Factors associated with survival in Adult Patients with Traumatic Arrest: A Retrospective Cohort Study from US Trauma Centers

Abdel-Badih Ariss
American University of Beirut Medical Center
Rana Bachir
American University of Beirut Medical Center
Mazen El Sayed (melsayed@aub.edu.lb)
American University of Beirut Medical Center

Research Article

Keywords: Traumatic arrest, survival, outcome, injury, resuscitation

Posted Date: December 1st, 2020

DOI: https://doi.org/10.21203/rs.3.rs-112660/v1

Version of Record: A version of this preprint was published at BMC Emergency Medicine on July 5th, 2021. See the published version at https://doi.org/10.1186/s12873-021-00473-9.

Abstract

Background: Traumatic arrests (TA) increasingly affect young adults worldwide with low reported survival rates. This study examines factors associated with survival (to hospital discharge) in traumatic arrests transported to US trauma centers.

Methods: This retrospective cohort study used the US National Trauma Databank 2015 dataset and included patients who presented to trauma centers with “no signs of life”. Univariate and bivariate analyses were done. Factors associated with survival were identified using multivariate regression analyses.

Results: The study included 5,980 patients with traumatic arrests. Only 664 patients (11.1%) survived to hospital discharge. Patients were predominantly in age group 16-64 (84.6%), were mostly males (77.8%) and white (55.1%). Most were admitted to Level I (55.5%) or Level II trauma centers (31.6%). Injuries were mostly blunt (56.7%) or penetrating (39.3%). Mean ISS was 23.71 (± 20.79).

Factors associated with decreased survival included: Age group ≥65 (Ref: 16-24), male gender, self-inflicted and other or undetermined types of injuries (Ref: assault), injuries to head & neck, injuries to torso and injury severity score (ISS) ≥ 16 (Ref: <16). While factors associated with increased survival included: All injury mechanisms (with the exception of Motor Vehicle Transportation (MVT)) (Ref: firearm), injuries to extremities or spine & back and all methods of coverage (Ref: self-pay).

Conclusion: Patients with traumatic arrests have poor outcomes with only 11.1 % surviving to hospital discharge. Factors associated with survival in traumatic arrests were identified. These findings are important for devising injury prevention strategies and help guide trauma management protocols to improve outcomes in traumatic arrests.

Level of evidence: Level III

Background

Traumatic arrests (TA) or traumatic deaths are increasingly affecting the young population worldwide. According to a 2014 report by the World Health Organization (WHO), more than 5 million individuals die from injuries each year which accounts for approximately 9% of global deaths.[1] Main causes of fatal injuries are road traffic injuries, homicide and suicide.[1] In the United States of America, TA has increased by 22.8% between the years 2000 and 2010, affecting mainly young adults.[2] As a result, traumatic fatalities compete with cancer and heart related mortality in the young population.[2]

Prior studies that examined traumatic arrests have reported very low survival rates ranging from 1.5% to 12.5 %.[3-5] Guidelines to withhold resuscitative measures specific for traumatic arrests have also been proposed in previous studies and by major organizations such as National Association of Emergency Medical Services Physicians and the American College of Surgeons Committee on Trauma (NAEMSP/ACS-COT) because of the futility of resuscitative measures for this condition.[6,7] Survival has however been increasing with the improvement of medical interventions as well as the establishment of trauma systems.[8,9]

Previously identified factors that may contribute to increased survival in traumatic arrests include emergency department thoracotomy,[9] presence of VF on admission,[10,11] witnessed TA,[11] pre-hospital chest decompression,[12]

admission to trauma center,[5,13] lower injury severity score (ISS), high Glasgow Coma score, Caucasian race and higher systolic blood pressure (SBP).[5]

With evolving trauma care, improved survival is expected and factors associated with survival might change. This study used the 2015 dataset from the US National Trauma Databank 1) to examine characteristics and outcomes of patients suffering from traumatic arrests and 2) to identify factors associated with survival in traumatic arrests victims who were treated in US trauma centers.

Methods

Study design

This retrospective cohort study used the 2015 public release dataset of the National Trauma Data Bank (collected in 2015 and released in 2017).

An Institutional Review Board Exemption was obtained at the American University Of Beirut to use this de-identified dataset.

