Police transport versus ground EMS: A trauma system-level evaluation of prehospital care policies and their effect on clinical outcomes

Michael W. Wandling, MD, Avery B. Nathens, MD, PhD, Michael B. Shapiro, MD, *and* **Elliott R. Haut, MD, PhD***, Baltimore, Maryland*

BACKGROUND: Rapid transport to definitive care ("scoop and run") versus field stabilization in trauma remains a topic of debate and has resulted in variability in prehospital policy. We aimed to identify trauma systems frequently using a true "scoop and run" police transport approach and to compare mortality rates between police and ground emergency medical services (EMS) transport.

METHODS: Using the National Trauma Databank (NTDB), we identified adult gunshot and stab wound patients presenting to Level 1 or 2 trauma centers from 2010 to 2012. Hospitals were grouped into their respective cities and regional trauma systems. Patients directly transported by police or ground EMS to trauma centers in the 100 most populous US trauma systems were included. Frequency of police transport was evaluated, identifying trauma systems with high utilization. Mortality rates and risk-adjusted odds ratio for mortality for police versus EMS transport were derived.

RESULTS: Of 88,564 total patients, 86,097 (97.2%) were transported by EMS and 2,467 (2.8%) by police. Unadjusted mortality was 17.7% for police transport and 11.6% for ground EMS. After risk adjustment, patients transported by police were no more likely to die than those transported by EMS (OR = 1.00, 95% CI: 0.69–1.45). Among all police transports, 87.8% occurred in three locations (Philadelphia, Sacramento, and Detroit). Within these trauma systems, unadjusted mortality was 19.9% for police transport and 13.5% for ground EMS. Risk-adjusted mortality was no different (OR = 1.01, 95% CI: 0.68–1.50).

CONCLUSIONS: Using trauma system-level analyses, patients with penetrating injuries in urban trauma systems were found to have similar mortality for police and EMS transport. The majority of prehospital police transport in penetrating trauma occurs in three trauma systems. These cities represent ideal sites for additional system-level evaluation of prehospital transport policies. (*J Trauma Acute Care Surg.* 2016;81: 931–935. Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Prognostic/epidemiologic study, level III.

KEY WORDS: Prehospital transport; trauma systems; penetrating trauma.

The development of trauma systems in the United States has helped improve the care of injured patients.[1] Trauma systems are typically designed and developed at the local, state, or regional level based on resource availability, geography, and need. However, in many settings, local history and culture of rescue personnel and trauma providers continue to shape practices. As a result, trauma systems have developed significant variability with respect to system-wide policies and protocols, including those for prehospital care. Prehospital trauma care protocols range from no intervention ("scoop and run") in some locations to fluid resuscitation, advanced life support, or rapid sequence intubation with mechanical ventilation in others.

To identify optimal prehospital management strategies, it is important to study the clinical implications of different prehospital policies. One example of a unique prehospital policy that could be of benefit to other urban trauma systems is the routine use of police transport for individuals with penetrating injuries. In Philadelphia, Pennsylvania, patients with penetrating injuries have been transported to the nearest trauma center by police officers for over 25 years.[2,3] Under the current policy that was implemented in 1996, "Police personnel will transport: Persons suffering from a serious penetrating wound, e.g., gunshot, stab wound and similar injuries of the head, neck, chest, abdomen and groin to the nearest accredited trauma center. Transportation will not be delayed to wait the arrival of the Fire Department paramedics."[4]

Major current initiatives of the American College of Surgeons Committee on Trauma (ACS COT), such as the Hartford Consensus, emphasize the importance of expanding the roles of police officers in providing basic trauma care, particularly in the arena of hemorrhage control.[5] Given these new recommendations, it is important to systematically evaluate the role that the police department currently plays in prehospital trauma care. Because of the current paucity of data regarding the implications of police department prehospital trauma care on clinical outcomes, we aimed to compare mortality rates for police transport (a true

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From the Division of Trauma & Critical Care, Department of Surgery (M.W.W., M.B.S.), Northwestern University Feinberg School of Medicine, Chicago, Illinois; Surgical Outcomes and Quality Improvement Center, Department of Surgery (M.W.W.), Center for Healthcare Studies, Northwestern University Feinberg School of Medicine, Chicago, Illinois; Division of Research and Optimal Patient Care (M.W.W.), American College of Surgeons, Chicago, Illinois; Department of Surgery (A.B.N.), Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada; Division of Acute Care Surgery, Department of Surgery (E.R.H.), The Johns Hopkins School of Medicine, Baltimore, Maryland; and The Johns Hopkins University School of Public Health (E.R.H.), Baltimore, Maryland.

