8%; $p < 0.0001$) but less likely to have had any CT scan done at the initial facility (44.7% vs. 53.0%; $p < 0.0001$).

Transferred patients were more likely to have sustained penetrating injuries (4.5% non-transfers vs. 6.5% transfers) and burn injuries (1.4% non-transfers vs. 4.7% transfers), whereas those discharged home from the initial facility without a transfer were more likely to sustain blunt injuries and injuries from anoxia ($p < 0.0001$). Reflecting our state's racial composition, most patients were white. There were small but statistically significant differences ($p < 0.001$) in race. Although most injuries did not occur at work, there was a slightly higher proportion of patients transferred who suffered the injury at work (5.2% vs. 4.8%, $p < 0.001$).

Although most of the injuries were sustained during the morning, which spanned between 7AM to before 3PM, most ED visits occurred in the afternoon 3PM to before 11PM. Those who were transferred were more likely to sustain the injuries during the morning (50.6% vs 39.0% non-transfers) and less likely to sustain it during the afternoon or night ($p < 0.0001$). However, those transferred were most likely to arrive to the initial Emergency Room during the late night shifts between 11PM to before 7AM (56.8% vs. 18.9% non-transfers, $p < 0.0001$) [Table 2]. Saturdays and Sundays were the busiest days for admissions, but most transferred patients were seen on Sunday and Monday. Summer months were in general the busiest months, and there were no differences in transfer rate between months.

Most injuries were considered manageable by a general surgeon and those that did not were classified based on which specialist consultant was required for its treatment. The consultant

categories included neurosurgery, orthopedic surgery, spine surgery, and facial surgery (Table 3). With the exception of orthopedic injuries, the transfer population had a higher proportion of injuries requiring a specialist's consultation. We later used this classification of injuries in our logistic regression. Most patients only required some sort of imaging studies before being discharged. The most common bedside procedures were local wound care followed by orthopedic procedures such as splinting, casting, and tendon repairs. Intubations and transfusions were uncommon in our population (Table 4).

A logistic regression was done using the more clinically significant variables and it showed the major factors associated to being transferred (Table 5). These included an ISS > 15, age > 65, and any blood transfusion. Neurosurgical, spine, and facial injuries were associated to being transferred, but on the other hand, orthopedic injuries were protective for being transferred. Spine injuries had the strongest association to being transferred. Graveyard shift visits to the ED (11PM to before 7AM) were associated to a five-fold likelihood of being transferred (OR 5.41; CI 4.72 – 6.20) compared to the morning shift. Having any CT scan done at the initial hospital was associated with not getting transferred (OR 0.30, CI 0.27 – 0.34).

Discussion

Our rate of secondary overtriage was 9.8%, yet it would not be meaningful to compare our transfer rates with those because of the difference in methodology. Although the literature reports a secondary overtriage rate between 6.9% and 39% [1, 9–11], the denominator previously used contains all transfer patients. The secondary overtriage population was compared to the transfer patients who were considered injured enough to consider the transfer appropriate. Our definition utilizes a different denominator, the minimally injured patient seen at the initial hospital who was not transferred. Thus the patient's we label as secondary overtriage are those who could have been potentially discharged home but were instead transferred to a higher level of care prior to being discharged. There were no other studies in the literature utilizing our definition, which we believe better allows the study of the decision that the treating physician at the initial facility must make of whether to transfer the patient. We confirm the previous finding that the pediatric population seems to be more often overtriaged than the adults [10].

Even though both transfer and non-transfer groups had seemingly minor injuries, the two populations were not equal. The transfer population was more severely injured and were also older, with the latter being potentially associated with having more co-morbidities. Both injury severity and age could be a provide a reason to transfer, yet the transfer population was still discharged in <48h with no surgical intervention. Although the need of any blood products was rare in our population, requiring a transfusion strongly favored the transfer side. This could perhaps be explained by two reasons. First, needing blood products could be a marker for injury severity. Second, many Level 3 and Level 4 hospitals have minimal blood product reserves given that they are rural hospitals with low patient volumes where maintaining such reserves would result in wastage. Therefore, any blood transfusion requirements would promptly trigger a transfer. We believe that smaller hospitals who may not have the resources for sustained transfusion needs, making the appropriate decision

when they transfer patients requiring blood transfusions, as the exact transfusion requirements could not be determined. The prevalence of alcohol in our transfer patients (61.7%) was higher than the ones found in the literature (47%) [12], perhaps indicating a higher incidence of alcohol consumption in the rural population.