Study Setting

The National Trauma Database represents the largest U.S trauma data registry, is maintained by The American College of Surgeons Committee on Trauma and collects information from more than 900 facilities across the U.S. This registry includes patients who sustained one or more injuries that resulted in death, transfer or admission to a hospital and who have a trauma related diagnosis code (ICD-9 CM (800-959.9) or ICD-10 CM (S00-S99, T07, T14, T20-T28, T30-T32 and T79.A1-T79.A9) except cases with ICD-9CM codes 905-909.9, 910-924.9 and 930-939.9 and ICD-10CM codes (S00, S10, S20, S30, S40, S50, S60, S70, S80, S90) [14].

The variables included in the database include patient related information (demographic, coverage, outcome), event related information (injury severity, characteristics, diagnosis, pre-hospital, ED and hospital information) in addition to other information related to quality assurance and process of care measures.

Study population

The 2015 NTDB data set contains 917,865 patients of which 8,026 presented to the ED with “no signs of life” defined as “having none of the following: organized EKG activity, pupillary responses, spontaneous respiratory attempts or movement, and unassisted blood pressure” [15]. These patients were assumed to have CPR in progress on admission to the ED as per the NTDB dictionary and were considered to have sustained a traumatic arrest. Only adult patients ((≥16y of age) were included. Patients were excluded if age was not recorded (-99), if transferred from other hospitals (recorded as inter-facility transfer) and if outcome was unknown (ED discharge disposition recorded as: not known/recorded, not applicable, home with services, home without services, left against medical advice, transferred to another hospital, other (jail, institution care facility, mental health) or hospital discharge disposition recorded as unknown).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 24). Descriptive analysis was initially performed. Categorical variables were presented using frequencies and percentages whereas the continuous variables were summarized using the mean ± SD. Depending on the cell count, Pearson's Chi-Square or Fishers' exact tests were used to compare the proportions of all categorical variables in terms of the outcome variable (survived: yes/no). To provide accurate estimates, missing data were handled through multiple imputations. A multivariate logistic regression using a forward selection procedure was conducted to find the best model that explains the association between hospital survival and all patients' demographic and clinical characteristics. More specifically, a multivariate analysis was performed by taking into consideration all factors deemed to be clinically or statistically significant. P-value of ≤ 0.05 was used to denote statistical significance.

Results

A total of 5,980 patients were included in the study (Figure 1). Only 664 patients (11.1%) survived to hospital discharge. Patients were predominantly in the age group 16-64 (84.6%) (Table 1). Patients were mostly males (77.8%) and white (55.1%). Receiving hospitals were mainly University hospitals (47.7%) and community hospitals (38.9%). Most patients were admitted to Level 1 (55.5%) or Level 2 Trauma Centers (31.6%). Hospitals located in the South region of the U.S received the largest number of patients with traumatic arrests (46.8%) (Table 1). Self-pay was the most common primary method of payment (38.5%) followed by private insurances (25.3%). Most patients were transported by ground ambulance (83.9%) and most had no reported comorbidity (70.7%). Injuries were mostly blunt (56.7%) followed by penetrating (39.3%). Most injuries were unintentional (58.2%) followed by assault (29.4%). The leading mechanism of injury was MVT (38.4%) followed by Firearm (34.4%). Types of reported injuries included mainly fractures (59.0%), internal organ damage (56.2%) and open wounds (50.6%). The torso and the head & neck were the most commonly affected regions (59.4% and 52.6%, respectively) (Table 2). Mean ISS was 23.71 ± 20.79 with more than half of the patients having severe injury (57.1%).

Results of the bivariate analysis (not shown) revealed that all independent variables except for ethnicity were significantly associated with the outcome (survived: yes/no).

Results of the logistic regression analysis revealed the following (Table 3): Demographic characteristics that were associated with decreased odds of survival included age group ≥65 (OR=0.612, 95%CI=0.426 – 0.879) and male gender (OR=0.638, 95%CI=0.496 – 0.820). Among facility related characteristics, location of hospital in South was positively associated with survival (OR=2.068, 95%CI=1.453 – 2.943) (reference Northeast). Reported comorbidity (OR=3.215, 95%CI=2.547 – 4.058), alcohol use (OR=2.910, 95% CI=2.109 – 4.015) or drug use (OR=5.163, 95%CI= 3.695 – 7.216) were associated with increased survival. All injury mechanisms (with the exception of MVT) were significantly associated with increased odds of survival when compared to injury by firearm. Additionally all methods of coverage were positively associated with survival when compared to self-pay.

