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Filled to the brim: The characteristics of over-triage at a level I trauma center



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ABSTRACT

Background: Interfacility transfers are necessary and valuable for the trauma system, but despite regional guidelines, many patients are inappropriately transferred. We evaluated over-triage at our Level I center and identified risk factors for over-triage.

Methods: Retrospective analysis at our Level I urban trauma center assessed patients transferred from regional facilities during 2017. Over-triage was defined as patients discharged <48 h without procedures. Exclusion criteria were leaving against medical advice or no outside records.

Results: Overall, 2352 patients met criteria. Nine hundred thirty (39.5%) with complete hospital records were discharged in <48 h; 498 (53.5%) received no procedural intervention and 909 (97.7%) were ultimately discharged home.

Conclusion: Many patients are inappropriately transferred to tertiary care centers without a definitive need for advanced services. Studies are needed to improve triage criteria without increasing under-triage.

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Introduction

Nationally, the American College of Surgeons (ACS) Committee on Trauma (COT) recommends “minimizing the time from injury to appropriate definitive care ... [to] have a positive influence on outcome”.¹ As such, the main focus of many regionalized trauma systems is to avoid undertriage, defined as patients with major trauma receiving suboptimal treatment at lower level facilities. However, in creating broader transfer guidelines to avoid such, the rate of over-triage, or the use of unneeded hospital resources on minor trauma, has correspondingly risen. The COT has deemed an

acceptable over-triage rate to be 25%–35% in order to maintain an undertriage rate of less than 5%.² Secondary over-triage transpires not at the scene of injury but at the initial hospital evaluation with an unnecessary transfer to a higher level of hospital care.³

The Metrolina Trauma Advisory Committee (MTAC), the regional RAC in Charlotte, NC, outlines regional criteria for inter-facility trauma transfers to aptly route appropriate patients to a higher level of care. This criterion is based on an initial physiologic presentation and the subsequent assessment and interpretation of results by an emergency room physician. These guidelines were created to expeditiously identify those in need of advanced resources as triage delays are logically associated with increased mortality.^{4,5} In our experience, despite regional guidelines and written agreements, many patients are inappropriately transferred to our Level I trauma center. Therefore, the goal of this study was to evaluate our over-triage occurrences to identify common etiologies and risk factors. We hypothesized that there are identifiable predictors of over-triage and identification of these will allow the authors to restructure and reinforce our triage guidelines to reduce over-triage while maintaining undertriage rates.

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Methods

Patient population

A retrospective analysis was conducted of the trauma registry at our ACS-verified Level I urban trauma center. All patients transferred from 31 regional facilities during 2017 were initially included. Exclusion criteria included leaving against medical advice or lack of outside hospital records. Secondary over-triage was defined as patients discharged in less than 48 h following transfer with a minimal injury burden (ISS<10).⁶ The need for operative intervention was not an exclusion if this was elective rather than emergent and did not require trauma surgeon expertise through retrospective review. Data was collected from the trauma registry and patient medical records. Information collected included baseline demographics, reason for transfer, injuries determined by the Level I trauma center, vitals and laboratory values, and procedures or interventions performed at the trauma center. Admission to the ICU was also documented as there are several subsets of over-triaged patients that are admitted there. In particular, all geriatric patients (age>55 years) are evaluated with the geriatric trauma score and those with very mild injuries may qualify for ICU admission for geriatric evaluation and resuscitation usually for 24 h. Additionally, patients transferred on the ventilator for alcohol intoxication, who once metabolized came off the ventilator quite rapidly, were admitted to the ICU initially. These patients often can be managed at other centers by critical care trained physicians as determined retrospectively by trauma surgeons. Interventions included operative, placement of orthopedic or neurosurgical equipment, and suture or laceration repair. Reasons for transfer were categorized and compared to the MTAC criteria for transfer which include Glasgow Coma Scale (GCS) \leq 13, abnormal or deteriorating CNS, spinal cord injury or neuro deficits, signs of hemodynamic instability, major chest wall injury with pneumothorax or hemothorax, widened mediastinum, suspected intra-abdominal injury, unstable pelvis, penetrating injury to multiple body regions, severe open fractures, and multiple long bone fractures (Appendix A).

Study design and statistical analysis

Patient who were discharged within 48 h of admission with minimal injury burden (over-triage) were compared to the patients who stayed more than 48 h. Patient characteristics were compared using descriptive statistics and univariate analyses including Chi-squared test for categorical outcomes and student's *t*-test for means of continuous data. Continuous variables were reported as mean and standard deviation. Statistical significance was set at two-tailed *p* value < 0.05. Multivariate stepwise logistic regression analysis was performed to adjust for confounding variables based on univariate analysis results and clinically pertinent risk factors, including age, gender, blunt or penetrating injury type, INR, time at referring facility, referring hospital GCS, revised trauma score, and ISS \leq 10. All data were analyzed using Statistical Analysis Software, version 9.4 (SAS Institute, Inc., Cary, NC).

