

Are Trauma Team Activations Essential and Cost Effective for Rollover Crashes?

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ABSTRACT

Background: Motor vehicle crashes (MVCs) are the leading cause of death for ages 2-34 years. Rollover (RO) is defined as any vehicle rotation of $\geq 90^\circ$ about any longitudinal or lateral axis occurring. The purpose of this study was to determine the cost effectiveness of RO mechanism as the sole triage criteria.

Methods: Detailed patient injury, demographics, costs and crash information were obtained on patients ≥ 16 years and seen at an ACS COT-verified level I trauma center from 2007-2008. Analysis was performed using SPSS v 17.

Results: 257 RO crash occupants were treated at this study center. The frequency of AIS ≥ 2 in these RO occupants was 74%. 62% (133/214) of patients triaged as partial TTA (PTTA) were discharged from the emergency department (ED), whereas all full TTA (FTTA) patients were admitted. 60% of all RO patients were reported to have utilized seat belts. Seat belt use decreased the risk of injury by four-fold (95% CI, 2.14-8.01). No other patient or crash characteristics contributed to this excess triage rate. Based on an average cost of \$6,000/TTA and our excess ED discharge rate exceeding the accepted national average rate of 37%, this trauma center could save \$498,000/year. Applying the same cost analysis to the NASS database could save \$190 million annually to the trauma systems nationally.

Conclusion: Consideration of physiometric data, and seat belt use in the triage of non-critically injured RO occupants could potentially save this trauma center up to \$2.5 million over a

five-year period and approximately \$0.95 billion dollars for the trauma systems nationwide over the same period.

Table 1 . Transport and team activation by type.

ED Triage	PTTA (83%)	FTTA (11%)	Consult (6%)
Transport			
ALS (54%)	60%	32%	26.5%
Air (35%)	31%	68%	26.5%
BLS (11%)	9%	0%	47%

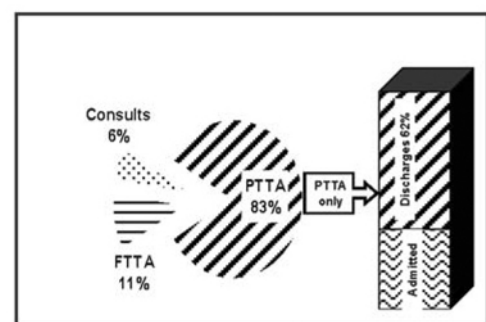


Figure 1. Rollover trauma team activation

INTRODUCTION



Documents

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Table 2. BLS and ALS Dispatch Criteria to Motor Vehicle Crashes

BLS Criteria	ALS Criteria
* Injury crash, no critical criteria or Mechanism * Unknown minor injury * Motorcycle crash, no critical criteria	* Decreased consciousness * Chest pain prior to crash * Unknown injury with the following mechanisms: - Vehicle vs fixed object (moderate to high speed) - Vehicle vs vehicle (head-on, T-bone, moderate to high speed) - Truck vs vehicle - Vehicle vs pedestrian - Vehicle vs motorcycle - Vehicle rollover * Occupant trapped or ejected * Major incident report/multiple casualties

Motor vehicle crashes (MVCs) are the leading cause of death for persons aged 2 to 34 years [1]. McLean et al reported that one-fifth of all MVCs in Australia were rollover crashes [2]. Rollover crashes are well known to cause serious injuries and result in higher medical expenses and insurance claims[2,3]. The total economic cost in the United States from motor vehicle crashes in 2000 was \$230 billion [4]. The comprehensive cost of the injuries and fatalities in rollovers is approximately \$40 billion per year. The frequency of rollover crashes varies by vehicle type ranging from 1.7% in passenger cars and as high as 6.3% for sport utility vehicles resulting in an overall average of 20% of all crashes, but contribute to 33% of the injury costs [2, 5]. The National Highway Traffic Safety Administration (NHTSA) has estimated the probability of death from a rollover MVC to be 2.7% versus 0.2% for a non-rollover crash [6].

Rollover crash characteristics are unique and can lead to a spectrum of injuries from the very serious to the minor. The number of vehicle turns, occupant characteristics and crash environment all contribute to the complexity of these types of crashes and resulting injuries. In 2003, NHTSA reported that 74% of rollover crash occupants sustained minimal or no injuries, 15% had moderate injuries and 10% were severely or fatally injured [7]. Similar findings were seen in a 2005 Australian study, which reported that one-third of rollover crash occupants were hospitalized and about two-thirds of the occupants did not require hospitalization [2].