Injury related factors associated with survival were also identified. Self-inflicted and other or undetermined types of injuries were associated with decreased survival when compared to assault type of injuries. Presence of specific types of injuries such as fractures (OR=2.025, 95%CI=1.540 – 2.663), internal organ damage (OR=1.907, 95%CI=1.439 – 2.527), and other nature of injury – a variable that was created by combining some injuries together - (OR=2.382, 95%CI=1.535 – 3.696) were all associated with higher odds of survival. Patients who had blood vessels (OR=0.637, 95%CI=0.417 – 0.975) or unspecified (OR=0.632, 95%CI=0.416 – 0.961) injuries were less likely to survive. Patients who had injuries in their extremities (OR=1.486, 95%CI=1.164 – 1.898) or spine & back (OR=1.769, 95%CI=1.285 – 2.436) were more likely to survive, whereas those who had injuries in their head &

neck (OR=0.417, 95%CI=0.323 – 0.537) or torso (OR=0.463 , 95%CI=0.349 – 0.616), or in unclassifiable site (OR=0.270 , 95%CI=0.152 – 0.479) had poor outcome. Injury severity score ≥ 16 was associated with decreased odds of survival from traumatic arrest (OR=0.094, 95%CI=0.069 – 0.127).

Discussion

Research involving traumatic arrests is rare. This study examined outcomes of patients with traumatic arrests treated in US trauma centers and identified factors associated with survival in this population using the largest trauma database in the US.

The overall survival to hospital discharge among patients with traumatic arrests was 11.1%. This rate is slightly lower than the rate of 12.5% reported by Ahmed et al[5] but higher than other survival rates reported in earlier studies.[13,16] Young, white and male individuals continue to be mostly affected by traumatic arrests.[1,5,11] Improved survival in traumatic arrests presenting to U.S hospitals has been previously attributed to the increasing frequency of emergency interventions such as ED thoracotomy and other procedures.[17] Variation in survival rates of patients with traumatic arrest is however mostly related to differences in study sample selections with most studies including in the denominator arrests that are not transported to hospitals.[18] Our study included only patients who were transported to a trauma center which might have overestimated the survival rate since patients declared dead on scene are not usually included in the NTDB registry.

There were several factors associated with increased survival in patients with traumatic arrests. Demographic factors positively associated with survival included age group (16-64) (compared to age ≥ 65) and female gender. This differs from previous studies[5, 16, 19] where no similar associations were reported. Patients in the younger age are usually expected to have better odds of survival because of lower comorbidities. Female gender was significantly associated with survival in this population. A previous study did not identify significant association between female gender and outcomes in severely injured patients.[20] Age stratification was however done in that study to account for hormonal status. The finding in our study need further examination with the potential role of other unmeasured confounders such as role of hormones based on age category (pre vs post-menopausal) and obesity etc.

Several injuries related characteristics were also significantly associated with survival. Type of trauma (blunt vs penetrating), which is mainly used for categorization in trauma study, was not significantly associated with survival similar to other studies.[5, 16, 21] Other previous studies however reported better outcomes with penetrating[22] or with blunt injuries.[23] These contradictory findings constitute a challenge for guidelines about withholding resuscitation in traumatic arrests:[16] Several case reports[24, 25] discuss exceptions to guidelines with unexpected return of spontaneous circulation in patients with arrests from blunt or penetrating injury.[16] Prehospital guidelines for withholding resuscitation in the field should therefore be carefully examined to avoid potential prehospital management errors in challenging cases such as cardiac arrest after trauma.[8] EMS providers frequently face challenges in detecting a pulse in patients with traumatic arrest[25] which could significantly impact survival of these patients if prehospital resuscitation is withheld.

The mechanisms of injuries were positively associated with survival when compared to firearm mechanism. Previous studies examining only blunt injury mechanisms showed survival benefit for patients with fall-related injuries when compared to MVT.[22,26] This study examined traumatic arrests from different injury mechanisms and

demonstrated poorer outcomes with firearm related injuries. In fact, case fatality rate of firearm has been previously shown to be much higher than any other mechanism of injury.[27, 28] This high firearm lethality is related to several factors including number of entrance wounds, range and site of entrance wounds and intentionality.[20, 29] The study findings highlight the need for better understanding of firearm related injuries and for developing preventive measures targeted to improve survival in this population.