Results

Patient characteristics and outcomes

Two thousand three hundred and fifty-two patients were transferred to the F.H. "Sammy" Ross Jr. Level I Trauma Center in 2017. A total of 80 patients were excluded for no outside hospital records (*n* = 72) or leaving against medical advice (*n* = 8). Of the remaining 2273 patients, 1082 were discharged in less than 48 h

and were evaluated for descriptive and univariate statistics. Of these, 930 of these had complete records and were able to included in the multivariate analysis (41.5%).

Patient characteristics are reported in Table 1. Over-triaged patients had a mean age of 36 years \pm 26.3 years. 35% of over-triaged patients were female, 69.5% were white, and 19.0% were African American. The mechanism of injury was blunt in the majority of cases (87%) versus penetrating (12%). Mechanism of transport included ground ambulance (87.9%), helicopter (7.6%) and private vehicle (4.3%). Forty-four percent of the transfers were activated as trauma codes: 7.7% level I, 19.0% level II, and 17.5% level III. The remaining 56% were seen as trauma consults.

Patient outcomes are reported in Table 2. Disposition of the majority of patients (94.1%) was to home without any home assistance. One hundred and thirty-six of these (12.6%) were discharged home immediately from the emergency department. The majority were first admitted for observation to the hospital floor units (61.2%) prior to discharge. Of those admitted to the intensive care unit, length of stay was 1.7 days \pm 0.56 days and ventilator days was 1.7 days \pm 0.63 days.

Multivariate analysis

After controlling for age, gender, blunt or penetrating injury type, INR, time at referring facility, referring hospital GCS, revised trauma score, and ISS \leq 10, the multivariate analysis did not demonstrate any clinically relevant cut-point that was significant for any transferring hospital variables.

Transfer criteria

Of the 930 patients discharged in less than 48 h, appropriate criteria for transfer were met by only 484 patients with 49.8% transferred for abnormal neurological exams (29.0% of all over-triaged patients) and 22.0% for intra-abdominal injury (Table 3). Table 3 demonstrates the criteria cited for transfer; some patients met multiple criteria.

446 patients (48.0%) did not meet MTAC defined transfer criteria. Cited reasons for these "inappropriate" transfers included subspecialty consultation (72.9%) of which 10.5% were for neurosurgery, 5.4% for ophthalmology, 5.2% for plastic surgery, 0.7% for urology and 50.7% for orthopedic consultation. The orthopedic consultations were primarily for hand injuries (10.1%), supracondylar fractures (16.4%) and extremity injuries (24.2%). Other reasons for transfer included rib fractures (5.2%), suspected vascular injury (4.7%), concern for non-accidental trauma (3.4%), or no transfer rationale (6.1%).

Interventions

Of the 930 patients, 498 patients (53.5%) received no procedural intervention (Table 4). The majority of these patients were observed (34.4%), given follow-up appointments (4.4%), or were transferred for an incorrect reason and subsequently discharged from the emergency department (6.7%). Four hundred and thirty-two patients did receive an intervention (48%) which was either an operation (35.1%) (of which the majority were orthopedic such as supracondylar or femur fracture fixation or laceration repair in the operating room), placement of orthopedic equipment (5.5%), sutures in the emergency department (3.3%), or a spinal brace (2.6%).

Of the 446 patients that did not meet transfer criteria, 136 of them received no procedural intervention (31.0%). Interventions for the remaining 310 inappropriately transferred patients included operative (57.4%), orthopedic splinting (6.5%), neurosurgery bracing

Table 1
Patient characteristics.