This study center is an American College of Surgeons Committee on Trauma (ACS COT) certified level I trauma center located in the state of Virginia. Of the 4,252 trauma patients seen during the study period (July 2007-July 2008), 39% (1657) were MVC occupants who were triaged, evaluated and treated at this center. One sixth (257) of these were involved in rollover crashes. The majority (75%) of occupants involved in rollover crashes sustained only minor

injuries which are defined as injuries with an abbreviated injury scale (AIS) ≤ 2 .

When an MVC is reported to the state emergency 9-1-1 system, Emergency Medical Services (EMS) personnel respond with a nationally recognized and accepted two-tier-protocol based on reported injury severity and/or crash type. The EMS dispatchers alert and activate either a Basic Life Support (BLS) or an Advanced Life Support (ALS) ambulance unit or both as necessary as delineated in [table 2](#).

<[table 2](#) here>

Overall, the level of ambulance service dispatched to each call takes into account the patient's condition, the duration of the injury or illness and the on-going care or monitoring that is required. Typically a BLS unit is dispatched to be the first responding unit at the scene to do the initial assessment followed by other EMS personnel as needed. However, in rollover crashes the ALS units are dispatched first regardless of injury severity. In addition the option of air medical transport is available. Subsequently rollover crash occupants are transported to the trauma center for evaluation by either air medical transport or ground ALS units.

Trauma patients evaluated at level I trauma centers are triaged based on criteria developed by the verification body of the ACS COT and based on their guidelines found in the publication called "Resource for Optimal Care of the Injured Patient" ([Table 3](#)).

<[table 3](#) here>

When trauma patients arrive at the trauma center, trauma teams are activated to provide advanced trauma life support care to these patients based on the severity of their injuries. Trauma centers throughout the United States use a two-tier

Table 3. ACS COT 2006 Trauma Code Activation Type and Activation Criteria

Partial Trauma Team Activation Criteria	Full Trauma Team Activation Criteria
1. Physiological Alterations - Loss of consciousness > 5 minutes - Pregnancy of ≥ 3 months 2. Anatomic Alterations - Maxillo-facial trauma - Significant subcutaneous air - Evidence of pelvic instability - Two or more long bone deformity - Major lacerations involving the fascia - Stab wound to head/neck/torso with a weapon of questionable effectiveness and stable vital signs 3. Mechanism of Injury - Ejection from vehicle - Pedestrian struck at ≥ 15 mph - Motorcycle crash ≥ 25 mph - Motor vehicle collision at ≥ 35 mph - Documented fall ≥ 20 feet or 2 stories - Burns, meeting ABA referral criteria	1. Airway and breathing emergencies 2. Systolic blood pressure <90 with signs and symptoms of shock 3. Glasgow Coma Score (GCS) of ≤ 8 4. Paralysis 5. Penetrating injury to the head/neck/torso 6. Crush to torso/upper thighs 7. Major amputations

trauma classification system to determine at what level to activate a multidisciplinary trauma team response to the anticipated arrival of trauma patients [3] (Table 3). The majority of rollover crashes are triaged as Partial Trauma Team Activation (PTTA) and a smaller percentage as Full Trauma Team Activation (FTTA) in the trauma center. If no life threatening injuries are discernable, the trauma team will not be activated but the trauma surgeon is available for a consultation to determine whether the patient requires trauma team activation, admission to the hospital or discharged from the ED. Rollover mechanism was removed as a trauma code activation (TTA) criterion by the ACS COT in 2006 [9]. However, trauma centers may still triage rollover crashes on mechanism criterion alone. While rollover crashes can result in ejections and severe injuries, the excessive number of rollover crash patients discharged from the ED at our level I trauma center raises the question of whether triage mechanisms to activate the trauma team on rollover crash occupants are appropriate.

SOURCE OF DATA

This article reports on the experience of an 833-bed suburban hospital with an ACS COT-certified level I trauma center that collected data on rollover motor vehicle crashes from July 2007-July 2008 as part of the Crash Injury Research and Engineering Network (CIREN) program. CIREN is a multi-center research program involving collaboration of clinicians and engineers in academia, industry, and government to study and analyze crash injuries and prevention. CIREN consists of eight level I trauma centers linked by a database under the leadership of the National Highway Traffic Safety Administration (NHTSA). Daily chart reviews by the CIREN center team determined whether a MVC was a rollover crash. Of the 1,657 MVCs treated during the study period, 257 (16%) were rollover crashes that were analyzed as our study population. Injuries, Injury Severity Score (ISS), admission status, length of stay and patient charge details were obtained from the trauma registry. The Fairfax County Police Department, Virginia State Police, and Fairfax County Fire and Rescue collaborated and participated in the data collection of this project.

METHODS

Study Variables