Injury body region was found to be significantly associated with survival: Injuries to vital locations such as head and neck, or torso were associated with poor outcomes. This was expected because of the risk of bleeding and hemorrhagic shock from damage to vital organs[30] and is in line with the ATLS approach to management of trauma patients by prioritizing management according to life-threatening injuries.[31] Other factors were also found to be positively associated with survival such as specific types of injuries (fractures, internal organ damage) in addition to alcohol or drug use. These are more likely related to reporting of such data elements in patients who survive after the initial resuscitation measures. Such patients are expected to have a more detailed documentation of minor injuries or better description of other elements contributing to the injury event.

As expected an injury severity score (ISS<16) was associated with higher survival in traumatic arrest patients. This finding is in line with previous studies [5, 13, 16, 25] and validates the need to incorporate ISS in outcome predictive models in not only trauma patients but also in traumatic arrests to avoid futility of extreme measures in resuscitation.

Our study also identified that hospital location in the South was associated with increased survival (reference Northeast) for patients with traumatic arrests. While improved outcomes in trauma patients have been previously linked to geographic clustering of trauma centers which are primarily located in the Northern area[32] and where patients benefit from the greatest access to trauma Level I and II centers within 45 and 60 minutes,[33] our study did not identify such association. In our study sample, more hospitals were located in the South (47.2%) than in the Northeast (13.9%). Patients in the South were more likely to survive as compared to those in the Northeast (17.1% vs. 13.4%) and additional stratification by mortality status revealed that disproportionate distribution of the participant hospitals may be responsible for this apparent survival differences between the two regions (Only two patients with firearm injury survived to hospital discharge in the Northeast as compared to 41 patients in the South). Further research should examine closely the impact of hospital region on survival in trauma patients.

Financial coverage status was also significantly associated with survival. When compared to self-payment or uninsured, all other methods of coverage were positively associated with survival. The available literature reports contradicting findings on financial coverage and association with survival in trauma patients. Greene et al. concluded that insurance status was a predictor of outcome with uninsured patients being at higher risk of death in both blunt and penetrating trauma[34] while Lober et al. noted a better survival in patients with no insurance coverage[19] attributing this finding to potentially larger proportion of healthy patients in the uninsured group. In this study of traumatic arrests any insurance status (compared to uninsured) was associated with improved outcomes. Further research is needed to clarify the reasons for this disparity such as examining resources utilization including but not limited to access to surgical procedures.

This study has potential limitations related to its retrospective nature and to availability of data reported in the database. The NTDB uses ICD-9 coding for the data retrieved from different hospitals and is like other national databases subject to coding variations and errors. This study did not include traumatic arrests that were not

transported to a trauma center which might have led to overestimation of the survival rate in this group of patients. The NTDB also uses “convenience samples” from disproportionate number of large to small hospitals that contribute to the database. This unequal sample size across regions and the lack of weighting should be taken into considerations when comparing outcomes across different US regions.

Despite these limitations, the NTDB is the largest database for trauma in the United States of America collecting data from over 900 hospitals and the study findings can be generalized to hospitals in the US and to other settings with similar trauma systems. .

Conclusion

Patients with traumatic arrests continue to have poor outcomes with only 11.1 % surviving to hospital discharge. Several factors were identified to be positively associated with survival in this population. Survival is higher for younger age group, female gender and with any type of insurance coverage. Patients with traumatic arrests from firearm mechanisms experience poor survival. These findings are important for future studies examining closely different predictors, and for devising injury prevention strategies. More evidence is needed to guide trauma management protocols and initiation of resuscitation to improve outcomes further in traumatic arrests.

Declarations

Ethics approval and consent to participate: An Institutional Review Board Exemption was obtained at the American University Of Beirut. No consent was obtained since the data was retrieved from a de-identified database i.e. NTDB (National Trauma Data Bank)

Consent for publication: Not applicable

Availability of data and materials: The datasets generated and/or analyzed during the current study are available in the National Trauma Data Bank (collected in 2015 and released in 2017) repository: https://www.facs.org/quality-programs/trauma/tqp/center-programs/ntdb

Funding: Not applicable.