Not surprisingly, there was a higher proportion of penetrating injuries in the transfer group, as more of these would require an operative intervention when compared to blunt mechanisms. Of note, Level 4 trauma centers are not required to have surgical capabilities, so anybody requiring a surgical evaluation would likely be transferred. Similarly, burn injury seems to tell the initial clinician that a specialist's evaluation is needed, which may involve a specialized wound care or even a surgical consultation.

The majority of our minimally injured patients only needed some imaging studies prior to discharge. Even though we looked at many bedside procedures, our findings were limited to three categories: local wound care, orthopedic procedures, and intubation. Procedures such as chest tubes would likely have resulted in a hospital stay longer than our 48 hour cutoff. Local wound care and intubation were likely markers of injury severity, and therefore favoring the transfer population. On the other hand, orthopedic procedures such as reductions and splinting were more common in the non-transfer group and seem to be comfortably managed by the rural physician. Overall, orthopedic injuries often present with a mechanism that is isolated to the extremity, and is perceived as less life threatening.

Spine injuries, however, resulted in almost a five-fold likelihood of being transferred. This is particularly surprising because a great majority of spine injuries are stable and can be managed non-operatively or with a brace. One study found that 42% isolated spine injury transfers were found to be inappropriate [13]. Our numbers do not distinguish between isolated spine injuries, so spine injuries could be a marker for other injuries in our population. We believe that in spine, neurosurgical and face injuries, there may be a perceived potential for progression towards a devastating neurological injury which prompts the rural physician to transfer. For isolated mild spine injuries tele-radiology has been suggested as a possible way for a specialist to evaluate a neurologically intact patient who has a spine injury in imaging [13].

Rural emergency departments seem to be best staffed during the day with a five-fold increase of transfers during the evening's "graveyard shift". We could not distinguish whether it was from an increase in the volume of trauma patients or from understaffing during this time. We believe that the protective effect of CT scans against transfers reflects more a practice bias, where once a patient has been identified as a transfer candidate, priority is placed on securing the transportation instead of completing the imaging studies at the referring facility. For those who are not transferred, the CT scan may relieve some of the uncertainty of a missed injury.

Our study has several limitations that arise from its design and the source of its data. First, we intended to look at secondary overtriage from the perspective of the initial facility where the minimally injured patient is seen in order to study the decision to transfer. In doing so, we have excluded the more severely injured patients from our study, a population perhaps

better studied for undertriage. Second, our database only captures patients transferred to a trauma center within the state of West Virginia, so transfers out of state and transfers to non-designated trauma centers were omitted. The numbers omitted, however, are believed to be small given that we have an inclusive system within the state where the all facilities contributing to trauma care do participate in the database. Finally, our data did not contain the level of the trauma center each patient came from and therefore we could not perform additional analysis regarding specific transfer practices of any individual hospital that may have created a bias in our data.

Conclusions

In our rural state, the majority of patients with minimal injuries are discharged from the initial facility where they are first seen. We believe this is the first study done from the rural hospital's perspective, comparing the minimally injured population that gets discharged home to those who were transferred to a higher level of care prior to being discharged. Secondary overtriage may result from the initial hospital's limited resources and operational goals. Some of these limitations are the availability of surgical specialists, blood products, and overall coverage during the "graveyard-shift." Although some of these transfers may seem to be medically unnecessary, they may be the feasible thing to do from a system's standpoint. For example, increasing blood availability at the rural hospitals may result in more wastage, and transferring patients requiring transfusions may be more efficient overall. Other solutions may involve tele-radiology for spine injuries where a specialist's involvement takes place without a transfer. Future studies on how rural hospitals treat specific injuries and manage particular resources may identify opportunities to reduce secondary overtriage.

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Figure 1.