	Overtriage No (n = 1269)	Overtriage Yes (n = 1081)	P-value
Age	54 (34–74)	36 (12–57)	<0.0001
Female gender	521 (41.1)	378 (35.0)	0.0025
Race			0.0251
White	926 (73.3)	745 (69.5)	
Black	244 (19.3)	204 (19.0)	
Asian	8 (0.6)	14 (1.3)	
American Indian	14 (1.1)	15 (1.4)	
Other	72 (5.77)	93 (8.7)	
Mechanism of Injury			<0.0001
Blunt	1179 (92.8)	943 (87.2)	
Penetrating	86 (6.8)	128 (11.8)	
Burn	1 (0.1)	2 (0.2)	
Other	4 (0.3)	9 (0.8)	
Method of Transport			<0.0001
Ground Ambulance	1048 (83.0)	940 (87.9)	
Helicopter	211 (16.7)	27.7 (7.6)	
Private Vehicle	2 (0.2)	46 (4.3)	
Trauma Activation			<0.0001
Level 1	219 (17.2)	83 (7.7)	
Level 2	351 (27.6)	206 (19.0)	
Level 3	112 (8.8)	189 (17.5)	
Emergency Department Assessment			
Systolic BP	135 (118–151)	131 (116–144)	0.0002
Diastolic BP	79 (68–88)	77 (68–86)	0.2328
Heart Rate	92 (76–103)	93 (77–104)	0.3722
pH	7.35 (7.30–7.41)	7.36 (7.34–7.41)	<0.0001
Lactate	1.94 (0.97–2.37)	1.78 (0.88–2.02)	0.0002
INR	1.29 (1.0–1.3)	1.52 (1.0–1.2)	<0.0001
ISS	12.91 (8–17)	7.35 (4–9)	<0.0001
Disposition from ED			<0.0001
Floor Admission	562 (44.3)	662 (61.2)	
Observation Unit	29 (2.3)	68 (6.3)	
Operating Room	121 (9.5)	81 (7.5)	
ICU	531 (41.8)	112 (10.4)	
Home Self Care	1 (0.1)	136 (12.6)	
Hospital Disposition			<0.0001
Home Self Care	721 (56.8)	1019 (94.1)	
Home with Services	54 (4.3)	11 (1.0)	
Hospice	31 (2.4)	2 (0.2)	
Long-term Care	8 (0.6)	0 (0.0)	
Skilled Nursing Facility	207 (16.3)	1 (0.1)	

N (%) or median (interquartile range).

Table 2
Hospital patient characteristics.

	Overtriage No (n = 1269)	Overtriage Yes (n = 1081)	P-value
Hospital Disposition			<0.0001
Home Self Care	721 (56.8)	1019 (94.1)	
Home with Services	54 (4.3)	11 (1.0)	
Hospice	31 (2.4)	2 (0.2)	
Long-term Care	8 (0.6)	0 (0.0)	
Skilled Nursing Facility	207 (16.3)	1 (0.1)	
Hospital LOS (days)	7.6 (3–9)	1.2 (1–1)	<0.0001
ICU Days	4.7 (2–5)	1.7 (1–2)	<0.0001
Ventilator Days	5.7 (2–7)	1.7 (1–2)	<0.0001

N (%) or median (interquartile range).

(3.8%), and suture repair (1.1%).

Discussion

It is undeniable that interfacility trauma transfers are necessary; however, patients are routinely transferred to tertiary care centers without a definitive need for their advanced assistance. Over-triage which we define based on prior studies as patients discharged in less than 48 h following transfer with minimal injury burden is considered satisfactory if rates remain less than 35%.^{1,7,8} High rates

of over-triage, although ensuring against under-triage which can infer substantial morbidity and mortality, can impose a significant financial burden upon both the patient and the healthcare system whilst diverting essential resources from those truly in need.^{7,9} Therefore, a judicious triage approach albeit not directly harmful, can indirectly cause resource depletion and insufficient care without improving outcomes.⁹ Literature demonstrates a wide range in secondary over-triage rates from 6.9% to 53% with associated factors including age, gender, drug use, and insurance status.^{3,7,8,10–15} The experience of the transferring physician has also been shown to affect this rate with those employed at higher volume centers less apt to inappropriately triage.¹⁶ Injury pattern can be predictive with increased rates of secondary over-triage in those with neurological or spinal trauma and/or head and neck trauma.^{3,8}

The analysis of our trauma transfers over the past year has highlighted several interesting trends that could allow for improvement in over-triage rates. Our overall over-triage rate was found to be approximately 53.5%. Of the over-triaged patients in 2017, 19.2% required only pain control, simple wound care, or arrangement of follow-up followed by emergency department discharge to home; care that could have been duplicated at referring emergency room locations and did not require a Level I trauma opinion (Table 4). It is more difficult to make that argument for the 34.4% of patients who were admitted for observation as the ability to rule out severe injury and determine non-operative intervention

Table 3
MTAC patient criteria for transfer.

	N	%
CNS	270	29.0%
GCS < or = 13	21 (2.3)	
Abnormal	222 (23.9)	
Deteriorating	3 (0.3)	
Spinal cord injury or neuro deficits	20 (2.2)	
Intubated/RSI	4 (0.4)	
Hemodynamic Status	10	1.1%
BP < 90	3 (0.3)	
HR > 120	6 (0.7)	
BP < 110	1 (0.1)	
SBP < 70 + (2x age in yrs)	0 (0)	
HR < 60	0 (0)	
HR > 160	0 (0)	
Torso	149	16.0%
Major chest wall injury with PXT/HTX	34 (3.7)	
SPO2 < 92%	3 (0.3)	
Cardiac injury	6 (0.7)	
Widened mediastinum	5 (0.5)	
Suspected intra-abdominal injury	98 (10.5)	
Unstable pelvis	3 (0.3)	
Multisystem Injury	73	7.8%
Penetrating injury to 2 or more areas in head/neck/ chest/abd/pelvis	21 (2.3)	
Injury to multiple body regions	52 (5.6)	
Extremities	63	6.8%
Severe open fractures	37 (4.0)	
Multiple long bone fractures	21 (2.3)	
Crushed, degloved, or mangled extremity	5 (0.5)	
Amputation proximal to wrist or ankle	0 (0)	
Burns	1 (0.1)	0.1%

Table 4
Characteristics of over-triaged patients.