Conflict of interest: All authors have declared that they have no financial conflict of interest

Authors Contribution: Dr. El Sayed conceptualized the study, provided insights into the discussion section and contributed to the write-up and editing of the manuscript. Ms. Rana Bachir was the lead statistician of this study, provided insight in data interpretation as well as contributing to the write up. Dr. Ariss carried out the literature reviews, provided insights into the discussion section and contributed the write up of the manuscript.

Acknowledgment: not applicable

References

1. World Health Organization. Injuries and violence: the facts; https://www.who.int/violence_injury_prevention/media/news/2015/Injury_violence_facts_2014/en/. Accessed 10 Jan 2019.

2. Rhee P, Joseph B, Pandit V, Aziz H, Vercruysse G, Kulvatunyou N, Friese RS (2014) Increasing trauma deaths in the United States. Ann Surg 260:13–21
3. Shimazu S, Shatney CH (1983) Outcomes of trauma patients with no vital signs on hospital admission. J Trauma 23:213–216
4. Battistella FD, Nugent W, Owings JT, Anderson JT (1999) Field triage of the pulseless trauma patient. Arch Surg 134:742–5; discussion 745-6
5. Ahmed N, Greenberg P, Johnson VM, Davis JM (2017) Risk stratification of survival in injured patients with cardiopulmonary resuscitation within the first hour of arrival to trauma centre: retrospective analysis from the national trauma data bank. Emerg Med J 34:282–288
6. Hopson LR, Hirsh E, Delgado J, Domeier RM, McSwain NE Jr, Krohmer J, National Association of EMS Physicians Standards and Clinical Practice Committee, American College of Surgeons Committee on Trauma (2003) Guidelines for withholding or termination of resuscitation in prehospital traumatic cardiopulmonary arrest: a joint position paper from the National Association of EMS Physicians Standards and Clinical Practice Committee and the American College of Surgeons Committee on Trauma. Prehosp Emerg Care 7:141–146
7. National Association of EMS Physicians, American College of Surgeons Committee on Trauma (2013) Withholding of resuscitation for adult traumatic cardiopulmonary arrest. Prehosp Emerg Care 17:291
8. Kleber C, Giesecke MT, Lindner T, Haas NP, Buschmann CT (2014) Requirement for a structured algorithm in cardiac arrest following major trauma: epidemiology, management errors, and preventability of traumatic deaths in Berlin. Resuscitation 85:405–410
9. Moore HB, Moore EE, Burlew CC, Biffl WL, Pieracci FM, Barnett CC, Bensard DD, Jurkovich GJ, Fox CJ, Sauaia A (2016) Establishing benchmarks for resuscitation of traumatic circulatory arrest: Success-to-rescue and survival among 1,708 patients. J Am Coll Surg 223:42–50
10. Lai C-Y, Tsai S-H, Lin F-H, et al (2018) Survival rate variation among different types of hospitalized traumatic cardiac arrest: A retrospective and nationwide study. Medicine (Baltimore) 97:e11480
11. Djarv T, Axelsson C, Herlitz J, Stromsoe A, Israelsson J, Claesson A (2018) Traumatic cardiac arrest in Sweden 1990-2016 - a population-based national cohort study. Scand J Trauma Resusc Emerg Med. https://doi.org/10.1186/s13049-018-0500-7
12. Huber-Wagner S, Lefering R, Qvick M, Kay MV, Paffrath T, Mutschler W, Kanz K-G, Working Group on Polytrauma of the German Trauma Society (DGU) (2007) Outcome in 757 severely injured patients with traumatic cardiorespiratory arrest. Resuscitation 75:276–285
13. Chen Y-C, Wu K-H, Hsiao K-Y, Hung M-S, Lai Y-C, Chen Y-S, Chang C-Y (2019) Factors associated with outcomes in traumatic cardiac arrest patients without prehospital return of spontaneous circulation. Injury 50:4–9
14. American College of Surgeons Committee on Trauma. (2015). ACS NTDB National Trauma Data Standard: Data Dictionary (2016 Admissions).
15. American College of Surgeons Committee on Trauma. National Trauma Databank User Manual: NTDB Research Data Set Admission Year 2006-2015. Chicago, IL: American College of Surgeons. 2015
16. Pickens JJ, Copass MK, Bulger EM (2005) Trauma patients receiving CPR: predictors of survival. J Trauma 58:951–958
17. Tisherman SA (2013) Salvage techniques in traumatic cardiac arrest: Thoracotomy, extracorporeal life support, and therapeutic hypothermia. Curr Opin Crit Care 1