Address for reprints: Elliott R. Haut, MD, PhD, FACS, Anesthesiology/Critical Care Medicine (ACCM) and Emergency Medicine, Division of Acute Care Surgery, Department of Surgery, The Johns Hopkins University School of Medicine, The Johns Hopkins University Bloomberg School of Public Health, Sheikh Zayed 6107C, 1800 Orleans St., Baltimore, MD 21287; email: ehaut1@jhmi.edu.

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"scoop and run" approach) to ground emergency medical services (EMS) transport. Additionally, we sought to identify cities and trauma systems that frequently utilize police transport for penetrating trauma and determine the implications of routine police transport at the trauma system level.

METHODS

Using the National Trauma Databank (NTDB), all patients admitted with penetrating injuries (gunshot wounds (GSW) and stab wounds) from January 1, 2010 to December 31, 2012 were identified. These mechanisms of injury were determined by ICD-9 external causes of injury codes (E-codes) that are included in the NTDB. Patients were included if they were ≥16 years old or ≤100 years old, were transported to the hospital by ground EMS or the police department, and were treated at a Level 1 or Level 2 trauma center in one of the 100 most populous trauma systems in the United States. Trauma systems were defined by the central counties of 2010 U.S. Census Metropolitan Statistical Areas, which are geographic areas consisting of a large population nucleus and adjacent communities with a high degree of integration with the population nucleus.[6] Cities were not used to define trauma systems because doing so would exclude trauma centers that are not located within the boundaries of a city yet still serve the city's population. Patients were excluded if they were transferred to or from another hospital or had incomplete records with respect to the primary outcome of in-hospital mortality. Study participants were limited to individuals with penetrating injury because they represent a unique subpopulation of trauma patients most likely to benefit from timely surgical intervention and least likely to derive significant benefit from out-of-hospital interventions.

Baseline characteristics for ground EMS and police transport were compared using χ^2 or Student's *t*-tests. The primary outcome was in-hospital mortality, which included deaths in the emergency department (ED), deaths before hospital discharge, and discharge disposition to hospice. Unadjusted mortality rates for ground EMS and police transport were compared for all included patients, and stratified for GSW and stab wound cohorts.

Using a general linear mixed effects model, risk-adjusted odds ratios for mortality for police versus ground EMS transport were calculated. Clustering by trauma center was performed to account for hospital-level variability when calculating risk-adjusted odds ratios for mortality. Models were derived for all penetrating injuries and for the GSW and stab wound cohorts. Models were adjusted heart rate (HR), presenting systolic blood pressure (SBP), Glasgow Coma Scale Motor Score (GCS-Motor), Injury Severity Score (ISS), age, gender, race/ethnicity, insurance status, and year of admission.[7,8] Multiple imputation was used to address missing data for HR, SBP, GCS-Motor, ISS, and gender.

All included patients were assigned to their respective trauma systems. System-level analyses were conducted to evaluate the proportion of patients in each city who were transported by ground EMS versus the police department. The utilization of police transport for penetrating trauma

