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The Forgotten Trauma Patient: Outcomes for Injured Patients Evaluated by Emergency Medical Services but not Transported to the Hospital

Kristan Staudenmayer, MD, MS¹, Renee Hsia, MD, MSc², Ewen Wang, MD¹, Karl Sporer, MD², David Ghilarducci, MD³, David Spain, MD¹, Robert Mackersie, MD⁴, John Sherck, MD⁵, Richard Kline, MD⁶, and Craig Newgard, MD, MPH⁷

Renee Hsia: renee.hsia@emergency.ucsf.edu; Ewen Wang: ewen@stanford.edu; Karl Sporer: karl.sporer@emergency.ucsf.edu; David Ghilarducci: daveghil@me.com; David Spain: dspain@stanford.edu; Robert Mackersie: rmackersie@sfghsurg.ucsf.edu; John Sherck: John.Sherck@hhs.sccgov.org; Craig Newgard: newgardc@ohsu.edu

¹Department of Surgery, Stanford University School of Medicine, Stanford, CA

²Department of Emergency Medicine, University of California San Francisco, San Francisco, CA

³Santa Clara County EMS, San Jose, CA

⁴Department of Surgery, University of California San Francisco, San Francisco, CA

⁵Department of Surgery, Santa Clara Valley Medical Center, San Jose, CA

⁶Trauma Services, Regional Medical Center, San Jose, CA

⁷Center for Policy and Research in Emergency Medicine, Department of Emergency Medicine, Oregon Health & Science University, Portland, Oregon

Abstract

Background—Injured patients who are not transported by ambulance to the hospital are often not included in trauma registries. The outcomes of these patients have until now been unknown. Understanding what happens to non-transported patients is necessary to better understand triage validity, patient outcomes, and costs associated with injury. We hypothesized that a subset of patients who were not transported from the scene would later present for evaluation and that these patients would have a non-zero mortality rate.

Methods—This is a population-based, retrospective cohort study of injured adults and children for three counties in California from 2006–2008. Pre-hospital data for injured patients for whom an

For all correspondences contact: Kristan Staudenmayer, MD, 300 Pasteur Drive, H3591, Stanford, CA 94305-5641, kristans@stanford.edu, Tel 650-721-6692, Fax 650-736-1663.

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ambulance was dispatched were probabilistically linked to trauma registry data from four trauma centers, state-level discharge data, ED records and death files (1-year mortality).

Results—A total of 69,413 injured persons that were evaluated at the scene by EMS were included in the analysis. Of these, 5,865 (8.5%) were not transported. Of those not transported, 1,616 (28%) were later seen in an ED and discharged and 92 (2%) were admitted. Seven (0.2%) patients later died.

Conclusion—Patients evaluated by EMS, but not initially transported from the field after injury often present later to the hospital. The mortality rate in this population was not zero and these patients may represent preventable deaths.

Level of Evidence—This is a Level III therapeutic study.

Keywords

Outcomes Assessment; Traumatic Brain Injury; Quality of Health Care

Background

Trauma systems are intended to ensure that the pre-hospital, hospital, and discharge phases of care are optimal for the injured patient. Evaluating the performance of trauma systems has relied primarily on review of trauma registry data. However, trauma registries do not represent all patients served by a trauma system, and often only include the subset of injured patients who were brought to a trauma center and who met certain criteria (e.g., field triage criteria, hospital stay >48 hours, death). One important population not included in trauma registries is the group of injured patients for whom the 9-1-1 system was activated, but who were not transported to the hospital. Studies in non-trauma patients indicate that 20-59% of patients who are not transported after an emergency medical services (EMS) call are seen by a medical professional within seven days.¹⁻³ Furthermore, there is an associated mortality rate for this group that ranges from zero to 0.2%.^{1,3} It is not known if these numbers are the same in trauma patients. Knowledge of the outcomes of non-transported trauma patients could help improve our assessment of trauma system performance.