Table 1

Patient Characteristics

	Non-transfer n=17,420 (90.2%)	Transfer n=1,896 (9.8%)	p-value
ISS >=15	292 (1.7%)	146 (7.7%)	<0.0001
ISS Mean $\pm$ (STD)	3.83 $\pm$ 3.4	6.64 $\pm$ 5.0	<0.0001
SBP at scene Mean $\pm$ (STD)	136.8 $\pm$ (22.4)	135.8 $\pm$ (22.1)	0.497
Weight (lbs) Mean $\pm$ (STD)	184.8 $\pm$ (51.8)	184.9 $\pm$ (49.0)	0.9385
SBP at ED Mean $\pm$ (STD)	140.0 $\pm$ (21.2)	138.3 $\pm$ (21.3)	0.0009
SBP < 90	90 (0.5%)	5 (0.3%)	0.1349
Received RBC	54 (0.3%)	21 (1.1%)	<0.0001
Received FFP	20 (0.1%)	7 (0.4%)	0.0049
Platelets	5 (0.03%)	19 (1.0%)	<0.001
Any Blood products	77 (0.4%)	45 (2.4%)	<0.0001
CT scan at initial ED	9367 (53.8%)	964 (50.8%)	0.0152
ETOH Positive	9194 (52.8%)	1170 (61.7%)	<0.0001
Injury Type			<0.0001
Anoxic	58 (0.3%)	2 (0.1%)	
Blunt	16307 (93.6%)	1676 (88.4%)	
Burn	224 (1.3%)	93 (4.9%)	
Penetrating	824 (4.4%)	124 (6.5%)	
Race			<0.0001
White	16626 (95.4%)	1749 (92.3%)	
Black	554 (3.2%)	41 (2.2%)	
Hispanic	88 (0.5%)	3 (0.2%)	
Asian	22 (0.1%)	0 (0.0%)	
Other	53 (0.3%)	9 (0.5%)	
Unknown	68 (0.4%)	94 (5.0%)	
Injured at Work			<0.0001
Yes	998 (5.7%)	138 (7.3%)	
No	15726 (90.3%)	1716 (90.5%)	
Unknown	99 (0.6%)	11 (0.6%)	

Table 2

Time of the day

	Non-Transfers	Transfers
Time of Injury *	N (%)	N (%)
Morning	6797 (39.0%)	958 (50.6%)
Afternoon	4376 (25.1%)	375 (19.8%)
Night	6241 (35.8%)	562 (29.7%)
Time of arrival at ED *		
Morning	5154 (29.6%)	319 (16.9%)
Afternoon	8969 (51.5%)	495 (26.3%)
Night	3287 (18.9%)	1072 (56.8%)

*
p < 0.0001

Table 3

Injuries requiring specialist consultant

Consultant	Non-Transfer	Transfer
Neurosurgery	5677 (32.6%)	864 (45.6%)
Orthopedic Surgery	6744 (38.7%)	535 (28.2%)
Spine Surgery	812 (4.7%)	312 (16.5%)
Facial Surgery	3369 (19.3%)	604 (31.9%)

Table 4

Procedures

Procedure	Total	Non-Transfer	Transfer	P value
Imaging	15339 (79.4%)	13834 (79.4%)	1505 (79.4%)	0.9700
Wound Care: Laceration Repair Local Hemostasis	3377 (17.5%)	2899 (16.6%)	478 (25.2%)	<0.0001
Orthopedic Bedside Procedure	2433 (12.6%)	2278 (13.1%)	155 (8.2%)	<0.0001
Intubation	198 (1.0%)	98 (0.6%)	100 (5.3%)	<0.0001
Transfusion	53 (0.3%)	27 (0.2%)	26 (1.4%)	<0.0001

Table 5

Factors Associated with Secondary Overtriage

Factors	Odds Ratio	95% Confidence Interval
ISS>15	3.63	2.85–4.64
Age > 65	1.20	1.04–1.40
Any Blood Transfusions	4.62	2.99–7.14
Neurosurgical Injuries	1.96	1.75–2.20
Orthopedic Injuries	0.84	0.75–0.94
Vertebral Injuries	4.82	4.11–5.66
Facial Injuries	1.65	1.46–1.87
11pm – 7am Arrival to ED	5.04	4.38–5.80
3pm – 11pm Arrival to ED	0.86	0.74–1.00
CT scan at initial facility	0.30	0.27–0.34