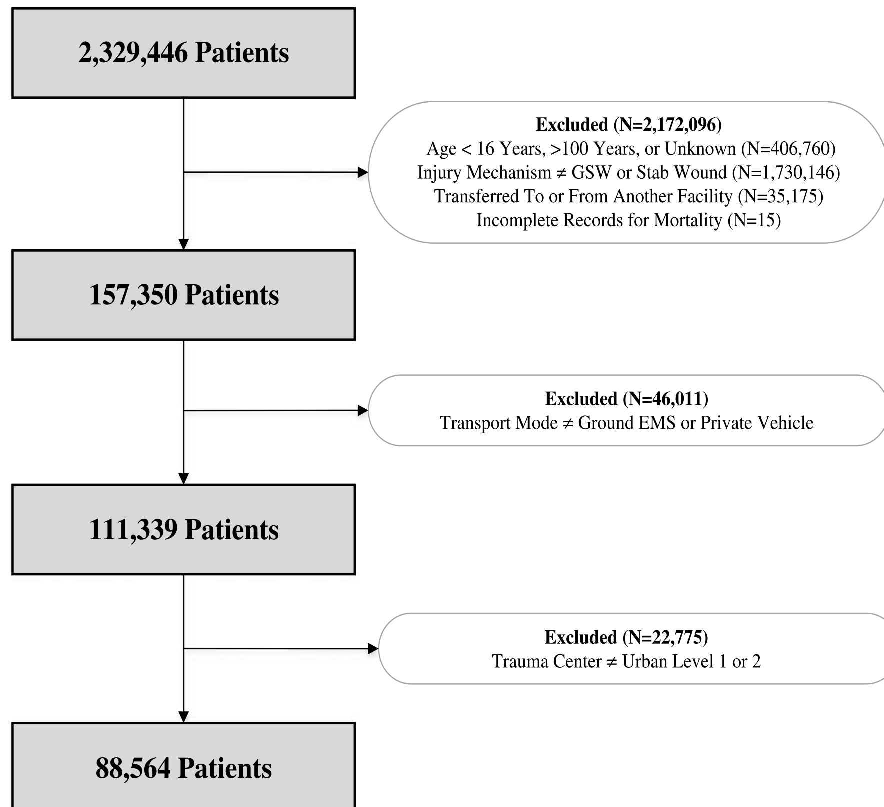

Figure 1. Flow diagram illustrating the selection of patients for this study from the NTDB between January 1, 2010 and December 31, 2012.

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TABLE 1. Baseline Characteristics of Sample Population by Mode of Prehospital Transportation

	All Patients n or Mean ± SD	Ground EMS n or Mean ± SD	Police n or Mean ± SD	*p*
Population size	88,564	86,097	2,467	—
Age	32.6 ± 13.4	32.7 ± 13.4	30.4 ± 11.3	<0.001†
Heart rate*	90.5 ± 31.3	90.6 ± 31.1	88.1 ± 37.2	<0.001†
Systolic blood pressure*	123.3 ± 41.5	123.6 ± 41.2	113.1 ± 48.8	<0.001†
GCS Motor Score*	5.4 ± 1.6	5.4 ± 1.6	5.1 ± 1.9	<0.001†
Injury Severity Score	10.2 ± 12.6	10.1 ± 12.5	14.2 ± 16.0	<0.001†
Gender	—	—	—	<0.001‡
Male	77,379 (87.4%)	75,141 (87.3%)	2,238 (90.7%)	
Female	11,185 (12.6%)	10,956 (12.7%)	229 (9.3%)	
Race/ethnicity	—	—	—	<0.001‡
Black	42,201 (47.7%)	40,775 (47.4%)	1,426 (57.8%)	
White	23,663 (26.7%)	23,420 (27.2%)	243 (9.9%)	
Hispanic	15,690 (17.7%)	15,430 (17.9%)	260 (10.5%)	
Asian	1,254 (1.4%)	1,232 (1.4%)	22 (0.9%)	
Other	5,756 (6.5%)	5,240 (6.1%)	516 (20.9%)	
Insurance	—	—	—	<0.001‡
Private	15,409 (17.4%)	15,111 (17.6%)	298 (12.1%)	
Governmental	26,270 (29.7%)	25,496 (29.6%)	774 (31.4%)	
Self-pay	31,931 (36.1%)	31,015 (36.0%)	916 (37.1%)	
Other	14,954 (16.9%)	14,475 (16.8%)	479 (19.4%)	
Injury mechanism	—	—	—	<0.001‡
GSW	47,224 (53.3%)	45,582 (52.9%)	1,642 (66.6%)	
Stab wound	41,340 (46.7%)	40,515 (47.1%)	825 (33.4%)	

*First documented value after arrival to the hospital.
†Student's *t*-test.
‡χ^2 test.

was evaluated and compared for each of the included trauma systems. The cities most frequently utilizing police transport were identified and used to create a subgroup for more focused analysis. Unadjusted mortality rates for ground EMS and police transport were compared for all patients and the GSW and stab wound cohorts within these trauma systems. Risk-adjusted odds ratios for mortality were also calculated for this subset of trauma systems.

The results of this study were two-sided and considered to be statistically significant at an alpha level of 0.05. SAS version 9.4 (SAS Institute Inc., Cary, NC) was used to perform all statistical analyses for this study. IRB exemption was obtained from the Northwestern University Feinberg School of Medicine Institutional Review Board.