Understanding the outcomes of these non-transported patients requires a population based approach. The increasing availability of electronic data has provided an opportunity to create such a resource. We used ambulance records, trauma registries, and statewide administrative sources to create a population-based injury database around a fixed geographic location. We hypothesized that a fraction of injured patients not transported to the hospital may later present to the hospital, be admitted, undergo operative procedures, or die. In order to determine which factors influenced non-transport, we also compared patients who were transported with those who were not transported.

Methods

Study population and data sources

This was a population-based retrospective cohort study involving three counties in California (San Francisco, Santa Clara, and San Mateo Counties). We included patients evaluated by the EMS agencies serving these counties over a 36-month period (January 2006 – December 2008). Data was collected as part of a larger effort, the Western Emergency Services Translational Research Network (WESTRN), which is a consortium of geographic regions, EMS agencies and hospitals. These regions and centers are linked through the National Institute of Health's Clinical and Translational Science Award (CTSA)

centers. This study received Institutional Review Board approval by all participating trauma centers.

Patient selection

The study sample included all patients (children and adults) for whom the 9-1-1 EMS system was activated and for which EMS provider(s) recorded a primary impression of “injury” or “trauma,” regardless of field disposition or outcome. We excluded inter-hospital transfers without an initial EMS response; EMS records listed as “cancelled,” “no patient found,” or “stand by” (i.e., calls without patient contact); and scheduled (i.e., non 9-1-1) transports. The EMS data served as the primary database to which data from four other sources could be linked. These data sources included: 1) trauma registry data from the three Level I trauma centers and the one Level II trauma center serving the region; 2) California statewide patient discharge data (all patients admitted to an acute care hospital within the state of California within 7 days of EMS dispatch) from the Office of Statewide Health Planning and Development (OSHPD); 3) California statewide emergency department data (all patients seen in emergency departments but not admitted within the state of California within 7 days of EMS dispatch) from OSHPD; and 4) Vital statistics data (one-year mortality) from OSHPD. Vital statistics data was only available for patients injured during 2006-2007. For trauma registry, admission and emergency department records, we focused primarily on matches to EMS records within 1 day of initial scene evaluation by EMS, but accepted matches up to 7 days from initial EMS contact.

Outcome linkage and definition

Data were linked using probabilistic linkage. Probabilistic linkage is a method that has been used to link patient data between different data sets when there is no unique identifier.³⁻⁷ Probabilistic linkage has been validated for linking ambulance records to trauma registry data.⁸ The strength of probabilistic linkage is that patient outcomes may be tracked from EMS call through emergency department evaluation, hospitalization and beyond, even when the patients may not be identified at the scene and no unique identifier exists. A detailed description of the probabilistic methodology used for the study, including estimated match rates, is in press.⁹

Patients who were not initially transported to the hospital after injury were compared to those patients that were transported. The primary outcomes of interest include linkage of an EMS record to an emergency department record, admission record, and vital statistics data. In addition, surgical procedures on admitted patients were evaluated. Non-transported patients who did not link to a hospital visit or death were assumed to be alive and without adverse consequences from their trauma. Patients who were recorded by EMS as transported to the hospital were assumed to have been evaluated at a hospital even if these records did not link to an emergency room visit or admission. In addition, patients who were not transported were divided into groups based on whether or not the EMS record linked to another record. These groups were compared to determine if any characteristics could predict which non-transports later presented to a hospital or died.

Variables included in the analysis included demographics, field vital signs, field Glasgow Coma Score (GCS), and mechanism of injury. Because ISS is not collected in state discharge or emergency department databases, we used a mapping function (ICDPIC Stata v. 11, StataCorp, College Station, TX) and ICD9 diagnoses coded to generate injury severity measures.

Statistical analysis

Statistical analysis was performed using STATA 10.1 for Windows (StataCorp LP, College Station, TX). Categorical data was compared using chi square analysis. Continuous data were compared using Student's T-test for normal data.

Results

There were a total of 69,413 injured patients evaluated by EMS from 2006-2008 within the three counties. Data on patient transport was available on 68,440 (99%) of these patients. A total of 5,865 (9%) patients for whom an ambulance was dispatched were not transported to a hospital. Only patients injured in 2006 and 2007 were available for linkage to vital statistics data. Only 3,282 (56%) of the non-transported patients were candidates for linkage to vital statistics data.