(n = 930)	n (%)
No Criteria Met for Transfer	446 (48.0)
Intervention	432 (46.5)
Operative	326 (35.1)
Orthopedic Equipment (cast, collar, splint, sling, boot)	51 (5.5)
Laceration repair in ED	31 (3.3)
TLSO brace	24 (2.6)
No Intervention	498 (53.5)
Observation	320 (34.4)
Follow-up arranged	41 (4.4)
Trauma consult without intervention	37 (4.0)
Incorrect Transfer Reason	62 (6.7)
Child maltreatment coordinator	14 (1.5)
Pain control	11 (1.2)
Other (bandaids, UTI, chest tube removal, IVF, request for no intervention)	13 (1.4)

does often take trauma expertise and experience, albeit this should be available at Level II and III trauma facilities.

Further, of the transfers analyzed, only 49.8% met appropriate MTAC transfer criteria. Therefore, 446 patients did not meet any transfer criteria yet were sent to our Level I center for reasons including subspecialty consultation, presumably because of lack of availability of specialists at the referring facility. At our facility, these transfers are accepted by the emergency room department who use the regional guidelines to direct their responses. Many of these accepted patients simply were given follow-up and did not receive any intervention. In regards to specifically the orthopedic injuries, we analyzed these encounters with an orthopedic trauma surgeon and per expert yet retrospective opinion, many of these patients would have benefitted from a referral or clinic appointment and did not need immediate transfer for services. Operations were often performed out of opportunity and not emergent or

urgent necessity and in fact, most of the isolated injuries may have been able to be managed by community orthopedic surgeons and not required timely trauma expertise or follow-up. This creates significant delays for elective patient cases and compounds upon the frequent lack of beds available for necessary transfers. Further, for patients transferred for neurosurgical evaluation, several studies demonstrate and recommend that patients with mild to moderate head injuries can be safely observed after a teleradiology consult with a neurosurgeon with low risk of deterioration requiring transfer.^{17,18} Therefore, although the over-triage rate of this population was 31.0%, this likely is an underestimate if patients who did not require time sensitive trauma operations were discounted.

Critical awareness of factors that increase the likelihood of over-triage can assist centers in decreasing unnecessary transfers and subsequently the use of unneeded hospital resources to allow for improvement in successful and cost-effective care.

Limitations

There are several limitations to our study based upon its retrospective nature. The amount of total trauma patients seen at the transferring hospitals is not available and as such, the number of injured patients not transferred cannot be evaluated. Further, we lack information regarding the workup and decision making done at the outside facility and their availability of specialists. Additionally, there were 152 patients identified who were transferred but did not have complete records to review their interventions and this data may be missing not at random due to patient or system factors unable to be assessed at this time. Further, there are many different definitions of over-triage and we chose one that we believed was appropriate for our institution. Other definitions however may not include any patients who underwent operative procedures or those admitted to the ICU. After review of each of these encounters, we believe these should be considered over-triaged cases. For instance, we reviewed all of the over-triaged patients who underwent procedures with our trauma surgeons and orthopedic trauma surgeons and, retrospectively, the majority of these patients could have been managed at the referring institution and did not need emergent operations. The ICU admissions can include patients with mild injury admitted solely for geriatric trauma scores or alcohol metabolism.

Conclusion

Our retrospective review demonstrates the considerable burden of over-triage to our Level I trauma center with significant room for improvement in our community's protocols and education as this high rate is not benign. A substantial number of these patients are minimally injured and either do not require the resources for which they are transferred, can be safely managed at the referring hospital, can receive those resources remotely, or are appropriate for follow up as an outpatient in a timely fashion with specialists. This overly cautious approach's subsequent burden is both an economic and social inconvenience to patients and their families and can ultimately pull resources away from those in critical need. Increased communication such as teleradiology conferences and collaboration between Level I trauma centers and the referring hospitals may improve unnecessary transfers.⁷ As Sorenson et al. stated, it is up to 'Level I trauma centers [to] lead their regions in delivering safe, efficient, and cost-effective care to injured patients.'⁸ The authors aim to do such through this information and hope others will follow suit and critically analyze their systems as well.

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Appendix A. Supplementary data

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