RESULTS

Of the 2,329,446 patients included in the NTDB from January 1, 2010 to December 31, 2012, 88,564 total patients at 297 trauma centers met inclusion criteria for the study (Fig. 1). A total of 86,097 patients (97.2%) were transported directly to a trauma center by ground EMS and 2,467 (2.8%) were transported by the police department. Baseline characteristics of patients transported by ground EMS and the police department are provided in Table 1. Patients transported by police were, in general, more physiologically deranged (lower SBP and lower GCS motor score). Mean ISS was significantly higher among patients transported by the police department when compared to those transported by ground EMS (14.2 vs. 10.1, respectively, $p < 0.001$).

The unadjusted overall mortality was 11.8% for all penetrating wounds, and 19.5% and 2.9% for GSWs and stab wounds, respectively. Patients with GSWs had an unadjusted mortality of 19.5%, whereas those with stab wounds had a mortality of 2.9%. Overall unadjusted mortality rates were higher for police transport than ground EMS for GSWs (25.2% vs. 19.3%, $p < 0.001$). No significant differences in mortality between police and ground EMS transport were found for stab wounds (2.7% vs. 2.9%, $p = 0.68$). After adjusting for age, gender, race, ISS, HR, SBP, GCS-Motor, and insurance status, patients with penetrating injuries transported by the police department were no more likely to die than those transported by ground EMS (OR = 1.00, 95% CI: 0.69–1.45). This held true when stratified for GSWs (OR = 0.92, 95% CI: 0.62–1.37) and stab wounds (0.55, 95% CI: 0.19–1.55) (Table 2).

City-level analyses revealed that 87.8% of all police transports occurred in only three cities' trauma systems: Philadelphia, PA; Sacramento, CA; and Detroit, MI. In Philadelphia 1,494 patients were transported by the police department, accounting for 60.6% of all police transports in the NTDB study cohort. In Sacramento, there were 520 patients transported by police and in Detroit there were 153, representing 21.1% and 6.2% of all NTDB police transports, respectively.

When limiting analyses to the three trauma systems most frequently utilizing police transport for penetrating trauma (Philadelphia, Sacramento, and Detroit), the overall unadjusted mortality rate was 19.9% for police transport and 13.5% for ground EMS. Unadjusted mortality rates were higher for police transport than ground EMS for GSWs (26.4% vs. 20.8%, $p < 0.001$) and not significantly different for stab wounds (3.5% vs. 3.3%, $p = 0.89$). After risk adjustment, patients transported by the police department were no more likely to die than those transported by ground EMS (OR = 1.01, 95% CI: 0.68–1.50). This held true for GSWs (OR = 0.93, 95% CI: 0.62–1.41) and stab wounds (OR = 0.32, 95% CI: 0.09–1.14). All

TABLE 2. Unadjusted Mortality Rates and Risk-Adjusted Odds Ratios for Mortality for Aggregate Study Population

	Unadjusted Mortality Rates				OR for Mortality
	All Patients n (%)	Ground EMS n (%)	Police n (%)	*p*	OR (95% CI)
All GSWs and stab wounds	10,422 (11.8%)	9,986 (11.6%)	436 (17.7%)	<0.001	1.00 (0.69–1.45)
GSWs only	9,221 (19.5%)	8,807 (19.3%)	414 (25.2%)	<0.001	0.92 (0.62–1.37)
Stab wounds only	1,201 (2.9%)	8,807 (19.3%)	22 (2.7%)	0.68	0.55 (0.19–1.55)

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TABLE 3. Unadjusted Mortality Rates and Risk-Adjusted Odds Ratios for Mortality Among Trauma Systems With High Utilization of Police Transport in Penetrating Trauma (Philadelphia, Sacramento, and Detroit)

	Unadjusted Mortality Rates				OR for Mortality
	All Patients n (%)	Ground EMS n (%)	Police n (%)	p	OR (95% CI)
All GSWs and stab wounds	1,345 (15.1%)	913 (13.5%)	432 (19.9%)	<0.001	1.01 (0.68–1.50)
GSWs only	1,230 (22.4%)	819 (20.8%)	411 (26.4%)	<0.001	0.93 (0.62–1.41)
Stab wounds only	115 (3.4%)	94 (3.3%)	21 (3.5%)	0.89	0.32 (0.09–1.14)

unadjusted and risk-adjusted mortality data for the high police transport utilization subgroup are provided in Table 3.