Outcomes for patients who were transported and who were not transported are shown in Table 1. For patients not transported to the hospital, 1,715 (29% of the non-transported) later linked to an emergency room visit, an admission, or a death. The majority of these were matches to an emergency room visit (1,616 or 28% of the non-transported). A total of 92 (2% of non-transported) patients were admitted. None of the patients who presented to the hospital after non-transport presented to a trauma center. Of this group, 15 (0.9%) patients did eventually match to a trauma center registry, which suggests that these patients were later transported from a nontrauma center to a trauma center. Of those non-transported who were later admitted, 12 patients had a surgery (2 chest surgeries, 7 abdominal surgeries, and 3 orthopedic surgeries), and four were transfused.

Seven patients (0.2% of non-transported available for linkage) who were not transported matched to a Vital Statistics death record within the study time period. (Table 2) Information on the cause and timing of death was available for only four of the seven patients. Two of these patients linked to a hospital admission, while five did not. The average time from EMS contact to death in patients for whom data was available was almost eight months (230 days). The available causes of death were medical diagnoses. None of the listed causes of death listed a mechanism consistent with injury.

For patients who were transported to the hospital, 49,223 (79%) of the patient data could be linked to the emergency room visit, and admission, or a death. Of transported patients that matched to a hospital record ($n = 48,256$), 36,467 (76%) were seen in the emergency room and discharged, while 11,789 (24%) were admitted. Vital statistics death records were matched to 967 (3%) of patients who were transported.

Non-transported patients differed from transported patients in their demographics, physiology, and mechanism of injury. (Table 3) Non-transported patients tended to be younger (37 vs. 47 years of age, $p=0.000$) and more often male (56% vs. 52%, $p=0.000$). Mean systolic blood pressure, heart rate, and GCS on the scene were similar in magnitude, but these differences did achieve statistical significance. The mechanism of injury for non-transported patients was more often motor vehicle collisions (30% vs. 20%), and less often gunshot wounds or stabbings (0.8% vs. 2%).

Those patients who were not transported to the hospital but who were later seen in an emergency room, admitted, or died were compared to patients who were not transported and had no evidence of a hospital visit or death. (Table 4) Patients who eventually visited a hospital tended to be younger (34 vs. 38 years of age, $p=0.000$). There was a statistically significant difference in the proportion who were male, but the magnitude of the difference was small (56.2% in non-transported vs. 56.1% in transported patients, $p=0.015$). The

proportion of non-transport patients who later visited the hospital was evaluated by mechanism. (Figure 2) Pedestrian injuries and victims of violent crimes who were not initially transported had higher rates of delayed presentation compared to patients who fell or were in an automobile accident. The likelihood of emergency room visits and admission for patients who were not transported were also examined by age group. (Figure 2) As the age of patients increased, the likelihood of visiting an emergency room decreased and likelihood of admission increased.

Discussion

This study represents the first population-based EMS study to evaluate the natural history of trauma patients accessing the emergency 9-1-1 system who are not transported the hospital. These patients are important to study as they represent a population that is invisible to trauma registries and databases currently used to evaluate trauma systems. We found the rate of non-transport to be approximately 9% of all ambulance dispatches for trauma. Thirty percent of these patients later presented to the hospital and/or died. Based on our estimates for linkage match rate, our values are conservative and the true rates of emergency room visits, admissions and mortality may be higher.

The findings in the current study are consistent with other studies that have looked at non-transports in other populations. The rate of non-transports in mixed medical/surgical patients ranges from 5%-48%.^{2,3,10-12} For patients not transported after an EMS dispatch, 20-59% were seen by a medical professional within seven days.¹⁻³ Knight et al. performed a population-based study of all EMS dispatches (medical and surgical) where patients refused transport in the state of Utah from 1996-1998.³ They found that 5% of patients refused transport. Of these patients, 20% were seen in an ED within 1 week, 1.2% were admitted, and 0.2% died. Trauma calls comprised 20% of their population, but almost 50% of the transport refusals involved a motor vehicle collision (MVC).