18. Crewdson K, Lockey D (2017) Mortality in traumatic cardiac arrest. Resuscitation 113:e21
19. Loberg JA, Hayward RD, Fessler M, Edhayan E (2018) Associations of race, mechanism of injury, and neighborhood poverty with in-hospital mortality from trauma: A population-based study in the Detroit metropolitan area. Medicine (Baltimore) 97:e12606
20. Pape M, Giannakópoulos GF, Zuidema WP, et al (2019) Is there an association between female gender and outcome in severe trauma? A multi-center analysis in the Netherlands. Scand J Trauma Resusc Emerg Med 27:16
21. Barnard E, Yates D, Edwards A, Fragoso-Iñiguez M, Jenks T, Smith JE (2017) Epidemiology and aetiology of traumatic cardiac arrest in England and Wales - A retrospective database analysis. Resuscitation 110:90–94
22. Beck B, Bray JE, Cameron P, Straney L, Andrew E, Bernard S, Smith K (2017) Predicting outcomes in traumatic out-of-hospital cardiac arrest: the relevance of Utstein factors. Emerg Med J 34:786–792
23. Stockinger ZT, McSwain NE Jr (2004) Additional evidence in support of withholding or terminating cardiopulmonary resuscitation for trauma patients in the field. J Am Coll Surg 198:227–231
24. Hamidian Jahromi A, Northcutt A, Youssef AM (2013) A patient with blunt trauma and cardiac arrest arriving pulseless at the emergency department; Is that enough reason to stop resuscitation? Review of literature and case report. Iran Red Crescent Med J 15:e11623
25. Zwingmann J, Lefering R, Feucht M, Südkamp NP, Strohm PC, Hammer T (2016) Outcome and predictors for successful resuscitation in the emergency room of adult patients in traumatic cardiorespiratory arrest. Crit Care. https://doi.org/10.1186/s13054-016-1463-6
26. Evans CCD, Petersen A, Meier EN, Buick JE, Schreiber M, Kannas D, Austin MA, Resuscitation Outcomes Consortium Investigators (2016) Prehospital traumatic cardiac arrest: Management and outcomes from the resuscitation outcomes consortium epistry-trauma and PROPHET registries. J Trauma Acute Care Surg 81:285–293
27. Hoyert DL, Kochanek KD, Murphy SL (1999) Deaths: final data for 1997. Natl Vital Stat Rep 47:1–104
28. Burt CW, Fingerhut LA (1998) Injury visits to hospital emergency departments: United States, 1992-95. Vital Health Stat 13 1–76
29. Beaman V, Annest JL, Mercy JA, Kresnow M j., Pollock DA (2000) Lethality of firearm-related injuries in the United States population. Ann Emerg Med 35:258–266
30. Kauvar DS, Lefering R, Wade CE (2006) Impact of hemorrhage on trauma outcome: an overview of epidemiology, clinical presentations, and therapeutic considerations. J Trauma 60:S3-11
31. The ATLS Subcommittee, American College of Surgeons', Committee on Trauma, and the International ATLS working group (2013) Advanced trauma life support (ATLS®): The ninth edition. J Trauma Acute Care Surg 74:1363–1366
32. Brown JB, Rosengart MR, Billiar TR, Peitzman AB, Sperry JL (2016) Geographic distribution of trauma centers and injury-related mortality in the United States. J Trauma Acute Care Surg 80:42–9; discussion 49-50
33. Branas CC, MacKenzie EJ, Williams JC, Schwab CW, Teter HM, Flanigan MC, Blatt AJ, ReVelle CS (2005) Access to trauma centers in the United States. JAMA 293:2626–2633
34. Greene WR, Oyetunji TA, Bowers U, Haider AH, Mellman TA, Cornwell EE, Siram SM, Chang DC (2010) Insurance status is a potent predictor of outcomes in both blunt and penetrating trauma. Am J Surg 199:554–557