DISCUSSION

This study demonstrates that for individuals with penetrating injuries in urban trauma systems, police transport is not associated with significant mortality differences when compared to similarly injured individuals transported by ground EMS. This study also identifies the three urban, U.S. trauma systems that most frequently utilize police transport and account for nearly 90% of police transports in penetrating trauma included in the NTDB. The results of this study are important because they focus on data from major urban trauma systems and can be used to support the implementation of policies to incorporate police transport into the prehospital management protocols of similar urban trauma systems. Additionally, the results of this study reveal trauma systems where police transport is currently used and further research efforts into their benefit could be focused.

Previous research has evaluated the implications of prehospital care on clinical outcomes after trauma. Numerous studies have shown equal or higher mortality with EMS compared to private vehicle transport.[9,10] In Philadelphia, studies have found that ground EMS confers no survival benefit to police transport, though among the most severely injured, police transport was associated with a survival advantage.[2,11] Other studies have demonstrated that prehospital intravenous fluid administration, endotracheal intubation, spine immobilization, and advanced life support are associated with higher mortality rates among certain subsets of trauma patients.[12–15] Work in Philadelphia has shown that the use of prehospital procedures in patients who ultimately undergo ED thoracotomy is also associated with higher mortality.[16] Additionally, research has demonstrated the importance of transport time in penetrating trauma, with shorter transport times being associated with improved survival.[17–19]

The results of this study reinforce previous findings from Philadelphia regarding the mortality implications of routine police transport, but represent the first time police transport has been compared to ground EMS nationally on a trauma system level. Additionally, this study represents the first time prehospital transport practices in trauma have been evaluated at the system level. The ability to derive trauma system-level data from the NTDB is a major strength of this study, as it facilitates system-level analyses for use in comparative effectiveness research.

Although prehospital police transport of the injured is not associated with different mortality rates than ground EMS transport, this trauma system-level analysis does support the viability of police transport as an alternative mode of prehospital transport in urban trauma systems. For example, in Chicago, IL individuals who are shot on the city's south side experience longer prehospital transport times and higher mortality than those similarly injured in other portions of the city because of the lack of a trauma center in close proximity to that part of the city.[20] As one example, Chicago could consider allowing police to transport these patients to the hospital to address this specific problem. Based on the results of this study, these patients would be unlikely to experience any worse outcomes than waiting for ground EMS transport and may actually end up having improved outcomes. Additionally, by identifying trauma systems that frequently utilize police transport, the results of this study can help trauma system leaders in cities like Chicago know where they can seek guidance if they are interested in instituting their own police transport protocol.

This study is not without limitations. As with all large, multicenter database analyses, there may be issues with data quality and missing data. Although there are auditing mechanism in place to identify errors in abstraction, errors may still occur. Missing data was not a major factor in this analysis, but where it occurred, it was handled with imputation. Patients were not randomly assigned to police or EMS transport; therefore, some selection bias may have occurred. We have attempted to overcome this with our risk-adjustment model. Risk adjustment is another potential limitation, as risk adjustment is limited to the variables collected by the NTDB. As a result, there may be potential confounders that were unable to be identified. Specifically, prehospital transport time is likely a significant confounder, but was unable to be utilized in the risk adjustment model due to inconsistent reporting of this information in the NTDB. Additionally, the results of this study are reflective of the data from the trauma centers that contribute to the NTDB. Although more than 800 centers contribute data, it is not mandatory and not all U.S. trauma centers participate. However, our ability to group all patients within a single city's trauma system is a novel approach, which has never been done before using the NTDB.

Police transport is not associated with significant mortality differences than ground EMS transport for individuals with penetrating injuries in urban trauma systems. Three urban trauma systems are responsible for the vast majority of police transports nationwide. System-level analyses like those performed in this study can improve the generalizability of results and identify trauma systems that can provide valuable insight into unique policies and protocols. The goal of any trauma system is to deliver optimal care to injured patients. An important part of accomplishing this is determining what system-level policies are beneficial in individual trauma systems and using that knowledge to drive policy change in trauma systems likely to derive similar benefits.

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AUTHORSHIP

M.W.W. participated in the study design, data analysis, and manuscript preparation. A.B.N. participated in the study design and manuscript preparation. M.B.S. participated in the study design and manuscript preparation. E.R.H. participated in the study design, data analysis, and manuscript preparation.

DISCLOSURES

The authors declare no conflicts of interest.

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