Similar to the study discussed above, the mortality rate for non-transported patients in the current study was 0.2%. This translates into a mortality rate of 0.02% for the entire injured population. Information about the death was available for only four of these patients. The time to death in these patients averaged 8 months, which suggests that trauma was not the proximate cause of death. Furthermore, two patients had a do-not-resuscitate status which suggests death was due to a pre-existing condition. However, it cannot be determined if trauma was the cause of death for the three patients for whom data was not available.

There appeared to be certain characteristics associated with emergency room visits and admission to the hospital after non-transport. Victims of violent crimes and pedestrian accidents were more often seen in an emergency room and discharged after non-transports (versus MVCs and falls). It is possible that these mechanisms of injury induce a psychological need to be seen that becomes apparent after the ambulance has left the scene.

Also, increasing age is more likely to be associated with an increasing likelihood of admission and a decreasing likelihood of being seen and discharged from an emergency department after non-transport. All patients under one year of age that were not initially transported were later evaluated at an acute care hospital, compared to 15% of patients older than 65. These data suggest that EMS providers be more aggressive in cases with a higher likelihood of delayed presentation to the hospital.

We do not know whether non-transport is initiated by the patient or the EMS provider because the reason for non-transport was not recorded by the EMS providers. It is possible that the majority of non-transports in our study were initiated by the patient because barriers do exist for EMS providers in our region to not transport. For example, EMS providers are

encouraged to contact a physician prior to deciding not to transport. Furthermore, the majority of EMS dispatches were conducted by a single private ambulance company with a financial incentive to transport. It is also possible that alcohol and social circumstances may have played a role in patients refusing transport. However, there are protocols in place within our system to determine if a patient has decisional capacity to refuse treatment.

Other studies have evaluated the reasons for non-transport. Pringle et al. conducted a prospective observational study of all EMS calls to determine whether non-transports were patient or medic-initiated. They found 66% of non-transports were patient-initiated. Schmidt et al. evaluated patients who were not transported after an EMS dispatch and followed patients up by a telephone survey to determine the reasons for non-transport.² They found that 53% of the non-transport patients refused transport because they felt it was not necessary. An additional 6% cited the cost of the ambulance as the reason for refusal. The remainder was divided between EMS provider judgment (14%) and other reasons. It is possible that the majority of refusals in our population are initiated by the patient for reasons similar to previous studies.

Also, it appears that when a patient is not transported but eventually seek care, they do not present to trauma hospitals. This may be due to many factors including the fact that many trauma centers are county hospitals, the presence of closer non-trauma hospitals, and lack of knowledge by patients about trauma regionalization. It is interesting that once non-transports present to non-trauma hospitals, they often remain there as fewer than 1% were transferred.

There are many limitations to this study. One of the most important limitations is that we do not know the reason for non-transport. Without this information, it is difficult to provide feedback and improve trauma systems. One process that is changing in our system is that the electronic records are going to force ambulance personnel to fill in all important fields. We are hoping that with this change, full information capture will allow us to better understand reasons for non-transport and will inform future protocol changes.

Trauma registry data can have inconsistent records on complications and diagnoses. Data from OSHPD contains administrative data but lacks hospital-based data such as patient physiology and is limited in the number of diagnoses it contains. Another limitation is the process of probabilistic linkage is the disparate data sources. We are not able to determine the “true” matches and non-matches for any site as such information would have required access to the original medical records. However, the validity of probabilistic linkage using identical software and approach to linkage analysis has a low mis-match rate (high specificity) across a variety of linkage scenarios.⁸ Our estimated match rates (sensitivity) for this region are high.⁹ Though we were unable to directly estimate specificity of the matches; we believe specificity remained high based on the previous linkage assessment at one study site.⁸

In conclusion, patients who are not initially transported to the hospital after an ambulance is dispatched for trauma often present to a non-trauma hospital later for evaluation and admission. These patients represent an invisible population of patients that previously have not been studied and should be considered when evaluating the performance of trauma systems.