Tables

Table 1: General Characteristics of Study Population

	Frequency (N=5980)	%
Age (years)		
16 – 64	5062	84.6%
≥ 65	918	15.4%
Gender		
Not Known/Not Recorded	3	0.0%
Female	1327	22.2%
Male	4650	77.8%
Race		
Not Known/Not Recorded	270	4.5%
American Indian	36	0.6%
Asian	96	1.6%
Black or African American	1876	31.4%
Native Hawaiian or Other Pacific Islander	18	0.3%
White	3292	55.1%
Other Race	392	6.6%
Hospital Teaching Status		
Community	2329	38.9%
Non-Teaching	801	13.4%
University	2850	47.7%
Trauma Designation level		
I	3316	55.5%
II	1892	31.6%
III	580	9.7%
IV	44	0.7%
Not applicable	148	2.5%
Geographic region for the hospital		
NORTHEAST	826	13.8%
MIDWEST	1179	19.7%
SOUTH	2800	46.8%
WEST	1129	18.9%

NA	46	0.8%
The patient's primary method of payment		
Not Known/Not Recorded	402	6.7%
Medicaid	728	12.2%
Medicare	655	11.0%
Not Billed (for any reason)	61	1.0%
Private/Commercial Insurance	1512	25.3%
Self-Pay	2302	38.5%
Other Government	119	2.0%
Other	201	3.4%
Mode of Transportation		
Not Known/Not Recorded	18	0.3%
Ground Ambulance	5017	83.9%
Helicopter Ambulance	517	8.6%
Fixed-wing Ambulance	6	0.1%
Police	79	1.3%
Public/Private vehicle walk-in	278	4.6%
Other	65	1.1%

Table 2: Clinical Characteristics and Outcomes of Patients

	Frequency (N=5980)	%
Comorbidity		
No	4228	70.7%
Yes	1752	29.3%
Type (nature) of trauma produced by an injury		
Blunt	3207	56.7%
Burn	62	1.1%
Other/unspecified	163	2.9%
Penetrating	2226	39.3%
Missing = 322 (5.4%)		
Injury Intentionality		
Assault	1666	29.4%
Self-inflicted	535	9.5%
Undetermined	82	1.4%
Unintentional	3292	58.2%
Other	83	1.5%
Missing = 322 (5.4%)		
Mechanism of Injury		
Cut/pierce	280	4.9%
Fall	687	12.1%
Firearm	1946	34.4%
MVT	2171	38.4%
Other specified and classifiable & Other specified, not elsewhere classifiable	74	1.3%
Struck by, against	126	2.2%
Transport, other & Unspecified	171	3.0%
Others	203	3.6%
Missing = 322 (5.4%)		
Alcohol Use		
No	5439	91 0%

Yes	541	9.0%
Drug Use		
No	5501	92.0%
Yes	479	8.0%
Nature of injury		
Amputations	91	1.5%
Blood vessels	980	16.4%
Burns	90	1.5%
Crush	37	0.6%
Dislocation	263	4.4%
Fractures	3528	59.0%
Internal organ	3363	56.2%
Nerves	29	0.5%
Open wounds	3025	50.6%
Sprains & strains	106	1.8%
System wide & late effects	91	1.5%
Unspecified	515	8.6%
Body region of Injury		
Extremities	2639	44.1%
Head & Neck	3145	52.6%
Spine & Back	877	14.7%
Torso	3554	59.4%
Unclassifiable by site	471	7.9%
Injury severity score	2438	40.8%
≤ 15	3415	57.1%
≥ 16	127	2.1%
Not Known / Not recorded		
ED Disposition		
Deceased/Expired	4491	75.1%
Floor bed (general admission, non-specialty unit bed)	490	8.2%

Intensive Care Unit (ICU)	366	6.1%
Observation unit (24 hour stays)	43	0.7%
Operating Room	479	8.0%
Telemetry/step-down unit (less acuity than ICU)	111	1.9%
Hospital Disposition		
Not Applicable	4491	75.1%
Deceased/Expired	496	8.3%
Discharged to home or self-care (routine discharge)	664	11.1%
Transferred to other destination	319	5.3%
Left against medical advice or discontinued care	10	0.2%

Table 3: Factors Associated with Survival in Traumatic Arrests Variable (Reference)