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Subsequent Medical Care after Non-Transport by Mechanism

Figure 1. Non-Transport Patients Who Sought Care By Mechanism of Injury

Subsequent Medical Care after Non-Transport, by Age Groups

Figure 2. Non-Transport Patients Who Sought Care By Age

Table 1
Outcomes of Non-transported Trauma Patients

	Non-transport		Transport	
	Number/Mean	(%, SD)	Number/Mean	(%, SD)
Total Number	5,865	8.5%	62,575	91.0%
Linked to ED visit, admission, or death				
Total linked	1,715	29.2%	49,223	78.7%
Seen in ED and Discharged	1,616	27.6%	36,467	58.3%
Admitted	92	1.6%	11,789	18.8%
Length of stay if admitted (days) *	NA	NA	5.5	0.08
Died (from VSS Data) **	7	0.2%	967	2.6%
No Match Found	4,150	70.8%	13,352	21.3%

* Length of stay available only for patients evaluated and admitted at an acute care hospital.

** Percentage expressed as percent of patient records available for VSS matching

Abbreviations: ED=Emergency Department

Table 2

Deaths in non-transported patients

Number	Age	Mechanism	Description	Do Not Resuscitate	Time to death (days)
1	49	unknown	Malignant neoplasm (unknown site)	Yes	216
2	68	Fall	unknown	unknown	unknown
3	75	MVC	Acute Myocardial Infarction	No	412
4	82	MVC	unknown	unknown	unknown
5	88	Fall	unknown	unknown	unknown
6	94	Fall	Pneumonia, unspecified	Yes	273
7	94	unknown	Coronary artery disease	No	18

Table 3
Characteristics of Transported Versus Non-Transported Patients

	Non-transports		Transports		Difference
	Number	(%, SD)	Number	(%, SD)	
Demographics	5,865	8.5%	62,575	91.0%	
Mean age	37.0	22.0	47.1	25.5	0.000
Male	3,201	56.1%	32,322	52.2%	0.000
Pre-hospital Initial Physiology					
Mean SBP	134.7	21.1	137.2	24.7	0.000
Mean HR	91.8	15.9	91.0	18.6	0.001
Mean GCS	15.0	0.3	14.7	1.4	0.000
Injury Severity*					
Mean ISS	NA	NA	1.4	0.02	NA
Mechanism of Injury					
MVC	1,732	29.5%	12,778	20.4%	0.000
Fall	667	11.4%	16,466	26.3%	
Pedestrian	93	1.6%	1,337	2.1%	
GSW and Stabbing	48	0.8%	1229	2.0%	
Assault/Rape	632	10.8%	3,727	6.0%	
Missing	2,081	35.5%	19,762	31.6%	
Other	612	10.4%	7,276	11.6%	

* Injury Severity Score (ISS) only available for Transports. For ISS in non-transports later evaluated at an acute care hospital, please see Table 4.

Abbreviations: SBP=Systolic Blood Pressure; HR=Heart Rate; GCS=Glasgow Coma Score; ISS= Injury Severity Score; MVC=Motor Vehicle Collision; GSW=Gunshot wound

Table 4

Comparison of non-transported patients who later were seen in an emergency department, admitted, or died compared non-transport survivors that did not present for acute hospital care.

	ED/Admit/Death N=1,718 (29%)	Did not link N=4,147 (71%)	Difference
	Number (%)	Number (%)	(SD)
Demographics			
Mean age	33.9	20.3	38.3 22.5 0.000
Number male	955	56.2%	2,246 56.1% 0.015
Physiology			
Mean SBP	133.8	20.8	135.1 21.2 0.044
Mean HR	92.4	15.5	91.6 16.0 0.096
Mean GCS	15.0	0.1	15.0 0.4 0.088
Injury Severity			
Mean ISS*	0.5	0.03	NA NA NA

* Injury Severity Score (ISS) only available for patients who later matched with a record at an acute care hospital.

Abbreviations: SBP=Systolic Blood Pressure; HR=Heart Rate; GCS=Glasgow Coma Score; ISS= Injury Severity Score