	Odds Ratio	95% CI	P-value
Age (years) ≥ 65 (16 – 64)	0.612	0.426 – 0.879	0.008
Gender Male (Female)	0.638	0.496 – 0.820	<0.001
Geographic region for the hospital (NORTHEAST)			
MIDWEST	1.478	0.992 – 2.202	0.055
SOUTH	2.068	1.453 – 2.943	<0.001
WEST	1.203	0.786 – 1.842	0.395
Comorbidity Yes (No)	3.215	2.547 – 4.058	<0.001
Injury Intentionality (Assault)			
Self-inflicted	0.218	0.108 – 0.442	<0.001
Unintentional	1.283	0.731 – 2.252	0.385
Other & Undetermined	0.156	0.037 – 0.657	0.011
Mechanism of Injury (Firearm)			
Cut/pierce	5.284	2.988 – 9.342	<0.001
Fall	7.229	3.843 – 13.599	<0.001
MVT[1]	1.138	0.614 – 2.107	0.682
Other specified and classifiable & Other specified, not elsewhere classifiable	2.792	1.071 – 7.282	0.036
Struck by, against	7.397	3.796 – 14.415	<0.001
Transport, other & Unspecified	3.085	1.437 – 6.623	0.004
Others[2]	4.123	1.898 – 8.958	<0.001
Alcohol use Yes (No)	2.910	2.109 – 4.015	<0.001
Drug use Yes (No)	5.163	3.695 – 7.216	<0.001
The patient's primary method of payment (Self Pay)			

Medicaid	2.297	1.565 – 3.370	<0.001
Medicare	2.935	1.886 – 4.567	<0.001
Private/Commercial Insurance	3.551	2.597 – 4.856	<0.001
Other Government	6.963	3.480– 13.933	<0.001
Other & Not Billed (for any reason)	2.974	1.747 – 5.062	<0.001
Mode of transportation (Ground ambulance)			
Helicopter ambulance & Fixed-wing ambulance	1.082	0.751 – 1.560	0.671
Public/Private vehicle walk-in	15.104	8.864 – 25.736	<0.001
Other & Police	1.252	0.378 – 4.152	0.713
Nature of injury Yes (No)			
Blood Vessels	0.637	0.417 – 0.975	0.038
Fractures	2.025	1.540 – 2.663	<0.001
Internal organ	1.907	1.439 – 2.527	<0.001
Unspecified	0.632	0.416 – 0.961	0.032
Other[3]	2.382	1.535 – 3.696	<0.001
Body region Yes (No)			
Extremities	1.486	1.164 – 1.898	0.001
Head & Neck	0.417	0.323 – 0.537	<0.001
Spine & Back	1.769	1.285 – 2.436	<0.001
Torso	0.463	0.349 – 0.616	<0.001
Unclassifiable by site	0.270	0.152 – 0.479	0.001
Injury Severity Score ≥ 16 (≤ 15)	0.094	0.069 – 0.127	<0.001

1 MVT is the combination of the following variables: MVT Motorcyclist & MVT Occupant & MVT Other & MVT Pedal cyclist & MVT Pedestrian & MVT Unspecified

2 Others is the combination of the following variables: Drowning/submersion & Fire/flame

& Hot object/substance & Machinery & Pedal cyclist, other & Pedestrian, other & Natural/environmental, Bites and stings & Natural/environmental, Other & Overexertion & Poisoning &

3 Other includes the following nature of injury: Amputations, Burns, Crush, Nerves, Sprains & strains, System wide & late effects

Variables that were included in the model are: age, gender, race, hospital teaching status, Geographic region for the hospital, comorbidity, ICD-9-CM Mechanism of Injury E-Code, Indication of the type (nature) of trauma produced by an injury, Injury Intentionality as defined by the CDC Injury Intentionality Matrix, Location where injury occurred, Whether patient used alcohol, Whether patient used drug, the patient's primary method of payment, Mode of Transportation, The Injury Severity Score reflecting the patient's injuries directly submitted by the facility regardless of the method of calculation, ICD-9 body region as defined by the Barell Injury Diagnosis Matrix (Blood vessels, Dislocation, Fractures, Internal organ, Open wounds, Unspecified, Other), Nature of injury as defined by the Barell Injury Diagnosis Matrix (Extremities, Head & Neck, Spine & Back, Torso, Unclassifiable by site)